Section 3 - Appendix 14

Environmental Construction Plan
Connecticut

This Appendix was formatted in its entirety as part of the Final FERC 7(c) Application, filed on November 20, 2015 (PF-14-22-000), Environmental Reports, Volume II; therefore, attachment references and page numbers contained within this document are not consistent with this permit application.

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

APPENDIX N

ENVIRONMENTAL CONSTRUCTION PLAN FOR CONNECTICUT

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LIST OF ACRONYMS and ABBREVIATIONS

Acronym	Full Name
AR	access road
AASHTO	American Association of State and Highway Transportation Officials
ATV	all-terrain vehicle
ATWS	additional temporary workspace or temporary site
Bcf/d	billion cubic feet per day
BFM	Bonded Fiber Mix
BMPs	Best Management Practices
CFR	Code of Federal Regulations
Commission or FERC	Federal Energy Regulatory Commission
Contractor	construction contractor
Crossing Plan	General Trail Crossing Plan
CTDEEP	Connecticut Department of Energy and Environmental Protection
°F	degrees Fahrenheit
ECP	Environmental Construction Plan
EI	Environmental Inspector
ER	Environmental Report
FDA	U.S. Food and Drug Administration
EIS	Environmental Impact Statement
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FERC or Commission	Federal Energy Regulatory Commission
FERC Director	FERC Director of the Office of Energy Projects
FGM	Flexible Growth Medium
HDD	horizontal directional drill
hp	horsepower
ISMP	Invasive Species Management Plan
lbs/acre	pounds per acre
Manual	2002 Connecticut Guidelines for Soil Erosion and Sediment Control (2007 Version)
MAOP	maximum allowable operating pressure
MLV	mainline valve
MOP	maximum operating pressure
MP	milepost

Acronym	Full Name
NED or Project	Northeast Energy Direct
NPDES	National Pollutant Discharge Elimination System
OSHA	Occupation Safety and Health Administration
PAM	polyacrylamide
permanent AR	permanent access road
PLS	pure live seed
the Plan	Tennessee's *Upland Erosion Control, Revegetation and Maintenance Plan*
the Procedures	Tennessee's *Wetland and Waterbody Construction and Mitigation Procedures*
Project	Northeast Energy Direct Project or NED Project
PSFM	Polymer Stabilized Fiber Matrix
psig	pounds per square inch, gauge
ROW	right-of-way
Secretary	The Secretary of the Commission serves as the official portal through which the Commission records all legal filings and notices of proceedings related to Commission actions, and all official actions of the Commission.
SFHA	FEMA Special Flood Hazard Areas
SWPPP	Stormwater Pollution Control Plan
TBD	to be determined
temporary AR	temporary access road
Tennessee or TGP	Tennessee Gas Pipeline Company, L.L.C.
TWS	temporary workspace
U.S.	United States
USC	U.S. Code
USDA-NRCS	United States Department of Agriculture Natural Resources Conservation Service
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UV	ultraviolet

1.0 INTRODUCTION

Tennessee Gas Pipeline Company, L.L.C. ("Tennessee" or "TGP") has filed 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"). The Environmental Report ("ER") is submitted in support of the application. 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 proposed Project will include construction of approximately 420 miles of pipeline (new pipeline, looping pipeline segments, and laterals) in Pennsylvania, New York, Massachusetts, New Hampshire, and Connecticut. Additionally, as part of the Project, Tennessee proposes to construct new compressor and meter stations and modify existing compressor and meter stations along its proposed and existing pipeline system. There also will be construction of appurtenant facilities, including mainline valves ("MLVs"), cathodic protection, and pig facilities through the Project area.

1.1 ENVIRONMENTAL CONSTRUCTION PLAN OBJECTIVES

The purpose of this Environmental Construction Plan ("ECP") is to avoid, minimize and/or mitigate the potential impacts to the surrounding environment before, during, and after construction of the Project by outlining mitigation, monitoring and maintenance procedures. For example, this ECP will outline general Best Management Practices ("BMPs") that Tennessee and its Construction Contractors ("Contractors") will implement before, during, and after construction to minimize erosion of disturbed soils and transportation of sediment outside of the construction right-of-way ("ROW") and into environmentally sensitive areas (e.g., wetlands, streams). The BMPs are designed to provide minimum standards for the protection of environmentally sensitive areas while accounting for the significantly varying field conditions that will be encountered during construction of the Project.

This ECP will provide specifications for the installation, implementation, and maintenance of the BMPs while allowing for flexibility in the selection of specific BMPs based on site-specific conditions. This document will be included as part of the construction contract and will provide Contractors and Environmental Inspectors ("EI") a reference to specific environmental conditions and associated BMP plans and procedures.

In general, the objectives of the ECP will be achieved by implementing the following practices during and after construction:

- Minimize the footprint and duration of the disturbance;
- Divert runoff away from exposed soil and to stabilized areas to prevent erosion and sedimentation;
- Install temporary and permanent soil erosion control measures; and
- Implement an effective inspection and maintenance program.

The ECP incorporates as one document the following:

- Aerial Alignment Sheets (Attachment N1);
- Typical Construction Drawings (Attachment N2);
- Spill Prevention and Response Plan ("SPRP") (Attachment N3);
- Waste Management Plan (Attachment N4);
- Horizontal Directional Drilling Contingency Plan (Attachment N5);
- Plan for Unanticipated Discoveries of Cultural and Paleontological Resources and Human Remains (Attachment N6);
- Unanticipated Discovery of Contamination Plan (Attachment N7);
- Blasting Management Plan (Attachment N8);
- Invasive Species Management Plan for Connecticut ("ISMP") (Attachment N9);
- Soil Protection and Subsoil Decompaction Mitigation Plan (Attachment N10);
- Organic Farm Protection Plan (Attachment N11);
- Winter Construction Plan (Attachment N12);
- General Trail Crossing Plan (Attachment N13);
- Tennessee's Upland Erosion Control, Revegetation, and Maintenance Plan ("Plan") (Attachment N14);
- Tennessee's Wetland and Waterbody Crossing Construction and Mitigation Procedures ("Procedures") (Attachment N15).

1.2 GUIDELINES

As a FERC regulated Project, the plan and procedures utilized for this Project and as described within this document were developed utilizing guidance from the following resources:

- FERC Wetland and Waterbody Construction and Mitigation Procedures (May 2013 Version);
- FERC Upland Erosion Control, Revegetation, and Maintenance Plan (May 2013 Version); and
- Connecticut Department of Energy and Environmental Protection's ("CTDEEP") 2002 Connecticut Guidelines for Soil Erosion and Sediment Control (2007 version) ("Manual").

The ECP utilizes information and guidance from the above noted resources regarding Project construction, restoration, and monitoring for the following:

- Agricultural Mitigation;
- Wetland/Waterbody Construction and Mitigation;
- Erosion and Sedimentation Controls;
- Stormwater Pollution Prevention; and
- Revegetation and Post-Construction Monitoring.

Applicable regulatory agency BMPs will be adhered to during and after the construction of the Project in accordance with regulatory permits and approvals. Any deviation from the approved construction drawings, or changes in the design of the specified BMPs will be approved by the on-site EI and/or must have approval from the applicable permitting agency, if necessary to comply with permit conditions.

2.0 PROJECT DESCRIPTION

2.1 GENERAL PROJECT DESCRIPTION

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 the Environmental Report ("ER"), 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") 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 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.

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 Pennsylvania and Connecticut.

[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.

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 5 feet outside the existing powerline easement boundary. This proposed alignment is reflected in the proposed impacts of the Project discussed in the ER and in the attached powerline co-location configurations, ROW-Config_05 and 06, included in Volume II, Appendix G of the ER.

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 5 feet outside the existing powerline easement boundaries is based on information obtained from consultation with power companies or from available public information. Tennessee is engaged in discussions 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. Tennessee is currently conducting surveys of the powerline easements and may adjust the proposed centerline location of the pipeline and overlapping areas for the Project to reflect the results of these surveys, including appropriate mitigation for safety and operational considerations, as well as landowner and agency concerns, avoidance of sensitive environmental resources, and construction considerations. The centerline of the pipeline may be moved to within an existing powerline easement, less than 5 feet from the existing power line boundary, or further than 5 feet from the existing powerline boundary.

Tennessee is requesting issuance of a certificate order for the Project during 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 will 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, 700 and 800 Lines (or systems), based on the region they serve.[2] 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 generally 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.

2.1.1 Pipeline Facilities

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 ROW. This proposed loop segment will be designed for a maximum allowable operating pressure ("MAOP") of 800 and a maximum operating pressure ("MOP") of 719 pounds per square inch, gauge ("psig").

A summary of the individual pipeline facilities and MP designations within each town, county, and state for each pipeline facility are provided in Table 2.1-1.

2.1.2 Aboveground Facilities

2.1.2.1 Compressor Stations

No new or modified compressor stations are proposed for the Project in the state of Connecticut.

2.1.2.2 Meter Stations

The modified meter stations in Connecticut will include:

- Easton – Fairfield County, Connecticut: Tennessee proposes to upgrade 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: Tennessee proposes to upgrade 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: Tennessee proposes to upgrade an existing meter station. Modifications include the replacement of the station inlet piping and the replacement of an existing 2-inch turbine meter run.

A summary of the meter station facilities is provided in Table 2.1-2.

[2] The NED Project mainline pipeline and certain laterals will be designated as the "900 Line" or "900 system" once constructed and placed in-service.

Table 2.1-1
Proposed Pipeline Facilities for the Project in Connecticut

Facility Name	Diameter (inches)	County	Township/Town	Segment[1]	Milepost		Length (miles)
					Begin	End	
300 Line CT Loop	24	Hartford	Farmington	S	0.00	0.15	0.15
300 Line CT Loop	24	Hartford	West Hartford	S	0.15	0.34	0.19
300 Line CT Loop	24	Hartford	Farmington	S	0.34	0.37	0.03
300 Line CT Loop	24	Hartford	West Hartford	S	0.37	0.51	0.14
300 Line CT Loop	24	Hartford	Farmington	S	0.51	0.73	0.22
300 Line CT Loop	24	Hartford	West Hartford	S	0.73	4.28	3.55
300 Line CT Loop	24	Hartford	Bloomfield	S	4.28	11.19	6.91
300 Line CT Loop	24	Hartford	Windsor	S	11.19	14.20	3.01
300 Line CT Loop	24	Hartford	East Granby	S	14.20	14.80	0.60
						Total	**14.80**

[1] Each segment is associated with its own set of MPs beginning at MP 0.00.

Table 2.1-2
Proposed Meter Stations for the Project in Connecticut

Facility Name	Associated Pipeline[1]	County	Township/Town	Segment[2]	Milepost[3]	New / Modified	New Capacity (dekatherms per day)	Area Required for Construction (acres)[4]	Area Required for Operation (acres)[5]
Easton (20853)	Existing TGP Line 300-1	Fairfield	Easton	N/A	Existing Facility	Modified	28,800	0.36	0.00
North Bloomfield (20453)	Existing TGP Line 300-1	Hartford	Bloomfield	S	10.86	Modified	80,000	0.24	0.00
Milford (20425)	Existing TGP Line 300-1	New Haven	Orange	N/A	Existing Facility	Modified	60,000	1.24	0.77
							Total	**1.84**	**0.77**

1 This column indicates the associated pipeline for each meter station.

2 Each segment is associated with its own set of MPs beginning at MP 0.00.

3 MPs are provided for meter stations and refer to the nearest MPs of the meter stations' associated segment.

4 Modified meter stations will require the area of the existing facility and temporary workspace during construction. New meter stations will require new permanent workspace for operation and temporary workspace during construction.

5 Area Required for Operation = new permanent workspace required for operation. Existing meter stations will not require new permanent workspace for operation. Acreage for permanent driveways required for access to new meter stations is included.

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2.1.2.3 Mainline Valves, Pig Facilities, and Cathodic Protection Facilities

For the Project, Tennessee proposes that MLVs will generally be installed and operated within the proposed permanent ROW associated with the applicable pipeline segment(s). MLV site components include valve, actuator, piping and communications equipment. Each MLV will generally consist of a 60-foot by 50-foot graveled area and will be fenced within the permanent ROW. Where practicable, Tennessee has sited appurtenant facilities close to public roads to limit the number of permanent access roads ("ARs"); however, some permanent ARs to these sites will be required. Tennessee has conducted a class study on each proposed pipeline segment and designed MLV locations that meet or exceed the federal spacing requirements.

Locations of MLVs are provided in Table 2.1-3 and included on full size 7.5-minute U.S. Geological Survey ("USGS") topographic maps (Volume II, Appendix E of the ER) and Aerial Alignment Sheets (Attachment N1).

Table 2.1-3
Proposed Appurtenant Aboveground Facilities for the Project in Connecticut

Facility Name[1]	Segment[2]	Approximate Milepost[3]	County	Township/Town	Approximate Area (acres)[4,5]
MLV-S-01	S	0.00	Hartford	Farmington	0.00
PL-S-01	S	0.00	Hartford	Farmington	0.00
MLV-S-02	S	6.97	Hartford	Bloomfield	0.00
MLV-S-03[6]	S	14.80	Hartford	East Granby	0.00
				Total	**0.00**

[1] The prefixes for the facility names are defined below:
MLV – "Mainline Valve"
PL – "Pig Launcher"

[2] Each segment is associated with its own set of MPs beginning at MP 0.00.

[3] The location of MLVs were determined based on a class location study utilizing digitized structures photo interpreted from aerial flights conducted in March 2015. Since the March 2015 flight there have been route deviations so certain portions of the current Project alignment do not have high resolution aerial imagery associated with them. Tennessee has utilized publicly available data for these areas; Tennessee anticipates flying these deviations in November 2015, weather permitting.

[4] All proposed appurtenant ancillary aboveground facilities, including MLVs, pig facilities, and blowoffs will be constructed and operated within areas of existing or new permanent easements associated with the pipeline facilities.

[5] Approximate Area impacts are additional permanent impacts not previously accounted for within the pipeline or AR impacts.

2.2 LAND REQUIREMENTS

The construction workspace (including TWS), additional temporary workspace ("ATWS"), permanent (or operational) ROW, temporary and permanent ARs, contractor yards, and aboveground facilities for the Connecticut portion of the Project will total approximately 289.99 acres (Table 2.2-1). Operation of the Connecticut portion of the Project facilities will require approximately 71.77 acres that will be maintained as permanent ROW (or fee-owned property of Tennessee) for compressor station facilities. Table 2.2-1 includes a summary of all Project-related land requirements that will be affected by construction and operation of the Project facilities (pipeline facilities, new and modified compressor stations, new and

modified meter stations, temporary and permanent ARs, and contractor yards). The USGS topographic maps (Volume II, Appendix E in the ER) and Aerial Alignment Sheets (Attachment N1), depict the location and configuration of all TWS and permanent construction workspace, and ARs and contractor yards (to the extent they have been identified) required for the Project. Typical Construction Drawings are provided in Attachment N2 of this ECP.

Table 2.2-1
Summary of Land Requirements for the Project in Connecticut

Facility	Land Affected During Construction (acres)[1]	New Permanent Easement Affected During Operation (acres)[2]	Land Affected Within TGP Existing Operational ROW (acres)
Pipeline	154.62	67.78	24.30
ATWS[3]	34.28	0.00	0.00
Compressor Stations	0.00	0.00	0.00
Meter Stations	1.84	0.77	0.60
Cathodic Protection Ground Beds	4.82	3.22	0.00
Total Temporary and Permanent ARs	16.57	0.00	0.00
Contractor Yards	77.86	0.00	0.00
Appurtenant Facilities[4]	0.00	0.00	0.00
Total	**289.99**	**71.77**	**24.90**

[1] Construction workspace acreage impacts were calculated along the pipeline facilities utilizing the construction limits (which encompasses TWS and operational ROW widths). Construction workspace through wetlands and waterbodies generally has been reduced to 75 ft as required and where practicable.

Pipe Diameter (inches)	Construction ROW Width (feet)
8 – 16	75
18 – 24	90*
26 – 36	100

* Exception is the Haverhill Lateral which will be constructed within a 75 feet ROW.

[2] Operational workspace acreage impacts were calculated along the pipeline facilities according to the following permanent ROW widths:

Pipe Diameter (inches)	New Permanent Easement Affected During Operation (ft)
8 – 16	30-50
18 – 24	30-50
26 – 36	50

[3] Acreages for ATWS are not included in the Land Affected During Operation pipeline acreage values.

[4] All appurtenant aboveground facilities, including MLVs and pig facilities, will be constructed and operated within areas of existing or new permanent easements associated with the pipeline facilities.

2.2.1 Pipeline Facilities

The approximate land requirements for the pipeline facilities are summarized in Table 2.2-1. The pipeline acreages are based on varying construction ROW widths to accommodate the outer diameter of the pipeline proposed for each pipeline segment. Tennessee's proposed construction ROW widths for each pipeline segment are provided in Table 2.2-2. These widths will be maintained through uplands. A reduced construction ROW width of 75 feet is proposed for areas crossing wetlands and waterbodies and has been incorporated into the pipeline workspace except where variance requested on site-specific basis. Preliminary pipeline ROW workspace configurations and dimensions are depicted in the Aerial Alignment Sheets (Attachment N1).

Table 2.2-2
Proposed Construction ROW Widths for the Project Pipeline Facilities in Connecticut

Facility Name	Diameter (inches)	Construction ROW Width (feet)[1]	Operational ROW Width (feet)[2,3]
300 Line Connecticut Loop	24	90	50

[1] Construction workspace acreage impacts were calculated along the pipeline facilities according to the following construction ROW widths (which encompasses TWS and the operational ROW widths described in footnote 2). Construction workspace through wetlands and waterbodies will be reduced to 75 feet as required and where practicable, as shown on the alignment sheets.

Pipe Diameter (inches)	Construction ROW Width (feet)
8 – 16	75
18 – 24	90
26 – 36	100

*Exception is the Haverhill Lateral which will be constructed within a 75 foot ROW.

[2] Operational workspace acreage impacts were calculated along the pipeline facilities according to the following permanent ROW widths:

Pipe Diameter (inches)	Operational ROW Width (feet)
8 – 16	50
18 – 24	50
26 – 36	50

[3] This includes 25 ft of existing Tennessee ROW in areas where the proposed pipeline is co-located with an existing Tennessee pipeline.

2.2.2 Aboveground and Appurtenant Facilities

The land requirements for the aboveground facilities are summarized in Table 2.2-3.

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Table 2.2-3
Land Requirements for the Project Aboveground and Appurtenant Facilities in Connecticut

Facility Name[1]	Facility Type	Associated Pipeline	County	Township/Town	Segment[2]	Milepost	New / Modified	Area Required for Construction (acres)[3]	Area Required for Operation (acres)[4]
MLV-S-01	Mainline Valve	300 Line CT Loop	Hartford	Farmington	S	0.00	New	0.00	0.00
PL-S-01	Pig Launcher	300 Line CT Loop	Hartford	Farmington	S	0.00	New	0.00	0.00
MLV-S-02	Mainline Valve	300 Line CT Loop	Hartford	Bloomfield	S	6.97	New	0.00	0.00
North Bloomfield (20453)	Meter Station	Existing TGP Line 300-1	Hartford	Bloomfield	S	10.86	Modified	0.24	0.00
MLV-S-03	Mainline Valve	300 Line CT Loop	Hartford	East Granby	S	14.80	New	0.00	0.00
Easton (20853)	Meter Station	Existing TGP Line 300-1	Fairfield	Easton	N/A	Existing Facility	Modified	0.36	0.00
Milford (20425)	Meter Station	Existing TGP Line 300-1	New Haven	Orange	N/A	Existing Facility	Modified	1.24	0.77
							Total	**1.84**	**0.77**

[1] The prefixes for the facility names are defined below:
MLV- Mainline Valve
PL - Pig Launcher

[2] Each segment is associated with its own set of MPs beginning at MP 0.00.

[3] Modified compressor and meter stations will require the area of the existing facilities and temporary workspace during construction. New compressor and meter stations will require new permanent workspace for operation and temporary workspace during construction. All proposed appurtenant ancillary aboveground facilities, including MLVs, pig facilities and blowoffs will be constructed and operated within areas of existing or new permanent easements associated with the pipeline facilities. No additional temporary or permanent impacts are anticipated for the construction of MLVs, pig facilities and blowoffs that are not already being accounted for in the pipeline facility impacts.

[4] Area Required for Operation = new permanent workspace required for operation. Existing meter stations will not require new permanent workspace for operation. All proposed appurtenant ancillary aboveground facilities, including MLVs, pig facilities and blowoffs will be operated within areas of existing or new permanent easements associated with the pipeline facilities. No additional temporary or permanent impacts are anticipated for the operation of MLVs, pig facilities and blowoffs that are not already being accounted for in the pipeline facility impacts. Permanent impacts for driveways to new compressor and meter stations are included in acreage provided for those facilities.

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2.2.3 Access Roads

Construction access to the Project areas and ancillary facilities will be by way of the construction ROW and existing and new public and private roads. Tennessee anticipates utilizing temporary and permanent ARs during the construction of each portion of the Project with permanent ARs to be used during operation of the Project. Where public road access is unavailable, Tennessee will identify private ARs. Locations of ARs proposed for the Project are provided in Table 2.2-4. Locations of proposed temporary ARs identified are depicted on USGS topographic maps (Volume II, Appendix E of the ER) and Aerial Alignment Sheets provided in Attachment N1.

Where possible, Tennessee has proposed to use existing roads as ARs for the Project; if no existing road is available for use, Tennessee has sited new ARs away from sensitive resources to the extent practicable. Temporary soil erosion and sediment control measures will be installed along the proposed ARs in accordance with this ECP.

Construction impacts associated with proposed ARs are included in Table 2.2-4.

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Table 2.2-4
Access Roads Associated with Pipeline Facilities in Connecticut

Facility Name	County	Access Road ID[1,2]	Segment	Nearest Milepost[3]	Modification Required	Project Previously Used	Road Type[4]	Existing Land Use[5]	Justification[6]	Length (ft)	Area Affected During Construction (acres)
300 Line Connecticut Loop	Hartford	NED-TAR-S-0100	S	0.07	Yes	Prop.	Dirt	OL/ROW, UF, WB/OW, PSS	N/A	2,706	1.24
300 Line Connecticut Loop	Hartford	TGP-TAR-S-0100	S	0.70	Yes	Ex. - TGP 300 Line	Dirt/Gravel	OL/ROW, RD, UF, WB/OW, PFO	N/A	18,654	8.57
300 Line Connecticut Loop	Hartford	NED-TAR-S-0101	S	3.62	Yes	Prop.	Dirt/Gravel	CI, OL/ROW, RD, UF	N/A	1,877	0.66
300 Line Connecticut Loop	Hartford	TGP-TAR-S-0200	S	7.43	Minor	Ex. - TGP 300 Line	Dirt/Gravel	OL/ROW, RE, UF, WB/OW, PFO, PEM	N/A	423	0.20
300 Line Connecticut Loop	Hartford	NED-TAR-S-0300	S	7.80	Minor	Prop.	Dirt/Gravel	AG, OL/ROW	N/A	525	0.24
300 Line Connecticut Loop	Hartford	TGP-TAR-S-0300	S	9.02	Minor	Ex. - TGP 300 Line	Gravel	OL/ROW, UF, PEM	N/A	964	0.44
300 Line Connecticut Loop	Hartford	TGP-TAR-S-0400	S	10.71	Minor	Ex. - TGP 300 Line	Gravel	AG, OL/ROW, RD, UF	N/A	1,520	0.70
300 Line Connecticut Loop	Hartford	NED-TAR-S-0400	S	11.72	Yes	Prop.	Dirt/Gravel	AG, OL/ROW, UF	N/A	4,444	2.04
300 Line Connecticut Loop	Hartford	NED-TAR-S-0500	S	13.21	Yes	Prop.	Dirt	CI, RD, UF	N/A	1,048	0.48
300 Line Connecticut Loop	Hartford	NED-TAR-S-0600	S	13.39	Minor	Prop.	Paved/Gravel	CI	N/A	1,051	0.48
300 Line Connecticut Loop	Hartford	NED-TAR-S-0700	S	14.49	No	Prop.	Paved	CI, OL/ROW, RD, UF	N/A	1,794	0.89
300 Line Connecticut Loop	Hartford	NED-TAR-S-0800	S	14.80	Minor	Prop.	Paved/Dirt	RD, RE, UF	N/A	240	0.11
300 Line Connecticut Loop	Hartford	NED-TAR-S-0900	S	14.80	Minor	Prop.	Paved/Dirt	CI, RD, PEM, PSS	N/A	762	0.52
									Total	**36,008**	**16.57**

Source: Landuse was digitized using aerial imagery from a flight conducted for the project in the spring of 2015.

[1] ARs previously used for Tennessee projects are denoted as "TGP-". New ARs to be used for the NED Project are denoted as "NED-".

[2] TAR denotes a temporary AR.

[3] Nearest MP indicates the point at which the AR connects with the pipeline construction ROW, or closest MP to the construction ROW if there is no direct connection.

[4] This column indicates the AR status (dirt, gravel, paved, etc.)

[5] RD = Roadways/Railroads; RE = Residential; UF = Upland Forest; CI = Commercial/Industrial; AG = Agricultural; PEM/PFO/PSS = Wetland; OL/ROW= Open Land; WB/OW= Waterbody; OTHER; WETLAND = wetland type not classified by NWI as PEM, PSS, or PFO.

[6] Justification is for permanent ARs only and specifies which aboveground or appurtenant facility the road will be used for during operation. Temporary ARs are used for the construction of the pipeline and are designated as N/A (Not Applicable).

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2.2.4 Contractor Yards

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. Acreages associated with the contractor yards are included in the overall land requirements for the Project, as detailed in Table 2.2-1, and locations of proposed contractor yards are provided in Table 2.2 5. Locations of proposed contractor yards are depicted on the USGS topographic maps (Volume II, Appendix E of the ER) and Aerial Alignment Sheets (Attachment N1). Tennessee continues to evaluate locations of proposed contractor yards for the Project in consultation with appropriate regulatory agencies, landowners, and other stakeholders. Tennessee notes that certain contractor yards included in this ER will be excluded from the Project scope due to environmental and land use constraints, and impacts associated with these contractor yards will be removed in a supplemental filing.

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. Although certain wetland impacts for these previously disturbed areas are included in Resource Report 2 of the ER, Tennessee will select contractor yard sites considering these environmental impacts identified during environmental field surveys and obtain the appropriate regulatory permits prior to utilizing these sites.

Table 2.2-5
Contractor Yards for the Project in Connecticut

County	Township/Town	Yard Name[1]	Existing Land Use[2]	Distance from Project (miles) and Direction	Area Affected During Construction (acres)[3]
Hartford	West Hartford	NED-S-0400	CI, UF	0.03 miles W of MP 3.63 (Segment S)	1.86
Hartford	Bloomfield	NED-S-0001	AG, RE	0.07 miles W of MP 7.87 (Segment S)	2.42
Hartford	East Granby	NED-S-0002	AG	0.35 miles NW of MP 11.83 (Segment S)	17.69
Hartford	Windsor	NED-S-0100	CI, UF, OL/ROW, RD	0.36 miles E of MP 13.25 (Segment S)	43.37
Hartford	East Granby	NED-S-0200	CI, UF, OL/ROW, RD	0.11 miles N of MP 14.59 (Segment S)	6.45
Hartford	East Granby	NED-S-0300	OL/ROW, PFO1E	0.81 miles N of MP 14.80 (Segment S)	6.07
				Total	**77.86**

Source: Landuse was digitized from publicly available aerial imagery.

[1] New contractor yards to be used for the NE Project are denoted as "NED-".

[2] RD = Roadways/Railroads; RE = Residential; UF = Forest; CI = Commercial/Industrial; AG = Agricultural; PEM/PFO/PSS = Wetlands; OL/ROW = Open Land; WB/OW = Waterbodies; Other.

[3] Yards will be used during the construction of the proposed pipeline facilities. No operational impacts will occur at these sites.

Note: The contractor yards listed in this table are more than required for the construction of the project and a final list will be determined as the sites are further evaluated through field surveys.

2.2.5 Additional Temporary Workspace (ATWS)

ATWS areas typically are required at road, railroad, wetland, and waterbody crossing locations (including horizontal directional drilling ("HDDs") for areas requiring specialized construction techniques, including steep slopes and agricultural land. The configurations and sizes of ATWS areas will be based on site-specific conditions and vary in accordance with the construction methodology, crossing type, and other construction needs. Tennessee has identified locations and acreages of ATWS that will be required to facilitate construction. ATWS requirements are summarized in Table 2.2-1. ATWS areas are depicted on the Aerial Alignment Sheets (Attachment N1) of this ECP.

Tennessee is requesting modifications from Sections II.A.1, V.B.2 and VI.B.1.a of its Procedures.

2.2.6 Non-Surveyed Areas

Surveys for the Project were initiated in July 2014 and were suspended in November 2014 due to winter weather conditions. Additional field surveys re-commenced in March 2015 and the field season is continuing as additional survey access permissions are granted through December 2015, weather permitting. Field surveys will resume in spring 2016. 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. This process may extend after the issuance of the certificate order, should the Project be approved by the Commission. Field survey data shown on the aerial alignment sheets included in Volume II, Appendix F, incorporates survey data obtained through September 29, 2015. Photo-interpreted data from high resolution aerial imagery and publicly available data sources were utilized for areas where field surveys have not yet been completed.

In March 2015, Tennessee flew the Project alignment as it was routed at the time to obtain a 1,600 high-resolution aerial imagery corridor. Tennessee has used this imagery to photo-interpret the boundaries for wetlands and waterbodies, ecological communities, and rare species habitat for areas with no access. 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. Since the March 2015 flight there have been route deviations so certain portions of the current Project alignment do not have high resolution aerial imagery associated with them. Tennessee has utilized publicly available data for these areas, Tennessee anticipates flying these deviations in November 2015, weather permitting.

3.0 SUPERVISION AND INSPECTION

The on-site Environmental Inspection staff will serve a vital role in implementing the ECP and ensuring that it is adhered to throughout the construction process. The inspectors may be required to make educated decisions regarding critical issues such as choosing the appropriate BMPs for specific stream and wetland crossings, including the location and placement of BMPs and dewatering procedures.

3.1 ENVIRONMENTAL INSPECTOR (EI)

- At least one EI is required for each construction spread during construction and restoration. The number and experience of EIs assigned to each construction spread should be appropriate for the length of the construction spread and the number/significance of resources affected.
- EIs will have peer status with all other activity inspectors. The EI will correct and report compliance problems, have "stop-task" authority and make "stop-work" recommendations to the Lead EI who has overall Project "stop-work" authority for a Project spread. The EI will discuss a potential “stop-work” action with appropriate Project personnel prior to construction shutdown and will notify the Construction Inspector when a stop-work recommendation is issued.
- The EIs will have the authority to stop activities that violate the environmental conditions of the FERC’s Orders, stipulations of other environmental permits or approvals, or land-owner easement agreements, and to order appropriate corrective action.

Tennessee’s Environmental Project Manager will be the primary liaison between the Project and agency representatives. The Environmental Project Manager will notify the appropriate agency in accordance with permit requirements or as required by law regarding all Project related activities, (e.g., a spill of hazardous material into a water source, requests for agency guidance, existing requirement variances).

3.2 RESPONSIBILITIES OF ENVIRONMENTAL INSPECTORS

Tennessee will employ EIs who will be responsible for ensuring that Contractors implement and maintain erosion and sediment control BMPs during construction.

At a minimum, the EI(s) will be responsible for:

- Ensuring compliance with the requirements of the ECP, the environmental conditions of the certificate order, the mitigation measures proposed by the applicant (as approved and/or modified by the certificate order), other applicable environmental permits, and environmental requirements in land-owner easement agreements;
- Identifying, documenting, and overseeing corrective actions, as necessary, to bring an activity into compliance;
- Verifying that the limits of authorized construction work areas and locations of ARs are properly marked before clearing and maintained throughout construction;
- Verifying the location of signs and highly visible flagging marking the boundaries of sensitive resource areas, waterbodies, wetlands, or areas with special requirements along the construction work area;
- Identifying erosion/sediment control and soil stabilization needs in all areas;
- Ensuring that the location of dewatering structures and slope breakers will not cause erosion or direct water into sensitive environmental resource areas, including cultural resource sites, wetlands, waterbodies, and sensitive species habitats;
- Verifying that dewatering activities are properly monitored and do not result in the deposition of sand, silt, and/or sediment into sensitive environmental resource areas, including wetlands, waterbodies, cultural resource sites, and sensitive species habitats. If such deposition is occurring, the EI will order the dewatering activity to stop and the design of the outlet structure will be modified to prevent reoccurrence;
- Ensuring that subsoil and topsoil are tested in agricultural and residential areas to measure compaction and determine the need for corrective action;

- Advising the Construction Manager when environmental conditions (such as wet weather or frozen soils) make it advisable to restrict or delay construction activities to avoid topsoil mixing, excessive rutting, or in some cases excessive compaction;
- Ensuring restoration of contours and topsoil;
- Verifying that the soils imported for agricultural or residential use are certified as free of noxious weeds and soil pests, unless otherwise approved in writing by the land-owner;
- Determining the need for and ensuring that erosion control devices are properly installed to prevent sediment flow into sensitive environmental resource areas (e.g., wetlands, waterbodies, cultural resource sites, and sensitive species habitats, and onto roads) and determining the need for additional erosion control devices;
- Inspecting and ensuring the maintenance of temporary erosion control measures at least:
  - On a daily basis in areas of active construction or equipment operation;
  - A minimum of once a week in areas with no construction or equipment operation;
  - Within 24 hours of each 0.5 inch of rainfall or greater. This means that an inspection will be required once a storm event has produced 0.5 inch, even if the storm event is still continuing. Inspections will be required within 24 hours of the first day of the storm that produces more than 0.5 inch of rainfall and within 24 hours after the end of the storm for multiple day storm events that produce 0.5 inch of rainfall or more per day.
- Ensuring the repair of all ineffective temporary erosion control measures within 24 hours of identification, or as soon as conditions allow if compliance with this timeframe will result in greater environmental impacts;
- Keeping records of compliance with the environmental conditions of the FERC Orders, and the mitigation measures proposed by Tennessee in the application submitted to the FERC, and other applicable environmental permits during active construction and restoration;
- Identifying areas that should be given special attention to ensure stabilization and restoration after the construction phase;
- Verifying that locations for any disposal of excess construction materials for beneficial reuse comply with applicable state and federal permit requirements;
- Monitoring hydrostatic test fill and discharge activities and conducting sampling of the test water;
- Working with water and wetland resource agencies to assure the ECP is properly implemented;
- Reviewing the Contractor's pre-job inventory and location of lubricants, fuels, and other materials which could be accidentally discharged into the environment;
- Consulting with Tennessee to determine reportable spill quantities for materials on the inventory;
- Classifying each material on the pre-job inventory, including those within designated storage areas, as hazardous or non-hazardous;
- Identifying, in conjunction with the Environmental Coordinator, the approved waste transporters and disposal sites for both hazardous and non-hazardous wastes;
- Approving the Contractor's spill containment equipment and spill response procedures and impact minimization measures submitted pursuant to Attachment N3 – Spill Prevention and Response Plan;
- Defining the duties and coordinating the responses of all persons involved in cleaning up a spill;
- Maintaining, with support from Tennessee, an up-to-date list of names, addresses, and phone numbers of all persons to be contacted in case of a spill (Attachment N3, Spill Prevention and Response Plan);
- Ensuring the Contractor conducts training for spill prevention and impact minimization as outlined in Attachment N3, Spill Prevention and Response Plan;

- Coordinating with Tennessee's Field Environmental Representative to determine if waste profiles exist for wastes generated during construction pursuant to Attachment N4, Waste Management Plan; and
- Coordinating with the Field Environmental Representative and Contractor to determine the type of waste and the party responsible for proper disposal, pursuant to Attachment N4, Waste Management Plan.

3.3 ENVIRONMENTAL TRAINING FOR CONSTRUCTION

As required, environmental training will be given to all company and Contractor personnel involved during construction of the Project. Construction personnel, including but not limited to, the Chief Inspector; Lead EI; EI; craft inspectors; Contractor job superintendent to loggers, welders, equipment operators, and laborers will be given environmental training. The level of training will vary depending on the type of work being performed by the personnel. Construction personnel are expected to maintain strict compliance with applicable permit conditions and approvals to protect the environment during construction. Training will be given prior to the start of construction and throughout the construction process, as needed, and will cover the following issues:

- The specifics of this ECP and the Spill Prevention and Response Plan;
- Job- or activity-specific permit requirements and conditions;
- Company policies and Project commitments;
- Cultural resource procedures and restrictions;
- Threatened and endangered species restrictions; and
- Any other pertinent information related to the job.

4.0 PRE-CONSTRUCTION PLANNING

This section states the pre-construction planning efforts that will be undertaken as part of the Project. Further details regarding the construction activities are presented in Section 5.0 – Construction Activities.

4.1 CONSTRUCTION WORK AREAS

Pipeline construction workspace requirements are a function of pipe diameter; equipment size; topography; geological rock formations; location of construction, such as at road crossings or waterbody crossings; pipeline crossovers; methods of construction, such as boring or open cut construction; and existing soil conditions encountered during construction. The proposed pipeline facilities in Connecticut include one 24-inch-diameter pipeline (Segment S). The construction workspace for the Project will generally be 90 feet wide in upland areas and reduced to 75 feet wide at wetland and waterbody crossings. ATWS areas will be required at certain locations and are explained in detail below. Proposed construction ROW widths are included in Table 2.2-2.

4.1.1 ROW and Staging Areas

Construction activities will be restricted to the ROW limits identified on the alignment sheets and approved by FERC and applicable regulatory agencies. Construction work areas required for safe construction (e.g., construction ROW, extra work space areas, contractor yards, ARs) will be identified

prior to construction. However, in limited, non-wetland areas, the construction ROW width may be expanded by up to 25 feet without approval from the FERC for the following situations (FERC 2013):

- To accommodate full width construction ROW topsoil segregation;
- To ensure safe construction where topographic conditions (e.g., steep side-slopes or soil limitations exist); and
- For truck turn-arounds where no reasonable alternative access exists in limited, non-wetland or non-forested areas.

Use of these limited areas is subject to land-owner approval and compliance with all applicable survey, permitting, mitigation, and reporting requirements. When such additional areas are used, each one will be identified and the need explained in the weekly or biweekly construction reports to the FERC, if required. The following material will be included in the reports (FERC 2013):

- The location of each additional area by station number and reference to a previously filed alignment sheet, or updated alignment sheets showing the additional areas;
- Identification of where the Commission's records contain evidence that the additional areas were previously surveyed; and
- A statement that land-owner approval has been obtained and is available in the Project files.

Prior written approval of the FERC Director of the Office of Energy Projects ("FERC Director") is required when the certificated construction ROW width is expanded by more than 25 feet (FERC 2013).

See Typical Construction Drawings 67 to 74 (Attachment N2) for typical construction ROW widths. Additional construction ROW configurations may be required at specific locations to facilitate construction including, but not limited to, steep side or vertical slopes, road crossings, crossovers, areas requiring full width topsoil segregation, existing utility crossings (e.g., electric transmission lines) and staging areas associated with wetland and waterbody crossings. These locations are shown on the Aerial Alignment Sheets in Attachment N1.

The ROW will be staked or otherwise marked in the field prior to the beginning of construction. Utility lines located within the Project ROW limits will be located and marked to prevent accidental damage during pipeline construction. The typical ROW widths will be as follows:

- The typical construction corridor width within upland areas is 90 feet, except where additional workspace is required for safety purposes. The 90-foot corridor is comprised of 35 feet of permanent easement, 15 feet of TWS on the spoil side, and 40 feet of TWS on the working side (Typical Construction Drawing 74 [Attachment N2]).
- The typical construction corridor width in wetland areas is 75 feet, which is comprised of 35 feet of permanent easement and 40 feet of TWS.

4.1.2 Off ROW Disturbance

With certain exceptions, construction activities will be restricted to within the limits identified on the construction drawings. The exceptions, which are required to comply with Tennessee's Plan and Procedures, include the installation of slope breakers, installation of energy-dissipating devices, installation of dewatering structures, drain tile repair or, for safety reasons, associated with steep slope construction, all of which are approved by the FERC. The Project has been designed to minimize

off-ROW disturbance to the extent practicable by proposing construction workspaces (e.g., top soil storage, subsoil storage, equipment travel lanes, etc.) wide enough to adequately and safely construct the Project.

4.1.3 Access Roads

Appropriate BMPs will be utilized and maintained on ARs during construction to limit potential impacts to areas located outside of the ROW. The following practices will be implemented, where practicable, to minimize potential impacts:

- Access to the ROW during construction and restoration activities will be permitted only by the new or existing ARs identified on the construction drawings and approved by applicable regulatory agencies;
- The Contractor will maintain safe conditions at all road crossings and access points during construction and restoration (e.g., implementing a maintenance and protection of traffic plan);
- Temporary and permanent ARs will be maintained as required during construction to fill potholes, install additional erosion and sediment control measures, and repair soft spots that may develop during heavy construction vehicle use;
- The Contractor will implement appropriate erosion and sedimentation control measures for construction/improvement of ARs;
- The Contractor will ensure that paved road surfaces utilized during construction are kept free of mud, sediment, and debris to the extent practicable;
- Construction entrances, where required by the applicable regulatory agencies, in residential or active agricultural areas will be placed on nonwoven geotextile fabric to facilitate removal after construction.
- ARs across a waterbody will use an equipment bridge, cross culvert, or other approved means in accordance with Section 6.0;
- Locate ARs, where possible, so that they do not impact wetlands. All ARs that will impact wetlands will require approval from applicable regulatory agencies and will be protected with the appropriate BMPs;
- Where temporary ARs impact wetlands, unless otherwise authorized by applicable permits, equipment mats or an equivalent protective layer will be used; and
- Minimize the limit of disturbance to only that needed to construct a stable AR where permanent ARs impact wetlands. This will be accomplished by steepening tie-in slopes to the extent practicable adjacent to wetlands while still maintaining a stable slope.

4.1.4 Contractor Yards

Tennessee has identified locations proposed to be utilized for contractor yards for the Project. Acreages associated with the contractor yards are included in the overall land requirements for the Project, as detailed in Table 2.2-1. The locations of proposed contractor yards are provided in Table 2.2-5. These areas will be used for equipment, pipe, and material storage, 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. Tennessee will advise all Contractors that they will utilize the contractor yard locations approved for the Project, and will not establish a staging or warehouse yard for this Project without Tennessee first being advised and the FERC granting permission to use the area.

If agricultural lands are utilized for contractor yards, the Contractor will strip and segregate topsoil prior to beginning construction activities. Areas used as contractor yards will be fully restored using the same scope of agricultural mitigation and restoration measures that apply to the pipeline construction ROW. At a minimum, the Contractor will perform the following measures at contractor yards associated with agricultural land:

- Strip and segregate topsoil in agricultural lands;
- Install erosion control structures as directed by the EI, outlined in this ECP, or identified on the construction drawings, and maintain them throughout construction and restoration activities;
- Implement and comply with the Spill Prevention and Response Plan;
- Implement the Soil Protection and Subsoil Decompaction Mitigation Plan as required; and
- Restore and revegetate disturbed areas in accordance with the measures outlined in this ECP and as directed by the EI.

Other land uses associated with contractor yards will be restored to pre-construction condition in accordance with this ECP and applicable regulatory guidelines.

4.1.5 Wetland/Waterbody Crossings

The pre-construction activities include survey of topographic surface elevations, as required, as well as field identification/delineation of wetlands and waterbodies within the pipeline ROW. The survey information will be used in conjunction with pre-construction photographs taken at the proposed crossing locations to document the pre-existing conditions of the proposed crossings to ensure that existing topography and stream profiles are re-established to the extent practicable during restoration. Construction plans will be prepared in accordance with Tennessee's Plan and Procedures and other applicable regulatory standards.

Waterbody crossings will be inspected daily during active construction and weekly during inactive construction. Once restored, crossings will be monitored to ensure that the stream banks and stream channel are stable. The monitoring will continue until adjacent areas are successfully revegetated.

4.2 AGRICULTURAL AREA PLANNING

4.2.1 Drain Tile and Irrigation Systems

For agricultural lands crossed by the Project, Tennessee will perform the following agricultural area planning measures:

- Attempt to locate existing drain tiles and irrigation systems;
- Contact land-owners and regional authorities to determine the locations of future drain tiles that are likely to be installed within 3 years of the authorized construction;
- Develop procedures for constructing through drain tile areas, maintaining irrigation systems during construction, and repairing drain tiles and irrigation systems after construction;
- Identify dewatering outlets and favorable locations for the protected day lighting of gravity flow drain outlets for new interceptors or replaced drain tiles; and
- Ensure the depth of cover over the pipeline is sufficient to avoid interference with drain tile systems in areas where drain tiles exist or are planned.

4.2.2 Grazing Deferment

Tennessee will contact farm operators during the planning phase to develop a plan to delay the pasturing of the ROW, following construction, until pasture areas are adequately revegetated. Tennessee will be responsible for maintaining the temporary fences on the ROW until the EI determines that the vegetation on the ROW is established and able to accommodate grazing. At such time, Tennessee will be responsible for the removal of the fences.

4.2.3 Agency Coordination

Tennessee will coordinate with appropriate agencies as outlined in the ECP. For agricultural lands, Tennessee will obtain recommendations from regional authorities, land management agencies, and/or Conservation Districts regarding the identification of highly erosive soils, permanent erosion control, and revegetation specifications.

4.3 SPILL PREVENTION AND RESPONSE PLAN

Tennessee has prepared a Spill Prevention and Response Plan to assist in prevention of any spills that may occur during the Project and to respond to any spills that do occur. The Contractor will be required to become familiar with the Spill Prevention and Response Plan and its contents prior to commencing any construction-related activities. The Spill Prevention and Response Plan can be found in Attachment N3 of this ECP.

4.4 WASTE MANAGEMENT PLAN

Tennessee has prepared a Waste Management Plan to outline the methods for disposal of construction debris (e.g., timber, slash, mats, garbage, drilling fluids, excess rock, etc.) prior to beginning construction activities. Off-site disposal in other than commercially operated disposal locations is subject to compliance with applicable surveys, land-owner permission, and mitigation requirements. These materials will not be permitted to be disposed of or buried within agricultural lands. The Waste Management Plan can be found in Attachment N4 of this ECP.

4.5 HORIZONTAL DIRECTION DRILLING CONTINGENCY PLAN

Tennessee has developed a HDD Contingency Plan to establish procedures for addressing potential impacts associated with an inadvertent release of drilling fluid through hydraulically induced cracks during the HDD process. The plan identifies operational procedures and responsibilities for the prevention, containment, and clean-up of drilling fluids that have ponded on the ground surface or within a waterbody in relation to an inadvertent release of drilling fluid event during HDD operations. The HDD Contingency Plan can be found in Attachment N5 of this ECP.

4.6 PLAN FOR UNANTICIPATED DISCOVERIES OF CULTURAL AND PALEONTOLOGICAL RESOURCES AND HUMAN REMAINS

In order to minimize the potential for the accidental discovery of cultural resources, Tennessee is in the process of conducting a detailed archaeological reconnaissance of the proposed Project area. Reconnaissance has not been completed in areas with any access. A Plan for Unanticipated Discoveries of Cultural and Paleontological Resources and Human Remains has been prepared for the Project to

ensure that Tennessee maintains compliance with all applicable regulations concerning the protection of cultural resources. The plan includes procedures and contact information that will be followed in the event cultural resources that have not been previously identified in the construction documents are discovered. Tennessee has coordinated with local federally recognized Native American Tribes to ascertain feedback on this plan. Tennessee has considered the suggestions made by the Tribes and has incorporated the comments in the plan where applicable. The Plan for Unanticipated Discoveries of Cultural and Paleontological Resources and Human Remains is included as Attachment N6 to this ECP.

4.7 UNANTICIPATED DISCOVERY OF CONTAMINATION PLAN

Tennessee has prepared an Unanticipated Discovery of Contamination Plan to outline practices to employ in the event of an unanticipated discovery of contamination in soil, groundwater, and sediment when excavating during construction and/or maintenance activities, as well as debris or waste materials deposited on the pipeline ROW and other Project areas. The purpose of the Unanticipated Discovery of Contamination Plan is to:

- Protect human health and worker safety;
- Prevent the spread of contamination; and
- Comply with applicable state and/or federal regulations.

The Unanticipated Discovery of Contamination Plan can be found in Attachment N7 of this ECP.

4.8 BLASTING MANAGEMENT PLAN

Tennessee has developed a Blasting Management Plan to outline the procedures and safety measures to which the Contractor will adhere to in the event that blasting is required for installation of the Project facilities. This Blasting Management Plan is intended to identify blasting operations, including safety, use, storage, and transportation of explosives, that are consistent with minimum safety requirements, as defined by federal (e.g., Title 27 (Code of Federal Regulations ["CFR"] 181 - Commerce in Explosives; Title 49 CFR 177 - Carriage by Public Highway; Title 29 CFR 1926.900 et seq. Subpart U - Safety and Health Regulations for Construction - Blasting and Use of Explosives; Title 29 CFR 1910.109 - Explosives and Blasting Agents (Occupational Safety and Health Administration [OSHA]); 29 CFR 1926.900-General Provisions and Standard Nos. 901, 902, and 904-912), state, and local regulations. The Blasting Management Plan can be found in Attachment N8 of the ECP.

4.9 INVASIVE SPECIES MANAGEMENT PLAN

Tennessee is in the process of conducting field surveys to identify occurrences of invasive species within the Project ROW and has prepared a state-specific ISMP for all construction activities associated with the Project. This ISMP is specific to revegetation of the ROW immediately following construction of the natural gas pipeline and aboveground facilities, as well as long-term post-construction monitoring of the ROW as required by applicable federal and state agencies. The Invasive Species Management Plan can be found in Attachment N9.

4.10 SOIL PROTECTION AND SUBSOIL DECOMPACTION MITIGATION PLAN

Tennessee has developed a Soil Protection and Subsoil Decompaction Mitigation Plan that outlines the special soil protection and subsoil mitigation measures and BMPs to be employed by Tennessee during construction of the Project on agricultural and residential properties. The Soil Protection and Subsoil Decompaction Mitigation Plan can be found in Attachment N10.

4.11 ORGANIC FARM PROTECTION PLAN

Tennessee has developed an Organic Farm Protection Plan (to outline the special procedures and BMPs to be employed by Tennessee during construction of the Project on identified farms that are organic certified or farms that are in active transition to become organic certified. This plan is intended to address the unique management and certification requirements of these organic farm operations. The Organic Farm Protection Plan can be found in Attachment N11.

4.12 WINTER CONSTRUCTION PLAN

Tennessee has prepared a Winter Construction Plan in anticipation of construction activities occurring during the winter. The plan includes special construction techniques and material handling procedures that will be required to safely construct the Project. The plan can be found in Attachment N12 of this ECP.

4.13 GENERAL TRAIL CROSSING PLAN

Tennessee has prepared a General Trail Crossing Plan ("Crossing Plan") in anticipation of the Project crossing hiking trails in the State of Connecticut. The Crossing Plan serves to establish protocols to protect recreational users during construction; avoid and minimize impacts to the trails; and to preserve their integrity and the user experience. The plan can be found in Attachment N13 of this ECP.

4.14 STORMWATER POLLUTION PREVENTION

This ECP has been prepared in compliance with the U.S. Environmental Protection Agency's ("USEPA") National Stormwater Program General Permit requirements and National Pollution Discharge Elimination System ("NPDES") requirements for stormwater discharges from construction activities. This ECP will be made available on each construction spread.

5.0 CONSTRUCTION ACTIVITIES

This section presents details regarding specific construction activities. Additional general sequencing of planning, installation, cleanup, and restoration are presented in later sections of this ECP.

5.1 GENERAL PIPELINE CONSTRUCTION SEQUENCE

Installation of the pipeline will typically proceed from one end of the construction spread to the other in an assembly line or "mainline" fashion. The spacing between the individual crews responsible for each

interdependent activity is based on anticipated rate of progress. The activities listed below are normally performed in the following sequence:

- Pre-construction planning;
- Survey and flagging the ROW;
- Clearing the ROW;
- Installing temporary sediment barriers;
- Grading the ROW;
- Installing temporary interceptor dikes;
- Trenching/excavating the trench;
- Pipe stringing and bending;
- Welding, weld inspection, and coating of field joints;
- Trench dewatering;
- Lowering the pipe into the trench;
- Padding/backfilling the trench;
- Hydrostatic testing of pipe; and
- ROW clean-up and restoration.

5.2 APPROVED AREAS OF DISTURBANCE

Project-related ground disturbance will be limited to the construction ROW, additional workspace areas, contractor yards, borrow and disposal areas, ARs, and other areas approved in the certificate order. Project-related ground disturbing activities outside these certificated areas, except those needed to comply with Tennessee's Plan and Procedures (e.g., slope breakers, energy-dissipating devices, dewatering structures, drain tile system repairs, etc.) will require prior FERC Director approval and applicable agency approval(s). All construction or restoration activities outside of the certificated areas are subject to applicable survey and mitigation requirements.

As previously noted, the standard construction corridor width for the Project will be 100 feet in all upland areas. The construction ROW width may be expanded by up to 25 feet to accommodate full construction ROW topsoil segregation, bedrock spoil storage, and to ensure safe construction where topographic conditions (such as side-slopes) or soil limitations require it. The construction corridor in wetlands and waterbodies will be 75 feet, which is as described in Tennessee's Plan and Procedures.

5.3 DISTURBANCE ADJACENT TO IDENTIFIED CULTURAL RESOURCE SITES

Any activity that causes ground disturbance has the potential to disturb cultural sites, and sites are often not readily identifiable by the untrained eye. Tennessee is coordinating with the CT State Historic preservation Office ("SHPO") to develop avoidance plans for any required cultural sites. Identified cultural resource sites will be cordoned off, where required and in accordance with applicable avoidance plans prior to construction activities beginning, including clearing activities to reduce the possibility of accidental impacts to significant cultural resource sites that are located directly adjacent to the construction corridor.

Temporary barriers, as necessary, will be installed in accordance with applicable avoidance plans. The temporary barriers may include orange safety fences, temporary chain link fencing, temporary concrete barriers, or a combination of all three. Any avoidance measures will be outlined in the avoidance plans,

approved by the SHPO. Tennessee will adhere to the avoidance plans to determine placement and type of avoidance measures needed. Temporary barriers will be maintained throughout construction and will be removed once construction and restoration of the workspace is complete.

To minimize unauthorized collecting of cultural resource material or vandalism to known cultural resource sites, the Contractor will inform construction crews of the requirements relating to cultural resource protection and all workers will attend mandatory training on the significance of cultural resources and the relevant federal regulations intended to protect them. Construction personnel who operate ground-disturbing equipment will receive special instruction on the types of cultural resources that may be encountered and the procedures to be followed if they encounter buried archaeological deposits or features. Construction workers and other Project personnel present in the workspace will be informed of the EI's authority to halt work if unidentified archeological resources are encountered. Personnel will be informed that they are subject to prosecution for knowingly disturbing historic or prehistoric sites or for collecting artifacts. Any violation may result in removal from the Project and/or may result in civil or criminal penalties in accordance with the Archaeological Resources Protection Act of 1979 (as amended) (U.S. Code [USC] 1979).

5.4 CLEARING

Clearing consists of the removal of vegetation and other obstructions from the ROW. Clearing will be restricted to only that portion of the ROW necessary for actual construction. Trees, brush, and other obstructions will be cleared to permit safe and efficient use of machinery and other construction equipment.

Various clearing methods may be employed, depending on tree size, contours of the land, and the ability of the ground to support clearing equipment. 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, as specified in landowner agreements.

- Timber not designated for other uses will be disposed of by the clearing Contractor, as designated by the EI or in approved areas that were identified prior to clearing.
- Timber will not be stacked in drainage ways or left within wetlands.

Brush, scrub vegetation, and woodchips may be disposed of in one of several ways, depending on applicable restrictions and the terms of applicable permits and/or easement agreements:

Brush

- Brush will not be piled along the edge of the ROW unless requested in writing by the land-owner or land managing agency.
- Tennessee does not plan to use brush piles as wildlife habitat unless requested in writing by the land-owner, land managing agency, or applicable regulatory agency. If required, brush piles will be a maximum of 12 feet wide and compacted to 4 feet high with breaks every 100 to 200 feet. Brush piles will not extend through wetlands or waterbodies.
- All brush will be removed from wetland and waterbody areas.
- Off-ROW stacking must be approved by the land-owner and the Commission.
- Brush piles may be chipped and spread across the ROW, in accordance with the restrictions outlined in the woodchips section below.

- Brush piles will not be burned during construction.

Woodchips

- Woodchips may be spread across the ROW within upland areas, with EI approval, in a manner that does not inhibit revegetation. Woodchips left on the ROW will require fertilizer application during restoration.
- Woodchips will not be left in agricultural lands, wetlands, waterbodies, or other sensitive areas or within 50 feet of these areas.
- Woodchips will not be stockpiled in such a manner that they may be transported into a wetland or agricultural land.

Temporary BMPs will be installed as necessary, and in accordance with approved plans, to prevent erosion within the ROW immediately after soil disturbances.

The following are standard procedures that Tennessee will follow during the clearing phase of construction:

- ROW boundaries (e.g., workspace limits) and wetland boundaries will be clearly delineated prior to clearing.
- Trees to be saved will be marked (flagging, construction fencing, etc.) before clearing begins.
- 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.
- Existing fences that need to be temporarily removed for access will be maintained by the use of a temporary fence section. Prior to being cut, the fence will be properly braced and similar material used to construct the section. At no time will an unattended section be left open. The section will be replaced after removing construction debris with a permanent fence of the same or similar material and condition.
- Pruning may be necessary to clear the ROW. Pruning cuts will be made as follows:
  - Cuts will be cut smooth;
  - Cuts will be made immediately in front of the branch collar;
  - Large, heavy branches will be precut on the underside to prevent splitting or peeling of bark; and
  - Climbing spurs will not be used on trees that are to remain standing.
- Trees will be felled into the ROW to prevent damage to trees adjacent to the ROW.
- Trees that have fallen into waterbodies or beyond the ROW as a result of the clearing activities will be removed immediately.

5.5 RESIDENTIAL AREA CONSTRUCTION

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. Tennessee will make every effort to ensure that construction activities minimize adverse impacts to residential properties and that restoration is prompt and thorough.

Throughout construction, traffic lanes and access to homes will be maintained, except for the brief periods essential for laying the new pipeline. The Contractor will erect temporary safety fences at the edge of the construction ROW for a distance of 100 feet on either side of any residence. Tennessee may use techniques such as stovepipe and drag section construction in order to minimize the impacts of construction in residential areas on a site-specific basis. Residential and commercial structures within 50 feet of construction are shown in Table 5.5-1. Site-specific residential construction plans will be utilized for residences within 50 feet of the edge of the construction ROW.

Affected landowners will be notified at least five days before construction commences, unless more advance notice is required pursuant to a landowner agreement. In addition, Tennessee will work to accommodate any special concerns regarding ornamental shrubs, trees, or structures by developing individual landowner agreements prior to construction.

Landowners whose access to their property will be affected by roadway construction will receive pre-construction notification either in person or via phone communications from Tennessee's land agents. At a minimum, Tennessee will attempt to provide individual notification to immediately affected landowners at least five days before construction commences and will attempt to provide general public notifications as early as possible or as required under permit conditions.

Tennessee will take measures to ensure that construction activities do not prevent access to residential areas by fire and emergency vehicles. At least one lane of traffic will be kept open for emergency vehicles when constructing on or across residential streets. During any period when a road is completely cut or temporarily closed, steel plates will be available on-site to immediately cover the open area to permit travel of emergency vehicles. In residential areas, topsoil replacement (i.e., importation of topsoil) is an acceptable alternative to topsoil segregation. Separation of segregated topsoil and subsoil will be maintained throughout construction where topsoil segregation is conducted. Segregated topsoil will not be used for padding the pipe or filling sandbags. Compaction testing may be performed prior to final restoration, and appropriate soil compaction mitigation will be performed in severely compacted areas. This may include, but is not limited, to disking, rototilling, and harrowing the subsoil prior to topsoil placement.

Tennessee will use a typical pipeline construction sequence in which the pipeline installation crew is followed by a separate backfill crew to ensure that the trench is backfilled within 10 days after pipeline installation in residential areas. Tennessee will require its Contractor, by contractual agreement, to backfill trenches in residential areas as soon as practicable after the installation of the pipeline.

As necessary to minimize impacts, Tennessee will use specialized stove pipe or drag section construction in residential areas. The stove pipe construction method typically is used when the pipeline is to be installed in very close proximity to an existing structure. A description of the stove-pipe and drag-section installation techniques can be found in Sections 5.16 and 5.17 of this ECP.

Residential areas will be restored and construction debris removed as soon as practicable or within 10 days after backfilling the trench. Lawns will be raked, topsoil added as necessary, and lawns restored per agreements with landowners. Ornamental shrubs will be replaced where possible. Contractors will restore fences, mailboxes, and other structures (not in conflict with the installed pipeline) removed during construction. Sidewalks, driveways, and roads will be restored as soon as practicable.

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 developed springs used for drinking water will include: yield, pH, petroleum based hydrocarbons, total suspended solids, total dissolved solids, nitrates, nitrites, arsenic, iron, manganese, lead, copper, and total coliform bacteria. 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.

Table 5.5-1
Residences and Commercial Buildings Within 50 Feet of Pipeline Facilities in Connecticut

Facility Name	County	Commercial Structure Line List Number or Residential Drawing Number	Building Type	Segment[1]	Milepost	Direction (NSEW)[2] / Distance[3] (feet)		Mitigation[4]
						Edge of Workspace	Pipeline Centerline	
300 Line CT Loop	Hartford	LA-SEG_S-RES-001	Residence Single Family	S	6.69	W / 0	NW / 20	See Drawings
300 Line CT Loop	Hartford	CT LT 712.00	Commercial Building	S	6.74	SE / 41	SE / 66	See Drawings
300 Line CT Loop	Hartford	CT LT 712.00	Commercial Building	S	6.75	SE / 32	SE / 57	See Drawings
300 Line CT Loop	Hartford	LA-SEG_S-RES-001	Residence Single Family	S	6.76	NE / 16	NW / 38	See Drawings
300 Line CT Loop	Hartford	LA-SEG_S-RES-001	Residence Single Family	S	6.80	NW / 12	NW / 42	See Drawings
300 Line CT Loop	Hartford	LA-SEG_S-RES-002	Residence Single Family	S	7.47	SW / 47	SE / 375	See Drawings
300 Line CT Loop	Hartford	LA-SEG_S-RES-003	Residence Single Family	S	7.49	NW / 46	SE / 277	See Drawings
300 Line CT Loop	Hartford	LA-SEG_S-RES-003	Residence Single Family	S	7.52	SE / 31	SE / 56	See Drawings
300 Line CT Loop	Hartford	LA-SEG_S-RES-003	Residence Single Family	S	7.58	SE / 28	SE / 53	See Drawings
300 Line CT Loop	Hartford	LA-SEG_S-RES-004	Residence Single Family	S	8.17	SE / 37	SE / 81	See Drawings
300 Line CT Loop	Hartford	LA-SEG_S-RES-004	Residence Single Family	S	8.22	SE / 28	SE / 53	See Drawings
300 Line CT Loop	Hartford	LA-SEG_S-RES-004	Residence Single Family	S	8.25	NW / 23	NW / 78	See Drawings

Table 5.5-1
Residences and Commercial Buildings Within 50 Feet of Pipeline Facilities in Connecticut

Facility Name	County	Commercial Structure Line List Number or Residential Drawing Number	Building Type	Segment[1]	Milepost	Direction (NSEW)[2] / Distance[3] (feet)		Mitigation[4]
						Edge of Workspace	Pipeline Centerline	
300 Line CT Loop	Hartford	LA-SEG_S-RES-005	Residence Single Family	S	8.31	NW / 42	NW / 132	See Drawings
300 Line CT Loop	Hartford	LA-SEG_S-RES-005	Residence Single Family	S	8.32	SE / 9	SE / 49	See Drawings
300 Line CT Loop	Hartford	LA-SEG_S-RES-005	Residence Single Family	S	8.34	NW / 7	NW / 22	See Drawings
300 Line CT Loop	Hartford	CT LT 736.00/CT LT 736.01	Commercial Building	S	10.86	W / 0	NW / 61	See Drawings
300 Line CT Loop	Hartford	LA-SEG_S-RES-006	Residence Single Family	S	12.39	NW / 38	NW / 153	See Drawings
300 Line CT Loop	Hartford	LA-SEG_S-RES-007	Commercial Building	S	13.15	SE / 49	SE / 74	See Drawings
300 Line CT Loop	Hartford	LA-SEG_S-RES-007	Trailer/Mobile Home	S	13.32	NW / 10	NW / 50	See Drawings
300 Line CT Loop	Hartford	CT LT 761.01	Commercial Building	S	14.41	NE / 32	SE / 99	See Drawings
300 Line CT Loop	Hartford	CT LT 761.00, CT LT 761.02	Commercial Building	S	14.43	W / 0	NW / 37	See Drawings
300 Line CT Loop	Hartford	CT LT 761.00, CT LT 761.02	Commercial Building	S	14.50	NW / 15	NW / 80	See Drawings
300 Line CT Loop	Hartford	CT LT 763.00	Commercial Building	S	14.66	W / 0	NW / 27	See Drawings
300 Line CT Loop	Hartford	CT LT 763.00	Commercial Building	S	14.69	NW / 14	NW / 54	See Drawings

Table 5.5-1
Residences and Commercial Buildings Within 50 Feet of Pipeline Facilities in Connecticut

Facility Name	County	Commercial Structure Line List Number or Residential Drawing Number	Building Type	Segment[1]	Milepost	Direction (NSEW)[2] / Distance[3] (feet)		Mitigation[4]
						Edge of Workspace	Pipeline Centerline	
300 Line CT Loop	Hartford	CT LT 764.02	Commercial Building	S	14.73	SE / 33	SE / 83	See Drawings
300 Line CT Loop	Hartford	CT LT 765.00	Commercial Building	S	14.76	W / 0	SE / 51	See Drawings

Source: Survey data, aerial photography interpretation

[1] Each segment is associated with its own set of mileposts beginning at MP 0.00.

[2] NSEW – "North, South, East, West"

[3] Distances are approximate and derived from aerial photography (where survey is not available). When multiple structures on a single parcel, the closest structure to the workspace or pipeline centerline is depicted. The associated drawings depict all structures.

[4] Residential Construction Plans are provided in Volume II, Appendix P of the ER.

5.6 AGRICULTURAL AREA CONSTRUCTION

Agricultural lands may include land used for crop or hay production. Agricultural land in the Project area is used predominantly for the production of field crops, such as hay and corn, and for livestock grazing.

Tennessee will minimize adverse impacts on agricultural land by implementing the BMPs found in this ECP. The BMPs related to agricultural lands were developed utilizing guidance provided in Tennessee's Plan and Procedures.

Tennessee will work with applicable agencies and land-owners in areas of agricultural land to ensure that proper restoration of any impacted land occurs, including replacement of segregated topsoil, stone removal, and compliance with reseeding recommendations.

Within agricultural lands crossed by the Project, Tennessee will negotiate with and reimburse land-owners/producers of products for damages or loss to their product as a result of the construction of the proposed Project. Tennessee will continue to identify specialty crop areas, organic farms, and drainage systems through land-owner discussions and will work with land-owners to avoid these features where possible. Where avoidance is not possible, Tennessee will work with land-owners to properly restore affected areas and/or drainage features. Tennessee will monitor restored areas after construction and address problem areas, including drainage problems related to the pipeline construction. Some of the measures that may be employed to mitigate impacts to agricultural resources are:

- Preparing a Grazing Deferment Plan with land-owners;
- Installing construction entrances at paved road crossings in agricultural areas with stone placed on top of geotextile fabric. The geotextile fabric facilitates removal of the stone during final restoration;
- Providing open trench fencing and crossings, where requested;
- Repairing subsurface drains;
- Segregating and stockpiling topsoil on cultivated lands;
- Removing stone and rock material so that the density, size, and distribution of the material is consistent with the areas surrounding the ROW;
- Performing subsoil decompaction and subsoil shattering;
- Conducting general monitoring and remediation measures to address topsoil thickness, rock content, trench settling, crop production, drainage, repair of fences, etc.;
- Conducting specific monitoring and restoration measures to include compaction testing and remedial action, where necessary, and control of soil saturations and seeps; and
- Reimbursing the land-owner for crop loss (specialty or otherwise) at market price for anticipated short- and long-term impacts.

Tennessee is in the process of identifying specialty crop areas through field surveys and discussions with affected land-owners. Specialty crop areas identified in the Project area to date are included in Table 5.6-1.

Table 5.6-1
Specialty Crop Lands Crossed by the Project in Connecticut

Crop Type	County	Township/Town	Tract Number	Segment[1]	Milepost		Approx. Acreage Impacted (acres)	
					Enter	Exit	Construction	Operation
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Source: Survey data.

[1] Each segment is associated with its own set of MPs beginning at MP 0.00.

5.6.1 Grading and Ditching/Lowering-in/Backfilling

Prior to initial grading, the EI will verify and record the depth of topsoil to be stripped and segregated. As applicable, full ROW topsoil stripping will be implemented, unless otherwise specified by the applicable regulatory agency, in all actively cultivated agricultural lands, which includes permanent or rotated cropland, hayfields, orchards, and vineyards. The topsoil will be replaced over the subsoil upon completion of backfilling operations and subsoil decompaction operations. The Contractor will be careful to maintain natural flow patterns by providing breaks in soil stockpiles during the excavation process. Trench breaker spacing within agricultural land will be in accordance with Section 5.27.

5.6.2 Topsoil Segregation

In agricultural land crossed by the Project, Tennessee will utilize the full ROW topsoil segregation, as required by landowner agreements, or as required by the USDA-NRCS or County Conservation Districts, or as appropriate based upon site-specific conditions. The depth of topsoil removal will include the "A" horizon down to the beginning of the subsoil "B" horizon, up to 12 inches.

Topsoil material will be stripped, stockpiled, and uniformly returned to restore the original soil profile. Where ROW construction requires cut-and-fill of the soil profile across grades, to the extent practicable, topsoil stockpiling will be located on the upslope edge of the ROW. Where topsoil cannot be separately stored on the upslope side, suitable ROW space will be provided on the downslope side to ensure the complete segregation of the topsoil from cut-and-fill material. Where topsoil segregation is conducted, Tennessee will maintain separation of salvaged topsoil and subsoil throughout construction. Segregated topsoil will not be used for padding the pipe or filling sandbags.

5.6.3 Subsoil Protection (Shallow Soils)

In agricultural soils dominated by a shallow depth to bedrock, Tennessee will mitigate the loss, or permanent damage to, the subsoil and corresponding damage to the soil profile by adhering to the measures outlined in the Soil Protection and Subsoil Decompaction Mitigation Plan (Attachment J10).

5.6.4 Drain Tiles

Agricultural drain tiles or irrigation systems identified along the proposed pipeline alignment during environmental field surveys are presented in Table 5.6-2. This table will be updated with drain tile locations identified through land-owner consultations and field surveys prior to construction.

Drainage tiles encountered will be marked, maintained during construction, and restored to pre-construction condition or better. The Contractor may cut through drainage tiles, except those in locations where such cutting is prohibited. Locations where tile cutting is prohibited will be marked with flagging by Tennessee and will be noted on the Construction Line List. Specific details on drain tile monitoring activities are provided in Section 11.0.

Encountered drain tiles will be referenced and flagged/staked adjacent to the trench and along the ROW edge (outer perimeter). A temporary support will be installed across the trench when required to maintain flow in the drainage system during construction. Smaller feeder drains will be capped so that flows are diverted to the primary drain on which the support system has been installed. Open ends of tile will be covered to prevent ingress of dirt, rock, or wildlife.

Tiles damaged during construction will be flagged then repaired or replaced to their original or better condition. All plastic pipes utilized to repair damaged drain tiles will conform to the American Association of State and Highway Transportation Officials ("AASHTO") M.252 specification. Filter-covered drain tiles will not be used unless the Conservation District and/or land-owner specify. Drain tiles will be permanently repaired before the pipeline trench is backfilled and within 20 days of construction completion, weather and soil conditions permitting. The drain tile marker will not be removed until the tile repairs have been inspected, approved, and accepted by the land-owner/tenant.

Tennessee will ensure that the depth of cover over the pipeline is sufficient to avoid interference with drain tile systems in areas where drain tiles exist or are planned. Other drainage-related impacts such as water seepage and ROW saturation that are created or exacerbated by the Project will be mitigated during monitoring and follow-up restoration (Section 11.0, Post-construction Activities).

Detailed records of drainage system repairs will be maintained and given upon request to the land-owner and the Conservation District offices for future reference.

Table 5.6-2
Agricultural Drain Tiles Along the Project in Connecticut

Facility	Segment	Approximate Milepost[1]	County	Township/Town	Tennessee Parcel ID
N/A	N/A	N/A	N/A	N/A	N/A

Source: Tennessee land agent title review.
[1] MPs represent enter and exit for the entire parcel, exact drain tile locations to be determined through additional land-owner consultation.

5.6.5 Irrigation

Water flow in existing crop irrigation systems will be maintained unless shutoff is coordinated with the affected parties. All damage to active crop irrigation systems resulting from the Project will be repaired/returned to operating condition as soon as practicable.

5.6.6 Construction in Agricultural Areas During Wet Weather

For construction within agricultural areas during wet weather, the on-site EI will have stop-work authority in the event that wet weather conditions place topsoil mixing with subsoils at risk. The EI will be able to stop work, assess the situation, and make decisions regarding when construction will resume and what alternative measures will be implemented to protect agricultural soils. The allowable depth of rutting prior to suspension of construction will vary based upon the depth of topsoil and if topsoil was segregated prior to the agricultural area becoming saturated.

If the topsoil has been segregated prior to the area becoming saturated, construction will proceed as normal through these areas as long as the equipment can safely traverse the saturated area and erosion control measures can be properly maintained.

The maximum depth of rutting through agricultural areas where topsoil has not been segregated prior to becoming saturated will be 4-inches, regardless of the depth of topsoil. Alternative construction procedures will be employed once the maximum allowable rutting depth is reached. Alternative

construction procedures that will be utilized in agricultural areas during an unseasonably wet construction season to prevent the risk and/or mixing of topsoil may include:

- The first construction procedure that will be attempted will include segregating the saturated topsoil layer and placing a sediment barrier around the pile to prevent it from mixing with the subsoil.
- If the agricultural area is too saturated to strip topsoil and the maximum allowable depth of rutting is reached, equipment mats will be used in the same manner that they are used in wetland areas. The equipment mats will provide a stable working surface for equipment and will prevent mixing of topsoil with subsoil.

5.6.7 Restoration and Revegetation

- Permanent stabilization is defined as a minimum uniform, perennial 80 percent vegetative cover with non-invasive species or other permanent non-vegetative cover with a density sufficient to resist accelerated erosion.
- Final grading will be completed within 20 days after backfilling (10 days in residential areas), weather permitting.
- Construction debris will be removed from the ROW.
- Rutting or compaction will be repaired prior to revegetating disturbed areas.
- The ROW will be graded to pre-construction contours, except where original contours were irregular and more uniform contours may be acceptable or are in accordance with individual land-owner agreements.
- The topsoil and subsoil will be tested for compaction in agricultural areas crossed by the Project. Cone penetrometers or other appropriate testing devices will be used. Tests will be conducted at intervals sufficient to determine the need for decompaction. Tests will be done on the same soil type under the same moisture conditions. Tests will be conducted in the following areas:
  - Undisturbed areas to use for comparison;
  - Soil stockpile areas;
  - The trenched zone;
  - The work area; and
  - Any traffic areas related to the Project.
- Agricultural and residential areas will be decompacted in accordance with the Soil Protection and Subsoil Decompaction Mitigation Plan, Attachment N10 of this ECP.
- Remove excess rock from at least the top 12 inches of soil in all cultivated or rotated cropland, managed pastures, hayfields, and residential areas, as well as other areas at the land-owner's request. The size, density, and distribution of rock on the construction work area shall be similar to adjacent areas not disturbed by construction. The land-owner or land management agency may approve other provisions in writing. As previously noted, the ROW will be restored, including rock removal, in a manner so that it is as close to pre-construction conditions as practicable.
- The ROW will be limed, fertilized, seeded, and mulched in accordance with guidance provided from applicable agency or land-owner consultation.

5.7 EQUIPMENT CROSSINGS

Construction of equipment crossings will occur during the clearing and grading process. The equipment crossings will include paved roadway crossings, waterbody crossings, and wetland crossings. Some of

the protective measures that will be utilized include equipment mats laid adjacent to and across streambeds if banks are high enough, flume pipe(s) covered by clean stone fill, dam and pump crossings, or portable bridges as approved by the EI and applicable regulatory agencies. The size and number of flume pipes will be adequate to handle the maximum anticipated design flow at the time of the crossing or the average daily spring flow, whichever is greater or applicable to the time of year the crossing. Stream channels will not be permanently straightened or realigned to conform with flume pipe dimensions or for any other reasons, unless approved by the applicable agency. Stream and wetland crossings will be constructed perpendicular to the stream banks or wetland edges where practicable. Additional information regarding waterbody and wetland crossings can be found in Sections 6.0 and 7.0, respectively.

5.8 CONSTRUCTION ENTRANCES

A construction entrance pad will be located at all locations where construction traffic enters or exits the ROW onto or from a public roadway or other paved surface. An entrance pad is intended to reduce off-site sedimentation by eliminating the tracking of excess soil onto paved roadways. The entrance pad serves as the designated point at which all construction traffic can access and exit the ROW. The entrance pad is typically constructed of stone or gravel placed on top of a durable geotextile fabric. The fabric facilitates the removal of the stone or gravel to more easily restore the area to its pre-construction condition. Topsoil will be stripped and segregated from the access points and roads in agricultural and residential lands prior to entrance pad installation.

Entrance pads will be installed within 48 hours from the time the grading crew moves to the location where a pad is required. The pads will be installed after the area is cleared, grubbed, and topsoil is stripped and segregated. All required entrance pads along the Project area will be installed as the construction crews progress to locations where pads are needed.

5.9 OPEN CUT ROAD CROSSINGS

Tennessee will employ measures to ensure construction activities will have access to residential areas by fire and emergency vehicles. Steel plates will be available on-site to immediately cover the open area to permit travel of emergency vehicles. Tennessee will utilize sandbags and flume pipes as necessary to carry existing road ditches over the trench line and under construction entrances. Tennessee will restore the pavement structure in accordance with applicable agency roadway design standards.

5.10 BACKFILLING

Prior to backfilling the trench, a final inspection will be made to assure that all debris has been removed from the trench, all padding material has been installed to required depths, and that the pipe and pipe coating are undamaged. All backfill material and methods will be subject to approval by the assigned inspector.

Subsoil excavated as part of the Project and sediment removed from BMPs will be combined and used to backfill the trench. Typically, excess soil is minimal and may be used to create a crown over the trench to counteract settling or may be spread evenly across the ROW, which will have a negligible effect of the overall grade. Where rock, gravel, or other materials are encountered of a size and shape that could cause damage to the pipe or pipe coating, either select padding material will be placed around the pipe to a thickness of 6 inches above the pipe, or a rock shield will be applied.

Multiple passes of heavy equipment will be used to compact the fill material. If a crown of soil is added over the pipeline to compensate for future settling of the soil, openings will be left in the crown to allow for lateral surface drainage.

Additional BMPs will be utilized in the event dewatering is required during pipe installation and backfilling activities. See Section 5.26 for a detailed description of trench dewatering activities.

Permanent trench breakers are intended to slow the flow of subsurface water along the trench and prevent the draining of an adjacent waterbody or wetland along the trench line. Tennessee will construct and maintain permanent trench breakers in accordance with Table 9.2-1.

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 5.10-1. Scour analysis and the potential for external damage may increase these depths. In actively cultivated agricultural lands, Tennessee plans to install the pipeline with 48 inches of cover, except where rock prevents this depth. In these cases, Tennessee's minimum specifications for depth of cover will be used.

Table 5.10-1
Tennessee's Minimum Specifications for Depth of Cover

Location[1]	Normal Soil (inches)	Consolidated Rock (inches)
U.S. Department of Transportation ("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.

5.11 BLASTING

Blasting may be necessary in areas with shallow bedrock. Before a decision is made to blast, the Contractor will investigate other rock excavation techniques including rock saws, hydraulic hoe-rams hammers, and ripper teeth. If necessary, blasting will be performed by registered blasters and monitored by blasting inspectors. The Contractor will develop site-specific blasting plans and procedures, which

will include, but are not limited to: notification requirements, controls to prevent and/or minimize fly rock, and procedures to minimize environmental impacts. The Project Blasting Management Plan can be found in Attachment N8 to this ECP. Implementation of the Blasting Management Plan during construction will be subject to approval by the applicable regulatory agency and will enhance safety and minimize damage to adjacent areas and structures. The Contractor will utilize blasting standards that will meet or exceed applicable regulatory requirements governing the use of explosives. Refer to Attachment N8, Blasting Management Plan for a detailed description of the measures that will be employed while blasting. Areas of shallow depth to bedrock that may require blasting are described in the Plan.

5.12 CONVENTIONAL BORING

Conventional boring consists of creating a shaft/tunnel for installation of a pipe or conduit to minimize surface disturbance. This is done by first excavating a bore pit and a 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 and uses an auger with a cutting head to tunnel to the receiving pit. 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 consists of approximately two, 50-foot by 100-foot staging areas 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 usually occur over a crossing distance of 50 to 60 feet and the maximum length a bore can 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 stability for the boring equipment to conduct a successful bore. Loosely packed sediment, free of rock material, is preferred when conducting boring operations. The topographic conditions at a site also may limit the use of this method, as preferred locations have level or moderately convex terrain, such that the depth of the bore pit does not present constructability or safety constraints.

5.13 JACKING

Jacking is another type of boring method in which an open-ended casing is forced, or jacked, through the earth below an artery. All materials are then removed from the casing so the proposed pipeline can be installed through the casing and welded to the adjacent pipeline.

5.14 HORIZONTAL DIRECTIONAL DRILLING (HDD)

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 the elimination of open cut trenching and equipment disturbance within sensitive resource areas; 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 and 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, drill 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 of the ROW. ATWS in the form of "false" ROW may be required to provide a straight corridor for handling pipe at HDD locations where the ROW changes direction in order 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.

Risks associated with a HDD crossing technique include:

- Potential inadvertent returns of fluids during drilling operations;
- Potential hole collapse during construction or subsequent settlement of HDD locations following installation;
- Pipeline inaccessibility for visual inspection and repairs; and
- Uneven cathodic protection on the pipeline.

Uneven cathodic protection across a pipeline segment can occur due to the effects of geologic strata changes and difficulty in identifying interference with cathodic protection due to external forces. The depth of the HDD pipe, pipeline anomalies, external pipeline coating, stress corrosion cracking, and external corrosion prevent visual inspection or repair. Therefore, the pipe utilized for HDD operations is generally thicker-walled pipe and subject to x-ray inspection following assembly, and is treated with fusion-boned epoxy coating and wrapped in rock-shield prior to installation. These measures are expected to minimize the potential for damage or corrosion occurring to the pipeline. The longer the length, the more forces are applied to the pipe and the larger potential for failures. In addition, in lieu of visual integrity inspections, HDD pipe segments will undergo internal corrosion inspections through use of the internal inspection facilities (e.g., pig facilities) constructed as part of the Project.

The following conditions will apply to HDD:

- Drilling fluid pits will be required to contain drilling fluids during all phases of the installation at the drill entry and exit locations. The pits are required so the fluid can be recycled throughout the drilling process. The fluids and cuttings will be disposed of in an approved manner periodically during, or at the completion of, the crossing installation.
- ATWS, including pipe staging areas and storage areas for drilling mud and borehole cuttings, will be located in upland areas outside of wetlands and riparian zones wherever practicable.
- Sediment barriers will be installed on the down gradient side of upland spoil storage areas.

5.15 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 pipejacking 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. 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 applications (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.

Table 5.15-1 summarizes potential trenchless installation locations for the Pipeline.

Table 5.15-1
Horizontal Directional Drilling Crossings for the Project in Connecticut

Facility Name	County	Township/Town	Segment[1]	Milepost[2]		Comment	Approx. Length (feet)[3,4]
				Begin	End		
300 Line CT Loop	Hartford	Windsor	S	11.29	11.59	Crossing of Farmington River	1,570
						Total	**1,570**

[1] Each segment is associated with its own set of MPs beginning at MP 0.00.
[2] Begin/End MPs are at the approximate locations of HDD entry/exit pits.
[3] Lengths represent horizontal distance and are approximate and subject to field verification.
[4] For exact lengths refer to the Site-Specific Horizontal Directional Drill Plans (Volume II, Appendix O).

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5.16 STOVE-PIPE

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.

5.17 DRAG-SECTION

The drag-section construction technique 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.

5.18 TOPSOIL SEGREGATION AND STORAGE

Topsoil handling objectives are to segregate, store, and redistribute the highest quality soils suitable for re-vegetation and maintenance of surface color. The highest quality soil is defined as surface soil that contains higher amounts of organic matter as well as the natural soil seed bank.

The topsoil stripping width, depth, and storage will vary along the pipeline route depending on site-specific criteria such as: potential safety hazards; construction techniques; land use; soil characteristics; grading requirements; land-owner vegetation preference; and methods for crossing wetlands, streams, canals, roads, etc.

In areas where topsoil separation is required, the Contractor will strip and segregate up to 12 inches of the topsoil layer in all areas. It will be the EIs responsibility to determine the depth of topsoil that the Contractor will strip and segregate. The topsoil depth will vary along the Project area and will generally be striped to a depth where the topsoil color changes to the color of a distinct underlying subsoil horizon.

Topsoil stripping widths will consist of blade width stripping, trench and spoil side stripping, and full ROW stripping. Trench width stripping may be substituted for blade width stripping where Tennessee and the Contractor agree that there would be no substantial difference between the two similar methods. The Contractor will strip and segregate topsoil from over the trench in wetlands except from the areas where standing water or saturated soils are present.

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 land-owner. In residential areas the Contractor may replace topsoil (i.e., import topsoil) if approved by the 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.

The stripped and segregated topsoil will be piled separately from the trench spoil. Topsoil will not be allowed to mix with subsoil or trench spoil. The Contractor will not use topsoil to pad the pipe, for trench breakers, or for any purpose other than its original use.

Additional segregation measures to protect the topsoil include:

- Gaps will be left in topsoil piles where natural swales, drains, and ditches are present, and where livestock and farm machinery crossings are located.
- Topsoil will be piled in a manner that minimizes increases in water content.
- Topsoil will not be stripped during excessively wet (soil moisture high enough to foul blades, rut deeply or conglomerate mud on tires and tracks) and/or inordinately windy conditions (large plumes of soil particles visibly moving during stripping operations). The presence of such conditions will be decided on jointly between the EI, Tennessee, and the Contractor.
- Topsoil will not be used as padding or backfill in the trench, to fill sacks for trench breakers, or for any other use as a construction material.
- Where boring methods are used for road crossings, railroad crossings, and all other areas impractical for trenching, topsoil will be stored on either side of the bore hole, separate from the spoil material.
- Topsoil will be pushed away from streams, trees, and wetlands and stored on the uphill side of the disturbance away from the spoil pile, where practicable.
- Stabilize topsoil piles and minimize loss due to wind and water erosion with use of sediment barriers, mulch, temporary seeding, tackifiers, or functional equivalents, where necessary.
- Topsoil restoration will not be conducted in frozen or wet conditions that do not allow for the even spreading of topsoil across the ROW.

The spoil may be stored on either side of the working area where grade cuts result in additional spoil. In such cases, topsoil will be stripped from the entire work space prior to grading so that subsoil is not stored on top of topsoil.

Refer to Section 5.6 for more detail related to topsoil segregation in agricultural areas.

5.19 STEEP SLOPE/RUGGED TERRAIN

Portions of the Project will traverse areas containing steep side slopes and steep terrain, which will require additional erosion control measures (BMPs) and construction techniques. The Contractor must ensure that the proposed construction activities are reasonable and appropriately timed to prepare, excavate, install the pipeline, backfill, and adequately stabilize the workspace in areas of steep slopes. Limiting the amount of time that an area of steep slope is exposed and destabilized is key to avoiding issues related to erosion and sedimentation. EIs will coordinate with the Contractor and Tennessee staff to ensure that the measures detailed within this ECP are implemented and adhered to throughout the construction process. Coordination will include weekly pre-construction meetings focused on areas forecasted to be disturbed. These meetings will allow for discussion of what equipment and materials are required to be on-site and available to stabilize critical areas within timeframes specified in this ECP and Stormwater Pollution Control Plan ("SWPPP"). EIs will have the ability to issue stop work orders and require additional erosion control measures over and above what is required within Tennessee's Plan and Procedures or this ECP if conditions warrant (Section 3.0 provides further information regarding Supervision and Inspection).

5.19.1 Construction Technique

The "two-tone" construction technique will be utilized to provide safe working conditions in areas of side-slope. In the two-tone construction technique, the uphill side of the construction ROW is cut during

grading. The material removed from the cut is used to fill the downhill side of the construction ROW to provide a safe, level surface for heavy equipment to operate on. The pipeline trench is excavated along the newly graded ROW. The two-tone construction technique will require ATWS to accommodate the additional volumes of fill material generated to create a level working surface. Areas requiring additional workspace are indicated on the aerial alignment sheets. Following pipeline installation and backfill of the trench, excavated material is placed back in the cut and compacted to restore the approximate original surface contours. Any springs or seeps found in the cut will be conveyed down-slope through a Lateral Intercept Drain or gravel trench drains installed as part of the cut restoration.

In construction area where the slope exceeds 30 percent or more, 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 piece of equipment at the top of the slope and using a winch to manipulate the construction equipment up and down the slope.

In areas of rugged topography, ROW restoration will begin within 20 days of final pipeline installation to minimize potential erosion and sedimentation control problems.

5.19.2 Erosion Control Measures (BMPs)

Erosion Control Measures include:

- Perimeter sediment barriers – silt fence and straw bale barriers;
- Temporary and permanent slope breakers (water bars);
- Mulching, hydromulching, and hydroseeding; and
- Erosion-control blankets.

Perimeter sediment barriers, such as silt fence and straw bales, will be installed immediately after initial disturbance of the soil. Temporary slope breakers (water bars) that consist of mounded and compacted soil will be installed across the ROW as clearing progresses to prevent the movement of disturbed soil off the ROW prior to grubbing, grading, and trenching operations. Permanent water bars will be installed during restoration. Following construction, seed will be applied to steep slopes, and the ROW will be mulched or covered with erosion-control fabric. Sediment barriers will be maintained as required until permanent vegetation is established.

Unless otherwise required for installation of the pipeline or worker safety, trees shall be cut flush to or just below existing grade and the associated stumps will be left in place to help stabilize the steep slopes.

Areas where erosion-control fabric is installed are specified in Section 5.25.2. Erosion control fabric will be closely monitored during the previously noted erosion and sedimentation control site inspections to determine if soil is eroding under the erosion control fabric. Inspections of these areas will include, but will not be limited to, observing:

- The density of the vegetation growing along the slope;
- Observing any mounds under the matting where it would ordinarily be expected to be smooth;
- Monitoring for breaches under the fabric; and
- Vegetation growth density.

Any areas found to have erosion underneath erosion control matting will be repaired within 24 hours of being identified, including any adjacent areas that may have been damaged as a result of the erosion. The type and extent of repairs will vary based on the severity of the erosion found.

Minor and moderate erosion may be repaired utilizing the following steps:

- Temporarily remove undamaged erosion control fabric;
- Repair the eroded section of the slope by filling it with suitable fill material;
- Apply surface roughening to the repaired area to help prevent surface runoff from channelizing;
- Reinstall/repair slope breakers and/or temporary swales as required;
- Hydromulch/seed the repaired area; and
- Reinstall any undamaged erosion control matting in accordance with the manufactures specifications.

In addition to the repair measures noted above, major erosion may require a location-specific design to address the specific issue that caused the problem. Some examples of problems include groundwater seepage and large contributing drainage areas that are uncontrolled prior to the construction workspace. Some examples of the engineered repairs that may be required to prevent future erosion include permanent diversion swales with stabilized outlets, underdrain piping within the slope and riprap revetment.

Tennessee and its Contractor will utilize a number of BMPs to help prevent rocks from rolling off the ROW during construction. The BMPs may include:

- Utilizing reinforced silt fence. The fence will be able to intercept smaller rocks from exiting the ROW due to its metal reinforcement; and/or
- The equipment operators excavating the trench line will take care when large rocks/boulders are encountered. The operators will make an indentation in the ground to cradle the large rocks and prevent them from rolling off the ROW.

Tennessee will utilize a number of methods to retrieve rocks that have rolled off of the ROW. These methods may include:

- Retrieving rocks by hand if they are small enough;
- Utilizing a winch to pull the rocks back onto the ROW; and
- If necessary, Tennessee will obtain all required approvals and variances should equipment need to be used off ROW to retrieve rocks.

Permanent trench breakers consisting of approved materials will be installed in the trench over and around the pipe in areas of slopes with high erosion potential. Trench breakers will be used to isolate wet areas and to minimize channeling of groundwater along the trench line.

A summary of included BMPs available for steep slope construction is included in Table 5.19-1. Areas of severe erosion potential for the pipeline and aboveground facilities are listed in Tables 5.19-2 and 5.19-3, respectively. Areas of severe erosion potential based on soil series map units crossed by the project are listed in Table 5.19-4.

Table 5.19-1
Best Management Practices for Steep Slopes

BMP	ECP Location	Key Points
Vegetative Establishment	Section 10.3	Seed slopes steeper than 30 percent immediately after rough grading if final grading will not occur immediately, weather permitting. Disturbed soils shall be seeded within 6 days of final grading, weather and soil conditions permitting.
Mulching	Section 5.25	Mulch on slopes of 8 percent or steeper will be held in place with jute or equivalent netting
Hydroseeding	Section 5.25.1	Shredded paper hydromulch will not be used on slopes steeper than 5 percent. Bonded Fiber Mix is a viable alternative.
Erosion Control Blankets	Section 5.25.2	Blankets will be installed on all slopes greater than 3:1 and within 50 feet of top of bank for all special protection waters.
Maintenance of Erosion Controls	Section 5.28	Daily inspection of active sites, weekly inspection of non-active sites until final stabilization is achieved.

Table 5.19-2
Areas of Severe Erosion Potential Crossed by the Project Pipeline Facilities in Connecticut

Facility Name	County	Segment[1]	Milepost		Crossing Length (miles)[2]
			Begin	End	
300 Line Connecticut Loop	Hartford	S	6.83	6.89	0.06
300 Line Connecticut Loop	Hartford	S	6.90	6.97	0.07
300 Line Connecticut Loop	Hartford	S	7.69	8.20	0.51
				Total	**0.64**

Source: USDA-NRCS 2014.
[1] Each segment is associated with its own set of MPs beginning at MP 0.00.
[2] Areas of soil that contain severe erosion potential. See Resource Report 7 of the ER for soil series information, including erosion potential and erosion hazard, for the soils disturbed by the Project.

Table 5.19-3
Areas of Severe Erosion Potential at Aboveground Facilities in Connecticut

Facility Name	County	Segment	Milepost[1]
MLV-S-02	Hartford	S	6.97

Source: USDA-NRCS 2014. - Erosion Potential and Steep Slopes (USDA-NRCS 2015).

[1] Areas of soil that contain severe erosion potential. See Resource Report 7 of the ER for soil series information, including erosion potential and erosion hazard, for the soils disturbed by the Project.

5.20 INTERIM STABILIZATION

5.20.1 General Procedures

Disturbed areas will be temporarily stabilized within the first 7 days of suspending work on a grading operation that exposes erodible soils where such suspension is expected to last for 1 to 12 months, or in locations that have not been restored by October 15. Disturbed areas will be seeded with using the following:

- Ryegrass (annual or perennial) at 40 pounds per acre ("lbs/acre") (approximately 1.0 lb/100 square foot ["ft^2"]) or use 1 lb/1,000 ft^2) during spring, summer or early fall; or
- Aroostook (if available) winter rye (cereal rye) at a rate of 120 lbs/acre (3.0 lbs/1,000 ft^2).

Clean straw mulch will be applied at a rate of 2 tons/acre. No soil amendments will be used in wetland areas unless otherwise approved in writing by the appropriate land management or applicable regulatory agency. Only weed-free straw mulch, not hay mulch, will be used where mulch is needed on agricultural land.

Tennessee has prepared a Winter Construction Plan in anticipation of construction continuing through the late autumn and winter season. The Winter Construction Plan outlines methods and measures such as snow management, frozen soil handling, temporary erosion and sediment control specific to winter construction, trench line backfilling, hydrostatic testing/dewatering measures, winter inspections and monitoring, and measures related to spring thaw that will be employed during the winter season. The Winter Construction Plan is included as Attachment N12 to this ECP.

The following procedures will be implemented along the disturbed ROW in the event that the final phases of construction occur too late in the year for restoration activities to adequately be performed:

- Install permanent slope breakers at specified intervals on all slopes, or as directed by the EI;
- Install temporary sediment barriers adjacent to stream and wetland crossings, as well as other critical areas;
- Seed and mulch the ROW and seed segregated topsoil piles; and
- Remove flumes from waterbody crossings to reestablish natural stream flow.

Table 5.19-4
Severe Erosion Potential Based on Soil Series Map Units
Crossed by the Project in Connecticut

Soil Series Map Unit	From Milepost	To Milepost	Facility	Facility Name	Segment	County	Erosion Potential	Capability Class	Drainage Characteristics	Wind Erodibility Group
Pipeline Facilities										
82D	6.83	6.97	Pipeline	300 Line Connecticut Loop	S	Hartford	Severe	4e	Well drained	5
82D	7.69	7.75	Pipeline	300 Line Connecticut Loop	S	Hartford	Severe	4e	Well drained	5
87D	7.75	7.92	Pipeline	300 Line Connecticut Loop	S	Hartford	Severe	4e	Well drained	5
82D	7.92	8.20	Pipeline	300 Line Connecticut Loop	S	Hartford	Severe	4e	Well drained	5
Access Roads[1]										
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Contractor Yards[1]										
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Source: Data set utilized for Severe Erosion Potential Based on Soil Series Map Units is, "Natural Resource Conservation Service (NRCS) - Soils (County Based) - Erosion Potential and Steep Slopes.

[1] "N/A - "Not Applicable." Based on current project layout, there are no ARs or contractor yard facilities in Connecticut which impact areas with sever erosion potential based on soil series map units.

5.20.2 Soil Binders

There are a number of soil binders, chemical stabilizers, or soil palliatives available from various manufacturers that provide temporary stabilization. Most of these are designed to be sprayed onto the soil surface with little or no preparation. Water-soluble anionic polyacrylamide ("PAM") may be applied to a disturbed area as a temporary soil-binding agent to reduce erosion due to wind and water. This practice is recommended for areas where timely establishment of a vegetative cover is not feasible (e.g., non-germinating season), wherever soils have high clay content, or where the vegetative cover is inadequate to provide protection from erosion.

PAM Specifications

- Anionic PAM mixtures must be environmentally safe and non-toxic to fish and other aquatic species, wildlife, and plants. It also should be non-combustible.
- Cationic PAM may not be used due to its toxicity to aquatic species.
- Anionic PAM mixtures must have <0.05 percent free acrylamide monomer by weight as established by the Food and Drug Administration ("FDA") and the USEPA.
- Acute toxicity test data should be provided from each manufacturer or supplier.
- The manufacturer should provide a product expiration date for anionic PAM based upon expiration of PAM in the pure form.

Application

- Anionic PAM will be applied in accordance with the recommended methods provided by the manufacturer or supplier for the specific site conditions (e.g., slope and soil type). A record of the application, including the date of application, product type, weather conditions, method of application, and the name of the applicator, will be kept on-site.
- Application rates will not exceed the manufacturer's recommendations. Repeated applications may be made if necessary to ensure adequate coverage.
- The application method used will provide uniform coverage to the target area while avoiding drift to non-target areas, especially paved areas.
- Manufacturer's recommendations for safe storage, mixing, and use of the product will be followed.
- Use of anionic PAM will be in conjunction with the other BMPs specified in this ECP.
- Anionic PAM will not be used instead of a protective liner in a channel or in place of mulch on a seeded area. However, seed may be added to the mixture at the time of application.
- Disposal of excess material will be in accordance with manufacturer's recommendations as well as applicable laws and regulations.
- Anionic PAM will not be applied within the floodway of a receiving stream channel or within 25 feet of other waterbodies.
- Anionic PAM may be used to temporarily stabilize topsoil stockpiles. However, anionic PAM may lose its effectiveness in as little as 2 months. Therefore, it might become necessary to reapply the mixture.
- Anionic PAM is not recommended for application on surfaces of pure sand or gravels with no fines or on snow-covered surfaces.
- A visible tracer or colorant may be added to the mixture to visually track its application.

5.21 TEMPORARY SLOPE BREAKERS (WATER BARS)

Temporary slope breakers are intended to reduce runoff velocity and divert water off the construction ROW. Temporary slope breakers will be constructed of soil. Silt fence, wood chips, 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. Tennessee will install temporary slope breakers on all disturbed areas as necessary to avoid excessive erosion. Temporary slope breakers will be installed on slopes greater than 5 percent where the base of the slope is less than 50 feet from waterbodies, wetlands, or road crossings or to prevent sediment transport into wetlands or waterbodies. Slope breakers will be installed at the spacing outlined in Table 5.21-1, based on the severity of the slope.

Tennessee will direct the outfall of each temporary slope breaker to a stable, well-vegetated area or construct an energy-dissipating device at the end of the slope breaker off the construction. The outfall will be positioned so that it prevents sediment discharge into wetlands, waterbodies, or other sensitive resources. The temporary slope breakers will be inspected and maintained throughout construction of the Project. Slope breakers will be installed so that construction traffic can pass over them safely without damaging them. Slope breakers will be repaired at the end of the same day they were damaged.

Table 5.21-1
Temporary Slope Breakers
(Waterbars)

Slope (percent)	Spacing (feet)
5-15	300
>15-30	200
>30	100

Source: FERC 2013.

5.22 TEMPORARY SWALES

A temporary swale is a structural measure consisting of a drainage way of mostly trapezoidal cross-section with a supporting ridge on the lower side that is constructed across the slope in order to intercept and convey runoff to stable outlets at non-erosive velocities. Diversion channels are used to divert runoff from undisturbed upslope areas and convey it around areas of earth disturbance. Temporary swales may be used where:

- Runoff from higher areas has the potential for damaging properties, causing erosion, or interfering with, or preventing the establishment of, vegetation on lower areas.
- Surface and/or shallow subsurface flow is damaging sloping upland.
- The length of slopes needs to be reduced so that soil loss will be kept to a minimum.
- Diversions are only applicable below stabilized or protected areas.
- Establishment on slopes less than 15 percent has been avoided.
- Construction of diversions will be in compliance with state drainage and water laws.

5.23 GRASSED WATERWAYS

Grassed waterways consist of natural or man-made channels of parabolic or trapezoidal cross-section that is below adjacent ground level and is stabilized by suitable vegetation and an erosion control liner as needed. The flow channel is normally wide and shallow and conveys the runoff down the slope. Its purpose is to transfer runoff without causing damage by erosion. They are used where added vegetative protection and/or a protective liner is needed to control erosion resulting from concentrated runoff.

5.24 SEDIMENT BARRIERS

A sediment barrier is a temporary barrier installed across or at the toe of a slope or upslope of a wetland or waterbody to intercept and retain small amounts of sediment from disturbed or unprotected areas. Sediment barriers may consist of silt fence or straw/hay bales. Tennessee will utilize sediment barriers in the following situations:

- Locations where sedimentation can pollute or degrade adjacent wetland and/or watercourses;
- At the outlet of a slope breaker when vegetation is not adequate to control erosion;
- Along banks of waterbodies between the graded construction ROW and waterbody after clearing and before grading;
- Downslope of any stockpiled soil in the vicinity of waterbodies and wetlands;
- At the base of slopes adjacent to road and railroad crossings until disturbed vegetation has been re-established;
- At side slope and downslope boundaries of the construction area where run-off is not otherwise directed by a slope breaker (a.k.a. water bar or diversion terrace);
- Within the construction ROW at boundaries between wetlands and adjacent disturbed upland areas;
- As necessary to prevent siltation of ponds, wetlands, or other waterbodies adjacent to/downslope of the construction ROW; and
- At the edge of the construction ROW as needed to contain spoil and sediment.

Sediment barriers will be inspected as outlined in Section 3.2 of this ECP. Repairs will be made within 24 hours after a problem, if any, is noted. Any excess sediment, as defined in the sediment barrier typical construction drawings in Attachment M2, will be removed from the barrier and re-incorporated into the site. Sediment barriers will be maintained throughout construction and remain in place until permanent revegetation has been judged successful by the EI. Successful revegetation will generally include a minimum uniform perennial vegetative cover of 80 percent.

5.24.1 Silt Fence

Silt fences may be used to control runoff from small disturbed areas when they are in the form of sheet flow, and the discharge is to a stable area. Only those fabric types specified for such use by the manufacturer will be used. To provide sufficient fabric for proper anchoring of the fence, standard filter fabric width will be a minimum of 30 inches; reinforced and super filter fabric width will be a minimum of 42 inches.

- The maximum slope length above any silt fence barrier will not exceed 25 feet for 2:1 slope steepness.

- Silt fence will be placed at existing level grade. Both ends of the fence will be extended at least 8 feet upslope at a 45 degree angle to the main fence alignment.
- The fence will be adequately anchored to the ground as shown on the BMP figures.
- Sediment will be removed when accumulations reach half the aboveground height of the fence.
- Any section of silt fence which has been undermined or topped will be immediately replaced with a rock filter outlet.
- Silt fence will be removed and properly disposed of when the tributary area is permanently stabilized.

Tennessee will not use silt fence in areas of concentrated flows (e.g., channels, swales, erosion gullies, across pipe outfalls, as inlet protection, etc.) or in areas where rock or rocky soils prevent the full and uniform anchoring of the fence. Use in forested areas is not recommended unless tree roots can be severed during excavation of the anchor trench. Silt fence will not be installed on uncompacted fills or in extremely loose soils (e.g., sandy loam), since it may result in undermining of the fence.

5.24.2 Hay/Straw Bale Barriers

Hay/straw bale barriers may be used to control runoff from small disturbed areas provided that runoff is in the form of sheet flow. Hay/straw bales will be considered a short-term control measure on this Project because they tend to deteriorate within approximately three (3) months after installation.

- Bales will be installed in an anchoring trench.
- The maximum slope length above any hay/straw bale barrier will not exceed 25 feet for 2:1 slope steepness.
- Hay/straw bale barriers will be placed at existing level grades with ends tightly abutting the adjacent bales. The first stake of each bale will be angled toward the adjacent bale to draw the bales together. Stakes will be driven flush with the top of the bale. Both ends of the barrier will be extended at least 8 feet upslope at a 45 degree angle to the main barrier alignment.
- Compacted backfill around the bales will extend approximately 4 inches above ground level.
- Sediment will be removed when accumulations reach 1/3 of the aboveground height of the barrier. Damaged or deteriorated bales will be replaced immediately upon inspection.
- Any section of the hay/straw bale barrier which has been undermined or over-topped will be immediately replaced with a rock filter outlet.
- Bales will be removed when the tributary area has been permanently stabilized.

Tennessee will not use hay/straw bale barriers in areas of concentrated flows (e.g., channels, swales, erosion gullies, across pipe outfalls, as inlet protection, etc.) or in areas where they cannot be properly staked (e.g., paved areas) or in areas where rock prevents full and uniform anchoring of the bales.

5.25 MULCHING

Mulch absorbs rainfall impact, increases the rate of infiltration, reduces soil moisture loss due to evaporation, moderates soil temperatures, provides a suitable environment for germination, and protects the seedling from intense sunlight. Seeded areas will be mulched or blanketed to minimize the potential for failure to establish an adequate vegetative cover, except in wetland areas, unless otherwise approved by applicable regulatory agencies. Mulching also may be used as a temporary stabilization measure for some disturbed areas in non-germinating seasons.

- Woodchips may be used on the ROW as temporary mulch in upland areas as long as it does not inhibit revegetation or is not placed in an agricultural area. Chips that are left on the ROW will require fertilizer application during the restoration process. Up to 1 ton/acre of woodchips may be added to mulch if areas are top-dressed with 11 pounds/acre of available nitrogen, 50 percent of which will be slow release. Woodchips will not be utilized in wetland areas.
- Weed-free straw and hay mulch will be anchored or tackified immediately after application to prevent being windblown. Liquid mulch tackifiers will not be used within 100 feet of wetlands or waterbodies.
- 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. Note: Crimping of hay or straw by running over it with tracked machinery is not recommended.
- Mulch on slopes of 8 percent or steeper will be held in place with jute or equivalent netting.
- Polymeric and gum tackifiers mixed and applied according to manufacturer's recommendations may be used to tack mulch. Application will be avoided during rain and on windy days. A 24-hour curing period and a soil temperature higher than 45 degrees Fahrenheit ("°F") are typically required to tackify mulch.
- Application of the tackifier will be heaviest at the edges of seeded areas and at crests of ridges and banks to prevent loss by wind. The remainder of the area will have tackifier applied uniformly. 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. Syntheticor 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.
- Liquid mulch tackifiers will not be used within 100 feet of wetlands or waterbodies.
- Lightweight plastic, fiber, or paper nets may be stapled over the mulch according to manufacturer's recommendations.
- Mulching within wetlands will be completed, as required by applicable regulatory agencies, using clean straw at the rate of 2 tons/acre. No soil amendments will be used in wetland areas unless approved by the appropriate land management or applicable regulatory agency.

5.25.1 Hydroseeding/Hydromulching

Hydroseeding (or hydraulic mulch seeding, hydro-mulching, hydroseeding) is an acceptable alternative seeding/stabilizing process that utilizes a slurry mix of a combination of seed, mulch, fertilizer, tackifying agents, and/or other additives. There are a number of advantages associated with hydroseeding/hydromulching.

- Stabilization of disturbed areas can be accelerated because hydroseeding can be completed in a short period of time.
- Hydroseeding can be very effective for hillsides and sloping lawns to help with erosion control and quick planting.
- Hydroseeding generally results in high germination rates with initial grass growth in about 1 week. Fiber or wood mulch, which is generally part of the slurry mix, mix accelerates the growing process by maintaining moisture around the seeds, thereby increasing the rate of germination.
- Hydro-mulching promotes fast seed germination by helping to prevent erosion along a slope, which prevents seed from washing away.

The following guidelines shall be followed when hydroseeding:

- Wherever seed and mulch is applied by hydroseeding methods, the seed and mulch should be applied in separate applications with the seed being applied first and the mulch sprayed on top of the seed. This is to ensure that the seed makes contact with the underlying soil. Soil preparation should be completed prior to adding seed to the hydroseeding equipment. Running seed through the pumping system can result in excessive abrasion of the seed and reduces the percentage of PLS in the application. Therefore, all site preparation will be completed prior to the arrival of the hydroseeder.
- Shredded paper hydromulch will not be used on slopes steeper than 5 percent. Wood fiber hydromulch may be applied on steeper slopes provided a tackifier is used. The application rate for any hydromulch will be 2,000 lbs/acre at a minimum.

There also are a number of hydraulic blankets (hydro-mulches) which can be applied to a steep slope to help prevent erosion and promote quick seed germination. The hydro-mulches include Bonded Fiber Mix ("BFM"), Flexible Growth Medium ("FGM"), and Polymer Stabilized Fiber Matrix ("PSFM").

- A BFM can be an effective method of stabilizing steep slopes when used properly. BFMs make use of a cross-linked hydrocolloid tackifier to bond thermally processed wood fibers. Application rates vary according to site conditions.
  - For slopes up to 3H:1V the BFM should be applied at a rate of 3,000 lbs/acre. Steeper slopes may need as much as 4,000 lbs/acre. In any case, the manufacturer's recommendations should be followed.
  - BFMs should only be used when no rain is forecast for at least 48 hours following the application. This is to allow the tackifier sufficient time to cure properly.
  - BFM will not be applied between September 30 and April 1.
- A FGM has the added component of 0.5 inch long, crimped organic or manmade fibers which add a mechanical bond to the chemical bond provided by BFMs. This increases the blanket's resistance to both raindrop impact and erosion due to runoff. Unlike BFMs, a FGM typically does not require a curing time to be effective.
- A PSFM also can be an effective method of stabilizing steep slopes when used properly. PSFMs make use of a linear soil stabilizing tackifier that works directly on soil to maintain soil structure, maintain pore space capacity, and flocculate dislodged sediment that will significantly reduce runoff turbidity.

PSFMs can be used in re-vegetation applications and for site winterization and/or dormant seeding (fall planting for spring germination) applications. Application rates vary according to site conditions and the typical suggested application rates are outlined in Table 5.25-1.

Table 5.25-1
Typical Application Rates for PSFMs

Typical Polymer Stabilized Fiber Matrix Application Rates Maximum Rainfall of ≤ 20"							
Slope	6:1	5:1	4:1	3:1	2:1	1.5:1	1:1
Soil Stabilizer (gallons/acre)	4	5	6	7	8	9	10
Fiber (lb/acre)	1,500	1,500	1,500	1,800	2,000	2,500	3,000

Source: Earthguard 2015.

5.25.2 Erosion Control Blankets

Matting or netting consists of jute, wood excelsior, or similar materials, and is used to anchor mulch and stabilize the surface of the soil during the critical period of vegetative re-establishment. Specific manufacturer installation instructions will be followed to ensure proper performance of the product. Erosion control matting may be utilized on the Project as follows:

- Matting or netting may be applied to critical, sensitive areas such as:
  - Erodible soils; and
  - All slopes steeper than 3:1;
- It may also be applied to any areas where temporary/permanent vegetation is not germinating to assist in protecting the seed bank; and
- Matting or netting will be anchored with pegs or staples.

There are various types of erosion control blankets for various types of situations. The matting types include short-term mattings with photodegradable netting and straw fiber, extended term mattings with ultra-violet ("UV")-stable netting, bio-degradable netting, and permanent reinforcement mats.

Extended term mattings will be primarily used along steep slopes (up to 1:1), along slope breakers, along stream banks and within erosion control swales. These mattings will remain stable for up to 36 months, which will allow up to three growing seasons for vegetation to establish and permanently stabilize the slope or stream bank.

Erosion control blankets will not be used to prevent slope failures. They will be used to help temporarily stabilize the slope to allow permanent vegetation to establish. Wherever slope stability problems are anticipated or encountered, appropriate measures such as reducing steepness of slope, diverting upslope runoff, reducing soil moisture, loading the toe, or buttressing the slope will be considered. The method utilized to stabilize the slope will be determined by the EI.

5.25.3 Dust Control

Dust control measures are practices that help reduce surface and air movement of dust from disturbed soil surfaces. The Contractor will coordinate with the EI to develop a dust control plan that will be implemented throughout the construction process. There are a number of methods that may be used to control dust including, but not limited to:

- Spraying/Irrigation – The Contractor may spray the ground surface with water until it is moist.

- Vegetative Cover – In areas not expected to handle vehicle traffic, the Contractor may re-establish permanent or temporary vegetative cover as a dust control measure. The vegetative cover will be in accordance with guidance provided in this ECP.
- Mulch – The Contractor may elect to mulch an area to control dust. Mulching will be in accordance with this ECP.
- Wind Breaks – The Contractor may construct wind breaks to reduce wind velocity through the ROW. The wind breaks may be trees or shrubs left in place during site clearing or constructed barriers such as a wind fence, snow fence, tarp curtain, hay bale, crate wall, or sediment wall.
- Tillage – The Contractor may perform deep tillage in large open areas such as agricultural lands to bring soil clods to the surface to rest on top of dust.
- Stone – The Contractor will be required to install stone construction entrances at all paved road crossings to prevent sediment transport onto the pavement surface.
- Spray-on Dust Suppressant Treatments – The Contractor may utilize spray-on dust suppressant treatments to suppress dust. Utilized chemicals will be required to be bio-degradable or water-soluble and are not anticipated to have a negative impact on the surrounding environment, including waterbodies and wildlife. Spray-on dust suppressant treatments will not be utilized within organic farm properties.

Other suppressants may be used as long as they have been shown to be environmentally safe and effective for their intended use. The Contractor will coordinate with the EI to determine which dust control method best accommodates their needs based on specific site and weather conditions. Tennessee will consult with applicable regulatory agencies prior to use of chemical dust suppressants.

5.26 TRENCH DEWATERING

Trench dewatering is the process of removing excess runoff and groundwater that has accumulated and is occupying the trench line to allow for the installation of the pipe and dry backfilling of the trench. The removal of any excess water within the trench line prior to backfilling is critical because it permits inspection of the bottom of the trench line and makes it easier to control the moisture content of the spoil material being placed in the trench. Controlling the moisture content of the backfill will permit heavy equipment to pass over the trench faster than waiting for saturated backfill to stabilize enough for equipment to pass without creating deep ruts over the pipe.

Trench dewatering management will be accomplished using a combination of BMPs that will be tailored to the site-specific conditions for each dewatering operation. The dewatering operation(s) may include some of the following:

- Sump pits may be utilized in conjunction with an appropriate outlet device to dewater the trench line. The pits may be placed within the trench line or adjacent to it, depending on the workspace configuration and the amount of water that is needed to be removed from the work area. The outlet device (e.g., filter bag) will provide an additional means of filtering the water. Sump pits will not be used alone where highly turbid waters are being pumped, such as typically results from active work areas. Sump pits will be located at a low point in the work area so that the water naturally drains toward the pit. The size and number of the pits required will depend upon the amount of water that must be pumped from the work area and the space available. The Contractor will work with the EI to determine the appropriate sump pit size.
- Sediment filter bags or other equivalent sediment control structures for pumped water will be used whenever water is pumped from the pipeline trench. Sediment filter bags (use only non-

woven geotextile filter bags), when implemented and maintained properly, prevent the discharge of heavily silt-laden water by effectively trapping particles larger than approximately 150 microns ("µ"). Filter bags will be placed in well-vegetated areas, where possible, which will provide additional water filtration upon discharge. Discharge to agricultural lands will not be conducted in active crop areas approved by the landowner. The pumping rate will not exceed the maximum recommended by the manufacturer. The filter bags will be changed when they become half full of sediment. Their sediment contents may be reincorporated onto the site, except in agricultural lands, or transported off-site to an approved waste disposal location. Filter bags will not be placed on slopes greater than 5 percent.

- Dewatering discharge locations will be into suitable areas that are well vegetated or other stable erosion resistant areas. They will be located so they do not allow the water to return to the active construction workspace. The EI will assist in choosing dewatering locations and has the authority to stop work and relocate the structure if the structure is not placed correctly or is causing sedimentation.
- If the water being discharged from the filter bag appears "milky" or excessively cloudy, then sediment corrals may be utilized to augment filter bag use. The corral will be located a minimum of 25 feet from any wetland or waterbody unless otherwise approved by the EI and will be closely monitored to ensure proper function to prevent turbid water from entering the wetland or waterbody. The Contractor and EI will monitor trenches holding water and begin dewatering activities as needed so that sediment laden water is not discharged directly from the excavated trench to resources.
- Hose intakes will be elevated off of the ditch bottom.

Under no circumstances will trench water or other forms of turbid water be directly discharged onto exposed soil, into any wetland or waterbody, into known cultural resource sites, or into locations of rare/sensitive species.

5.27 TEMPORARY TRENCH BREAKERS

Trench breakers are intended to slow the flow of subsurface water along the trench. Trench breakers may be constructed of materials such as sand bags, foam, unexcavated portions of the ditch, subsoil earth filled bags or equivalent. Topsoil and concrete will not be used for filling trench breaker bags.

- Temporary trench breakers will be spaced as noted Table 5.27-1. At a minimum, trench breakers will be installed at the same spacing as upslope temporary slope breakers. Any modifications to the spacing noted will be made by an Engineer or similarly qualified professional. Temporary trench breakers will be installed at the same spacing as if permanent slope breakers were required in agricultural fields and residential areas where slope breakers are not typically required.
- Temporary trench breakers will be installed at the base of slopes greater than 5 percent where the base of the slope is less than 50 feet from a waterbody or wetland and where needed to avoid modifying waterbody or wetland hydrology.
- The base level of each breaker is established on the trench floor, prior to pipe laying, to ensure control against significant water-piping and internal erosion. The bulk remainder of each trench breaker will be installed after the pipe is installed in the trench and prior to backfilling.
- If required, the top of trench breakers placed in agricultural fields will not be closer than 2 feet from the restored surface.

Oversaturation of soils behind trench breakers may be prevented by installing underdrains adjacent to and across the pipeline trench to carry excess water down slope. Underdrain installation on steep slopes will be perpendicular to contours and will include installing lateral intercept pipes across the pipeline trench and a header pipe to convey the water down slope. Installation on steep side slopes will be parallel to contours and will include installing the underdrain in undisturbed soil uphill of the pipeline. All excess water conveyed by the underdrain pipes will be discharged into riprap outlet protection and then a stable area.

Table 5.27-1
Temporary Trench Breaker Spacing

Slope (percent)	Spacing (feet)
5-15	300
>15-30	200
>30	100

Source: FERC 2013.

5.28 MAINTENANCE OF EROSION CONTROL DEVICES

Although primarily the responsibility of the EI, all inspectors and construction personnel are responsible for regularly inspecting and assessing the condition of the erosion and sediment control devices employed during construction. The EI will inspect all disturbed areas of the construction spread(s) (e.g., construction ROW, pipe storage yards, temporary contractor yards, etc.) that have not been permanently stabilized:

- On a daily basis in areas of active construction or equipment operation;
- A minimum of once a week in areas with no construction or equipment operation; and
- Within 24 hours of each 0.5 inch of rainfall or greater. This means that an inspection will be required once a storm event has produced 0.5 inch, even if the storm event is still continuing. Inspections will be required within 24 hours of the first day of the storm that produces more than 0.5 inch of rainfall and within 24 hours after the end of the storm for multiple day storm events that produce 0.5 inch of rainfall or more per day.

Inspections to assess the condition of the erosion and sediment control devices will be performed periodically by Tennessee personnel until the Commission and other applicable regulatory agency determines that the entire ROW is permanently revegetated following completion of construction.

All BMPs found to be deficient will be fixed within 24 hours of the inspection, with the exception of temporary slope breakers, which will be checked and repaired at the end of each day where construction traffic has disturbed them.

5.29 HYDROSTATIC TESTING

Hydrostatic testing verifies the structural integrity of the constructed pipeline segments. Integrity is tested by capping pipeline segments with test manifolds and filling the capped segments with water. The water

is then pressurized to at or above the MAOP of the pipeline and held for 8 hours (4 hours for pre-tested, pre-fabricated units or short visible sections). Any significant loss of pressure indicates that a leak may have occurred and that the pipeline needs to be repaired and re-tested prior to being put into service.

The source of the water used for testing is typically taken from local streams, rivers, or potable water supply systems. Hydrostatic testing of the pipeline will be performed in multiple sections along the Project area. The sections will be selected based on the length of the section and/or elevation change of the terrain. All hydrostatic testing activities will be performed in compliance with applicable regulatory requirements. Potential sources of hydrostatic pressure test water for the Project are listed in Table 5.29-1.

Environmental impacts associated with the withdrawal and discharge of test water will be minimized by:

- Submitting a Notice of Intent for Coverage under the NPDES General Permit for Discharges from Hydrostatic Testing of Tanks and Pipelines at least 60 days prior to construction for testing in Connecticut.
- Withdrawing water from either state-designated Class A waters, waterbodies which provide habitat for federally listed threatened or endangered species or waterbodies designated as public water supplies for testing procedures will not occur unless written permission is obtained from the applicable regulatory agency.
- Inspection of all welds and hydrostatic testing of the pipeline sections will be performed before HDD installation under waterbodies or wetlands.
- Locating hydrostatic test manifolds outside of wetlands and riparian areas as practicable.
- Withdrawing from and discharging to water sources will comply with appropriate agency requirements.
- Screening the water inlet to avoid intake of fish.
- Maintaining adequate stream flow rates during withdrawal activities to protect aquatic life, provide for all existing waterbody uses, and downstream withdrawals of water by existing users.
- Anchoring the discharge pipe for safety.
- Discharging test water into a suitable receiving body of water, across a well-vegetated area or filtered through a filter bag or other erosion control barrier.
- Discharging test water against a splash plate or other energy dissipating device approved by the EI to aerate, slow, and disperse the flow.
- Controlling the rate of discharge at a level that appropriately prevents flooding or erosion.
- Discharging into state-designated exceptional value waters, waterbodies which provide habitat for federally listed threatened or endangered species, or waterbodies designated as public water supplies will only occur if written permission from the appropriate federal, state, or local permitting agency is obtained.

Table 5.29-1
Potential Sources of Hydrostatic Pressure Test Water for the Project in Connecticut

Potential Water Source[1]	Segment[2]	Approximate Milepost	Manifold/Discharge Location	Water Quantity (gallons)
West Hartford Reservoir #3	S	0.70	0.70	460,184
Farmington River	S	11.40	11.40	538,710
			Total	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, Hartford County, CT
- Bloomfield, Hartford County, CT
- Windsor, Hartford County, CT
- East Granby, Hartford County, CT

[2] Each segment is associated with its own set of MPs beginning at MP 0.00.

6.0 WATERBODY CROSSINGS

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

- A "minor waterbody" includes all waterbodies less than or equal to 10 feet wide at the water's edge at the time of construction.
- An "intermediate waterbody" includes all waterbodies greater than 10 feet wide but less than or equal to 100 feet wide at the water's edge at the time of construction.
- A "major waterbody" includes all waterbodies greater than 100 feet wide at the water's edge at the time of construction.

Tennessee will utilize dry crossing techniques for the majority of the waterbodies crossed by the Project that have flowing water present at the time of crossing. The pipeline will be buried with a minimum cover of 5 feet over the pipe, unless it is in consolidated rock where the minimum cover depth may decrease. A summary of the waterbodies crossed by the Project can be found in Table 6.0-1.

Tennessee will work to protect and minimize potential adverse impacts to waterbodies by:

- Accelerating construction activities in waterbodies;
- Limiting clearing of vegetation between ATWS areas and the edge of the waterbody to the certificated construction ROW;
- Limiting the use of equipment operating in the waterbodies to those required to construct the crossing;
- Crossing non-essential construction equipment over an equipment bridge;
- Maintaining downstream flow rates by use of adequately sized pumps or flume pipes to protect aquatic life and prevent interruption of existing downstream uses;
- Crossing waterbodies perpendicular to the waterbody as engineering and routing conditions permit;
- Restoring the stream channel and banks to pre-construction contours;

- Removing all construction equipment and materials from within the waterbody as soon as practicable; and
- Permanently stabilizing stream banks immediately following the pipe installation.

Table 6.0-1
Summary of Waterbodies Crossed by the Project in Connecticut

Facility Name	Perennial Stream Crossings	Intermittent Stream Crossings	Ephemeral Stream Crossings	Unknown/Other Crossings[1]	Crossing Length (feet)[2]
300 Line CT Loop	13	29	6	2	819
Aboveground Facilities	0	0	0	0	N/A
Contractor Yards	0	0	0	0	N/A
ARs	3	0	0	0	9
				Total	**828**

Source: USGS 2015.
[1] Includes the following: Unknown; NF = No Flow; AP = Artificial Path; C = Connector; R = Reservoir; RUB = Riverine Unconsolidated Bottom; L = Lake.
[2] N/A = Not Applicable. The Project will not cross waterbodies at aboveground facilities or contractor yards. However, number of stream crossings indicated reflects 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.

6.1 CONSTRUCTION RESTRICTIONS

Tennessee has identified the in-stream construction restriction windows listed in Table 6.1-1 and will consult with CTDEEP regarding timing for in-stream work.

Tennessee, to the extent practicable, will complete all open cut crossing pipe installation activities, including trenching and backfilling, across "minor" waterbody crossings (less than 10 feet wide) within 24 hours and "intermediate" waterbodies (10 feet to 100 feet wide) within 48 hours, unless blasting or other rock breaking measures are required. A site-specific crossing plan will be developed if site conditions will not allow for the crossings to be completed within the noted time restrictions. A site-specific plan also will be developed for "major" waterbody crossings (100 feet wide and greater).

Table 6.1-1
Construction Timing Restrictions for Fisheries Crossed by the Project in Connecticut

State	Water and Classification	In-Stream Work Window[1]	Applicable Regulation
Connecticut	Coldwater Fisheries	June 1 to September 30	FERC 2013
	Coolwater and Warmwater Fisheries	June 1 to November 30	FERC 2013

[1] Timing restrictions specific to each waterbody crossing along the Project segments are identified in Resource Report 2 of the final ER.

6.2 WATERBODY SETBACKS FOR CONSTRUCTION ACTIVITIES

Where applicable, waterbody setbacks will be maintained at all times. The setback distances vary based on the type of activity being performed. Activities such as stacking cut lumber, discharging water from trenches, ATWS areas, and fueling equipment all have different setback distance requirements. All waterbody setbacks (e.g., ATWS setbacks, refueling restrictions, etc.) will be clearly marked in the field with signs and/or highly visible flagging prior to pipeline construction and will be maintained until construction-related ground disturbing activities are complete.

Tennessee and its Contractor will structure their operations in accordance with the following setback requirements adjacent to waterbodies:

- Employees handling fuels and other hazardous materials are properly trained;
- Equipment is in good operating order and inspected on a regular basis;
- Fuel trucks transporting fuel to on-site equipment travel only on approved ARs;
- Equipment will be parked overnight and/or fueled and maintained at least 100 feet from a waterbody boundary;
- Hazardous materials, including chemicals, fuels, and lubricating oils, are not stored within 100 feet of a waterbody boundary, unless the location is approved for such use by applicable regulatory agencies and monitored by Tennessee EIs. This applies to storage of these materials only, it does not apply to normal operation or use of equipment in these areas;
- Concrete coating activities are not performed within 100 feet of a waterbody boundary, unless the location is an existing industrial site designated for such use;
- ATWS areas will be located a minimum of 50 feet from the edge of a waterbody except where the adjacent upland consists of cultivated or rotated cropland or other disturbed land. A variance will be requested for all areas where a 50-foot setback is not maintained;
- Cut lumber will be stacked a minimum of 50 feet from the edge of a waterbody;
- Pumped water from trench dewatering operations will not be directly discharged into a waterbody. Pumped water will be discharged into an appropriately sized filter device (e.g., filter bag, sediment coral) located in a well vegetated area a minimum of 50 feet from the edge of a waterbody; and
- Any excavated material from the trench line will be placed a minimum of 10 feet from the top of the waterbody bank.

6.3 MAINTENANCE OF EROSION CONTROL DEVICES AT WATERBODY CROSSINGS

Erosion control devices will be installed immediately after initial clearing of the workspace adjacent to waterbodies and will be properly maintained throughout construction and reinstalled as necessary (such as after backfilling of the trench) until replaced by permanent erosion controls or until restoration of adjacent upland areas is complete. Temporary erosion and sediment control measures are addressed in more detail in other sections of this ECP; however, the following specific measures may be implemented at waterbody crossings:

- Sediment barriers will be installed across the entire construction ROW at all waterbody crossings where necessary to prevent the flow of sediments into the waterbody. In the travel lane, these may consist of removable sediment barriers or drivable berms. Removable sediment barriers may

be removed during the construction day, but will be re-installed after construction has stopped for the day or when heavy precipitation is imminent;
- Where waterbodies are adjacent to the construction ROW, sediment barriers will be installed along the edge of the construction ROW as necessary to contain spoil and sediment within the construction ROW; and
- Trench breakers will be used at all waterbody crossings, as necessary, to prevent diversion of water into upland portions of the pipeline trench and to keep any accumulated trench water out of the waterbody, unless otherwise approved by the EI to allow natural flow of water into the waterbody.

As previously noted, erosion control devices, including at or adjacent to waterbodies, will be maintained in proper working condition as required by this Plan and applicable permit conditions. Inspecting and ensuring the maintenance of temporary erosion control measures will be conducted at a minimum:

- On a daily basis in areas of active construction or equipment operation;
- A minimum of once a week in areas with no construction or equipment operation; and
- Within 24 hours of each 0.5 inch of rainfall or greater. This means that an inspection will be required once a storm event has produced 0.5 inch, even if the storm event is still continuing. Inspections will be required within 24 hours of the first day of the storm that produces more than 0.5 inch of rainfall and within 24 hours after the end of the storm for multiple day storm events that produce 0.5 inch of rainfall or more per day.

6.4 ADDITIONAL TEMPORARY WORK SPACE AREAS

Except where noted in Tennessee's Procedures and in Table 8.1-4 in Resource Report 8, ATWS areas (such as staging areas and additional spoil storage areas) will be located at least 50 feet away from the edge of a waterbody, except where the adjacent upland consists of actively cultivated or rotated cropland or other disturbed land. Tennessee will limit clearing of vegetation between ATWS areas and the edge of the waterbody to the certificated construction ROW and limit the size of ATWS areas to the minimum needed to construct the waterbody crossing.

6.5 SPOIL PLACEMENT/CONTROL

Spoil from minor and intermediate waterbody crossings, as well as upland spoil from major waterbody crossings, will be placed in the construction ROW at least 10 feet from the water's edge or in ATWS areas. Tennessee will attempt to maintain a minimum of 15 feet of undisturbed vegetation, including spoil pile placement, between the waterbody and the construction workspace where the workspace parallels but does not intersect a waterbody, except where maintaining this offset will result in a greater environmental impact, or is not practicable due to the configuration of the waterbody, or impacts worker safety. Sediment barriers will be used to prevent the flow of spoil or heavily silt-laden water into any waterbody. Spoil will not be stored within waterbodies, unless otherwise approved by applicable regulatory agencies on a site-specific basis.

6.6 BLASTING AND EXPLOSIVES IN WATERBODIES

Blasting may be required to excavate streambeds where bedrock is encountered at shallow depths to allow pipeline installation in accordance with federal depth requirements. The final determination on the need for blasting will be made at the time of construction by the contractor in consultation with Tennessee. In

the event blasting is required, the pipeline Contractor will develop a detailed blast plan for in-water blasting operations. This detailed in-water Blasting Management Plan will comply with applicable requirements and permit conditions relative to in-water blasting operations. Areas along the proposed Project with shallow depth to bedrock area are summarized in Resource Report 1.

6.7 WATERBODY CROSSING PROCEDURES

Waterbody crossing procedures will be selected based upon the site-specific conditions, as well as consultation with applicable regulatory agencies. Mobilization of construction equipment, trench excavation, and backfilling will be performed in a manner that will minimize the potential for erosion and sedimentation within the waterbody. Erosion control measures will be implemented to confine water quality impacts to within the designated work areas and minimize impacts to downstream resources.

Some of the engineering design guidelines followed in developing site-specific waterbody crossings include:

- Crossings will be constructed as close to perpendicular to the axis of the waterbody channel as engineering and field conditions permit;
- Tennessee will attempt to maintain a minimum of 15 feet of undisturbed vegetation between the waterbody and the construction workspace where the pipeline parallels but does not cross a waterbody, except where maintaining this offset will result in a greater environmental impact;
- Tennessee will attempt to minimize the number of waterbody crossings where waterbodies meander or have multiple channels;
- Tennessee will maintain flow rates downstream of the crossing to protect aquatic life, and prevent the interruption of existing downstream waterbody uses; and
- Waterbody setbacks will be clearly marked in the field with signs and/or highly visible flagging through the course of construction-related activities.

Open cut crossing techniques will be applied at intermittent streams that are dry and expected to remain dry at the time of construction. Dry crossing techniques will be applied at perennial streams and all waterbodies with discernible water flow at the time of construction. Wet crossing techniques will be applied at locations where the other crossing techniques were determined impractical and are approved by applicable regulatory agencies.

6.7.1 Wet Open Cut Crossings

Minor waterbodies with no discernible flow at the time of construction may be crossed using the open cut crossing method (i.e., bed and bank disturbance with no stream flow bypass equipment installed). Consistent with Tennessee' Procedures, Tennessee plans to complete construction activities within 24 hours at minor open cut stream crossings and within 48 hours at intermediate open cut crossings. A site-specific plan will be developed for all major waterbody crossings to outline the timeframe and procedures that will be followed during installation of the crossing.

Clearing

All waterbodies may be crossed once by the clearing crews if the stream is not flowing, prior to installing equipment crossings. These crews may construct temporary crossings with equipment mats or equivalent. Temporary crossings may only be used by the clearing crews. The subsequent crews will be responsible for removing the temporary equipment crossing and constructing the long-term equipment crossing.

Trenching/Lowering-in/Backfilling

For conventional trench crossings with no discernible flow at the time of construction, the pipeline will be placed deep enough to meet the minimum cover requirement of 5 feet, provided rock is not encountered. Consistent with Tennessee's Procedures, Tennessee plans to complete construction activities within 24 hours at minor conventional trench stream crossings and within 48 hours at intermediate conventional trench crossings, not including the time for blasting preparation and blasting.

Contractors will use an excavator or dragline to excavate the trench across the waterbody. Equipment used to dig the trench will work from the stream banks, equipment crossings, or by straddling the trench line where the width of the waterbody prohibits excavations solely from the banks. The depth of the trench will be sufficient to allow a minimum of 5 feet of cover over the pipeline below the streambed, unless in shallow bedrock.

Cleanup/Restoration

- Waterbody banks will be stabilized and temporary sediment barriers will be installed within 24 hours of completing instream construction activities.
- All waterbody banks will be returned to pre-construction contours or to a stable angle of repose as determined by the EI and approved by applicable regulatory agencies.
- Revegetate disturbed riparian areas with conservation grasses and legumes or native plant species as specified by the EI or conditioned by applicable regulatory agencies.

6.7.2 Dry Crossing Methods

Dry crossing techniques will allow the waterbody flow to be maintained at all times during construction. Continuous downstream flow will be maintained by utilizing one of the following techniques:

- Fluming the waterbody;
- Damming and pumping the flow from upstream to downstream;
- Installing a cofferdam;
- Open cut waterbodies with no flow and no anticipated flow at the time of crossing;
- Conventional bore (Section 5.12);
- Direct Pipe® (Section 5.15); or
- HDD under the waterbody (Section 5.14).

Clearing/Grading

- Clearing crews will construct temporary equipment crossings by using equipment mats or temporary equipment bridges prior to crossing the waterbody.

- Temporary crossings will only be used by clearing crews; subsequent crews will be responsible for constructing the long term equipment crossing and removing the temporary ones.
- Skidders and other vehicles will not drag trees or brush across waterbodies.

Trenching/Lowering-in/Backfilling

Flumed Crossing

The banks of waterbodies will be left in place as hard plugs until the pipe is pre-fabricated and ready to be installed. The Contractor will install a flume pipe(s) over the trench line after blasting is complete but prior to trenching and will maintain the flume pipes until restoration is complete. The size and number of flume pipes will be determined prior to installation based on engineering calculations. The size and number of pipes will be adequate to handle the maximum anticipated flow during the time of the crossing.

Excavation equipment will work around the flume pipe while excavating the trench line. The pipeline will be threaded under the flume pipe, and the trench will be backfilled while waterbody flows are maintained through the flume pipe(s). The waterbody flow may be temporarily pumped around the crossing so the flume pipe can be removed to lower in the pipe, or the flume pipe will be completely removed in low flow conditions with no other provisions required if the topographic conditions will not permit the pipe to be threaded under the pipe. Flume pipes will be permanently removed as part of restoration.

Dam and Pump

Another method for completing a dry crossing of a waterbody is to install temporary dams at the upstream and downstream limits of the workspace and use one or more pumps to convey the water flow around the workspace. Pumping will maintain waterbody flows during in-stream activities (except blasting). The pipeline will be lowered in while the waterbody flow is pumped around the site. The stream banks will be left in place as hard plugs until the pipe is ready to be lowered.

Personnel will be present to monitor the pump(s) while in operation. If a natural sump is not available for the intake hose, an in-stream sump will be created using double bagged sandbags or sump pits as directed by the EI. All pump intake hoses will be screened, and pump discharges be directed through energy dissipaters and applicable outlet BMPs (e.g., filter bag). A spare pump(s) will be available at the site for immediate use if required by the EI to pump larger quantities of water or if the in-use pump mechanically fails. Pumps will be placed within secondary containment (e.g., concrete mixing tubs, or other containment unit) to contain any potential oil or fuel spills while the pump is in operation.

If the time between any phases of the work become more complicated than anticipated or if it is determined that the pumps cannot handle the flow within the waterbodies, the pumps will be discontinued and flumes will be installed to maintain the flow.

Cofferdam

A cofferdam is a temporary barrier that is installed around or across the workspace in waterbodies to isolate it during construction and allow for dry working conditions. Cofferdams will be used for waterbody crossings with high flow volumes that precludes 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 two-thirds of the crossing, and the second stage would consist of completing the remaining one-third of the crossing. Typical cofferdam materials include, but are not limited to, sand bags, sheet piling, timber lagging, and inflatable dams.

The typical installation procedure will consist of the following:

1. Installing turbidity curtains around the work area;
2. Installing the cofferdam;
3. Dewatering the work area and maintaining it in a dewatered state;
4. Excavating the trench;
5. Installing the pipeline and an anti-seep collar, or equivalent, near the end of the pipe installed to help prevent water from traveling along the trench and flooding the work area during stage 2;
6. Backfilling the trench and restoring the waterbody bed and banks;
7. Removing all equipment from the work area;
8. Filling the area with water from outside the cofferdam;
9. Removing the cofferdam and turbidity curtain; and
10. Follow procedures 1 through 9 to construct the remaining third of the crossing, stage 2. Stage 2 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 modifications when constructing stage 2 of the cofferdam over the pipe that was installed during stage 1. Driving of the cofferdam will not be permitted within 5 feet of either side of the pipe installed during stage 1. 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 sand bags or an equivalent material. As noted above, an anti-seep collar or equivalent will be installed during stage 1 to help prevent flooding the work area.

Open Cut

The open cut method 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 Tennessee's Procedures, Tennessee plans to complete construction activities within 24 hours at minor open cut stream crossings and within 48 hours at intermediate open cut crossings. A minimum cover depth of 5 feet will be maintained over the pipeline for all designated waterbodies crossed with the 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.

Horizontal Directional Drilling

A site-specific plan will be developed for waterbodies that will be crossed using the HDD method. The site-specific plan(s) will include:

- Site-specific construction details that show the location of mud pits, pipe assembly areas, and all associated workspace areas to be disturbed or cleared for construction;
- A description of how an inadvertent release of drilling mud would be contained and cleaned up; and
- A contingency plan for each crossing will be prepared in the event the directional drill is unsuccessful and how the abandoned drill hole would be sealed, if necessary.

The HDD Contingency Plan for inadvertent release of drilling fluids is included in Attachment N5 of this ECP.

7.0 WETLAND CROSSINGS

The term "wetland" as used in this ECP includes any area that satisfies the requirements of the current Federal methodology for identifying and delineating wetlands. Wetland areas have been delineated prior to construction and are identified on the aerial alignment sheets, Attachment N1. The requirements outlined below do not apply to wetlands in actively cultivated or rotated cropland. Standard agricultural upland protective measures, (e.g., workspace, topsoiling requirements, etc.) will apply to agricultural wetland areas.

Table 7.0-1 summarizes the wetland impacts associated with the Project.

Table 7.0-1
Wetland Impact Summary by Wetland Type in Connecticut

County	Township	Palustrine Emergent (acres affected)		Palustrine Forested (acres affected)		Palustrine Scrub-Shrub (acres affected)		Other Wetland[3] (acres affected)		Township 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
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 publicly 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 publicly available data was used where there was no parcel access and no photo interpreted aerial coverage. The publicly 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 Table 2.3-12, "Areas of Greater than 75 feet of Workspace within Wetlands."

[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 is not included in the operational wetland impacts.

[3] Wetland type not classified by NWI as PEM, PSS, or PFO.

7.1 GENERAL GUIDELINES

Tennessee will develop site-specific wetland crossing plans to be implemented during construction. Tennessee will protect and minimize potential adverse impacts to wetlands by:

- Ensuring that applicable construction personnel are educated on wetland construction techniques, where wetlands are located, etc.;
- Maintaining a typical workspace width of 75 feet, where possible, through wetlands;
- Accelerating construction activities in and immediately adjacent to wetlands to the extent practicable to limit the activity in the wetland;
- Maintaining a 50-foot setback, where possible, between ATWS areas and the edge of the wetland;
- Limiting the use of equipment operating in the wetlands to those required to construct the pipeline;
- Restoring the wetland to pre-construction contours;
- Removing all construction equipment and materials from within the wetland as soon as practicable;
- Permanently stabilizing adjacent upland areas following the pipe installation;
- Inspecting the ROW periodically during and after construction and repairing any erosion control or restoration features until permanent revegetation is successful, which is a minimum of uniform, perennial 80 percent vegetative cover; and
- When wetland areas are temporarily disturbed, isolate and stockpile topsoil for replacement after backfilling is completed. If temporary vegetative stabilization is necessary, apply annual ryegrass at the rate not exceeding 40 lbs/acre. Mulch using clean straw (weed free) at the rate of 2 tons/acre. Soil amendments will not be used in wetland areas unless otherwise approved by the EI or applicable permitting agency.

Locations that require ATWS within 50 feet of a wetland and areas of greater than 75 feet of workspace within a wetland can be found on the aerial alignment sheets provided in Attachment N1.

7.1.1 Construction in Non-Saturated Wetlands

Non-saturated wetlands are defined as having no standing water or saturated soils at the time of construction (i.e., ground is stable enough for equipment to cross without rutting). Standard pipeline construction methods will be used in wetlands where soils are dry enough at the time of construction to support equipment. The following construction techniques will apply to non-saturated wetlands:

- Minimize vegetation clearing and stump removal within the wetland.
- If utilized, equipment mats will be placed over existing vegetation in the travel lane.
- Sediment barriers will be installed where necessary across the entire construction ROW at all wetland crossings to prevent the flow of sediments into the wetland. In the travel lane, these may consist of removable sediment barriers or drivable berms. Removable sediment barriers may be removed during the construction day, but will be re-installed after construction has stopped for the day or when heavy precipitation is imminent.
- Topsoil segregation (trench and spoil pile) will be performed as long as there is sufficient topsoil present to allow for mechanical separation by equipment and the soil is not frozen or saturated.
- Dirt, rock, pulled stumps, or brush rip-rap will not be used to stabilize the travel lane.
- Remove cut vegetation and stumps in trench line, leave stumps and associated root system in areas outside of the trench line that do not require removal to allow for safe working conditions.

- Install trench breakers at each wetland boundary (on upland side).
- When wetland areas are temporarily disturbed, isolate and stockpile topsoil for replacement after grading is completed. If temporary vegetative stabilization is necessary, apply annual ryegrass at the rate not exceeding 40 lbs/acre. Mulch using clean straw (weed free) at the rate of 2 tons/acre.
- Soil amendments will not be used in wetland areas unless otherwise approved by the EI or applicable permitting agency.
- Soil will be decompacted where necessary using a harrow, paraplow, Paratill® or other equipment where equipment mats are not utilized.

7.1.2 Construction in Saturated Wetlands

Saturated wetlands are defined as having standing water or highly saturated soils at the time of construction. The following construction techniques will apply to saturated wetlands:

- Minimize vegetation clearing and stump removal by removing only vegetation and stumps in the trench line, unless they pose a safety risk within the travel lane;
- Install a sediment barrier across the ROW and wetland boundary as necessary;
- Trees and brush will be cut at ground level by hand, with low ground pressure equipment, or with equipment that does not cause excessive rutting of topsoil or with equipment supported by equipment mats;
- Temporary roads to be used in wetlands are those existing roads that can be used with no modifications or improvements, other than routine repair and no impact on the wetland (i.e., use of equipment mats);
- Topsoil segregation will not be conducted in inundated wetlands;
- Permanent slope breakers will be installed at the base of all slopes adjacent to wetlands;
- Temporary roads will be constructed with appropriate equipment mats;
- Pipe joints may be welded outside of the wetlands and carried in and installed using the "push-pull" or "float" technique;
- Dirt, rock, pulled stumps, or brush rip-rap will not be used to stabilize the travel lane; and
- Install trench breakers at each wetland boundary, on upland side.

In areas of unconsolidated soils such as muck and till, Tennessee will utilize sediment barriers to contain those soils within the workspace. The type of sediment barrier employed will vary depending on the amount and physical properties of the material that has to be contained. There are no anticipated areas of muck within the Project area.

7.2 STANDARD PIPELINE CONSTRUCTION IN WETLANDS

The size of ATWS areas at wetland crossings will be minimized to the extent practicable and will be located at least 50 feet from the edge of the wetland where topographic conditions permit. Locations where ATWS is required to be located within 50 feet of the edge of the wetland can be found on the Aerial Alignment Sheets provided in Attachment N1 and Table 8.1-4 in Resource Report 8. The wetlands and setbacks will be clearly marked with flagging prior to the start of construction. Spoil will be temporarily placed immediately adjacent to the trench line where topsoil has been segregated or transported to an approved upland area adjacent to the wetland for temporary storage.

Hazardous materials, chemicals, fuels, and lubricating oils will not be stored, nor will concrete coating activities be performed, within 100 feet of a wetland or waterbody boundary unless otherwise approved

by the applicable regulatory agencies. Refueling will not take place within 100 feet of any waterbody or wetland unless associated with refueling of pumps being utilized for a dry waterbody crossing, or as otherwise approved by applicable regulatory agencies.

Aboveground facilities will not be located in any wetland, except where the location of such facilities outside of wetlands would prohibit compliance with USDOT regulations.

The standard construction procedures used to cross small wetlands will be similar to those used on upland areas. However, if the trench contains water, temporary trench breakers will be left in the trench prior to entering the wetland. This procedure will minimize silt discharges into the wetland. If construction activities breach a permeable layer, the bottom of the trench will be re-sealed with a non-permeable soil layer. In addition, permanent trench breakers will be installed at the point where the trench enters and exits a wetland to ensure maintenance of existing hydrology. Backfill will be well compacted, especially at the edges of the wetland. Original topographic conditions will be restored immediately after the completion of construction.

Construction in larger wetland areas may use the "push-pull" or "float" techniques. Equipment mats will be used to provide a working surface for the movement of equipment, personnel, and materials. The trench may be excavated using a dragline or clamshell dredge. The excavated material will be stored adjacent to the trench.

The pipe will be stored and fabricated in staging areas located outside the wetland. As necessary, the pipe will be weighted to provide negative buoyancy so that the pipe sits firmly on the bottom of the trench in submerged situations. Temporary floats may be attached to the pipe to provide short-term positive buoyancy to push the pipe through the wetland over the trench. After floating the pipe into place, the floats will be removed and the pipe will be lowered to the bottom of the trench. This operation will be repeated as necessary with pre-fabricated sections of pipe welded together outside of the wetland limits and pushed into place until the wetland crossing is complete. The pipe will then be backfilled with the native spoil material that was stockpiled adjacent to the trench or temporarily stored outside of the wetland limits. The wetlands will be restored to the pre-construction contours immediately following construction. Any excess spoil material will either be removed or redistributed within the ROW in such a manner that the pre-construction surface water flow patterns are not impacted.

7.3 EQUIPMENT MATS

The EI may require equipment mats be used to prevent unnecessary damage to the soil structure in wetlands with standing water. Generally, there will be several equipment mats laid side by side in the construction travel area. Tennessee will attempt to utilize a maximum of two equipment mats stacked on top of each other to allow construction equipment to safely traverse the wetland area. Equipment mats will generally be placed directly over existing vegetation where grading is not required. All equipment mats will be removed from the wetland immediately following construction of the pipeline. Rock, soil material from outside the wetland, tree stumps, or brush riprap will not be used to support equipment on the construction ROW.

7.4 CLEARING

Wetland boundaries and setbacks will be clearly marked in the field with signs and/or highly visible flagging until construction-related ground disturbing activities are complete. No rubber-tired equipment will be allowed to work in wetlands unless it will not damage the root systems or cause rutting and its use

is approved by the EI. Bulldozers will not be used for clearing within wetlands. Trees and brush will be cut to ground level by hand or with hydroaxes, tree shears, or grinders.

The minimum clearing necessary to safely construct the pipeline will be completed. Equipment mats may be placed over the top of existing vegetation, including shrubs, where possible.

Stumps will be left in place, except within the trench line or unless the removal is necessary to ensure worker safety. Stumps may be ground down to a suitable height for safety reasons. Tennessee will attempt to leave the cut tree root system intact where removal is not required for construction or worker safety. All timber and brush will be removed from the wetlands. Grindings will be removed from the wetlands to the extent that removal will not disturb intact wetland areas. All cleared debris (e.g., slash, logs, brush, woodchips, stumps, etc.) will be completely removed from the wetland and wetland buffer areas and will be disposed of in approved disposal areas or as directed by the EI. The EI will photo document areas before and after clearing activities for use in revegetation/restoration plans.

7.5 TEMPORARY SOIL REMOVAL

- No grading will occur in wetlands.
- Topsoil will be segregated over the trench line and returned as an even layer in the same horizon, except for areas with standing water or where soils are saturated or frozen.
- Erosion control measures will be installed prior to soil removal at all wetland crossings.
- Topographic elevations will be documented prior to soil removal activities so that disturbed areas can be restored to pre-construction contours. Unnatural (or anthropogenic) features and unstable grades will be noted by the EI prior to construction activities so they can be reestablished during restoration activities, where appropriate.
- Wetlands will be revegetated, unless standing water is present, in accordance with the following:
  - Ryegrass (annual or perennial) at 30 ls/acre (approximately 0.7 lb/100 ft^2 or use 1 lb/1,000 ft^2) during spring, summer or early fall; or
  - Aroostook (if available) winter rye (cereal rye) at a rate of 100 lbs/acre (2.5 lbs/1,000 ft^2.)
- No fertilizers, lime, or mulch will be utilized in wetland areas unless required in writing by applicable regulatory agencies.

7.6 TRENCHING

The topsoil in wetlands will be stripped from the trench line and spoil storage area and segregated if it is not saturated or frozen and its depth is sufficient to allow mechanical separation. Topsoil stripping (in non-saturated conditions) will be performed up to a depth of 12 inches or as determined by the EI. The segregated topsoil will be stockpiled separately from subsoil for later restoration of the ROW. Spoil piles will be contained with appropriate erosion control measures to prevent sediment migration off the ROW or into wetlands.

7.7 LOWERING-IN/BACKFILLING

The trench will be backfilled with subsoil first. After the subsoil has been rough graded, topsoil that was previously segregated will be replaced in an even layer over the trench. The replaced topsoil depth will be the same as the pre-construction depth. It is important to utilize only the topsoil segregated from each specific wetland because it contains seeds, rhizomes, and other plant propagules, which will aid rapid re-colonization by indigenous wetland species. Rock present in the pre-construction wetland conditions

will be placed in the wetlands in the same approximate configuration (density and size) as pre-construction conditions. Pre- and post-construction photos will be taken to aid in the replacement of these features.

Permanent trench breakers will be installed at both boundaries of the wetland to prevent draining of the wetland along the pipeline trench, if warranted. The trench breakers are required to prevent water flow along the trench line which could result in undermining of the pipeline. Pipeline padding is generally not required in wetland locations because the wetland soils used to backfill the trench are generally soft and the pipe is either concrete coated or has set on weights installed to ensure negative buoyancy, which provides extra protection from the backfill material damaging the pipe coating.

7.8 MAINTENANCE OF WETLAND EROSION CONTROL DEVICES

Erosion control devices will be installed immediately after initial earth disturbance of the wetland or adjacent upland. Erosion control devices will be properly maintained throughout construction and reinstalled as necessary (such as after backfilling of the trench) until replaced by permanent erosion control measures or restoration of adjacent upland areas is complete. Temporary erosion and sediment control measures are addressed in more detail in this ECP; however, the following specific measures will be implemented at wetland crossings:

- Sediment barriers will be installed across the entire construction ROW at all wetland crossings where necessary to prevent the flow of sediments into the wetland. In the travel lane, these may consist of removable sediment barriers or drivable berms. Sediment barriers may be removed during the construction day, but will be re-installed after construction has stopped for the day and/or when heavy precipitation is imminent.
- Where wetlands are adjacent to the construction ROW and the ROW slopes toward the wetland, sediment barriers will be installed along the edge of the construction ROW as necessary to prevent sediment flow into the wetland.
- The trench will be dewatered (either on or off the construction ROW) in a manner that does not cause erosion and does not result in heavily silt laden water flowing into any wetland or waterbody. The dewatering structures will be removed as soon as possible after the completion of dewatering activities.

As previously noted, erosion control devices, at or adjacent to wetlands, will be maintained in properly working condition at all times. Inspecting and ensuring the maintenance of temporary erosion control measures will be conducted at a minimum:

- On a daily basis in areas of active construction or equipment operation;
- A minimum of once a week in areas with no construction or equipment operation; and
- Within 24 hours of each 0.5 inch of rainfall or greater. This means that an inspection will be required once a storm event has produced 0.5 inch, even if the storm event is still continuing. Inspections will be required within 24 hours of the first day of the storm that produces more than 0.5 inch of rainfall and within 24 hours after the end of the storm for multiple day storm events that produce 0.5 inch of rainfall or more per day.

8.0 SITE-SPECIFIC CONTACT INFORMATION AND NOTIFICATIONS

Contact information for appropriate regulatory agencies regarding the proposed Project is recorded in this Section. The contact information will be needed to contact applicable agencies prior to construction to ensure that all site-specific conditions are listed and implemented during all phases of the construction process.

The following shall be notified prior to the start of any construction-related activity:

- The CTDEEP must be notified in 10 days prior to construction and 15 days prior to hydrostatic testing. Send notification to:

  Connecticut Department of Energy and Environmental Protection
  79 Elm Street
  Hartford, CT 06106-5127
  Phone: 860-424-3000

- The following information will be filed with the Secretary of the Commission ("Secretary") prior to the beginning of construction:

  A schedule identifying when trenching or blasting would occur within each waterbody greater than 10 feet wide, or within any designated coldwater fishery. The Project sponsor will revise the schedule as necessary to provide FERC staff at least 14 days advance notice. Changes within this last 14-day period must provide for at least 48 hours advance notice.

9.0 RESTORATION

9.1 RIGHT-OF-WAY CLEANUP AND PERMANENT RESTORATION

ROW cleanup and permanent restoration operations will commence immediately following backfill operations. Permanent re-establishment of final grades and drainage patterns, as well as restoration and revegetation measures, serve to minimize post-construction erosion by establishing a vegetative cover to protect the soil, and also by using structures which can divert or slow runoff and trap sediment. The Contractor will restore disturbed portions of the construction ROW and supplemental work areas, as approved by Tennessee, applicable regulatory agencies, and as agreed to in writing by the land-owner.

Tennessee will complete upland final grading, topsoil replacement, and installation of permanent erosion control structures within 20 days after backfilling the trench in all areas except residential areas, which will be completed within 10 days. The trench will be backfilled as soon as practicable in areas where public safety is a concern or where motor vehicle access is required. The contractor will have steel plates on site to temporarily cover the trench in an emergency. Permanent restoration of waterbodies and wetlands will be initiated immediately after backfilling, weather permitting. Temporary erosion control measures (e.g., trench breakers, slope breakers, sediment barriers, etc.) will be maintained to prevent high velocity stormwater runoff from potentially affecting downstream sensitive resources.

Steep slopes will require specialized techniques during the restoration process (Steep Slope, Section 5.19). These slopes will be permanently stabilized as soon as possible after installation of the pipeline to prevent severe erosion and possible slope failure (e.g., landslides). Permanent stabilization will be accomplished by implementing the following BMPs:

- Install trench breakers in accordance with the spacing provided in this ECP, and adequately compact backfill between the trench breakers. The trench line preparation also may include installation of underdrain pipes within slopes that appear to be excessively wet or contain shallow depth to bedrock. The underdrain pipe will prevent the slope from becoming saturated and decrease the potential for subsidence.
- Final grading will include installation of permanent slope breakers in accordance with the spacing and specifications provided in this ECP and roughening the surface between the slope breakers to decrease surface runoff velocity.
- Slope roughening to aid in establishment of vegetative cover from seed, reduce runoff velocity, increase infiltration and to reduce erosion by providing for trapping of sediment. Slope roughening methods may include tracking, grooving, and stair-stepping.
- Revegetation will include hydroseeding the construction workspace with specialized seed mixes, as available, and mulch tackifiers.
- Install extended-term erosion control matting along the slope and slope breakers. The type of erosion control matting will be selected based on the severity of the slope.
- All steep slopes will be inspected in accordance with the schedule outlined in Section 3.0 of this ECP. The EI will review these areas to ensure that erosion is not occurring underneath the matting. Any erosion noted during the inspection will be repaired within 24 hours of the inspection.

Tennessee has prepared a Winter Construction Plan in anticipation of construction activities occurring during the winter. The plan includes special construction techniques and material handling procedures that will be required to safely construct the Project. The Plan can be found in Attachment N12 of the ECP.

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

Rock excavated from the trench may be used to backfill the trench only to the top of the existing bedrock profile and only if it will not damage the pipe. In agricultural lands, rock will not be returned to the trench any higher than 24 inches below the top of the "B" horizon sub-soil surface. Tennessee will remove excess rock from at least the top 12 inches of soil in all residential areas. Excess rock will be removed from agricultural areas in accordance with Section 5.6. In general, stone and rock material 4 inches in diameter and larger in size will be removed and disposed of in residential areas. The size, density, and distribution of rock on the construction work area will be similar to adjacent areas not disturbed by construction, or as approved in writing by the land-owner. Rock that is not returned to the trench will be considered construction debris, unless approved for use as cover/surface stabilization or for some other use on the construction work areas by the land-owner.

Tennessee will grade the construction ROW to restore pre-construction contours and leave the soil in the proper condition for planting. Segregated topsoil will be spread across the ROW where it was segregated from evenly and to the same approximate layer depths documented during pre-construction surveys by the

EI. Where trench compaction has not been done, the ROW will be graded to pre-construction contours, as practicable, with a small crown of soil left over the trench to compensate for settling, but will not interfere with natural drainage. Openings will be left in the trench-line crown to allow for lateral surface drainage, as approved by the EI.

Construction debris and equipment will be removed from all upland, waterbody, and wetland construction work areas unless the land-owner or land managing agency approves otherwise in writing. The disturbed ROW will be seeded within 6 working days of final grading, weather and soil conditions permitting.

Tennessee will remove temporary erosion control measures when replaced by permanent ones or when permanent revegetation is successful and the area is considered stabilized by the EI.

9.2 PERMANENT EROSION CONTROL DEVICES

9.2.1 Trench Breakers

Trench breakers are intended to slow the flow of subsurface water along the trench and prevent the draining of an adjacent waterbody or wetland along the trench line. Trench breakers may be constructed of materials such as sand bags or polyurethane foam. Topsoil will not be used to construct trench breakers.

Tennessee will construct and maintain permanent trench breakers in areas as specified by the EI, applicable regulatory requirements or at the same spacing as and upslope of permanent slope breakers. In agricultural fields and residential areas where slope breakers are not typically required, trench breakers will be installed at the same spacing as if permanent slope breakers were required. Spacing for permanent trench breaker spacing is listed in Table 9.2-1.

At a minimum, trench breakers will be installed at the base of slopes greater than 5 percent where the base of the slope is less than 50 feet from a waterbody or wetland and where needed to avoid draining a waterbody or wetland.

Table 9.2-1
Permanent Trench Breaker Spacing

Slope (percent)	Spacing (feet)
5-15	300
>15-30	200
>30	100

Source: FERC 2013.

9.2.2 Permanent Slope Breakers (Waterbars)

Permanent slope breakers are intended to reduce runoff velocity, divert water off the construction ROW, and prevent sediment deposition into sensitive resources. Permanent slope breakers may be constructed using soil or some functional equivalent.

Permanent slope breakers will be constructed and maintained in all areas, except cultivated areas (including rotation hayfields and pastures) and lawns, using spacing recommendations obtained from Tennessee's Plan. The spacing will be as shown in Table 9.2-2 unless closer spacing is necessary to avoid excessive erosion on the construction ROW:

In general, slope breakers will be constructed with a 2 to 8 percent slope across the ROW to convey surface flow to a stable area without causing water to pool behind the breaker. In the absence of a stable outlet area, an approved energy dissipating device will be constructed at the end of the breaker.

Slope breakers may extend slightly (approximately 4 feet) beyond the edge of the construction ROW to effectively drain water off the disturbed area. Slope breakers that extend beyond the edge of the construction ROW will be subject to compliance with applicable survey requirements.

The EI may direct construction of permanent slope breakers to replace temporary erosion control barriers at road, waterbody and wetland crossings, as required.

At the discretion of the EI, permanent slope breakers that may alter the permanent overland flow characteristics to wetland areas may not be installed. In such case, hay or straw bales, or an approved equal, may be utilized as temporary slope breakers adjacent to wetland boundaries only until restoration is complete to ensure the wetland hydrologic characteristics remain unaltered.

Table 9.2-2
Permanent Slope Breakers
(Water bars)

Slope (percent)	Spacing (feet)
5-15	300
>15-30	200
>30	100

Source: FERC 2013.

9.3 WATERBODY AND WETLAND CROSSING RESTORATION

9.3.1 Waterbody Crossings

Tennessee will utilize the following criteria to restore disturbed waterbodies to as close to their pre-construction condition as practicable:

- Clean stone or native cobbles will be used for the upper 1 foot of trench backfill in waterbodies that contain coldwater fisheries;
- For open cut crossings, waterbody crossing banks will be stabilized and temporary sediment barriers will be installed within 24 hours of completing in-stream construction activities;
- For dry-ditch crossings, streambed and bank stabilization will be completed prior to returning flow to the waterbody channel;
- All waterbody banks will be returned to pre-construction contours or to a stable angle of repose as approved by the applicable regulatory agencies;
- Application of riprap for bank stabilization will comply with applicable regulatory agency approvals. In general, Tennessee, to the extent practicable, will employ natural stream bank

restoration techniques (e.g., planting native plant species to stabilize the banks) before utilizing riprap stabilization. The use of riprap will generally be limited to areas where flow conditions preclude effective vegetative stabilization techniques such as seeding and erosion control fabric;
- Disturbed riparian areas will be revegetated with conservation grasses and legumes or native woody plant species;
- Permanent slope breakers will be installed across the construction ROW at the base of slopes greater than 5 percent that are less than 50 feet from the waterbody, or as needed to prevent sediment transport into the waterbody; and
- Sediment barriers will be installed as outlined in other sections of this Plan and as approved or specified by the EI. As approved by the EI, earthen berms may be utilized as sediment barriers adjacent to the waterbodies.

9.3.2 Wetland Crossings

Tennessee will utilize the following criteria to restore disturbed wetland areas to as close to their pre-construction condition as practicable:

- All equipment mats, temporary timber riprap, and other construction debris will be removed during the final grading of the ROW. Once backfilling is complete, the original surface contours and flow regimes will be restored. During final grading, wetlands (including areas within the 100-foot buffer) will be restored to their original contours and the buffer areas seeded and mulched as soon after backfilling as practicable (preferably within 48 hours but not longer than 1 week) with the exception of the travel portion of the ROW, which also will be restored using these procedures after the travel way is no longer required.
- For each wetland crossed, trench breakers will be installed at the base of slopes near the boundary between the wetland and adjacent upland areas and the trench bottom will be sealed as necessary to maintain the original wetland hydrology in areas where the pipeline trench may affect the groundwater hydrology.
- Permanent slope breakers will be installed across the construction ROW at the base of slopes greater than 5 percent where the base of the slope is less than 50 feet from the wetland, or as needed to prevent sediment transport into the wetland. At the discretion of the EI and the Contractor, permanent slope breakers that may alter the permanent overland flow characteristics to wetland areas may not be installed. At the discretion of the EI, hay or straw bales, or an approved equal, will be utilized as temporary slope breakers at the wetland boundaries until restoration is complete to ensure the wetland hydrology remains intact in these situations.
- Sediment barriers will be installed as outlined in other sections of this Plan and as approved or specified by the EI.

Tennessee, at a minimum, will employ the following measures to maximize the success of wetland revegetation:

- Disturbed wetland areas will be temporarily revegetated with annual ryegrass or a native perennial seed mix at a rate of 40 lbs/acre, unless standing water is present. The temporary vegetation will stabilize the area until indigenous wetland species can re-establish themselves. As required by applicable regulatory agencies, mulch will consist of clean straw (weed free) applied at a rate of 2 tons/acre.
- No fertilizers, lime or mulch will be utilized in wetland areas unless required in writing by applicable regulatory agencies.

- If the affected wetland is within an active agricultural parcel, reseeding will be performed according to consultation with applicable regulatory agencies or individual land-owner agreements. If inclement weather limits the effectiveness of reseeding efforts, at the discretion of the EI and as allowed by applicable permits, the ROW will be mulched (with straw only) to minimize erosion until conditions are suitable for reseeding. The temporary mulch cover will be monitored and maintained until conditions are suitable for completing restoration. No fertilizer or lime will be used in wetlands unless approved in writing by the applicable regulatory agency. Permanent stabilization is defined as a minimum uniform, perennial 80 percent vegetative cover with native plant species or other permanent non-vegetative cover with a density sufficient to resist accelerated erosion.

The following measures will be undertaken to maximize and monitor the success of revegetation during forested wetland restoration:

- Minimizing removal of stumps, to the extent practicable, while allowing for safe working conditions, stumps will be left in place within the construction ROW to re-sprout following construction and restoration;
- As indicated in the clearing section of this Plan, tree stumps will only be removed from the trench line, unless specifically authorized by the EI and required for construction safety;
- Following construction, ROW maintenance in wetlands will be limited to clearing 10 feet on either side of the center of the pipeline. Trees within 15 feet of the pipeline greater than 15 feet in height may be selectively cut and removed from the permanent ROW to prevent potential conflicts with the pipeline.

9.4 RESIDENTIAL AREAS

Tennessee will complete final grading, topsoil replacement, and installation of permanent erosion control structures within 10 days after backfilling the trench in residential areas. The restoration and mitigation efforts in residential areas will be completed in accordance with federal and state requirements and include site-specific residential construction plans for residences located within 50 feet of the edge of construction workspace for the pipeline.

Tennessee will, at a minimum:

- Remove construction debris immediately after backfilling;
- Lawns will be raked, topsoil added as necessary, and restored per written agreements with land-owners;
- Ornamental shrubs will be replaced where possible;
- Contractors will restore fences, mailboxes, and other structures (that do not conflict with the installed pipeline) removed during construction. Sidewalks, driveways, and roads will be restored as soon as practicable;
- Tennessee will offer the land-owners testing of water wells within 200 feet of the construction workspace, both before and after construction; and
- After restoration is completed, a Tennessee representative will contact land-owners to ensure that conditions of all agreements have been met and that the land-owner has been compensated for damage incurred during construction.

In residential areas, topsoil replacement (i.e., importation of topsoil) may be required and is an acceptable alternative to topsoil segregation.

9.5 AGRICULTURAL AREAS

Tennessee will complete final grading, topsoil replacement, installation or repair of subsurface drainage facilities prior within 20 days after backfilling the trench in agricultural areas. The restoration and mitigation efforts in agricultural areas will be completed in accordance with applicable federal and state requirements. Tennessee will work with applicable agricultural land-owners to develop grazing deferment plans as part of the restoration process to ensure that the ROW restoration is successful.

9.5.1 Subsoil Decompaction

Subsoil will be de-compacted prior to replacement of segregated topsoil. Specific additional details are included in Attachment N10, Soil Protection and Subsoil Decompaction Plan, of this ECP.

9.5.2 Subsurface Drainage Systems

Typical restoration measures associated with subsurface drainage systems may include:

- Tile repairs will be designed with substantial support placed beneath the replaced section of tile to prevent sagging of the tile line in the event that settlement occurs within the trench.
- All replacements/repairs consisting of plastic pipe will conform to the AASHTO M.252 specification.
- A qualified professional will be responsible for analyzing the adequacy of existing drain tile systems and to determine if they will be able accommodate additional system connections from excessively saturated soil areas resulting from pipeline construction. In general, the existing system will be upgraded to accommodate the increase in flows or a new system will be installed as a standalone system with its own outlet, if the existing system is deemed inadequate.
- At the time a tile is cut, the exposed ends of the drain pipe will be plugged or covered to prevent the tile from becoming clogged with dirt and debris.

10.0 REVEGETATION

10.1 GENERAL

Tennessee will be responsible for ensuring successful revegetation of soils disturbed by Project-related activities, including agricultural and residential areas. Agricultural lands will be restored to their pre-construction condition or better based on the vegetation surrounding the ROW. Agricultural areas will be restored in accordance with Attachment N14, Tennessee's Upland Erosion Control, Revegetation, and Maintenance Plan, of this ECP. Turf, ornamental shrubs, and specialized landscaping will be replaced in accordance with land owner agreements or the land owner will be compensated accordingly. Tennessee will utilize personnel familiar with local horticultural and turf establishment practices to conduct the restoration work.

In upland areas, Tennessee will complete final grading, topsoil replacement, and installation of permanent erosion control structures within 20 days after backfilling the trench except in residential areas, which will

be completed within 10 days. Permanent restoration of waterbodies and wetlands shall be initiated immediately after backfilling, weather permitting.

Permanent stabilization is defined as a minimum uniform, perennial 80 percent vegetative cover or other permanent non-vegetative cover with a density sufficient to resist accelerated erosion.

In general, rough grading will occur after backfilling. The ROW will then be limed and fertilized (no fertilizer or lime will be used in wetlands or waterbodies) in accordance with land-owner agreements or as approved by applicable regulatory agencies. The lime and fertilizer will be disked or blended into the worked soil. If necessary, any excess rocks or stones will be picked up utilizing a mechanical rock rake or by hand, so that the size and density of rocks is similar to adjacent, undisturbed areas. The ROW will be final graded to ensure that all ruts or mounds of soil are smoothed out. Seed and mulch will be applied at rates specified in this report or as directed by the EI. In agricultural areas, additional procedures for restoration and revegetation will be performed in accordance with those outlined in Attachment N10, Soil Protection and Subsoil Decompaction Mitigation Plan and Attachment N14, Tennessee's Upland Erosion Control, Revegetation, and Maintenance Plan.

Tennessee will pay close attention to revegetation and stabilization of steep slopes to help prevent erosion. Steep slopes will generally be hydro-seeded or hydro-mulched in accordance with Section 5.26.1 of this ECP. All slopes 1(v):3(h) and steeper will be covered with erosion control matting to help prevent erosion and allow vegetation to establish. The Contractor will be required to final grade and seed the slope prior to installing the erosion control matting.

10.2 SOIL ADDITIVES

Tennessee will work with affected land-owners prior to construction to gather data relevant to the most recent pre-construction application of soil additives. Fertilizers and soil modifiers will be applied as determined by the EI or in accordance with written recommendations from the applicable regulatory agency. Site-specific fertilizer and soil pH modifiers, as required in writing by applicable regulatory agencies or land-owner, will be incorporated into the top 2 inches of soil during, or as soon as practicable, after application. Soil additives and fertilizers will not be used within wetlands or waterbodies unless required in writing by the applicable regulatory agency. Soil additives will be incorporated into agricultural areas in accordance with Attachment N14, Tennessee's Upland Erosion Control, Revegetation, and Maintenance Plan, of this ECP.

10.3 SEEDING REQUIREMENTS

Tennessee will perform seeding practices as outlined below:

- In non-agricultural areas, prepare a firm seedbed in disturbed areas to a depth of 3 to 4 inches using appropriate equipment. The seedbed will be scarified in areas that will be hydroseeded to facilitate lodging and germination of seed.
- Seeding will not be conducted in actively cultivated croplands unless requested in writing by the land-owner. Permanent seeding, consistent with the impacted field's specific requirements, will be applied in long-term and rotation hayfields and pastures.
- Perform seeding of permanent vegetation within the recommended seeding dates noted below or as determined in the field by the EI. If seeding cannot be done within those dates, appropriate temporary erosion control measures will be used and seeding of permanent vegetation at the

appropriate time within the next recommended seeding season based on ROW soil will be performed.

- Disturbed soils will be seeded within 6 working days of final grading, weather and soil conditions permitting, unless otherwise required by the applicable regulatory agency, land-owner, or land management agency.
- Seeding rates will be based on PLS rate applications.
- All seed will be used within 12 months of the seed testing date as noted by the manufacturer.
- Legume seed will be treated with an inoculant specific to the species using the manufacturer's recommended rate of inoculant appropriate for the seeding method (broadcast, drill, or hydro).
- A seed drill equipped with a cultipacker will be the preferred seed application apparatus unless written recommendations from an applicable regulatory agency specifies otherwise.
- All broadcast or hydroseeding performed in lieu of drilling will be placed at double the recommended seeding rate. The seedbed will be firmed with a cultipacker or roller in areas where seeding is paced with the broadcast method. In rocky soils or where site conditions may limit the effectiveness of this equipment, other alternatives may be appropriate (e.g., use of a chain drag) to lightly cover the seed after application, as approved by the EI.
- Seed slopes steeper than 30 percent immediately after rough grading if final grading will not occur immediately, weather permitting.

Any seeding conducted after October 15 (late season ROW stabilization activities) will be considered "temporary", or as an "interim stabilization measure", as it may result in poor seed germination and high mortality. Temporary and permanent seed and mulch rates can be found in Section 10.4 of this ECP.

10.4 SEEDING AND MULCHING MIXTURES AND RATES

Temporary Revegetation

After grading and excavation is completed within an area, vegetation will be sown promptly after ceasing earthwork in those areas. Hay, straw mulch, or other similar material will be applied to newly seeded areas to protect against erosion until the vegetation is established. Hay, straw mulch, or other similar material will be applied at a rate of at least 2 tons per acre. Mulch will not be applied in wetland areas. As noted in the previous section, any seeding completed after October 15 will be considered "temporary", or as an "interim stabilization measure", as it may result in poor seed germination and high mortality. Disturbed areas that are final graded between June 1 and August 1 and October 15 and March 15 (of the following year) will be seeded with the temporary seed mixes noted in Table 10.4-1 to ensure quick establishment. Locations that are seeded with temporary seed mixes will be supplemented with the appropriate permanent seed mix, as available, during the seeding date windows of March 15 to June 1 and August 1 to October 15.

Permanent Seeding and Mulching

Topsoil will be replaced prior to permanent stabilization in applicable locations along the Project ROW. Disturbed areas shall be seeded with the appropriate seed mixture, as available, as outlined in Tables 10.4-2 and 10.4-3. Lime and fertilizer will be applied in accordance with soil test recommendations. Hay, straw mulch, or other similar material will be applied at a rate of at least 2 tons per acre, unless otherwise required by applicable regulatory agencies. As previously noted, temporary seed mixes noted in Table 10.4-1 will be applied, as available, to all disturbed areas outside of the noted permanent seed mix windows. The seed mixes noted below were developed from the CT Manual. As

recommended by the CTDEEP, seed mixtures will not be applied to disturbed areas that contain rare plants; these areas will be allowed to revegetate naturally (MacKay 2015).

Table 10.4-1
Temporary Seeding and Mulching

Species	Per Acre	Per 1,000 ft^2	Plant Characteristics
Annual Ryegrass	40 lbs	1 lb	May be added in mixes. Will mow out of most stands
Perennial Ryegrass	40 lbs	1 lb	Use for winter cover. Tolerates cold and low moisture.
Winter Rye	120 lbs	3 lb	Quick germination and heavy spring growth. Dies back in June with little regrowth.
Oats	86 lbs	2 lbs	In northern Connecticut, will winter kill with the first killing frost and may throughout the state in severe winters.
Winter Wheat	120 lbs	3 lbs	Quick germination with moderate growth. Dies back in June with no regrowth.
Millet	20 lbs	0.5 lb	Warm season small grain. Dies with frost in September.
Sudangrass	30 lbs	0.7 lbs.	Tolerates warm temperatures and droughty conditions.
Buckwheat	15 lbs	0.4 lb	Hardy plant that will reseed itself and is good as a green manure crop.
Weeping Lovegrass	5 lbs	0.2 lb	Warm-season perennial. May bunch. Tolerates hot, dry slopes, acid infertile soils. Excellent nurse crop. Usually winter kills.
DOT All Purpose Mix[1]	150 lbs	3.4 lbs	Suitable for all conditions.

Source: CTDEEP 2007.
[1] See Table 10.4-3 for seeding mixture requirements.

Table 10.4-2
Selecting Seed Mix to Match Need for Connecticut

Area to be Seeded	Mixture Number	
	Mowing Desired	Mowing Not Required
Borrow Areas, Roadsides, Dikes, Levees, Pond Banks and other Slopes and Banks	1, 2, 3, 4, 5, 8	5, 6, 7, 8, 9, 10, 11, 12, 16, ***22***
A) Well or excessively drained soil[2]	2	5, 6
B) Somewhat poorly drained soils[2]	2	5, 6, 11
C) Variable drainage soils[2]		

Table 10.4-2
Selecting Seed Mix to Match Need for Connecticut

Area to be Seeded	Mixture Number	
	Mowing Desired	**Mowing Not Required**
Drainage Ditch and Channel Banks A) Well or excessively drained soil[2] B) Somewhat poorly drained soils[2] C) Variable drainage soils[2]	1, 2, 3, 4 2 2	9, 10, 11, 12
Diversions A) Well or excessively drained soil[2] B) Somewhat poorly drained soils[2] C) Variable drainage soils[2]	2, 3, 4 2 2	9, 10, 11
Effluent Disposal	-	5, 6
Gravel Pits[3]	-	26, 27, 28
Gullied and Eroded Areas	-	3, 4, 5, 8, 10, 11, 12
Minespoil and Waste, and other Spoil Banks (If toxic substances and physical properties not limiting)[3]	-	15, 16, 17, 18, 26, 27, 28
Shorelines (Fluctuating water levels)	-	5, 6
Ski Slopes	-	4, 10
Sod Waterways and Spillways	1, 2, 3, 4, 6, 7, 8	1, 2, 3, 4, 6, 7, 8
Sunny Recreation Areas (Picnic areas and playgrounds or driving and archery ranges, natural trails)	1, 2, ***23***	-
Camping and Parking, Nature Trails (shaded)	19, ***21, 23***	-
Sand Dunes (Blowing sand)	25	-

Table 10.4-2
Selecting Seed Mix to Match Need for Connecticut

Area to be Seeded	Mixture Number	
	Mowing Desired	Mowing Not Required
Woodland ARs, Skid Trails and Log Yarding Areas	-	9, 10, 16, ***22***, 26
Lawns and High Maintenance Areas	1, 19, ***21, 29***	-

Source CTDEEP 2007.

[1] The numbers following in these columns refer to seed mixtures in Table 10.4-3. Mixes for shady areas are in bold- italics print (including mixes 20 through 24).

[2] See county soil survey for drainage class. Soil surveys are available from the County Soil and Water Conservation District Office.

[3] Use mix 26 when soil passing a 200 mesh sieve is less than 15 percent of total weight. Use mixes 26 and 27 when soil passing a 200 mesh sieve is between 15 and 20 percent of total weight. Use mixes 26, 27, and 28 when soil passing a mesh sieve is above 20 percent of total weight.

Table 10.4-3
Seed Mixtures for Permanent Seeding for Connecticut

Number	Seed Mixture (Variety)	lbs/acre	lbs/1,000 ft^2
1[5]	Kentucky Bluegrass Creeping Red Fescue (Pennlawn, Wintergreen) Perennial Ryegrass (Norlea, Manhattan)	20 20 5 Total 45	0.45 0.45 0.10 Total 1.00
2[5]	Creeping Red Fescue (Pennlawn, Wintergreen) Redtop (Streeker, Common) Tall Fescue (Kentucky 31) or Smooth Bromegrass (Saratoga, Lincoln)	20 2 20 Total 42	0.45 0.05 0.45 Total 0.95
3[5]	Creeping Red Fescue (Pennlawn, Wintergreen) Bird's-foot Trefoil (Empire, Viking) with inoculant[1] Tall Fescue (Kentucky 31) or Smooth Bromegrass (Saratoga, Lincoln)	20 8 20 Total 48	0.45 0.20 0.45 Total 1.10
4[5]	Creeping Red Fescue (Pennlawn, Wintergreen) or Tall Fescue (Kentucky 31) Redtop (Streeker, Common) Bird's-foot Trefoil (Empire, Viking) with inoculant[1]	20 2 8 Total 30	0.45 0.05 0.20 Total 0.70

Table 10.4-3
Seed Mixtures for Permanent Seeding for Connecticut

Number	Seed Mixture (Variety)	lbs/acre	lbs/1,000 ft^2
5[5]	White Clover Perennial Rye Grass	10 2 Total 12	0.25 0.05 Total 0.30
6[5]	Creeping Red Fescue Redtop (Streeker, Common) Perennial Rye Grass	20 2 20 Total 42	0.50 0.05 0.50 Total 1.05
7[5]	Smooth Bromegrass (Saratoga, Lincoln) Perennial Ryegrass (Norleas, Manhattan) Bird's-foot Trefoil (Empire, Viking) with inoculant[1]	15 5 10 Total 30	0.35 0.10 0.25 Total 0.70
8[6]	Switchgrass (Blackwell, Shelter, Cave-in-Rock) Weeping Lovegrass Little Bluestem (Blaze, Aldous, Camper)	10[1] 3 10[1] Total 23	0.25 0.07 0.25 Total 0.57
9[5]	Creeping Red Fescue (Pennlawn, Wintergreen) Redtop (Streeker, Common) Crown Vetch (Chemung, Penngift) with inoculant[1] (or Flatpea [Lathco] with inoculant)[1] Tall Fescue (Kentucky 31) or Smooth Bromegrass (Saratoga, Lincoln) Redtop (Streeker, Common)	10 15 (30) 15 2 Total 42 (or 57)	0.25 0.35 (0.75) 0.35 0.05 Total 1.00 (or 1.40)
10[5]	Creeping Red Fescue (Pennlawn, Wintergreen) Redtop (Streeker, Common) Crown Vetch (Chemung, Penngift) with inoculant[1] (or Flatpea (Lathco) with inoculant[1])	20 2 15 (30) Total 37 (or 52)	0.45 0.05 0.35 (0.75) Total 0.85 (or 1.25)
11[5]	Bird's-foot Trefoil (Empire, Viking) with inoculant[1] Crown Vetch (Chemung, Penngift) with inoculant[1] Creeping Red Fescue (Pennlawn, Wintergreen) or Tall Fescue (Kentucky 31) or Smooth Bromegrass (Saratoga, Lincoln)	8 15 20 Total 43	0.20 0.35 0.45 Total 1.00
12[6]	Switchgrass (Blackwell, Shelter, Cave-in-Rock) Perennial Ryegrass (Norlea, Manhattan) Crown Vetch (Chemung, Penngift) with inoculant[1]	101 5 15 Total 45	0.25 0.10 0.35 Total 1.05

Table 10.4-3
Seed Mixtures for Permanent Seeding for Connecticut

Number	Seed Mixture (Variety)	lbs/acre	lbs/1,000 ft^2
13[6]	Crown Vetch (Chemung, Penngift) with inoculant[1] (or Flatpea [Lathco] with inoculant)[1] Switchgrass (Blackwell, Shelter, Cave-in-Rock) Perennial Ryegrass (Norleas, Manhattan)	10 (30) 5[1] 5 Total 20 (or 40)	0.25 (0.75) 0.10 0.10 Total 0.45 (or 0.95)
14[5]	Crown Vetch (Chemung, Penngift) with inoculant[1] (or Flatpea [Lathco] with inoculant)[1] Perennial Ryegrass (Norlea, Manhattan)	15 (30) 10 Total 25 (or 40)	0.35 (0.75) 0.25 Total 0.60 (or 1.00)
15[5]	Switchgrass (Blackwell, Shelter, Cave-in-Rock) Big Bluestem (Niagara, Kaw) or Little Bluestem (Blaze, Aldous, Camper) Perennial Ryegrass (Norlea, Manhattan) Bird's-foot Trefoil (Empire, Viking) with inoculant[1]	5[1] 5[1] 5 5 Total 20	0.10 0.10 0.10 0.10 Total 0.40
16[5]	Tall Fescue (Kentucky 31) Flatpea (Lathco) with inoculant[1]	20 30 Total 50	0.45 0.75 Total 1.20
17[6]	Deer Tongue (Tioga) with inoculant[1] Bird's-foot Trefoil (Empire, Viking) with inoculant[1] Perennial Ryegrass (Norlea, Manhattan)	10[1] 8 3 Total 21	0.25 0.20 0.07 Total 0.52
18[6]	Deer Tongue (Tioga) with inoculant[1] Crown Vetch (Chemung, Penngift) with inoculant[1] Perennial Ryegrass (Norlea, Manhattan)	10[1] 15 3 Total 28	0.25 0.35 0.07 Total 0.67
19[3]	Chewings Fescue Hard Fescue Colonial Bentgrass Bird's-foot Trefoil (Empire, Viking) with inoculant[1] Perennial Ryegrass	35 30 5 10 20 Total 100	0.80 0.70 0.10 0.20 0.50 Total 2.30

Table 10.4-3
Seed Mixtures for Permanent Seeding for Connecticut

Number	Seed Mixture (Variety)	lbs/acre	lbs/1,000 ft^2
20[5]	Deleted due to invasive species		
21[5]	Creeping Red Fescue (Pennlawn, Wintergreen)	Total 60	Total 1.35
22[5]	Creeping Red Fescue (Pennlawn, Wintergreen) Tall Fescue (Kentucky 31)	40 20 Total 60	0.90 0.45 Total 1.35
23[5]	Creeping Red Fescue (Pennlawn, Wintergreen) Flatpea (Lathco) with inoculant[1]	15 30 Total 45	0.35 0.75 Total 1.35
24[5]	Tall Fescue (Kentucky 31)	Total 150	Total 3.60
25[5]	American Beachgrass (Cape)	58,500 culms/acre	1,345 culms/100 ft^2.
26[6]	Switchgrass (Blackwell, Shelter, Cave-in-Rock) Big Bluestem (Niagara, Kaw) Little Bluestem (Blaze, Aldous, Camper) Sand Lovegrass (NE-27, Bend) Bird's-foot Trefoil (Empire, Viking)	4.0 4.0 2.0 1.5 2.0 Total 13.5	0.10 0.10 0.05 0.03 0.05 Total 0.33
27[5]	Flatpea (Lathco) Perennial Pea (Lancer) Crown Vetch (Chemung, Penngift) Tall Fescue (Kentucky 31)	10 2 10 2 Total 24	0.20 0.05 0.20 0.20 Total 0.65
28[5]	Orchardgrass (Pennlate, Kay, Potomac) Tall Fescue (Kentucky 31) Redtop (Streeker, Common) Bird's-foot Trefoil (Empire, Viking)	5 10 2 2 Total 22	0.10 0.20 0.05 0.10 Total 0.45

Table 10.4-3
Seed Mixtures for Permanent Seeding for Connecticut

Number	Seed Mixture (Variety)	lbs/acre	lbs/1,000 ft^2
29	Turf Type Tall Fescue (Bonanza, Mustang, Rebel II, Spartan, Jaguar) or Perennial Rye ("Future 2000" mix; Fiesta II, Blazer II, and Dasher II)	175 to 250	6 to 8

Source: CTDEEP 2007.

[1] Use proper inoculant for legume seeds, use four times recommended rate when hydroseeding.

[2] Use Pure Live Seed (PLS) = Percent germination X-percent purity / 100

Example: Common Bermuda seed with 70 percent germination and 80 percent purity.

70 x 80 or 56 or 56 percent
100 100
10 lbs PLS/acre 17.9 lbs/acre of bagged seed
56 percent

[3] DOT All-purpose mix.

[4] Wild flower mix containing New England aster, baby's breath, black eye Susan, catchfly, dwarf columbine, purple coneflower, lance-leaved coreopsis, cornflower, ox-eye daisy, scarlet flax, foxglove, gayfeather, rocky larkspur, Spanish larkspur, corn poppy, spurred snapdragon, wallflower and/or yarrow may be added to any seed mix given. Most seed suppliers carry a wild flower mixture that is suitable for the Northeast and contains a variety of both annual and perennial flowers. Seeding rates for the specific mixtures should be followed.

[5] Considered to be a cool season mix.

[6] Considered to be a warm season mix.

11.0 POST-CONSTRUCTION ACTIVITIES

11.1 MONITORING

Tennessee will conduct follow-up inspections of disturbed areas after the first and second growing seasons (normally months 3 to 9 and months 15 to 21 after seeding, respectively) to determine the success of revegetation in upland and agricultural areas. Monitoring in wetland areas will be completed annually for the first 3 years after construction or until wetland revegetation is successful. At the end of 3 years after construction, a report will be filed with the Secretary identifying the status of the wetland revegetation efforts.

11.1.1 Agricultural Areas

In agricultural areas, revegetation shall be considered successful when upon visual survey, crop growth and vigor are similar to adjacent undisturbed portions of the same field, unless the easement agreement specifies otherwise. Monitoring will be performed by Tennessee for not less than two seasons following the completion of initial restoration. Tennessee will continue to monitor and correct problems with topsoil replacement, soil-profile compaction, rocks, drainage and irrigation systems resulting from pipeline construction in active agricultural areas until restoration is determined successful.

Restoration will be considered successful if the ROW surface condition, including the topsoil and the horizon of the upper subsoil, is similar to adjacent undisturbed lands, construction debris is removed (unless requested otherwise by the land-owner or land managing agency), revegetation is successful, and proper drainage for agricultural land, including the mitigation of ROW water boils and saturation, has been restored. Chronic water boils or areas of field saturation influenced by pipeline trenching can be mitigated either by follow-up monitoring and installation of interceptor drain tiles or the implementation of a well-planned system of permanent sandbag trench breakers designed to handle the varieties of slope. These measures will help avoid serious hydrology issues and make the mitigation of field saturation easier to manage.

11.1.2 Upland Areas (Non-Agricultural)

Revegetation in non-agricultural areas will be considered successful if upon visual survey the density and cover of non-invasive vegetation (or crops in cultivated cropland) is similar in density and cover to adjacent undisturbed lands. Revegetation efforts will be continued until revegetation is determined successful. The EI will recommend a course of action for noxious weed control measures and the need for additional restoration measures.

11.1.3 Wetland Areas

Tennessee will monitor wetland revegetation efforts annually for the first 3 years after construction or until wetland revegetation is determined successful. Annual reports will continue to be filed until wetland revegetation is determined successful. Revegetation will be considered successful if the cover of herbaceous and/or woody species is at least 80 percent of the type, density, and distribution of the vegetation in adjacent wetland areas that were not disturbed by construction. Tennessee will develop and implement, in consultation with a professional wetland ecologist and/or applicable regulatory agencies, as needed, a plan to revegetate the wetland with native wetland species if an area is not showing signs of re-establishing native wetland plant communities subsequent to the third growing season following construction. Tennessee will incorporate any wetland monitoring measures required by applicable regulatory agencies in addition to those outlined above.

11.2 ROUTINE ROW MAINTENANCE

Tennessee will be responsible for maintenance of the ROW. For the majority of its system, Tennessee maintains its easements by mechanical means (i.e., tractor with mower or brush hog). Routine vegetation maintenance clearing may be performed on a frequency of approximately once every 3 years. However, to facilitate periodic surveys and emergency access, Tennessee may maintain a 10-foot corridor centered over the pipeline as needed.

The as necessary vegetation maintenance will be consistent with the following procedures:

- Vegetation cutting/trimming will be limited to a 10-foot wide area centered on the pipeline.
- In no case will routine vegetation maintenance clearing occur between April 15 and August 1 of any year, unless otherwise approved by applicable regulatory agencies.
- In some instances, as approved by land-owners and regulatory agencies, herbicides may be applied in certain locations (typically at compressor stations or above-ground sites such as valves or pig facilities).

- Herbicides will not be used within 100 feet of a wetland or waterbody, except as specified by the applicable regulatory agency.

The 3-year routine vegetation maintenance clearing procedures will be consistent with the following procedures:

- In upland areas (non-agricultural), the full ROW will be maintained in an herbaceous state.
- Trees will be cut, trimmed, and/or removed from within the permanent ROW down to their stumps;
- Maintenance within agricultural lands will consist of removing all trees from the permanent ROW. In actively cultivated or specialty crop areas, Tennessee will maintain the permanent ROW in accordance with land owner and/or land management agency written agreements.
- In wetland areas, routine vegetation cutting/trimming will be limited to a 10-foot wide area centered on the pipeline.
- In wetland areas, trees within 15 feet of the pipeline that are greater than 15 feet in height will be selectively cut and removed from the permanent ROW. Buffers of undisturbed areas will be maintained 25 feet beyond the limits of wetland;
- Vegetation maintenance clearing adjacent to waterbodies will be limited to allow a riparian strip of at least 25 feet wide, as measured from the waterbodies mean high water mark, to permanently revegetate with native plant species across the entire construction ROW. Trees within 15 feet of the pipeline that are greater than 15 feet in height will be selectively cut and removed from the permanent ROW adjacent to waterbodies.

11.3 REPORTING

Tennessee will maintain records that identify by MPs:

- Method of application, application rate, and type of fertilizer, pH modifying agent, seed, and mulch used;
- Acreage treated;
- Dates of backfilling and seeding;
- Names of land-owners requesting special seeding treatment and a description of the follow-up actions;
- The location of any subsurface drainage repairs or improvements made during restoration; and
- Any problem areas and how they were addressed.

Tennessee will file with the Secretary quarterly activity reports documenting the results of follow-up inspections, any problem areas, including those identified by the land-owner, and corrective actions taken for at least 2 years following construction in upland and agricultural lands.

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

11.4 OFF-ROAD VEHICLE CONTROL

Tennessee will use one or more of the following measures in cooperation with the land-owner, if warranted or required, to control off-road vehicles:

- Posting, as necessary, appropriate signage;
- Installing a locking gate with fencing to prevent bypassing of the gate;
- In extremely sensitive areas, planting conifers or other appropriate shallow-rooted trees and/or shrubs across the ROW except where access is required for Tennessee's use. The spacing of trees and/or shrubs and length of ROW planted will make a reasonable effort to prevent unauthorized vehicle access and screen the ROW from view. A gate may be used in conjunction with the screening. This method will be used only when reflected on site-specific plans or other specifications; or
- Installing a barrier across the ROW consisting of slash and timber, piping, a line of boulders or a combination thereof.

Signs, gates, and marker posts will be maintained as necessary.

12.0 ECP MODIFICATIONS TO THE FERC PLAN AND PROCEDURES

This section outlines the Connecticut-specific modifications to FERC's Plan and Procedures that are being proposed as part of the Project. Tennessee has included modifications that have been incorporated Project-wide (noted below in italics) into Tennessee's Plan and Procedures (Attachments N13 and N14, respectively).

12.1 UPLAND EROSION CONTROL, REVEGETATION, AND MAINTENANCE PLAN

1. *Silt fence, staked hay, straw bales, and sand bags 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 supersedes the Commission's Plan (Section IV.F.1.a).*

12.2 WETLAND AND WATERBODY CONSTRUCTION AND MITIGATION PROCEDURES

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. *Areas of workspace greater than 75 feet wide within wetlands are identified in Table 2.3-12 of Resource Report 2 of the ER. Justification for including workspace greater than 75 feet within wetlands also is provided in the table per Commission's Procedure (Section VI.A.3).*
3. *Tennessee acknowledges that the Project will require certain ATWS to be located within 50 feet of waterbodies and wetlands. Tennessee has provided site-specific locations of these ATWS and justifications per the Commission's Procedures (Section V.B.2and VI.B.1.a) in Resource Report 8 of the ER.*
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).

5. Tennessee proposes to restore wetlands with seed and mulch in accordance with CTDEEP or other applicable regulatory agencies. Seed mixes, mulching type, and application rates are in Section 10.0 of this ECP (Procedures VI.C.5).

13.0 REFERENCES

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

ATTACHMENT N1

AERIAL ALIGNMENT SHEETS

Included Under Separate Cover

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

ATTACHMENT N2

TYPICAL CONSTRUCTION DRAWINGS

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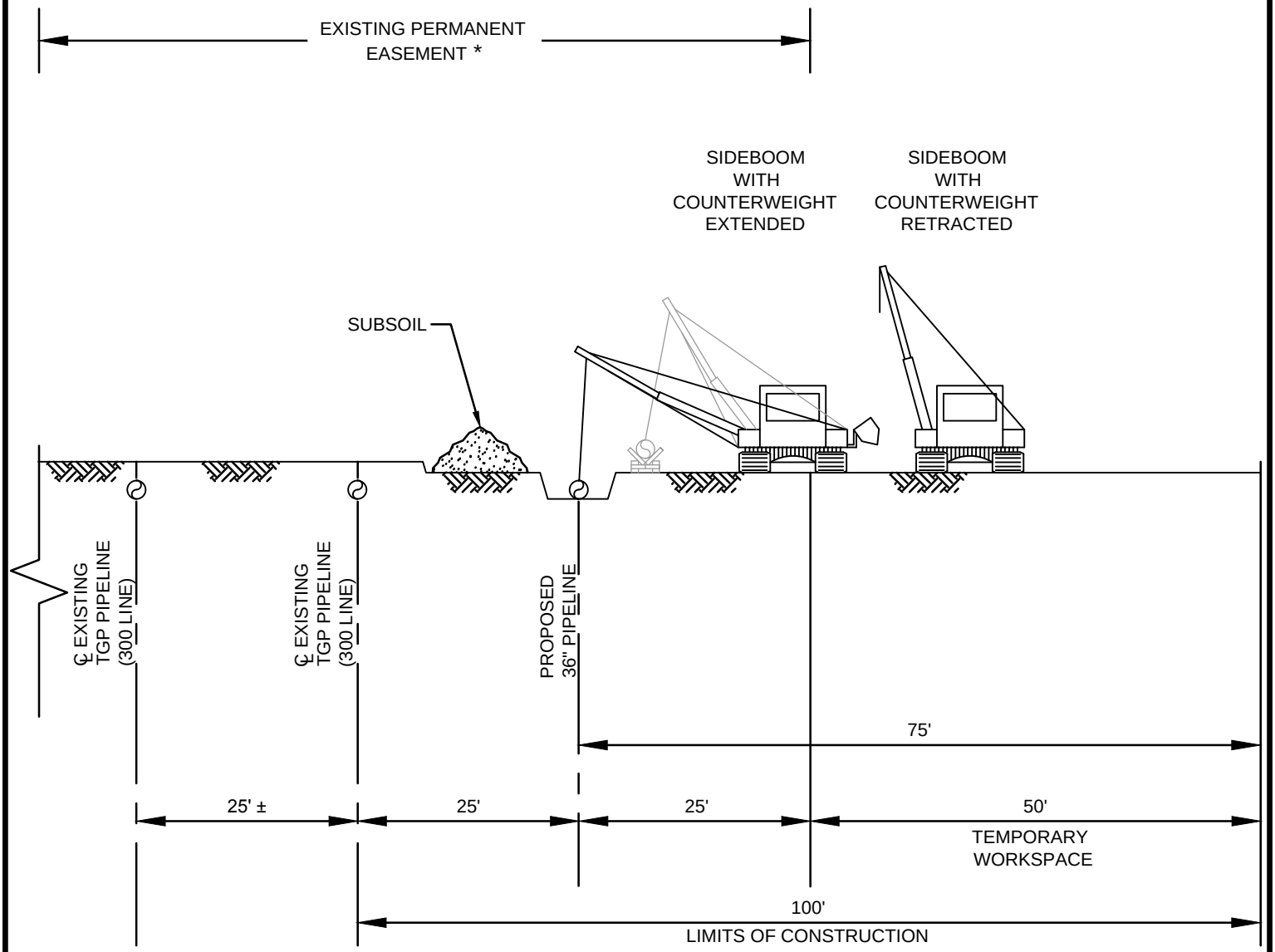

PROFILE
(NOT TO SCALE)

NOTES:

1. CONSTRUCTION RIGHT-OF-WAY WILL TYPICALLY BE 100 FEET WIDE CONSISTING OF 50 FEET OF EXISTING PERMANENT EASEMENT AND 50 FEET OF TEMPORARY WORKSPACE. ADDITIONAL TEMPORARY WORKSPACE (ATWS) WILL BE NECESSARY AT MAJOR ROADS, RAILROADS, RIVER CROSSINGS AND OTHER SPECIAL CIRCUMSTANCES, AS REQUIRED. CERTAIN SITUATIONS MAY REQUIRE A NARROWER WIDTH.
2. ADD 25 FEET OF ATWS ON WORKING SIDE (TYPICALLY) FOR TOPSOIL STORAGE IN AGRICULTURAL FIELDS, RESIDENTIAL YARDS, AND AS PER LANDOWNER AGREEMENTS.
3. LEAVE GAPS IN SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH UPLAND SOILS INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING. AVOID SCALPING VEGETATED GROUND SURFACE WHEN BACKFILLING TOPSOIL AND SPOIL PILES.
4. THE OFFSET FROM AN EXISTING TGP PIPELINE, WHERE APPLICABLE, WILL BE 25 FEET, BUT MAY BE INCREASED OR DECREASED DEPENDING ON THE SITE SPECIFIC CONSTRUCTION REQUIREMENTS.

* EXISTING PERMANENT EASEMENT VARIES BASED ON EXISTING PROPERTY RIGHTS.

NO	DATE	BY	DESCRIPTION	PROJ. ID	APPR.

REVISIONS

ENG. RECORD		DATE
DRAWN BY:	HMM	04/2015
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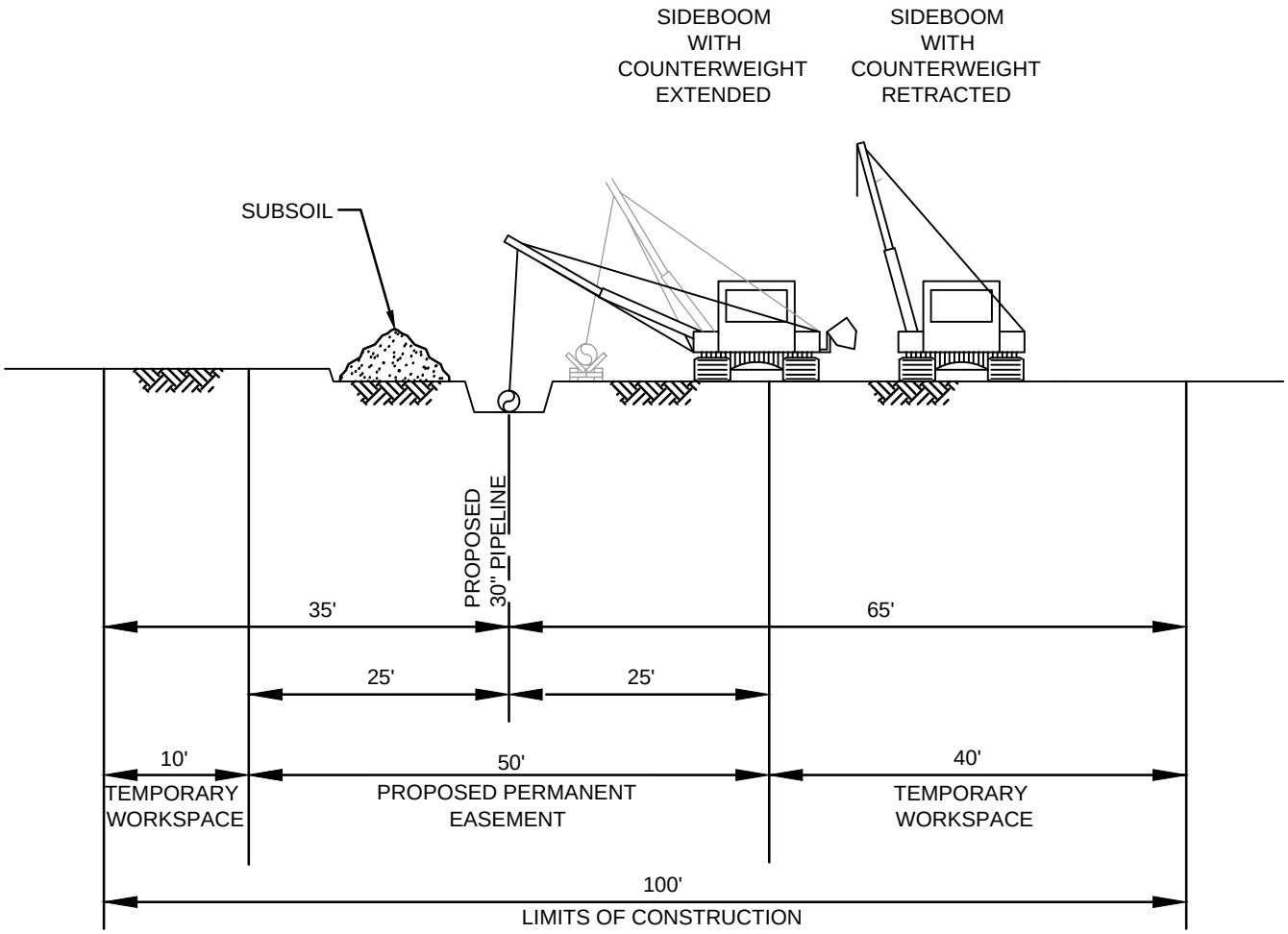
PROJECT APPROVAL		
SURVEY DATE:		
SCALE: N.T.S.		
PROJECT ID:		
FILE NAME:		

100' CORRIDOR PARALLEL TO EXISTING TGP 300 LINE

DWG. NO. ROW-CONFIG_01



PROFILE
(NOT TO SCALE)

NOTES:

1. CONSTRUCTION RIGHT-OF-WAY WILL TYPICALLY BE 100 FEET WIDE CONSISTING OF 50 FEET OF PROPOSED PERMANENT EASEMENT AND 50 FEET OF TEMPORARY WORKSPACE. ADDITIONAL TEMPORARY WORKSPACE (ATWS) WILL BE NECESSARY AT MAJOR ROADS, RAILROADS, RIVER CROSSINGS AND OTHER SPECIAL CIRCUMSTANCES, AS REQUIRED. CERTAIN SITUATIONS MAY REQUIRE A NARROWER WIDTH.
2. ADD 25 FEET OF ATWS ON WORKING SIDE (TYPICALLY) FOR TOPSOIL STORAGE IN AGRICULTURAL FIELDS, RESIDENTIAL YARDS, AND AS PER LANDOWNER AGREEMENTS.
3. LEAVE GAPS IN SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH UPLAND SOILS INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING. AVOID SCALPING VEGETATED GROUND SURFACE WHEN BACKFILLING TOPSOIL AND SPOIL PILES.

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SCALE: N.T.S.		
PROJECT ID:		
FILE NAME:		

100' CORRIDOR (GREENFIELD) STANDARD

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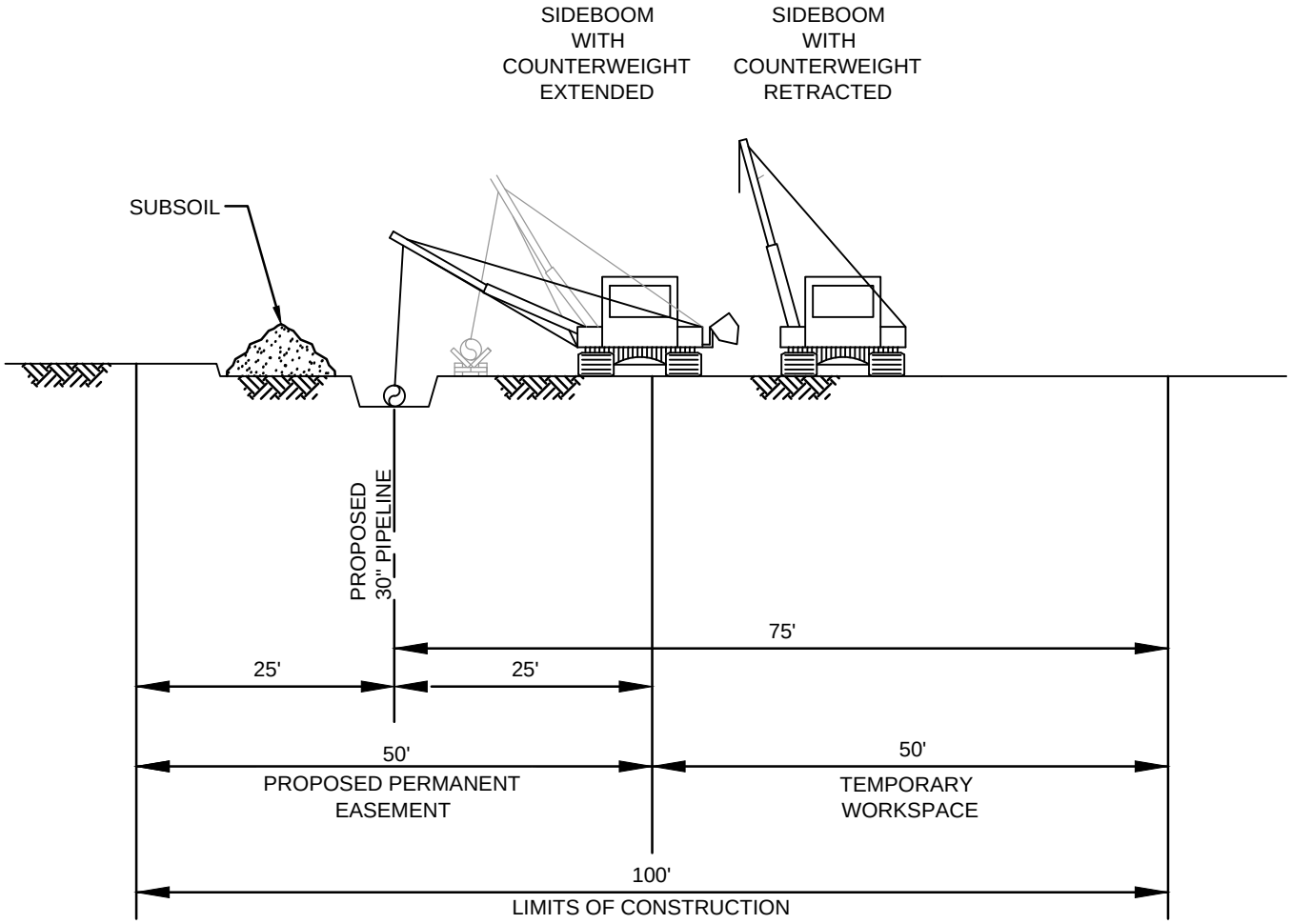

PROFILE
(NOT TO SCALE)

NOTES:

1. CONSTRUCTION RIGHT-OF-WAY WILL TYPICALLY BE 100 FEET WIDE CONSISTING OF 50 FEET OF PROPOSED PERMANENT EASEMENT AND 50 FEET OF TEMPORARY WORKSPACE. ADDITIONAL TEMPORARY WORKSPACE (ATWS) WILL BE NECESSARY AT MAJOR ROADS, RAILROADS, RIVER CROSSINGS AND OTHER SPECIAL CIRCUMSTANCES, AS REQUIRED. CERTAIN SITUATIONS MAY REQUIRE A NARROWER WIDTH.
2. ADD 25 FEET OF ATWS ON WORKING SIDE (TYPICALLY) FOR TOPSOIL STORAGE IN AGRICULTURAL FIELDS, RESIDENTIAL YARDS, AND AS PER LANDOWNER AGREEMENTS.
3. LEAVE GAPS IN SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH UPLAND SOILS INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING. AVOID SCALPING VEGETATED GROUND SURFACE WHEN BACKFILLING TOPSOIL AND SPOIL PILES.

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100' CORRIDOR (GREENFIELD 50/50)

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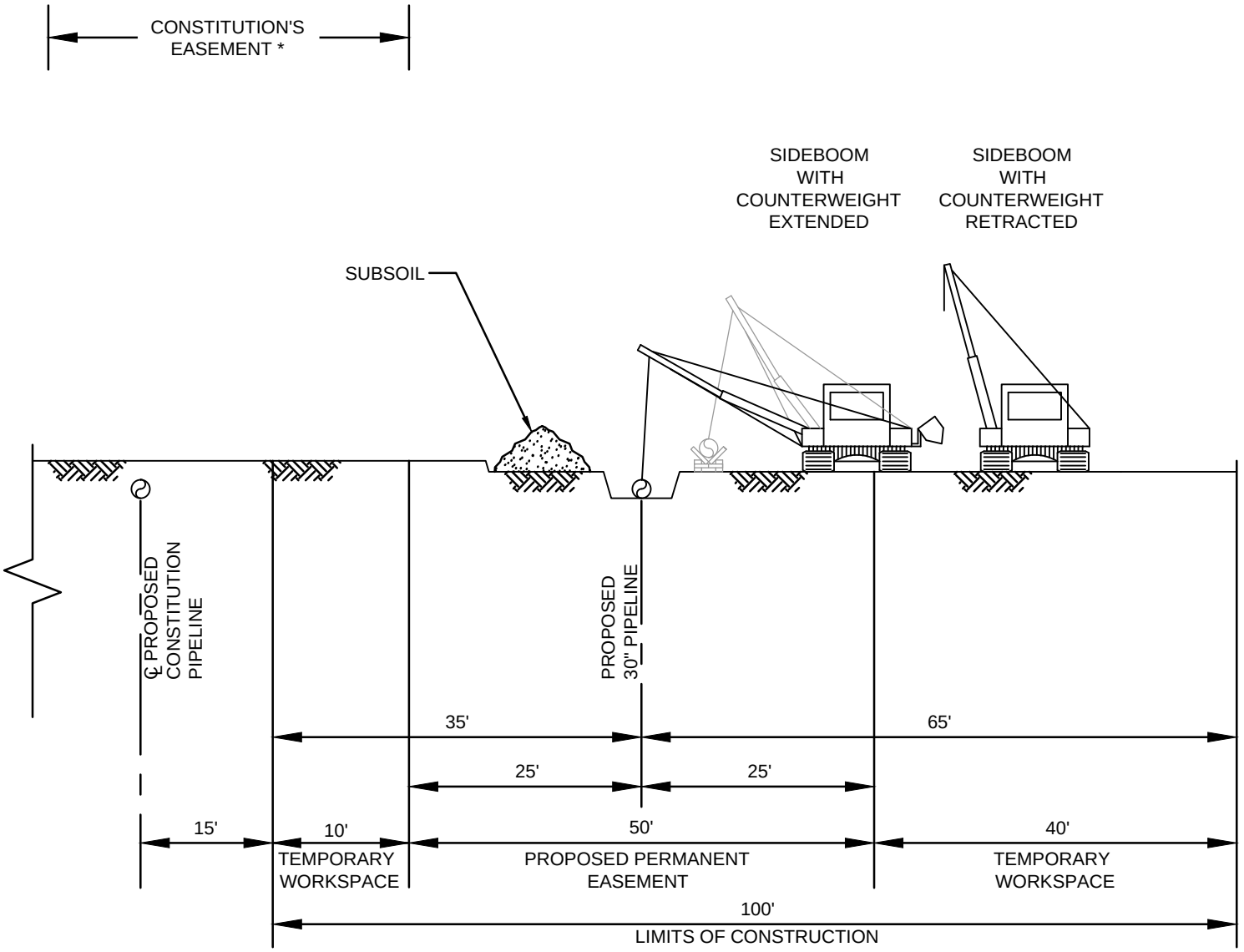

PROFILE
(NOT TO SCALE)

NOTES:

1. CONSTRUCTION RIGHT-OF-WAY WILL TYPICALLY BE 100 FEET WIDE CONSISTING OF 50 FEET OF PROPOSED PERMANENT EASEMENT AND 50 FEET OF TEMPORARY WORKSPACE. ADDITIONAL TEMPORARY WORKSPACE (ATWS) WILL BE NECESSARY AT MAJOR ROADS, RAILROADS, RIVER CROSSINGS AND OTHER SPECIAL CIRCUMSTANCES, AS REQUIRED. CERTAIN SITUATIONS MAY REQUIRE A NARROWER WIDTH.
2. ADD 25 FEET OF ATWS ON WORKING SIDE (TYPICALLY) FOR TOPSOIL STORAGE IN AGRICULTURAL FIELDS, RESIDENTIAL YARDS, AND AS PER LANDOWNER AGREEMENTS.
3. LEAVE GAPS IN SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH UPLAND SOILS INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING. AVOID SCALPING VEGETATED GROUND SURFACE WHEN BACKFILLING TOPSOIL AND SPOIL PILES.
4. THE OFFSET FROM THE PROPOSED CONSTITUTION PIPELINE, WHERE APPLICABLE, WILL BE 50 FEET, BUT MAY BE INCREASED OR DECREASED DEPENDING ON THE SITE SPECIFIC CONSTRUCTION REQUIREMENTS.

* CONSTITUTION'S PROPOSED PERMANENT EASEMENT IS TYPICALLY 50' WIDE CENTERED ON THE CONSTITUTION PIPELINE, BUT MAY VARY.

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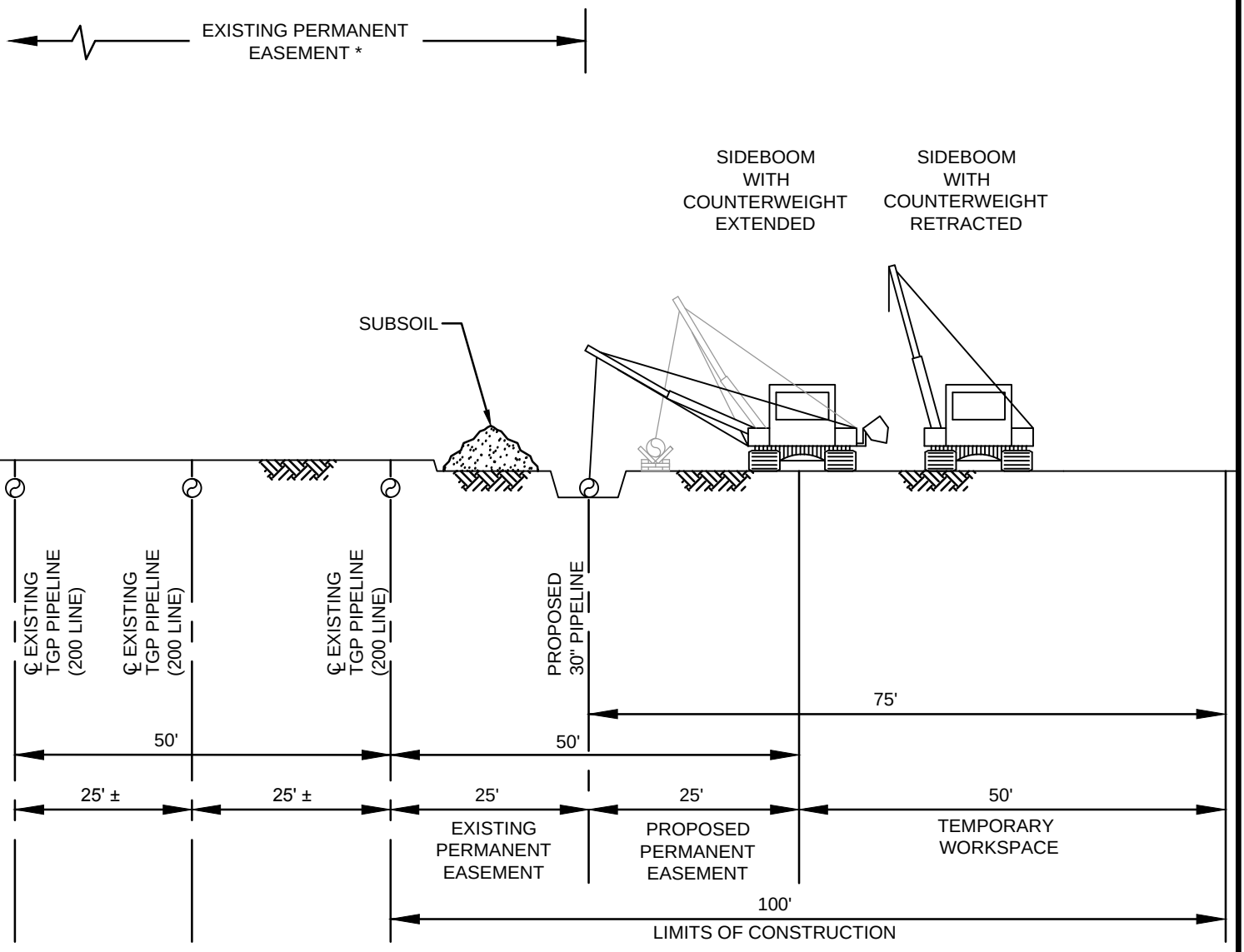
SCALE: N.T.S.		
PROJECT ID:		
FILE NAME:		

100' CORRIDOR PARALLEL TO CONSTITUTION (50' OFFSET)

DWG. NO. ROW-CONFIG_03



PROFILE
(NOT TO SCALE)

NOTES:

1. CONSTRUCTION RIGHT-OF-WAY WILL TYPICALLY BE 100 FEET WIDE CONSISTING OF 25 FEET OF EXISTING PERMANENT EASEMENT, 25 FEET OF PROPOSED PERMANENT EASEMENT, AND 50 FEET OF TEMPORARY WORKSPACE. ADDITIONAL TEMPORARY WORKSPACE (ATWS) WILL BE NECESSARY AT MAJOR ROADS, RAILROADS, RIVER CROSSINGS AND OTHER SPECIAL CIRCUMSTANCES, AS REQUIRED. CERTAIN SITUATIONS MAY REQUIRE A NARROWER WIDTH.
2. ADD 25 FEET OF ATWS ON WORKING SIDE (TYPICALLY) FOR TOPSOIL STORAGE IN AGRICULTURAL FIELDS, RESIDENTIAL YARDS, AND AS PER LANDOWNER AGREEMENTS.
3. LEAVE GAPS IN SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH UPLAND SOILS INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING. AVOID SCALPING VEGETATED GROUND SURFACE WHEN BACKFILLING TOPSOIL AND SPOIL PILES.
4. THE OFFSET FROM EXISTING PIPELINE, WHERE APPLICABLE, WILL BE 25 FEET, BUT MAY BE INCREASED OR DECREASED DEPENDING ON THE SITE SPECIFIC CONSTRUCTION REQUIREMENTS.

* EXISTING PERMANANT EASEMENT VARIES BASED ON EXISTING PROPERTY RIGHTS

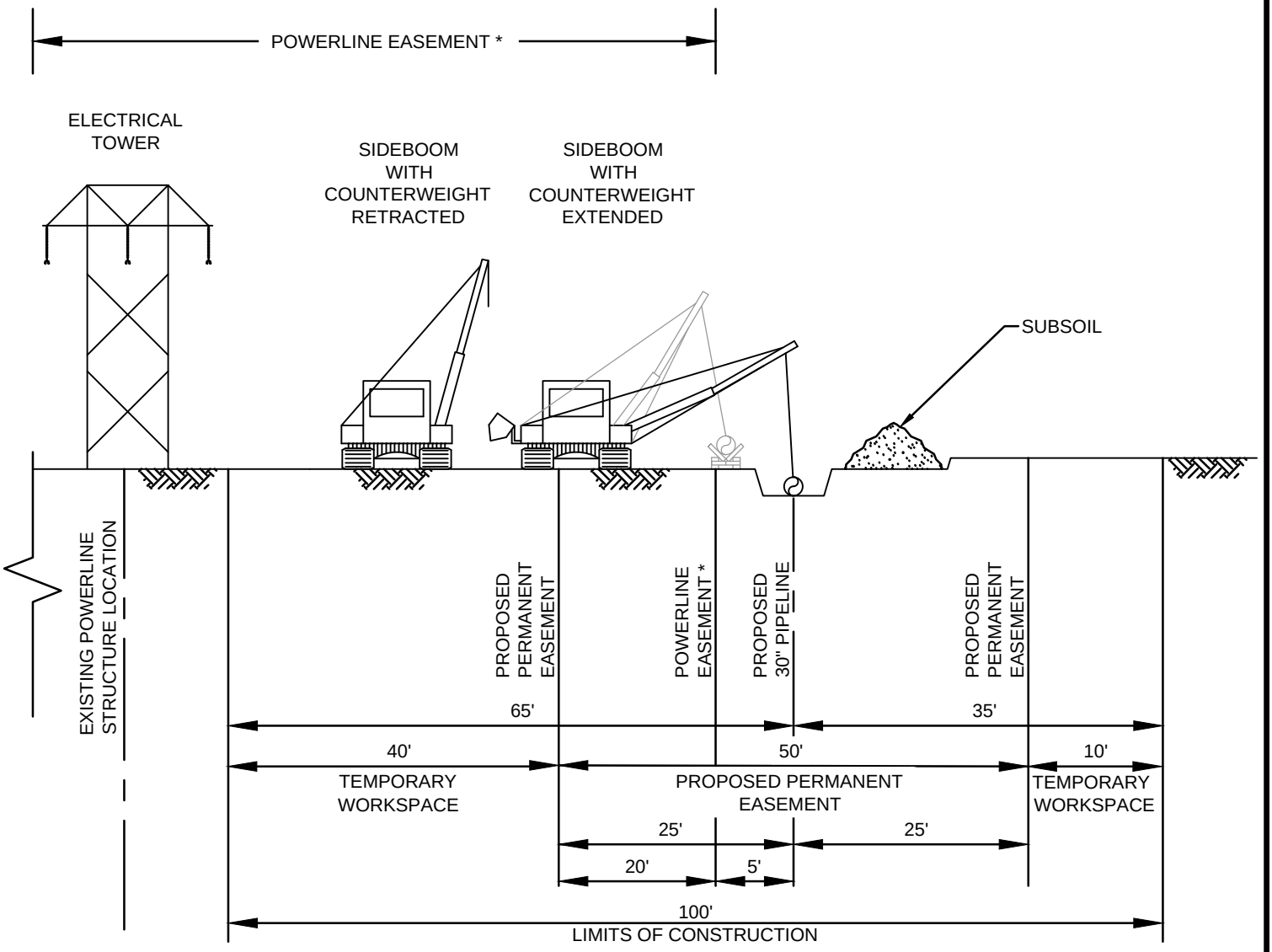
NO	DATE	BY	DESCRIPTION	PROJ. ID	APPR.

REVISIONS

ENG. RECORD		DATE
DRAWN BY:	HMM	02/2015
DRAWING APPROVAL		
PROJECT APPROVAL		
SURVEY DATE:		
SCALE: N.T.S.		
PROJECT ID:		
FILE NAME:		

100' CORRIDOR PARALLEL TO EXISTING TGP LINE

DWG. NO. ROW-CONFIG_04



PROFILE
(NOT TO SCALE)

NOTES:

1. CONSTRUCTION RIGHT-OF-WAY WILL TYPICALLY BE 100 FEET WIDE CONSISTING OF 50 FEET OF PROPOSED PERMANENT EASEMENT (20 FEET OF THE PROPOSED PERMANENT EASEMENT BEING SHARED WITH THE POWERLINE'S EASEMENT) AND 50 FEET OF TEMPORARY WORKSPACE. ADDITIONAL TEMPORARY WORKSPACE (ATWS) WILL BE NECESSARY AT MAJOR ROADS, RAILROADS, RIVER CROSSINGS AND OTHER SPECIAL CIRCUMSTANCES, AS REQUIRED. CERTAIN SITUATIONS MAY REQUIRE A NARROWER WIDTH.
2. ADD 25 FEET OF ATWS ON THE WORKING SIDE (TYPICALLY) FOR TOPSOIL STORAGE IN AGRICULTURAL FIELDS, RESIDENTIAL YARDS, AND AS PER LANDOWNER AGREEMENTS.
3. LEAVE GAPS IN SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH UPLAND SOILS INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING. AVOID SCALPING VEGETATED GROUND SURFACE WHEN BACKFILLING TOPSOIL AND SPOIL PILES.

* EXISTING POWERLINE EASEMENT VARIES BASED ON EXISTING PROPERTY RIGHTS

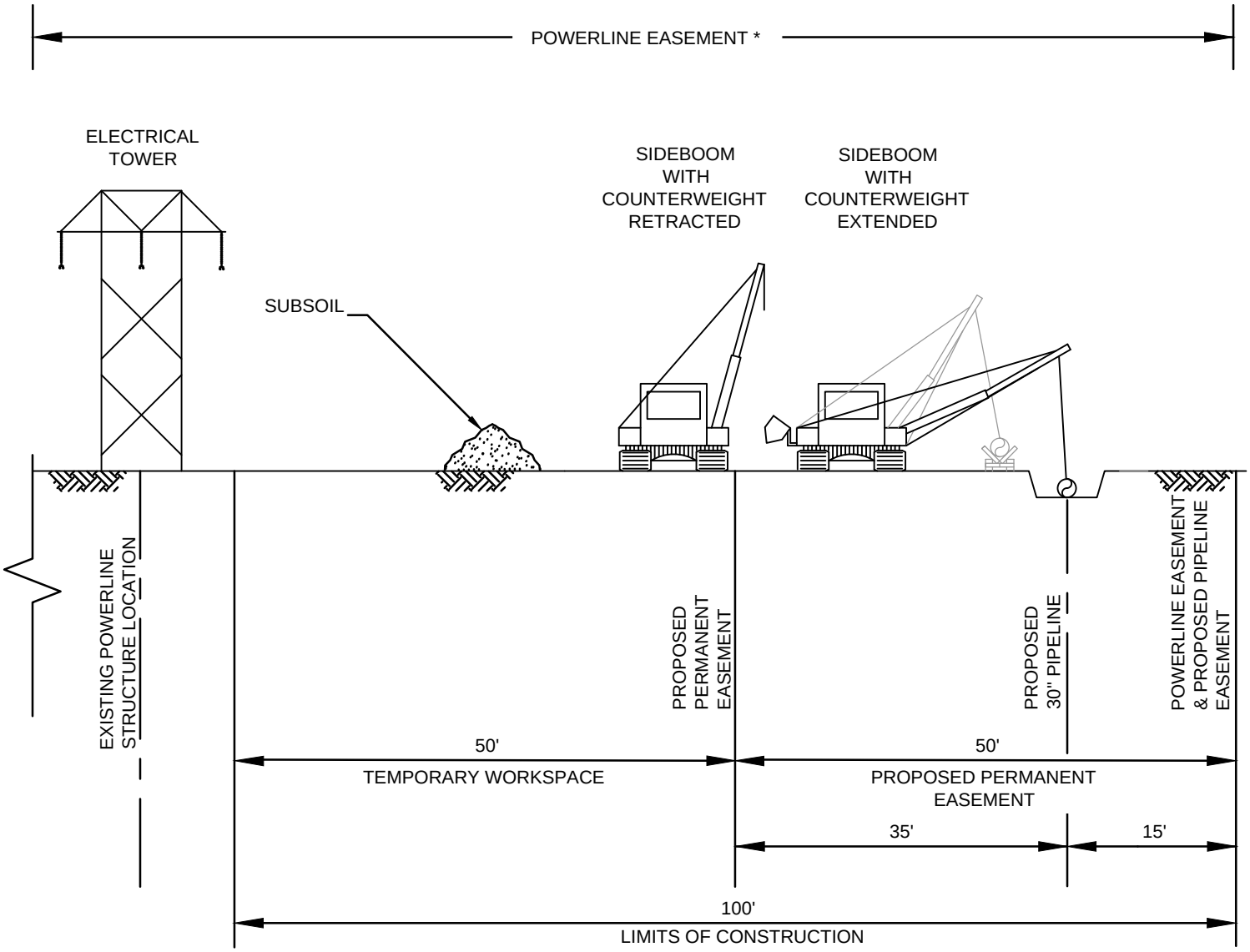
NO	DATE	BY	DESCRIPTION	PROJ. ID	APPR.

REVISIONS

ENG. RECORD		DATE
DRAWN BY:	HMM	04/2015
DRAWING APPROVAL		
PROJECT APPROVAL		
SURVEY DATE:		
SCALE: NONE		
PROJECT ID:		
FILE NAME:		

100 FT. CORRIDOR PIPELINE OUTSIDE POWERLINE EASEMENT FOR 30" PROPOSED PIPELINE

DWG. NO. ROW-CONFIG_05A



PROFILE
(NOT TO SCALE)

NOTES:

1. CONSTRUCTION RIGHT-OF-WAY WILL TYPICALLY BE 100 FEET WIDE CONSISTING OF 50 FEET OF PROPOSED PERMANENT EASEMENT AND 50 FEET OF TEMPORARY WORKSPACE. ADDITIONAL TEMPORARY WORKSPACE (ATWS) WILL BE NECESSARY AT MAJOR ROADS, RAILROADS, RIVER CROSSINGS AND OTHER SPECIAL CIRCUMSTANCES, AS REQUIRED. CERTAIN SITUATIONS MAY REQUIRE A NARROWER WIDTH.
2. ADD 25 FEET OF ATWS ON WORKING SIDE (TYPICALLY) FOR TOPSOIL STORAGE IN AGRICULTURAL FIELDS, RESIDENTIAL YARDS, AND AS PER LANDOWNER AGREEMENTS.
3. LEAVE GAPS IN SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH UPLAND SOILS INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING. AVOID SCALPING VEGETATED GROUND SURFACE WHEN BACKFILLING TOPSOIL AND SPOIL PILES.
4. TYPICAL USED IN LOCATIONS WHERE TERRAIN, STRUCTURES OR OTHER OBSTACLES OBSTRUCT PIPELINE OUTSIDE THE EASEMENT.

* EXISTING POWERLINE EASEMENT VARIES BASED ON EXISTING PROPERTY RIGHTS.

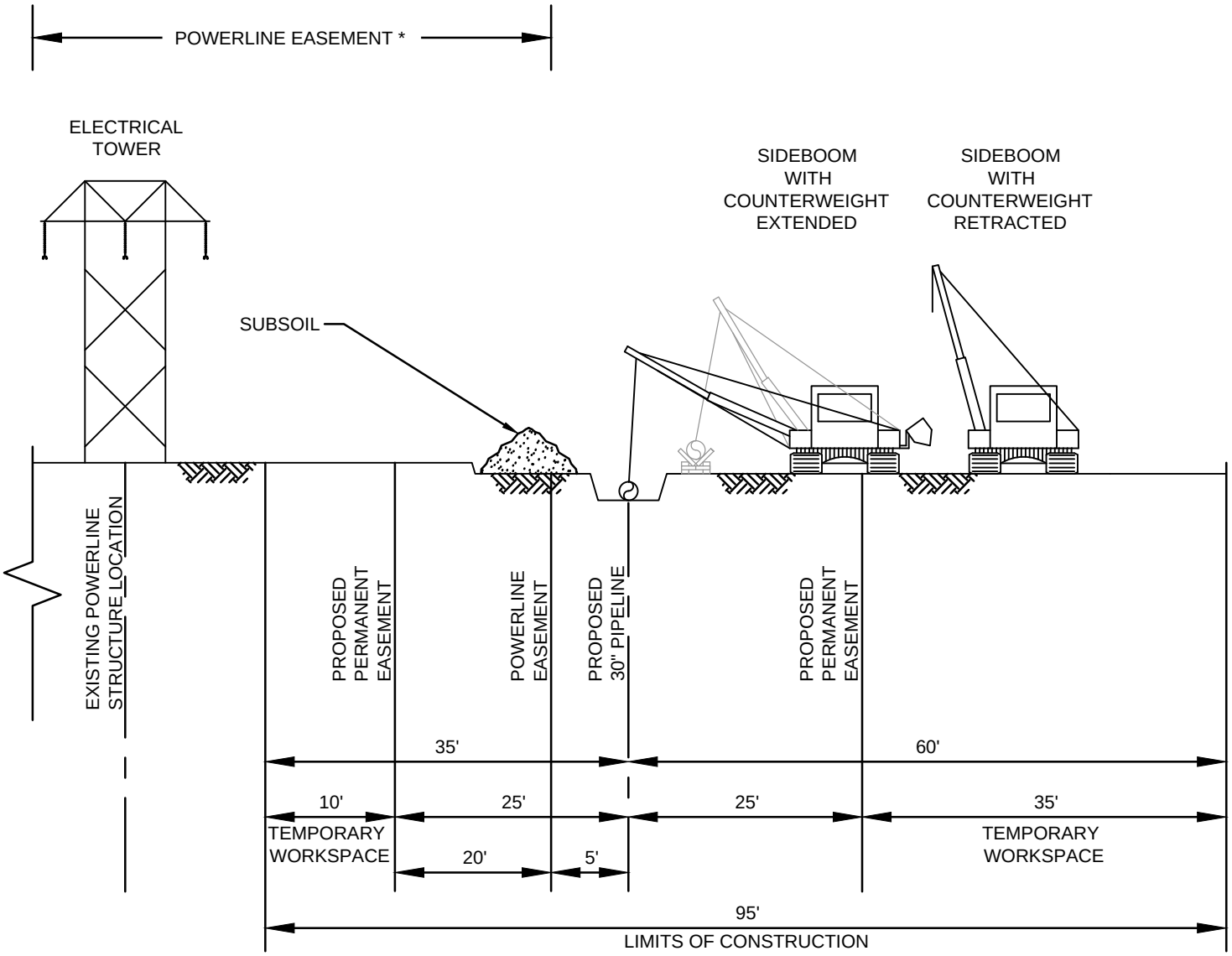
NO	DATE	BY	DESCRIPTION	PROJ. ID	APPR.

REVISIONS

ENG. RECORD		DATE
DRAWN BY:	HMM	04/2015
DRAWING APPROVAL		
PROJECT APPROVAL		
SURVEY DATE:		
SCALE: NONE		
PROJECT ID:		
FILE NAME:		

100 FT. CORRIDOR PIPELINE INSIDE POWERLINE EASEMENT FOR 30" PROPOSED PIPELINE

DWG. NO. ROW-CONFIG_05B



PROFILE
(NOT TO SCALE)

NOTES:

1. CONSTRUCTION RIGHT-OF-WAY WILL TYPICALLY BE 95 FEET WIDE CONSISTING OF 50 FEET OF PROPOSED PERMANENT EASEMENT (20 FEET OF THE PROPOSED PERMANENT EASEMENT BEING SHARED WITH THE POWERLINE'S EASMENT) AND 45 FEET OF TEMPORARY WORKSPACE. ADDITIONAL TEMPORARY WORKSPACE (ATWS) WILL BE NECESSARY AT MAJOR ROADS, RAILROADS, RIVER CROSSINGS AND OTHER SPECIAL CIRCUMSTANCES, AS REQUIRED. CERTAIN SITUATIONS MAY REQUIRE A NARROWER WIDTH.
2. ADD 25 FEET OF ATWS ON WORKING SIDE (TYPICALLY) FOR TOPSOIL STORAGE IN AGRICULTURAL FIELDS, RESIDENTIAL YARDS, AND AS PER LANDOWNER AGREEMENTS.
3. LEAVE GAPS IN SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH UPLAND SOILS INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING. AVOID SCALPING VEGETATED GROUND SURFACE WHEN BACKFILLING TOPSOIL AND SPOIL PILES.

* EXISTING POWERLINE EASEMENT VARIES BASED ON EXISTING PROPERTY RIGHTS

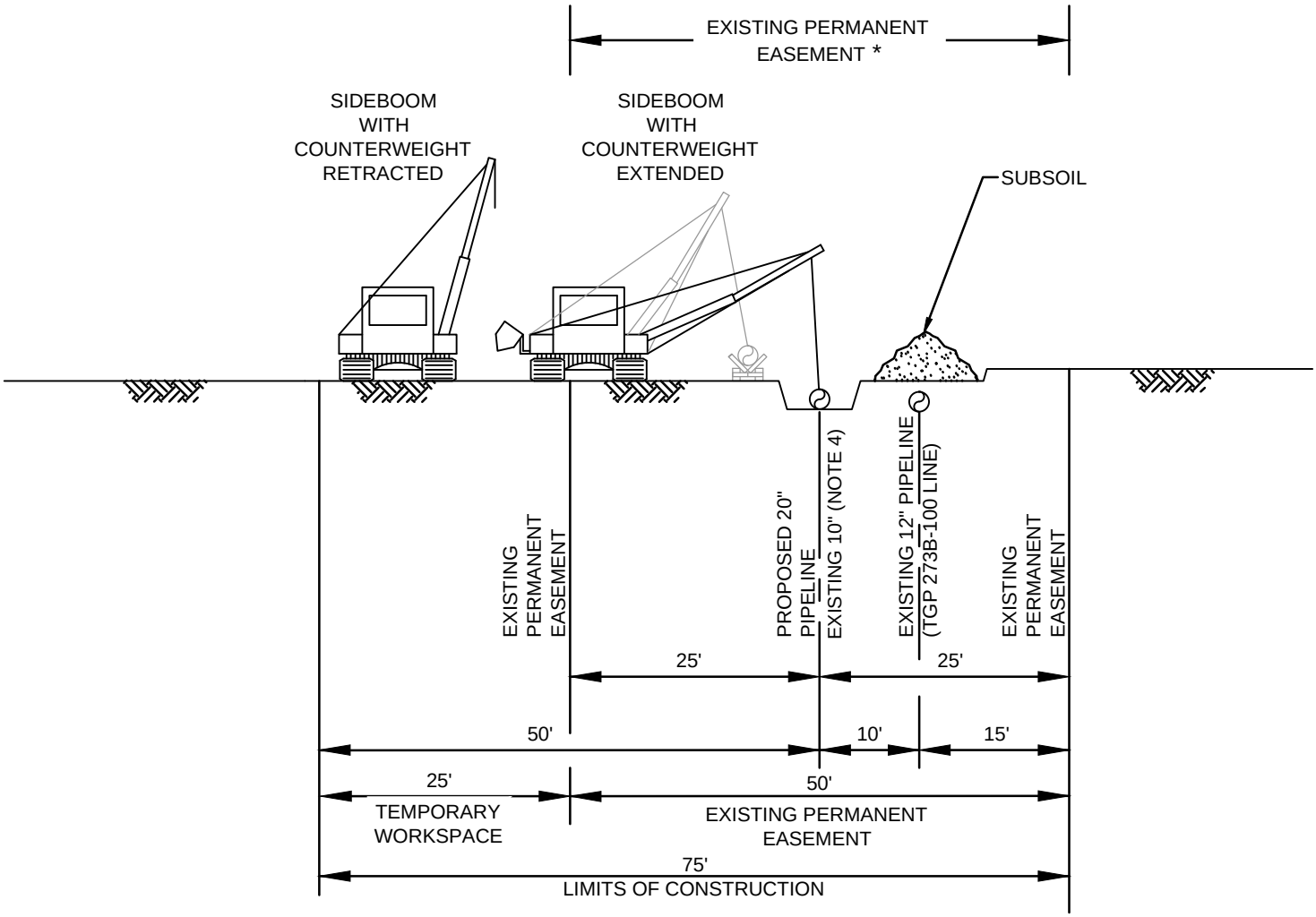
NO	DATE	BY	DESCRIPTION	PROJ. ID	APPR.

REVISIONS

ENG. RECORD		DATE
DRAWN BY:	HMM	04/2015
DRAWING APPROVAL		
PROJECT APPROVAL		
SURVEY DATE:		
SCALE: NONE		
PROJECT ID:		
FILE NAME:		

95 FT. CORRIDOR PIPELINE OUTSIDE POWERLINE EASEMENT FOR 30" PROPOSED PIPELINE

DWG. NO. ROW-CONFIG_06



PROFILE
(NOT TO SCALE)

NOTE:

1. CONSTRUCTION RIGHT-OF-WAY WILL TYPICALLY BE 75 FEET WIDE CONSISTING OF 50 FEET OF EXISTING PERMANENT EASEMENT AND 25 FEET OF TEMPORARY WORKSPACE. ADDITIONAL TEMPORARY WORKSPACE (ATWS) WILL BE NECESSARY AT MAJOR ROADS, RAILROADS, RIVER CROSSINGS AND OTHER SPECIAL CIRCUMSTANCES, AS REQUIRED. CERTAIN SITUATIONS MAY REQUIRE A NARROWER WIDTH.
2. ADD 25 FEET OF ATWS ON WORKING SIDE (TYPICALLY) FOR TOPSOIL STORAGE IN AGRICULTURAL FIELDS, RESIDENTIAL YARDS, AND AS PER LANDOWNER AGREEMENTS.
3. LEAVE GAPS IN SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH UPLAND SOILS INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING. AVOID SCALPING VEGETATED GROUND SURFACE WHEN BACKFILLING TOPSOIL AND SPOIL PILES.
4. A PORTION OF THE EXISTING 10" TGP 270B - 300 PIPELINE WILL BE REMOVED AND REPLACED WITH A PROPOSED 20" PIPELINE.

* EXISTING PERMANENT EASEMENT VARIES BASED ON EXISTING PROPERTY RIGHTS.

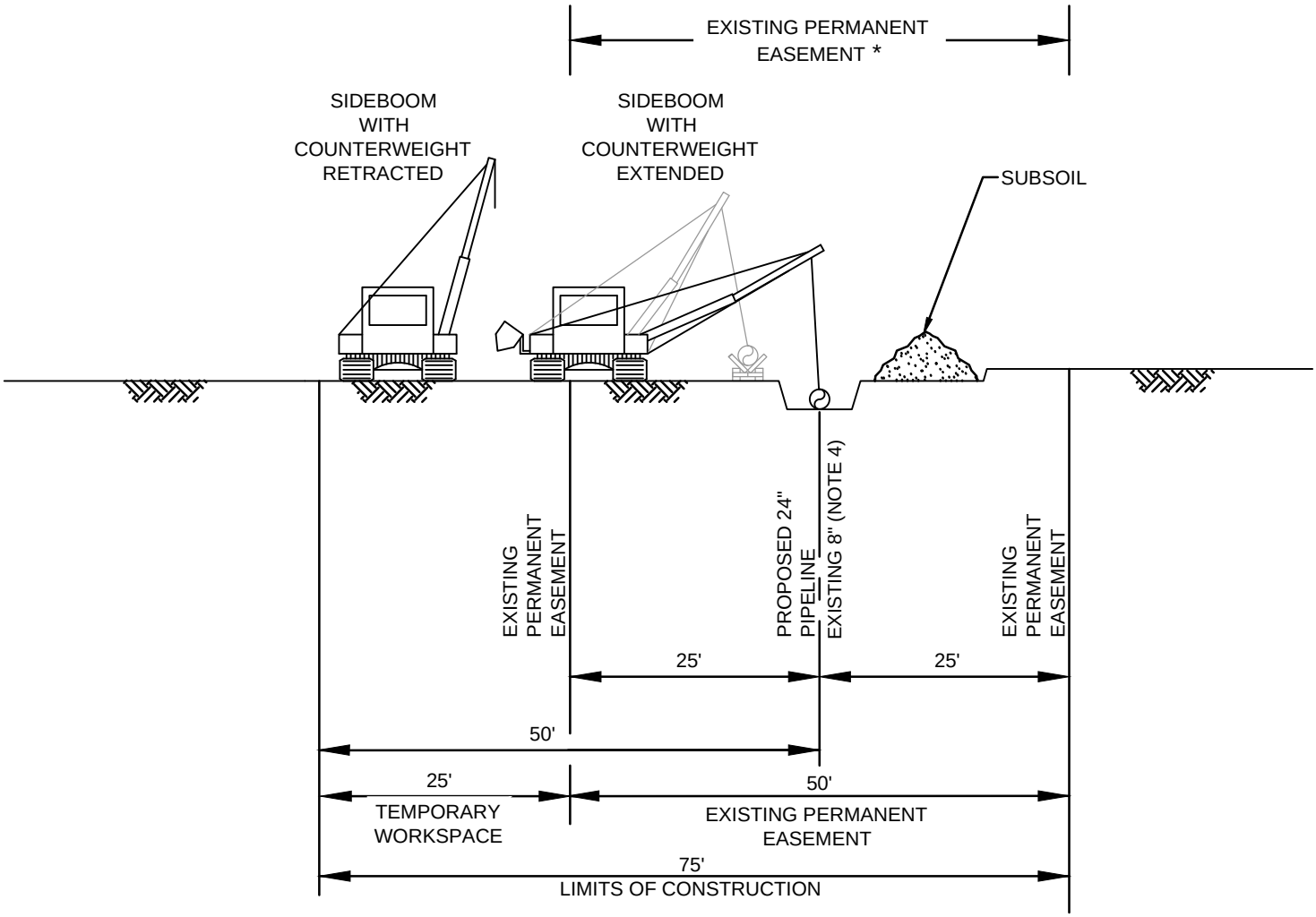
NO	DATE	BY	DESCRIPTION	PROJ. ID	APPR.

REVISIONS

ENG. RECORD		DATE
DRAWN BY:	HMM	04/2015
DRAWING APPROVAL		
PROJECT APPROVAL		
SURVEY DATE:		
SCALE: N.T.S.		
PROJECT ID:		
FILE NAME:		

TAKE-UP & RELAY FOR SEGMENT P 20" PROPOSED PIPELINE

DWG. NO. ROW-CONFIG_07A



PROFILE
(NOT TO SCALE)

NOTE:

1. CONSTRUCTION RIGHT-OF-WAY WILL TYPICALLY BE 75 FEET WIDE CONSISTING OF 50 FEET OF EXISTING PERMANENT EASEMENT AND 25 FEET OF TEMPORARY WORKSPACE. ADDITIONAL TEMPORARY WORKSPACE (ATWS) WILL BE NECESSARY AT MAJOR ROADS, RAILROADS, RIVER CROSSINGS AND OTHER SPECIAL CIRCUMSTANCES, AS REQUIRED. CERTAIN SITUATIONS MAY REQUIRE A NARROWER WIDTH.
2. ADD 25 FEET OF ATWS ON WORKING SIDE (TYPICALLY) FOR TOPSOIL STORAGE IN AGRICULTURAL FIELDS, RESIDENTIAL YARDS, AND AS PER LANDOWNER AGREEMENTS.
3. LEAVE GAPS IN SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH UPLAND SOILS INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING. AVOID SCALPING VEGETATED GROUND SURFACE WHEN BACKFILLING TOPSOIL AND SPOIL PILES.
4. A PORTION OF THE EXISTING 8" TGP 270C - 1000 PIPELINE WILL BE REMOVED AND REPLACED WITH A PROPOSED 24" PIPELINE.

* EXISTING PERMANENT EASEMENT VARIES BASED ON EXISTING PROPERTY RIGHTS.

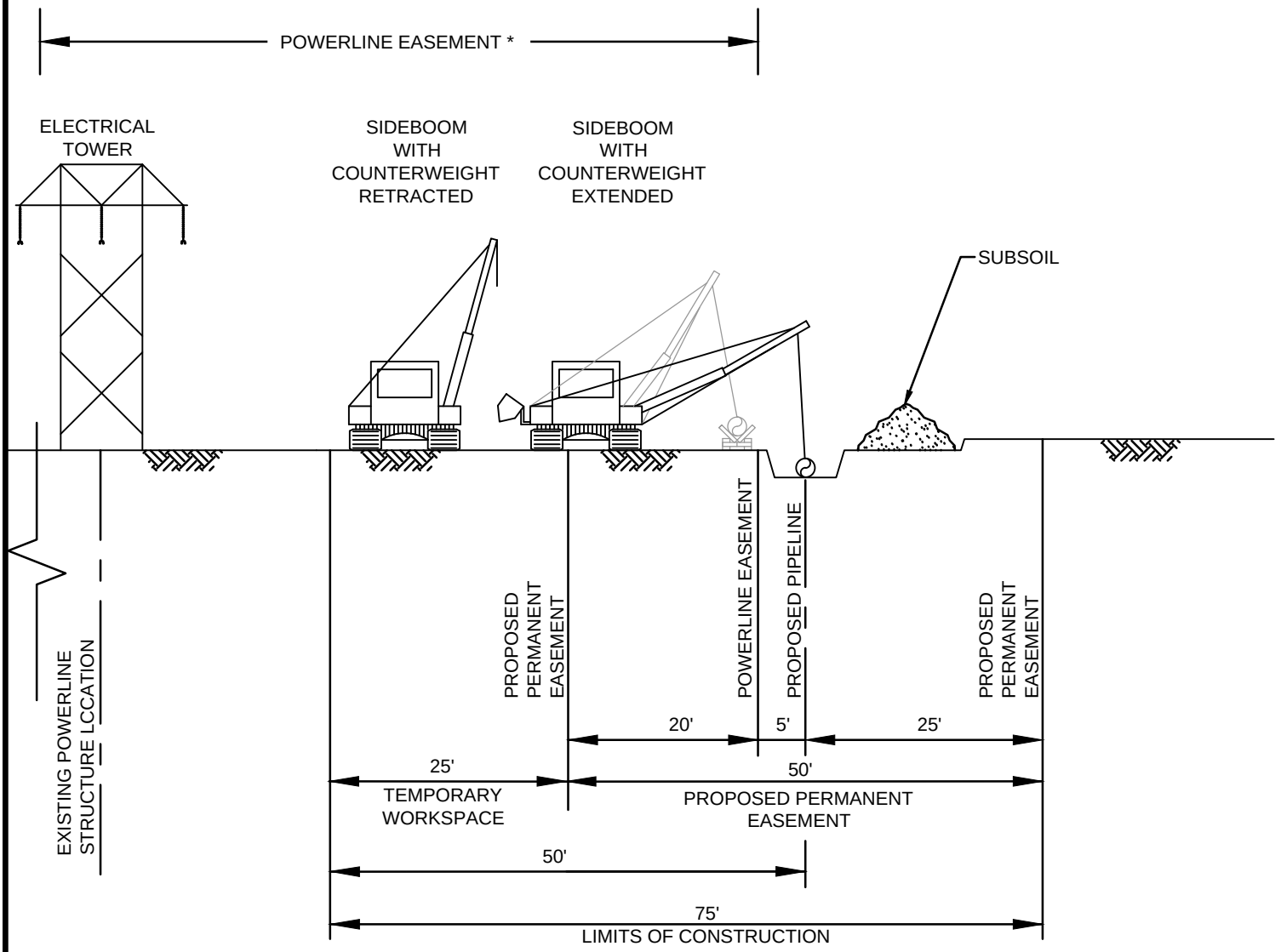
NO	DATE	BY	DESCRIPTION	PROJ. ID	APPR.

REVISIONS

ENG. RECORD		DATE
DRAWN BY:	HMM	04/2015
DRAWING APPROVAL		
PROJECT APPROVAL		
SURVEY DATE:		
SCALE: N.T.S.		
PROJECT ID:		
FILE NAME:		

TAKE-UP & RELAY FOR SEGMENT O 24" PROPOSED PIPELINE

DWG. NO. ROW-CONFIG_07B



PROFILE
(NOT TO SCALE)

NOTES:

1. CONSTRUCTION RIGHT-OF-WAY WILL TYPICALLY BE 75 FEET WIDE CONSISTING OF 50 FEET OF PROPOSED PERMANENT EASEMENT (20 FEET OF THE PROPOSED PERMANENT EASEMENT BEING SHARED WITH THE POWERLINE EASEMENT) AND 25 FEET OF TEMPORARY WORKSPACE. ADDITIONAL TEMPORARY WORKSPACE (ATWS) WILL BE NECESSARY AT MAJOR ROADS, RAILROADS, RIVER CROSSINGS AND OTHER SPECIAL CIRCUMSTANCES, AS REQUIRED. CERTAIN SITUATIONS MAY REQUIRE A NARROWER WIDTH.
2. ADD 25 FEET OF ATWS ON WORKING SIDE (TYPICALLY) FOR TOPSOIL STORAGE IN AGRICULTURAL FIELDS, RESIDENTIAL YARDS, AND AS PER LANDOWNER AGREEMENTS.
3. LEAVE GAPS IN SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH UPLAND SOILS INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING. AVOID SCALPING VEGETATED GROUND SURFACE WHEN BACKFILLING TOPSOIL AND SPOIL PILES.

* EXISTING POWERLINE EASEMENT VARIES BASED ON EXISTING PROPERTY RIGHTS.

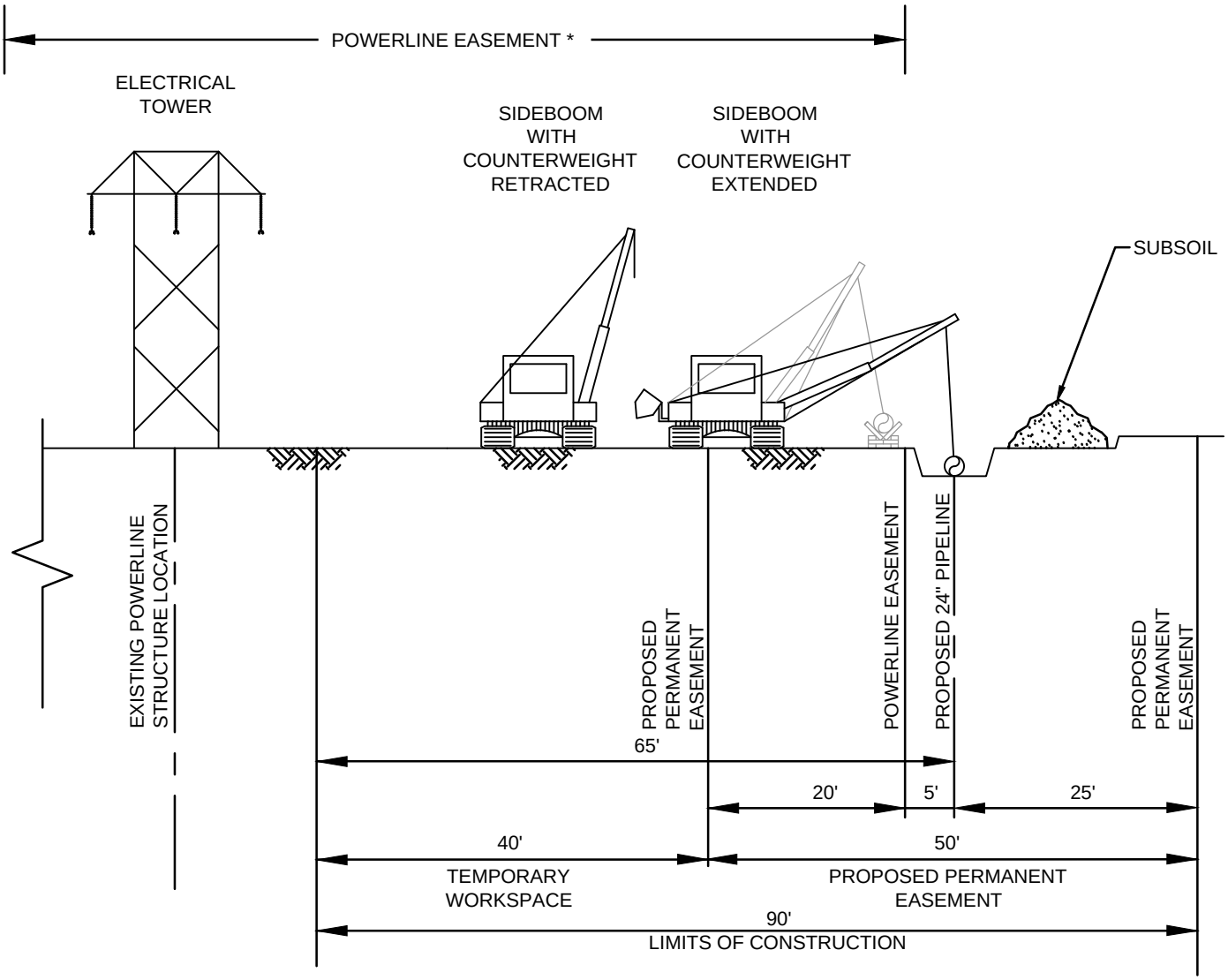
NO	DATE	BY	DESCRIPTION	PROJ. ID	APPR.

REVISIONS

ENG. RECORD		DATE
DRAWN BY:	HMM	04/2015
DRAWING APPROVAL		
PROJECT APPROVAL		
SURVEY DATE:		
SCALE: N.T.S.		
PROJECT ID:		
FILE NAME:		

75' CORRIDOR PIPELINE OUTSIDE POWERLINE EASEMENT FOR 12" PROPOSED PIPELINE

DWG. NO. ROW-CONFIG_08



PROFILE
(NOT TO SCALE)

NOTE:

1. CONSTRUCTION RIGHT-OF-WAY WILL TYPICALLY BE 90 FEET WIDE CONSISTING OF 50 FEET OF PROPOSED PERMANENT EASEMENT(20 FEET OF THE PROPOSED PERMANENT EASEMENT BEING SHARED WITH THE POWERLINE EASEMENT) AND 40 FEET OF TEMPORARY WORKSPACE. ADDITIONAL TEMPORARY WORKSPACE (ATWS) WILL BE NECESSARY AT MAJOR ROADS, RAILROADS, RIVER CROSSINGS AND OTHER SPECIAL CIRCUMSTANCES, AS REQUIRED. CERTAIN SITUATIONS MAY REQUIRE A NARROWER WIDTH.
2. ADD 25 FEET OF ATWS ON WORKING SIDE (TYPICALLY) FOR TOPSOIL STORAGE IN AGRICULTURAL FIELDS, RESIDENTIAL YARDS, AND AS PER LANDOWNER AGREEMENTS.
3. LEAVE GAPS IN SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH UPLAND SOILS INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING. AVOID SCALPING VEGETATED GROUND SURFACE WHEN BACKFILLING TOPSOIL AND SPOIL PILES.

* EXISTING POWERLINE EASEMENT VARIES BASED ON EXISTING PROPERTY RIGHTS

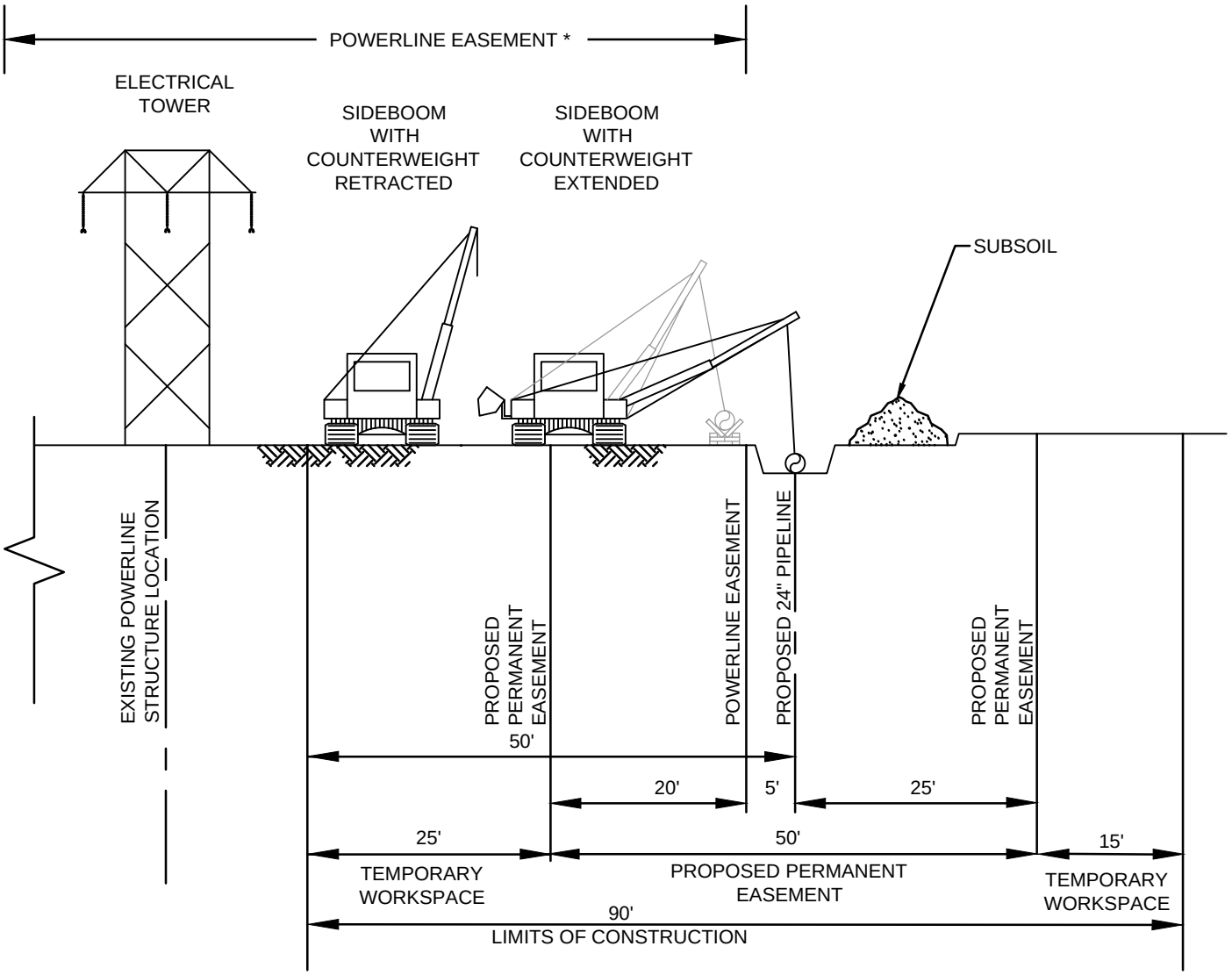
NO	DATE	BY	DESCRIPTION	PROJ. ID	APPR.

REVISIONS

ENG. RECORD		DATE
DRAWN BY:	HMM	04/2015
DRAWING APPROVAL		
PROJECT APPROVAL		
SURVEY DATE:		
SCALE: N.T.S.		
PROJECT ID:		
FILE NAME:		

90' CORRIDOR PIPELINE OUTSIDE POWERLINE EASEMENT FOR 24" PROPOSED PIPELINE

DWG. NO. ROW-CONFIG_09A



PROFILE
(NOT TO SCALE)

NOTE:

1. CONSTRUCTION RIGHT-OF-WAY WILL TYPICALLY BE 90 FEET WIDE CONSISTING OF 50 FEET OF PROPOSED PERMANENT EASEMENT(20 FEET OF THE PROPOSED PERMANENT EASEMENT BEING SHARED WITH THE POWERLINE EASEMENT) AND 40 FEET OF TEMPORARY WORKSPACE. ADDITIONAL TEMPORARY WORKSPACE (ATWS) WILL BE NECESSARY AT MAJOR ROADS, RAILROADS, RIVER CROSSINGS AND OTHER SPECIAL CIRCUMSTANCES, AS REQUIRED. CERTAIN SITUATIONS MAY REQUIRE A NARROWER WIDTH.
2. ADD 25 FEET OF ATWS ON WORKING SIDE (TYPICALLY) FOR TOPSOIL STORAGE IN AGRICULTURAL FIELDS, RESIDENTIAL YARDS, AND AS PER LANDOWNER AGREEMENTS.
3. LEAVE GAPS IN SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH UPLAND SOILS INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING. AVOID SCALPING VEGETATED GROUND SURFACE WHEN BACKFILLING TOPSOIL AND SPOIL PILES.

* EXISTING POWERLINE EASEMENT VARIES BASED ON EXISTING PROPERTY RIGHTS

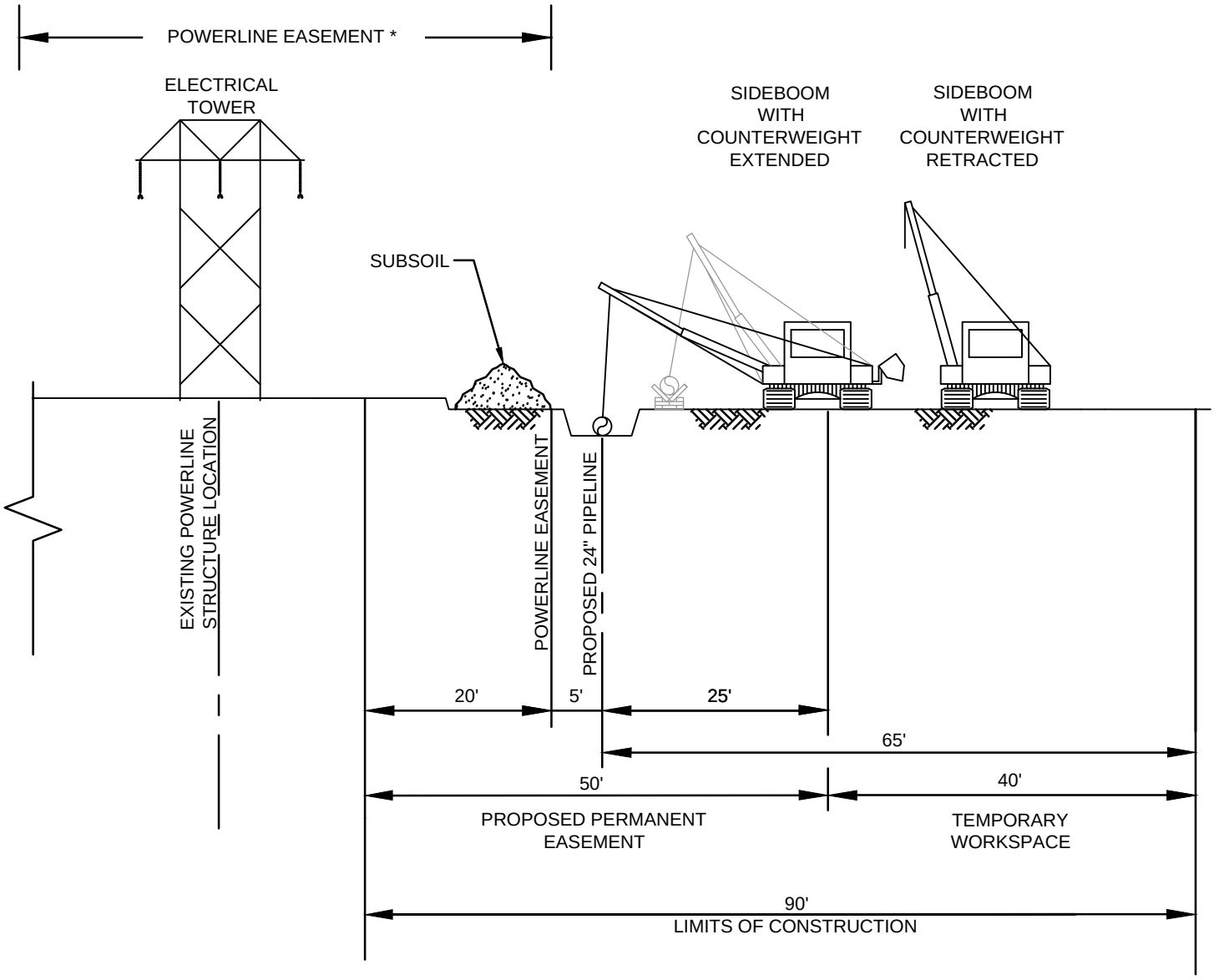
NO	DATE	BY	DESCRIPTION	PROJ. ID	APPR.

REVISIONS

ENG. RECORD		DATE
DRAWN BY:	HMM	04/2015
DRAWING APPROVAL		
PROJECT APPROVAL		
SURVEY DATE:		
SCALE: N.T.S.		
PROJECT ID:		
FILE NAME:		

90' CORRIDOR PIPELINE OUTSIDE POWERLINE EASEMENT FOR 24" PROPOSED PIPELINE

DWG. NO. ROW-CONFIG_09B



PROFILE
(NOT TO SCALE)

NOTE:

1. CONSTRUCTION RIGHT-OF-WAY WILL TYPICALLY BE 90 FEET WIDE CONSISTING OF 50 FEET OF PROPOSED PERMANENT EASEMENT (20 FEET OF THE PROPOSED PERMANENT EASEMENT BEING SHARED WITH THE POWERLINE EASEMENT) AND 40 FEET OF TEMPORARY WORKSPACE. ADDITIONAL TEMPORARY WORKSPACE (ATWS) WILL BE NECESSARY AT MAJOR ROADS, RAILROADS, RIVER CROSSINGS AND OTHER SPECIAL CIRCUMSTANCES, AS REQUIRED. CERTAIN SITUATIONS MAY REQUIRE A NARROWER WIDTH.
2. ADD 25 FEET OF ATWS ON WORKING SIDE (TYPICALLY) FOR TOPSOIL STORAGE IN AGRICULTURAL FIELDS, RESIDENTIAL YARDS, AND AS PER LANDOWNER AGREEMENTS.
3. LEAVE GAPS IN SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH UPLAND SOILS INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING. AVOID SCALPING VEGETATED GROUND SURFACE WHEN BACKFILLING TOPSOIL AND SPOIL PILES.

* EXISTING POWERLINE EASEMENT VARIES BASED ON EXISTING PROPERTY RIGHTS.

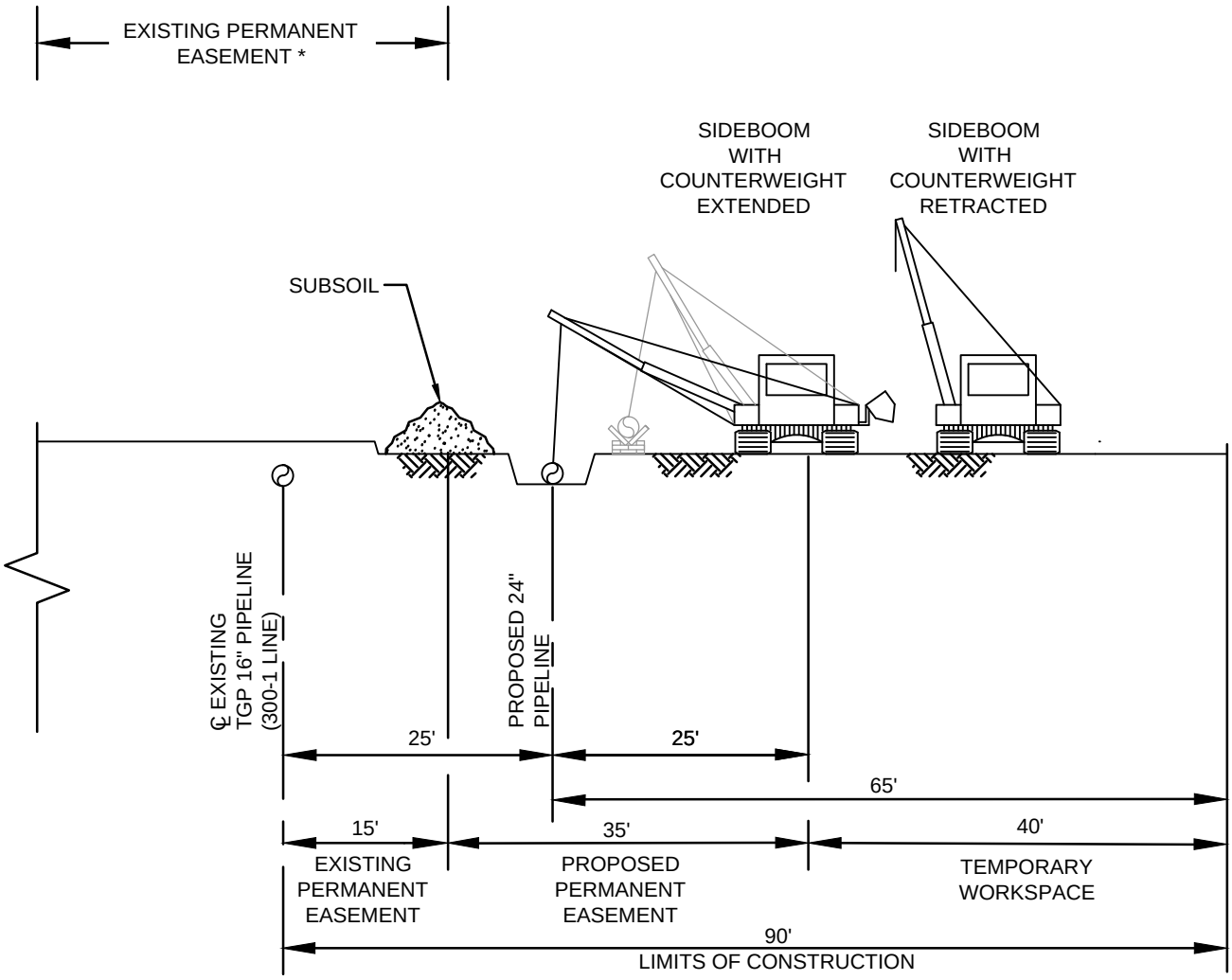
NO	DATE	BY	DESCRIPTION	PROJ. ID	APPR.

REVISIONS

ENG. RECORD		DATE
DRAWN BY:	HMM	04/2015
DRAWING APPROVAL		
PROJECT APPROVAL		
SURVEY DATE:		
SCALE: N.T.S.		
PROJECT ID:		
FILE NAME:		

90' CORRIDOR PIPELINE OUTSIDE POWERLINE EASEMENT FOR 24" PROPOSED PIPELINE

DWG. NO. ROW-CONFIG_9C



PROFILE
(NOT TO SCALE)

NOTES:

1. CONSTRUCTION RIGHT-OF-WAY WILL TYPICALLY BE 90 FEET WIDE CONSISTING OF15 FEET OF EXISTING PERMANENT EASEMENT, 35 FEET OF PROPOSED PERMANENT EASEMENT, AND 40 FEET OF TEMPORARY WORKSPACE. ADDITIONAL TEMPORARY WORKSPACE (ATWS) WILL BE NECESSARY AT MAJOR ROADS, RAILROADS, RIVER CROSSINGS AND OTHER SPECIAL CIRCUMSTANCES, AS REQUIRED. CERTAIN SITUATIONS MAY REQUIRE A NARROWER WIDTH.
2. ADD 25 FEET OF ATWS ON WORKING SIDE (TYPICALLY) FOR TOPSOIL STORAGE IN AGRICULTURAL FIELDS, RESIDENTIAL YARDS, AND AS PER LANDOWNER AGREEMENTS.
3. LEAVE GAPS IN SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH UPLAND SOILS INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING. AVOID SCALPING VEGETATED GROUND SURFACE WHEN BACKFILLING TOPSOIL AND SPOIL PILES.
4. THE OFFSET FROM EXISTING PIPELINE, WHERE APPLICABLE, WILL BE 25 FEET, BUT MAY BE INCREASED OR DECREASED DEPENDING ON THE SITE SPECIFIC CONSTRUCTION REQUIREMENTS.

* EXISTING PERMANENT EASEMENT VARIES BASED ON EXISTING PROPERTY RIGHTS.

NO	DATE	BY	DESCRIPTION	PROJ. ID	APPR.

REVISIONS

ENG. RECORD		DATE
DRAWN BY:	HMM	04/2015
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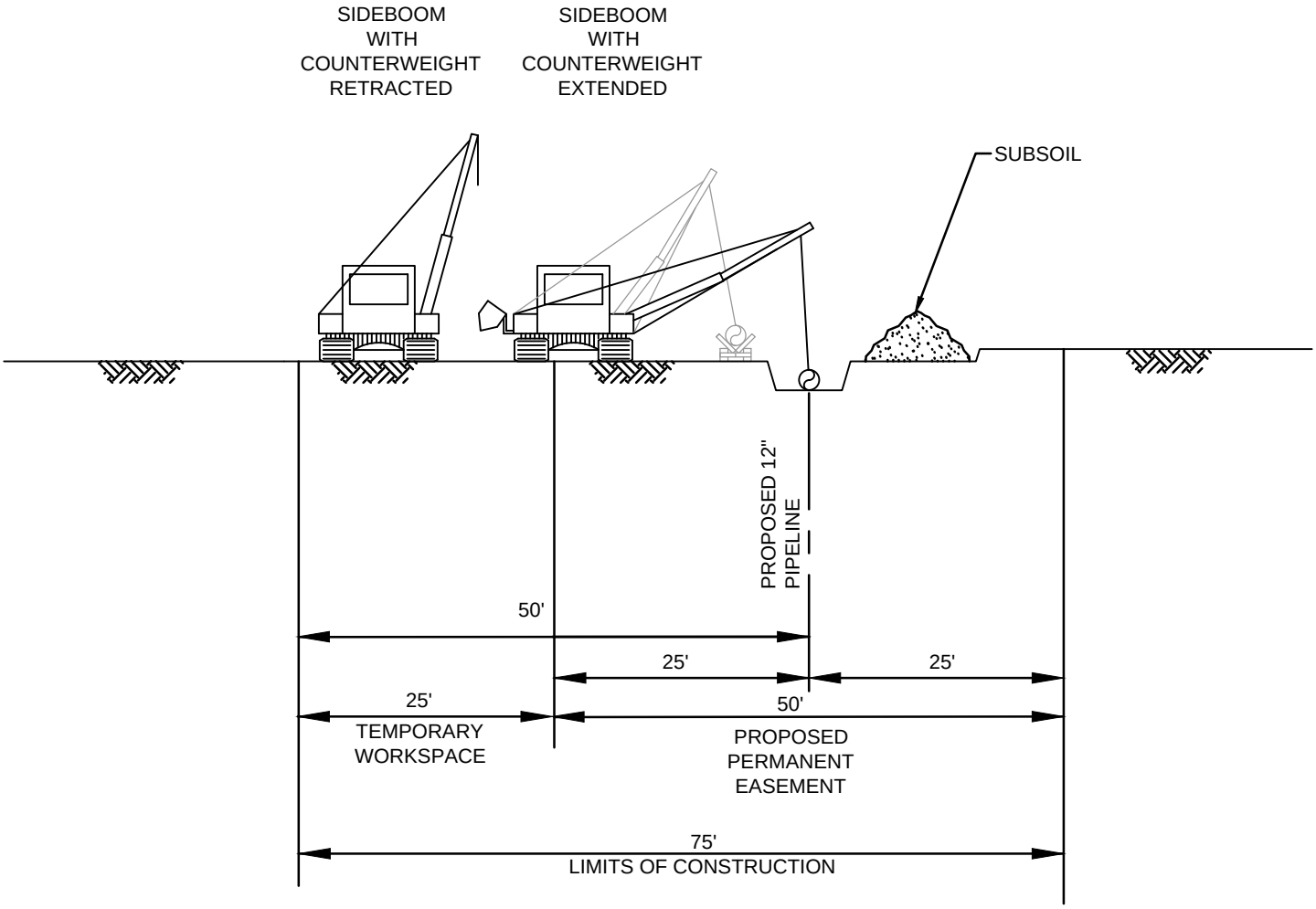
PROJECT APPROVAL		
SURVEY DATE:		
SCALE: N.T.S.		
PROJECT ID:		
FILE NAME:		

90' CORRIDOR PARALLEL TO 300-1 LINE FOR 24" PROPOSED PIPELINE

DWG. NO. ROW-CONFIG_10



PROFILE
(NOT TO SCALE)

NOTE:

1. CONSTRUCTION RIGHT-OF-WAY WILL TYPICALLY BE 75 FEET WIDE CONSISTING OF 50 FEET OF PROPOSED PERMANENT EASEMENT AND 25 FEET OF TEMPORARY WORKSPACE. ADDITIONAL TEMPORARY WORKSPACE (ATWS) WILL BE NECESSARY AT MAJOR ROADS, RAILROADS, RIVER CROSSINGS AND OTHER SPECIAL CIRCUMSTANCES, AS REQUIRED. CERTAIN SITUATIONS MAY REQUIRE A NARROWER WIDTH.
2. ADD 25 FEET OF ATWS ON WORKING SIDE (TYPICALLY) FOR TOPSOIL STORAGE IN AGRICULTURAL FIELDS, RESIDENTIAL YARDS AND AS PER LANDOWNER AGREEMENTS.
3. LEAVE GAPS IN SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH UPLAND SOILS INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING. AVOID SCALPING VEGETATED GROUND SURFACE WHEN BACKFILLING TOPSOIL AND SPOIL PILES.

NO	DATE	BY	DESCRIPTION	PROJ. ID	APPR.

REVISIONS

ENG. RECORD		DATE
DRAWN BY:	HMM	04/2015
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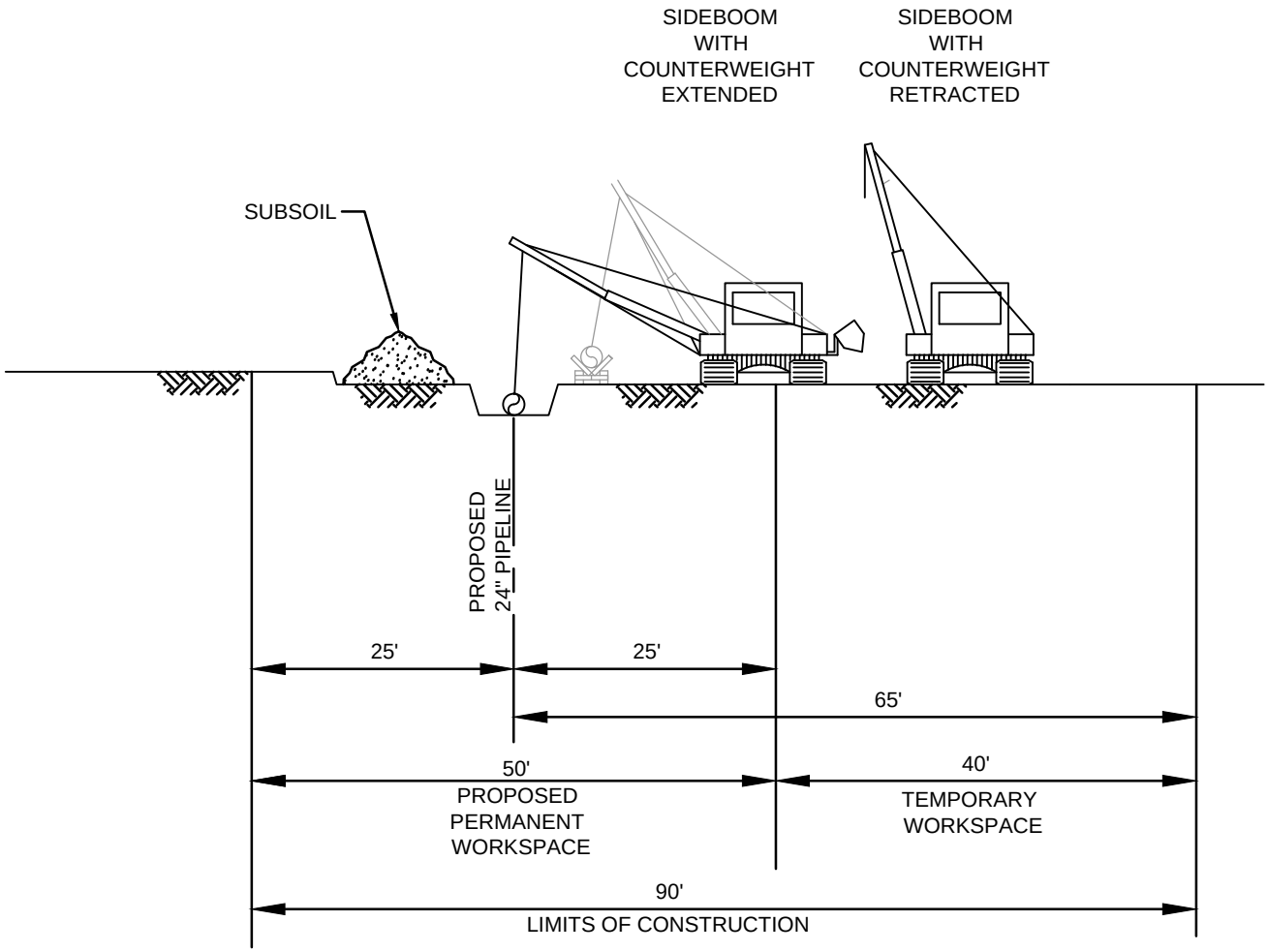
PROJECT APPROVAL		
SURVEY DATE:		
SCALE: N.T.S.		
PROJECT ID:		
FILE NAME:		

75' CORRIDOR (GREENFIELD) FOR PROPOSED 12" PIPELINE

DWG. NO. ROW-CONFIG_11



PROFILE
(NOT TO SCALE)

NOTES:

1. CONSTRUCTION RIGHT-OF-WAY WILL TYPICALLY BE 90 FEET WIDE CONSISTING OF 50 FEET OF PROPOSED PERMANENT EASEMENT AND 40 FEET OF TEMPORARY WORKSPACE. ADDITIONAL TEMPORARY WORKSPACE (ATWS) WILL BE NECESSARY AT MAJOR ROADS, RAILROADS, RIVER CROSSINGS AND OTHER SPECIAL CIRCUMSTANCES, AS REQUIRED. CERTAIN SITUATIONS MAY REQUIRE A NARROWER WIDTH.
2. ADD 25 FEET OF ATWS ON WORKING SIDE (TYPICALLY) FOR TOPSOIL STORAGE IN AGRICULTURAL FIELDS, RESIDENTIAL YARDS, AND AS PER LANDOWNER AGREEMENTS.
3. LEAVE GAPS IN SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH UPLAND SOILS INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING. AVOID SCALPING VEGETATED GROUND SURFACE WHEN BACKFILLING TOPSOIL AND SPOIL PILES.

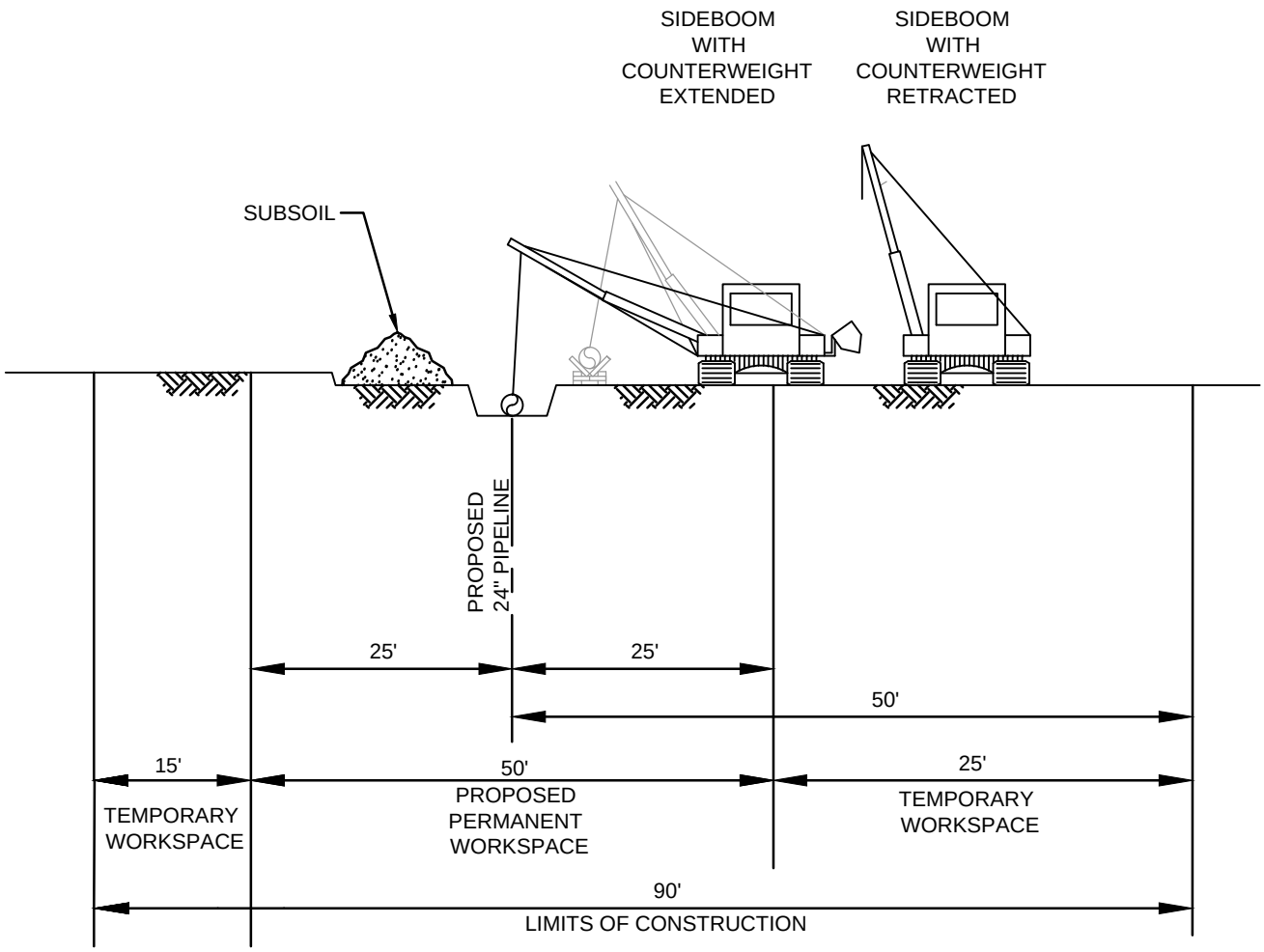
NO	DATE	BY	DESCRIPTION	PROJ. ID	APPR.

REVISIONS

ENG. RECORD		DATE
DRAWN BY:	HMM	04/2015
DRAWING APPROVAL		
PROJECT APPROVAL		
SURVEY DATE:		
SCALE: N.T.S.		
PROJECT ID:		
FILE NAME:		

90' CORRIDOR (GREENFIELD 50/40) FOR 24" PROPOSED PIPELINE

DWG. NO. ROW-CONFIG_12A



PROFILE
(NOT TO SCALE)

NOTES:

1. CONSTRUCTION RIGHT-OF-WAY WILL TYPICALLY BE 90 FEET WIDE CONSISTING OF 50 FEET OF PROPOSED PERMANENT EASEMENT AND 40 FEET OF TEMPORARY WORKSPACE. ADDITIONAL TEMPORARY WORKSPACE (ATWS) WILL BE NECESSARY AT MAJOR ROADS, RAILROADS, RIVER CROSSINGS AND OTHER SPECIAL CIRCUMSTANCES, AS REQUIRED. CERTAIN SITUATIONS MAY REQUIRE A NARROWER WIDTH.
2. ADD 25 FEET OF ATWS ON WORKING SIDE (TYPICALLY) FOR TOPSOIL STORAGE IN AGRICULTURAL FIELDS, RESIDENTIAL YARDS, AND AS PER LANDOWNER AGREEMENTS.
3. LEAVE GAPS IN SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH UPLAND SOILS INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING. AVOID SCALPING VEGETATED GROUND SURFACE WHEN BACKFILLING TOPSOIL AND SPOIL PILES.

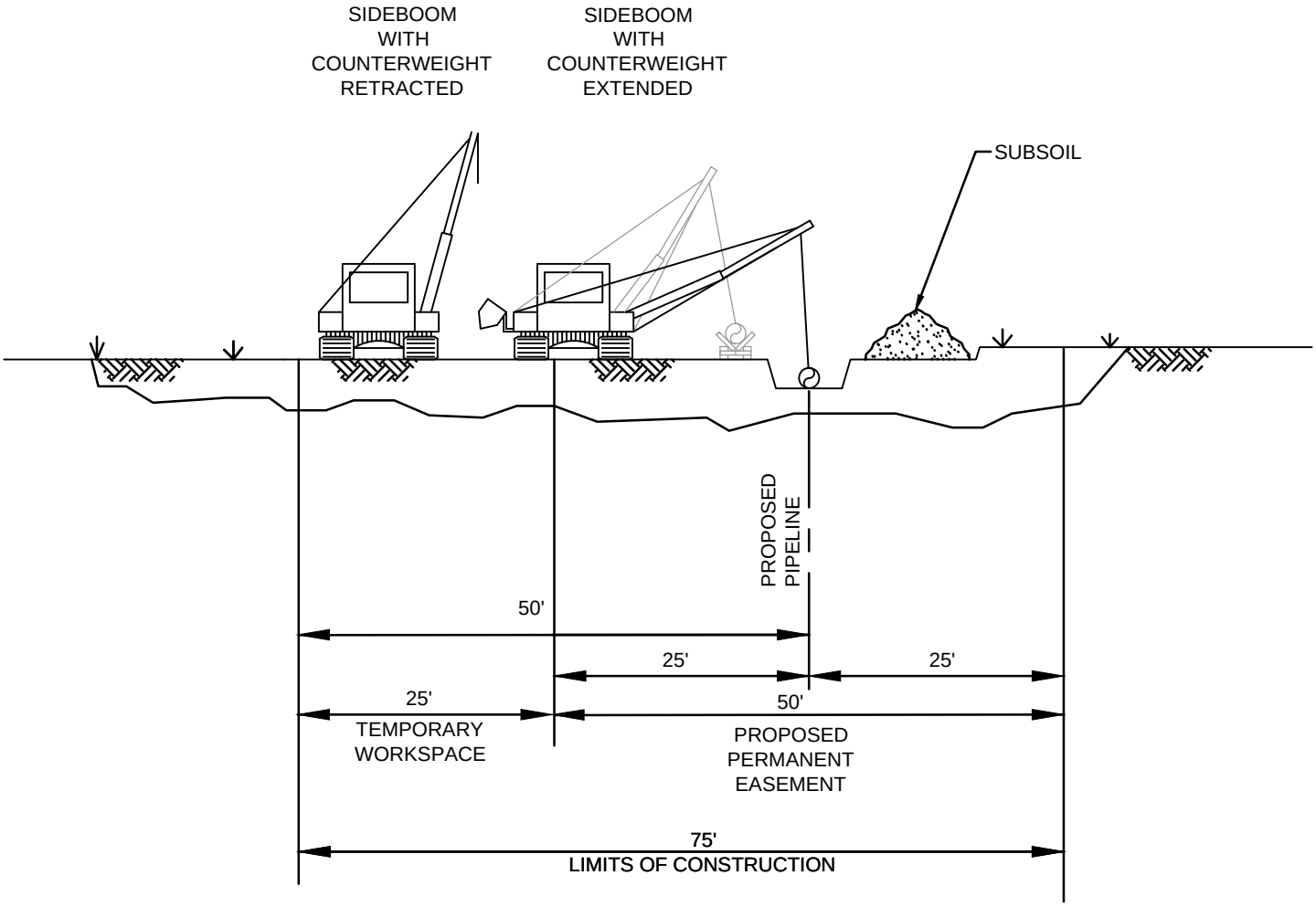
NO	DATE	BY	DESCRIPTION	PROJ. ID	APPR.

REVISIONS

ENG. RECORD		DATE
DRAWN BY:	HMM	04/2015
DRAWING APPROVAL		
PROJECT APPROVAL		
SURVEY DATE:		
SCALE: N.T.S.		
PROJECT ID:		
FILE NAME:		

90' CORRIDOR (GREENFIELD) FOR 24" PROPOSED PIPELINE

DWG. NO. ROW-CONFIG_12B



PROFILE
(NOT TO SCALE)

NOTES:

1. CONSTRUCTION RIGHT-OF-WAY THROUGH WETLANDS WILL TYPICALLY BE 75 FEET WIDE CONSISTING OF 50 FEET OF PROPOSED PERMANENT EASEMENT AND 25 FEET OF TEMPORARY WORKSPACE.
2. LEAVE GAPS IN SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH UPLAND SOILS INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING. AVOID SCALPING VEGETATED GROUND SURFACE WHEN BACKFILLING TOPSOIL AND SPOIL PILES.

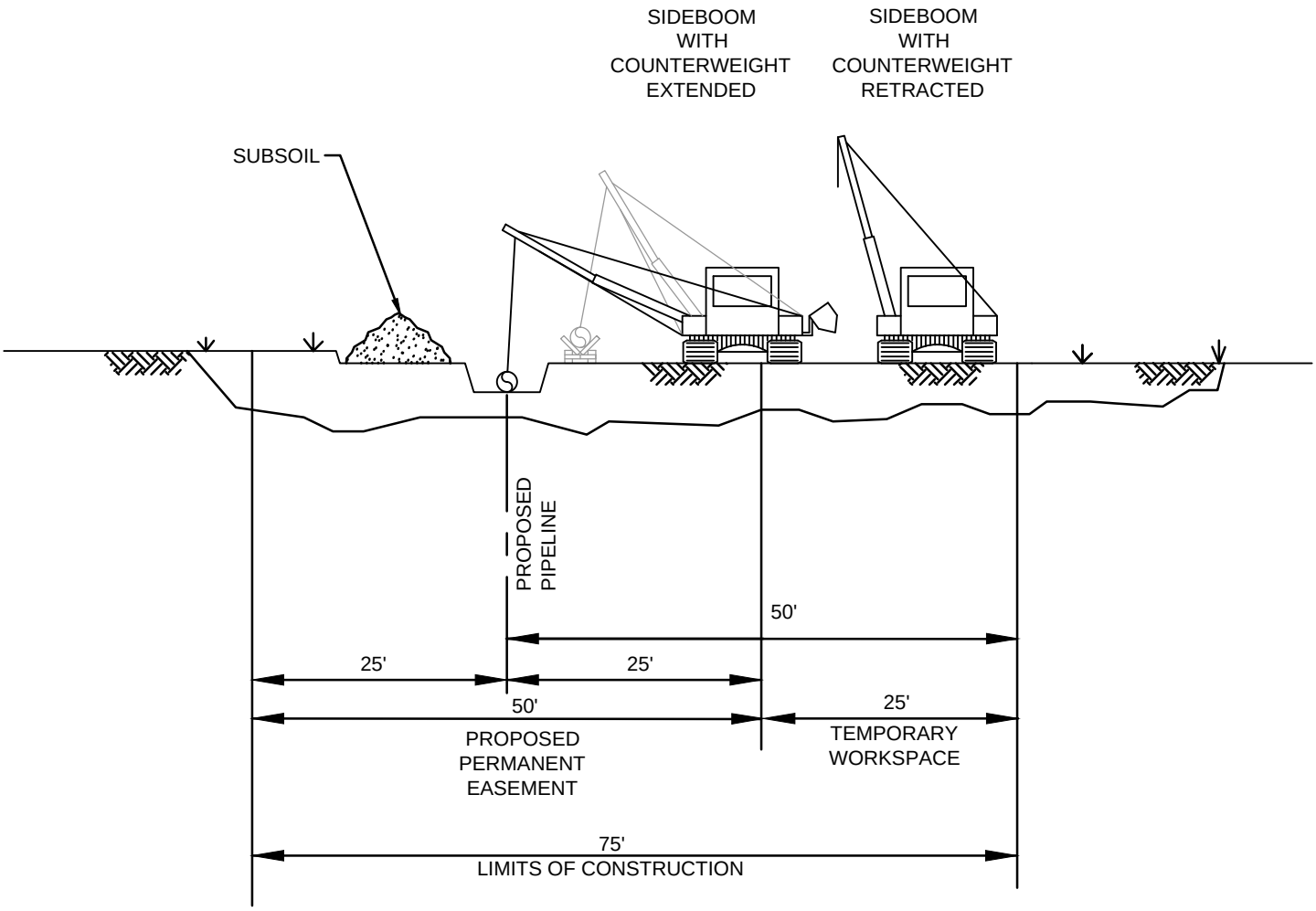
NO	DATE	BY	DESCRIPTION	PROJ. ID	APPR.

REVISIONS

ENG. RECORD		DATE
DRAWN BY:	HMM	04/2015
DRAWING APPROVAL		
PROJECT APPROVAL		
SURVEY DATE:		
SCALE: N.T.S.		
PROJECT ID:		
FILE NAME:		

75' CORRIDOR (WETLANDS)

DWG. NO. ROW-CONFIG_13



PROFILE
(NOT TO SCALE)

NOTES:

1. CONSTRUCTION RIGHT-OF-WAY THROUGH WETLANDS WILL TYPICALLY BE REDUCED TO 75 FEET WIDE CONSISTING OF 50 FEET OF PROPOSE PERMANENT EASEMENT AND 25 FEET OF TEMPORARY WORKSPACE.
2. LEAVE GAPS IN SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH UPLAND SOILS INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING. AVOID SCALPING VEGETATED GROUND SURFACE WHEN BACKFILLING TOPSOIL AND SPOIL PILES.

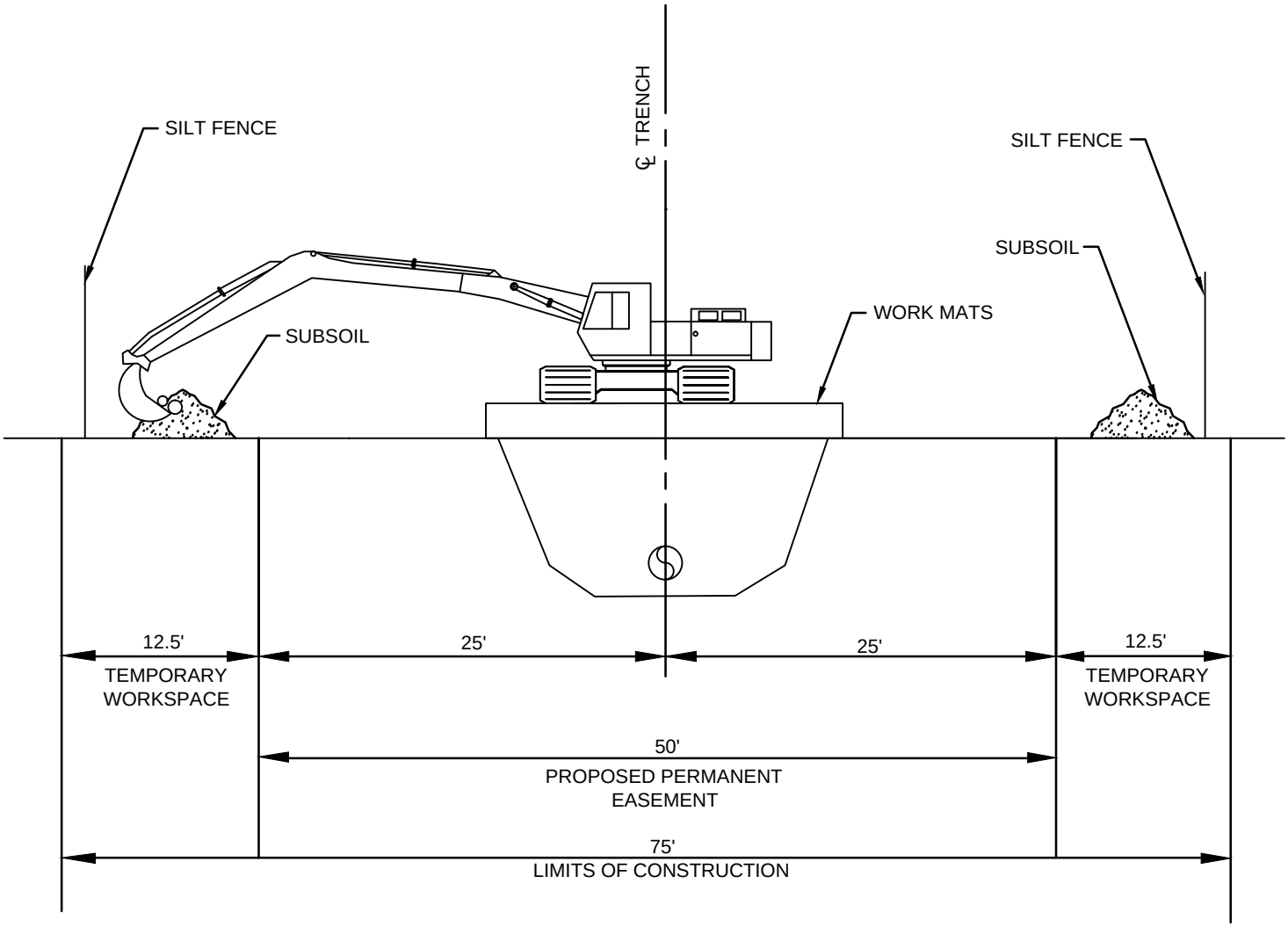
NO	DATE	BY	DESCRIPTION	PROJ. ID	APPR.

REVISIONS

ENG. RECORD		DATE
DRAWN BY:	HMM	04/2015
DRAWING APPROVAL		
PROJECT APPROVAL		
SURVEY DATE:		
SCALE: N.T.S.		
PROJECT ID:		
FILE NAME:		

75' CORRIDOR (WETLANDS)

DWG. NO. ROW-CONFIG_14



PROFILE
(NOT TO SCALE)

NOTES:

1. CONSTRUCTION RIGHT-OF-WAY THROUGH WETLANDS WILL TYPICALLY BE REDUCED TO 75 FEET WIDE CONSISTING OF 50 FEET OF PROPOSE PERMANENT EASEMENT AND 25 FEET OF TEMPORARY WORKSPACE.
2. LEAVE GAPS IN SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH UPLAND SOILS INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING. AVOID SCALPING VEGETATED GROUND SURFACE WHEN BACKFILLING TOPSOIL AND SPOIL PILES.

NO	DATE	BY	DESCRIPTION	PROJ. ID	APPR.

REVISIONS

ENG. RECORD		DATE
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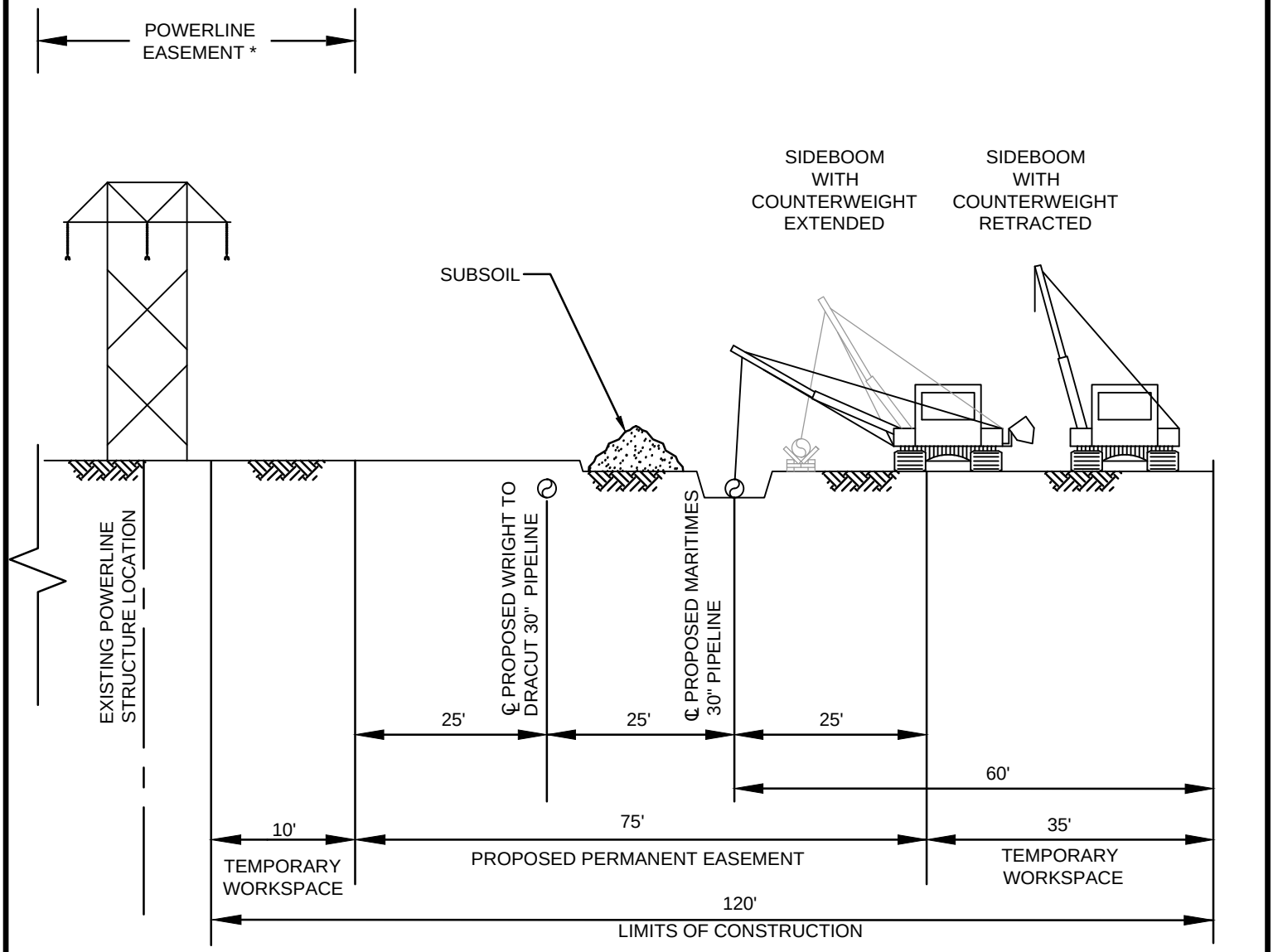
DRAWING APPROVAL		
PROJECT APPROVAL		
SURVEY DATE:		
SCALE: N.T.S.		
PROJECT ID:		
FILE NAME:		

75' CORRIDOR PUSH/PULL WETLAND CROSSING METHOD

DWG. NO. ROW-CONFIG_15



PROFILE
(NOT TO SCALE)

NOTES:

1. CONSTRUCTION RIGHT-OF-WAY WILL TYPICALLY BE 120 FEET WIDE CONSISTING OF 75 FEET OF PROPOSED PERMANENT EASEMENT AND 50 FEET OF TEMPORARY WORKSPACE. ADDITIONAL TEMPORARY WORKSPACE (ATWS) WILL BE NECESSARY AT MAJOR ROADS, RAILROADS, RIVER CROSSINGS AND OTHER SPECIAL CIRCUMSTANCES, AS REQUIRED. CERTAIN SITUATIONS MAY REQUIRE A NARROWER WIDTH.
2. ADD 25 FEET OF ATWS ON WORKING SIDE (TYPICALLY) FOR TOPSOIL STORAGE IN AGRICULTURAL FIELDS, RESIDENTIAL YARDS, AND AS PER LANDOWNER AGREEMENTS.
3. LEAVE GAPS IN SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH UPLAND SOILS INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING. AVOID SCALPING VEGETATED GROUND SURFACE WHEN BACKFILLING TOPSOIL AND SPOIL PILES.

* EXISTING POWERLINE EASEMENT VARIES BASED ON EXISTING PROPERTY RIGHTS

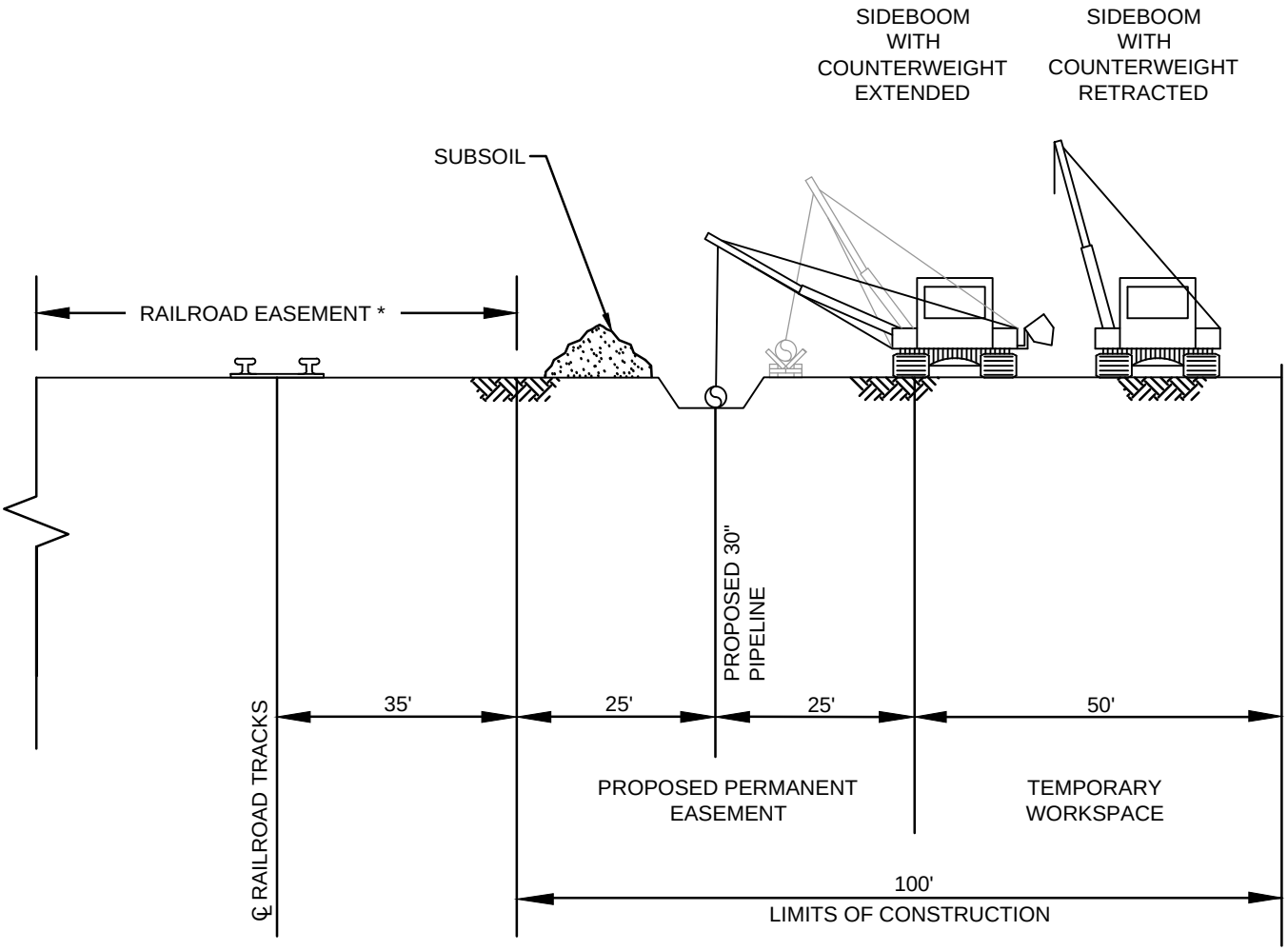
NO	DATE	BY	DESCRIPTION	PROJ. ID	APPR.

REVISIONS

ENG. RECORD		DATE
DRAWN BY:	HMM	04/2015
DRAWING APPROVAL		
PROJECT APPROVAL		
SURVEY DATE:		
SCALE: N.T.S.		
PROJECT ID:		
FILE NAME:		

120' CORRIDOR SEG K & L ; PARALLEL CONSTRUCTION FOR PROPOSED 30" PIPELINES

DWG. NO. ROW-CONFIG_16



PROFILE
(NOT TO SCALE)

NOTE:

1. CONSTRUCTION RIGHT-OF-WAY WILL TYPICALLY BE 100 FEET WIDE CONSISTING OF 50 FEET OF PROPOSED PERMANENT EASEMENT AND 50 FEET OF TEMPORARY WORKSPACE. ADDITIONAL TEMPORARY WORKSPACE (ATWS) WILL BE NECESSARY AT MAJOR ROADS, RAILROADS, RIVER CROSSINGS AND OTHER SPECIAL CIRCUMSTANCES, AS REQUIRED. CERTAIN SITUATIONS MAY REQUIRE A NARROWER WIDTH.
2. ADD 25 FEET OF ATWS ON WORKING SIDE (TYPICALLY) FOR TOPSOIL STORAGE IN AGRICULTURAL FIELDS, RESIDENTIAL YARDS, AND AS PER LANDOWNER AGREEMENTS.
3. LEAVE GAPS IN SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH UPLAND SOILS INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING. AVOID SCALPING VEGETATED GROUND SURFACE WHEN BACKFILLING TOPSOIL AND SPOIL PILES.

* EXISTING RAILROAD EASEMENT VARIES BASED ON EXISTING PROPERTY RIGHTS

NO	DATE	BY	DESCRIPTION	PROJ. ID	APPR.

REVISIONS

ENG. RECORD		DATE
DRAWN BY:	HMM	04/2015
DRAWING APPROVAL		
PROJECT APPROVAL		
SURVEY DATE:		
SCALE: N.T.S.		
PROJECT ID:		
FILE NAME:		

100' CORRIDOR PARALLEL TO EXISTING RAILROAD FOR 30" PROPOSED PIPELINE

DWG. NO. ROW-CONFIG_17

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

ATTACHMENT N3

SPILL PREVENTION AND RESPONSE PLAN

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1.0 INTRODUCTION

Tennessee Gas Pipeline Company, L.L.C. ("Tennessee" or "TGP") has filed 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"). The Environmental Report ("ER") is submitted in support of the application. 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 proposed Project will include construction of approximately 420 miles of pipeline (new pipeline, looping pipeline segments, and laterals) in Pennsylvania, New York, Massachusetts, New Hampshire, and Connecticut. Additionally, as part of the Project, Tennessee proposes to construct new compressor and meter stations and modify existing compressor and meter stations along its proposed and existing pipeline system. There will also be construction of appurtenant facilities, including mainline valves ("MLVs"), cathodic protection, and pig facilities through the Project area.

2.0 PREVENTATIVE MEASURES

The Spill Prevention and Response Plan ("SPRP") provides preventative and mitigative measures to be employed by Tennessee during construction of the Project and/or operations and maintenance activities for the Project facilities. Methods listed in this plan are based on approved spill controls plans that Tennessee has used successfully in the past and are established to minimize the environmental impact associated with spills or releases at fuel, lubricant, or hazardous materials storage areas, during normal upland construction and refueling activities, and during special refueling activities within 100 feet of perennial stream banks, wetland boundaries, or within municipal watersheds. The Project's on-site Environmental Inspector ("EI") is responsible for ensuring that Tennessee's construction contractors ("Contractors") implement the measures and procedures outlined in this SPRP. The responsibilities of these inspectors are described in Tennessee's Upland and Erosion Control, Revegetation, and Maintenance Plan ("Plan", Attachment N14) and Wetland and Waterbody Construction and Mitigation Procedures ("Procedures", Attachment N15).

2.1 TRAINING

The Contractor will instruct personnel on the operation and maintenance of equipment to prevent the accidental discharge or spill of fuel, oil, and lubricants. Personnel will also be made aware of the pollution control laws, rules, and regulations applicable to their work.

Spill prevention briefings with the construction crew will be scheduled and conducted by the Contractor to ensure adequate understanding of spill prevention measures. These briefings will highlight:

- Precautionary measures to prevent spills;
- Sources of spills, such as equipment failure or malfunction;
- Standard operating procedures in case of a spill;

- Equipment, materials, and supplies available for clean-up of a spill; and
- A list of known spill events.

A spill is an un-permitted release of product, raw materials, or chemicals outside any secondary containment and into the environment. Spills can occur as a result of leaks, accidents, or third-party incidents.

2.2 EQUIPMENT INSPECTION/MAINTENANCE

The Contractor will inspect and maintain equipment that must be fueled and/or lubricated according to a strict schedule. The Contractor will submit to Tennessee for approval written documentation of the methods used and work performed.

All containers, valves, pipelines, and hoses will be examined regularly to assess their general condition. The examination will identify any signs of deterioration that could cause a spill and signs of leaks, such as accumulated fluids. All leaks will be promptly corrected and/or repaired.

2.3 REFUELING

1. The Contractor will ensure that fuel trucks transporting fuel to on-site equipment travel only on approved access roads ("ARs"); that all equipment is parked overnight and/or fueled at least 100 feet from a waterbody or in an upland area; equipment is refueled and lubricated within the right-of-way ("ROW"), compressor station yard, meter station site, contractor yard, fee property, or other permitted area and at least 100 feet away from all waterbodies and wetlands, with the following exceptions:
   - The EI finds, in advance, that no reasonable alternative is available and the Contractor and Tennessee have taken appropriate steps (including secondary containment structures) to prevent spills and provide for prompt cleanup in the event of a spill;
   - Areas such as rugged terrain or steep slopes where movement of equipment to refueling stations would cause excessive disturbance to the ROW or workspace;
   - Areas where removing equipment from a wetland for servicing would increase adverse impacts to the wetland;
   - Sites where moving equipment to refueling stations from pre-fabricated equipment pads is impracticable or where there is a barrier from the waterbody/wetland (i.e., road or railroad);
   - Locations where the waterbody or wetland is located adjacent to a road crossing, compressor station yard, or meter station site (from which the equipment can be serviced); and
   - Refueling of immobile equipment, including, but not limited to, bending and boring machines, air compressors, padding machines, and hydro-test fill pumps. Pumps operating within 100 feet of a waterbody or wetland boundary utilize appropriate secondary containment systems to prevent spills.

   In these areas, auxiliary fuel tanks will be used to reduce the frequency of refueling operations and in no case will refueling take place within 100 feet of any known potable water wells.

2. The Contractor will ensure that all refueling is done pursuant to the following conditions:
   - Impact minimization measures and equipment will be sufficient to prevent discharged fluids from leaving the ROW, compressor station yard, meter station site, workspace, or from

- Reaching wetlands or waterbodies, and will be readily available for use. These will include a combination of the following:
  a. Dikes, berms, or retaining walls sufficiently impervious to contain spilled oil;
  b. Sorbent and barrier materials in quantities determined by the Contractor to be sufficient to capture the largest reasonably foreseeable spill;
  c. Drums or containers suitable for holding and transporting contaminated materials;
  d. Curbing;
  e. Culverts, gutters, or other drainage systems;
  f. Weirs, booms, or other barriers;
  g. Spill diversion or retention ponds; and
  h. Sumps and collection systems.
- All spills will be cleaned up immediately. Containment equipment will not be used for storing contaminated material.

3. Concrete coating activities will not be performed within 100 feet of a wetland or waterbody boundary, unless the location is an existing industrial site designated for such use. These activities can occur closer only if the EI determines that there is no reasonable alternative, and the project sponsor and its contractors have taken appropriate steps (including secondary containment structures) to prevent spills and provide for prompt cleanup in the event of a spill.
4. The Contractor will prepare, for approval by Tennessee, a list of the type, quantity, and the storage location of containment and cleanup equipment to be used during construction.

2.4 STORAGE

Storage containment areas will not have drains, unless such drains lead to a containment area or vessel where the entire spill can be recovered. The Contractor will ensure that bulk storage of hazardous materials, including chemicals, fuels, and lubricating oils will have appropriate secondary containment systems.

2.5 PERSONNEL SUPPORT

Prior to construction, the ROW inspector or agent will identify and prepare a written inventory of water wells within 200 feet of the construction site. The Construction ROW Agent will notify the authorities of all potable water supply intakes located within 3 miles downstream of any crossings a minimum of 1 week prior to construction.

3.0 IMPACT MINIMIZATION MEASURES

Containment is the immediate priority in the case of a spill. A spill will be contained on Tennessee's property, ROW, compressor station yard, meter station site, or workspace, if possible. Clean up procedures will begin immediately after a spill is contained. In no case will containment equipment be used to store contaminated material.

Project operations will be structured in a manner that provides for the prompt and effective cleanup of spills of fuel and other hazardous materials. The Contractor will ensure the following measures are followed:

- Construction crew (including cleanup crews) has on hand sufficient supplies of absorbent and barrier materials to allow the rapid containment and recovery of spilled materials and knows the procedure for reporting spills and unanticipated discovers of contaminate;
- Construction crew has on hand sufficient tools and material to stop leaks; and
- Names and telephone numbers for all local, state, and federal agencies (including, if necessary, the U.S. Coast Guard and the National Response Center) that must be notified of a spill and follow the requirements of those agencies in cleaning up the spill, excavating and disposing of soils or other materials contaminated by a spill, and collecting and disposing of waste generated during spill cleanup.

Immediately report any spill or release of the following materials *regardless of location* (on-property or off-property) to the EI for notification and to the appropriate Tennessee representative as indicated below:

- Oil or petroleum products;
- Hazardous substances or hazardous wastes;
- Chemicals;
- Unplanned natural gas (flaring or venting); and
- Asbestos-containing materials ("ACMs").

Tennessee Division 10 Offices

Area Operations Supervisor: Joe Eveson

Area Environmental Coordinator: Amanda Paul

Area Operations Manager: Don Perkins

Kinder Morgan Corporation Houston Office (Houston, Texas)

Connecticut Project Manager: Matthew Nowak

Environmental Project Manager: Mike Letson

Department Manager: Adrienne Mason

Department Director: Gina Dorsey

If a spill enters a body of water, the Contractor will immediately take samples upstream and downstream from point of entry and refrigerate samples. If advised, additional analysis will be completed and/or additional samples will be gathered.

If the EI agrees and the Contractor determines that a spill is small enough such that the construction crew can safely handle it, the crew will use construction equipment to containerize all spilled material, contaminated soil, and sorbent material in a manner consistent with the spilled materials' characterization.

If the EI agrees and the Contractor determines that a spill cannot be adequately excavated and disposed of by the construction crew alone, the Contractor will contact waste containment specialists. The Contractor

will ensure that all excavated wastes are transported to a Tennessee-approved disposal facility licensed to accept such wastes. Wastes will not be transported to a Tennessee facility (i.e., compressor station, meter station, etc.) unless the Field Environmental Coordinator approves it in writing.

The Contractor will prepare a Construction Site Spill Report form to be given to Tennessee that includes:

- The date, time, and location of the occurrence or discovery of the occurrence;
- A description or identity of the material spilled;
- An estimate of the quantity spilled;
- The circumstances that caused the spill (e.g., equipment failure);
- A list of waterbodies affected or potentially affected by the spill;
- A statement verifying whether a sheen is present;
- The size of the affected area;
- An estimate of the depth that the material has reached in water or on soil;
- A determination of whether the spill will migrate off of Tennessee's property or the ROW or workspace;
- A determination of whether the spill is under control;
- A statement verifying that clean-up has begun and a description of the methods being used to clean up the spill;
- The names of the people observing the spill (with their affiliations) and the extent of injuries, if any; and
- The Field "Report of Spill" form.

Tennessee will ensure that the Contractor's spill report is complete and forward it to the Field Environmental Coordinator. The Contractor will follow the *"Contractor's Environmental Guidelines - Waste Disposal and Spill Notification"* procedures regarding all required regulatory notifications, subject to Tennessee's prior approval, and for obtaining any necessary state and local licenses, permits, or other authorizations associated with the Project, except as otherwise provided in the scope of work. The Contractor is responsible for knowing what state and local environmental authorizations are necessary for the specific job at hand. Any above-mentioned permits, clearances, or authorizations obtained by the Contractor will be furnished to Tennessee.

The following releases require immediate (within 1 hour of discovery) notification to the National Response Center:

1. Any petroleum product released into streams, rivers, lakes, or dry washes;
2. A release that exceeds the reportable quantity ("RQ") of any Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA") hazardous substances in any 24-hour period which is not fully contained;
3. A release of a hazardous substance or hazardous waste which occurs during transportation; and
4. A release of hazardous waste which contains a RQ of a hazardous substance.

The National Response Center (1-800-424-8802) will be notified immediately if spills occur above threshold levels (Clean Water Act ["CWA"], 40 Code of Federal Regulations ["CFR"] 110.10) into surface waters and/or wetlands.

4.0 SUGGESTED EQUIPMENT LIST

Section 1.3 of these Procedures states that the Contractor will prepare a list of the type, quantity, and location of storage, containment, and cleanup equipment to be used on the construction site. The list will include the Procedures and impact minimization measures to be used in response to a spill. The Contractor's choice of impact minimization measures and equipment will be tailored to meet the characteristics of the affected terrain, as well as the types and amounts of material that could potentially be spilled. The types of equipment that Tennessee expects to use to control spills at terrestrial sites and wetlands are described in the FERC's Plan.

4.1 TERRESTRIAL CONSTRUCTION

General equipment that the Contractor will use for spill containment and cleanup on terrestrial areas includes:

- Sorbents (pillows, socks, and wipe sheets) for containment and pickup of spilled liquids;
- Commercially available spill kits (or the functional equivalent thereof) that are prepackaged, self-contained spill kits containing a variety of sorbents for small to large spills;
- Structures such as gutters, culverts, and dikes for immediate spill containment;
- Shovels, backhoes, etc., for excavating contaminated materials;
- Sumps and collection systems; and
- Drums, barrels, and temporary storage bags to clean up and transport contaminated materials.

4.1.1 Fuels and Lubricating Oil Storage

The Contractor will implement special measures to prevent spills in areas where trucks carrying fuel and oil barrels are loaded. Containment equipment will be kept close to tanks and barrels to minimize spill response time, and will include absorbent pads or mats. The quantity and capabilities of the mats will be sufficient to capture the largest foreseeable spill, given ROW or workspace characteristics, crankcase and other fuel vessel capacities.

4.1.2 Routine Refueling and Maintenance

Absorbent pads and mats will be placed on the ground beneath equipment before refueling and maintenance. Equipment that will be stored on-site for routine refueling and maintenance includes small sorbent kits (or their functional equivalent).

4.1.3 Equipment Failure

Kits with the capacity of absorbing up to 5 gallons of liquid can fit beneath the operator's seat on construction equipment for use in an equipment failure.

4.2 WATERBODY AND WETLAND CROSSINGS

For each wetland and waterbody crossed, the equipment listed below will be available, in addition to that needed for terrestrial construction. This equipment will be stored close to the water or wetland to minimize response time, and will include:

- Oil containment booms and the related equipment needed for rapid deployment; and
- Equipment to remove oils from water, such as oleophilic and hydrophobic absorbent booms and mats, and/or mechanical skimmers.

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

ATTACHMENT N4

WASTE MANAGEMENT PLAN

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TABLE OF CONTENTS

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1.0 INTRODUCTION

Tennessee Gas Pipeline Company, L.L.C. ("Tennessee" or "TGP") has filed 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"). The Environmental Report ("ER") is submitted in support of the application. 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 proposed Project will include construction of approximately 420 miles of pipeline (new pipeline, looping pipeline segments, and laterals) in Pennsylvania, New York, Massachusetts, New Hampshire, and Connecticut. Additionally, as part of the Project, Tennessee proposes to construct new compressor and meter stations and modify existing compressor and meter stations along its proposed and existing pipeline system. There will also be construction of appurtenant facilities, including mainline valves ("MLVs"), cathodic protection, and pig facilities through the Project area.

This Waste Management Plan outlines waste identification and characterization procedures that the construction contractor ("Contractor") will adhere to during Project construction.

2.0 WASTE IDENTIFICATION AND CHARACTERIZATION

2.1 IDENTIFYING WASTES

Wastes may be grouped into four categories, each requiring different forms of disposal:

- Hazardous wastes - Wastes that meet one of the criteria of ignitable, corrosive, reactive, toxic, or is specifically listed as hazardous waste by regulation. These wastes require special handling and disposal;
- Non-hazardous wastes - Wastes that do not fall into the other categories. This includes general trash;
- Special wastes - Wastes that do not meet the criteria for hazardous wastes, but may present special hazards or require special handling. Examples of special wastes are asbestos, polychlorinated biphenyls ("PCBs"), radioactive waste, and naturally occurring radioactive material ("NORM"). It is important to note that some states have their own classification of special wastes; and
- Universal wastes - To reduce the amount of hazardous waste in municipal solid waste streams, the U.S. Environmental Protection Agency ("USEPA") and many states recognize batteries, thermostats and lamps (e.g., fluorescent light bulbs) as "universal" which allows easier handling of these wastes.

2.2 WASTE CHARACTERIZATION

The Environmental Inspector ("EI") will coordinate with the Field Environmental Representative to determine if waste profiles exist for wastes generated during construction. If the classification of a waste is unknown, the waste must be characterized using test results or knowledge of the process generating the waste to determine the proper handling requirements for that waste. The EI will coordinate with the Field Environmental Representative and Contractor to determine the type of waste and the party responsible for proper disposal. The information below is used to characterize a waste:

- Source of the waste;
- Material Safety Data Sheets ("MSDS") for materials comprising the waste;
- Laboratory results from waste testing, as applicable; and
- If no existing waste profile exists, contact the Field Environmental Representative for waste characterization and sampling instructions.

Prior to waste characterization, a number of general guidelines will be adhered to when handling or storing wastes:

- Ensure that the Contractor's Environmental Guidelines in the contract are followed;
- Ensure that the Contractor provides a list to the EI of all hazardous materials or potential contaminants that are to be used or stored on the Project site;
- DO NOT bury any waste with the exception of stumps, rocks, or boulders as approved within the Tennessee's Upland Erosion Control, Revegetation and Maintenance Plan ("Plan", Attachment N14) and the Tennessee's Wetland and Waterbody Construction and Mitigation Procedures ("Procedures", Attachment N15);
- Never mix any waste awaiting characterization with other wastes;
- Never ship any waste unless it has been characterized;
- Never ship any hazardous waste from the job site to a compressor station without prior approval from the Field Environmental Representative and compressor station;
- Ship wastes, along with the required manifests, only to Tennessee-approved facilities; and
- Never ship drums of waste to a compressor station without prior approval from the Field Environmental Representative and the compressor station.

3.0 WASTE TYPES

3.1 HAZARDOUS WASTE

Common wastes include, but are not limited to: pipeline sludge, spent pigs, sandblast abrasive (depending on type and use), paint thinner, and solvents.

The following procedures apply to the storage of waste determined to be hazardous for all classes of generators:

- Store hazardous wastes using the Department of Transportation ("DOT") approved containers, a frac tank (bulk liquid wastes); a covered steel roll-off container with a poly-liner (bulk solid

wastes like contaminated soil);, or on a thick poly-liner and provide the area with a poly-liner cover and temporary containment berm (bulk solid wastes);

- When using DOT-approved containers, ensure the containers are kept closed or sealed (except when waste is being added), maintained in good condition (not damaged, leaking, or corroded), and store compatible substances that will not react with the hazardous waste. For example, store acidic wastes in plastic or plastic-lined containers rather than steel containers;
- Label hazardous waste containers (drums, tanks, roll-off containers) with a hazardous waste label as soon as any hazardous waste is placed into the container. Use a waterproof pen to complete the following information on the label:
  - Generator name, address, and phone number;
  - Generator USEPA identification number;
  - Description of waste (contact the Field Environmental Representative to obtain a waste description);
  - The 4-digit USEPA waste code (the Field Environmental Representative will provide USEPA waste codes); and
  - Accumulation date (the date the waste was added to the container, if not from satellite storage, or the date it was brought to the waste storage area from a satellite accumulation area);
- Label waste piles with a weatherproof sign identifying the waste and the date the waste pile was started. Waste piles are to be placed on poly-liner, covered to protect them from weather, and surround with barricade tape; and
- Store hazardous waste in a designated hazardous waste storage area (or in a designated satellite accumulation area) that is covered or protected from the weather; has an impermeable floor, surrounded by curbing or use spill pallets; and is more than 50 feet away from the facility property line if ignitable or reactive hazardous waste is stored in the area.

Hazardous waste storage areas should be managed as follows:

- Identify as hazardous and non-hazardous waste appropriately;
- Arrange the containers by waste type, keeping similar hazardous wastes together;
- Separate any incompatible waste by a dike, berm, wall, or other containment device;
- Turn containers so labels may be read easily and ensure that enough isle space is left between drums to inspect for leaks and to gain access to respond to spills or fire;
- Handle waste containers carefully to prevent rupture or leaks and protect containers from extreme temperatures;
- Large quantity generators, and in some states, small quantity generators must have a contingency plan; weekly inspections of hazardous wastes; and specific training provided to personnel; and
- Hazardous waste can only be disposed of at approved facilities. Contact the Field Environmental Representative for a list of approved facilities.

3.2 NON-HAZARDOUS WASTE

Common wastes include, but are not limited, to oily rock/soil, oily rags, sandblast abrasive (depending on type and use), and general trash/garbage.

Non-hazardous waste storage areas should be managed as follows:

- Turn containers so labels may be read easily;

- Non-hazardous waste is waste that has not been found to be hazardous through testing or by generator knowledge but has special transportation and disposal requirements, which may include State permitting and approvals;
- Store non-hazardous wastes using one of the following methods:
  - In DOT-approved containers;
  - In a frac tank (bulk liquid wastes);
  - In a covered steel roll-off container with a poly-liner (e.g., bulk solid wastes like contaminated soil or used sandblasting abrasive); and
  - On a thick poly-liner and provide the area with a poly-liner cover and temporary containment berm (bulk solid wastes).
- When using DOT-approved containers, ensure the containers are:
  - Kept closed or sealed (except when waste is being added); and
  - In good condition (not damaged, leaking or corroded).
- Label non-hazardous waste containers (drums, tanks, roll-off containers) with a non-hazardous waste label identifying the contents as soon as waste is placed into the container;
- Store non-hazardous waste segregated from hazardous waste storage or satellite accumulation areas; and
- Non-hazardous waste can only be disposed of at approved facilities. Contact the Field Environmental Representative for a list of approved facilities.

Some States allow sandblast sand to be left in the ditch if sandblasting bare pipe only. Contact the Project Environmental Coordinator to verify if this type of activity may occur.

3.3 SPECIAL WASTE (ASBESTOS AND PCB)

Common wastes include, but are not limited to: asbestos or asbestos containing material ("ACM") and PCBs.

3.3.1 Asbestos/ACM

Check with the Project Environmental Coordinator to determine if there are any additional state-specific requirements that may apply. However, at a minimum:

- Store in double, six-mil thick plastic bags, or single bags in DOT-approved drums.
- When placing asbestos into waste containers:
  - Ensure that the asbestos is thoroughly wet before closing the container for the final time;
  - Gloves and other solids can be added before sealing;
  - Seal all containers by securing the drum lids or by wrapping the neck of plastic bags with duct tape;
  - Store containers in an area where the waste is secure and not easily disturbed; and
  - For accumulation containers, each item must be individually wrapped and placed in the drum.
- Mark or label the container with the following information:
  - The letters "RQ" for reportable quantity, if the waste contains 1 pound or more of friable asbestos;
  - The word "Waste";
  - The word "Asbestos" and the identification number for asbestos "NA2212";
  - The facility name and address; and

  - A warning label stating "DANGER; CONTAINS ASBESTOS FIBERS; AVOID CREATING DUST; CANCER AND LUNG DISEASE HAZARD".
- Ship asbestos waste to a Company-approved disposal facility. Contact the Field Environmental Representative for a list of approved facilities.
- Pipe coated with non-friable asbestos can be sold and transported to a scrap dealer or individual buyer. Written notification to the dealer or buyer must include a disclosure and release document that indicates that the pipe is coated with an asbestos-containing material. Tennessee has a specific document for this purpose that contains the appropriate language. Contact the Field Environmental Representative for details on transferring pipe coated with non-friable asbestos.
- When preparing sections of pipe coated with friable asbestos-containing material for transportation to a Tennessee-approved disposal facility:
  - Pipe joints must be less than 40 feet long for transportation by trailer (also verify whether or not a specific pipe length is required by the disposal company);
  - Pipe joints must be less than 20 feet long for transportation in a roll-off box;
  - Wrap ends of pipe with polyvinyl and duct tape or place in a sealed roll-off container;
  - A manifest is required for transportation to a disposal facility; and
  - Provide state environmental or health department registration, if applicable.
- Use vehicles that meet DOT requirements to transport asbestos waste. If the amount of asbestos-containing material being transported is 1,000 pounds or more, a commercial driver's license with hazardous materials endorsement is required.
- Ensure that the vehicle transporting regulated asbestos-containing material (friable) from the facility is marked with signs warning of asbestos danger while the vehicle is being loaded or unloaded. The sign should read "DANGER; ASBESTOS DUST HAZARD; CANCER AND LUNG DISEASE HAZARD; AUTHORIZED PERSONNEL ONLY".
- Inspect all containers before and after unloading/loading to ensure:
  - All drum tops are secured;
  - Duct tape has been placed around the necks of all bags and there are no punctures. Place additional bags over the outside of any punctured bags and secure the necks of the new bags with duct tape; and
  - All containers are properly labeled.
- The type of shipping papers required depends on the applicable state. A waste shipping record must be completed for each shipment. Check with the Project Environmental Coordinator to determine if there are any additional state-specific requirements that may apply.
- Ensure shipping papers are completed as follows:
  - Check the "RQ" column on the shipping paper or mark "RQ" before the shipping name if the shipment contains 1 pound or more of friable asbestos;
  - DOT shipping name is "Waste Asbestos" or, if the asbestos waste is mixed with a binder, filler, or other material, "Waste Asbestos Mixture";
  - Hazard Class Identification Number is "Class 9";
  - North American Identification Number is "NA2212"; and
  - Packing group is "PG III".
- Never dispose of asbestos-containing wastes by placing it in a container with other trash, by burying, using as fill material, or leaving in a pipe excavation ditch.
- Dispose of asbestos-containing wastes as soon as practicable at a disposal facility that is permitted to accept asbestos. Contact the Field Environmental Representative for a list of approved disposal sites for asbestos-containing wastes.

3.3.2 PCB Waste

In some states, PCB wastes are hazardous wastes and all hazardous waste requirements must be followed in addition to those listed in this Waste Management Plan. Check with the Project Environmental Coordinator to determine if there are any additional state-specific requirements that may apply.

- PCB wastes may be stored for 30 days without any special storage requirements.
- PCB wastes may be stored up to 1 year within an USEPA-defined storage area. Contact the Project Environmental Coordinator for assistance on setting up a PCB waste storage area.
- At a minimum, store liquid PCB wastes in DOT-approved containers or on pallets with containment designed to capture any drips or leaks.
- Protect storage containers or equipment from weather.
- Mark PCB wastes with the proper PCB label before placing into storage. The basic PCB label is 6"x6", white or yellow, which can be reduced as small as 2"x2".
- Mark all PCB wastes with the date the item was removed from service or the date that the waste was generated and enter this information on the PCB waste log. Mark the storage area with a sign.
- Company vehicles can only be used to transport PCB wastes from a Company location where the waste was generated to another Company location where the waste will be stored. Placards are required if transporting:
  - More than 99.4 pounds of PCB waste in containers; and
  - One or more PCB transformers with 500 parts per million ("ppm") or more PCBs.
- Check containers before and after loading to ensure that they are in good condition, are not leaking, and that all covers are secured.
- A hazardous waste manifest must accompany each shipment of PCB waste.
- Contact the Project Environmental Coordinator for a list of Tennessee-approved PCB disposal facilities. Dispose all PCB wastes at an approved facility.
- Once the PCB waste has been shipped to an approved disposal facility, the owner or operator of the disposal facility will send the manifest and acknowledgement of receipt to the generator identified on the manifest which accompanied the shipment of PCB waste within 30 days of the date the disposal facility received the waste. If an acknowledgement of receipt is not received with the manifest, the waste generators will confirm by telephone by the close of business that the disposal facility received the manifested waste and document the acknowledgement in the PCB log. The disposal facility should also send a Certificate of Disposal within 30 days of actual disposal of the waste.

3.4 UNIVERSAL WASTE

Common wastes include, but are not limited to: batteries, thermostats, and fluorescent light bulbs.

- If any universal waste is generated during construction, contact the Field Environmental Representative for storage and disposal instructions.

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ATTACHMENT N5

HORIZONTAL DIRECTIONAL DRILL CONTINGENCY PLAN

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1.0 INTRODUCTION

Tennessee Gas Pipeline Company, L.L.C. ("Tennessee" or "TGP") 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"). The Environmental Report ("ER") is submitted in support of the application. 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 proposed Project will include construction of approximately 420 miles of pipeline (new pipeline, looping pipeline segments, and laterals) in Pennsylvania, New York, Massachusetts, New Hampshire, and Connecticut. Additionally, as part of the Project, Tennessee proposes to construct new compressor and meter stations and modify existing compressor and meter stations along its proposed and existing pipeline system. There will also be construction of appurtenant facilities, including mainline valves ("MLVs"), cathodic protection, and pig facilities through the Project area.

Tennessee proposes to use the horizontal directional drilling ("HDD") methodology to install 30-inch diameter pipeline proposed as part of the Project. Tennessee is proposing to use the HDD methodology to avoid certain roadways, railroad tracks, and sensitive resource areas that present difficulties for conventional construction methodologies. HDD is a widely-used trenchless construction method that accomplishes the installation of pipelines and buried utilities with minimal impact to the obstacle being crossed; however, the amount of workspace required for equipment staging is greater than the open-cut crossing method. The purpose of this HDD Plan is to present Tennessee's HDD feasibility assessment as well as Tennessee's plan for site preparation and for minimizing environmental impact associated with HDD drilling fluids. A list of HDD crossing in Connecticut is included in Table 1.0-1.

Table 1.0-1
Horizontal Directional Drilling Crossings for the Project in Connecticut

Facility Name	County	Township/Town	Segment[1]	Milepost[2]		Comment	Approx. Length (feet)[3,4]
				Begin	End		
300 Line Connecticut Loop	Hartford	Windsor	S	11.29	11.59	Avoidance of Farmington River	1,570
						Total	**1,570**

[1] Each segment is associated with its own set of MPs beginning at MP 0.00.
[2] Begin/End MPs are at the approximate locations of HDD entry/exit pits.
[3] Lengths are approximate and subject to field verification.
[4] For exact lengths refer to the HDD site-specific drawings.

2.0 FEASIBILITY ASSESSMENT

2.1 TECHNICAL FEASIBILITY

Tennessee has not yet completed geotechnical site investigations of all proposed HDD locations. However, when completed, this effort will include performing multiple boreholes at the HDD crossing along the proposed pipeline alignment, reviewing the boring logs from the subsurface investigation, and conducting soil and core sample laboratory testing. Tennessee's geotechnical investigations will determine if the proposed crossing is geotechnically feasible.

2.2 CONTINGENCY PLANS FOR FLOODING

Tennessee recognizes the potential for localized short-term flooding events and longer term flooding events during construction, including HDD activities. Tennessee will be prepared for both types of events through diligent planning, attentive monitoring, and proper site preparation.

If a short-term flooding event occurs before construction crews have mobilized to the site, the construction crews will wait until water levels subside before mobilizing and setting up. If a short-term flooding event occurs after construction crews have mobilized and set up, construction crews will react appropriately depending on the water level. If the water level is such that work can be performed safely and in accordance with Tennessee's Upland Erosion Control, Revegetation and Maintenance Plan (Attachment N14) and Tennessee's Wetland and Waterbody Construction and Mitigation Procedures (Attachment N15), construction will continue using site preparation techniques for saturated conditions and proper monitoring will continue to ensure any water does not reach a level that is unmanageable. If there is a potential that water could reach a level that could jeopardize safety and/or compliance with Tennessee's Plan and Procedures, Tennessee will demobilize crews and equipment until the water level subsides.

In preparation for longer term/seasonal flooding events near major waterbodies, Tennessee will plan to schedule construction during the months when historical data indicates lower streamflow. If flooding occurs during the historically lower streamflow months, Tennessee will wait until conditions improve so that work can be performed safely and in accordance with Tennessee's Plan and Procedures.

2.3 CONTINGENCY IF HDD IS UNSUCCESSFUL

In the event that an HDD installation is unsuccessful, Tennessee will evaluate the failed installation to determine if the conditions that resulted in the failure can be effectively mitigated. Tennessee will notify the appropriate regulatory agencies of the failed installations and provide information to determine whether a second HDD attempt has a reasonable chance to succeed. If it is determined that a second HDD attempt has a reasonable chance of success, Tennessee will relocate the entry and/or exit point as necessary (subject to any necessary approvals to move the entry and/or exit point locations) and proceed with a second attempt to install the crossing by HDD. If this second HDD attempt fails (or if Tennessee determines that a second HDD attempt does not have a reasonable chance to succeed), the crossing will be installed by open cut excavation or other alternative construction method along roughly the same alignment as the initial HDD attempt. In the event that a drilled hole is abandoned, the hole will be filled with a mixture of bentonite and drilled spoil.

Tennessee would provide on-site inspection during the HDD process to maintain adequate daily progress reports, as-built information, and other applicable construction documentation that would describe the events leading up to an HDD failure. Tennessee would submit this documentation to the appropriate agencies, notifying them of the HDD failure and the subsequent schedule for implementing the approved alternate crossing method. The HDD Contractor would not demobilize until Tennessee has received approvals from the appropriate regulatory agencies for an alternate crossing method. The alternate crossing method would not be implemented until Tennessee has received confirmation that appropriate agencies have received the documentation of HDD failure and approved an alternative crossing method.

3.0 SITE PREPARATION

3.1 RIGSITE AND PULL SECTION

A typical large rig HDD spread can be moved onto a site in 7 to 10 tractor-trailer loads. Workspace dimensions of 250 feet by 200 feet are typically required at entry and exit points to support the drilling operation. Positioning of equipment within this work area will vary due to differing Contractor preferences and setup requirements; however; the entry point fixes the location of the rig, control cab, and drill pipe. The rig must be aligned with the drilled segment and positioned no more than 25 feet back from the entry point. The control cab and drill pipe must be positioned adjacent to the rig.

The rig site must be cleared and graded as necessary to allow movement and erection of equipment. Equipment typically is supported on the ground surface, although timber mats may be used where soft ground is encountered. In the event that water levels do not allow for use of timber mats, a working platform will be constructed with geotextile fabric underneath rock. The perimeter of the workspace will be lined with sediment barriers to prevent sediment or drilling fluids from leaving the site. As with any construction, Tennessee's HDD Contractor will have adequate supplies of pumps, hay bales, silt fence, and sand bags on-site.

Wheeled vehicle access to the rig site must be maintained throughout the course of construction for delivery of fuel and supplies. If soft ground is encountered, access will be maintained with timber mats or geotextile fabric underneath rock. Access to support HDD operations in the immediate vicinity of the exit point will require a dry work site and vehicle access. These activities will be carried out in accordance with the Tennessee's Plan and Procedures.

Pull section fabrication is accomplished using the same construction methods used to lay a pipeline; therefore, similar workspace is required. It is preferable to have workspace in line with the drilled segment and extending back from the exit point the length of the pull section, plus 200 feet. This length allows the pull section to be prefabricated in one continuous length prior to installation. If space is not available, the pull section may be fabricated in two or more sections, which are welded together during installation. Workspace for pull section fabrication must be cleared and may need to be graded level. Equipment typically is supported on the ground surface, although timber mats may be used where soft ground is encountered. These activities will be carried out in accordance with Tennessee's Plan and Procedures.

3.2 BORE PITS

Drilling fluid collection pits will be excavated within roughly 20 feet of both the entry and exit points to contain drilling fluid returning from the hole until it can be pumped into aboveground tanks for processing. The specific locations and dimensions of these collection pits will be determined by the selected HDD Contractor based on factors like positioning of equipment and anticipated drilling fluid pumping rates. Typically, drilling fluid collection pit dimensions are 10 feet long by 10 feet wide by 5 feet deep.

3.3 ADDITIONAL TEMPORARY WORKSPACE

Additional temporary workspace ("ATWS") is typically required for the pull section fabrication portion of the HDD process. The configuration and size of ATWS areas will be based on site-specific conditions and will vary in accordance with the construction methodology, crossing type, and other construction needs. ATWS is shown on Project aerial alignment sheets (Attachment N1) and the site-specific HDD plan and profile drawings, provided in the FERC Project Environmental Report ("ER").

3.4 SPOIL STORAGE AND DISPOSAL

Spoil resulting from HDD operations will either be stored within the limits of the temporary workspace ("TWS") or hauled to a remote disposal site in accordance with applicable environmental regulations, right-of-way ("ROW") and workspace agreements, and permit requirements.

3.5 DEPTH AND DIAMETER OF BORE HOLE

The depths of the proposed HDD installations will be shown on the site-specific HDD plan and profile drawings, (Volume II, Appendix O). The minimum diameter of the pre-reamed boreholes for pipeline installations is anticipated to be 12 inches greater than the diameter of the product pipe, in accordance with HDD industry standards.

3.6 WATER SOURCE

Preliminary sources of HDD pre-test segment water sources and volumes for the proposed Project are identified in Table 3.6-1. Tennessee will create a water withdrawal plan to be provided with the Implementation Plan prior to construction, which will ensure that prescribed thresholds from the applicable state agencies are not surpassed during the water withdrawal process. Tennessee will apply for the appropriate water withdrawal permits using a preliminary plan based on estimated water volume and withdrawal timing needs.

Table 3.6-1
Approximate Horizontal Directional Drill Water Usage in Connecticut

HDD ID[1]	Potential Water Source	Segment[2]	Approximate Milepost	Water Quantity[3] (gallons)
HDD-15	Farmington River	S	11.46	500,000
			Total	**500,000**

1 HDD IDs are identified on the Horizontal Directional Drill Site Specific drawings.

2 Each segment is associated with its own set of mileposts beginning at MP 0.00.

3 Water Quantity is the approximate water required for executing the drill (pilot bore, reaming, swab, and pull back operations) and for buoyancy control during construction. The water quantities are conservative estimates and may vary based on site specific conditions.

4.0 DRILLING FLUID CONTINGENCY PLAN

4.1 BACKGROUND

All stages of HDD involve circulating drilling fluid from surface equipment, through the drill pipe to the down-hole assembly, and back to the surface through the annular space between the pipe and the wall of the hole. Drilling fluid returns collected at the entry and exit points are processed through the cleaning system, which removes spoil from the drilling fluid and allows it to be reused. The cleaning system uses mechanical separation by shakers, de-sanders, and de-silters. Drilling fluid and cuttings will be transported to an approved disposal site.

4.2 DRILLING FLUID FUNCTIONS

The principal functions of drilling fluid in HDD pipeline installation are listed below.

4.2.1 Jetting

On crossings through soft soils, soil is excavated by jetting high velocity fluid streams through nozzles on drill bits or reaming tools.

4.2.2 Power Downhole Mud Motor

On crossings through harder soils or rock, power required to turn the bit and mechanically drill a hole is transmitted to a downhole motor by the drilling fluid.

4.2.3 Transportation of Spoil

Drilled spoil, consisting of excavated soil or rock cuttings, is suspended in the fluid and carried to the surface by the fluid stream flowing in the annulus between the pipe and the wall of the hole.

4.2.4 Hole Stabilization

Stabilization of the drilled hole is accomplished by the drilling fluid building up a "wall cake", which seals pores and holds soil particles in place. This process is critical in HDD pipeline installation as holes are often in unconsolidated formations and are uncased.

4.2.5 Cooling and Cleaning of Cutters

The downhole assembly gets hot during drilling. The drilling fluid cools the bits and cutters on the downhole assembly. Drilled spoil build-up on the bit or reamer cutters is removed by high velocity fluid streams directed at the cutters. Cutters are also cooled by the fluid.

4.2.6 Reduction of Friction

Friction between the pipe and the drilled hole is reduced by the lubricating properties of the drilling fluid.

4.3 DRILLING FLUID COMPOSITION

The major component of drilling fluid used in HDD pipeline installation is fresh water obtained at the crossing location. In order for water to perform the required functions, it is generally necessary to modify its properties by adding a viscosifier. The viscosifier used almost exclusively in HDD drilling fluids is naturally occurring bentonite clay typically mined by "open pit" methods from locations in Wyoming and South Dakota. Bentonite is soft clay, formed by the weathering of volcanic ash, with the unique characteristic of swelling to several times its original volume when contacted by water. It is not a hazardous material as defined by the U.S. Environmental Protection Agency's ("USEPAs") characteristics of ignitability, corrosivity, reactivity, or commercial chemicals. It is also used to seal earth structures (e.g., ponds or dams and as a suspending component in livestock feeds).

The properties of bentonite used in drilling fluids are often enhanced by the addition of polymers. This enhancement typically involves increasing the yield. That is, reducing the amount of dry bentonite required to produce a given amount of drilling fluid. Non-treated bentonite yields in excess of 85 barrels (3,570 gallons) of drilling fluid per ton of material. Addition of non-toxic polymers to produce high yield bentonite can increase the yield to more than 200 barrels (8,400 gallons) per ton of material. Typical HDD drilling fluids are made with high yield bentonite and are composed of less than 4 percent viscosifier by volume, with the remaining components being water and drilled spoil. The drilling fluid is non-toxic and meets National Sanitation Foundation International/American National Standards Institute ("ANSI") Standard 60 for safe drinking water requirements. This is the same drilling fluid used for drilling drinking water wells, so there is no risk to drinking water from its use.

4.4 DISPOSAL OF EXCESS DRILLING FLUID

Disposal of excess drilling fluid will be the responsibility of the selected HDD Contractor. Prior to beginning HDD operations, the Contractor will be required to submit its proposed drilling fluid disposal procedures to Tennessee for approval. Tennessee will review these procedures and verify that they comply with all environmental regulations, ROW and workspace agreements, and permit requirements.

The method of disposal applied to each crossing will be dependent upon the size and location of the crossing, as well as any applicable regulations. Potential disposal methods include transportation to a

remote disposal site or land farming on the construction workspace with the approval of the landowner. Land farming involves distributing the excess drilling fluid evenly over an open area and mechanically incorporating it into the soil. Where land farming is employed, the condition of the land farming site will be governed by Tennessee's standard cleanup and site restoration specifications. Land farming will not be employed where prohibited by state and local regulations.

4.5 MINIMIZATION OF ENVIRONMENTAL IMPACT

The most effective way to minimize environmental impact associated with HDD drilling fluids is to maintain drilling fluid circulation to the extent practicable. However, resources spent in an effort to maintain circulation should be weighed against the potential benefits achieved through full circulation. It should be recognized that in subsurface conditions that are not conducive to annular flow, restoration of circulation may not be practicable or possible. In such cases, environmental impacts can often be minimized most effectively by completing HDD operations in the shortest possible amount of time.

Steps that may be taken by the Contractor to either prevent lost circulation or regain circulation include, but are not limited to, the following:

- Size the hole frequently by advancing and retracting the drill string in order to keep the annulus clean and unobstructed;
- When drilling fluid flow has been suspended, establish circulation slowly before advancing;
- Minimize annular pressures by minimizing density and flow losses. Viscosity should minimally meet hole cleaning and stabilization requirements;
- Minimize gel strength;
- Control balling of material on bits, reaming tools, and pipe in order to prevent a plunger effect from occurring;
- Control penetration rates and travel speeds in order to prevent a plunger effect from occurring;
- Seal a zone of lost circulation using a high viscosity bentonite plug;
- Employ the use of lost circulation materials. Note that any lost circulation materials proposed for use must be approved by Tennessee prior to utilization; and
- Suspend drilling activities for a period of 6 to 8 hours.

Inadvertent returns are the unplanned and uncontrolled release of drilling mud to the surrounding rock and sand, which travels towards the ground surface. Inadvertent returns typically occur through rock fractures, low density soils or unconsolidated geology. If inadvertent surface returns occur on dry land, it will be the responsibility of the HDD Contractor to contain, collect, and restore the disturbed area in accordance with the requirements of Tennessee's construction specifications. If inadvertent returns occur within a wetland, waterway or other sensitive areas, Tennessee will notify appropriate parties and evaluate the potential impact of the release on a site-specific basis in order to determine an appropriate course of action. In general, Tennessee does not believe that it is environmentally beneficial to try to contain and collect drilling fluid returns in a waterway. HDD drilling fluids are nontoxic and discharge of the amounts normally associated with inadvertent returns does not pose a threat to the environment and public health and safety (Section 4.3). Placement of containment structures and attempts to collect drilling fluid within a waterway often result in greater environmental impact than simply allowing the drilling fluid returns to dissipate naturally.

4.6 MONITORING

To ensure that HDD operations are conducted in accordance with established requirements and standard HDD Industry practice, Tennessee will provide an engineer experienced in HDD construction to monitor the HDD Contractor's performance at the jobsite. The primary functions of Tennessee's Field Engineer will be to document construction activities, report on the HDD Contractor's performance, and notify Tennessee if the HDD Contractor fails to conform to established requirements. Established requirements to which the HDD Contractor must conform to include, but are not limited to, the construction drawings, technical specifications, permits, easement agreements, and Contractor submittals.

The monitoring protocol that will be applied by Tennessee's Field Engineer relative to drilling fluid related issues is described in detail below.

Drilling Fluid Monitoring Protocol

The drilling fluid monitoring protocol to be applied will vary depending upon the following operational conditions:

- Condition 1: Full Circulation;
- Condition 2: Loss of Circulation; and
- Condition 3: Inadvertent Returns.

Monitoring Protocol for Condition 1 – Full Circulation

When HDD operations are in progress and full drilling fluid circulation is being maintained at one or both of the HDD endpoints, the following monitoring protocol will be implemented:

- The presence of drilling fluid returns at one or both of the HDD endpoints will be periodically documented;
- Land-based portions of the drilled alignment will be periodically walked and visually inspected for signs of inadvertent drilling fluid returns as well as surface heaving and settlement. Waterways will be visually inspected from the banks for a visible drilling fluid plume; and
- Drilling fluid products present at the jobsite will be documented.

If an inadvertent drilling fluid return is detected during routine monitoring, the monitoring protocol associated with Condition 3 will be implemented immediately.

Monitoring Protocol for Condition 2 – Loss of Circulation

When HDD operations are in progress and drilling fluid circulation to the HDD endpoints is lost or severely diminished, the following monitoring protocol will be implemented. It should be noted that lost circulation is common and anticipated during HDD installation and does not necessarily indicate that drilling fluid is inadvertently returning to a point on the surface.

- Tennessee's Field Engineer will notify Tennessee that drilling fluid circulation to the HDD endpoints has been lost or severely diminished.

- Tennessee's Field Engineer will document steps taken by the HDD Contractor to restore circulation. If the Contractor fails to comply with the requirements of the HDD Specification, Tennessee's Field Engineer will notify Tennessee so that appropriate actions can be taken.
- If circulation is regained, Tennessee's Field Engineer will inform Tennessee and resume the monitoring protocol associated with Condition 1.
- If circulation is not re-established, Tennessee's Field Engineer will increase the frequency of visual inspection along the drilled path alignment as appropriate. Additionally, Tennessee's Field Engineer will document periods of Contractor downtime (during which no drilling fluid is pumped) and the Contractor's drilling fluid pumping rate should it become necessary to estimate lost circulation volumes.

Monitoring Protocol for Condition 3 – Inadvertent Returns

If an inadvertent return of drilling fluids is detected, the following monitoring protocol will be implemented:

- Tennessee's Field Engineer will first reduce the pressure, if possible and commence containment of drilling mud.
- Tennessee's Field Engineer will then notify Tennessee that an inadvertent drilling fluid return has occurred and provide documentation with respect to the location, magnitude, and potential impact of the return.
- If the inadvertent return occurs on land, Tennessee's Field Engineer will document steps taken by the HDD Contractor to contain and collect the return. Inadvertent surface returns of drilling fluids will be contained immediately with hand placed barriers (i.e., hay bales, sand bags, silt fences, etc.) and collected using pumps, as practicable. If the amount of the surface return is not enough to allow practical collection, the affected area will be diluted with fresh water and the fluid allowed to dry and dissipate naturally. If the amount of the surface return exceeds that which can be contained with hand placed barriers, small collection sumps (less than 5 cubic yards) may be used. If the amount of the surface return exceeds that which can be contained and collected using small sumps, drilling operations will be suspended until surface return volumes can be brought under control. If the Contractor fails to comply with the requirements of the HDD Specification, Tennessee's Field Engineer will notify Tennessee so that appropriate actions can be taken.
- If the inadvertent return occurs in a waterway, Tennessee, after notifying appropriate regulatory agencies, will determine if the return poses a threat to the environment.
- If it is determined by the EI that the return does not pose a threat to the environment, such as sensitive environmental areas, protected species or their habitat, and/or cultural or archaeological sites, HDD operations will continue. Tennessee's Field Engineer will monitor and document the inadvertent return as well as periods of Contractor downtime and the Contractor's drilling fluid pumping rate in case it becomes necessary to estimate inadvertent return volumes.
- If it is determined by the EI that the return does pose a threat to the environment, such as sensitive environmental areas, protected species or their habitat, and/or cultural or archaeological sites, drilling operations will be suspended until containment measures are implemented by the Contractor. Documentation of any containment measures employed will be provided by Tennessee's Field Engineer. Once adequate containment measures are in place, the Contractor will be permitted to resume drilling operations, subject to the condition that drilling operations will again be suspended immediately should the containment measures fail. Tennessee's Field Engineer will periodically monitor and document both the inadvertent return and the effectiveness

of the containment measures. Periods of Contractor downtime and the Contractor's drilling fluid pumping rate also will be documented in case it becomes necessary to estimate inadvertent return volumes. Upon completion of the HDD installation, Tennessee will clean up the drilling fluid returns to the satisfaction of appropriate regulatory agencies and any affected parties.

4.7 NOTIFICATION

In the event of an inadvertent drilling fluid return within a waterway, Tennessee will contact the following agencies no later than 24 hours after detection: United States Army Corps of Engineers; Pennsylvania State Department of Environmental Protection; and U.S. Fish and Wildlife Service ("USFWS") will also be contacted in the event of potential impacts to federal-listed species. Details of the inadvertent return within a waterway will contain, at a minimum:

- The location and nature of the release;
- Corrective actions being taken; and
- Whether the release poses any threat to public health and safety.

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ATTACHMENT N6

PLAN FOR UNANTICIPATED DISCOVERIES OF CULTURAL AND PALEONTOLOGICAL RESOURCES AND HUMAN REMAINS

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Table 4a-1
Pennsylvania Unanticipated Discoveries Contact Information

Agency	Contact	Address and Phone Number	Email
PA GS	Gale Blackmer	DCNR – Bureau of Topographic and Geologic Survey 3240 Schoolhouse Road Middletown, PA 17057-3534 (717) 702-2032	gblackmer@pa.gov
Tribal Contacts			
Stockbridge-Munsee Band of Mohican Indians	Bonney Hartley THPO	400 Broadway #718 Troy, NY, 12181 (518) 326-8870	Bonney.Hartley@mohican-nsn.gov
Oneida Nation of Wisconsin	Corina Williams THPO	P.O. Box 365 Oneida, WI 54155-0365 (920) 496-5386	cwilliam@oneidanation.org
Saint Regis Mohawk Tribe	Arnold Printup THPO	412 State Route 37 Akwesasne, NY 13655 (518) 358-2272 x163	arnold.printup@srmt-nsn.gov
Seneca Nation of Indians	Scott Abrams THPO	90 Ohio Way Salamanca, NY 14779 (716) 945-1790 x 3580	Scott.Abrams@sni.org
	Jay Toth Tribal Archaeologist		jay.toth@sni.org
Oneida Indian Nation	Jesse Bergevin Historic Resources Specialist	2037 Dream Catcher Plaza Oneida, NY13421 (315) 829-8463	jbergevin@oneida-nation.org
	Ray Halbritter Nation Representative	5218 Patrick Road Verona, NY 13478	N/A
Onondaga Nation	Tony Gonyea Faithkeeper	RR#1 Box 245 Onondaga Nation, via Nedrow, NY 13120 (315) 952-3109	onondationhispres@aol.com
Cayuga Nation	Clint Halfton, THPO	P.O. Box 803 Seneca Falls, NY 13148 (315) 568-0750	Tina Orbaker (reception) tina.orbaker@gmail.com
Eastern Shawnee Tribe of Oklahoma	Robin Dushane THPO	70500 E 128 Rd. Wyandotte, OK 74370 (918) 553-4104	rdushane@estoo.net
	Dee Gardner		dgardner@estoo.net
Delaware Nation	Nekole Alligood Director	31064 State Highway 281 Anadarko, OK 73005 (405) 247-8903	NAlligood@delawarenation.com
	Jason Ross Section 106 Program Manager		jross@delawarenation.com

Table 4a-1
Pennsylvania Unanticipated Discoveries Contact Information

Agency	Contact	Address and Phone Number	Email
Delaware Tribe	Brice Obermeyer THPO	Delaware Tribe Historic Preservation Office Roosevelt Hall, Rm 212 1200 Commercial St. Emporia, KS 66801	bobermeyer@delawaretribe.org
	Susan Bachor (Eastern Projects Review)	Department of Anthropology Gladfelter Hall, Rm. 207 Temple University 1115 W. Polett Walk Philadelphia, PA 19122 (610) 761-7452	temple@delawaretribe.org
Seneca-Cayuga Tribe of Oklahoma	Paul Barton Historic Preservation Officer	23701 S. 655 Road Grove, OK 74344 (918) 787-7979	pbarton@sctribe.com
Shawnee Tribe	Kim Jumper THPO	29 South 69a Highway Miami, OK 74354 (918) 542-2441	Kim.jumper@shawnee-tribe.com
Tuscarora Nation	Leo Henry	Hope Road Tuscarora Nation Via Lewiston, NY 14092 (716) 601-4737	N/A
	Bryan Printup	5226 Walmore Road Lewiston, NY 14092 (716) 264-6011	bprintup@hetf.org
Tonawanda Seneca Nation	Christine Abrams Darwin Hill, Chief	7027 Meadville Road Basom, NY 14013	tonseneca@aol.com
Absentee-Shawnee Tribe of Oklahoma	Joseph Blanchard, Director of Cultural Preservation	2025 S. Gordon Cooper Drive Shawnee, OK 74801 (405) 275-4030 x 302	joseph.blanchard@astribe.com
	Carol Butler THPO Specialist		carol.butler@astribe.com
Law Enforcement and Coroner/Medical Examiner (for anticipated discoveries of human remains only)			
Bradford County Sherriff	Clinton J. Walters	Bradford County Courthouse 301 Main Street Towanda, PA 18848 (570) 265-1701	bcsheriff@bradfordco.org
Bradford County Coroner	Thomas M. Carman	129 Canton Street Troy, Pa 16947 (570) 297-0720	bccoroner@westernems.com

Table 4a-1
Pennsylvania Unanticipated Discoveries Contact Information

Agency	Contact	Address and Phone Number	Email
Susquehanna County Sherriff	Lance M. Benedict	Susquehanna Courthouse PO Box 218 Montrose, PA 18801 (570) 278-4600	-
Susquehanna County Coroner	Anthony J. Conarton	PO Box 218 Montrose, PA 18801 (570) 278-6630	coroner58@susqco.com

All construction work involving subsurface disturbance in the immediate vicinity of the resource will be halted, unless immediate cessation of construction activities will create an unsafe condition or endanger the construction crew. Specifically, work will be stopped at the location where the potential archaeological resource was found and will not resume within 100 feet (in any direction) of the find until the construction is cleared to proceed.

The cultural resource consultant will conduct an on-site inspection of the identified archaeological discovery by the next business day. The THPO (or a designated tribal representative if a THPO has not been appointed) will be notified of the on-site inspection and provided the opportunity to send a tribal monitor to participate in the site visit. This on-site inspection will assess the nature of the archaeological discovery to determine if it represents an archaeological site and if the site is eligible for inclusion in the National Register of Historic Places ("NRHP"). The cultural resource consultant will contact Tennessee upon returning from the initial inspection with further description of the discovery and a recommendation regarding the need for future treatment. Tennessee will then consult with the FERC, the SHPO, and the THPO to determine the NRHP eligibility of the archaeological discovery. The SHPO and THPO will respond following contacts to all appropriate consulting parties.

If the cultural resource consultant determines that the archaeological discovery is not potentially significant, is an isolated find, or is completely disturbed by prior construction activities, and if the SHPO and THPO concur with this finding, the cultural resource consultant will inform Tennessee that construction may resume. The decision will be documented by the cultural resource consultant. The method of documentation will be determined at the time and, depending on the circumstances, may range from a letter report to an email.

If the cultural resource consultant determines that the archaeological discovery represents a significant archaeological site and the SHPO and THPO concur with this determination, then the cultural resource consultant will develop a plan for additional archaeological investigations and/or mitigation of the identified archaeological site. This plan may include further archaeological study or coordination with Native American groups or other interested parties. The plan will be submitted to Tennessee for their review. Tennessee will then submit this plan to the SHPO and THPO for review and concurrence. If the SHPO and/or THPO fail to comment within two business days of receiving the proposed treatment plan, Tennessee may assume concurrence and implement the plan. All proposed archaeological investigations will conform to the Secretary of Interior's (SOI's) Standards for Archeological Documentation and will be conducted by an archaeologist who meets or exceeds the SOIs Professional Qualification Standards for Archeology as published in the Federal Register ("FR") on September 29, 1983.

Construction in the area of the archaeological site will not resume until all required fieldwork and consultation/coordination tasks are completed. Upon receipt of FERC, SHPO and THPO concurrence that all required fieldwork has been completed, the cultural resource consultant will notify Tennessee that work at the location of the archaeological discovery may resume. The decision will be documented appropriately by the cultural resource consultant. The method of documentation may range from a letter report to an e-mail, depending on the circumstances. A technical report describing the work at all locations where unanticipated discoveries resulted in additional survey and/or data recovery will be prepared and submitted to Tennessee for review within one year of the completion of fieldwork. Tennessee, or an approved agent of Tennessee, will submit the reviewed technical report to the SHPO, the THPO, and the FERC.

Paleontological Resources

In the event that a previously unidentified paleontological resource of possible importance is discovered during ground-disturbing activities, Tennessee will immediately notify the FERC, the applicable state agency, and Tennessee's cultural resources consultant. Contact information for the agencies is listed in Table 4a-1. Generally, within the Project, important paleontological resources that may be found include vertebrate fossils in unconsolidated deposits, such as wetlands, bogs, alluvial deposits, or lake clays. Fossil finds are not regulated in Pennsylvania, except on state or federally owned land, but the presence of Pleistocene vertebrate fossils may signal the associated presence of archaeological materials.

All construction work involving subsurface disturbance in the immediate vicinity of the resource will be halted, unless immediate cessation of construction activities will create an unsafe condition or endanger the construction crew. Specifically, work will be stopped at the location where the potential paleontological resource was found and will not resume within 100 feet (in any direction) of the find until the construction is cleared to proceed by the FERC and the applicable state agency.

Tennessee's cultural resources consultant will conduct an on-site inspection of the identified discovery by the next business day. The consultant will contact Tennessee upon returning from the initial inspection with further description of the discovery and a recommendation regarding the need for future treatment. If archaeological materials are found in association with the paleontological discovery, then investigation and reporting protocols will follow the procedures outlined for historic properties.

Human Remains

Unanticipated discovery of human remains and/or funerary objects found anywhere in the Project area are of concern and must be reported. Human remains may be full burials, may be represented only by decomposing bones found in the ground in an area of darker soil, may be more recent burials with identifiable caskets or their remains, or they may be represented only by an individual bone or tooth. All discoveries must be reported and appropriately addressed. The treatment of any human remains encountered during construction of the Project will be guided by the policy statement adopted by the Advisory Council on Historic Preservation ("ACHP") ("Advisory Council on Historic Preservation, Policy Statement Regarding Treatment of Burial Sites, Human Remains, and Funerary Objects" [ACHP 2007]), by the relevant state laws and guidelines ("Pennsylvania Historical and Museum Commission, Policy on the Treatment of Human Remains"), and Tribal policies, including the Haudenosaunee Tuscarora Nation's "Protocol for Handling Discovery of Human Remains" and "Policy on Human Remains" as well as the Stockbridge-Munsee Band of Mohican Indians' "Policy for Treatment and Disposition of Human Remains and Cultural Items That May be Discovered Inadvertently During

Planned Activities" and "Buffer Zone Policy" (Haudenosaunee Tuscarora Nation, No Date; Stockbridge Munsee Mohican 2002; Appendix 4a-A). It is imperative that all burial sites, human remains, and funerary objects be treated with dignity and respect, and that all measures are taken to protect such remains from undue harm until the area is cleared and reopened to Tennessee for the resumption of Tennessee's activities and operations. Remains should be covered and not moved or disturbed. Whenever possible, Tennessee will preserve human remains in place.

If any personnel on the construction site identifies potential human remains (including teeth, single bones, bone fragments, etc.) or indicators of potential human remains, such as gravestones or other means of marking potential grave sites, all construction work that will affect the remains' integrity or harm them will immediately stop. The remains will be left in place and will not be touched, moved, or further disturbed until assessed by all designated parties (Table 4a-1). Again, the remains will be carefully covered, and access to the area of the remains will be precluded. Per the Stockbridge-Munsee Band of Mohican Indians "Policy for Treatment and Disposition of Human Remains and Cultural Items That May be Discovered Inadvertently During Planned Activities", tobacco will be placed with the remains by a representative of the tribe (Stockbridge Munsee Mohican Tribe 2002).

Immediately upon discovery of possible human remains, Tennessee will contact the FERC, the county coroner and coroner/medical examiner, the SHPO, tribes, and Tennessee's cultural resource consultant (Table 4a-1). The coroner and law enforcement will assess the remains and make the determination of whether or not they are forensic or historical in nature. The medical examiner may also determine if the remains are Native American. A request to hold on photography, pending a determination of ethnicity, will made to the county coroner for consideration.

If the remains are determined to be non-human and no other archaeological features that require evaluation are present, then this will be conveyed to Tennessee. Tennessee will convey these findings to the FERC, the SHPO, and tribes. Upon concurrence with these findings, construction work will resume in the area of the remains.

If the remains are determined to be human and forensic in nature, the remains will come under the jurisdiction of law enforcement. The SHPO and tribes will be notified that the human remains are not historical in nature.

If the remains are determined to be human and historical in nature, the cultural resource consultant and THPO/tribal representatives will conduct a site visit to examine the human remains within 24 hours of discovery. Documentation of non-Native American remains should include photographs, a map indicating the location of the remains, and a brief written description. Upon a determination of Native American ethnicity, however, no photographs or remains or associated funerary objects will be taken. Drawings of remains determined to be of Native American ethnicity will be allowed. This information will be provided to the SHPO and the tribes within 24 hours of the site visit.

If the human remains are determined to be historical in nature but ethnicity cannot be clearly identified, an expert may be brought in to review the remains and determine affiliation. The remains will be left in situ for examination. No additional study of the remains will be authorized without first consulting with the SHPO and tribes.

In consultation with the FERC, SHPO, and coordination with the tribes and other interested parties, Tennessee and the cultural resource consultant will develop a plan for the treatment of the human remains

that are historical in nature. If the remains are determined to be Native American, the plan will be similar to the guidance provided in the Native American Graves Protection and Repatriation Act ("NAGPRA"; 43 CFR 10.5(e)) in keeping with the Unanticipated Historic Properties and Human Remains policy as presented in the FERC's "Guidelines for Reporting on Cultural Resources Investigations for Pipeline Projects" (FERC 2002). If the remains are determined to be non-Native American, the FERC and the cultural resource consultant will coordinate with the SHPO and other appropriate parties to develop a plan. The plan may include preservation in place, exhumation and reburial, scientific study, and/or cultural rituals. The plan will be completed within 15 days of the discovery. Any deviations from the plan during implementation must be approved by the consulting parties. Final decisions regarding the disposition of any human remains and any associated funerary objects, including repatriation, will be made by the FERC.

ATTACHMENT 4a-2: Plan for Unanticipated Discoveries of Cultural and Paleontological Resources and Human Remains – New York

As part of the Section 106 process, a protocol must be developed and put in place for the handling of any unanticipated archaeological resources that might be exposed during the implementation and construction of the proposed Northeast Energy Direct Project (NED Project" or "Project"). For this purpose Tennessee Gas Pipeline Company, L.L.C ("Tennessee"), and its cultural resource consultant have developed the following Unanticipated Discovery Plan ("UDP"). This plan also covers unanticipated discoveries of paleontological resources.

Historic Properties

In the event that a previously unidentified archaeological resource or item of possible historical or cultural importance is discovered during ground-disturbing activities, Tennessee will immediately notify the Federal Energy Regulatory Commission ("FERC"), the appropriate State Historic Preservation Office ("SHPO"), Tribal Historic Preservation Office ("THPO"), or appropriate tribal representative, and their cultural resource consultant. Appropriate contacts organized by state and federal agency are listed in Table 4a-2.

Table 4a-2
New York Unanticipated Discoveries Contact Information

Agency	Contact	Address and Phone Number	Email
FERC	Eric Tomasi	Federal Energy Regulatory Commission 888 First Street, N.E. Washington, DC 20426 (202) 502-8097	eric.tomasi@ferc.gov
FERC	Paul Friedman	Federal Energy Regulatory Commission 888 First Street, N.E. Washington, DC 20426 (202) 502-8059	Paul.Friedman@ferc.gov

Table 4a-2
New York Unanticipated Discoveries Contact Information

Agency	Contact	Address and Phone Number	Email
NY SHPO	Philip Perazio	Division for Historic Preservation New York State Office of Parks, Recreation and Historic Preservation Peebles Island, PO Box 189, Waterford, NY 12188 (518) 237-8643 x 3276	Philip.Perazio@parks.ny.gov
NYSM Office of State Geologist	Lisa Amati	State Paleontologist, Curator of Invertebrate Paleontology and Paleobotany New York State Museum 222 Madison Ave, Albany, NY 12230 518-474-8949	lisa.amati@nysed.gov
Tribal Contacts			
Stockbridge-Munsee Band of Mohican Indians	Bonney Hartley THPO	400 Broadway #718 Troy, NY 12181 (518) 326-8870	Bonney.Hartley@mohican-nsn.gov
Saint Regis Mohawk Tribe	Arnold Printup THPO	412 State Route 37 Akwesasne, NY 13655 (518) 358-2272 x163	arnold.printup@srmt-nsn.gov
Seneca Nation of Indians	Scott Abrams THPO	90 Ohi:yo' Way Salamanca, NY 14779 (716) 945-1790 x 3580	Scott.Abrams@sni.org
	Jay Thoth Tribal Archaeologist		jay.toth@sni.org
Oneida Indian Nation	Jesse Bergevin Historic Resources Specialist	2037 Dream Catcher Plaza Oneida, NY 13421 (315) 829-8463	jbergevin@oneida-nation.org
	Ray Halbritter Nation Representative	5218 Patrick Road Verona, NY 13478	N/A
Oneida Nation of Wisconsin	Corina Williams THPO	P.O. Box 365, Oneida, WI 54155-0365 (920) 496-5386	cwilliam@oneidanation.org
Delaware Tribe of Indians	Brice Obermeyer THPO	Delaware Tribe Historic Preservation Office, Roosevelt Hall, Rm 212 1200 Commercial St. Emporia, KS 66801	bobermeyer@delawaretribe.org

Table 4a-2
New York Unanticipated Discoveries Contact Information

Agency	Contact	Address and Phone Number	Email
	Susan Bachor (Eastern Projects Review)	Department of Anthropology Gladfelter Hall, Rm. 207 Temple University 1115 W. Polett Walk Philadelphia, PA 19122 (610) 761-7452	temple@delawaretribe.org
Delaware Nation	Nekole Alligood Director	31064 State Highway 281 Anadarko, OK 73005 (405) 247-8903	NAlligood@delawarenation.com
	Jason Ross Section 106 Program Manager		jross@delawarenation.com
Onondaga Nation	Tony Gonyea Faithkeeper	RR#1 Box 245, Onondaga Nation, via Nedrow, NY 13120 (315) 952-3109	e-mail via Steven Thomas (stevethomas808@yahoo.com)
Shawnee Tribe	Kim Jumper THPO	29 South 69a Highway Miami, OK 74354 (918) 542-2441	kim.jumper@shawnee-tribe.com
Eastern Shawnee Tribe of Oklahoma	Robin Dushane THPO	12705 E. 705 Road Wyandotte, OK 73502 (918) 666-2435 x247	rdushane@estoo.net
	Dee Gardner Historic Preservation Representative		dgardner@estoo.net
Cayuga Nation	Clint Halfton THPO	PO Box 803 Seneca Falls, NY 13148 (315) 568-0750	e-mail via Tina Orbaker tina.orbaker@gmail.com
Seneca-Cayuga Tribe of Oklahoma	Paul Barton Historic Preservation Officer	23701 S. 655 Road Grove, OK 74344	pbarton@sctribe.com
Tonawanda Seneca Nation of New York	Christine Abrams	7027 Meadville Road Basom, NY 14013 (716) 542-4244 or (716) 542-234	tonseneca@aol.com
	Darwin Hill		
Tuscarora Nation	Leo Henry Chief	Hope Road, Tuscarora Nation Via Lewiston, NY 14092 (716) 601-4737	N/A
	Bryan Printup Section 106 Specialist	5226 Walmore Road Lewiston, NY 14092 (716) 264-6011	bprintup@hetf.org

Table 4a-2
New York Unanticipated Discoveries Contact Information

Agency	Contact	Address and Phone Number	Email
Law Enforcement and Coroner/Medical Examiner Contacts (for unanticipated discoveries of human remains only)			
Broome County Sheriff	David E. Harder	Public Safety Facility 155 Lt. Van Winkle Drive Binghamton, NY 13905 (607) 778-1911	bcsheriff@co.broome.ny.us
Broome County Coroner	-	Broome County Dispatch (607) 788-1911	-
Chenango County Sheriff	Ernest R. Cutting	Chenango County Sheriff's Office 279 County Route 46 Norwich , NY 13815 (607) 334-2000	-
Chenango County Medical Examiner	-	24 Conkey Ave Norwich, NY 13815 (607) 336-8965	-
Delaware County Sheriff	Thomas E. Mills	280 Phoebe Ln, Suite One Delhi, NY 13753 (607) 746-2336	-
Delaware County Medical Examiner	Dr. Richard J. Ucci	13 Railroad Ave, PO Box 67 Stamford, NY 12167 (607) 432-8752	-
Schoharie County Sheriff	Anthony F. Desmond	PO Box 689, 157 Depot Ln Schoharie, NY 12157 (518) 295-8114	-
Schoharie County Coroner	-	276 Main St., PO Box 667 Schoharie, NY 12157 (518) 295-8365	-
Albany County Sheriff	Craig D. Apple Sr.	16 Eagle St. Albany, NY 12207 (518) 487-5400	-
Albany County Coroner	Harold L. Joyce	Albany County Office Building 112 State St, 7Th Floor Albany, NY 12207 (518) 445-7604	-
Rensselaer County Sheriff	Jack Mahar	4000 Main St. Troy, NY 12180 (518) 266-1900	-

Table 4a-2
New York Unanticipated Discoveries Contact Information

Agency	Contact	Address and Phone Number	Email
Rensselaer County Medical Examiner	-	Rensselaer Medical Examiner Office County Office Building Troy, NY 12182 (518) 270-2626	-

All construction work involving subsurface disturbance in the immediate vicinity of the resource will be halted, unless immediate cessation of construction activities will create an unsafe condition or endanger the construction crew. Specifically, work will be stopped at the location where the potential archaeological resource was found and will not resume within 100 feet (in any direction) of the find until the construction is cleared to proceed.

The cultural resource consultant will conduct an on-site inspection of the identified archaeological discovery by the next business day. The THPO (or a designated tribal representative if a THPO has not been appointed) will be notified of the on-site inspection and provided the opportunity to send a tribal monitor to participate in the site visit. This on-site inspection will assess the nature of the archaeological discovery to determine if it represents an archaeological site, and if the site is eligible for inclusion in the National Register of Historic Places ("NRHP"). The cultural resource consultant will contact Tennessee upon returning from the initial inspection with further description of the discovery and a recommendation regarding the need for future treatment. Tennessee will then consult with the FERC, the SHPO, and the THPO to determine the NRHP eligibility of the archaeological discovery. The SHPO and THPO will respond following contacts to all appropriate consulting parties.

If the cultural resource consultant determines that the archaeological discovery is not potentially significant, is an isolated find, or is completely disturbed by prior construction activities, and if the SHPO and THPO concur with this finding, the cultural resource consultant will inform Tennessee that construction may resume. The decision will be documented by the cultural resource consultant. The method of documentation will be determined at the time and, depending on the circumstances, may range from a letter report to an e-mail.

If the cultural resource consultant determines that the archaeological discovery represents a significant archaeological site and the SHPO and THPO concur with this determination, then the cultural resource consultant will develop a plan for additional archaeological investigations and/or mitigation of the identified archaeological site. This plan may include further archaeological study or consultation with Native American groups or other interested parties. The plan will be submitted to Tennessee for their review. Tennessee will then submit this plan to the SHPO and THPO for review and concurrence. If the SHPO and/or THPO fail to comment within two business days of receiving the proposed treatment plan, Tennessee may assume concurrence and implement the plan. All proposed archaeological investigations will conform to the Secretary of Interior's (SOI's) Standards for Archeological Documentation and will be conducted by an archaeologist who meets or exceeds the SOI's Professional Qualification Standards for Archeology as published in the Federal Register on September 29, 1983 (*Federal Register* 48:190:44738-44739).

Construction in the area of the archaeological site will not resume until all required fieldwork and consultation and coordination tasks are completed. Upon receipt of FERC, SHPO and THPO concurrence that all required fieldwork has been completed, the cultural resource consultant will notify Tennessee that work at the location of the archaeological discovery may resume. The decision will be documented appropriately by the cultural resource consultant. The method of documentation may range from a letter report to an e-mail, depending on the circumstances. A technical report describing the work at all locations where unanticipated discoveries resulted in additional survey and/or data recovery will be prepared and submitted to Tennessee for review within one year of the completion of fieldwork. Tennessee, or an approved agent of Tennessee, will submit the reviewed technical report to the SHPO, the THPO, and the FERC.

Paleontological Resources

In the event that a previously unidentified paleontological resource of possible importance is discovered during ground-disturbing activities, Tennessee will immediately notify the FERC, the applicable state agency, and Tennessee's cultural resources consultant. Contact information for the agencies is listed in Table 4a-2. Generally, within the Project area, important paleontological resources that may be found include vertebrate fossils in unconsolidated deposits, such as wetlands, bogs, alluvial deposits, or lake clays. Fossil finds are not regulated in New York, except on state or federally owned land, but the presence of Pleistocene vertebrate fossils may signal the associated presence of archaeological materials.

All construction work involving subsurface disturbance in the immediate vicinity of the resource will be halted, unless immediate cessation of construction activities will create an unsafe condition or endanger the construction crew. Specifically, work will be stopped at the location where the potential paleontological resource was found and will not resume within 100 feet (in any direction) of the find until the construction is cleared to proceed by the FERC and the applicable state agency.

Tennessee's cultural resources consultant will conduct an on-site inspection of the identified discovery by the next business day. The consultant will contact Tennessee upon returning from the initial inspection with further description of the discovery and a recommendation regarding the need for future treatment. If archaeological materials are found in association with the paleontological discovery, then investigation and reporting protocols will follow the procedures outlined for historic properties.

Human Remains

Unanticipated discovery of human remains and/or funerary objects found anywhere in the Project area is of concern and must be reported. Human remains may be full burials, may be represented only by decomposing bones found in the ground in an area of darker soil, may be more recent burials with identifiable caskets or their remains, or they may be represented only by an individual bone or tooth. All discoveries must be reported and appropriately addressed. The treatment of any human remains encountered during construction of the Project will be guided by the policy statement adopted by the Advisory Council on Historic Preservation ("ACHP") ("Advisory Council on Historic Preservation, Policy Statement Regarding Treatment of Burial Sites, Human Remains, and Funerary Objects", [ACHP 2007]) and by the relevant state laws and guidelines ("State Historic Preservation Office/New York State Office of Parks, Recreation and Historic Preservation Human Remains Discovery Protocol") and tribal policies, including the Haudenosaunee Tuscarora Nation's "Protocol for Handling Discovery of Human Remains" and "Policy on Human Remains" (Haudenosaunee Tuscarora Nation n.d.), and the Stockbridge-Munsee Band of Mohican Indian "Policy for Treatment and Disposition of Human Remains

and Cultural Items That May be Discovered Inadvertently During Planned Activities" and "Buffer Zone Policy" (Stockbridge Munsee Mohican 2002) (Appendix 4a-A). It is imperative that all burial sites, human remains, and funerary objects be treated with dignity and respect, and that all measures be taken to protect such remains from undue harm until the area is cleared and reopened to Tennessee for the resumption of Tennessee's activities and operations. Remains should be covered and not moved or disturbed. Whenever possible, Tennessee will preserve human remains in place.

If any personnel on the construction site identifies potential human remains (including teeth, single bones, bone fragments, etc.) or indicators of potential human remains, such as gravestones or other means of marking potential grave sites, all construction work that will affect the remains' integrity or harm them will immediately stop. Again, the remains will be left in place and will not be touched, moved, or further disturbed until assessed by all designated parties (Table 4a-2). The remains will be carefully covered, and access to the area of the remains will be precluded. Per the Stockbridge-Munsee Band of Mohican Indians "Policy for Treatment and Disposition of Human Remains and Cultural Items That May be Discovered Inadvertently During Planned Activities," tobacco will be placed with human remains by a representative of the tribe (Stockbridge Munsee Mohican Tribe 2002).

Immediately upon discovery of possible human remains, Tennessee will contact the FERC, the county police and coroner/medical examiner, the SHPO, tribes, and the cultural resource consultant immediately upon discovery of possible human remains (Table 4a-2). The coroner and law enforcement will assess the remains and make the determination of whether or not they are forensic or historical in nature. The medical examiner may also determine if the remains are Native American.

If the remains are determined to be non-human and no other archaeological features that require evaluation are present, then this will be conveyed to Tennessee. Tennessee will convey these findings to the FERC, the SHPO, and tribes. Upon concurrence with these findings, construction work will resume in the area of the remains.

If the remains are determined to be human and forensic in nature, the remains will come under the jurisdiction of law enforcement. The SHPO and tribes will be notified that the human remains are not historical in nature.

If the remains are determined to be human and historical in nature, the cultural resource consultant and THPO/tribal representatives will conduct a site visit to examine the remains within 24 hours of discovery. Documentation of the non-Native American remains should include photographs, a map indicating the location of the remains, and a brief written description. Upon a determination of Native American ethnicity, no photographs of the remains or associated funerary objects will be taken. However, drawings of remains determined to be of Native American ethnicity will be allowed. The documentation information will be provided to the SHPO and the tribes within 24 hours of the site visit. This information will be provided to the SHPO and the tribes within 24 hours of the site visit.

If the human remains are determined to be historical in nature but ethnicity cannot be clearly identified, an expert may be brought in to review the remains and determine affiliation. The remains will be left in situ for examination. No additional study of the remains will be authorized without first consulting with the SHPO and tribes.

In consultation with the FERC and SHPO and coordination with the tribes and other interested parties, Tennessee and the cultural resource consultant will develop a plan for the treatment of the remains that

are historical in nature. If the remains are determined to be Native American, the plan will be similar to the guidance provided in the Native American Graves Protection and Repatriation Act ("NAGPRA"; 43 CFR 10.5(e)). In keeping with the Unanticipated Historic Properties and Human Remains policy as presented in the FERC's "Guidelines for Reporting on Cultural Resources Investigations for Pipeline Projects" (FERC 2002). If the remains are determined to be non-Native American, the FERC and the cultural resource consultant will coordinate with the SHPO and other appropriate parties to develop a plan. The plan may include preservation in place, exhumation and reburial, scientific study, and/or cultural rituals. Any deviations from the plan during implementation must be approved by the consulting parties. Final decisions regarding the disposition of any human remains and any associated funerary objects, including repatriation, will be made by the FERC.

ATTACHMENT 4a-3: Plan for Unanticipated Discoveries of Cultural and Paleontological Resources and Human Remains – Massachusetts

As part of the Section 106 process, a protocol must be developed and put in place for the handling of any unanticipated archaeological resources that might be exposed during the implementation and construction of the proposed Northeast Energy Direct Project ("NED Project" or "Project"). For this purpose, Tennessee Gas Pipeline Company, L.L.C ("Tennessee") and its cultural resource consultant have developed the following Unanticipated Discovery Plan ("UDP"). This plan also covers unanticipated discoveries of paleontological resources.

Historic Properties

In the event that a previously unidentified archaeological resource or item of possible historical or cultural importance is discovered during ground-disturbing activities, Tennessee will immediately notify the Federal Energy Regulatory Commission ("FERC"), the appropriate State Historic Preservation Office ("SHPO"), Tribal Historic Preservation Office ("THPO") or appropriate tribal representative, Massachusetts Commission on Indian Affairs, and their cultural resource consultant. Appropriate contacts organized by state and federal agency are listed in Table 4a-3.

Table 4a-3
Massachusetts Unanticipated Discoveries Contact Information

Agency	Contact	Address and Phone Number	Email
FERC	Eric Tomasi	Federal Energy Regulatory Commission 888 First Street, N.E. Washington, DC 20426 (202) 502-8097	eric.tomasi@ferc.gov
FERC	Paul Friedman	Federal Energy Regulatory Commission 888 First Street, N.E. Washington, DC 20426 (202) 502-8059	Paul.Friedman@ferc.gov

Table 4a-3
Massachusetts Unanticipated Discoveries Contact Information

Agency	Contact	Address and Phone Number	Email
MA SHPO	Brona Simon	Massachusetts Historical Commission 220 Morrissey Boulevard Boston, MA 02125-3314 (617) 727-8470	brona.simon@sec.state.ma.us
MA Commission on Indian Affairs	John Peters	100 Cambridge Street, Suite 300 Boston, MA 02114 (617) 573-12912	john.peters@state.ma.us
MA Geological Survey	Stephen B. Mabee	Department of Geosciences 269 Morrill Science Center University of Massachusetts 611 North Pleasant Street Amherst, MA 01003-9297 (413) 545-4814	sbmabee@geo.umass.edu
Tribal Contacts			
Stockbridge-Munsee Band of Mohican Indians	Bonney Hartley THPO	400 Broadway #718 Troy, NY 12181 (518) 326-8870	Bonney.Hartley@mohican-nsn.gov
Delaware Nation	Nekole Alligood Director	31064 State Highway 281 Anadarko, OK 73005 (405) 247-8903	NAlligood@delawarenation.com
	Jason Ross Section 106 Program Manager		jross@delawarenation.com
Delaware Tribe of Indians	Brice Obermeyer THPO	Delaware Tribe Historic Preservation Office Roosevelt Hall, Rm 212 1200 Commercial St. Emporia, KS 66801	bobermeyer@delawaretribe.org
	Susan Bachor (Eastern Projects Review)	Department of Anthropology Gladfelter Hall, Rm. 207 Temple University 1115 W. Polett Walk Philadelphia, PA 19122 (610) 761-7452	temple@delawaretribe.org
Mashpee Wampanoag Indian Tribal Council, Inc.	Ramona Peters THPO	483 Great Neck Road South Mashpee, MA 02649 (508) 477-0208 (x101 Ramona Peters and x102 David Weeden)	rpeters@mwtribe.com
	David Weeden Deputy THPO		dweeden@mwtribe.com

Table 4a-3
Massachusetts Unanticipated Discoveries Contact Information

Agency	Contact	Address and Phone Number	Email
Wampanoag Tribe of Gay Head (Aquinnah)	Bettina Washington THPO	20 Black Brook Road Aquinnah, MA 02535-9701 (508) 645-9265	bettina@wampanoagtribe.net
Narragansett Indian Tribe	John Brown THPO	Narragansett Indian Longhouse 4425D South County Trail Charlestown, RI 02813 Mr. Brown (401) 491-9459; Mr. Harris (413) 325-7691; (401) 474-5907	brwnjbb123@aol.com
	Doug Harris Deputy THPO		dhnithpo@gmail.com
Mohegan Tribe of Indians of Connecticut	James Quinn THPO	13 Crow Hill Road Uncasville, CT (860) 862-6893	jquinn@moheganmail.com
Mashantucket Pequot Tribal Nation	Marissa Turnbull THPO	Natural Resources Protection & Regulatory Affairs 550 Trolley Line Blvd. PO Box 3202 Mashantucket, CT 06338-3202 (860) 396-7570	mturnbull@mptn-nsn.gov
Shinnecock Nation	Roddy Smith	Shinnecock Nation Cultural Resource Department PO Box 5006 Southampton, NY 11969	wabush@aol.com
Law Enforcement and Coroner/Medical Examiner Contacts (for unanticipated discoveries of human remains only)			
Office of the Chief Medical Examiner	-	720 Albany Street Boston, MA 02118 (617) 267-6767	Office of the Chief Medical Examiner
Berkshire County Sheriff	Thomas N. Bowler	467 Cheshire Road Pittsfield, MA 01201 (413) 447-7117	-
Hampshire County Sheriff	Robert J. Garvey	492 Pleasant Street Northampton, MA (413) 585-0618	-
Franklin County Sheriff	Christopher Donelan	160 Elm Street Greenfield, MA 01301 (413) 774-4014	-
Middlesex County Sheriff	Peter J. Koutoujian	400 Mystic Avenue Medford, MA 02155 (781) 960-2800	-

Table 4a-3
Massachusetts Unanticipated Discoveries Contact Information

Agency	Contact	Address and Phone Number	Email
Essex County Sheriff	Frank G. Cousins Jr.	20 Manning Ave. (Headquarters) Middleton, MA 01949 (978) 750-1900	-
Worcester County Sheriff	Lewis G. Evangelidis	5 Paul X. Tivnan Drive West Boylston, MA 01583 (508) 854-1800	-

All construction work involving subsurface disturbance in the immediate vicinity of the resource will be halted, unless immediate cessation of construction activities will create an unsafe condition or endanger the construction crew. Specifically, work will be stopped at the location where the potential archaeological resource was found and will not resume within 100 feet (in any direction) of the find until the construction is cleared to proceed.

The cultural resource consultant will conduct an on-site inspection of the identified archaeological discovery by the next business day. The THPO (or a designated tribal representative if a THPO has not been appointed) will be notified of the on-site inspection and provided the opportunity to send a tribal monitor to participate in the site visit. This on-site inspection will assess the nature of the archaeological discovery to determine if it represents an archaeological site, and if the site is eligible for inclusion in the National Register of Historic Places ("NRHP"). The cultural resource consultant will contact Tennessee upon returning from the initial inspection with further description of the discovery and a recommendation regarding the need for future treatment. Tennessee will consult with the FERC, the SHPO, and the THPO to determine the NRHP eligibility of the archaeological discovery. The SHPO and THPO will respond following contacts to all appropriate consulting parties.

If the cultural resource consultant determines that the archaeological discovery is not potentially significant, is an isolated find, or is completely disturbed by prior construction activities, and if the SHPO and THPO concur with this finding, the cultural resource consultant will inform Tennessee that construction may resume. The decision will be documented by the cultural resource consultant. The method of documentation will be determined at the time and, depending on the circumstances, may range from a letter report to an e-mail.

If the cultural resource consultant determines that the archaeological discovery represents a significant archaeological site and the SHPO and THPO concur with this determination, then the cultural resource consultant will develop a plan for additional archaeological investigations and/or mitigation of the identified archaeological site. This plan may include further archaeological study or coordination with Native American groups or other interested parties. The plan will be submitted to Tennessee for their review. Tennessee will then submit this plan to the SHPO and THPO for review and concurrence. If the SHPO and/or THPO fail to comment within two business days of receiving the proposed treatment plan, Tennessee may assume concurrence and implement the plan. All proposed archaeological investigations will conform to the SOIs Standards for Archeological Documentation and will be conducted by an archaeologist who meets or exceeds the SOIs Professional Qualification Standards for Archeology as published in the FR on September 29, 1983.

Construction in the area of the archaeological site will not resume until all required fieldwork and consultation and/or coordination tasks are completed. Upon receipt of FERC, SHPO and THPO concurrence that all required fieldwork has been completed, the cultural resource consultant will notify Tennessee that work at the location of the archaeological discovery may resume. The decision will be documented appropriately by the cultural resource consultant. The method of documentation may range from a letter report to an e-mail, depending on the circumstances. A technical report describing the work at all locations where unanticipated discoveries resulted in additional survey and/or data recovery will be prepared and submitted to Tennessee for review within one year of the completion of fieldwork. Tennessee, or an approved agent of Tennessee, will submit the reviewed technical report to the SHPO, the THPO and the FERC.

Paleontological Resources

In the event that a previously unidentified paleontological resource of possible importance is discovered during ground-disturbing activities, Tennessee will immediately notify the FERC, the appropriate State agency, and Tennessee's cultural resources consultant. Contact information for the agencies is listed in Table 4a-3. Generally, within the Project, important paleontological resources that may be found include vertebrate fossils in unconsolidated deposits, such as wetlands, bogs, alluvial deposits, or lake clays. Fossil finds are not regulated in Massachusetts, except on state or federally owned land, but the presence of Pleistocene vertebrate fossils may signal the associated presence of archaeological materials.

All construction work involving subsurface disturbance in the immediate vicinity of the resource will be halted, unless immediate cessation of construction activities will create an unsafe condition or endanger the construction crew. Specifically, work will be stopped at the location where the potential paleontological resource was found and will not resume within 100 feet (in any direction) of the find until the construction is cleared to proceed by the FERC and the applicable state agency.

Tennessee's cultural resources consultant will conduct an on-site inspection of the identified discovery by the next business day. The consultant will contact Tennessee upon returning from the initial inspection with further description of the discovery and a recommendation regarding the need for future treatment. If archaeological materials are found in association with the paleontological discovery, then investigation and reporting protocols will follow the procedures outlined for historic properties.

Human Remains

Unanticipated discovery of human remains and/or funerary objects found anywhere in the Project is of concern and must be reported. Human remains may be full burials, may be represented only by decomposing bones found in the ground in an area of darker soil, may be more recent burials with identifiable caskets or their remains, or they may be represented only by an individual bone or tooth. All discoveries must be reported and appropriately addressed. The treatment of any human remains encountered during construction of the Project will be guided by the policy statement adopted by the Advisory Council on Historic Preservation ("ACHP") ("Advisory Council on Historic Preservation, Policy Statement Regarding Treatment of Burial Sites, Human Remains, and Funerary Objects" [ACHP 2007]) and by the relevant state laws and guidelines (Massachusetts General Laws c. 7, s. 38A; c. 38, s.6; c. 9, ss. 26A & 27C; and c. 114, s. 17, all as amended, "Know How #4, Information and Assistance from the Massachusetts Historical Commission" [MHC, n.d.], and Tribal policies, including the Stockbridge-Munsee Band of Mohican Indian's "Policy for Treatment and Disposition of Human Remains and Cultural Items That May be Discovered Inadvertently During Planned Activities" and "Buffer Zone

Policy" [Stockbridge Munsee Mohican Tribe 2002] (Appendix 4a-A). It is imperative that all burial sites, human remains, and funerary objects be treated with dignity and respect, and that all measures be taken to protect such remains from undue harm until the area is released to Tennessee for the resumption of Tennessee's activities and operations. Remains should be covered and not moved or disturbed. Whenever possible, Tennessee will preserve human remains in place.

If any personnel on the construction site identifies potential human remains (including teeth, single bones, bone fragments, etc.) or indicators of potential skeletal remains, such as gravestones or other means of marking potential grave sites, all construction work that will affect the remains' integrity or harm them will immediately stop. Again, the remains will be left in place and will not be touched, moved, or further disturbed until assessed by all designated parties (Table 4a-3). The remains will be carefully covered, and access to the area of the remains will be precluded. Per the Stockbridge-Munsee Band of Mohican Indians' "Policy for Treatment and Disposition of Human Remains and Cultural Items That May be Discovered Inadvertently During Planned Activities", tobacco will be placed with human remains by a representative of the tribe (Stockbridge Munsee Mohican Tribe 2002).

Immediately upon discovery of possible human remains, Tennessee will contact the FERC, the county police, the Office of the Chief Medical Examiner ("OCME") in Boston, the SHPO, tribes, and Tennessee's cultural resource consultant (Table 4a-3). Per Massachusetts state law, the medical examiner will assess the remains to determine if they are over 100 years old and if so, contact the State Archaeologist. A request to hold on photography, pending a determination of ethnicity, will be made to the county coroner for consideration.

If the remains are determined to be non-human and no other archaeological features that require evaluation are present, then this will be conveyed to Tennessee. Tennessee will convey these findings to the FERC, the SHPO, and tribes. Upon concurrence with these findings, construction work will resume in the area of the remains.

If the remains are determined to be human and forensic in nature, the remains will come under the jurisdiction of law enforcement. The SHPO and tribes will be notified that the human remains are not historical in nature.

If the remains are determined to be human and historical in nature, the cultural resource consultant and THPO/tribal representatives will conduct a site visit to examine the human remains within 24 hours of discovery. Documentation of non-Native American remains should include photographs, a map indicating the location of the remains, and a brief written description. Upon a determination of Native American ethnicity, no photographs of the remains or associated funerary objects will be taken without first consulting with the tribes. However, drawings of remains determined to be of Native American ethnicity will be allowed. This information will be provided to the SHPO and the tribes within 24 hours of the site visit.

The State Archaeologist will determine if the remains are Native American. The State Archaeologist will, in turn, notify the Commission on Indian Affairs, and all appropriate THPO/tribal representatives that such an evaluation is to be made. The Commission on Indian Affairs may choose to designate a representative to be present during the evaluation. If the remains are Native American, then the State Archaeologist, the Commission on Indian Affairs, THPO/tribal representative(s), and the landowner will confer to decide the disposition of the remains. If it is determined that the remains must be removed, the parties will arrange for their removal. The remains will then be delivered to the Commission on Indian

Affairs for reinterment. All appropriate THPO/tribal representatives will be notified regarding the movement of any Native American remains to the Commission on Indian Affairs.

ATTACHMENT 4a-4: Plan for Unanticipated Discoveries of Cultural and Paleontological Resources and Human Remains – New Hampshire

As part of the Section 106 process, a protocol must be developed and put in place for the handling of any unanticipated archaeological resources that might be exposed during the implementation and construction of the proposed Northeast Energy Direct Project ("NED Project" or "Project"). For this purpose Tennessee Gas Pipeline Company, L.L.C ("Tennessee") and its cultural resource consultant have developed the following Unanticipated Discovery Plan ("UDP"). This plan also covers unanticipated discoveries of paleontological resources.

Historic Properties

In the event that a previously unidentified archaeological resource or item of possible historical or cultural importance is discovered during ground-disturbing activities, Tennessee will immediately notify the Federal Energy Regulatory Commission ("FERC"), the appropriate State Historic Preservation Office ("SHPO"), Tribal Historic Preservation Office ("THPO") or appropriate tribal representative, and their cultural resource consultant. Appropriate contacts organized by state and federal agency are listed in Table 4a-4.

Table 4a-4
New Hampshire Unanticipated Discoveries Contact Information

Agency	Contact	Address and Phone Number	Email
FERC	Eric Tomasi	Federal Energy Regulatory Commission 888 First Street, N.E. Washington, DC 20426 (202) 502-8097	eric.tomasi@ferc.gov
FERC	Paul Friedman	Federal Energy Regulatory Commission 888 First Street, N.E. Washington, DC 20426 (202) 502-8059	Paul.Friedman@ferc.gov
NH SHPO	Edna Feighner	New Hampshire Division of Historical Resources Review and Compliance 19 Pillsbury Street Concord, NH 03301-3570 (603) 271-2813	edna.feighner@dcr.nh.gov
NH Geological Survey	Rick Chormann	State Geologist and Director New Hampshire Geological Survey PO Box 95, 29 Hazen Dr. Concord, NH 03302-0095 (603) 271-1975	frederick.chormann@des.nh.gov

Table 4a-4
New Hampshire Unanticipated Discoveries Contact Information

Agency	Contact	Address and Phone Number	Email
Tribal Contacts			
Narragansett Indian Tribe	John Brown THPO	Narragansett Indian Longhouse 4425D South County Trail Charlestown, RI 02813 Mr. Brown (401) 491-9459; Mr. Harris (413) 325-7691; (401) 474-5907	brwnjbb123@aol.com
	Doug Harris Deputy THPO		dhnithpo@gmail.com
Stockbridge-Munsee Band of Mohican Indians	Bonney Hartley THPO	400 Broadway #718 Troy, NY 12181 (518) 326-8870	Bonney.Hartley@mohican-nsn.gov
Delaware Nation	Nekole Alligood Director	31064 State Highway 281 Anadarko, OK 73005 (405) 247-8903	NAlligood@delawarenation.com
	Jason Ross Section 106 Program Manager		jross@delawarenation.com
Delaware Tribe of Indians	Brice Obermeyer THPO	Delaware Tribe Historic Preservation Office Roosevelt Hall, Rm 212 1200 Commercial Street Emporia, KS 66801	bobermeyer@delawaretribe.org
	Susan Bachor (Eastern Projects Review)	Department of Anthropology, Gladfelter Hall, Rm. 207 Temple University 1115 W. Polett Walk Philadelphia, PA 19122 (610) 761-7452	temple@delawaretribe.org
Wampanoag Tribe of Gay Head (Aquinnah)	Bettina Washington THPO	20 Black Brook Road Aquinnah, MA 02535-9701 (508) 645-9265	bettina@wampanoagtribe.net
Mohegan Tribe of Indians of Connecticut	James Quinn THPO	13 Crow Hill Road Uncasville, CT (860) 862-6893	jquinn@moheganmail.com
Mashantucket Pequot Tribal Nation	Marissa Turnbull THPO	Natural Resources Protection & Regulatory Affairs 550 Trolley Line Blvd. PO Box 3202 Mashantucket, CT 06338-3202 (860) 396-7570	mturnbull@mptn-nsn.gov

Table 4a-4
New Hampshire Unanticipated Discoveries Contact Information

Agency	Contact	Address and Phone Number	Email
Shinnecock Nation	Roddy Smith	Shinnecock Nation Cultural Resource Department PO Box 5006 Southampton, NY 11969	wabush@aol.com
Law Enforcement and Coroner/Medical Examiner Contacts (for unanticipated discoveries of Human Remains only)			
OCME	-	246 Pleasant Street Suite 218 Concord, NH 03301-2598 (603) 271-1235	-
Cheshire County Sheriff	Eliezer "Eli" Rivera	Cheshire County Sheriff's Office 12 Court Street Keene, NH 03431 (603) 352-4238	-
Hillsborough County Sheriff	James A. Hardy	329 Mast Road Goffstown, NH 03045 (603) 627-5610 Or 19 Temple St Nashua, NH 03060 (603) 882-1456	info@hcsonh.us
Rockingham County Sheriff	Michael W. Downing	101 North Road Brentwood, NH 03833 (603) 679-1877 (dispatch)	-

All construction work involving subsurface disturbance in the immediate vicinity of the resource will be halted, unless immediate cessation of construction activities will create an unsafe condition or endanger the construction crew. Specifically, work will be stopped at the location where the potential archaeological resource was found and will not resume within 100 feet (in any direction) of the find until the construction is cleared to proceed.

The cultural resource consultant will conduct an on-site inspection of the identified archaeological discovery by the next business day. The THPO (or a designated tribal representative if a THPO has not been appointed) will be notified of the on-site inspection and provided the opportunity to send a tribal monitor to participate in the site visit. This on-site inspection will assess the nature of the archaeological discovery to determine if it represents an archaeological site, and if the site is eligible for inclusion in the National Register of Historic Places ("NRHP"). The cultural resource consultant will contact Tennessee upon returning from the initial inspection with further description of the discovery and a recommendation regarding the need for future treatment. Tennessee will consult with the FERC, SHPO, and the THPO to

determine NRHP eligibility of the archaeological discovery. The SHPO and THPO will respond following contacts to all appropriate consulting parties.

If the cultural resource consultant determines that the archaeological discovery is not potentially significant, is an isolated find, or is completely disturbed by prior construction activities, and if the SHPO and THPO concur with this finding, the cultural resource consultant will inform Tennessee that construction may resume. The decision will be documented by the cultural resource consultant. The method of documentation will be determined at the time and, depending on the circumstances, may range from a letter report to an e-mail.

If the cultural resource consultant determines that the archaeological discovery represents a significant archaeological site and the SHPO and THPO concur with this determination, the cultural resource consultant will develop a plan for additional archaeological investigations and/or mitigation of the identified archaeological site. This plan may include further archaeological study or coordination with Native American groups or other interested parties. The plan will be submitted to Tennessee for their review. Tennessee will then submit this plan to the SHPO and THPO for review and concurrence. If the SHPO and THPO fail to comment within two business days of receiving the proposed treatment plan, Tennessee may assume concurrence and implement the plan. All proposed archaeological investigations will conform to the Secretary of Interior's (SOI's) Standards for Archeological Documentation and will be conducted by an archaeologist who meets or exceeds the SOIs Professional Qualification Standards for Archeology as published in the FR on September 29, 1983.

Construction in the area of the archaeological site will not resume until all required fieldwork and consultation and/or coordination tasks are completed. Upon receipt of FERC, SHPO and THPO concurrence that all required fieldwork has been completed, the cultural resource consultant will notify Tennessee that work at the location of the archaeological discovery may resume. The decision will be documented appropriately by the cultural resource consultant. The method of documentation may range from a letter report to an e-mail, depending on the circumstances. A technical report describing the work at all locations where unanticipated discoveries resulted in additional survey and/or data recovery will be prepared and submitted to Tennessee for review within one year of the completion of fieldwork. Tennessee, or an approved agent of Tennessee, will submit the reviewed technical report to the SHPO, the THPO, and the FERC.

Paleontological Resources

In the event that a previously unidentified paleontological resource of possible importance is discovered during ground-disturbing activities, Tennessee will immediately notify the FERC, the applicable state agency, and Tennessee's cultural resources consultant. Contact information for the agencies is listed in Table 4a-4. Generally, within the Project, important paleontological resources that may be found include vertebrate fossils in unconsolidated deposits, such as wetlands, bogs, alluvial deposits, or lake clays. Fossil finds are not regulated in New Hampshire, except on state or federally owned land, but the presence of Pleistocene vertebrate fossils may signal the associated presence of archaeological materials.

All construction work involving subsurface disturbance in the immediate vicinity of the resource will be halted, unless immediate cessation of construction activities will create an unsafe condition or endanger the construction crew. Specifically, work will be stopped at the location where the potential paleontological resource was found and will not resume within 100 feet (in any direction) of the find until the construction is cleared to proceed.

Tennessee's cultural resources consultant will conduct an on-site inspection of the identified discovery by the next business day. The consultant will contact Tennessee upon returning from the initial inspection with further description of the discovery and a recommendation regarding the need for future treatment. If archaeological materials are found in association with the paleontological discovery, then investigation and reporting protocols will follow the procedures outlined for historic properties.

Human Remains

Unanticipated discovery of human remains found anywhere in the Project is of concern and must be reported. Human remains may be full burials, may be represented only by decomposing bones found in the ground in an area of darker soil, may be more recent burials with identifiable caskets or their remains, or they may be represented only by an individual bone or tooth. All discoveries must be reported and appropriately addressed. The treatment of any human remains encountered during construction of the Project will be guided by the policy statement adopted by the Advisory Council on Historic Preservation ("ACHP") ("Advisory Council on Historic Preservation, Policy Statement Regarding Treatment of Burial Sites, Human Remains, and Funerary Objects" [ACHP 2007]), by the relevant state laws and guidelines (Title XIX, Historic Preservation Section 227-c:8 a-h; "What to Do Upon Encountering Human Remains, Before or During Land-Altering Activities in New Hampshire" [NH DHR 2008]), and tribal policies (Appendix 4a-A). It is imperative that all burial sites, human remains, and funerary objects be treated with dignity and respect, and that all measures be taken to protect such remains from undue harm until the area is cleared and reopened to Tennessee for the resumption of Tennessee's activities and operations. Remains should be covered and not moved or disturbed. Whenever possible, Tennessee will preserve human remains in place.

If any personnel on the construction site identifies potential human remains (including teeth, single bones, bone fragments, etc.) or indicators of potential human remains, such as gravestones or other means of marking potential grave sites, all construction work that will affect the remains' integrity or harm them will immediately stop. Again, the remains will be left in place and will not be touched, moved, or further disturbed until assessed by all the designated parties (Table 4a-4). The remains will be carefully covered, and access to the area of the remains will be precluded. Per the Stockbridge-Munsee Band of Mohican Indians' "Policy for Treatment and Disposition of Human Remains and Cultural Items That May be Discovered Inadvertently During Planned Activities", tobacco will be placed with human remains by a representative of the tribe (Stockbridge Munsee Mohican Tribe 2002).

Immediately upon discovery of possible human remains, Tennessee will contact FERC, the county police and coroner/medical examiner, the State Archaeologist, tribes, and the cultural resource consultant (Table 4a-4). The coroner and law enforcement will assess the remains and make the determination of whether or not they are forensic or historical in nature. A request to hold on photography, pending a determination of ethnicity, will be made to the county coroner for consideration. If the remains are determined to be historical, the medical examiner will notify the State Archaeologist, who will then take jurisdiction over the remains. Per state law, the State Archaeologist has 48 hours to make arrangements with the landowner for the protection or removal of the human remains (Title XIX, Section 227-c: 8 b). The State Archaeologist may make arrangements with the landowner for a longer period of time if it is agreed to be mutually beneficial. Once the State Archaeologist has taken jurisdiction over the remains, they will be responsible for consultation with THPO/tribal representatives and agencies, analysis, and disposition of the remains as detailed in Title XIX Section 227-c:8 c-g.

If the remains are determined to be non-human and no other archaeological features that require evaluation are present, this will be conveyed to Tennessee. Tennessee will convey these findings to the FERC, SHPO, and THPO/tribal representatives. Upon concurrence with these findings, construction work will resume in the area of the remains.

If the remains are determined to be human and forensic in nature, the remains will come under the jurisdiction of law enforcement and the medical examiner. The SHPO and THPO/tribal representatives will be notified that the remains are not archaeological.

If the remains are determined to be human and historical in nature and the State Archaeologist, in consultation with the tribes, has identified whether the remains will be preserved in place or removed, the THPO/tribal representatives and the cultural resource consultant will conduct a site visit to examine the remains. Documentation of remains should include photographs, a map indicating the location of the remains, and a brief written description. Upon a determination of Native American ethnicity, no photographs of the remains or associated funerary objects will be taken. However, drawings of remains determined to be of Native American ethnicity will be allowed. This information will be provided to the SHPO and the tribes within 48 hours of the site visit.

ATTACHMENT 4a-5: Plan for Unanticipated Discoveries of Cultural and Paleontological Resources and Human Remains – Connecticut

As part of the Section 106 process, a protocol must developed and put in place for the handling of any unanticipated archaeological resources that might be exposed during the implementation and construction of the proposed Northeast Energy Direct Project ("NED Project" or "Project"). For this purpose Tennessee Gas Pipeline Company, L.L.C ("Tennessee") and its cultural resource consultant have developed the following Unanticipated Discovery Plan ("UDP"). This plan also covers unanticipated discoveries of paleontological resources.

Historic Properties

In the event that a previously unidentified archaeological resource or item of possible historical or cultural importance is discovered during ground-disturbing activities, Tennessee will immediately notify the Federal Energy Regulatory Commission ("FERC"), the appropriate State Historic Preservation Office ("SHPO"), Tribal Historic Preservation Office ("THPO"), or appropriate tribal representative, and their cultural resource consultant. Appropriate contacts organized by state and federal agency are listed in Table 4a-5.

Table 4a-5
Connecticut Unanticipated Discoveries Contact Information

Agency	Contact	Address and Phone Number	Email
FERC	Eric Tomasi	Federal Energy Regulatory Commission 888 First Street, N.E. Washington, DC 20426 (202) 502-8097	eric.tomasi@ferc.gov

Table 4a-5
Connecticut Unanticipated Discoveries Contact Information

Agency	Contact	Address and Phone Number	Email
FERC	Paul Friedman	Federal Energy Regulatory Commission 888 First Street, N.E. Washington, DC 20426 (202) 502-8059	Paul.Friedman@ferc.gov
CT SHPO	Cathy Labadia	State Historic Preservation Office One Constitution Plaza Hartford, CT 06103 (860) 256-2764	Catherine.Labadia@ct.gov
CT Geological Survey	Margaret Thomas	Department of Energy and Environmental Protection 79 Elm Street Hartford, CT 06106 (860)424-3583	margaret.thomas@ct.gov
Tribal Contacts			
Stockbridge-Munsee Band of Mohican Indians	Bonney Hartley THPO	400 Broadway #718 Troy, NY 12181 (518) 326-8870	Bonney.Hartley@mohican-nsn.gov
Delaware Nation	Nekole Alligood Director	31064 State Highway 281 Anadarko, OK 73005 (405) 247-8903	NAlligood@delawarenation.com
	Jason Ross Section 106 Program Manager		jross@delawarenation.com
Delaware Tribe of Indians	Brice Obermeyer THPO	Delaware Tribe Historic Preservation Office Roosevelt Hall, Rm 212 1200 Commercial St. Emporia, KS 66801	bobermeyer@delawaretribe.org
	Susan Bachor (Eastern Projects Review)	Department of Anthropology, Gladfelter Hall, Rm. 207 Temple University 1115 W. Polett Walk Philadelphia, PA 19122 (610) 761-7452	temple@delawaretribe.org
Mohegan Tribe of Indians of Connecticut	James Quinn THPO	13 Crow Hill Road Uncasville, CT (860) 862-6893	jquinn@moheganmail.com

Table 4a-5
Connecticut Unanticipated Discoveries Contact Information

Agency	Contact	Address and Phone Number	Email
Mashantucket Pequot Tribal Nation	Marissa Turnbull THPO	Natural Resources Protection & Regulatory Affairs 550 Trolley Line Blvd. PO Box 3202 Mashantucket, CT 06338-3202 (860) 396-7570	mturnbull@mptn-nsn.gov
Narragansett Indian Tribe	John Brown THPO	Narragansett Indian Longhouse 4425D South County Trail Charlestown, RI 02813 (401) 491-9459; (413) 325-7691; (401) 474-5907	brwnjbb123@aol.com
	Doug Harris Deputy THPO		dhnithpo@gmail.com
Wampanoag Tribe of Gay Head (Aquinnah)	Bettina Washington THPO	20 Black Brook Road Aquinnah, MA 02535-9701 (508) 645-9265	bettina@wampanoagtribe.net
Shinnecock Nation	Roddy Smith	Shinnecock Nation Cultural Resource Department PO Box 5006 Southampton, NY 11969	wabush@aol.com
Law Enforcement and Coroner/Medical Examiner (for unanticipated discoveries of Human Remains only)			
Connecticut State Marshal Commission	-	165 Capitol Ave., Room 279 Hartford, CT 06106 (860) 713-5372	-
Office of the Chief Medical Examiner	-	11 Shuttle Road Farmington, CT 06032 (860) 679-3980	-

All construction work involving subsurface disturbance in the immediate vicinity of the resource will be halted, unless immediate cessation of construction activities will create an unsafe condition or endanger the construction crew. Specifically, work will be stopped at the location where the potential archaeological resource was found and will not resume within 100 feet (in any direction) of the find until the construction is cleared to proceed.

The cultural resource consultant will conduct an on-site inspection of the identified archaeological discovery by the next business day. The THPO will be notified of the on-site inspection and provided the opportunity to send a tribal monitor to participate in the site visit. This on-site inspection will assess the nature of the archaeological discovery to determine if it represents an archaeological site, and if the site is eligible for inclusion in the National Register of Historic Places ("NRHP"). The cultural resource consultant will contact Tennessee upon returning from the initial inspection with further description of the discovery and a recommendation regarding the need for future treatment. Tennessee will then consult

with the FERC, SHPO, and THPO to determine NRHP eligibility of the archaeological discovery. The SHPO and THPO will respond following contacts to all appropriate consulting parties.

If the cultural resource consultant determines that the archaeological discovery is not potentially significant, is an isolated find, or is completely disturbed by prior construction activities, and if the SHPO and THPO concur with this finding, the cultural resource consultant will inform Tennessee that construction may resume. The decision will be documented by the cultural resource consultant. The method of documentation will be determined at the time and, depending on the circumstances, may range from a letter report to an e-mail.

If the cultural resource consultant determines that the archaeological discovery represents a significant archaeological site and the SHPO and THPO concur with this determination, the cultural resource consultant will develop a plan for additional archaeological investigations and/or mitigation of the identified archaeological site. This plan may include further archaeological study or coordination with Native American groups or other interested parties. The plan will be submitted to Tennessee for their review. Tennessee will then submit this plan to the SHPO and THPO for review and concurrence. If the SHPO and/or THPO fail to comment within two business days of receiving the proposed treatment plan, Tennessee may assume concurrence and implement the plan. All proposed archaeological investigations will conform to the Secretary of Interior's (SOI's) Standards for Archeological Documentation and will be conducted by an archaeologist who meets or exceeds the SOIs Professional Qualification Standards for Archeology as published in the FR on September 29, 1983.

Construction in the area of the archaeological site will not resume until all required fieldwork and consultation and/or coordination tasks are completed. Upon receipt of the FERC, the SHPO, and the THPO concurrence that all required fieldwork has been completed, the cultural resource consultant will notify Tennessee that work at the location of the archaeological discovery may resume. The decision will be documented appropriately by the cultural resource consultant; the method of documentation may range from a letter report to an e-mail, depending on the circumstances. A technical report describing the work at all locations where unanticipated discoveries resulted in additional survey and/or data recovery will be prepared and submitted to Tennessee for review within one year of the completion of fieldwork. Tennessee, or an approved agent of Tennessee, will submit the reviewed technical report to the SHPO, the THPO, and the FERC.

Paleontological Resources

In the event that a previously unidentified paleontological resource of possible importance is discovered during ground-disturbing activities, Tennessee will immediately notify the FERC, the applicable state agency, and Tennessee's cultural resources consultant. Contact information for the agencies is listed in Table 4a-5. Generally, within the Project area, important paleontological resources that may be found include vertebrate fossils in unconsolidated deposits, such as wetlands, bogs, alluvial deposits, or lake clays. Fossil finds are not regulated in Connecticut, except on state or federally owned land, but the presence of Pleistocene vertebrate fossils may signal the associated presence of archaeological materials.

All construction work involving subsurface disturbance in the immediate vicinity of the resource will be halted, unless immediate cessation of construction activities will create an unsafe condition or endanger the construction crew. Specifically, work will be stopped at the location where the potential paleontological resource was found and will not resume within 100 feet (in any direction) of the find until the construction is cleared to proceed.

Tennessee's cultural resources consultant will conduct an on-site inspection of the identified discovery by the next business day. The consultant will contact Tennessee upon returning from the initial inspection with further description of the discovery and a recommendation regarding the need for future treatment. If archaeological materials are found in association with the paleontological discovery, then investigation and reporting protocols will follow the procedures outlined for historic properties.

Human Remains

Unanticipated discovery of human remains found anywhere in the Project area is of concern and must be reported. Human remains may be full burials, may be represented only by decomposing bones found in the ground in an area of darker soil, may be more recent burials with identifiable caskets or their remains, or they may be represented only by an individual bone or tooth. All discoveries must be reported and appropriately addressed. The treatment of any human remains encountered during construction of the Project will be guided by the policy statement adopted by the Advisory Council on Historic Preservation ("ACHP") (Advisory Council on Historic Preservation, Policy Statement Regarding Treatment of Burial Sites, Human Remains, and Funerary Objects [ACHP 2007]) and by the relevant state laws and guidelines and tribal policies (Appendix 4a-A). It is imperative that all burial sites, human remains, and funerary objects be treated with dignity and respect, and that all measures be taken to protect such remains from undue harm until the area is cleared and reopened to Tennessee for the resumption of Tennessee's activities and operations. Remains should be covered and not moved or disturbed. Whenever possible, Tennessee will preserve human remains in place.

If any personnel on the construction site identifies potential human remains (including teeth, single bones, bone fragments, etc.) or indicators of potential human remains, such as gravestones or other means of marking potential grave sites, all construction work that will affect the remains' integrity or harm them will immediately stop. Again, the remains will be left in place and will not be touched, moved, or further disturbed until assessed by all designated parties (Table 4a-5). They will be carefully covered and access to the area of the remains will be precluded. A request to hold on photography, pending a determination of ethnicity, will be made to the county coroner for consideration.

Immediately upon discovery of possible human remains, Tennessee will contact FERC, the county police and coroner/medical examiner, the SHPO, tribes, and Tennessee's cultural resource consultant (Table 4a-5). The coroner and law enforcement will assess the remains and make the determination of whether or not they are forensic or historical in nature. The medical examiner may also determine if the remains are Native American.

If the remains are determined to be non-human and no other archaeological features that require evaluation are present, this will be conveyed to Tennessee. Tennessee will then convey these findings to the FERC, the SHPO, and tribes. Upon concurrence with these findings, construction work will resume in the area of the remains.

If the remains are determined to be human and forensic in nature, the remains will come under the jurisdiction of law enforcement. The SHPO and tribes will be notified that the remains are not archaeological.

If the remains are determined to be human and historical in nature, the cultural resource consultant and THPO/tribal representatives will conduct a site visit to examine the remains within 24 hours of discovery. Documentation of non-Native American remains should include photographs, a map indicating the

location of the remains, and a brief written description. Upon a determination of Native American ethnicity, no photographs of the remains or associated funerary objects will be taken. However, drawings of the remains are allowed. This information will be provided to the SHPO and the tribes within 24 hours of the site visit.

If the human remains are determined to be historical but ethnicity cannot be clearly identified, an expert may be brought in to review the remains and determine affiliation. The remains will be left in situ for examination. No additional study of the remains will be authorized without first consulting with the SHPO and tribes.

In consultation with the FERC and SHPO and coordination with the tribes, and other interested parties, Tennessee and the cultural resource consultant will develop a plan for the treatment of the remains. If the remains are determined to be Native American, the plan will be similar to the guidance provided in the NAGPRA (43 CFR 10.5(e)) in keeping with the Unanticipated Historic Properties and Human Remains policy as presented in the FERC's "Guidelines for Reporting on Cultural Resources Investigations for Pipeline Projects" (FERC 20021993). If the remains are determined to be non-Native, the FERC and cultural resource consultant will coordinate with the SHPO and other appropriate parties to develop a plan. The plan may include preservation in place, exhumation and reburial, scientific study, and/or cultural rituals. Any deviations from the plan during implementation must be approved by the consulting parties. Final decisions regarding the disposition of any human remains and associated funerary objects, including repatriation, will be made by the FERC.

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APPENDIX 4a-A

Advisory Council on Historic Preservation, Policy Statement Regarding Treatment of Burial Sites, Human Remains, and Funerary Objects, Advisory Council on Historic Preservation (2007) and by the Relevant State Laws and Guidelines and Tribal Policies

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Preserving America s Heritage

ADVISORY COUNCIL ON HISTORIC PRESERVATION

POLICY STATEMENT
REGARDING
TREATMENT OF BURIAL SITES, HUMAN REMAINS AND FUNERARY OBJECTS

Preamble: This policy offers leadership in resolving how to treat burial sites, human remains, and funerary objects in a respectful and sensitive manner while acknowledging public interest in the past. As such, this policy is designed to guide federal agencies in making decisions about the identification and treatment of burial sites, human remains, and funerary objects encountered in the Section 106 process, in those instances where federal or state law **does not prescribe a course of action**.

This policy applies to all federal agencies with undertakings that are subject to review under Section 106 of the National Historic Preservation Act (NHPA; 16 U.S.C. § 470f), and its implementing regulations (36 CFR Part 800). To be considered under Section 106, the burial site must be or be a part of a historic property, meaning that it is listed, or eligible for listing, in the National Register of Historic Places.

The Advisory Council on Historic Preservation (ACHP) encourages federal agencies to apply this policy throughout the Section 106 process, including during the identification of those historic properties. In order to identify historic properties, federal agencies must assess the historic significance of burial sites and apply the National Register criteria to determine whether a property is eligible. Burial sites may have several possible areas of significance, such as those that relate to religious and cultural significance, as well as those that relate to scientific significance that can provide important information about the past. This policy does not proscribe any area of significance for burial sites and recognizes that the assessment must be completed on a case-by-case basis through consultation.

The policy is not bound by geography, ethnicity, nationality, or religious belief, but applies to the treatment of all burial sites, human remains, and funerary objects encountered in the Section 106 process, as the treatment and disposition of these sites, remains, and objects are a human rights concern shared by all.

This policy also recognizes the unique legal relationship between the federal government and tribal governments as set forth in the Constitution of the United States, treaties, statutes and court decisions, and acknowledges that, frequently, the remains encountered in Section 106 review are of significance to Indian tribes.

Section 106 requires agencies to seek agreement with consulting parties on measures to avoid, minimize, or mitigate adverse effects to historic properties. Accordingly, and consistent with Section 106, this policy does not recommend a specific outcome from the consultation process. Rather, it focuses on issues and perspectives that federal agencies ought to consider when making their Section 106 decisions. In many cases, federal agencies will be bound by other applicable federal, tribal, state, or local laws that do

prescribe a specific outcome, such as the Native American Graves Protection and Repatriation Act (NAGPRA). The federal agency must identify and follow applicable laws and implement any prescribed outcomes.

For undertakings on federal and tribal land that encounter Native American or Native Hawaiian human remains and funerary objects, NAGPRA applies. NHPA and NAGPRA are separate and distinct laws, with separate and distinct implementing regulations and categories of parties that must be consulted.[1] Compliance with one of these laws does not mean or equal compliance with the other. Implementation of this policy and its principles does not, in any way, change, modify, detract or add to NAGPRA or other applicable laws.

Principles: When burial sites, human remains, or funerary objects will be or are likely to be encountered in the course of Section 106 review, a federal agency should adhere to the following principles:

Principle 1: Participants in the Section 106 process should treat all burial sites, human remains and funerary objects with dignity and respect.

Principle 2: Only through consultation, which is the early and meaningful exchange of information, can a federal agency make an informed and defensible decision about the treatment of burial sites, human remains, and funerary objects.

Principle 3: Native Americans are descendants of original occupants of this country. Accordingly, in making decisions, federal agencies should be informed by and utilize the special expertise of Indian tribes and Native Hawaiian organizations in the documentation and treatment of their ancestors.

Principle 4: Burial sites, human remains and funerary objects should not be knowingly disturbed unless absolutely necessary, and only after the federal agency has consulted and fully considered avoidance of impact and whether it is feasible to preserve them in place.

Principle 5: When human remains or funerary objects must be disinterred, they should be removed carefully, respectfully, and in a manner developed in consultation.

Principle 6: The federal agency is ultimately responsible for making decisions regarding avoidance of impact to or treatment of burial sites, human remains, and funerary objects. In reaching its decisions, the federal agency must comply with applicable federal, tribal, state, or local laws**.**

Principle 7: Through consultation, federal agencies should develop and implement plans for the treatment of burial sites, human remains, and funerary objects that may be inadvertently discovered.

Principle 8: In cases where the disposition of human remains and funerary objects is not legally prescribed, federal agencies should proceed following a hierarchy that begins with the rights of lineal descendants, and if none, then the descendant community, which may include Indian tribes and Native Hawaiian organizations.

[1] The ACHP's publication *Consulting with Indian Tribes in the Section 106 Process* and the National Association of Tribal Historic Preservation Officers' publication *Tribal Consultation: Best Practices in Historic Preservation* provide additional guidance on this matter.

DISCUSSION:

Principle 1: Participants in the Section 106 process should treat all burial sites, human remains and funerary objects with dignity and respect.

Because the presence of human remains and funerary objects gives a historic property special importance as a burial site or cemetery, federal agencies need to consider fully the values associated with such sites. When working with human remains, the federal agency should maintain an appropriate deference for the dead and the funerary objects associated with them, and demonstrate respect for the customs and beliefs of those who may be descended from them.

Through consultation with descendants, culturally affiliated groups, descendant communities, and other parties, federal agencies should discuss and reach agreement on what constitutes respectful treatment.

Principle 2: Only through consultation, which is the early and meaningful exchange of information, can a federal agency make an informed and defensible decision about the treatment of burial sites, human remains, and funerary objects.

Consultation is the hallmark of the Section 106 process. Federal agencies must make a "reasonable and good faith" effort to identify consulting parties and begin consultation early in project planning, after the federal agency determines it has an undertaking and prior to making decisions about project design, location, or scope.

The NHPA, the ACHP's regulations, and Presidential Executive Orders set out basic steps, standards, and criteria in the consultation process, including:

- Federal agencies have an obligation to seek out all consulting parties [36 CFR § 800.2(a)(4)], including the State Historic Preservation Officer (SHPO)/Tribal Historic Preservation Officer (THPO) [36 CFR § 800.3(c)].

- Federal agencies must acknowledge the sovereign status of Indian tribes [36 CFR § 800.2(c)(2)(ii)]. Federal agencies are required to consult with Indian tribes on a government-to-government basis in recognition of the unique legal relationship between federal and tribal governments, as set forth in the Constitution of the United States, treaties, statutes, court decisions, and executive orders and memoranda.

- Consultation on a government-to-government level with Indian tribes cannot be delegated to non-federal entities, such as applicants and contractors.

- Federal agencies should solicit tribal views in a manner that is sensitive to the governmental structures of the tribes, recognizing their desire to keep certain kinds of information confidential, and that tribal lines of communication may argue for federal agencies to provide extra time for the exchange of information.

- Properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization may be determined eligible for inclusion on the National Register [16 U.S.C. § 470a(d)(6)(A)], and federal agencies must consult with any Indian tribe or Native Hawaiian organization that attaches religious and cultural significance to such historic properties [16 U.S.C. § 470a(d)(6)(B) and 36 CFR § 800.2(c)(2)(ii)(D)].

Principle 3: Native Americans are descendants of original occupants of this country. Accordingly, in making decisions, federal agencies should be informed by and utilize the special expertise of Indian tribes and Native Hawaiian organizations in the documentation and treatment of their ancestors.

This principle reiterates existing legal requirements found in federal law, regulation and executive orders, and is consistent with positions that the ACHP has taken over the years to facilitate enfranchisement and promote broad participation in the Section 106 process. Federal agencies must consult with Indian tribes on a government-to-government basis because they are sovereign nations.

Indian tribes and Native Hawaiian organizations bring a special perspective on how a property possesses religious and cultural significance to them. Accordingly, federal agencies should utilize their expertise about, and religious and cultural connection to, burial sites, human remains, and associated funerary objects to inform decision-making in the Section 106 process.

Principle 4: Burial sites, human remains and funerary objects should not be knowingly disturbed unless absolutely necessary, and only after the federal agency has consulted and fully considered avoidance of impact and whether it is feasible to preserve them in place.

As a matter of practice, federal agencies should avoid impacting burial sites, human remains, and funerary objects as they carry out their undertakings. If impact to the burial site can be avoided, this policy does not compel federal agencies to remove human remains or funerary objects just so they can be documented.

As this policy advocates, federal agencies should always plan to avoid burial sites, human remains, and funerary objects altogether. When a federal agency determines, based on consultation with Section 106 participants, that avoidance of impact is not appropriate, the agency should minimize disturbance to such sites, remains, and objects. Accordingly, removal of human remains or funerary objects should occur only when other alternatives have been considered and rejected.

When a federal agency determines, based on consultation with Section 106 participants, that avoidance of impact is not appropriate, the agency should then consider any active steps it may take to preserve the burial site in place, perhaps through the intentional covering of the affected area, placement of markers, or granting of restrictive or other legal protections. In many cases, preservation in place may mean that, to the extent allowed by law, the locations of burial sites, human remains, and funerary objects should not be disclosed publicly. Alternatively and consistent with the Section 106 regulations [36 CFR § 800.5(a)(2)(vi)], natural deterioration of the remains may be the acceptable or preferred outcome of the consultation process.

Principle 5: When human remains or funerary objects must be disinterred, they should be removed carefully, respectfully, and in a manner developed in consultation.

When the federal agency decides that human remains or funerary objects must be disturbed, they should be removed respectfully and dealt with according to the plan developed by the federal agency in consultation. "Careful" disinterment means that those doing the work should have, or be supervised by people having, appropriate expertise in techniques for recognizing and disinterring human remains.

This policy does not endorse any specific treatment. However, federal agencies must make a reasonable and good faith effort to seek agreement through consultation before making its decision about how human remains and/or funerary objects shall be treated.

The plan for the disinterment and treatment of human remains and/or funerary objects should be negotiated by the federal agency during consultation on a case-by-case basis. However, the plan should provide for an accurate accounting of federal implementation. Depending on agreements reached through the Section 106 consultation process, disinterment may or may not include field recordation. In some instances, such recordation may be so abhorrent to consulting parties that the federal agency may decide it is inappropriate to carry it out. When dealing with Indian tribes, the federal agency must comply with its legal responsibilities regarding tribal consultation, including government-to-government and trust responsibilities, before concluding that human remains or funerary objects must be disinterred.

Principle 6: The federal agency is ultimately responsible for making decisions regarding avoidance of impact to or treatment of burial sites, human remains, and funerary objects. In reaching its decisions, the federal agency must comply with applicable federal, tribal, state, or local laws.

Federal agencies are responsible for making final decisions in the Section 106 process [36 CFR § 800.2(a)]. The consultation and documentation that are appropriate and necessary to inform and support federal agency decisions in the Section 106 process are set forth in the ACHP's regulations [36 CFR Part 800].

Other laws, however, may affect federal decision-making regarding the treatment of burial sites human remains, and funerary objects. Undertakings located on federal or tribal lands, for example, are subject to the provisions of NAGPRA and the Archaeological Resources Protection Act (ARPA). When burial sites, human remains, or funerary objects are encountered on state and private lands, federal agencies must identify and follow state law when it applies. Section 106 agreement documents should take into account the requirements of any of these applicable laws.

Principle 7: Through consultation, federal agencies should develop and implement plans for the treatment of burial sites, human remains, and funerary objects that may be inadvertently discovered.

Encountering burial sites, human remains, or funerary objects during the initial efforts to identify historic properties is not unheard of. Accordingly, the federal agency must determine the scope of the identification effort in consultation with the SHPO/THPO, Indian tribes and Native Hawaiian

organizations, and others before any archaeological testing has begun [36 CFR § 800.4(a)] to ensure the full consideration of avoidance of impact to burial sites, human remains, and funerary objects.

The ACHP's regulations provide federal agencies with the preferred option of reaching an agreement ahead of time to govern the actions to be taken when historic properties are discovered during the implementation of an undertaking. In the absence of prior planning, when the undertaking has been approved and construction has begun, the ACHP's post-review discovery provision [36 CFR § 800.13] requires the federal agency to carry out several actions:

(1) make reasonable efforts to avoid, minimize, or mitigate adverse effects to such discovered historic properties;
(2) notify consulting parties (including Indian tribes and Native Hawaiian organizations that might attach religious and cultural significance to the affected property) and the ACHP within 48 hours of the agency's proposed course of action;
(3) take into account the recommendations received; and then
(4) carry out appropriate actions.

NAGPRA prescribes a specific course of action when Native American and Native Hawaiian human remains and funerary objects are discovered on federal or tribal lands in the absence of a plan—cessation of the activity, protection of the material, notification of various parties, consultation on a course of action and its implementation, and then continuation of the activity. However, adherence to the plan under Principle 5 would cause new discoveries to be considered "intentional excavations" under NAGPRA because a plan has already been developed, and can be immediately implemented. Agencies then could avoid the otherwise mandated 30 day cessation of work for "inadvertent discoveries."

Principle 8: In cases where the disposition of human remains and funerary objects is not legally prescribed, federal agencies should proceed following a hierarchy that begins with the rights of lineal descendants, and if none, then the descendant community, which may include Indian tribes and Native Hawaiian organizations.

Under the ACHP's regulations, "descendants" are not identified as consulting parties by right. However, federal agencies shall consult with Indian tribes and Native Hawaiian organizations that attach religious and cultural significance to burial sites, human remains and associated funerary objects, and be cognizant of their expertise in, and religious and cultural connection to, them. In addition, federal agencies should recognize a biological or cultural relationship and invite that individual or community to be a consulting party [36 CFR § 800.3(f)(3)].

When federal or state law does not direct disposition of human remains or funerary objects, or when there is disagreement among claimants, the process set out in NAGPRA may be instructive. In NAGPRA, the "ownership or control" of human remains and associated funerary objects lies with the following in descending order: specific lineal descendants; then tribe on whose tribal lands the items were discovered; then tribe with the closest cultural affiliation; and then tribe aboriginally occupying the land, or with the closest "cultural relationship" to the material.

Definitions Used for the Principles

- **Burial Site**: Any natural or prepared physical location, whether originally below, on, or above the surface of the earth, into which as a part of the death rite or ceremony of a culture, individual human remains are deposited [25 U.S.C. 3001.2(1)].
- **Consultation:** The process of seeking, discussing, and considering the views of other participants, and, where feasible, seeking agreement with them regarding matters arising in the Section 106 review process [36 CFR § 800.16(f)].
- **Consulting parties:** Persons or groups the federal agency consults with during the Section 106 process. They may include the State Historic Preservation Officer; the Tribal Historic Preservation Officer; Indian tribes and Native Hawaiian organizations; representatives of local governments; applicants for federal assistance, permits, licenses, and other approvals; and/or any additional consulting parties [based on 36 CFR § 800.2(c)]. Additional consulting parties may include individuals and organizations with a demonstrated interest in the undertaking due to the nature of their legal or economic relation to the undertaking or affected properties, or their concern with the undertaking's effects on historic properties [36 CFR § 800.2(c)(6)].
- **Disturbance:** Disturbance of burial sites that are listed in or eligible for listing in the National Register of Historic Places will constitute an adverse effect under Section 106. An adverse effect occurs when "an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, setting, materials, workmanship, feeling, or association" [36 CFR § 800.5(a)(1)].
- **Federal land:** Lands under a federal agency's control. Mere federal funding or permitting of a project does not turn an otherwise non-federal land into federal land (see *Abenaki Nation of Mississquoi* v. *Hughes*, 805 F. Supp. 234 (D. Vt. 1992), aff'd, 990 F. 2d 729 (2d Cir. 1993) (where the court found that a Clean Water Act permit issued by the US Army Corps of Engineers did not place the relevant land under federal "control" for NAGPRA purposes).
- **Funerary objects:** "items that, as part of the death rite or ceremony of a culture, are reasonably believed to have been placed intentionally at the time of death or later with or near individual human remains" [25 U.S.C. 3001(3)(B)].
- **Historic property:** "Any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. It includes artifacts, records, and remains that are related to and located within such properties, and it includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register of Historic Places criteria" [36 CFR § 800.16(1)].
- **Human remains:** The physical remains of a human body. The term does not include remains or portions of remains that may reasonably be determined to have been freely given or naturally shed by the individual from whose body they were obtained, such as hair made into ropes or nets [see 43 CFR § 10.2(d)(1)].
- **Indian Tribe**: "An Indian tribe, band, nation, or other organized group or community, including a Native village, Regional Corporation or Village Corporation, as those terms are defined in Section 3 of the Alaska Native Claims Settlement Act [43 U.S.C. 1602], which is recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians" [36 CFR § 800.16(m)].
- **Native American:** Of, or relating to, a tribe, people, or culture that is indigenous to the United States [25 U.S.C. 3001 (9)]. Of, or relating to, a tribe, people, or culture indigenous to the Unites States, including Alaska and Hawaii [43 CFR 10.2(d)].

- **Native Hawaiian:** Any individual who is a descendant of the aboriginal people who, prior to 1778, occupied and exercised sovereignty in the area that now constitutes the state of Hawaii [36 CFR § 800.16(s)(2)].
- **Native Hawaiian Organization:** Any organization which serves and represents the interests of Native Hawaiians; has as a primary and stated purpose the provision of services to Native Hawaiians; and has demonstrated expertise in aspects of historic preservation that are significant to Native Hawaiians [36 CFR § 800.16(s)].
- **Policy statement:** A formal statement, endorsed by the full ACHP membership, representing the membership's collective thinking about what to consider in reaching decisions about select issues, in this case, human remains and funerary objects encountered in undertakings on federal, tribal, state, or private lands. Such statements do not have the binding force of law.
- **Preservation in place:** Taking active steps to ensure the preservation of a property.
- **Protection of Historic Properties**: Regulations [36 CFR Part 800] implementing Section 106 of the National Historic Preservation Act.
- **Section 106**: That part of the National Historic Preservation Act which establishes a federal responsibility to take into account the effects of undertakings on historic properties and to provide the Advisory Council on Historic Preservation a reasonable opportunity to comment with regard to such action.
- **State Historic Preservation Officer:** The official appointed or designated pursuant to Section 101(b)(1) of NHPA to administer the state historic preservation program.
- **Tribal Historic Preservation Officer**: The official appointed by the tribe's chief governing authority or designated by a tribal ordinance or preservation program who has assumed the responsibilities of the SHPO for purposes of Section 106 compliance on tribal lands in accordance with Section 101(d)(2) of NHPA.
- **Treatment:** Under Section 106, "treatments" are measures developed and implemented through Section 106 agreement documents to avoid, minimize, or mitigate adverse effects to historic properties.

Acronyms Used for the Policy Statement
- **ACHP**: Advisory Council on Historic Preservation.
- **ARPA**: Archaeological Resources Protection Act [16 U.S.C. 470aa-mm].
- **NHPA**: National Historic Preservation Act [16 U.S.C. § 470f].
- **NAGPRA**: The Native American Graves Protection and Repatriation Act [25 U.S.C. 3001 et seq].
- **SHPO**: State Historic Preservation Officer
- **THPO**: Tribal Historic Preservation Officer

[The members of the Advisory Council on Historic Preservation unanimously adopted this policy on February 23, 2007]

APPENDIX C

PENNSYLVANIA HISTORICAL AND MUSEUM COMMISSION
POLICY ON THE TREATMENT OF HUMAN REMAINS

Adopted March 10, 1993

The PHMC developed this policy to serve as a guide for persons conducting agency programs for PHMC, persons excavating for any reason on Commonwealth land, and persons excavating under a permit authorized by a state agency, other than PHMC, who discover human remains or a burial site. It serves to prevent the destruction of unmarked burials, encourage respectful treatment of all human remains, and the role of Native American groups, in compliance with NAGPRA. The policy further attempts to balance the scientific and research value of skeletal material and associated funeral objects.

This policy offers more guidance in two specific areas:

1) Deals with burial sites discovered during CRM projects, archaeological field investigations, grant funded projects, and all earth moving projects on state land. The discovery of human remains should trigger a process that encourages careful and dignified treatment and mandates the notification of appropriate parties. The issue of human remains and burial sites is not directly addressed in NAGPRA, however, the PA policy hopes to follow this legislation as closely as possible.
2) The treatment of existing collections of skeletal material, associated and unassociated funerary objects, sacred objects and objects of cultural patrimony.

Definitions

For the purposes of this policy, the following definitions should apply:
Burial site: any natural or prepared physical location below, on, or above the surface of the earth into which, as part of a death rite or ceremony of a culture, human remains have been deposited whether marked or unmarked.

Policy I – Discovery of Human Remains

This policy is activated when the discovery of human remains falls within one of three categories:

1) When human remains are uncovered, disturbed, or exposed in the course of archaeological field investigations undertaken during Commonwealth funded, permitted, or assisted projects.
2) When human remains are inadvertently discovered during earth moving activity on Commonwealth lands.
3) When human remains re discovered during state permitted activities occurring off Commonwealth land, when the permit is granted by any agency of the state government, except the PHMC.

This policy outlines the procedures to be followed if the discovery of human remains fall within category 1 or 2. It is further designed to give guidance to discoveries that fall within category 3. It will be implemented in part through PHMC archaeological guidelines, through its Grants Program, through its contract documents, and through archaeological permits granted for archaeological investigations on state lands.

1. In field situations, human remains may be encountered under two sets of circumstances – (1) during a planned archaeological investigation, or (2) during routine ground disturbance from excavations and construction, known as unexpected discovery.

Archaeological Investigations (Category 1)
Any person doing archaeological excavations through permits or grants through the PHMC must have a contingency plan for the treatment of human remains or a burial site as part of their research proposal. This plan should identify expected lineal descendants or culturally affiliated groups

- When human remains are encountered in the manner they were anticipated, the treatment plan should be activated.
- If, during the course of investigation, it appears that human remains are encountered that were unanticipated, then work at the site should stop. The coroner and the BHP should be notified of the find.

Unexpected Discoveries (Category 2 required action, Category 3 guidance)
Any person while undertaking earth moving activities occurring off Commonwealth land who becomes aware that human remains or a burial site are being disturbed shall cease all activity in the area of the site. If it appears that the remains may be of a historic or prehistoric nature, the PHMC should be notified of the find.

2. Whether human remains are encountered through archaeological investigation or through inadvertent discovery, it is the intention of this policy to allow an opportunity for consultation with groups that may be culturally affiliated with or may be lineal descendants of the deceased. This will give all parties involved an opportunity to develop a plan for the remains.

Archaeological Investigation (Category 1)
The treatment plan developed as part of the scope of work should be implemented.

Unexpected Discovery (Category 2 and 3)
The Commission has one week to notify potential lineal descendants or culturally affiliated groups.

3. Based on the above notification and following consultation, the PHMC will consider the concerns and recommendations of all parties who are able to

establish lineal descent or cultural affiliation with the individual(s) associated with the burial site.

4. Once consultation is completed, the PHMC will develop and direct a final treatment plan. This should be competed within fifteen days. The plan may recommend any of a number of treatment plans. These include:
    - Leaving the human remains *in situ* if the burial will not be disturbed and can be protected in this manner
    - Removal and immediate reburial by the appropriate culturally affiliated group or direct lineal descendant
    - Removal of the human remains and examination undertaken by a qualified osteologist to gather basic information
    - Removal and examination of the remains

5. Funerary objects and grave goods directly associated with unmarked human remains should be treated in the same manner as human remains.

State Historic Preservation Office/
New York State Office of Parks, Recreation and Historic Preservation
Human Remains Discovery Protocol
(August 2014)

In the event that human remains are encountered during construction or archaeological investigations, the New York State Historic Preservation Office (SHPO) recommends that the following protocol is implemented:

- At all times human remains must be treated with the utmost dignity and respect. Should human remains or suspected human remains be encountered, work in the general area of the discovery will stop immediately and the location will be immediately secured and protected from damage and disturbance.

- If the services of a skeletal biologist are necessary to determine if the remains are human, we recommend that this work take place on site and no bone leave the site.

- Human remains or associated artifacts will be left in place and not disturbed. No skeletal remains or materials associated with the remains will be collected or removed until appropriate consultation has taken place and a plan of action has been developed.

- The county coroner/medical examiner, local law enforcement, the SHPO, the appropriate Indian Nations, and the involved agency will be notified immediately. The coroner and local law enforcement will make the official ruling on the nature of the remains, being either forensic or archaeological.

- If human remains are determined to be Native American, the remains will be left in place and protected from further disturbance until a plan for their avoidance or removal can be generated. Please note that avoidance is the preferred choice of the SHPO and the Indian Nations. The involved agency will consult SHPO and appropriate Indian Nations to develop a plan of action that is consistent with the Native American Graves Protection and Repatriation Act (NAGPRA) guidance. Photographs of Native American human remains and associated funerary objects should not be taken without consulting with the involved Indian Nations.

- If human remains are determined to be non-Native American, the remains will be left in place and protected from further disturbance until a plan for their avoidance or removal can be generated. Please note that avoidance is the preferred choice of the SHPO. Consultation with the SHPO and other appropriate parties will be required to determine a plan of action.

KnowHow #4

INFORMATION AND ASSISTANCE FROM THE MASSACHUSETTS HISTORICAL COMMISSION

What to Do When Human Burials are Accidentally Uncovered

1. Why are bones sometimes found?

In Massachusetts, many unmarked graves exist without gravestones, fences, tombstones, or other surface indications of their presence. These are chiefly the graves of prehistoric and historic Indians, which may never have been marked at all; and graves which had been identified at one time in the past, but the markings are no longer visible. As a result, bones are often found during ordinary ground disturbance activities such as the construction of new homes, utilities, or roads; in the agricultural or industrial use of a site; or the excavation of sand or gravel borrow. Bones are also sometimes found eroding out of areas exposed by natural erosion, floodwater scouring, or sand dune formation.

A new law has been enacted which establishes procedures to follow when human bones are accidentally discovered.

2. Who is involved?

Private citizens, State and Local Police, Medical Examiners, State Archaeologist, and the Commission on Indian Affairs.

3. What should you do if you discover bones?

Do not touch or disturb the bones. Notify the state or local police and the regional medical examiner about the discovery and location.

4. What does the Medical Examiner do?

The Medical Examiner investigates the discovery to determine whether the bones are human, and whether they are recent or more than 100 years old. If the bones are less than 100 years old, a criminal investigation may be warranted. If the bones are more than 100 years old, the Medical Examiner then notifies the State Archaeologist, who immediately conducts an archaeological investigation of the site. Throughout these investigations, the police authorities must insure that the site is protected from further damage.

5. What does the State Archaeologist do?

The State Archaeologist investigates the site to determine the age, cultural association and identity of the burial. If the State Archaeologist determines that the burial is that of a Native American, the Commission on Indian Affairs is notified. The State Archaeologist consults with the landowner to determine whether the burial can remain undisturbed. In the case of development projects, the owner and State Archaeologist discuss whether there are prudent and feasible steps the owner can take to protect the burial. If it is impossible to avoid future harm to the burial, the State Archaeologist removes the remains.

6. What does the Commission on Indian Affairs do?

The archaeological investigation of Indian burials is monitored by the Commission on Indian Affairs to insure that the remains are treated respectfully.

> Please remember: Once bones or artifacts are removed from the site, valuable information concerning the identity and age of the human remains is lost. Therefore, it is important not to disturb the site in any way until the State Archaeologist can conduct an investigation and record the discovery.

BIBLIOGRAPHY

Massachusetts General Laws, Chapter 38, section 6; Chapter 9, sections 26A & 27C; Chapter 7, section 38A; Chapter 114, section 17; as amended by Chapter 659 of the Acts of 1983 and Chapter 386 of the Acts of 1989.

For Further Information:

Please contact the State Archaeologist at the Massachusetts Historical Commission.

William Francis Galvin
Secretary of the Commonwealth
Chairman, Massachusetts Historical Commission
Massachusetts Archives Building, 220 Morrissey Boulevard, Boston, MA 02125
Phone: (617) 727-8470 Fax: (617) 727-5128
Website: www.sec.state.ma.us/mhc

2 New Hampshire Burial Laws

In the laws of New Hampshire (the Revised Statutes Annotated, or RSA for short) there are several chapters that deal with cemeteries and human remains. Three are particularly pertinent here.

RSA 227-C:8 a-g is the set of statutes that defines the duties of the Division of Historical Resources. Among those duties are the responsibilities of the State Archaeologist to: 1) oversee the excavation and analysis of unmarked human burials discovered in the course of construction activities, 2) attempt to contact any individuals or groups with an interest in such remains, and 3) manage the disposition of these remains once they are excavated and analyzed.

RSA 289 deals with cemeteries but more important here is **RSA 290** which deals with burials and reinterments. Specifically, this statute makes it illegal, under most circumstances, to disinter a human body without a permit. Such a disinterment is a misdemeanor, but it is important to note that the *accidental* discovery of buried human remains is not a crime.

RSA 635 is a part of the NH Criminal Code enacted by the 1987 legislature. This provision sets out the circumstances under which it is permitted to alter or remove cemetery items and/or the remains they mark. Such disturbances require written permission from those with rights to the burial ground, when they can be found, or from the local governing body if owners or descendants cannot be found. This statute also prohibits the possession or sale of tombstones and other objects from cemeteries. Violation of this law is a class B felony.

Contact Information

Richard A. Boisvert, State Archaeologist
NH Division of Historical Resources
19 Pillsbury Street, 2nd Floor
Concord, NH 03301-3570

603-271-6433

richard.a.boisvert@dcr.nh.gov

www.nh.gov/nhdhr/

This project has been financed in part with a federal "Historic Preservation Fund" matching grant from the National Park Service of the United States Department of the Interior, through the New Hampshire Division of Historical Resources/State Historic Preservation Office. However, its contents and opinions do not necessarily reflect the views or policies of the Department of the Interior or the Division of Historical Resources, nor does the mention of trade names or commercial products constitute endorsement or recommendation by the Department of the Interior or the State of New Hampshire.

WHAT TO DO UPON ENCOUNTERING HUMAN REMAINS

Before or During Land-Altering Activities in New Hampshire

A guide for planners, builders, landowners, developers, and local governments

NEW HAMPSHIRE DIVISION OF HISTORICAL RESOURCES

State of New Hampshire, Department of Cultural Resources — 603-271-3483
19 Pillsbury Street, Concord, NH 03301-3570 — 603-271-3558
TDD Access: Relay NH 1-800-735-2964 — FAX 603-271-3433
www.nh.gov/nhdhr — *preservation@dcr.nh.gov*

January 2008

1 A Statement of Principles

Historians and archaeologists often help contemporary society remember its ancestors by studying materials and objects that were never intended by their makers to be memorials. Given this, the protection of old cemeteries and graveyards is particularly important because it is a way of honoring our forbears by respecting the things they made specifically for us to remember them by.

A second guiding principle allows us to extend our concern beyond extant cemeteries from the historic period to encompass all buried human remains. That principle, supported by the weight of judicial opinion throughout the U.S., is the idea that once a place has been used for human burial, it remains a special place in perpetuity, regardless of subsequent land transfers. In sections 3 and 4 of this pamphlet we spell out specific procedures for dealing with both marked and unmarked human burials and burial places encountered during the course of ground-disturbing activities.

The goal of the DHR in formulating and publicizing these procedures is simply to ensure that there is someone to speak for every burial place in New Hampshire, public and private, historic and prehistoric. Citizens with rights to private burial grounds and descendants of those interred in them can speak for some private burial grounds, and local governments can speak for public cemeteries within their jurisdiction. The role of the DHR is nothing more than to speak for private cemeteries and Native American Indian burial places which have no other advocates. In these cases our purpose is to extend to these memorials and remains the same kind of respect that any of us would want for the remains of our own ancestors.

3 Marked Burials

If you plan a landscape alteration, you should try to locate any old burial grounds in the area you intend to alter. There are many sources of this kind of information, including USGS quadrangle maps, town histories, and two organizations: The New Hampshire Historical Society and the New Hampshire Old Graveyard Association. In addition, under a recently-enacted New Hampshire statute, towns are obligated to keep information on old gravesites. This list of sources is not exhaustive, but it is a good start.

If there are marked burials in the path of your proposed construction, the DHR would prefer that they be left undisturbed, and state law requires a 25-foot buffer zone around most cemeteries. However, marked burials may be removed legally, and this requires two sets of approvals.

First, you need to determine who holds rights to the cemetery. Rights to visit, maintain, and approve alterations to a private cemetery belong to those who established the cemetery — and to their descendants — regardless of subsequent transfers of the surrounding property. The written permission of the holders of these rights is required to move a private cemetery. If those who hold these rights are impossible to locate, then written permission is required from the local government, which will consult with the DHR.

Second, the removal of burials to another location requires a permit. Typically, a funeral director applies to the NH Department of Health and Human Services for this permit, which must be countersigned by the local health officer. The DHR has the authority to review these applications and advise the Department of Health and Human Services.

4 Unmarked Burials

In the event that land-disturbing activities uncover unmarked human remains, a second set of procedures applies.

First, excavation must be discontinued and the local police notified. The police will call in the county medical examiner who will make an investigation to determine whether the remains require a criminal investigation or an archaeological investigation.

In the latter case, the county medical examiner will notify the State Archaeologist who has, in most cases, 48 hours to arrange with the landowner for the protection or removal of the remains. The State Archaeologist oversees the removal and analysis of the remains and has the responsibility of attempting to consult with individuals who may have an interest in them, next of kin and/or appropriate Native American groups. If located, next of kin or Native American groups will have the right to determine what happens to the remains after they have been analyzed.

Finally, there are provisions for determining who will bear the costs of archaeological work necessitated by the discovery of unmarked burials. In the case of privately funded, non-commercial land-altering activities, the DHR will fund the work. For privately funded commercial land alteration, the land owner will bear the cost of archaeology. And in the case of state funded land alteration, the department funding the construction will also fund the archaeology.

4.7 Protocol for Handling Discovery of Human Remains

	Known Burials	Unidentified Burials
When to contact?	**Intentional excavation** At the earliest time in decision-making process.	**Inadvertent Discovery** Upon discovery.
Which Nation to contact?	If find is within existing Nation boundary, contact that Nation's Cultural Resource representatives. If the find is within the traditional land use area (fifty mile radius from the current nation territory, contact the closest Nation's Cultural Resource Representative. If the find is within the aboriginal territory of each nation, as shown on the attached map, contact the Nation within that territory. For finds located within fifty miles on either side of the boundary lines shown on the map, contact the Cultural Resource Representatives of both Nations.	
Who to contact?	Haudenosaunee Cultural Resource Representatives HSCBRR	Haudenosaunee Cultural Resource Representatives HSCBRR
How to contact?	Contact list is provided.	
Information Required	Brief description of the find or potential find; site map and any information on the known cultural history of the area and summary of nearby archaeological findings.	
	Nation will send a representative to review the site.	Company must hire a Native American on-site observer.
Next steps	***Non-disturbance of burials is preferred.*** If after proper consultation, the remains must be removed, we prefer to have them reburied close to their original location as possible, provided the future sanctity of the grave can be assured. ***No remains should be removed without proper cultural protocols.*** If no safe local burial ground can be offered, the Haudenosaunee will reclaim the remains for reburial at an undisclosed location. The local government /state agency/developer must pay all of the costs for such reburial. All objects associated with the original burial must be reburied as well. All of the soil in the immediate area of the burial should also be placed in the new grave.	
Time Frame	30 to 45 days	As soon as possible

Band of Mohican Indians

Stockbridge-Munsee Community
Policy for
Treatment and Disposition of Human Remains and Cultural Items
That May be Discovered Inadvertently During Planned Activities

Purpose

The purpose of this policy is to describe the procedures that will be followed by all federal agencies, in the event there is an inadvertent discovery of human remains, that are identified as Stockbridge-Munsee (Mohican).

Treatment and Disposition of Human Remains and Cultural Items

1. The federal agency shall contact the Stockbridge-Munsee President's office (715) 793-4111 or Stockbridge-Munsee Historic Preservation Office (715) 793-3970, after hours (715)304-8155, as soon as possible, but no later than three (3) days, after the discovery of Stockbridge-Munsee, Mohican remains

2. Place tobacco with the remains and funeral objects

3. Cover remains and funeral objects with a natural fiber cloth such as cotton or muslin when possible.

4. No photographs to be taken

5. The preferred treatment of inadvertently discovered human remains and cultural items is to leave human remains and cultural items in-situ and protect them from further disturbance.

6. Non-destructive "in-field" documentation of the remains and cultural items will be carried out in consultation with the Tribe, who may stipulate the appropriateness of certain methods of documentation.

7. If the remains and cultural items are left in-situ, no disposition takes place and the requirements of 43 CFR 10 Section 10.4-10.6 will have been fulfilled.

8. The specific locations of discovery shall be withheld from disclosure (with the exception of local law officials and tribal officials as described above) and protected to the fullest extent by federal law

9. If remains and funeral objects are to be removed from the site consultation will begin between the Stockbridge-Munsee Tribe and the federal agency.

Stockbridge-Munsee Community

BAND OF THE MOHICAN INDIANS

TRIBAL COUNCIL OFFICES

RESOLUTION

Date: September 17, 2002 Number: 052-02

Whereas, the Stockbridge-Munsee Community, Band of Mohican Indians, is a federally recognized Indian Tribe organized under a Constitution and By-laws approved on November 18, 1937; and

Whereas, the Tribe's duly elected governing body, the Stockbridge-Munsee Tribal Council, is empowered under the Constitution to make and enforce laws and otherwise exercise its powers consistent with the Constitution; and

Whereas, the National Historic Preservation Act, Section 106 (16 USC 470F) applies to projects and developments within the Stockbridge-Munsee Reservation and its ancestral lands, if there is any federal monies being used for the project, if project is on tribal land, if any federal permits are needed, or if on land affiliated with a federally recognized tribe, and

Whereas, known burials have been discovered within the Stockbridge-Munsee Reservation, and it is known that Section 106 applies to these burials; and

Whereas, the Repatriation Committee recommends the following: that an area of 50 feet surrounding any known burial site (a circumference of 100 feet) may not be disturbed by any phase of a project or development, nor may any part of the grounds within the defined area be disturbed in any way after completion of the project; now

Therefore Be It Resolved, that the Stockbridge-Munsee Tribal Council hereby accepts the recommendation of the Committee and adopts this resolution for the protection of burial sites now and in the future.

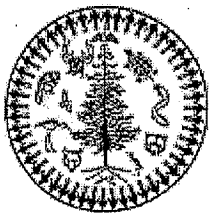
CERTIFICATION

I, the undersigned, as Secretary of the Stockbridge-Munsee Tribal Council, hereby certify that the Tribal Council is composed of 7 members of whom 4, constituting a quorum, were present at a meeting duly called, noticed and convened on September 17, 2002 and that the foregoing resolution was adopted by a vote of 3 for, 0 members against, and 0 members abstaining and that said resolution was not rescinded or amended in any way.

Gregory E. Miller, Vice-Chairman
Stockbridge-Munsee Tribal Council

Diane D. Mattingly, Acting Secretary
Stockbridge-Munsee Tribal Council

N8476 MOH HE CON NUCK ROAD • BOWLER, WI 54416 • (715) 793-4111 • FAX: (715) 793-1307



The Haudenosaunee Policies on this page are the official word of the Haudenosaunee Confederacy as promulgated by the Grand Council of Chiefs concerning cultural patrimony & repatriation.

Note:

From Kanatiyosh. The policies contain statements that are important to insure cultural sensitivity towards the Haudenosaunee. The statements are evidence of why some school projects, museums, private collections, sellers, governments, and etc., are not being culturally sensitive or respectful to the Haudenosaunee.

Haudenosaunee Policy on Human Remains

Haudenosaunee Beliefs

We have been taught that we bury our dead into the ground so that their bodies can become part of the scared Earth. We believe that we come from the Mother Earth and that the human remains that rest within the Earth are an important spiritual connection to the spirit of the Earth. The Earth is enriched by the dead as our flesh becomes part of the soil.

The souls of the dead have a path of destiny that they must follow. We refer to this as their journey after life. In this way, we feel that the dead are around us and hover over us as
we hold ceremonies or dances. We believe that the dead have power and it is dangerous to neglect the spiritual needs of the dead.

The protection of the human remains and associated graves, sacred burial sites and related objects from the graves of the Haudenosaunee are the responsibility of each generation of chiefs, clan mothers, and faithkeepers. We believe that the remains, the associated burial objects and the actual soil in which they rest is sacred. There is no acceptable excuses to justify the desecration of this sacred burial.

Violation of Our Spiritual Rights

Removing the remains from their eternal resting place is a great desecration to both the dead and the living. The disturbance, destruction, and theft of the dead is a violation of the religious and spiritual welfare of the Haudenosaunee.

As long as the human remains are disturbed, there will be spiritual consequences to our people. The desecration of the graves of our ancestors, no matter what the age of the burial, is a violation of our religious freedom.

Permits issued by the State of New York or any other local government, to allow anyone
to violate the sanctity of the graves of our ancestors can no longer be tolerated. In the past, our ancestors buried many objects along with the body with the belief that in the afterlife,
you will need all of those things that you need in this life.

All types of objects have been associated with burials, including decorated clothing, glass beads, shell beads, silver combs, tools and weapons, ceramic and metal cooking pots, wampum belts, strings of wampum, and a variety of personal items. The removal of these objects from the grave is a theft from the dead.

Violation of Our Human Rights

The remains of our dead are not "archaeological resources" that are subjects of study. They are human beings who once lived on this land. They had real lives and feelings. They had
spiritual expectations about their final resting places. To look at Native Peoples as objects rather than people is a gross violation of our human rights.

All graves and burial sites, Native or not, deserve respect. Our dead relatives deserve the basic human right to a dignified burial. We do not believe in the use of permanent headstones to mark graves of our ancestors and state law makes a difference between cemeteries and unmarked burials.

Our burial sites deserve to be considered hallowed ground, whether they are

marked or not. There has been a double standard in dealing with our people and non-Native remains. Non-Native grave sites are often afforded more protection than Native burials.

Despite the efforts of state agencies to identify Native grave locations, construction permits are issued nonetheless. Our dead deserve the same right to an eternal resting place as all other races and religions.

Violation of Our Treaty Rights

The unearthing of the remains of our ancestors from their eternal resting place is also a violation of the promises made to the Haudenosaunee under the terms of the Canandaigua
Treaty of 1794. By that treaty, the United States, including the State of New York, promised not to "disturb" the Haudenosaunee in the free use and enjoyment of their lands.

We have been on record protesting the desecration of our graves. The continual destruction of Native graves, the stealing of the Native remains and the looting of burial objects causes us serious mental, emotional, and spiritual harm.

Our people are continually upset by these events and we have been forced to adjust our spiritual traditions to accommodate outside developments. The desecration of our dead violates the mutual respect promised by the United States as they pledged a firm and permanent friendship between our peoples.

The treaty also promised to remove the cause of complaint that upsets our peace. We therefore make it clear that the desecration of the graves of our ancestors causes great harm to our people and the United States and State of New York have an obligation to protect the general welfare of our people as promised in the legally binding treaties.

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

ATTACHMENT N7

UNANTICIPATED DISCOVERY OF CONTAMINATION PLAN

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1.0 INTRODUCTION

Tennessee Gas Pipeline Company, L.L.C. ("Tennessee" or "TGP") has filed 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"). The Environmental Report ("ER") is submitted in support of the application. 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 proposed Project will include construction of approximately 420 miles of pipeline (new pipeline, looping pipeline segments, and laterals) in Pennsylvania, New York, Massachusetts, New Hampshire, and Connecticut. Additionally, as part of the Project, Tennessee proposes to construct new compressor and meter stations and modify existing compressor and meter stations along its proposed and existing pipeline system. There will also be construction of appurtenant facilities, including mainline valves ("MLVs"), cathodic protection, and pig facilities through the Project area.

The intent of this Unanticipated Discovery of Contamination Plan ("UDC Plan") is to outline practices that will be employed in the event of an unanticipated discovery of contamination in soil, groundwater, and sediment when excavating during construction of the Project and/or operations and maintenance activities for the Project facilities, as well as debris or waste materials deposited on the pipeline right-of-way ("ROW") for Tennessee's pipeline system. The purposes of this UDC Plan are to:

- Protect human health and worker safety;
- Prevent the spread of contamination; and
- Comply with applicable state and/or federal regulations.

2.0 PRE-JOB PLANNING, REVIEW, AND ASSESSMENT

Prior to the commencement of Project construction activities or operations and maintenance activities, the Project's Chief Inspector ("CI"), Environmental Inspector ("EI"), District Manager, and/or their designee(s) will complete a review of Tennessee's pipeline ROW and aboveground facility locations where Project construction or operations and maintenance activities are planned in order to assess the potential for the presence of known or potential contamination. An assessment will be made of the likelihood of encountering contamination during any excavation activities. The scope of the review and assessment will reflect the size of the Project, Tennessee's past experience in the Project work areas, and available information from public sources and any site investigations conducted. Attached to this UDC Plan is a database listing of known hazardous waste release sites within 0.25 mile of the Project.

For the Project, the review and assessment will consist of a site reconnaissance of the proposed work areas, interviews with property owners in the proposed work areas, and a review of any publicly available information. It may also be necessary to consult with Tennessee's Field Environmental Services ("FES") Department, to conduct an environmental database search, and/or perform further investigation.

Generally, Tennessee does not anticipate that this review will identify contamination along the pipeline ROW where Project construction and/or operations and maintenance activities will occur, but may identify work areas where there is a higher potential for contamination along the pipeline ROW.

For Project construction and/or operations and maintenance activities, including any excavations at existing aboveground facility locations, there may be a higher likelihood of encountering unanticipated contamination due to the age of these facilities, as well as the use of regulated substances at these facilities.

If Tennessee determines that there is a high likelihood that the planned Project construction and operations and maintenance activities will be conducted in close proximity to, or within, known or suspected contaminated sites, the FES will be consulted by the EI.

The results of the review and assessment will be reviewed by the CI and EI prior to start of Project construction and/or operations and maintenance activities so that any identified or potentially contaminated sites and/or areas are located and available information is reviewed for potential impacts.

In the event that Tennessee determines that the planned Project construction and/or operations and maintenance activities will impact a confirmed contaminated site, the FES will work with the appropriate regulatory agency, property owner, and responsible party to ensure the Project construction and/or maintenance activities are conducted in accordance with applicable and established site requirements. Where feasible and practicable, a re-route or other modification to the Project facilities may be considered. Postponement of the Project construction and/or operations and maintenance activities may also be necessary.

If contaminated sites are identified for planned work areas of the Project, Tennessee will develop and maintain a list of the affected sites, including information on how the determination was made (i.e., database search, property owner, agency report).

3.0 UNANTICIPATED DISCOVERY RESPONSE

In the event unanticipated contaminated soil, groundwater, or other potential environmental contamination are encountered during Project construction and/or maintenance activities (e.g., malodorous soils and/or groundwater with visible staining and/or sheen), Tennessee will implement the following general procedures:

1. All Project construction and/or operations and maintenance activities in the immediate vicinity of areas where suspected contamination or unknown wastes are encountered will be halted;
2. All construction, oversight, and observing personnel will be evacuated to a road or other accessible up-wind location until the types and levels of potential contamination can be verified by qualified personnel. This assessment may include, but not be limited to: observation by a qualified health and safety professional, field screening using the appropriate air sampling devices, and/or laboratory analysis of suspect material;
3. The Project's CI, EI, and/or District Manager will be notified and they will consult with Tennessee's FES on follow-up actions;
4. Following consultation with on-site personnel, Tennessee's FES will be responsible for designating follow-up actions, including mobilizing Emergency Response personnel and

coordinating with the U.S. Environmental Protection Agency ("USEPA") and/or state and local agencies, as appropriate;

5. If an immediate or imminent threat to human health or the environment exists, the EI, CI, District Manager, and/or their designee will immediately contact the appropriate responding agency:
   - For construction of the Project, the contact numbers for fire, police, and the state environmental hotline may be found in the Environmental Contacts List for the Project; and
6. If an immediate or imminent threat to human health or the environment does **not** exist, or has been abated, a determination will be made, after consulting with all responsible parties, regarding any necessary remedial action. If Tennessee or its qualified contractor personnel are responsible for any remedial action, such actions will be limited to the Project's certificated work areas only.
   - Representative samples of the suspected contaminated media (i.e., soil, water, and waste) may need to be submitted for laboratory analysis to determine waste classification and/or agency notification requirements;
   - The Project CI, EI, District Manager, and/or their designee(s) will consult with the FES for the appropriate analyses, sampling methodology, and sampling frequency;
   - Any excavated soils or waste that are suspected of containing contamination above the appropriate clean-up standard, or otherwise regulated for disposal, will be placed on plastic sheeting and covered at the end of each work day or placed in an appropriate container to prevent the spread of any further contamination. Containers must be closed or covered and any storage areas cordoned off with orange safety fence. All containers will be clearly labeled with the name of the contents and any known hazard associated with the material identified on the container. Known hazardous wastes will be labeled with the words "Hazardous Waste" and the date the waste was placed in the container; and
   - Water or groundwater suspected of being contaminated will **not** be discharged to grade, without prior state approval. Options such as on-site storage tanks or discharge to publicly-owned treatment works may be considered. Limiting and/or diverting the flow of clean surface water away from the affected area, as well as other measures, may be implemented to minimize impacts and exposure to the Project's work areas.
7. If it is determined that Tennessee or its qualified contractor will be responsible for arranging for disposal of any affected materials (soil, water, waste), the materials will be characterized and disposed of properly and in compliance with applicable requirements at a permitted facility in a timely manner. All disposal documentation will be obtained and maintained in the Project files, with copies sent to the FES.
   - If USEPA-regulated hazardous wastes, Toxic Substance Control Act wastes, or state hazardous wastes are generated, a USEPA generator identification number will need to be obtained. The FES must be contacted to assist in either obtaining a project-specific ID number or providing an USEPA ID number for an existing facility.

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Attachment N7-A

Results of Environmental Contamination Data Base Reviews

(excerpt from FERC ER Resource Report 8, Section 8.3.6.5)

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Tennessee received information from the CTDEEP (Riese 2014) concerning remediation inventory sites in the Project area. Information on those sites that are located within 0.25 mile is provided in Tables N7-A-1 and N7-A-2. From information gathered as of the date of this Resource Report, no risk of encountering impacted soils or groundwater from the identified sites during Project construction is anticipated.

Should any hazardous materials be encountered during pipeline construction, Tennessee will dispose of and/or mitigate for any hazardous materials uncovered in accordance with applicable federal and state regulations. Additionally, Tennessee will implement its Project-specific Upland Erosion Control, Revegetation and Maintenance Plan (Attachment N14) and Wetland and Waterbody Construction and Mitigation Procedures (Attachment N15), and its Project-specific ECP for Connecticut, Volume II, Appendix N, during construction of the Project facilities to minimize potential disturbance of contaminated media. Should surface or subsurface contamination be encountered during construction, it will be addressed and handled in accordance with this UDC Plan and federal, state, and local requirements.

References

Connecticut Government. 2015. Connecticut List of Significant Environmental Hazards Reported to the DEP on September 30, 2014. [Online WWW]. Available URL: http://www.ct.gov/deep/lib/deep/site_clean_up/hazard_notification/hazardnotificationsummary.pdf. [Accessed January 22, 2015].

Riese, F. 2014. Letter from Frederick Riese, Connecticut Department of Energy & Environmental Protection to Lori Ferry, AECOM. December 18, 2014.

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Table N7-A-1
Listings of Known Hazardous Waste Release Events Within 0.25 Mile of the Pipeline in Connecticut

Site Name	Segment[1]	Nearest Milepost	Approximate Location		Address of Hazardous Waste Release Site			Relevant Database(s)/ Source(s)	Status and Contamination Issues	Comments
			Distance from Pipeline (feet)	Direction from Pipeline	Street	Township/ Town	County			
Residential Property	S	11	948	NW	542 Tunxis Avenue Extension	Bloomfield	Hartford	Connecticut Government 2015; Riese 2014	Hazardous Notification in 2009 (Leaking above-ground tank). Impacted soil removed.	No impact based on status/location

Sources: Connecticut Government 2015; Riese 2014.

[1] Each segment is associated with its own set of MPs beginning at MP 0.00.

Table N7-A-2
Listings of Known Hazardous Waste Release Events Within 0.25 Mile of the Meter Stations and Compressor Stations in Connecticut

Facility Name	Facility Type	Site Name	Segment[1]	Nearest Milepost	Approximate Location		Address of Hazardous Waste Release Site			Relevant Database(s)/ Source(s)	Status and Contamination Issues	Comments
					Distance from Facility (feet)	Direction from Facility	Street	Township/ Town	County			
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

Sources: Riese 2014; Connecticut Government 2015

N/A - "Not Applicable." Indicates that no Hazardous Waste Release Sites are identified within 0.25 mile of the meter stations and compressor stations.

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Tennessee Gas Pipeline Company, L.L.C.
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ATTACHMENT N8

BLASTING MANAGEMENT PLAN

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1.0 INTRODUCTION

Tennessee Gas Pipeline Company, L.L.C. ("Tennessee" or "TGP") has filed 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"). The Environmental Report ("ER") is submitted in support of the application. 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 proposed Project will include construction of approximately 420 miles of pipeline (new pipeline, looping pipeline segments, and laterals) in Pennsylvania, New York, Massachusetts, New Hampshire, and Connecticut. Additionally, as part of the Project, Tennessee proposes to construct new compressor and meter stations and modify existing compressor and meter stations along its proposed and existing pipeline system. There also will be construction of appurtenant facilities, including mainline valves ("MLVs"), cathodic protection, and pig facilities through the Project area.

This Blasting Management Plan ("Plan") outlines the procedures and safety measures that the construction contractor ("Contractor") will adhere to while implementing blasting activities along the pipeline right-of-way ("ROW") during the Project. The Contractor will be required to submit a Blasting Specification Plan to Tennessee that is consistent with the provisions of this Blasting Management Plan. The Contractor's plan, when approved by Tennessee, will be incorporated into the Contractor's scope of work.

2.0 OBJECTIVE

This Plan is intended to identify blasting procedures, including safety, use, storage, and transportation of blasting materials that are consistent with minimum safety requirements as defined by applicable Federal regulations (e.g., Title 27 Code of Federal Regulations ["CFR"] 181 - Commerce in Explosives; Title 49 CFR 177 - Carriage by Public Highway; Title 29 CFR 1926.900 et seq. Sub-part U - Safety and Health Regulations for Construction – Blasting and Use of Explosives; Title 29 CFR 1910.109 – Explosives and Blasting Agents (OSHA); 29 CFR 1926.900 – General Provisions and Sections 901, 902, and 904-911), applicable state and local regulations, and Kinder Morgan Construction Specifications for Land Pipeline Construction. Additionally, this Plan is intended to address environmental aspects of blasting activities and to identify areas of concern along the proposed pipeline loop segments.

3.0 GENERAL REQUIREMENTS

Blasting operations will be conducted by or under the direct and constant supervision of personnel legally licensed and certified to perform such activities in the jurisdiction where blasting occurs. Prior to any blasting activities, the contractor will provide Tennessee with appropriate information documenting the experience, licenses, and permits associated with all blasting personnel.

Blasting-related operations, including obtaining, transporting, storing, handling, loading, detonating, and disposing of blasting material; drilling; and ground-motion monitoring, will comply with all applicable federal, state, and local regulations, permit conditions and the construction contract.

Blasting for grade or trench excavation will be used where deemed necessary by a construction expert after examination of the site and in other locations only after other reasonable means of excavation have been used and are unsuccessful in achieving the required results. Tennessee may specify locations (e.g., foreign line crossings, near structures) where consolidated rock will be removed by approved mechanical equipment such as rock-trenching machines, rock saws, hydraulic rams, or jack hammers in lieu of blasting.

Before blasting, a site-specific Blasting Specification Plan must be submitted by the Contractor to Tennessee for approval. Tennessee will contract a third-party engineer with expertise in blasting operations to review the site-specific blasting plan. The engineer will analyze the data to determine the combined stress level of each affected pipeline and will make recommendations and/or forward approval to Tennessee before blasting may commence.

Special blasting controls will be required where dry waterbody crossings are specified. The type of blasting material, size of charges, sequence of firing, etc. will be selected to minimize shock wave stresses on aquatic life adjacent to the blasting area. In addition to the use of matting to control fly rock, where specified, the Contractor will furnish the necessary labor and equipment to employ air bubble curtains.

Tennessee will contract a third-party inspector that will be present during construction and blasting activities to monitor the Contractor and their blasting operations. Approval is required to proceed prior to each blast. Approval does not relieve the Contractor from responsibility or liability.

4.0 PRE-BLASTING REQUIREMENTS

Prior to the initiation of blasting operations, the Contractor will comply with the following:

- The Contractor will obtain all required federal, state, and local permits relating to the transportation, storage, handling, loading, and detonation of blasting materials;
- The Contractor will place all necessary "One-Calls" 48 hours prior to construction where One-Call systems are in place;
- The Contractor will be responsible for the protection of all existing underground facilities;
- Before performing any work on, or accessing the ROW, the Contractor will verify to Tennessee that all property owners have been notified of the impending construction and blasting activities; and
- The Contractor will submit to the Tennessee representative its site-specific Blasting Plan for approval prior to execution of any blasting activity.

5.0 SITE-SPECIFIC BLASTING PLANS

For each area determined to require blasting, a site-specific blasting plan will be created. The Contractor's site-specific blasting plan will include, at a minimum, the following information:

- Blaster's name, company, copy of license, and statement of qualifications; seismograph company, names, equipment and sensor location;
- Site location (milepost ["MP"] and station), applicable alignment sheet number(s), and associated rock type and geological structure (solid, layered, or fractured);
- Copies of all required federal, state, and local permits;
- Methods and materials including blasting material type, product name and size, weight per unit, and density; stemming material; tamping method; blasting sequence; use of non-electrical initiation systems for all blasting operations; magazine type; and locations and security for storage of blasting materials and detonating caps;
- Site dimensions, including blasting depth, distribution, and maximum charge and weight per delay; hole depth, diameter, pattern, and number of holes per delay;
- Dates and hours of conducting blasting; distance and orientation to nearest aboveground and underground structures; schedule identifying when blasting is scheduled within each waterbody greater than 10 feet wide, or within any designated coldwater fishery; and
- Blasting procedures for:
  - Storing, handling, transporting, loading, and firing blasting materials;
  - Prevention of misfires, fly rock, fire prevention, noise, and stray current accidental-detonation;
  - Signs, flagmen, and warning signals prior to each blast;
  - Those locations where the pipeline route:
    - Parallels or crosses an electrical transmission corridor, cable or pipeline;
    - Parallels or crosses a highway or road;
    - Is within or adjacent to forested areas;
    - Approaches within 200 feet of a water well or spring; or
    - Approaches within 1,000 feet of any residence, building or occupied structure;
  - Local notification;
  - Inspections after each blast; and
  - Disposal of waste blasting material.

6.0 MONITORING

During blasting operations, Tennessee will contract a third-party blasting inspector to monitor operations in the following manner:

- The third-party blasting monitor will provide seismographic equipment to measure the peak particle velocity ("PPV") of all blasts in the vertical, horizontal, and longitudinal directions. Seismic monitoring can only be discontinued if: 1) the blasting schedule and blasting performance consistently produce PPVs at the pipeline that are lower than the maximum allowable limit; and 2) a Tennessee representative provides written authorization;

- The third-party blasting monitor will measure the PPV at the adjacent pipeline, at any water wells, potable springs, and any aboveground structures within 200 feet of the blasting; and
- The third-party blasting monitor will complete a Blasting Log Record immediately after each blast and submit a copy to a Tennessee representative.

7.0 LIMITS ON PEAK PARTICLE VELOCITY

Any proposed blast will be monitored to ensure that the PPV will not exceed the specified maximum velocities. Maximum velocities are: 4 inches per second measured adjacent to an underground pipeline and for any aboveground or underground structure.

For all aboveground facilities within 200 feet of the blasting, the third-party blasting monitor will provide additional seismograph equipment to determine the PPV at the aboveground facility. If the measured PPV at an existing pipeline or other structure exceeds the above limits, the contractor will stop blasting activities immediately and notify Tennessee. The Blasting Management Plan must be modified to reduce the PPV prior to any further blasting.

The frequency caused by the detonation of blasting charge will not drop below 25 hertz without the review and approval of the designated Tennessee Blasting Representative.

The minimum time delay between the detonation of charges will be 8 milliseconds.

All blasting activity occurring within 300 feet of high pressure pipelines will require seismological surveillance (PPV and frequency) for every blast unless otherwise agreed upon following the review of the Blasting Plan. Pipelines affected by blasting are to be leak surveyed in the affected area following the completion of the blasting operation.

Note: Limits on PPV for surface structures are based on studies which established the limits at which plaster in homes will crack. The primary purpose of the limit is to prevent damage to homes. Tennessee's designated blasting representative may increase the limit for other structures such as steel transmission line towers, as appropriate and approve higher velocities for given site-specific conditions in advance.

8.0 SAFETY

8.1 PROTECTION OF ABOVEGROUND AND UNDERGROUND STRUCTURES

Where blasting is determined to be required, Tennessee will identify any municipal water mains proposed for crossing and will consult the local water authority. Reports of identified crossings will include location by MP, owner, and status and results of contacts with the water authority.

The Contractor will exercise control to prevent damage to aboveground and underground structures, including buildings, pipelines, utilities, springs, and water wells. The Contractor will implement the following procedures:

- If blasting occurs within 200 feet of identified water well or potable springs, Tennessee will hire a third-party blasting monitor to conduct water flow performance and water quality testing before blasting. If the water well or spring is damaged, the well or spring will be repaired or otherwise restored, or the well owner will be compensated for damages. Tennessee will provide an alternative potable water supply to the landowner until repairs occur. Locations of water wells or systems within 200 feet of the construction work area are indicated on Tennessee's construction alignment sheets.
- If blasting occurs within 200 feet of any aboveground structures, the Contractor and Tennessee's third-party blasting monitor will inspect structures before and after blasting. In the unlikely event that damage occurs to the aboveground structure, the owner will be compensated.
- The Contractor will be responsible for the ultimate resolution of all damage claims resulting from blasting. Such liability is not restricted by the 200-foot inspection requirement cited above;
- Blasting will not be allowed within 15 feet of an existing pipeline, unless specifically authorized by Tennessee.
- Holes that have contained blasting materials will not be re-drilled. Holes will not be drilled where danger exists of intersecting another hole containing blasting materials.
- Blasting mats or padding will be used on all shots where necessary to prevent scattering of loose rock outside of the approved construction workspace areas and to prevent damage to nearby structures and overhead utilities.
- Blasting will not begin until occupants of nearby buildings, residences, places of business, places of public gathering, and farmers have been notified by the Contractor sufficiently in advance to protect personnel, property, and livestock. The Contractor will notify all such parties at least 48 hours prior to blasting.
- Blasting in or near environmentally sensitive areas, such as streams and wildlife areas, may include additional restrictions.
- All blasting will be subject to the following limitations:
  - Maximum PPV of 4 inches per second in any of three mutually perpendicular axes, measured at the lesser distance of the nearest facility or the edge of the permanent easement;
  - Maximum drill size will be 2.5 inches unless approved by Tennessee;
  - Maximum quantity of blasting material per delay will be governed by the recorded measurements as influenced by work site conditions;
  - Blasting agents and ignition methods will be approved by Tennessee. Ammonium nitrate fuel oil and other free-flowing blasting materials and blasting agents are not acceptable and will not be used;
  - Drill holes will not be left loaded overnight; and
  - Good stemming material is to be used in all holes;
- The drilling pattern will be set in a manner to achieve smaller rock fragmentation (maximum 1 foot in diameter) to use as much as possible of the blasted rock as backfill material after the pipe has been padded in accordance with the specifications. The Contractor will submit the proposed drilling pattern to Tennessee for approval prior to implementation.

- Under pipeline crossings and all other areas where drilling and blasting are required within 15 feet of existing natural gas facilities:
  - Drill holes will be reduced to a maximum of 2 inches or less in diameter;
  - The number of holes shot at one time will be limited to three unless otherwise approved by Tennessee; and
  - Appropriate delay between charges to attain desired fragmentation.

8.2 PROTECTION OF PERSONNEL

The Contractor will include in its procedures all federal, state, county, and local safety requirements for blasting. The Contractor's procedures will address, at a minimum, the following requirements:

- Only authorized, qualified, and experienced personnel will handle blasting materials.
- No blasting materials will be located where they may be exposed to flame, excessive heat, sparks, or impact. Smoking, firearms, matches, open flames, and heat- and spark-producing devices will be prohibited in or near explosive magazines or while blasting materials are being handled, transported, or used.
- A code of blasting signals will be established, posted in conspicuous places, and utilized during blasting operations. Employee training will be conducted on the use and implementation of the code.
- The Contractor will use every reasonable precaution including, but not limited to, visual and audible warning signals, warning signs, flag person, and barricades to ensure personnel safety.
- Warning signs, with lettering a minimum of 4 inches in height on a contrasting background, will be erected and maintained at all approaches to the blast area.
- Flaggers will be stationed on all roadways passing within 1,000 feet of the blast area to stop all traffic during blasting operations.
- All personnel not involved in the actual detonation will stand back at least 1,000 feet and workers involved in the actual detonation will stand back at least 650 feet from the time the blast signal is given until the "ALL CLEAR" has been sounded.
- No loaded holes will be left unattended or unprotected. No blasting materials or blasting agent will be abandoned.
- In the case of a misfire, the blaster will provide proper safeguards for personnel until the misfire has been re-blasted or safely removed.
- The exposed areas of the blast will be matted wherever practicable. In cases where such a procedure is not deemed to be feasible, the Contractor will submit an alternative procedure for review by Tennessee. The site in question must be visited and examined by a Tennessee representative before any approval is granted.
- Tennessee may employ two-way radios for communication between vehicles and office facilities. The Contractor will advise Tennessee and other pipeline contractors of any need to cease use of such equipment during blasting activities.
- All loading and blasting activity will cease and personnel in and around the blast area will retreat to an area of safety during the approach and progress of an electrical storm irrespective of the type of blasting materials or initiation system used. T**HIS IS A MAJOR SAFETY PRECAUTION AND WILL ALWAYS BE OBSERVED**. All blasting materials, all electrical initiation systems, and all non-electric initiation systems are susceptible to premature initiation by lightning.
- Previous blast areas must be inspected to verify the absence of misfires. No drilling may commence until such inspection occurs. If a misfire occurs adjacent to a hole to be drilled, the

misfire will be cleared by the blaster using whatever techniques are called for by the situation prior to commencement of drilling. If a misfire occurs at some distance from the drilling area, drilling may be stopped while clearing preparations are underway. When the misfire is to be cleared by re-shooting, drilling will be shut down and personnel evacuated to a place of safety prior to detonation.

- All transportation of blasting materials will be conducted in accordance with applicable federal, state, and local laws and regulations. Vehicles used to transport blasting materials will be in proper working condition and equipped with tight wooden or non-sparking metal floors and sides. If blasting materials are carried in an open-bodied truck, they will be covered with a waterproof and flame-resistant tarpaulin. Wiring will be fully insulated to prevent short-circuiting and at least two fire extinguishers will be carried. The truck will be plainly marked to identify its cargo so that the public may be adequately warned. Metal, flammable, or corrosive substances will not be transported in the same vehicle with blasting materials. There will be no smoking and no unauthorized or unnecessary personnel will be allowed in the vehicle. Competent, qualified personnel will load and unload blasting materials into or from the vehicle.
- No sparking metal tools will be used to open kegs or wooden cases of blasting materials. Metallic slitters will be used to open fiberboard cases, provided the metallic slitter does not come in contact with the metallic fasteners of the case. There will be no smoking, no matches, no open lights, or other fire or flame nearby while handling or using blasting materials. Blasting materials will not be placed where they are subject to flame, excessive heat, sparks, or impact. Partial cases or packages of blasting materials will be re-closed after use. No blasting materials will be carried in the pockets or clothing of personnel. The wires of an electric blasting cap will not be tampered with in any way. Wires will not be uncoiled. The use of electric blasting caps will not be permitted during dust storms or near any other source of large charges of static electricity. Uncoiling of the wires or use of electric caps will not be permitted near radio-frequency transmitters. The firing circuit will be completely insulated from the ground or other conductors.
- No blast will be fired without a positive signal from the person in charge. This person will ensure that all surplus blasting materials are in a safe place; all persons, vehicles, and/or boats are at a safe distance; and adequate warning has been given. Adequate warning of a blast will consist, of but not be limited to, the following:
  - Notification to nearby homeowners and local agencies if necessary;
  - Stop vehicular and/or pedestrian traffic near the blast site; and
  - Signal given by an air horn, whistle, or similar device using standard warning signals.
- Only authorized and necessary personnel will be present where blasting materials are being handled or used.
- Condition of the hole will be checked with a wooden tamping pole prior to loading. Surplus blasting materials will not be stacked near working areas during loading. Detonating fans will be cut from spool before loading the balance of charge into the hole. No blasting materials will be forced into a bore hole past an obstruction. Loading will be done by a blaster holding a valid license or by personnel under his direct supervision.
- Should fly-rock leave the ROW even after all necessary precautions have been taken, it will be collected immediately and disposed of at approved disposal sites. This work will not be left to the cleanup crew.

8.3 PROTECTION OF THREATENED AND ENDANGERED SPECIES

- Tennessee will consult with state and federal agencies regarding areas proposed for blasting where sensitive habitats or species are known to occur. Areas identified as containing sensitive

habitats or species, as directed by the appropriate agencies, will be staked and flagged. A qualified Project biologist will survey the proposed blasting zone identified by the Contractor immediately in advance of any drilling or blasting. Areas will be checked before and after blasting for the presence of sensitive species, and disturbance to species and habitats will be resolved in accordance with guidance provided by the appropriate agencies.

8.4 PROTECTION OF STREAMS

- Blasting in streams will comply with Tennessee's Upland Erosion Control, Revegetation and Maintenance Plan (Attachment N14) and Tennessee's Wetland and Waterbody Construction and Mitigation Procedures (Attachment N15). Tennessee will notify appropriate state authorities at least 48 hours before beginning trenching or blasting within a waterbody crossed by the project. Tennessee will comply with all federal and state permits issued for the project.

8.5 LIGHTNING HAZARD

- A risk of accidental detonation caused by lightning strikes exists at any time the workplace is experiencing an electrical storm and there are loaded holes on site. If this hazard is judged to exist by the Tennessee representative, work will discontinue at all operations and workers will be moved to secure positions away from the loaded holes. Furthermore, workers will not return to the work site until the storm has passed and the Tennessee representative has indicated it is clear to return.
- Tennessee's Contractor will have on site approved lightning detectors (model SD-2508 manufactured by Electronics Division of S.D.I. International, Model 350 manufactured by Thomas Instruments Inc., Skyscan Lightning Detector manufactured by Skyscan Technologies or equivalent) capable of measuring the degree of electrical activity as a storm approaches, and the distance to the storm front from the instrument on the ROW.

9.0 STORAGE REQUIREMENTS

- All blasting materials, blasting agents, and initiation devices will be stored in locked magazines that have been located, constructed, approved, and licensed in accordance with local, state, and federal regulations.
- The storage of blasting materials, blasting agents, and initiation devices is not permitted on the ROW and will only be stored at approved staging areas or contractor yards.
- Magazines will be dry, well-ventilated, reasonably cool (painting of the exterior with a reflective color), bullet and fire resistant, and kept clean.
- Initiation devices will not be stored in the same box, container, or magazine with other blasting materials. Blasting materials, blasting agents, or initiation devices will not be stored in wet or damp areas; near oil, gasoline, cleaning solvents; or near sources of heat radiators, steam pipes, stoves, etc. No metal or metal tools will be stored in the magazine. There will be no smoking, matches, open lights, or other fire or flame inside or within 50 feet of storage magazines or blasting materials. The loading and unloading of blasting materials into or out of the magazine will be done in a business-like manner with no loitering, horseplay, or prank playing.
- Magazines will be kept locked at all times unless blasting materials are being delivered or removed by authorized personnel. Admittance will be restricted to the magazine keeper, blasting

supervisor, or licensed blaster. Magazine construction will meet the requirements of Bureau of Alcohol, Tobacco and Fire Arms ("ATF") P5400.7 "Explosives Law and Regulations" and be in accordance with local, state, or federal regulations and the Blaster's Handbook.

- Accurate and current records of the blasting material inventory will be kept to ensure that oldest stocks are utilized first, to satisfy regulatory requirements and for immediate notification of any loss or theft. Magazine records will reflect the quantity of explosions removed, the amount returned, and the net quantity used at the blasting site.
- When blasting materials are taken from the storage magazine, they will be kept in the original containers until used. Small quantities of blasting materials may be placed in day boxes, powder chests, or detonator boxes. Any blasting material not used at the blast site will be returned to the storage magazine and replaced in the original container as soon as practicable.
- Magazine locations will be in accordance with local, state, or federal regulations. Where no regulations apply, magazines will be located in accordance with the latest edition of the 175th Anniversary Edition of the Blaster's Handbook and ATF P5400-7, Explosives Law and Regulations.
- Magazines will be marked in minimum 3-inch high letters with the words "DANGER – EXPLOSIVES" prominently displayed on all sides and roof.

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ATTACHMENT N9

INVASIVE SPECIES MANAGEMENT PLAN

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LIST OF ACRONYMS and ABBREVIATIONS

Acronym	Full Name
AR	access road
BMP	Best Management Practice
CFR	Code of Federal Regulations
Commission or FERC	Federal Energy Regulatory Commission
Contractor	construction contractor
CTDEEP	Connecticut Department of Energy and Environmental Protection
CIPC	Connecticut Invasive Plants Council
°F	degrees Fahrenheit
ECP	Environmental Construction Plan
EI	Environmental Inspector
EMAP	Environmental Mobile Application for Projects
FERC or Commission	Federal Energy Regulatory Commission
ISMP	Invasive Species Management Plan
GPS	Global Positioning System
MLV	mainline valve
MP	milepost
NED or Project	Northeast Energy Direct
the Plan	Tennessee's *Upland Erosion Control, Revegetation and Maintenance Plan*
the Procedures	Tennessee's *Wetland and Waterbody Construction and Mitigation Procedures*
Project	Northeast Energy Direct Project or NED Project
R.C.S.A.	Regulations of Connecticut State Agencies
ROW	right-of-way
TBD	to be determined
Tennessee or TGP	Tennessee Gas Pipeline Company, L.L.C.
U.S.	United States
USACOE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USDA	United States Department of Agriculture

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1.0 INTRODUCTION

Tennessee Gas Pipeline Company, L.L.C. ("Tennessee" or "TGP") has filed 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"). The Environmental Report ("ER") is submitted in support of the application. 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 proposed Project will include construction of approximately 420 miles of pipeline (new pipeline, looping pipeline segments, and laterals) in Pennsylvania, New York, Massachusetts, New Hampshire, and Connecticut. Additionally, as part of the Project, Tennessee proposes to construct new compressor and meter stations and modify existing compressor and meter stations along its proposed and existing pipeline system. There will also be construction of appurtenant facilities, including mainline valves ("MLVs"), cathodic protection, and pig facilities through the Project area.

Tennessee has prepared a state-specific Connecticut Invasive Species Management Plan ("ISMP") for the proposed Project to minimize the spread of invasive species during construction of the natural gas pipeline and aboveground facilities located in Connecticut. The movement of vehicles, equipment, and personnel, and the transport of materials and/or construction debris to and from areas that are inhabited by invasive species could result in the unintentional spread of these species during construction. Additionally, recently disturbed areas may provide an opportunity for the colonization and spread of invasive species. This plan will serve as a guidance document for the control of invasive plant species during construction.

2.0 EXISTING CONDITIONS

The Connecticut portion of the Project is located within the Northeastern Coastal Zone ecoregion (U.S. Environmental Protection Agency ["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 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 degrees Fahrenheit ("°F") and average temperatures between 35 and 50°F (United States Department of Agriculture ["USDA"] 2005).

The Project crosses multiple land use types in Connecticut, from human-altered landscapes: residential, agricultural, commercial/industrial, transportation corridors (roadways, railroad), and utility transmission corridors, to relatively undisturbed natural landscapes, including forested uplands, open land, forested wetlands, non-forested wetlands, and waterbodies. Human-altered landscapes often create suitable conditions for establishment of the quick-germinating, fast-growing, nutrient-poor soil-loving species that typically characterize invasive plant species. Although the Project area in Connecticut remains

predominantly rural, it has had a long history of settlement since colonial times, with agriculture and timber harvesting as the predominant industries having influenced land development. Consequently, even the relatively undisturbed lands can consist of long abandoned agricultural fields and second- to third-growth woodland, which may have sufficiently altered the natural vegetation community, allowing for establishment of invasive plant species.

Tennessee has conducted an invasive plant baseline inventory, on those accessible portions of the proposed Project area, to determine the presence, location, and extent of invasive plant species at all NED facilities. Results from the baseline surveys, identifying the milepost ("MP") location, of specific species documented by field biologists is provided in Table 2.2-1.

Table 2.2-1 Invasive Species Preliminary Occurrence by Milepost for the Project in Connecticut

Common Name[1]	Scientific Name	USDA Code	Milepost[2]	Facility Name	Segment	County, Town	Percent Cover
Morrow's Honeysuckle, Russian Olive, Multiflora Rose	*Lonicera morrowii, Elaeagnus angustifolia, Rosa multiflora*	LOMO, ELAN, ROMU	3.58	300 Line CT Loop	S	Hartford, West Hartford	17
Morrow's Honeysuckle, Russian Olive, Multiflora Rose, Japanese Stilt Grass	*Lonicera morrowii, Elaeagnus angustifolia, Rosa multiflora, Microstegium vimineum*	LOMO, ELAN, ROMU, MIVI	3.68	300 Line CT Loop	S	Hartford, West Hartford	21
Winged Euonymus, Multiflora Rose, Japanese Barberry	*Euonymus alatus, Rosa multiflora, Berberis thunbergii*	EUAL, ROMU, BETH	5.96	300 Line CT Loop	S	Hartford, Bloomfield	3
Multiflora Rose, Japanese Barberry, European Privet	*Rosa multiflora, Berberis thunbergii, Ligustrum vulgare*	ROMU, BETH, LIVU	6.55	300 Line CT Loop	S	Hartford, Bloomfield	4
European Privet, Multiflora Rose, Common Buckthorn, Amur Maple	*Ligustrum vulgare, Rosa multiflora, Rhamnus cathartica, Acer ginnala*	LIVU, ROMU, RHCA, ACGI	6.93	300 Line CT Loop	S	Hartford, Bloomfield	13

Table 2.2-1 Invasive Species Preliminary Occurrence by Milepost for the Project in Connecticut

Common Name[1]	Scientific Name	USDA Code	Milepost[2]	Facility Name	Segment	County, Town	Percent Cover
Multiflora Rose, European Privet, Oriental Bittersweet, Common Buckthorn, Winged Euonymus	*Rosa multiflora, Ligustrum vulgare, Celastrus orbiculatus, Rhamnus cathartica, Euonymus alatus*	ROMU, LIVU, CEOR, RHCA, EUAL	7.06	300 Line CT Loop	S	Hartford, Bloomfield	41
Reed Canary Grass	*Phalaris arundinacea*	PHAR	7.13	300 Line CT Loop	S	Hartford, Bloomfield	30
Oriental Bittersweet, Multiflora Rose, Russian Olive	*Celastrus orbiculatus, Rosa multiflora, Elaeagnus angustifolia*	CEOR, ROMU, ELAN	7.15	300 Line CT Loop	S	Hartford, Bloomfield	46
Reed Canary Grass, Multiflora Rose, Japanese Barberry, Winged Euonymus, Oriental Bittersweet, Japanese Honeysuckle	*Phalaris arundinacea, Rosa multiflora, Berberis thunbergii, Euonymus alatus, Celastrus orbiculatus, Lonicera japonica*	PHAR, ROMU, BETH, EUAL, CEOR, LOJA	7.28	300 Line CT Loop	S	Hartford, Bloomfield	100
Autumn Olive, Japanese Barberry, Oriental Bittersweet, Multiflora Rose	*Elaeagnus umbellata, Berberis thunbergii, Celastrus orbiculatus, Rosa multiflora*	ELUM, BETH, CEOR, ROMU	7.44	300 Line CT Loop	S	Hartford, Bloomfield	45

Table 2.2-1 Invasive Species Preliminary Occurrence by Milepost for the Project in Connecticut

Common Name[1]	Scientific Name	USDA Code	Milepost[2]	Facility Name	Segment	County, Town	Percent Cover
Common Reed, Reed Canary Grass, Multiflora Rose, Japanese Barberry, Winged Euonymus, Oriental Bittersweet	*Phragmites australis ssp. australis, Phalaris arundinacea, Rosa multiflora, Berberis thunbergii, Euonymus alatus, Celastrus orbiculatus*	PHAUA, PHAR, ROMU, BETH, EUAL, CEOR	7.47	300 Line CT Loop	S	Hartford, Bloomfield	96
Japanese Barberry, Multiflora Rose, Japanese Barberry, Oriental Bittersweet, Russian Olive	*Berberis thunbergii, Rosa multiflora, Berberis thunbergii, Celastrus orbiculatus, Elaeagnus angustifolia*	BETH, ROMU, BETH, CEOR, ELAN	7.67	300 Line CT Loop	S	Hartford, Bloomfield	10
European Privet, Multiflora Rose, Japanese Barberry, Oriental Bittersweet, Russian Olive	*Ligustrum vulgare, Rosa multiflora, Berberis thunbergii, Celastrus orbiculatus, Elaeagnus angustifolia*	LIVU, ROMU, BETH, CEOR, ELAN	7.74	300 Line CT Loop	S	Hartford, Bloomfield	22
Multiflora Rose, Autumn Olive, Japanese Barberry	*Rosa multiflora, Elaeagnus umbellata, Berberis thunbergii*	ROMU, ELUM, BETH	7.90	300 Line CT Loop	S	Hartford, Bloomfield	28

Table 2.2-1 Invasive Species Preliminary Occurrence by Milepost for the Project in Connecticut

Common Name[1]	Scientific Name	USDA Code	Milepost[2]	Facility Name	Segment	County, Town	Percent Cover
Multiflora Rose, Morrow's Honeysuckle, European Privet, Japanese Barberry	*Rosa multiflora, Lonicera morrowii, Ligustrum vulgare, Berberis thunbergii*	ROMU, LOMO, LIVU, BETH	8.07	300 Line CT Loop	S	Hartford, Bloomfield	31
Multiflora Rose, Morrow's Honeysuckle, Reed Canary Grass	*Rosa multiflora, Lonicera morrowii, Phalaris arundinacea*	ROMU, LOMO, PHAR	8.08	300 Line CT Loop	S	Hartford, Bloomfield	20
Oriental Bittersweet	*Celastrus orbiculatus*	CEOR	8.23	300 Line CT Loop	S	Hartford, Bloomfield	6
Japanese Barberry	*Berberis thunbergii*	BETH	8.35	300 Line CT Loop	S	Hartford, Bloomfield	6
Japanese Barberry, Multiflora Rose, Oriental Bittersweet, European Privet	*Berberis thunbergii, Rosa multiflora, Celastrus orbiculatus, Ligustrum vulgare*	BETH, ROMU, CEOR, LIVU	8.43	300 Line CT Loop	S	Hartford, Bloomfield	58
Japanese Barberry, Multiflora Rose, Morrow's Honeysuckle, European Privet	*Berberis thunbergii, Rosa multiflora, Lonicera morrowii, Ligustrum vulgare*	BETH, ROMU, LOMO, LIVU	8.47	300 Line CT Loop	S	Hartford, Bloomfield	65
Reed Canary Grass, European Privet, Multiflora Rose, Common Reed, Morrow's Honeysuckle	*Phalaris arundinacea, Ligustrum vulgare, Rosa multiflora, Phragmites australis ssp. australis, Lonicera morrowii*	PHAR, LIVU, ROMU, PHAUA, LOMO	8.54	300 Line CT Loop	S	Hartford, Bloomfield	50

Table 2.2-1 Invasive Species Preliminary Occurrence by Milepost for the Project in Connecticut

Common Name[1]	Scientific Name	USDA Code	Milepost[2]	Facility Name	Segment	County, Town	Percent Cover
Japanese Barberry, Multiflora Rose, Morrow's Honeysuckle, European Privet	*Berberis thunbergii*, *Rosa multiflora*, *Lonicera morrowii*, *Ligustrum vulgare*	BETH, ROMU, LOMO, LIVU	8.66	300 Line CT Loop	S	Hartford, Bloomfield	65
Japanese Barberry, Multiflora Rose, Morrow's Honeysuckle, Reed Canary Grass	*Berberis thunbergii*, *Rosa multiflora*, *Lonicera morrowii*, *Phalaris arundinacea*	BETH, ROMU, LOMO, PHAR	8.68	300 Line CT Loop	S	Hartford, Bloomfield	41
Japanese Barberry, Multiflora Rose, Reed Canary Grass	*Berberis thunbergii*, *Rosa multiflora*, *Phalaris arundinacea*	BETH, ROMU, PHAR	8.70	300 Line CT Loop	S	Hartford, Bloomfield	23
Japanese Barberry, Multiflora Rose, Morrow's Honeysuckle, Reed Canary Grass	*Berberis thunbergii*, *Rosa multiflora*, *Lonicera morrowii*, *Phalaris arundinacea*	BETH, ROMU, LOMO, PHAR	8.74	300 Line CT Loop	S	Hartford, Bloomfield	41
Japanese Barberry, Multiflora Rose, Reed Canary Grass	*Berberis thunbergii*, *Rosa multiflora*, *Phalaris arundinacea*	BETH, ROMU, PHAR	8.76	300 Line CT Loop	S	Hartford, Bloomfield	23
Multiflora Rose, Reed Canary Grass, Japanese Barberry, Russian Olive	*Rosa multiflora*, *Phalaris arundinacea*, *Berberis thunbergii*, *Elaeagnus angustifolia*	ROMU, PHAR, BETH, ELAN	8.89	300 Line CT Loop	S	Hartford, Bloomfield	82

Table 2.2-1 Invasive Species Preliminary Occurrence by Milepost for the Project in Connecticut

Common Name[1]	Scientific Name	USDA Code	Milepost[2]	Facility Name	Segment	County, Town	Percent Cover
Multiflora Rose, Reed Canary Grass, Japanese Barberry, Russian Olive	*Rosa multiflora, Phalaris arundinacea, Berberis thunbergii, Elaeagnus angustifolia*	ROMU, PHAR, BETH, ELAN	9.04	300 Line CT Loop	S	Hartford, Bloomfield	82
Multiflora Rose, Reed Canary Grass, Japanese Barberry, Russian Olive	*Rosa multiflora, Phalaris arundinacea, Berberis thunbergii, Elaeagnus angustifolia*	ROMU, PHAR, BETH, ELAN	9.12	300 Line CT Loop	S	Hartford, Bloomfield	21
Reed Canary Grass, Multiflora Rose	*Phalaris arundinacea, Rosa multiflora*	PHAR, ROMU	9.30	300 Line CT Loop	S	Hartford, Bloomfield	81
Multiflora Rose, Reed Canary Grass, Oriental Bittersweet, Common Buckthorn, Winged Euonymus	*Rosa multiflora, Phalaris arundinacea, Celastrus orbiculatus, Rhamnus cathartica, Euonymus alatus*	ROMU, PHAR, CEOR, RHCA, EUAL	9.41	300 Line CT Loop	S	Hartford, Bloomfield	33
Reed Canary Grass, Multiflora Rose, Oriental Bittersweet	*Phalaris arundinacea, Rosa multiflora, Celastrus orbiculatus*	PHAR, ROMU, CEOR	9.60	300 Line CT Loop	S	Hartford, Bloomfield	82
Multiflora Rose, Oriental Bittersweet, Morrow's Honeysuckle, Japanese Barberry	*Rosa multiflora, Celastrus orbiculatus, Lonicera morrowii, Berberis thunbergii*	ROMU, CEOR, LOMO, BETH	9.71	300 Line CT Loop	S	Hartford, Bloomfield	35

Table 2.2-1 Invasive Species Preliminary Occurrence by Milepost for the Project in Connecticut

Common Name[1]	Scientific Name	USDA Code	Milepost[2]	Facility Name	Segment	County, Town	Percent Cover
Multiflora Rose, Oriental Bittersweet, Morrow's Honeysuckle, Japanese Barberry	*Rosa multiflora, Celastrus orbiculatus, Lonicera morrowii, Berberis thunbergii*	ROMU, CEOR, LOMO, BETH	9.96	300 Line CT Loop	S	Hartford, Bloomfield	35
Multiflora Rose, Oriental Bittersweet, Morrow's Honeysuckle, Japanese Barberry	*Rosa multiflora, Celastrus orbiculatus, Lonicera morrowii, Berberis thunbergii*	ROMU, CEOR, LOMO, BETH	10.05	300 Line CT Loop	S	Hartford, Bloomfield	26
Multiflora Rose, Oriental Bittersweet, Morrow's Honeysuckle, Japanese Barberry	*Rosa multiflora, Celastrus orbiculatus, Lonicera morrowii, Berberis thunbergii*	ROMU, CEOR, LOMO, BETH	10.22	300 Line CT Loop	S	Hartford, Bloomfield	7
Japanese Barberry, Reed Canary Grass, Multiflora Rose	*Berberis thunbergii, Phalaris arundinacea, Rosa multiflora*	BETH, PHAR, ROMU	10.31	300 Line CT Loop	S	Hartford, Bloomfield	16
Purple Loosestrife	*Lythrum salicaria*	LYSA	10.44	300 Line CT Loop	S	Hartford, Bloomfield	50

Table 2.2-1 Invasive Species Preliminary Occurrence by Milepost for the Project in Connecticut

Common Name[1]	Scientific Name	USDA Code	Milepost[2]	Facility Name	Segment	County, Town	Percent Cover
Russian Olive, Multiflora Rose, Common Buckthorn, Oriental Bittersweet	*Elaeagnus angustifolia, Rosa multiflora, Rhamnus cathartica, Celastrus orbiculatus*	ELAN, ROMU, RHCA, CEOR	10.71	300 Line CT Loop	S	Hartford, Bloomfield	8
Russian Olive, Multiflora Rose, Common Buckthorn, Oriental Bittersweet, Japanese Barberry	*Elaeagnus angustifolia, Rosa multiflora, Rhamnus cathartica, Celastrus orbiculatus, Berberis thunbergii*	ELAN, ROMU, RHCA, CEOR, BETH	10.88	300 Line CT Loop	S	Hartford, Bloomfield	7
Multiflora Rose, Japanese Barberry, Reed Canary Grass, Russian Olive, Oriental Bittersweet	*Rosa multiflora, Berberis thunbergii, Phalaris arundinacea, Elaeagnus angustifolia, Celastrus orbiculatus*	ROMU, BETH, PHAR, ELAN, CEOR	11.15	300 Line CT Loop	S	Hartford, Bloomfield	41
Multiflora Rose, Japanese Barberry, Oriental Bittersweet	*Rosa multiflora, Berberis thunbergii, Celastrus orbiculatus*	ROMU, BETH, CEOR	11.17	300 Line CT Loop	S	Hartford, Bloomfield	14

Table 2.2-1 Invasive Species Preliminary Occurrence by Milepost for the Project in Connecticut

Common Name[1]	Scientific Name	USDA Code	Milepost[2]	Facility Name	Segment	County, Town	Percent Cover
Multiflora Rose, Japanese Barberry, Reed Canary Grass, Russian Olive, Oriental Bittersweet	*Rosa multiflora, Berberis thunbergii, Phalaris arundinacea, Elaeagnus angustifolia, Celastrus orbiculatus*	ROMU, BETH, PHAR, ELAN, CEOR	11.24	300 Line CT Loop	S	Hartford, Windsor	41
Common Reed	*Phragmites australis ssp. australis*	PHAUA	11.28	300 Line CT Loop	S	Hartford, Windsor	20
Multiflora Rose, Japanese Barberry, Reed Canary Grass, Russian Olive, Oriental Bittersweet	*Rosa multiflora, Berberis thunbergii, Phalaris arundinacea, Elaeagnus angustifolia, Celastrus orbiculatus*	ROMU, BETH, PHAR, ELAN, CEOR	11.32	300 Line CT Loop	S	Hartford, Windsor	41
Japanese Barberry, Narrowleaf Bittercress, Oriental Bittersweet	*Berberis thunbergii, Cardamine impatiens, Celastrus orbiculatus*	BETH, CAIM, CEOR	11.32	300 Line CT Loop	S	Hartford, Windsor	21
Multiflora Rose, Japanese Barberry, Reed Canary Grass, Russian Olive, Oriental Bittersweet	*Rosa multiflora, Berberis thunbergii, Phalaris arundinacea, Elaeagnus angustifolia, Celastrus orbiculatus*	ROMU, BETH, PHAR, ELAN, CEOR	11.37	300 Line CT Loop	S	Hartford, Windsor	41

Table 2.2-1 Invasive Species Preliminary Occurrence by Milepost for the Project in Connecticut

Common Name[1]	Scientific Name	USDA Code	Milepost[2]	Facility Name	Segment	County, Town	Percent Cover
Japanese Barberry, Multiflora Rose	*Berberis thunbergii, Rosa multiflora*	BETH, ROMU	11.40	300 Line CT Loop	S	Hartford, Windsor	3
Common Reed, Multiflora Rose	*Phragmites australis ssp. australis, Rosa multiflora*	PHAUA, ROMU	13.80	300 Line CT Loop	S	Hartford, Windsor	2
Multiflora Rose, Russian Olive, Reed Manna Grass	*Rosa multiflora, Elaeagnus angustifolia, Glyceria maxima*	ROMU, ELAN, GLMA	13.83	300 Line CT Loop	S	Hartford, Windsor	15
Purple Loosestrife, Multiflora Rose, Reed Canary Grass	*Lythrum salicaria, Rosa multiflora, Phalaris arundinacea*	LYSA, ROMU, PHAR	13.98	300 Line CT Loop	S	Hartford, Windsor	7
Multiflora Rose, Russian Olive, Reed Canary Grass	*Rosa multiflora, Elaeagnus angustifolia, Phalaris arundinacea*	ROMU, ELAN, PHAR	14.05	300 Line CT Loop	S	Hartford, Windsor	15
Multiflora Rose, Reed Canary Grass	*Rosa multiflora, Phalaris arundinacea*	ROMU, PHAR	14.22	300 Line CT Loop	S	Hartford, East Granby	3
Multiflora Rose, Reed Canary Grass	*Rosa multiflora, Phalaris arundinacea*	ROMU, PHAR	14.31	300 Line CT Loop	S	Hartford, East Granby	11

Table 2.2-1 Invasive Species Preliminary Occurrence by Milepost for the Project in Connecticut

Common Name[1]	Scientific Name	USDA Code	Milepost[2]	Facility Name	Segment	County, Town	Percent Cover
Oriental Bittersweet, Winged Euonymus	*Celastrus orbiculatus*, *Euonymus alatus*	CEOR, EUAL	14.51	300 Line CT Loop	S	Hartford, East Granby	50
Oriental Bittersweet, Russian Olive	*Celastrus orbiculatus*, *Elaeagnus angustifolia*	CEOR, ELAN	14.68	300 Line CT Loop	S	Hartford, East Granby	100
Poison Ivy, Oriental Bittersweet	*Celastrus orbiculatus*	CEOR	14.79	300 Line CT Loop	S	Hartford, East Granby	21

[1] Presence and location of invasive species are based on the results of the baseline inventory surveys conducted within the survey corridor from September 2014 to September 2015 (ongoing in areas where survey access becomes available).

[2] MPs for mapped species polygons and wetlands containing species are listed using the midpoint.

3.0 INVASIVE SPECIES MANAGEMENT

The following best management practices ("BMPs") will be employed to control the transport of invasive species from areas where they may currently occur along the Project route in Connecticut. Measures, such as training personnel in the identification of invasive species; inspecting and cleaning equipment; and practices to encourage rapid stabilization, restoration, and revegetation of disturbed work areas, are incorporated to minimize adverse impacts resulting from the presence of invasive species. Tennessee's plan, outlined in the following sections, will be to implement a program to prevent the introduction or spread of invasive species resulting from construction and restoration of the Project.

Tennessee will ensure the BMPs detailed in this ISMP are implemented by construction contractors ("Contractor") during all phases of construction. Requirements of the ISMPs will be identified to Contractors during the required preconstruction environmental training. Compliance or non-compliance with these requirements will be recorded in the field by Environmental Inspectors ("EIs"), and details of the activities will be captured in the weekly construction inspection reports, which will be submitted to the FERC for review and comment.

3.1 MEASURES TO PREVENT OR CONTROL THE TRANSPORT OF INVASIVE PLANT SPECIES

Tennessee will perform the following measures to prevent or control the transport of invasive plant species:

- Prior to construction, Tennessee will provide training to educate Contractor(s) and subcontractor(s) with respect to the site-specific protocols for controlling transport of invasive plant species within or outside of the Project workspace limits.
- Locations containing invasive species will be marked with signage during construction in order to facilitate awareness.
- EIs will be employed during construction to monitor and provide oversight and implementation of this ISMP.
- When upland invasive species are cut, the slash will be removed from the site and disposed of.
- After final re-grading, the restored ROW will be seeded with a seed mix free of invasive species to restore herbaceous cover over the disturbed ROW and help prevent establishment of invasive species which can colonize at disturbed sites.
- Equipment used within wetlands will be tracked, often operating on top of construction mats. These measures will minimize the amount of soil disturbance within wetlands in which invasive species might colonize.
- To the extent practicable, the movement of soils, gravel, rock, and other fill materials infested with invasive plants to locations relatively free of invasive plants will be avoided. Soil, gravel, rock, and other fill material will come from sources on and off the site that are visibly free of invasive plants, if such sources are available.
- Revegetation of disturbed areas free of invasive species prior to construction will utilize seed and other plant materials that have been checked by EIs and certified by suppliers as noxious-weed-free.

3.2 MEASURES TO PREVENT OR CONTROL THE TRANSPORT OF INVASIVE INSECT SPECIES

Invasive insect species potentially occurring within the Project area include the emerald ash borer (*Agrilus planipennis)* and the Asian longhorn beetle (*Anoplophora glabripennis*). Prior to construction, Tennessee will provide training to educate Contractor(s) and subcontractor(s) with respect to identifying these species. If these insects are found during the course of the Project, they will be reported to the Connecticut Department of Energy and Environmental Protection ("CTDEEP") as well as the USDA. When conducting clearing operations, Tennessee's Contractor will adhere to the CTDEEP firewood restrictions to protect forests from invasive species by adhering to regulations (Regulations of Connecticut State Agencies ["R.C.S.A."] Section 22-84); as well as the USDA federal regulations pertaining to the treatment and transport of materials within quarantine locations (7 Code of Federal Regulations ["CFR"] Part 301).

3.3 MEASURES TO PREVENT OR CONTROL THE TRANSPORT OF INVASIVE AQUATIC SPECIES

3.3.1 Hydrostatic Pressure Testing

Following pipeline installation, Tennessee will hydrostatically pressure test the new pipeline system in accordance with the requirements outlined in CFR Part 192 – Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards. Prior to testing, Tennessee will obtain applicable water withdrawal and discharge permits,.

Where possible the hydrostatic test water will be discharged to the same watershed from which it was collected. In locations where invasive aquatic species have been identified, hydrostatic test water will be discharged in level, vegetated upland areas at sufficient distances from surface waters to prevent the overland transport of any aquatic invasive species into a water feature. The rate of discharge flow will be controlled to prevent erosion.

Additional protective measures that will be implemented during hydrostatic testing operations include:

- During the filling of the pipeline, the water intake at the location where water is being taken will be screened with a 0.1-inch mesh screen (or as recommended by state agencies) to prevent entrainment of invasive vegetation.
- The intake rate/volume will be low enough to prevent impingement of aquatic species or debris on the screen.
- The intake hose and screen will be kept off the bottom of the waterbody to prevent uptake of sediment.
- No equipment will enter the waterbody, except the water withdrawal intake apparatus, which will be cleaned and dried before being used at each subsequent waterbody if applicable.

3.3.2 Waterbody Crossings

The procedures for all waterbody crossings associated with the Project will be conducted in accordance with the BMPs outlined in this Connecticut ECP. To minimize the potential for the transport of invasive aquatic species, Tennessee will consult applicable regulatory agencies regarding

the known or potential presence of invasive aquatic species. Waterbodies with known or potential populations of invasive aquatic species will be identified to Project personnel to ensure that the proper procedures are implemented during in-stream construction activities, such that equipment and materials do not impact unaffected waterbodies within the ROW. Additional BMPs specific to minimizing the potential transport of aquatic invasive species include:

- Restricting equipment and materials to only those necessary for waterbody construction, and reviewing all materials to make certain they are visibly free of vegetation and debris prior to entering and exiting a waterbody.

3.4 GENERAL MANAGEMENT ACTIVITIES

Disturbed wetland areas within the ROW will be restored and seeded in accordance with this ECP, which incorporates guidance from CTDEEP's *Guidelines for Soil Erosion and Sediment Control* (2002), as well as guidance contained within Tennessee's *Upland Erosion Control, Revegetation, and Maintenance Plan* and Tennessee's *Wetland and Waterbody Construction and Mitigation Procedures*. Additionally, any supplemental fill soils or topsoil materials that need to be imported to the Project site for restoration purposes to re-establish preconstruction grades and contours will be clean, debris-free, and contaminant-free soils obtained from reputable suppliers to minimize importation of invasive plant species.

Post-construction monitoring of invasive plant species will be conducted for a period of 3 years concurrent with upland and wetland restoration success monitoring. Monitoring reports detailing the success of restoration will identify invasive plant species' locations and densities, which will be used to determine if species-specific management measures are necessary. Relative density of invasive species found on the ROW will be compared to the off ROW densities and if on ROW density is significantly greater than the adjacent off ROW plant community, then Tennessee will develop a plan to address the invasive species which may include mechanical removal, biological treatments, or if requested by the landowner or land managing agency and in accordance with regulatory requirements, spot treatment by herbicides.

4.0 SUMMARY/CONCLUSIONS

Tennessee will conduct invasive species management within the Project workspace areas in Connecticut in a manner that is consistent with the objective of the Project. The proposed management activities outlined within this Plan are expected to prevent the inadvertent spread of existing populations of invasive species and will promote the establishment of native plant populations.

5.0 REFERENCES

USDA. 2005. United States Department of Agriculture Description of Ecological Subregions: Sections of the Conterminous United States. [Online WWW]. Available URL: http://na.fs.fed.us/sustainability/ecomap/section_descriptions.pdf. [Accessed January 2015].

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ATTACHMENT N9-A

INVASIVE PLANT SPECIES LIST – CONNECTICUT

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Plant Species List
Tennessee Pipeline - Connecticut

Species listed below may occur within the survey area based on known distribution records.

Common Name	Scientific Name	Source
Amur maple	*Acer ginnala*	1
Norway maple	*Acer platanoides*	1
Sycamore maple	*Acer pseudoplatanus*	1
Goutweed	*Aegopodium podagraria*	1
Tree-of-heaven	*Ailanthus altissima*	1
Garlic mustard	*Alliaria petiolata*	1
Porcelain-berry	*Ampelopsis brevipedunculata*	1
Small carpetgrass or Hairy jointgrass	*Arthraxon hispidus (Thunb.) Makino*	1
Mugwort or Common wormwood	*Artemisia vulgaris L.*	1
Common kochia	*Bassia scoparia*	1
Japanese barberry	*Berberis thunbergii*	1
European or Common barberry	*Berberis vulgaris*	1
Downy brome or Cheatgrass	*Bromus tectorum*	1
Flowering rush	*Butomus umbellatus*	1
Carolina fanwort	*Cabomba caroliniana*	1
Pond water-strawort	*Callitriche stagnalis Scop.*	1
Narrowleaf bittercress	*Cardamine impatiens*	1
Japanese or Asiatic sand sedge	*Carex kobomugi*	1
Oriental bittersweet	*Celastrus orbiculatus*	1
Spotted knapweed	*Centaurea stoebe*	1
Canada thistle	*Cirsium arvense*	1
Black swallow-wort	*Cynanchum louiseae*	1
European or Pale swallow-wort	*Cynanchum rossicum*	1
Jimsonweed	*Datura stramonium*	1
Brazilian waterweed	*Egeria densa*	1
Common water-hyacinth	*Eichhornia crassipes*	1
Russian olive	*Elaeagnus angustifolia*	1
Autumn olive	*Elaeagnus umbellata*	1
Crested late-summer mint	*Elsholtzia ciliata*	1
Winged euonymus or Burning bush	*Euonymus alatus*	1

Common Name	Scientific Name	Source
Cypress spurge	*Euphorbia cyparissias*	1
Leafy spurge	*Euphorbia esula*	1
Glossy buckthorn	*Frangula alnus*	1
Slender snake cotton	*Froelichia gracilis*	1
Ground ivy	*Glechoma hederacea*	1
Reed mannagrass	*Glyceria maxima*	1
Giant hogweed	*Heracleum mantegazzianum*	1, 2
Dames rocket	*Hesperis matronalis*	1
Japanese hops	*Humulus japonicus*	1
Water thyme or Hydrilla	*Hydrilla verticillata*	1, 2
Ornamental jewelweed	*Impatiens glandulifera*	1
Cogongrass	*Imperata cylindrica*	1, 2
Yellow or water flag iris	*Iris pseudacorus*	1
Perennial or Broadleaved pepperweed	*Lepidium latifolium*	1
Border privet	*Ligustrum obtusifolium*	1
California privet	*Ligustrum ovalifolium*	1
European privet	*Ligustrum vulgare*	1
Japanese honeysuckle	*Lonicera japonica*	1
Amur honeysuckle	*Lonicera maackii*	1
Morrow's honeysuckle	*Lonicera morrowii*	1
Tatarian honeysuckle	*Lonicera tatarica*	1
Bell's honeysuckle	*Lonicera x bella*	1
Dwarf of fly honeysuckle	*Lonicera xylosteum*	1
Ragged robin	*Lychnis flos-cuculi*	1
Moneywort or Creeping charlie	*Lysimachia nummularia*	1
Garden loosestrife	*Lysimachia vulgaris*	1
Purple loosestrife	*Lythrum salicaria*	1
European waterclover	*Marsilea quadrifolia*	1
Japanese stiltgrass	*Microstegium vimineum*	1
Chinese silvergrass or Maiden grass	*Miscanthus sinensis*	1
Forget-me-not	*Myosotis scorpioides*	1
Parrot-feather watermilfoil	*Myriophyllum aquaticum*	1
Broadleaf or Twoleaf watermilfoil	*Myriophyllum heterophyllum*	1
Hybrid variable or Broadleaf watermilfoil	*Myriophyllum heterophyllum x. M laxum*	1

Common Name	Scientific Name	Source
Eurasian watermilfoil	*Myriophyllum spicatum*	1
Brittle water-nymph	*Najas minor*	1
Onerow yellowcress or One-rowed water-cress	*Nasturtium microphyllum*	1
Watercress	*Nasturtium officinale*	1
American water lotus	*Nelumbo lutea*	1
Yellow floating heart	*Nymphoides peltata*	1
Scotch thistle	*Onopordum acanthium*	1
Star-of-bethlehem	*Ornithogalum nutans, O. umbellatum*	1
Princess or Empress tree	*Paulownia tomentosa*	1
Mile-a-minute	*Persicaria perfoliata*	1
Reed canary grass	*Phalaris arundinacea*	1
Common reed	*Phragmites australis ssp. australis*	1
Water lettuce	*Pistia stratiotes*	1
Canada bluegrass	*Poa compressa*	1
Bristled knotweed	*Polygonum cespitosum*	1
White poplar	*Populus alba*	1
Curly pondweed	*Potamogeton crispus*	1
Kudzu	*Pueraria montana*	1
Lesser celandine or Fig buttercup	*Ranunculus ficaria*	1
Common buckthorn	*Rhamnus cathartica*	1
Black locust	*Robinia pseudoacacia*	1
Multiflora rose	*Rosa multiflora*	1
Rugosa or Beach rose	*Rosa rugosa*	1
Wineberry	*Rubus phoenicolasius*	1
Common sheep sorrel	*Rumex acetosella*	1
Kariba-weed or Giant salvinia	*Salvinia molesta*	1, 2
Tansy ragwort	*Senecio jacobaea*	1
Cup plant	*Silphium perfoliatum*	1
Bittersweet nightshade	*Solanum perfoliatum*	1
European water chestnut	*Trapa natans*	1
Coltsfoot	*Tussilago farfara*	1
Garden heliotrope	*Valeriana officinalis*	1

Sources:

1: Connecticut Invasive Plants Council's Connecticut Revised Invasive Plants List (November 2014).

2: USDA Federal Noxious Weed List.

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ATTACHMENT N9-B

INVASIVE SPECIES FACT SHEETS – CONNECTICUT

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American Water Lotus (*Nelumbo lutea*)

A plant profile for this species can be found at the United States Department of Agriculture website at the following link:

http://plants.usda.gov/core/profile?symbol=NELU

Invasive Plants in Pennsylvania

Amur Maple

Acer ginnala

Photo: Paul Wray, Iowa State U., www.invasive.org

Background:

Amur Maple is a native of central and northern China, Manchuria and Japan, and was introduced into the United States in the 1860s. It is still being sold commercially for ornamental use as well as for wildlife and shelterbelt plantings.

Range:

In the United States this tree ranges from Maine to North Dakota and as far south as Kentucky. It is considered invasive across most of its U.S. range.

Image courtesy of USDA PLANTS Database

Description:

Amur maple is a small tree that grows up to 20 feet high with a broad crown, but sometimes pruned as a hedge. Twigs are smooth and light colored. Leaves are opposite, longer than they are wide, and have three shallow lobes and double-toothed edges. Fall leaf color is a brilliant red. Fragrant flowers appear in loose clusters in May and June. Fruit are numerous reddish, two-winged, inch long samaras that mature in late summer and persist on the tree until late fall.

Photo: Leslie Mehrhoff, U. of Connecticut, www.bugwood.org

Habitat:

Often found in early successional forests, forest edges, open disturbed areas, roadsides and as planted ornamentals in yards and gardens. Amur maple tolerates a wide range of soils and pH values. It grows best on moist-well drained soils.

Biology and Spread:

Amur maple spreads primarily though wind-dispersal of abundant winged samaras in late summer and fall.

Photo: Stacey Leicht, U. of Connecticut, www.bugwood.org

Ecological Threat:

Amur maple can displace native shrubs and understory trees in open woods, and shades out native grasses and herbaceous plants in more open habitats. This plant has been widely planted for its hardiness and tolerates a wide range of hardiness zones (zones three through eight).

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www.dcnr.state.pa.us

How to Control this Species:

Mechanical control

Prescribed fire will set back Amur maple, but not eliminate it. Small infestations can be controlled by grubbing out individual plants.

Chemical Control

These trees can be controlled using a cut-stump treatment with glyphosate herbicide or the cut-stump or basal bark treatment around the trunk with triclopyr herbicide.

Look-A-Likes:

Amur maple is most easily mistaken for a small red maple (*Acer rubrum*). The terminal leaf lobes in Amur maple tend to be more elongate. The undersurface of Amur maple leaves are light green, while red maple tends to have a much paler light color. Amur maple flowers are white and fragrant, while red maple flowers are non-fragrant and red. Amur maple samaras have nearly parallel wings and persist into late fall, while red maple samaras have more angled wings and tend not to persist.

Native alternatives:

A number of native alternatives are similar in size or fall color including mountain maple (*Acer spicatum*), American hornbeam (*Carpinus caroliniana*), pagoda dogwood (*Cornus alternifolia*), fireberry hawthorn (*Crategus chrysocarpa*), pin cherry (*Prunus pensylvanica*), nanny-berry (*Viburnum lentago*) and high-bush cranberry (*Viburnum trilobum*).

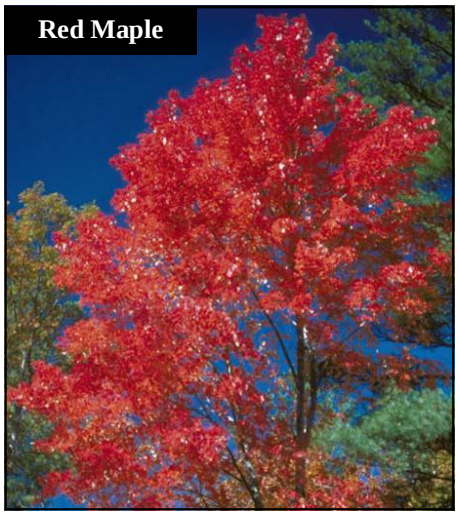

Photo: Robert Anderson, USDA FS, www.forestryimages.org

Photo: Rob Routledge, Sault College, www.forestryimages.org

Photo: Rob Routledge, Sault College, www.forestryimages.org

Photo: John Ruter, U. of Georgia, www.forestryimages.org

References:

Amur Maple fact sheet: http://www.dnr.state.mn.us/invasives/terrestrialplants/woody/amurmaple.html

U.S. Forest Service Weed of the Week: http://na.fs.fed.us/fhp/invasive_plants/weeds/armur-maple.pdf

Invasive Plant Atlas of New England: http://nbii-nin.ciesin.columbia.edu/ipane/icat/browse.do?specieId=31

Plant Conservation Alliance's Alien Plant Working Group

LEAST WANTED

Asiatic Sand Sedge

Carex kobomugi Ohwi

Sedge family (Cyperaceae)

Download PDF version formatted for print (118 KB)

FACT SHEET LINKS

Photographic List
⊞ Complete List
⊞ Aquatics
⊞ Herbaceous Plants
⊞ Shrubs
⊞ Trees
⊞ Vines

NATIVE RANGE

Coastal areas of northeastern Asia

DESCRIPTION

Asiatic sand sedge is a perennial adapted to coastal beaches and dunes and possibly the only Carex species found in upper beach habitat along the U.S. Atlantic Coast. The mature sedge is a coarse and stout member of the genus that forms extensive colonies through cord-like rhizomes that extend many feet under the sand and produce new shoots. Flowering and fruiting occurs April through June and individual plants have either male or female flowers. As with many other members of the genus Carex, the flowers are numerous, subtended by scales, and arranged in spikes at the end of a flowering stalk that is triangular in cross section. A papery sac or perigynium encloses the female flowers, each of which develops into a single-seeded fruit, called an achene.

Because flowering culms are evident for a relatively brief period during the spring, and some colonies and new infestations may spread extensively without flowering, it is useful to learn to recognize the plant in its sterile form. Asiatic sand sedge may be confused with at least two colonial, rhizomatous native grass species - American beach grass (*Ammophila breviligulata*) and beach panic grass (*Panicum amarum*). Leaves of Asiatic sand sedge are longer tapering than those of the above grasses, have a yellow-green rather than bluish-green cast, and small teeth along the margin that are easily felt or seen with the help of magnification. These differences become more obvious when observed in the field. Several species of

another sedge genus, Cyperus, sometimes grow on dunes and on wash flats and strongly resemble Carex when not in flower. However, these Cyperus species flower from late summer to fall, have leaves without serrated margins and, unlike Asiatic sand sedge, are weakly to non-rhizomatous.

ECOLOGICAL THREAT

Asiatic sand sedge invades wash flat habitat occupied by the federally listed plant, seabeach amaranth (*Amaranthus pumilus*), which is a poor competitor against it. On established, vegetated sand dunes, Asiatic sand sedge can out-compete native dune-binding grasses, like American beach grass and sea oats (*Uniola paniculata*). Dunes dominated by Asiatic sand sedge are also more vulnerable to wind blowouts and storm erosion. There is evidence to suggest that fewer native plant species, and fewer individuals, occur on dunes dominated by Asiatic sand sedge than on comparable dunes dominated by the native American beach grass.

DISTRIBUTION IN THE UNITED STATES

Asiatic sand sedge occurs in maritime areas from Massachusetts to North Carolina.

HABITAT IN THE UNITED STATES

Asiatic sand sedge grows on primary dunes and on upper parts of ocean beach wash flats that have recently been disturbed by ocean storms. Like American beach grass, it appears to create more habitat for itself by trapping wind-blown sand to form dunes. Sand burial appears to stimulate the growth of rhizomes.

BACKGROUND

Asiatic sand sedge was first observed in the United States, at Island Beach, New Jersey in 1929. Specimens were collected on the Virginia part of the Delmarva (Delaware-Maryland-Virginia) Peninsula as early as the 1940s. Although the circumstances of its introduction are unclear, sand sedge was apparently introduced intentionally for use as a sand binder in erosion-prone areas and may have spread accidentally as a result of its use as a packing material in ship cargo.

BIOLOGY & SPREAD

Once established, Asiatic sand sedge spreads primarily by vegetative means, through production of rhizomes. Sexual reproduction, which requires both male and female plants to be present, is not necessary for a colony to expand locally. Expansion of a colony was observed at Island Beach, New Jersey, despite the absence of any seedlings. Long-distance dispersal of Asiatic sand sedge is uncertain but it is likely that its seeds are tolerant of salt water immersion and carried by ocean currents and

storm surges. Plant fragments may be dispersed by ocean currents, and may remain viable after extended salt-water immersion, but this has not been confirmed. Some observation suggests that inundation by storm surges can kill growing plants. In newly forming colonies, sexual reproduction may be somewhat limited, since plants of the opposite sex may not occur nearby. Pollen may be carried long distances by the wind. Much research is needed to gain a better understanding of modes of dispersal and establishment of Asiatic sand sedge.

MANAGEMENT OPTIONS

Various mechanical and chemical methods have been used successfully in managing Asiatic sand sedge. Regardless of method, it is important to avoid breaking underground parts and leaving them untreated and to conduct follow-up monitoring and treatment if needed. Mapping infestations with a Global Positioning System (GPS) prior to treatment is very helpful for relocating sites, especially in sandy natural areas like beaches with few permanent landmarks. Cooperation and coordination among coastal area land managers should lead to more effective control.

Because Asiatic sand sedge is capable of forming extensive colonies, early detection and treatment of infestations is critical for effective management. The potential for considerable long-distance dispersal of seeds necessitates routine monitoring and possible follow up treatments, even after it is believed to be eradicated. Because of the likelihood of leaving viable below-ground parts after an excavation, it is important to revisit the site in subsequent years to ensure that an infestation has been eradicated.

Manual

Excavation of individual plants by digging and hand-pulling is feasible and has been successful when used to control small infestations (e.g., fewer than 200 shoots). This method may not be economically or logistically feasible on larger control projects. Excavation generally involves digging with a shovel under and around each individual plant shoot to expose and loosen the roots. Individual shoots are often connected to other shoots by cordlike rhizomes that are about ¼ inch thick and often of considerable length. Once shoot and roots are loose, all rhizomes need to be gently excavated by hand, following them through the sand to minimize breaking. Rhizome parts left buried are likely to grow into new plants. Because the tips of new tillers (shoots) can be sharp enough to puncture skin, it is important to wear thick gloves when handling below-ground parts. Plants should be removed from the beach and disposed of in habitat unsuitable for the sedge (e.g., lawns), spread out to dry, or composted in black plastic until dead.

Chemical

Larger colonies of Asiatic sand sedge that have formed considerable dunes are probably most effectively controlled using chemical herbicides. A 2% glyphosate (e.g. Roundup®, Rodeo®, etc.) and water solution applied to the leaves during the growing season has provided effective control. One or two treatments in the

same season followed by spot treatments are usually needed. Mid-summer (June through July in Maryland and New Jersey) treatments are just as effective as fall (October in Maryland) applications and allow for same season monitoring and re-treatment. Because rhizomes can be extensive, follow-up monitoring and treatment are necessary for several seasons to ensure long-term control.

Good coverage of herbicide is needed but can be difficult because of the plant's narrow leaves. To help track application and to minimize misapplication and waste, a colorant can be added to the spray solution. Herbicide applications should be made when the chance of rain is low for at least six hours after application and when winds are minimal (e.g., 0-7 mph), to minimize drift of herbicide to non-target areas. Herbicide users should read and follow all label instructions and, when possible, mix chemicals where a spill containment and/or clean-up facility is available instead of on site. Transport of herbicide is likely to be more rapid through sand than in other soils, and microbial activity that can break down herbicides is likely to be low in beach sand. When it is necessary to mix herbicide on the beach or dunes, it is recommended to mix over a waterproof basin set on top of a waterproof tarp.

USE PESTICIDES WISELY: ALWAYS READ THE ENTIRE PESTICIDE LABEL CAREFULLY, FOLLOW ALL MIXING AND APPLICATION INSTRUCTIONS AND WEAR ALL RECOMMENDED PERSONAL PROTECTIVE GEAR AND CLOTHING. CONTACT YOUR STATE DEPARTMENT OF AGRICULTURE FOR ANY ADDITIONAL PESTICIDE USE REQUIREMENTS, RESTRICTIONS OR RECOMMENDATIONS.

NOTICE: MENTION OF PESTICIDE PRODUCTS ON THIS WEB SITE DOES NOT CONSTITUTE ENDORSEMENT OF ANY MATERIAL.

CONTACTS

For more information on the management of Asiatic sand sedge, please contact:

- Chris Lea, Assateague Island National Seashore, Berlin, MD; chris_lea at nps.gov
- Greg McLaughlin, New Jersey Division of Parks and Forestry, Office of Natural Lands Management, Trenton, NJ; gmclaugh at dep.state.nj.us
- Virginia Natural Heritage Program/Virginia Native Plant Society fact sheet http://www.dcr.state.va.us/dnh/fscako.pdf

SUGGESTED ALTERNATIVE PLANTS

Asiatic sand sedge was originally introduced as a dune stabilizer, although it is apparently less effective in this role than native species, such as American beach grass (*Ammophila breviligulata*), which occurs throughout the North American range of Asiatic sand sedge. In the southernmost part of this range, sea oats (*Uniola paniculata*) is the dominant native dune binding grass.

Dune Restoration and Planting
Once successful control of Asiatic sand sedge has been achieved, establishing native vegetation is an integral part of dune restoration. Native species such as American beachgrass (*Ammophila breviligulata*) and sea oats (*Uniola paniculata*) should be planted to protect vulnerable dunes from storm damage and blowouts and to prevent re-colonization by Asiatic sand sedge. American beachgrass establishes itself well on primary foredunes were shifting sands are common and should be planted during late winter to early spring. In primary backdune areas and places where sands are usually more stable, consideration should be given to planting species such as seaside goldenrod (*Solidago sempervirens*), beach panic grass (*Panicum amarum*), dune panic grass (*Panicum amarulum*), and sea-rocket (*Cakile edentula*), in combination with American beachgrass and sea oats.

OTHER LINKS

- Invasive Plant Atlas of New England

AUTHORS
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Greg McLaughlin, New Jersey Division of Parks and Forestry, Office of Natural Lands Management, Trenton, NJ

EDITOR
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PHOTOGRAPHS
Helen Hamilton, National Park Service, Assateague Island National Seashore, Berlin, MD

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USDA, NRCS. 2009. The PLANTS Database (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Virginia Department of Conservation and Recreation and Virginia Native Plant Society. Date unknown. (Fact Sheet) Invasive alien plants of Virginia: Asiatic Sand Sedge (*Carex kobomugi*) Ohwi.

Plant Conservation Alliance, Alien Plant Working Group.

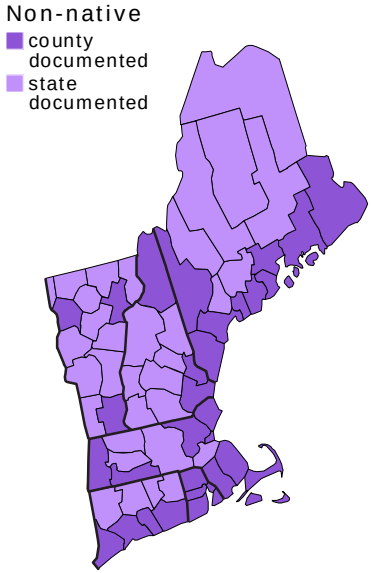
FACT SHEET LIST | APWG HOME PAGE

Comments, suggestions, and questions about the website should be directed to the webmaster.

http://www.nps.gov/plants/alien/fact/cako1.htm
Last updated: 07-Jul-2009

New England Distribution

Adapted from BONAP data

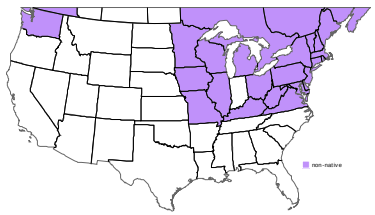


about the labels on this map

Found this plant? Take a photo and post a sighting.

North America Distribution

Adapted from BONAP data



Rosa rugosa Thunb.

beach rose

Facts About

Rugosa rose is notable for its rough (rugose) and leathery leaves, which conserve water well in its dry habitats of coastal dunes. It forms dense swards with masses of pink or white flowers that appear in mid-summer; sometimes the flowers have double-corollas. Although rugosa rose is regarded as a common feature of New England's beaches, it actually was introduced to the region in the 1770's from Asia. It disperses by means of its hips (fruits) which float or are carried by mammals. It is regarded as potentially invasive in the state of Connecticut.

Habitat

No enlarge

Family

Rosaceae

Genus

Rosa

Need Help? GET HELP

Anthropogenic (man-made or disturbed habitats), coastal beaches (sea beaches), dunes

Characteristics

Habitat	terrestrial
New England state	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont
Growth form	the plant is a shrub (a woody plant with several stems growing from the base)
Leaf type	the leaf blade is compound (made up of two or more discrete leaflets
Leaves per node	there is one leaf per node along the stem
Leaf blade edges	the edge of the leaf blade has teeth
Leaf duration	the leaves drop off in winter (or they wither but persist on the plant)
armature on plant	the plant has spines, prickles, or thorns
Leaf blade length	50–130 mm
Leaf stalk	the leaves have leaf stalks
Fruit type (general)	• the fruit is dry but does not split open when ripe • the fruit is fleshy
Bark texture	the bark of an adult plant is thin and smooth
Twig winter color	gray
Bud scale number	there are three or more scales on the winter bud, and they overlap like shingles, with one edge covered and the other edge exposed

Show All Characteristics

Wetland Status

Usually occurs in non-wetlands, but occasionally in wetlands. (Wetland indicator code: FACU)

New England Distribution and Conservation Status

Distribution

Connecticut	present, invasive
Maine	present

Massachusetts	present
New Hampshire	present
Rhode Island	present
Vermont	present

Conservation Status

Exact status definitions can vary from state to state. For details, please check with your state.

Massachusetts	unranked (S-rank: SNR)

Information from Dichotomous Key of Flora Novae Angliae

16. *Rosa rugosa* Thunb. E

beach rose. CT, MA, ME, NH, RI, VT. Atlantic coast beaches and strands, dunes, roadsides. This species shows single and double corollas in New England.

16×?. This very rare rose hybrid is known from VT. It is commonly referred to as *Rosa*'Hollandica' in horticultural literature. It is similar to *Rosa rugosa* in having the larger prickles pubescent and numerous small glands on the abaxial leaf surface. It differs from that species in its lighter green, less rugose leaflets, straight or weakly curved fruiting pedicels, ascending fruiting sepals, and hips 8–15(–20) mm in diameter (vs. dark green and prominently rugose leaflets, curved fruiting pedicels, erect fruiting sepals, and hips 20–25 mm in diameter in *R. rugosa*). The other parent of this rose is unknown, but study suggests it may be *R. davurica* Pall., *R. luciae*, or *R. multiflora* (Mikanagi et al. 1994).

The Go Botany project is supported in part by the National Science Foundation.
www.nsf.gov

Bittersweet Nightshade (*Solanum dulcamara*)

A plant profile for this species can be found at the United States Department of Agriculture Forest Service website at the following link:

http://www.na.fs.fed.us/fhp/invasive_plants/weeds/bittersweet-nightshade.pdf

FACT SHEET: BLACK LOCUST

Black Locust

Robinia pseudoacacia L.
Pea family (Fabaceae)

NATIVE RANGE

Southeastern United States; on the lower slopes of the Appalachian Mountains, with separate outliers north along the slopes and forest edges of southern Illinois, Indiana, and Missouri

DESCRIPTION

Black locust is a fast growing tree that can reach 40 to 100 feet in height at maturity. While the bark of young saplings is smooth and green, mature trees can be distinguished by bark that is dark brown and deeply furrowed, with flat-topped ridges. Seedlings and sprouts grow rapidly and are easily identified by long paired thorns. Leaves of black locust alternate along stems and are composed of seven to twenty one smaller leaf segments called leaflets. Leaflets are oval to rounded in outline, dark green above and pale beneath. Fragrant white flowers appear in drooping clusters in May and June and have a yellow blotch on the uppermost petal. Fruit pods are smooth, 2 to 4 inches long, and contain 4 to 8 seeds. Two other locusts native to the Appalachians, Robinia viscosa (with pink flowers), and Robinia hispida (with rose-purple flowers), are used in cultivation and may share black locust's invasive tendencies.

ECOLOGICAL THREAT

Black locust poses a serious threat to native vegetation in dry and sand prairies, oak savannas and upland forest edges, outside of its historic North American range. Native North American prairie and savanna ecosystems have been greatly reduced in size and are now represented by endangered ecosystem fragments. Once introduced to an area, black locust expands readily into areas where their shade reduces competition from other (sun-loving) plants. Dense clones of locust create shaded islands with little ground vegetation. Lack of ground fuel limits the use of fire in natural disturbance regimes. The large, fragrant blossoms of black locust compete with native plants for pollinating bees.

DISTRIBUTION IN THE UNITED STATES

Black locust has been planted in many temperate climates and is naturalized throughout the United States, within and outside of its historical range, and in some parts of Europe.

HABITAT IN THE UNITED STATES

Black locust is an early successional plant, preferring full sun, well drained soils and little competition. It is commonly found in disturbed areas such as old fields, degraded woods, and roadsides. Due to its rapid growth, black locust has been promoted by state and federal agencies and nurseries, and is sometimes planted in or near prairies, oak savannas and native woodland edges.

BACKGROUND

Black locust has been planted extensively for its nitrogen fixing abilities, as a source of nectar for honeybees, and for fenceposts and hardwood lumber. The clonal pattern of growth and connected roots are promoted for erosion control. It is also used for mine soil reclamation. Black locust is susceptible to some damage from two native insects, the locust borer (*Megacyllene robiniae*) and the locust leafminer (*Odontota dorsalis*).

Plant Conservation Alliance's Alien Plant Working Group
Weeds Gone Wild: Alien Plant Invaders of Natural Areas
http://www.nps.gov/plants/alien/

BIOLOGY & SPREAD

Black locust reproduces vigorously by root suckering and stump sprouting to form groves (or clones) of trees interconnected by a common fibrous root system. Physical damage to roots and stems increases suckering and sprouting, making control difficult. Black locust clones easily spread in quality and restorable natural areas. Although black locust produces abundant seeds, they seldom germinate.

MANAGEMENT OPTIONS

Mowing and burning are only effective in reducing the further spread of young shoots from a clone or parent tree. To kill a clone, cutting alone is ineffective. Herbicides applied to the stems or cut stumps spread into the root system and provide better control. From mid-June to August hand sprayer application of 6.25% glyphosate solution (15:1 water:glyphosate) to stumps cut near the ground has been used by the Minnesota Department of Natural Resources, Region V State Parks Resource Management Office. Resprouting and suckering from dense clones may require follow up treatment after a few years*.

*Because plants that appear to have been killed can resprout even several years after treatment with herbicide, annual monitoring should be conducted and follow-up treatments made as needed.

Throughout the year a 25% triclopyr solution in basal oil (3:1 oil:triclopyr) applied immediately to cut stumps using backpack sprayers has been used with success by the Scientific and Natural Areas Program in Minnesota. Thoroughly wet the cut stump and bark below the cut, down to the root collar, but avoid runoff. Any runoff will kill surrounding vegetation, especially if treated in the winter before snow melt.

USE PESTICIDES WISELY: Always read the entire pesticide label carefully, follow all mixing and application instructions and wear all recommended personal protective gear and clothing. Contact your state department of agriculture for any additional pesticide use requirements, restrictions or recommendations.

NOTICE: mention of pesticide products on this page does not constitute endorsement of any material.

SUGGESTED ALTERNATIVE PLANTS

For erosion control, soil enrichment, and nectar sources, plant native grasses and other native herbs, shrubs and trees that are appropriate for your soil and moisture conditions. If tree plantings will affect nearby natural communities, plant oak tree species native to your area for timber or shade. Contact the native plant society in your state or a state forester or resource manager for recommendations on appropriate, non-invasive native tree and shrub species for your site.

OTHER LINKS

- http://www.invasive.org/search/action.cfm?q=Robinia%20pseudoacacia
- http://nbii-nin.ciesin.columbia.edu/ipane/icat/browse.do?specieId=102

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Larry Morse, The Nature Conservancy, Arlington, VA

PHOTOGRAPHS

John M. Randall, The Nature Conservancy, Davis, CA.

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USDA, NRCS. 2009. The PLANTS Database (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Brazilian Water-weed (*Egeria densa*)

A plant profile for this species can be found at the United States Department of Agriculture website at the following link:

http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_010909.pdf

Invasive Plants in Pennsylvania

Bristled Knotweed

Persicaria longiseta

Photo: Leslie Mehrhoff, U. of Connecticut, www.invasive.org

Background:

Also known as Oriental lady's thumb, Asiatic smartweed, Asiatic waterpepper, bunchy knotweed, bristly lady's-thumb, long-bristled smart-weed and tufted knotweed.

Range:

This plant is native to south-east Asia where it is a common weed of rice paddies. It was first discovered in North America near Philadelphia in 1910. Now it can now be found throughout the eastern U.S. and Canada as well as some Midwestern and south-western states.

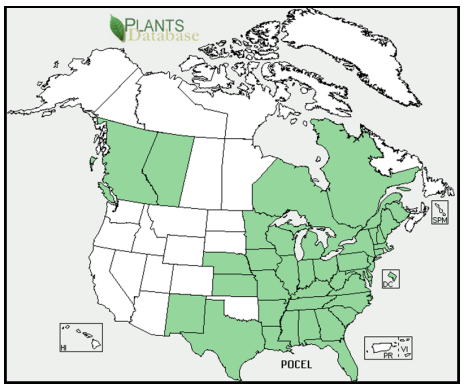
pennsylvania
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
www.dcnr.state.pa.us

Description:

This annual plant has stems that can reach over three feet in height. Leaves are thin, up to three inches in length, and alternate along the stem. Flowers are small, dark pink and arranged in thin spikes at the tips of the stems.

Habitat:

This plant occurs mainly in moist habitats including wetlands, wet meadows and riparian areas, including forested areas. However, it has also been reported in upland forests in parts of the U.S., including at Valley Forge National Historical Park and Gettysburg National Military Park. It also grows in disturbed areas along train tracks and roads.



Map courtesy of USDA PLANTS Database

Biology and Spread:

This plant produces many small, smooth seeds that may spread as a result of wildlife. Seeds can survive five or more years in the soil before sprouting. Railroads may have played a role in its dispersal across the U.S. The plant also spreads by a fibrous root and shallow taproot structure.

Ecological Threat:

Little is known about this species' specific impact on the environment but some suggest that it can displace native species by outcompeting them for sunlight and space, especially in disturbed areas.

Photo: Leslie Mehrhoff, U. of Connecticut, www.invasive.org

How to Control this Species:

The most cost-effective method for managing any invasive plant species is to prevent its establishment and spread by maintaining healthy natural communities and by frequently monitoring the area for new occurrences. When that is not possible, there are several control options available:

Bristled knotweed can be removed by hand pulling, digging up small infestations or frequent mowing.

It can also be controlled by any general-use herbicide, though in wet areas be sure to use an herbicide that is approved for use in wetlands. As with any herbicide, be sure to follow the directions on the label.

Little information is currently available about the use of fire as a control agent, although it is assumed that fire would kill the entire plant, as it does not have deeply rooted rhizomes. Fire's affect on the seeds is unknown.

References:

U.S. Forest Service: http://www.fs.fed.us/database/feis/plants/forb/perlon/all.html

USDA PLANTS Database: http://plants.usda.gov

For More Information:

To learn more about invasive plants in Pennsylvania and the northeast, here are some useful resources:

DCNR Invasive Species Site:
http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

Plant Invaders of Mid-Atlantic Natural Areas, National Park Service:
http://www.nps.gov/plants/alien/pubs/midatlantic/midatlantic.pdf

Invasive Plants Field and Reference Guide, U.S. Forest Service:
http://na.fs.fed.us/pubs/misc/ip/ip_field_guide.pdf

Look-A-Likes:

There are many *Persicaria* species that look similar, including some native ones. The key to identifying bristled knotweed is the papery sheath around the leaf joint with long, fine bristles at the top (*see photo below*).

Pennsylvania smartweed
(*Persicaria pensylvanica laevigata)*

Photo: Robert Mohlenbrock, USDA

Spotted ladysthumb
(*Persicaria maculosa* Gray)

Photo: Steve Dewey, Utah State U., www.bugwood.org

NC STATE UNIVERSITY

Aquatic Weed Fact Sheet
College of Agriculture and Life Sciences
Crop Science Department

Stratford Kay and Steve Hoyle

Brittle Naiad

Najas minor

Brittle naiad (also called slender, spiny, or bushy naiad) is a highly invasive, submersed annual aquatic plant introduced into the United States from Europe. It has established from Ontario west to Illinois and southward to Florida. This plant has spread rapidly in the Southeast and Mid-Atlantic states, where it grows either in mixed stands with other invasive exotic species (e.g., hydrilla) or as a monoculture, excluding native plants and producing conditions adverse to fish and waterfowl. It can form dense shoals and surface mats in water 12 ft. in depth, and is readily spread by boat traffic and water movements. Brittle naiad is widely distributed in North Carolina and has caused some serious problems in a few locations, including Lake Gaston, where it commonly replaces other more invasive exotics (e.g., hydrilla) following management operations.

The stems of brittle naiad are highly branched and may grow to a length of 4 ft. or more. The stems also fragment readily, hence the common name "brittle" naiad. Leaves are opposite, strap-shaped, about one inch in length, and have prominent marginal teeth. Near the growing tips of the stems the internodes are very short, giving a bushy appearance to the plant. Reproduction is by fragmentation and seed production. Flowers are very small and are produced singly in the leaf axils from early spring through late summer. Single-seeded fruits mature in summer through late fall. Seed germination occurs in early spring. The plants are annual and do not persist beyond late fall. Brittle naiad superficially resembles and often is confused with another submersed vascular plant, coontail (Ceratophyllum spp.), and the macroalga, muskgrass (Chara sp.). It can be distinguished from coontail by its oppositely paired, unbranched, straplike, leaves (coontail leaves occur in whorls of 4 or 5 and are forked at the tips). It also can be distinguished readily from muskgrass by breaking the stems: if the stem remains turgid, it's brittle naiad.

For additional information visit our web site at:

http://www.cropsci.ncsu.edu/aquaticweeds

AWFS 006-99

Invasive Plants in Pennsylvania

Burning Bush

Euonymus alatus

Leslie J. Mehrhoff, UConn
www.forestryimages.org

Background:

Burning bush, also commonly known as winged euonymus, was introduced into the United States in 1860 for use as an ornamental shrub. Its attractive, bright red fall foliage and desirable form has made this shrub a popular ornamental and an easy go-to plant used by landscape designers. As a result, it is commonly planted along interstate highways, as hedges and in foundation plantings.

Range:

Native to northeastern Asia, winged euonymus has escaped throughout the Northeast and Midwestern United States.

pennsylvania
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
www.dcnr.state.pa.us

Description:

Burning bush is a fast-growing, deciduous shrub that may reach five to 15 feet in height. Its green stems usually have prominent, corky wings. Elliptic leaves with finely serrated margins are arranged in opposite formation and turn a brilliant purplish-red to scarlet in the fall. Flowers are small and yellowish-green, becoming fruits that split to expose four red-orange seeds in late fall.

Barry Rice, Sarracenia,
James H. Miller, USDA Forest Service
www.forestryimages.org

Habitat:

Winged euonymus quickly escapes into woodlands, mature forests and open fields. It is highly adaptable to a variety of soil types and pH levels, although it generally doesn't do well in dry areas. It is tolerant of full shade.

Biology and Spread:

This shrub is a prodigious seed producer. Many germinate where they fall, close to the mother plant, creating a dense bed of seedlings. Others are carried by birds, allowing infestations to spread rapidly.

Ecological Threat:

Winged euonymus easily outcompetes native plants with its large, dense silhouette. Lacking pests and tolerant of deep shade, this shrub can force itself into moist forested sites, creating large thickets that displace native herbs and shrubs. This displacement has negative consequences for both aquatic and terrestrial ecosystems.

Leslie J. Mehrhoff, UConn
www.forestryimages.org

How to Control this Species:

Physical

Seedlings, up to two feet tall, can be easily hand-pulled, especially when the soil is moist.

Larger plants must be dug out with a spading fork, pulled with a weed wrench, or cut. The stump must be ground out or the re-growth clipped; be sure to remove a majority of the root system.

Chemical

Glyphosate can be applied as a foliar spray or painted on cut stumps.

Look-A-Likes:

Winged euonymous may be confused with other species of euonymous, including our native strawberry bush (*Euonymus americana*). Saplings of native sweetgum (*Liquidambar styraciflua*) also have winged stems.

Karan A. Rawlins, University of Georgia
www.forestryimages.org

Native Alternatives:

A wide variety of native shrubs provide beauty and wildlife value to the landscape, including:

Dow Gardens
www.forestryimages.org

Chris Evans, River to River CWMA
www.forestryimages.org

Rob Routledge, Sault College
www.forestryimages.org

Vern Wilkins
www.forestryimages.org

James Miller & Ted Bodner, SWSS
www.forestryimages.org

References:

Center for Invasive Species and Ecosystem Health: http://www.invasive.org/browse/subinfo.cfm?sub=3023

U.S. National Park Service: http://www.nps.gov/plants/alien/pubs/midatlantic/eual.htm

For More Information:

DCNR Invasive Species Site: http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

DCNR Invasive Exotic Plant Tutorial for Natural Lands Managers: http://www.dcnr.state.pa.us/forestry/invasivetutorial/winged_euonymus.htm

California Privet (*Ligustrum ovalifolium*)

A plant profile for this species can be found at the United States Department of Agriculture website at the following link:

http://plants.usda.gov/core/profile?symbol=LIOV

Invasive Plants in Pennsylvania

Canada Thistle

Cirsium arvense

Steve Dewey, Utah State University
www.forestryimages.org

Background:

Canada thistle was probably introduced into the United States by accident in the early 1600s. By 1954, it had been declared a noxious weed in 43 states. It is considered one of the most tenacious and economically important agricultural weeds and is becoming increasingly recognized as a problem in natural areas.

Range:

Despite its name, Canada thistle is native to temperate regions of Eurasia. In North America, it is distributed throughout Canada and the northern United States, from northern California to Maine and south to Virginia.

pennsylvania
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
www.dcnr.state.pa.us

Description:

Canada thistle is an erect herbaceous perennial with an extensive creeping rootstock. Its leaves are irregularly lobed with spiny, toothed margins. Rose-purple or sometimes white flower heads appear in terminal clusters from June through October. The small seeds have feathery plumes.

Steve Dewey, Utah State University
www.forestryimages.org

Habitat:

This plant does best in open and disturbed upland areas, but also invades wet places with fluctuating water levels, such as stream bank meadows. It is commonly found in barrens, glades, meadows, prairies, fields, pastures and waste places.

Biology and Spread:

Canada thistle produces an abundance of feathery seeds, which are quickly dispersed in the wind. The seeds can remain viable in the soil for up to 20 years or more. The fibrous taproot is capable of sending out lateral roots, which sprout shoots at frequent intervals.

Ecological Threat:

Once established in an area, Canada thistle crowds out and replaces native plants, changing the structure and species composition of plant communities and reducing diversity. This thistle outcompetes native plants through shading, competition for soil resources and possibly through the release of toxic allelochemicals.

Alec McClay, McClay Ecoscience
www.forestryimages.org

How to Control this Species:

Because Canada thistle is a perennial and spreads primarily by its root system, the entire plant must be destroyed for effective control.

Control efforts may be more successful when Canada thistle is under environmental stress, such as during droughts and floods, or after a very severe winter.

Canada thistle is stubborn and difficult to remove. Management practices that limit soil disturbance and encourage diverse native plant communities will help prevent establishment of this species.

Physical

For light infestations, black plastic sheeting can be used to smother this thistle. Repeated and frequent pulling or hand-cutting will eventually starve underground stems. This should be performed at least three times each season.

Mowing does not kill Canada thistle unless repeated monthly for up to four years. This method is not recommended for natural areas.

Late spring burns, between May and June, are detrimental to this invasive.

Chemical

In areas interspersed with desirable native plants, targeted application of a systemic herbicide, such as glyphosate, works well. For extensive infestations in disturbed areas, a broad application may be more effective. Repeated applications are usually necessary in order to exhaust the seed bank.

Herbicide treatment is best done in late summer or fall when plants are in the rosette stage.

Varying the type of herbicide used will prevent clone colonies from becoming resistant.

Look-A-Likes:

Native species of thistle (*Cirsium* sp.), some of which are rare, could be confused with Canada thistle. Before control is attempted, the thistle species in question should be accurately identified.

Field Thistle

Chris Evans, River to River CWMA
www.forestryimages.org

References:

Center for Invasive Species and Ecosystem Health:
http://www.invasive.org/browse/subinfo.cfm?sub=2792

Plant Conservation Alliance's Alien Plant Working Group:
http://www.nps.gov/plants/alien/fact/ciar1.htm

For More Information:

DCNR Invasive Species Site: http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

DCNR Invasive Exotic Plant Tutorial for Natural Lands Managers:
http://www.dcnr.state.pa.us/forestry/invasivetutorial/canada_thistle.htm

Canada Bluegrass (*Poa compressa*)

A plant profile for this species can be found at the United States Department of Agriculture website at the following link:

http://plants.usda.gov/plantguide/pdf/pg_poco.pdf

Carolina Fanwort (*Cabomba caroliniana*)

A plant profile for this species can be found at the United States Department of Agriculture Forest Service website at the following link:

http://www.na.fs.fed.us/fhp/invasive_plants/weeds/carolina-fanwort.pdf

Invasive Plants in Pennsylvania

Cheatgrass

Bromus tectorum

Steve Dewey, Utah State University
www.forestryimages.org

Background:

Cheatgrass was first introduced into North America sometime before 1860. Evidence suggests that it arrived as a seed lot and ballast soil contaminant. It may have been spread throughout the country by trains, which used contaminated straw as packing material. Cheatgrass is used as a feed for livestock and is sometimes planted to decrease erosion.

Range:

A native of Mediterranean Europe, cheatgrass now ranges across North America and is particularly problematic in the west and Canada.

pennsylvania
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
www.dcnr.state.pa.us

Description:

Cheatgrass is an annual grass that forms tufts up to two feet tall. Short, soft hairs cover its leaves and sheaths. The flowers, which appear in early summer, occur in drooping terminal clusters that take on a greenish, red or purple hue. Most plants usually die and fall over by July. During this stage, they are extremely flammable.

Chris Evans, River to River CWMA
www.forestryimages.org

Habitat:

Cheatgrass is mostly found in disturbed sites, such as waste areas, roadsides, agricultural fields, pastures and rights-of-way. It does well in open areas with dry, sandy soil.

Biology and Spread:

The seeds of this invasive plant are dispersed by gravity, wind and other mechanical means. Their barbed awns are capable of piercing and adhering to fur and clothing. When the seeds germinate in the fall, the developing root system expands during the winter, allowing cheatgrass to exploit water and nutrients early, giving it a head start in spring.

Ecological Threat:

Cheatgrass thrives in disturbed areas. Once established on a site, it prevents natives from returning. Cheatgrass has the ability to draw down soil moisture and nutrients to very low levels, thus gaining a competitive advantage. Its tendency to mature early and dry out promotes fire, which has fundamentally changed many ecosystems in the West.

Steve Dewey, Utah State University
www.forestryimages.org

How to Control this Species:

Physical

It is important to avoid disturbance caused by overgrazing, cultivation and frequent fires.

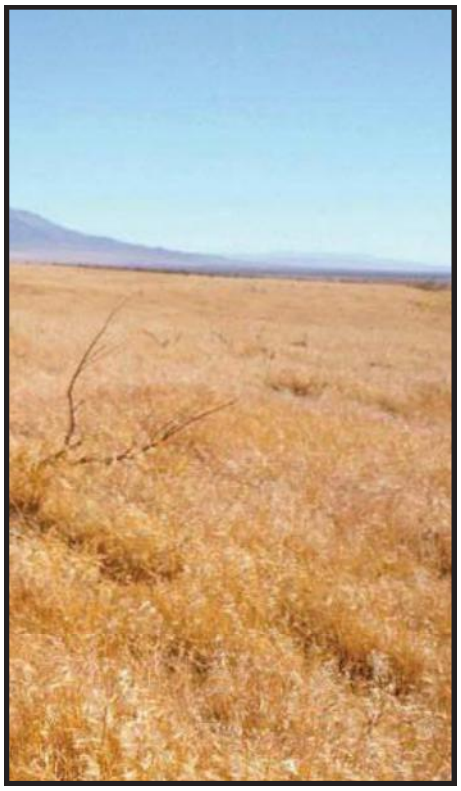
Small infestations can be controlled by hand pulling. Care must be taken to remove most of the root. Treatment should be followed by re-seeding of native perennials.

Mowing or cutting is not recommended; seed will continue to mature on cut plants. Prescribed fire can be dangerous with cheatgrass.

Chemical

Herbicide should be applied in early spring or late fall when non-target species are dormant to ensure selective control. Cheatgrass is controlled best when plants are less than four inches in height and growing vigorously.

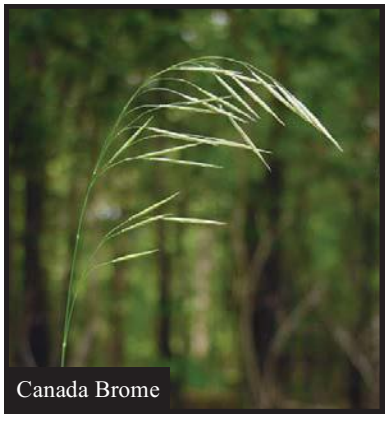
A variety of herbicides are used in the control of cheat-grass. Some, such as quizalofop, hit cheatgrass in early spring, while others, such as atrazine, take care of seedlings in the fall. Be sure to follow herbicide instructions carefully.



John M. Randall, The Nature Conservancy
www.forestryimages.org

Look-A-Likes:

Cheatgrass could easily be confused with other native grasses, especially bromes, such as Canada brome (*Bromus pubescens*).



Dan Tenaglia,
www.missouriplants.com

References:

Center for Invasive Species and Ecosystem Health: http://www.invasive.org/browse/subinfo.cfm?sub=5214

Global Invasive Species Database: http://www.issg.org/database/species/ecology.asp?fr=1&si=266

Invasive Plant Atlas of New England: http://nbii-nin.ciesin.columbia.edu/ipane/icat/browse.do?specieId=107

For More Information:

DCNR Invasive Species Site: http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

DCNR Invasive Exotic Plant Tutorial for Natural Lands Managers: http://www.dcnr.state.pa.us/forestry/invasivetutorial/cheatgrass.htm

Invasive Plants in Pennsylvania

Chinese Silvergrass

Miscanthus sinensis Anderss.

Photo: James Miller, USDA Forest Service, www.invasive.org

Background:

This grass was brought to the U.S. from Asia in the late 1800s as an ornamental landscape plant. It is also referred to as Eulalia, zebra grass and *Miscanthus*. Some cultivars of this plant are being used as a biofuel crop.

Range:

It can be found throughout the eastern U.S., Colorado and California. There is a large population along the PA Turnpike near Valley Forge.

pennsylvania
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
www.dcnr.state.pa.us

Description:

Growing up to 12 feet tall, this densely-bunched grass grows upright with silvery midveins on the leaves. The flowering stalks can reach 15 feet or more in length and contain numerous bristled seeds (*see photo below*).

Photo: Chris Evans, River to River CWMA, www.invasive.org

Habitat:

This grass will grow many places but prefers well-drained soils and full sun to reach maximum height. It is common on old home sites but also found along roadsides, old fields and forest edges.

Biology and Spread:

This species spreads primarily through its vigorous roots and rhizomes. The viability of its seeds is in question.

Ecological Threat:

Chinese silvergrass can escape from landscape plantings into natural areas, particularly disturbed sites, where it displaces native vegetation. It is extremely flammable, so the risk of wildfires increases in areas with this grass.

Photo: James Miller, USDA Forest Service, www.invasive.org

How to Control this Species:

Manual control of this species is NOT recommended. Digging out the plants will most likely result in re-sprouts because of the abundant rhizomes.

Chinese silvergrass can be effectively controlled with several readily available herbicides such as a two-percent solution of glyphosate in water during the fall or a four-percent solution in the late spring. Be sure to follow the label and all state herbicide requirements.

Look-A-Likes:

Our native big bluestem grass (*Andropogon gerardii*) may be confused with Chinese silvergrass due to its large size. Big bluestem's distinguishing feature is the three-prong flower spike that looks like a turkey's foot (*see photo below*). Sugarcane plumegrass (*Saccharum giganteum*) is another look-a-like.

Photo: Chris Evans, River to River CWMA, www.forestryimages.org

Native Alternatives:

There are no native species of *Miscanthus* in the eastern U.S. but there are several native warm season grasses that can be used for landscaping, including:

Switchgrass
(*Panicum virgatum*)

Photo: James Miller & Ted Bodner, Southern Weed Science Society, www.forestryimages.org

References:

Center for Invasive Species and Ecosystem Health:
http://www.invasive.org/browse/subinfo.cfm?sub=3052

Invasive Exotic Plant Tutorial for Natural Lands Managers: http://www.dcnr.state.pa.us/forestry/invasivetutorial/miscanthus.htm

USDA Forest Service Weed of the Week factsheet:
http://www.na.fs.fed.us/fhp/invasive_plants/weeds/chinese-silvergrass.pdf

For More Information:

To learn more about invasive plants in Pennsylvania, here are some other useful resources:

Plant Invaders of Mid-Atlantic Natural Areas, National Park Service:
http://www.nps.gov/plants/alien/pubs/midatlantic/midatlantic.pdf

Invasive Plants Field and Reference Guide, U.S. Forest Service:
http://na.fs.fed.us/pubs/misc/ip/ip_field_guide.pdf

Cogongrass (*Imperata cylindrica*)

A plant profile for this species can be found at the United States Department of Agriculture website at the following link:

http://plants.usda.gov/core/profile?symbol=IMCY

Coltsfoot (*Tussilago farfara*)

A plant profile for this species can be found at the United States Department of Agriculture website at the following link:

http://plants.usda.gov/core/profile?symbol=TUFA

Invasive Plants in Pennsylvania

Common Buckthorn

Rhamnus cathartica

John M. Randall, The Nature Conservancy
www.forestryimages.org

Background:

Common buckthorn was introduced into North America as an ornamental shrub in the mid 1800s. Prized for its hardiness and ability to thrive in a variety of soil and light conditions, common buckthorn was planted extensively for use in hedges, farm shelter belts and wildlife habitat. It is no longer available for purchase.

Range:

Native to Eurasia, common buckthorn can now be found throughout the Northeast and North-central regions of the United States.

pennsylvania
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
www.dcnr.state.pa.us

Description:

Common buckthorn is a dioecious shrub or small tree growing up to 22 feet high. Twigs are often tipped with a spine. Cutting the stems reveals distinctive yellow sapwood and pink to orange heartwood. The glossy, dark green leaves remain late into fall, and are broadly oval with up-curved veins and toothed margins. In spring, dense clusters of yellow-green flowers emerge from stems near the bases of leaf stalks. Small black fruits appear in fall.

Paul Wray, Iowa State University
www.forestryimages.org

Habitat:

Common buckthorn prefers light shade, but is tolerant of many conditions, including full shade. It often invades upland sites, such as open oak woodlands, tree fall gaps and woods edges. It may also be found in prairies and open fields.

Biology and Spread:

The plentiful fruit, which produce a laxative effect, are eaten by birds and small mammals, allowing for long-range dispersal. Most of the fruit falls directly beneath the parent, creating a dense understory of seedlings characteristic of buckthorn stands.

Ecological Threat:

Common buckthorn forms dense, even-aged thickets, which crowd out native shrubs and herbs and prevent woody plant regeneration. When open woodlands, savannas and prairies are invaded, fire is suppressed, changing the disturbance regimes of these ecosystems. Invasive shrubs like common buckthorn are population sinks for nesting songbirds due to higher predation rates. Common buckthorn is also an alternate host of oat crown rust, which lowers oat yield and quality.

John M. Randall, The Nature Conservancy
www.forestryimages.org

How to Control this Species:

Physical

Seedlings less than three feet tall can usually be pulled by hand. Saplings can be removed with a weed wrench, but individuals with a large base diameter are best dealt with by cutting. The resulting stump should be dug out or treated with herbicide. Girdling is also effective.

If enough fuel is present, prescribed burns have a large impact on seedlings and the current year's seeds.

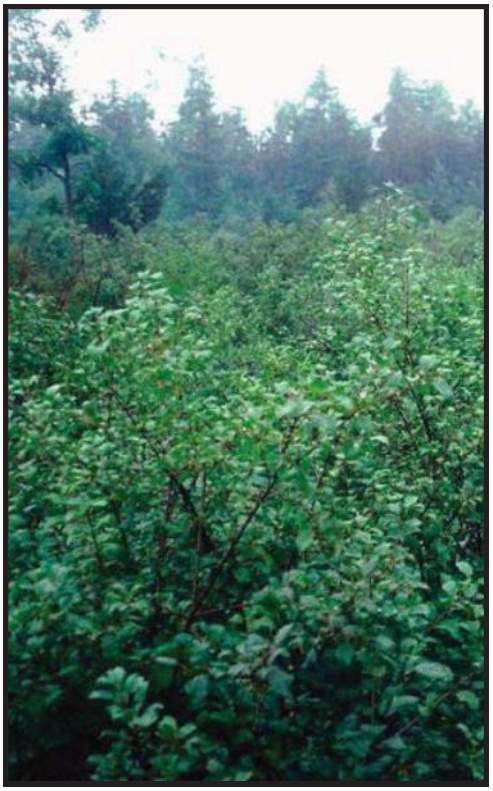
Be sure to remove and dispose of any ripened fruit from the restoration site.

Chemical

Herbicide applications may be done early in the season just after the trees have leafed out, but those conducted in the fall or early winter appear to be most effective.

Use a systemic herbicide, such as glyphosate, in order to destroy the root system.

Brush applications on recently cut stumps, in addition to the basal bark method, often achieve good results.



John M. Randall, The Nature Conservancy
www.forestryimages.org

Look-A-Likes:

Common buckthorn may be confused with native buckthorns (*Rhamnus* spp.) and cherries (*Prunus* spp.).

Rob Routledge, Sault College
www.forestryimages.org

References:

Plant Conservation Alliance's Alien Plant Working Group:
http://www.nps.gov/plants/alien/fact/rhca1.htm

University of Minnesota:
http://conservancy.umn.edu/bitstream/60097/1/6.5.Gale.pdf

For More Information:

DCNR Invasive Species Site: http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

DCNR Invasive Exotic Plant Tutorial for Natural Lands Managers: http://www.dcnr.state.pa.us/forestry/invasivetutorial/common_glossy_buckthorn.htm

Invasive Plants in Pennsylvania

Common Reed

Phragmites australis ssp. *australis*

Leslie J. Mehrhoff, U. of Connecticut
www.forestryimages.org

Background:

Although this species is indigenous to North America (ssp. *americanus*), a more invasive genotype, originating in the Old World, was introduced in the late 18th or early 19th centuries. Common reed most likely arrived in contaminated ballast material.

Range:

Native to Eurasia, the Old World genotype of common reed can now be found throughout southern Canada and the lower 48 states.

pennsylvania
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
www.dcnr.state.pa.us

Description:

Common reed is a tall, perennial grass that can reach 15 feet in height. A dense network of roots and rhizomes reach a depth of three feet underground. Its leaves are elongate with rough margins. In late July and August, feathery flower plumes, purple or golden in color, tower over wetlands. Stands include both live and dead stems from the previous year's growth.

Rebekah D. Wallace, University of Georgia
www.forestryimages.org

Habitat:

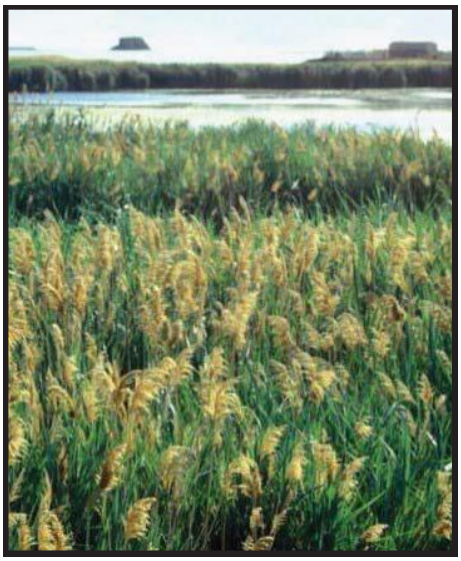
Common reed can be found in tidal and non-tidal brackish and freshwater marshes, river edges, shores of lakes and ponds, roadsides and disturbed areas. It is especially common in alkaline and slightly saline environments, but is quite tolerant of a variety of wetland conditions.

Biology and Spread:

Colonization of new sites is typically accomplished by wind-dispersed seeds, which are produced in abundance, but at low viability. Fragments of rhizomes may be washed to new locations along rivers and shorelines or transported by heavy machinery. Common reed spreads horizontally by sending out quickly growing rhizome runners.

Ecological Threat:

Common reed can rapidly take over wetland communities, crowding out native plants, changing hydrology, altering wildlife habitat and increasing fire potential.



John M. Randall, The Nature Conservancy
www.forestryimages.org

How to Control this Species:

Physical

Cutting, pulling, or mowing can be done in late July, which removes most of the food reserves produced by the plant that season. The placement of black plastic over cut stems has had some success at dampening populations.

Excavation of sediments may also be effective, but small fragments of root left in the soil may lead to reestablishment.

All cut shoots should be removed to prevent re-sprouting.

Chemical

Glyphosate-based herbicides are most effective for established populations. Be sure to use a formulation approved for aquatic use.

Herbicides are best applied in early fall after the plant has flowered, either as a cut stump treatment or as a foliar spray.

Treatment will often need to be repeated for several years to prevent any surviving rhizomes from re-sprouting.

Steve Dewey, Utah State University
www.forestryimages.org

Look-A-Likes:

Native and non-native genotypes of common reed are quite similar. Common reed could also be confused with wild rice (*Zizania aquatica*) and reed canary grass (*Phalaris arundinacea*).

Richard Old, XID Services, Inc.
www.forestryimages.org

References:

Global Invasive Species Database: http://www.issg.org/database/species/ecology.asp?fr=1&si=301

Plant Conservation Alliance's Alien Plant Working Group: http://www.nps.gov/plants/alien/fact/phau1.htm

For More Information:

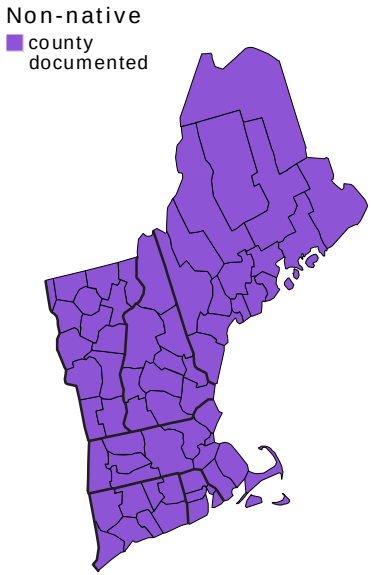
DCNR Invasive Species Site: http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

Plant Invaders of Mid-Atlantic Natural Areas, National Park Service: http://www.nps.gov/plants/alien/pubs/midatlantic/midatlantic.pdf

Invasive Plants Field and Reference Guide, U.S. Forest Service: http://na.fs.fed.us/pubs/misc/ip/ip_field_guide.pdf

New England Distribution

Adapted from BONAP data

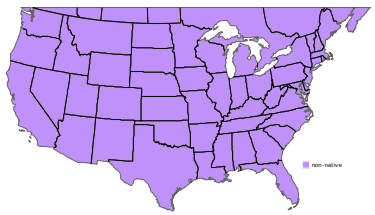


about the labels on this map

Found this plant? Take a photo and post a sighting.

North America Distribution

Adapted from BONAP data



Rumex acetosella L.

common sheep sorrel, sheep dock

Facts About

Sheep dock, probably originally from Europe, has been introduced almost everywhere in the world.

Habitat

Anthropogenic (man-made or disturbed habitats), meadows and fields, shores of rivers or lakes

Sometimes Confused With

Rumex acetosa:

basal lobes of leaf blades directed straight backward and seed-like fruit 2-2.5 mm long (vs.R. acetosella, with basal lobes of leaf blades directed outward and seed-like fruit 0.9-1.5 mm long).

Synonyms

Acetosella vulgaris (Koch) Fourr. ssp. *pyrenaica* (Pourret ex Lapeyr.) Á. Löve

Rumex acetosella var. *pyrenaicus* (Pourret ex Lapeyr.) Timbal-Lagrave

Rumex pyrenaicus Pourret ex Lapeyr.

Family

Polygonaceae

Genus

Rumex

Notes on Subspecies and Varieties in New England

Our subspecies is *Rumex acetosella* L. ssp. *pyrenaicus* (Pourret ex Lapeyr.) Akeroyd.

Need Help? GET HELP

Characteristics

Habitat	terrestrial, wetlands
New England state	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont
Flower petal color	• green to brown • pink to red
Leaf type	the leaves are simple (lobed or unlobed but not separated into leaflets)
Leaf arrangement	alternate: there is one leaf per node along the stem
Leaf blade edges	the edge of the leaf blade is entire (has no teeth or lobes)
Flower symmetry	there are two or more ways to evenly divide the flower (the flower is radially symmetrical)
Number of sepals, petals or tepals	there are six petals, sepals, or tepals in the flower
Fusion of sepals and petals	the petals or the sepals are fused into a cup or tube
Stamen number	6
Fruit type (general)	the fruit is dry but does not split open when ripe
Fruit length	0.9–1.5 mm

Show All Characteristics

Wetland Status

Usually occurs in non-wetlands, but occasionally in wetlands. (Wetland indicator code: FACU)

New England Distribution and Conservation Status

Distribution

Connecticut	present, invasive, prohibited
Maine	present
Massachusetts	present
New Hampshire	present
Rhode Island	present
Vermont	present

Conservation Status

Exact status definitions can vary from state to state. For details, please check with your state.

Massachusetts unranked (S-rank: SNR)

Information from Dichotomous Key of Flora Novae Angliae

2. *Rumex acetosella* L. ssp. *pyrenaicus* (Pourret *ex* Lapeyr.) Akeroyd E

sheep dock. *Acetosella vulgaris* (Koch) Fourr. ssp. *pyrenaica* (Pourret *ex* Lapeyr.) A. Löve; *Rumex acetosella* L. var. *pyrenaicus* (Pourret *ex* Lapeyr.) Timbal-Lagrave; *R. pyrenaicus* Pourret *ex* Lapeyr. • CT, MA, ME, NH, RI, VT. Fields, roadsides, waste areas, shorelines, clearings. Our material of *Rumex acetosella* (i.e., ssp. *pyrenaicus*) is characterized by simple basal lobes and inner tepals becoming adnate to the fruit. Other subspecies of *R. acetosella* are generally considered not to occur in North America (e.g., forms with inner tepals easily separated from fruit; forms with multifid basal lobes), but their distributions are poorly known and they are probably overlooked.

New England Wild Flower Society
180 Hemenway Road, Framingham, MA 01701

The Go Botany project is supported in part by the National Science Foundation.
www.nsf.gov

Common Kochia (*Kochia scoparia*)

A plant profile for this species can be found at the United States Department of Agriculture website at the following link:

http://plants.usda.gov/factsheet/pdf/fs_kosc.pdf

Crested Latesummer Mint (*Elsholtzia ciliata*)

A plant profile for this species can be found at the United States Department of Agriculture website at the following link:

http://plants.usda.gov/core/profile?symbol=ELCI

Cup Plant (*Silphium perfoliatum*)

A plant profile for this species can be found at the United States Department of Agriculture website at the following link:

http://plants.usda.gov/plantguide/pdf/cs_sipe2.pdf

Invasive Plants in Pennsylvania

Curly Pondweed

Potamogeton crispus

Photo: Leslie Mehrhoff, U. of Connecticut, www.invasive.org

Background:

This aquatic invader is also known as curlyleaf, curly-leaved or crispy-leaved pondweed. It was introduced into the U.S. in the mid-1800s from its native range in Eurasia, Africa and Australia, possibly as a hitchhiker on boats.

Range:

The earliest known records of this plant in the U.S. occurred in Philadelphia in 1841, with limited distribution to the northeast and part of California by 1900. It can now be founds throughout most of the U.S. and Ontario.

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www.dcnr.state.pa.us

Description:

This is the only species of pondweeds in North America with serrate leaves, making it easily identifiable. The plant gets its name from the wavy edges on the one to two-inch long, dark green submerged leaves. Leaves alternate along the stem. Each plant may grow up to six feet long.

Habitat:

Curly pondweed tolerates fresh or slightly brackish water and can grow in shallow, deep, still or flowing waters. It prefers clear or slightly turbid waters as it is fairly shade intolerant.

Photo: Richard Old, XID Services, www.invasive.org

Biology and Spread:

This plant is unusual in that it flowers and fruits in late spring and early summer; the rest of the plant decays. Small new plants overwinter, even under ice, and continue to grow once the water warms. Plant buds called turions (*see photo below*) and other plant fragments can be spread by waterfowl, boaters and aquatic plant enthusiast and re-root in new habitats.

Photo: Leslie Mehrhoff, U. of Connecticut, www.invasive.org

Ecological Threat:

Due to the excessive growth of this plant, it can become a nuisance and inhibit recreation. It also competes with, and sometime displaces, native plant life. When it dies back in mid-summer it can lead to algal blooms from an increase in phosphorus concentration in the water.

How to Control this Species:

Manual removal of this plant is difficult due to the brittle nature of the plant. Avoid fragmenting the plant and be sure to remove all stem parts for effective control.

Several herbicides that are approved for aquatic use can effectively kill curly pond-weed. Be sure to follow the label and all state herbicide requirements.

Native Alternatives:

American lotus
(*Nelumbo lutea*)

Graves Lovell, Alabama DCNR
www.forestryimages.com

Pond weed
(*Potamogeton nodosus*)

Hermann Falkner, www.freeimagefinder.com

Wild celery
(*Vallisneria americana*)

Photo: Nancy Rybicki, USGS

References:

USGS Nonindigenous Aquatic Species: http://nas.er/usgs.gov

Center for Invasive Species and Ecosystem Health:
http://www.invasive.org/browse/subinfo.cfm?sub=6219

Invasive Exotic Plant Tutorial for Natural Lands Managers:
http://www.dcnr.state.pa.us/forestry/invasivetutorial/curly_pondweed_M_C.htm

For More Information:

To learn more about invasive plants in Pennsylvania and the northeast, here are some useful resources:

Plant Invaders of Mid-Atlantic Natural Areas, National Park Service:
http://www.nps.gov/plants/alien/pubs/midatlantic/midatlantic.pdf

A Field Guide to Common Aquatic Plants of Pennsylvania:
http://pubs.cas.psu.edu/FreePubs/pdfs/agrs110.pdf

Pennsylvania SeaGrant:
http://seagrant.psu.edu/publications/ais.htm

Photo: Chris Evans, River to River CWMA,
www.invasive.org

Cypress Spurge (*Euphorbia cyparissias*)

A plant profile for this species can be found at the United States Department of Agriculture Forest Service website at the following link:

http://www.na.fs.fed.us/fhp/invasive_plants/weeds/cypress-spurge.pdf

Invasive Plants in Pennsylvania

Dame's Rocket

Hesperis matronalis

Richard Old, XID Services, Inc.
www.forestryimages.org

Background:

Dame's rocket was introduced as a garden plant during the Colonial period. It is still available in horticulture, especially as a common component of "wildflower" seed mixes, which can partly be blamed for its success. This plant is now so abundant that many mistakenly believe it is a native wildflower.

Range:

Native to Eurasia, dame's rocket can now be found across the United States, except in the extreme southern regions.

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Description:

Dame's rocket is a showy short-lived perennial. First-year plants develop into low rosettes that remain green all winter. Flowering plants, which may reach three feet in height, have erect stems with pointed, alternately arranged leaves. The four-petaled flowers range in color from purple to pink to white. Each flower develops into a thin, wiry seedpod that splits lengthwise to release tiny seeds.

Richard Old, XID Services, Inc.
www.forestryimages.org

Habitat:

This plant grows in moist woodlands, woodland edges, roadsides, thickets, disturbed sites and open ground. It prefers partial sun and moist, non-acidic soil.

Biology and Spread:

Reproduction is only by seed. Dame's rocket is a prolific bloomer and produces large quantities of seed from May to July. The seeds are scattered when the dehiscent fruits open. They are eaten and dispersed by ground-foraging birds and stick to tires, shoes and clothing.

Ecological Threat:

The extent of its impact on native vegetation and its patterns of spread are not well documented. Often forming dense monocultures, it may compete with native plants for water, light and nutrients.

Leslie J. Mehrhoff, University of Connecticut
www.forestryimages.org

How to Control this Species:

Physical

Hand-pulling or digging out plants can be effective techniques for small infestations.

If plants are pulled while in flower and left on the ground, seedpods will continue to ripen. It is best if they are bagged or burned.

Where there is sufficient leaf litter, burning has been found to be an effective control method.

Chemical

For large infestations, a foliar application of an herbicide, such as glyphosate or triclopyr, can be effective.

This is best done in very early spring or late fall to avoid damaging native vegetation. Rosettes stay green all winter.

Leslie J. Mehrhoff, University of Connecticut
www.forestryimages.org

Native Alternatives:

Dame's rocket is easily replaced by showier natives such as our phloxes (*Phlox* sp.), obedient plant (*Physostegia virginiana*) and blazing star (*Liatris spicata*).

Stefan Bloodworth
www.wildflower.org

Look-A-Likes:

Dame's rocket resembles money plant (*Lunaria annua*), a common exotic garden escape, as well as our native phlox species.

Albert F. W. Vick
www.wildflower.org

References:

Center for Invasive Species and Ecosystem Health: http://www.invasive.org/browse/subinfo.cfm?sub=5702

Forest Invasive Plants Resource Center: http://na.fs.fed.us/spfo/invasiveplants/factsheets/pdf/dames-rocket.pdf

Wisconsin Department of Natural Resources: http://dnr.wi.gov/invasives/fact/dames_rocket.htm

For More Information:

DCNR Invasive Species Site: http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

DCNR Invasive Exotic Plant Tutorial for Natural Lands Managers: http://www.dcnr.state.pa.us/forestry/invasivetutorial/Dames_rocket.htm

Invasive Plants in Pennsylvania

Empress or Princess Tree

Paulownia tomentosa (Thunb.) Sieb. & Zucc. ex Steud.

Photo: Jessica Sprajcar, DCNR

Background:

Also known as Royal paulownia, this tree is native to eastern Asia. It was first introduced into North America around 1840 for ornamental purposes and for wood carving. Plantations of this tree are still grown in the U.S. for export to Japan, where the wood is highly prized.

Range:

This tree can be found from southern New England through the Mid-Atlantic states to parts of the south. Its range extends to Arkansas, a few counties in Texas and scattered locations in Washington state.

Description:

This deciduous tree can grow up to 60 feet in height with a trunk diameter of up to two feet. Leaves are very large (six to 12 inches long), alternate along the stem, and are hairy on the underside. The bark is rough, gray-brown and interlaced with shiny, smooth areas. Showy, fragrant, violet flower clusters bloom in the spring. Thin, pecan-shaped fruit capsules open in the fall and persist well into winter.

Photo: Tuscarora State Forest District

Habitat:

Paulownia usually invades roadsides, streambanks, forest edges and other disturbed habitats. It tolerates infertile and acidic soils and drought.

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Biology and Spread:

Once a tree reaches the age of eight to 10, it is capable of producing twenty million seeds that are spread by wind and water. Trees also have the ability to sprout prolifically from buds on the stems and roots, allowing it to survive fire, cutting and other disturbances. Sprouts can grow up to 15 feet in a single season.

Ecological Threat:

This aggressive tree can take over certain habitats, displacing native vegetation.

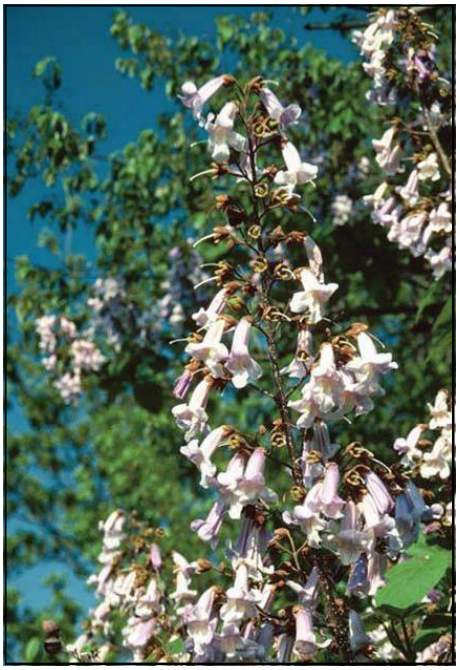

Photo: James Allison, Georgia DNR, www.invasive.org

How to Control this Species:

Manual and Mechanical

Seedlings can be hand pulled, especially when the soil is moist. Be sure to remove all roots to prevent resprouts.

Cutting and girdling are not suggested, as they may encourage the tree to send up root suckers. Cutting should only be used in conjunction with an herbicide treatment or as an emergency treatment to prevent seed production.

Chemical

Seedlings and small trees can be controlled by applying a two percent solution of glyphosate or triclopyr and water plus a 0.5 percent non-ionic surfactant to thoroughly wet the leaves.

Larger trees can be killed by cutting the tree and immediately applying a 50 percent solution of glyphosate or triclopyr and water to the outer 20 percent of the stump. A basal bark application of 25 percent triclopyr with 75 percent horticultural oil will also work, as long as the ground is not frozen.

References:

Plant Conservation Alliance's Least Wanted List: http://www.nps.gov/plants/alien/fact/pato1.htm

Center for Invasive Species and Ecosystem Health: http://www.invasive.org/browse/subinfo.cfm?sub=2426#images

Southeast Exotic Pest Plant Council: http://www.se-eppc.org/manual/princess.html

Look-A-Likes:

Princess tree may be confused with the native Northern catalpa (*Catalpa speciosa*). Both trees have similar size, leaf and flower structure. However, paulownia has a hollow pith, while catalpa is solid and whitish. Catalpa leaves are whorled and more pointed at the tip. Catalpa fruits are much longer (eight to 18 inches) than paulownia's (one to 2 inches).

Non-Invasive Alternatives:

Kentucky Coffeetree
(*Gymnocladus dioicus*)

Photo: Richard Webb, www.forestryimages.org

Cucumber-tree
(*Magnolia acuminate*)

Photo: Charles Bryson, USDA, www.forestryimages.org

Photo: Paul Wray, Iowa State U., www.forestryimages.org

Invasive Plants in Pennsylvania

Eurasian Water-milfoil

Myriophyllum spicatum L.

Photo: Richard Old, XID Services, www.invasive.org

Background:

Eurasian watermilfoil is native to Europe, Asia and northern Africa. It was accidentally introduced into the U.S. sometime between the late 1800s and 1940s, either from the aquarium trade or attached to boats.

Range:

This aquatic invader can now be found throughout most of the continental U.S., with concentrations around the Great Lakes, New England and Pacific Northwest.

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Description:

This submerged aquatic invasive has stems that grow up to the water's surface, usually 10 feet in length but potentially as much as 30 feet. The delicate leaflets give the plant a feathery appearance.

Habitat:

Found in lakes, ponds and other aquatic environments where stagnant to slow moving water is found. It prefers fresh water but can tolerate brackish conditions. This plant thrives in disturbed areas.

Photo: Alison Fox, U. of Florida, www.invasive.org

Biology and Spread:

Most regeneration of this plant is from its rhizomes, but new plants may emerge from each joint on the stem and root upon contact with mud. The plants produce seeds (*see image below*) but they are not considered an important means of dispersal.

Photo: Steve Hurst, USDA NRCS, www.invasive.org

Ecological Threat:

Once this plant becomes established the dense mats of leaves block light, leading to a decline in the abundance of native plants. It can also reduce habitat for fish spawning and breeding and impact recreational uses.

How to Control this Species:

Prevention

Monitoring and prevention are the most important steps to keep milfoil under control, since it can be difficult to treat once it's present. Check all equipment and boats for plant fragments before leaving the area. Remove all debris, bag and dispose of.

Limiting disturbance to lake bottoms and the native vegetation growing there will help minimize the chances of Eurasian water milfoil colonizing the area.

Manual and Mechanical

Large harvesting equipment can be used to mechanically remove large infestations of milfoil. A rake can be used for smaller infestations.

Harvesting should take place before most native plants emerge, usually early summer. Substantial regrowth may occur if harvesting takes place too early in the season. Multiple harvests in the same growing season work best. All plant fragments must be removed for adequate control.

Lowering or raising the water level can be effective in reducing the plants' growth. Shade barriers may also be used to reduce overall growth rates.

Chemical

Fluridone is a selective herbicide that can be used to treat milfoil and several other invasive aquatic weeds, although it can also harm native aquatic plants, so its use should be limited. Application should be made before or during the early stages of plant growth.

Look-A-Likes:

There is a native version of watermilfoil—Northern water-milfoil (*Myriophyllum sibiricum*) that looks very similar to the Eurasian species, so extreme care must be taken when treating a waterbody. It also resembles our native coontail (*Ceratophyllum* spp.) and the invasive parrotfeather (*Myriophyllum aquaticum*).

Photo: Graves Lovell, AL DCN, www.invasive.org

References:

Center for Invasive Species and Ecosystem Health: http://www.invasive.org/browse/subinfo.cfm?sub=3055

Invasive Exotic Plant Pest Tutorial for Natural Lands Managers: http://www.dcnr.state.pa.us/forestry/invasivetutorial/Eurasian_water.htm

A Field Guide to Common Aquatic Plants of Pennsylvania: http://pubs.cas.psu.edu/FreePubs/pdfs/agrs110.pdf

For More Information:

To learn more about invasive plants in Pennsylvania and the northeast, here are some useful resources:

Pennsylvania SeaGrant: http://seagrant.psu.edu/publications/ais.htm

DCNR Invasive Species Site: http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

Invasive Plants in Pennsylvania

European Water Chestnut

Trapa natans L.

Photo: Leslie Mehrhoff, IPANE

Background:

Water chestnut was brought to the U.S. by water gardeners in the 1800s, after which it quickly became established.

Range:

This plant is a native of Eurasia, where it is vanishing from portions of its native range. It was first observed in North America near Concord, Massachusetts in 1859. Since then it has spread to most New England and Mid-Atlantic states, including Pennsylvania. It has established itself within Bucks, Pike and Dauphin counties, perhaps others.

Description:

This is an annual aquatic plant made up of submerged leaves and a buoyant rosette of floating green, glossy, roundly-triangular leaves with toothed edges. The plant's stem can reach up to 15 feet in length.

The flowers are small, white and form at the center of the stem. They appear in mid to late July. The hard nuts ripen one month later and have four short, sharp spines that can puncture shoe leather.

Photo: Leslie Mehrhoff, IPANE

Habitat:

This plant can grow in any freshwater body, although it prefers nutrient rich waters less than 16 feet deep.

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Biology and Spread:

Water chestnut has a high reproductive rate, producing up to 20 nuts per rosette per season. The blackish nuts have sharp, half-inch long spines that can get caught on animals and gear. The seeds can remain viable up to 12 years, although most germinate within the first two. The plant also spreads vegetatively. Any fragment of leaf can get stuck to a boat or animal and be transported elsewhere, where it may then re-root.

Photo: Steve Hurst, USDA PLANTS Database

Ecological Threat:

This aquatic plant can form dense floating mats that limit light and oxygen to other species. Water chestnut can outcompete native organisms for nutrients and space and offer little nutritional value for wildlife.

Water chestnut is also economically damaging: it can make boating and swimming dangerous and costs hundreds of thousands of dollars to control.

How to Control this Species:

A combination of treatments is often the most effective against this plant. Eradication will require several years since seeds can remain viable for so long. Infected waters may need to be monitored for five to 12 years to try to eliminate it.

Photo: Leslie Mehrhoff, IPANE

Small populations are easy to remove by hand. Pull out the plant and dispose of it far away from the water, ideally in a trash bag.

Larger infestations can be removed with a floating weed harvester. This will help open up navigational passageways and may or may not provide a long-term control solution, depending on follow-up monitoring.

Chemical control is no longer widely used due to possible impacts to other species. However, the herbicide 2, 4-D has been deemed safe for this use.

Native Alternatives:

Some aquatic nurseries carry native and non-invasive alternatives. However, because of the similarity in appearance among aquatic plants, they are easily confused.

To avoid purchasing an aquatic plant that may become invasive, contact your local conservation district or Master Gardener for help in purchasing safe and appropriate native aquatic plants.

References:

SeaGrant Pennsylvania factsheet on water chestnut:
http://seagrant.psu.edu/publications/factsheets/waterchestnut2011reduced.pdf

Invasive Exotic Plant Tutorial for Natural Lands Managers:
http://www.dcnr.state.pa.us/forestry/invasivetutorial/water_chestnut.htm

Water Chestnut in the Chesapeake Bay Watershed: A Regional Management Plan:
http://www.anstaskforce.gov/Species%20plans/Water%20Chestnut%20Mgt%20Plan.pdf

For More Information:

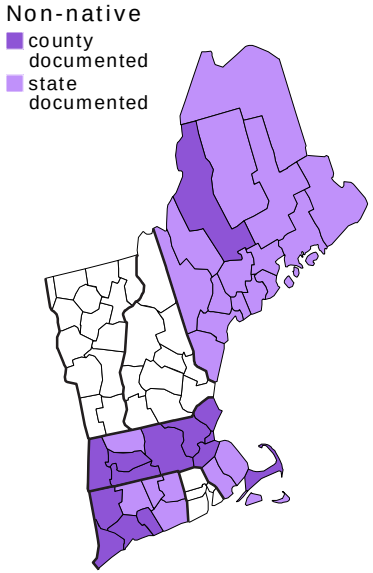
To learn more about invasive plants in Pennsylvania here are some useful resources:

Plant Invaders of Mid-Atlantic Natural Areas, National Park Service:
http://www.nps.gov/plants/alien/pubs/midatlantic/midatlantic.pdf

Invasive Plants Field and Reference Guide, U.S. Forest Service:
http://na.fs.fed.us/pubs/misc/ip/ip_field_guide.pdf

New England Distribution

Adapted from BONAP data

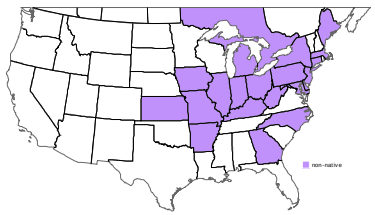


about the labels on this map

Found this plant? Take a photo and post a sighting.

North America Distribution

Adapted from BONAP data



Marsilea quadrifolia L.

European water-clover

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Facts About

The leaves of water shamrock are divided into four segments that give it the appearance of a clover or shamrock. It is the only water shamrock in New England, and it was introduced from Europe into a lake in Connecticut in 1862.

Habitat

Lacustrine (in lakes or ponds), riverine (in rivers or streams), shores of rivers or lakes


enlarge

Family

Marsileaceae

Genus

Marsilea

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Characteristics

Habitat	aquatic
New England state	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont
Leaf divisions	the leaf blade is compound (divided into leaflets)
Plant growth form	the leaves float on the surface of the water
Spore-bearing leaflets	the spore-bearing fronds are dramatically different from the sterile fronds
Sorus shape	there are no sori, or they are concealed in leaf segments or hardened, capsule-like structures derived from a modified leaflet
Leaf stalk scales	there are no scales on the leaf stalk
Leaf stalk hairs	• the leaf stalk has hairs • there are no hairs on the leaf stalk
Leaf blade length	1.4–4.2 cm
Leaf vein tips	the veins go all the way to the edge of the leaf blade

Show All Characteristics

Wetland Status

Occurs only in wetlands. (Wetland indicator code: OBL)

New England Distribution and Conservation Status

Distribution

Connecticut	present, invasive, prohibited
Maine	present
Massachusetts	present
New Hampshire	absent
Rhode Island	absent
Vermont	absent

Conservation Status

Exact status definitions can vary from state to state. For details, please check with your state.

Massachusetts unranked (S-rank: SNR)

Information from Dichotomous Key of Flora Novae Angliae

1. *Marsilea quadrifolia* L. E

European water-clover. CT, MA, ME, NH, RI, VT. Shallow, still or slow-moving water, sometimes stranded on mud.

New England Wild Flower Society
180 Hemenway Road, Framingham, MA 01701

The Go Botany project is supported in part by the National Science Foundation.
www.nsf.gov

Flowering Rush (*Butomus umbellatus*)

A plant profile for this species can be found at the United State Department of Agriculture website at the following link:

http://na.fs.fed.us/fhp/invasive_plants/weeds/flowering-rush.pdf

Fly Honeysuckle (*Lonicera xylosteum*)

A plant profile for this species can be found at the United State Department of Agriculture website at the following link:

http://www.plants.usda.gov/core/profile?symbol=LOXY

Invasive Plant Atlas of New England

COMMON NAME

Forget-me-not
true forget-me-not
yelloweye forget-me-not
water scorpion-grass

FULL SCIENTIFIC NAME

Myosotis scorpioides L.

FAMILY NAME COMMON

Borage family

FAMILY SCIENTIFIC NAME

Myosotis scorpioides

IMAGES

(/ipane/icat/jpg/uconn_ipane_myososcorp_01a.jpg)Aquatic incursion

(/ipane/icat/jpg/uconn_ipane_myososcorp_03a.jpg)Flower close-up

(/ipane/icat/jpg/uconn_ipane_myososcorp_04a.jpg)Terrestrial incursion

(/ipane/icat/jpg/uconn_ipane_myososcorp_05a.jpg)Seedlings

(/ipane/icat/jpg/uconn_ipane_myososcorp_06a.jpg)Habit

NOMENCLATURE/SYNONYMS

Synonyms: *Myosotis palustris* (L.) Hill

DESCRIPTION

Botanical Glossary (http://glossary.gardenweb.com/glossary/)

Myosotis scorpioides is an herbaceous perennial that grows 20-60 cm (8-20 in.) in height. This plant often creeps, and has fibrous roots or stolons. The leaves of this plant are pubescent and evergreen. The lower leaves are usually oblanceolate while its other leaves are usually more oblong or elliptic. These leaves are obtuse and narrow at the base. They are 2.5-8 cm (1-3 in.) long and 7-20 mm (0.25-0.75 in.) wide. The small flowers are usually blue (rarely white) with a yellow center. They are flat and measure 6-7 mm (0.25 in.) wide. The racemes are located terminally and are many-flowered. The pedicel is longer than the calyx, which is strigose. The nutlets, which contain the seeds, are angled and keeled on the inner side. Page References Bailey 834, Crow & Hellquist 285, Fernald 1204, Gleason & Cronquist 422, Holmgren 396, Magee & Ahles 861, Newcomb 194, Peterson & McKenny 334. See reference section below for full citations.

SIMILAR SPECIES

Myosotis laxa Lehm. (Bay forget-me-not)

Myosotis sylvatica Ehrh. ex Hoffmann (Woodland forget-me-not) *Myosotis sylvatica* is often found in dry woods (not in the wet habitats where *M. scorpioides* grows), and has hooked hairs on its calyx. *Myosotis laxa* has smaller flowers than *M. scorpioides*.

REPRODUCTIVE/DISPERSAL MECHANISMS

Myosotis scorpioides reproduces by means of seeds. Since these plants are often found in shallow streams, their seeds can be moved by water.

DISTRIBUTION

Myosotis scorpioides is native to most of Europe and the western part of Asia. In the United States it has been reported from Maine south to Georgia and west to Minnesota, South Dakota, Missouri, Arkansas and Louisiana. It has also been reported from the west coast states, north to Alaska, and east to New Mexico, Colorado, Wyoming and Montana. *Myosotis scorpioides* has been reported from all of the New England states.

HISTORY OF INTRODUCTION IN NEW ENGLAND

Myosotis scorpioides was a popular garden plant, and was most likely introduced via intentional planting.

HABITATS IN NEW ENGLAND

Edge, Floodplain Forest, Herbaceous Wetland, Lake or Pond, River or Stream, Wet Meadow, Yard or Garden
Myosotis scorpioides naturalizes in wet places, often along the banks of streams.

THREATS

Myosotis scorpioides is able to form large monocultures, especially in situations where it is in or near a stream. It is still commonly planted in gardens, allowing it to escape into natural environments.

DOCUMENTATION NEEDS

Documentation required: A photograph of the habit with flowers.
Best time for documentation: Spring, summer, fall.

ADDITIONAL INFORMATION

Northern Prairie Wildlife Research Center (http://www.npwrc.usgs.gov/resource/plants/florane/species/8/myosscor.htm)
Description, images, and a map

Integrated Taxonomic Information System (http://www.itis.gov)
Taxonomic information

PLANTS Database (http://plants.usda.gov/core/profile?symbol=MYSC)
General information and map

Germplasm Resources Information Network (GRIN) (http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?24815)
Taxonomic information

Connecticut Botanical Society (http://www.ct-botanical-society.org/galleries/myosotisscor.html)
Description and an image

Burke Museum of Natural History and Culture (http://biology.burke.washington.edu/herbarium/imagecollection.php?Genus=Myosotis&Species=scorpioides)
Description, images, and a map

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Garden Heliotrope (*Heliotropium arborescens*)

A plant profile for this species can be found at the United States Department of Agriculture website at the following link:

http://plants.usda.gov/core/profile?symbol=HEAR16

Garden Loosestrife (*Lysimachia vulgaris*)

A plant profile for this species can be found at the United States Department of Agriculture website at the following link:

http://plants.usda.gov/core/profile?symbol=LYVU

Invasive Plants in Pennsylvania

Garlic Mustard

Alliaria petiolata

Chris Evans, River to River CWMA
www.forestryimages.org

Background:

Garlic mustard was likely introduced into the United States by early European settlers for culinary or medicinal purposes. It was first recorded in Long Island, New York in 1868.

Chris Evans, River to River CWMA
www.forestryimages.org

Range:

Native to Europe, garlic mustard now ranges from eastern Canada, south to Georgia and as far west as Oregon.

pennsylvania
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
www.dcnr.state.pa.us

Description:

Garlic mustard is a cool season biennial herb with triangular to heart-shaped leaves. Leaves give off an odor of garlic when crushed. First-year plants appear as a rosette of leaves that remain green through winter, maturing the following spring. Button-like clusters of white flowers give way to erect, slender pods by May. Dead stalks of dry, brown seedpods hold viable seed throughout the summer.

Chris Evans, River to River CWMA
www.forestryimages.org

Habitat:

This invasive is frequently found in moist, shaded soil of river floodplains, forests, edges and openings, especially in disturbed areas. Garlic mustard is associated with calcareous soils and does not tolerate high acidity.

Biology and Spread:

Garlic mustard plants develop rapidly, each individual producing thousands of seeds that scatter nearby. Because white-tailed deer find garlic mustard distasteful, they further its expansion by eliminating native competition, as well as by exposing the soil and seedbed through trampling.

Ecological Threat:

Highly shade-tolerant, garlic mustard is capable of invading high-quality, mature forests. To the detriment of spring ephemeral wildflowers, garlic mustard quickly forms monocultures by monopolizing resources. Its allelopathic compounds inhibit seed germination of other species.

Toothwort (*Dentaria* sp.), the host plant of the rare West Virginia white butterfly (*Pieris virginiensis*), is one of the spring ephemerals outcompeted by garlic mustard. The butterfly is drawn to lay its eggs on garlic mustard, a fatal mistake for its offspring. Garlic mustard may also disrupt the mutualistic relationship between native trees and mycorrhizal fungi.

How to Control this Species:

Physical

Because garlic mustard seeds can remain viable in the soil for five years or more, effective management is a long-term commitment. The goal of management is to prevent further seed production and to nip pioneering colonies in the bud.

For small infestations, hand-pulling is extremely effective. Larger infestations may be controlled by cutting. This should be done when the plant is in flower. All plant material should be removed from the site following treatment, since seeds can still develop on cut stems.

Chemical

For heavy infestations, where the risk to non-target species is minimal, the systemic herbicide glyphosate may be useful.

Herbicide can be applied at any time of the year, including winter (to kill overwintering rosettes) as long as the temperature remains above 50° Fahrenheit, and rain is not expected for at least 8 hours.

Chemical control is best done in late fall when most native plants are dormant.

Prevention

Infestations may be prevented by monitoring and removing pioneering plants. Disturbances, such as foot traffic, overgrazing and erosion, should be minimized.

A regular burning regime in fire-adapted oak woodlands can also prevent infestations.

Dave Cappaert, Michigan State University
www.forestryimages.org

Look-A-Likes:

Many native white-flowered plants occur alongside garlic mustard, and may be mistaken for it. These include tooth-worts, sweet cicely (*Osmorhiza claytonia*) and early saxifrage (*Saxifraga virginica*).

Wendy VanDyk Evans
www.forestryimages.org

References:

Center for Invasive Species and Ecosystem Health:
http://www.invasive.org/browse/subinfo.cfm?sub=3005

Plant Conservation Alliance's Alien Plant Working Group:
http://www.nps.gov/plants/alien/fact/alpe1.htm

For More Information:

DCNR Invasive Species Site: http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

DCNR Invasive Exotic Plant Tutorial for Natural Lands Managers:
http://www.dcnr.state.pa.us/forestry/invasivetutorial/garlic_mustard.htm

Invasive Plants in Pennsylvania

Giant Hogweed

Heracleum mantegazzianum

Terry English, USDA APHIS PPQ
www.forestryimages.org

Background:

Giant hogweed, an enormous member of the carrot family *Apiaceae*, was brought to the United States as an ornamental and as a source for the anise-scented spice golpar, which is used in Iranian cooking. It is now designated as a federal noxious weed.

Range:

This plant is native to central and southwest Asia, but has been introduced into Europe and North America. In the United States, it can be found primarily in the Northeast, Great Lakes and Northwest regions.

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Description:

Giant hogweed is an incredibly tall biennial or perennial herb, growing up to 20 feet in height. Its stout stems are hollow with purple splotches and course bristles. Deeply incised compound leaves with stiff hairs can grow up to five feet in width. The large umbrella-shaped flower heads have numerous small white flowers, which develop into flattened, oval-shaped fruit.

Robert Vidéki, Doronicum Kft.
www.forestryimages.org

Habitat:

Giant hogweed can be found along railroads, roadsides, rights-of-ways, vacant lots, streams, rivers, waste areas and fallow fields, particularly in disturbed soils.

Biology and Spread:

Over 100,000 seeds are produced annually by each plant. These seeds can be spread by animals, surface runoff of rain, or by wind. Prolific seed production, combined with a rapid growth rate, results in dense colonies.

Ecological Threat:

Because of its size and rapid growth, giant hogweed is an aggressive competitor capable of displacing native plants. It dies back during the winter months, leaving bare ground open to erosion on riverbanks and steep slopes. The sap of giant hogweed makes human skin sensitive to ultraviolet light, resulting in severe burns and blisters. Contact with the eyes can cause permanent blindness.

Donna R. Ellis, University of Connecticut
www.forestryimages.org

How to Control this Species:

Physical

Individual plants can be dug up, making sure to remove the entire root system.

Repeated mowing or cutting can eventually starve the plant of energy. This practice needs to be performed numerous times during a growing season.

Extreme care should be taken when undertaking these methods. Protective clothing and eye protection are a good idea.

Chemical

Foliar treatments with glyphosate or triclopyr have been effective. Glyphosate is considered the best choice, and should be applied in spring or early summer when plants are actively growing. A follow-up application in mid-summer may be necessary. Glyphosate is nonselective and may kill desirable plants, including grasses.

Biocontrol

Cattle and pigs are apparently not affected by the sap and eat giant hogweed without harm.

If You See This Plant:

Giant hogweed is on the Pennsylvania Noxious Weed Control List. It is illegal to sell, plant or transport this species. If you believe that you have found a new population of this plant, please contact Melissa Bravo, PA Dept. of Agriculture, at 717-787-7204.

Robert Vidéki, Doronicum Kft. www.forestryimages.org

Look-A-Likes:

Some of our larger native members of the carrot family, such as cow parsnip (*Heracleum maximum*) and purple-stemmed angelica (*Angelica atropurpurea*), may be confused with giant hogweed.

William M. Ciesla, Forest Health Mgmt. Intl. www.forestryimages.org

References:

New York Sea Grant: http://www.dec.ny.gov/docs/lands_forests_pdf/ghfactnyseagrant.pdf

St. Lawrence-Eastern Lake Ontario PRISM of New York State: http://www.sleloinvasives.org/about-invasives/target-species/giant-hogweed/

USDA Forest Service: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/giant-hogweed.pdf

For More Information:

DCNR Invasive Species Site: *http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm*

Giant Salvinia (*Salvinia molesta*)

A plant profile for this species can be found at the United States Department of Agriculture website at the following link:

https://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/gsalvinia.pdf

Invasive Plants in Pennsylvania

Glossy Buckthorn

Frangula alnus

Gil Wojciech, PFRI
www.forestryimages.org

Background:

Glossy buckthorn was first introduced into the United States in the mid 1800s as an ornamental. It has been used for hedges and wildlife habitat. A variety of cultivars are still sold in some nurseries.

Range:

Native to Eurasia, glossy buckthorn has invaded the Northeast and North-central regions of the United States.

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www.dcnr.state.pa.us

Description:

Glossy buckthorn is a shrub or small tree growing to a height of 10 to 25 feet. The bark is gray or brown with closely spaced, white lenticels. The simple, alternate leaves are papery and dark green with a shiny upper surface and a dull, hairy or smooth lower surface. Pale yellow flowers emerge in small clusters from the leaf axils throughout the growing season. The round fruit is red to dark purple.

John M. Randall, The Nature Conservancy
www.forestryimages.org

Habitat:

This invasive can be found in a wide variety of habitats, including nutrient-poor soils, full sun and dense shade. It is particularly a problem in wetlands such as swamps, bogs, fens and wet meadows.

Biology and Spread:

Glossy buckthorn spreads by seed, recruiting birds that eat its prolific berries. Seeds may also be spread by water since fresh fruit can float for over two weeks. Dispersal may be significant in areas that receive frequent and extensive fall and winter flooding.

Ecological Threat:

Glossy buckthorn is particularly aggressive in wet areas, rapidly producing a dense shade that eliminates native plants. It also engages in species-specific allelopathy, changing the structure of native plant communities.

Leslie J. Mehrhoff, U. of Connecticut,
www.forestryimages.org

How to Control this Species:

Physical

Seedlings less than three feet tall can usually be pulled by hand. Saplings can be removed with a weed wrench, but individuals with a large base diameter are best dealt with by cutting. The resulting stump should be dug out or treated with herbicide. Girdling is also effective.

If enough fuel is present, prescribed burns have a large impact on seedlings and the current year's seeds.

Be sure to remove and dispose of any ripened fruit from the restoration site.

Chemical

Herbicide applications may be done early in the season just after the trees have leafed out, but those conducted in the fall or early winter appear to be most effective.

Use a systemic herbicide, such as glyphosate, in order to destroy the root system.

Brush applications on recently cut stumps, in addition to the basal bark method, often achieve good results.

Native Alternatives

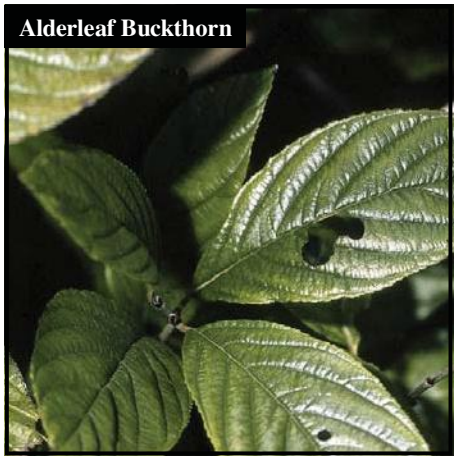
Many low-growing native trees and shrubs are available:

Steven Katovich, USDA Forest Service
www.forestryimages.org

Vern Wilkins
www.forestryimages.org

Look-A-Likes:

Glossy buckthorn may be confused with native buckthorns (*Rhamnus* spp.) and cherries (*Prunus* spp.).



Robert H. Mohlenbrock, USDA NRCS
www.plants.usda.gov

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USDA Forest Service: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/glossy-buckthorn.pdf

For More Information:

DCNR Invasive Species Site: http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

DCNR Invasive Exotic Plant Tutorial for Natural Lands Managers: http://www.dcnr.state.pa.us/forestry/invasivetutorial/common_glossy_buckthorn.htm

Goutweed

Aegopodium podagraria L.
Carrot family (Apiaceae, formerly Umbelliferae)

NATIVE RANGE

Most of Europe and northern Asia, to eastern Siberia

DESCRIPTION

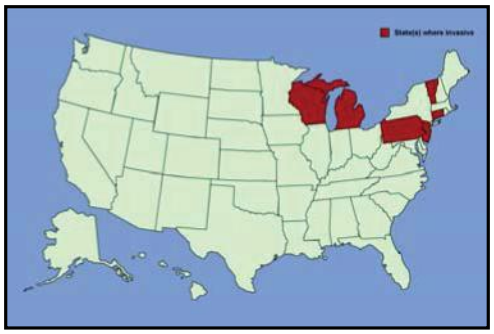
Goutweed, also known as bishop's-weed and snow-on-the-mountain, is an herbaceous perennial plant. It is one of several species of Aegopodium, native to Europe and Asia. Most leaves are basal, with the leafstalk attached to an underground stem, or rhizome. The leaves are divided into three groups of three leaflets, making it "triternate." The leaflets are toothed and sometimes irregularly lobed. Foliage of the "wild" type is medium green in color; a commonly planted variegated form has bluish-green leaves with creamy white edges. Sometimes reversion back to solid green or a mixture of solid green and the lighter variegated pattern occurs within a patch.

Small, white, five-petaled flowers are produced in mid-summer. Flowers are arranged in flat-topped clusters (called compound umbels) and are held above the ground on a leafy stem up to about 3 feet tall. The seeds are small and elongate, similar in size and shape to carrot seeds, and ripen in late summer. In contrast to the dense foliage cover produced by goutweed, flowering shoots are uncommon in densely shaded areas.

The rhizomes of goutweed are long, white, and branching, superficially resembling those of quackgrass (*Elytrigia repens*, also known as *Agropyron repens*). Patches of goutweed typically form a dense canopy and can exclude most other herbaceous vegetation. Because of this, it is often used as a low-maintenance ground cover.

ECOLOGICAL THREAT

Goutweed is an aggressive invasive plant that forms dense patches, displaces native species, and greatly reduces species diversity in the ground layer. Goutweed patches inhibit the establishment of conifers and other native tree species as well.



DISTRIBUTION IN THE UNITED STATES

Goutweed is currently known to occur in twenty-nine states in the mid-Atlantic, Northeast and Northwest (USDA PLANTS) and is reported to be invasive in natural areas in Connecticut, Michigan, New Jersey, Pennsylvania, Vermont, and Wisconsin (WeedUS Database).

HABITAT IN THE UNITED STATES

Goutweed is an ecologically versatile species. It is found in old gardens and flowerbeds, around shrubs and other plantings, and in a variety of other disturbed habitats such as felled forests, abandoned fields, and pastures. In Eurasia, goutweed is primarily a species of deciduous and southern boreal forests, and it expands aggressively in similar habitats in North America. Goutweed appears to do best on moist soil and in light to moderate shade, but is highly shade-tolerant and capable of invading closed-canopy forests.

BACKGROUND

Goutweed was apparently first brought to North America as an ornamental during the early stages of European settlement and was well established in the U.S. by 1863. In parts of Russia, the leaves are sometimes used as a salad ingredient and potherb in the spring.

Plant Conservation Alliance's Alien Plant Working Group
Weeds Gone Wild: Alien Plant Invaders of Natural Areas
http://www.nps.gov/plants/alien/

BIOLOGY & SPREAD

Goutweed is vigorous, rhizomatous perennial that spreads mainly by vegetative means. Patches increase in size through extension of the rhizome system. The flowers are pollinated by a wide variety of insects, including beetles, bees, and especially small flies. The seeds have no apparent morphological features that would facilitate dispersal. Goutweed seeds require cold stratification to germinate. While established goutweed plants are highly competitive in shaded environments, seedlings generally need recently disturbed soil and rather bright light in order to survive. Goutweed apparently does not form a long-lived seed bank, and the seeds generally germinate the year after ripening. Establishment of goutweed seedlings in the shade is rare. The primary vector for dispersal to new areas is humans. Most goutweed colonies spread to neighboring natural areas from intentional plantings, or by the dumping of yard waste that includes discarded rhizomes.

MANAGEMENT OPTIONS

A variety of methods are available for controlling goutweed, depending on the extent of the infestation and the amount of time and labor available. Regardless of the control method used, the patch should be carefully monitored periodically for a few years. New shoots should be dug up and destroyed. Once goutweed control has been achieved, revegetation with native or non-invasive exotic plant materials is recommended. This is particularly important on sites where erosion is a concern or where other invasive species are likely to colonize the site if left alone.

Biological

There are no biological control organisms currently available for *Aegopodium podograria* in North America.

Chemical

Systemic herbicides such as glyphosate (Roundup®) that are translocated to the roots and kill the entire plant are most effective for goutweed control. However, glyphosate is non-specific and can damage or kill desirable native plants that are accidentally sprayed in the course of treating the goutweed. Contact herbicides are usually ineffective because goutweed readily leafs out again after defoliation.

Manual

Small patches of goutweed can be eliminated by careful and persistent hand-pulling or digging up of entire plants along with underground stems (rhizomes). Pulled plants can be piled up and allowed to dry for a few days before bagging and disposing of them. Be careful to pick up all rhizomes which, if left behind, can reroot and sprout new plants. For large patches, a team of volunteers or use of herbicide is recommended.

Mechanical

Where appropriate, frequent short mowing may control or slow the spread of goutweed in lawns, along roadsides, and other areas.

Physical

Preventing goutweed from photosynthesizing in early spring (at the time of leaf-out) can control the plant by depleting its carbohydrate reserves. This can be accomplished by covering the patch with black plastic sheeting when the leaves start to emerge from the ground in the spring, and leaving it in place through the summer. A more effective option is to cut all plants once they've fully leafed out, using a mower, scythe, or weed-whacker type machine, and then cover the area with plastic. Covering the plants in mid- or late summer, after they have regained substantial starch reserves, is probably much less effective.

CONTACTS
For more information on the management of goutweed, please contact:

- Steve Garske, Great Lakes Indian Fish & Wildlife Commission, Odanah, WI (715-682-6619; steveg@glifwc.org)
- David Schimpf, Department of Biology, University of Minnesota - Duluth, Duluth, MN (218-726-7265; dschimpf@d.umn.edu)

SUGGESTED ALTERNATIVE PLANTS
Contact your local native plant society for other species suitable for your area (http://www.nps.gov/plants).

OTHER LINKS
- http://nbii-nin.ciesin.columbia.edu/ipane/icat/browse.do?specieId=34

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Invasive Plant Atlas of New England

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Ground Ivy (*Glechoma hederacea*)

A plant profile for this species can be found at the United States Department of Agriculture Forest Service website at the following link:

http://www.na.fs.fed.us/fhp/invasive_plants/weeds/ground-ivy.pdf

Maine Volunteer Lake Monitoring Program

Maine's Interactive Field Guide to Aquatic Invaders
and Their Native Look Alikes

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HYBRID VARIABLE WATER-MILFOIL

Myriophyllum heterophyllum X Myriophyllum laxum

Milfoil comparison table

NOT NATIVE TO MAINE - INVASIVE

NOTE: All leafy milfoils display a wide range of vegetative variability. Any milfoil found in Maine waters should be considered "suspicious" until a positive identification has been confirmed by someone with the appropriate expertise.

The invasive variable water-milfoil hybrid is not explicitly prohibited by Maine law. However, the hybrid is half variable water-milfoil and, as such, is treated as a prohibited invasive plant by the Maine Department of Environmental Protection.

Habitat: The invasive water-milfoil hybrid is an extremely well adapted plant, able to thrive in a wide variety of environmental conditions. It grows well in still and flowing waters, and can survive under ice. The hybrid grows rooted in water depths from 1 to 5 meters on various substrates including organic muck, silt, sand and gravel.

Description: This hybrid milfoil is a cross between variable water-milfoil (*M. heterophyllum*) and loose water-milfoil (*M. laxum*), a milfoil native to the southeastern United States. The hybrid is a submersed, aquatic plant with branching stems emerging from dense, spreading roots. Feather-divided leaves are arranged in densely packed whorls. (Some of the leaves in the whorl may be slightly offset.) There are generally 4 to 6 leaves per whorl and 5 to 14 pairs of thread-like leaflets on each leaf. The dense leaf arrangement give this plant a bottle brush appearance. Stems are typically reddish in color (even bright red). Leaves may also be red. Flowers occur on emergent spikes.

Two features (both present on the emergent flower spike) distinguish the hybrid from its invasive parent, variable water-milfoil (*M. heterophyllum*): 1) The bracts and flowers of the hybrid are arranged both alternately and whorled, as opposed to the strictly whorled arrangement found on the flower spikes of *M. heterophyllum*. 2) The bracts of the hybrid range from pinnately lobed, to elongate and entire. (Bracts on *M. heterophyllum* are mostly serrated and blade-shaped.)

The hybrid does not produce winter buds; *M. heterophyllum* does.

variable water-milfoil hybrid stems

Flowers and bracts are arranged both alternately and whorled along the emergent flower spike; bracts range from pinnately lobed, to elongate and entire;

Origin and U.S. Range: Currently unknown, however it is known to be in Maine.

Annual Cycle: The invasive milfoil hybrid is an extremely hardy aquatic perennial that propagates primarily through root division and fragmentation. Flowering spikes typically emerge from the water in mid to late summer, but not all colonies produce flowers. Toward the end of the growing season some plants break apart and die back to their rootstalks; others overwinter intact. New growth sprouts from roots and overwintering plants and plant fragments as the water begins to warm in the spring, growing rapidly toward the surface. Certain milfoils are able to hybridize with other, closely related, milfoil species. (See above.)

Look Alikes: May be confused with bladderworts, hornworts, mermaid weeds, water crowfoots, and other leafy water-milfoils.

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(Adobe Acrobat file) - To get the free Acrobat Reader go to Adobe.com.

Click Images for Larger Version

Water Quality Monitoring

Aquatic Invasive Monitoring

Maine Volunteer Lake Monitoring Program

vlmp@mainevlmp.org
24 Maple Hill Road, Auburn, ME 04210
(207)-783-7733
www.MaineVolunteerLakeMonitors.org

Invasive Plants in Pennsylvania

Hydrilla

Hydrilla verticillata

Photo: USDA APHIS PPQ, www.invasive.org

Background:

Hydrilla is believed to be native to Asia or Africa, although it is now widely spread across the globe. It was first introduced to North American as an aquarium plant in the 1950s.

Range:

Hydrilla is more commonly found in southern states on both the east and west coasts, but it is showing up more frequently in the Mid Atlantic and New England states as time goes by.

Description:

This is a submerged aquatic plant that can grow in water as deep as 20 to 40 feet. Leaves are whorled in bunches of three to eight, but most often with five. The midribs of the small leaves are reddish in color with the undersides having small, raised teeth. Fruits are cylindrical and contain up to five seeds.

Habitat:

This species tolerates a variety of pollutants and a range of water chemistry. It will grow in lakes, ponds, stream and rivers.

Photo: Leslie Mehrhoff, U. of Connecticut, www.invasive.org

Biology and Spread:

The primary means of spread is vegetatively. Living stem sections can break off and root elsewhere. Late in the season herbicide-resistant tubers (*see photo below*) form at the end of the stolons, allowing for rapid recolonization of a treated site. Seed production appears to be minimal in the north.

Photo: Tim Murphy, U. of Georgia, www.invasive.org

Ecological Threat:

Hydrilla forms dense floating mats that can restrict native vegetation, impact recreation and slow water flow. Annual control efforts in Florida alone cost millions of dollars. It was identified as a federal noxious weed in 1979, meaning it is illegal to sell, plant and transport this species.

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How to Control this Species:

Prevention

Monitoring and prevention are the most important steps to keep hydrilla under control, since it can be difficult to treat once it's present.

Check all equipment and boats for plant fragments before leaving the area. Remove all debris, bag and dispose of.

Limiting disturbance to lake bottoms and the native vegetation growing there will help minimize the chances of hydrilla colonizing the area.

Manual or Mechanical

Removal of the plant can temporarily open up water-ways but the resulting plant fragments can help spread the vegetation even faster. Repeated monitoring is necessary to deter regrowth.

Hydrilla may be able to be controlled with seasonal water drawdowns. This is most effective when the tubers are developing in the fall and before regrowth occurs in the spring. However, tubers may remain dormant even after the pond has been drained.

Chemical

Systemic herbicides can provide for more long-term control. Fluridone is one such herbicide. It is intended for large-scale infestations and has minimal long-term effects on native plants. It can reduce but not altogether eliminate a population of hydrilla.

Photo: David Moorhead, U. of Georgia, www.invasive.org

Look-A-Likes:

Hydrilla can be confused with the exotic Brazilian egeria (*Ergeria densa* Planch.) and the native waterweeds: Canadian or common waterweed (*Elodea Canadensis* Michx.) and Nutali's or western waterweed (*E. nattallii*). The difference lies in the number of leaves and the presence of tubers on hydrilla.

Photo: Robert Videki, www.invasive.org

References:

Center for Invasive Species and Ecosystem Health: http://www.invasive.org/browse/subinfo.cfm?sub=3028

Invasive Exotic Plant Pest Tutorial for Natural Lands Managers: http://www.dcnr.state.pa.us/forestry/invasivetutorial/hydrilla.htm

For More Information:

To learn more about invasive plants in Pennsylvania and the northeast, here are some useful resources:

A Field Guide to Common Aquatic Plants of Pennsylvania: http://pubs.cas.psu.edu/FreePubs/pdfs/agrs110.pdf

Pennsylvania SeaGrant: http://seagrant.psu.edu/publications/ais.htm

Invasive Plants in Pennsylvania

Japanese and European Barberry

Berberis thunbergii and *B. vulgaris*

Leslie J. Mehrhoff, U. of Connecticut
www.forestryimages.org

Background:

Japanese barberry was introduced into the United States as an ornamental plant in 1875. It was promoted as a substitute for European barberry, the latter which was found to be a host for the black stem grain rust. European barberry was originally planted by settlers for hedge-rows, dye and jam-making. Japanese barberry is still widely planted for landscaping and hedges.

Range:

Japanese and European barberry, native to Japan and Europe respectively, can now be found throughout the northern half of the U.S., particularly the Northeast.

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Description:

Both species are dense, spiny shrubs with oval leaves, which are serrate in European barberry and often red-tinged in Japanese barberry. The spines of European barberry are three-pronged. In mid-spring to early summer, drooping clusters of pale yellow flowers develop, turning into bright red berries.

Leslie J. Mehrhoff, U. of Connecticut
www.forestryimages.org

Habitat:

Barberry is shade tolerant, drought resistant and adaptable to a variety of wooded habitats, wetlands and disturbed areas. Japanese barberry is a more pressing problem than its European relative.

Biology and Spread:

Barberry produces a large number of seeds that have a high germination rate. Seeds are dispersed by birds and small mammals, which feed on the berries. Barberry can spread vegetatively by rooting from branches touching the ground.

Ecological Threat:

Barberry forms dense stands in natural habitats including forests, open woodlands, wetlands and meadows. Once established, it displaces native plants and reduces wildlife habitat and forage, increasing pressure on natives by white-tailed deer. It has been found to alter the pH and biological activity of soil. Barberry is also a human health hazard, not only because it has sharp spines, but also because it acts as a nursery for deer ticks, which can transmit Lyme disease.

Leslie J. Mehrhoff, U. of Connecticut
www.forestryimages.org

How to Control this Species:

Physical

Barberry is easy to identify in spring because it is one of the first shrubs to leaf out.

Using thick gloves, small plants can be pulled by hand, while larger plants should be dug up. Be sure to remove the entire root system and to bag and dispose of any plant material, including fallen fruits.

Mowing or cutting is not advisable except to make removal easier.

This plant is sensitive to fire; prescribed burns and weed torches are good options.

Chemical

Systemic herbicides, such as glyphosate and triclopyr, are effective in managing barberry.

Herbicide can be applied as a basal bark or cut stump application. Late summer during fruiting may be the best time to apply herbicide, but early spring applications may avoid non-target impacts.

Large thickets of barberry can be controlled with foliar spray applications. Triclopyr only targets broadleaf species, but glyphosate is non-selective.

Look-A-Likes:

American barberry (*Berberis canadensis*), an uncommon plant of open hillside slopes thought to be extirpated from Pennsylvania, could be mistaken for an invasive barberry.

Will Cook, Duke University
www.duke.edu

Native Alternatives:

Many attractive native shrubs are available for purchase:

Julie Makin
www.wildflower.org

Sally & Andy Wasowski
www.wildflower.org

James H. Miller & Ted Bodner, SWSS
www.forestryimages.org

References:

Global Invasive Species Database: http://www.issg.org/database/species/ecology.asp?si=592&fr=1&sts=

Wisconsin Department of Natural Resources: http://dnr.wi.gov/invasives/fact/barberry.htm

For More Information:

DCNR Invasive Species Site: http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

DCNR Invasive Exotic Plant Tutorial for Natural Lands Managers: http://www.dcnr.state.pa.us/forestry/invasivetutorial/japanese_euro_barberry.htm

Invasive Plants in Pennsylvania

Japanese Hops

Humulus japonica

Photo: Chris Evans, River to River CWMA, www.invasive.org

Background:

This vine is native to China, Japan, Korea and Taiwan. It was brought to the U.S. in the mid-to-late 1800s as an ornamental and as a medicinal plant. This is not the type of hops used for beer making.

Range:

Japanese hops is found in scattered counties throughout New England, the Mid-Atlantic and Midwest states, and as far south as Alabama.

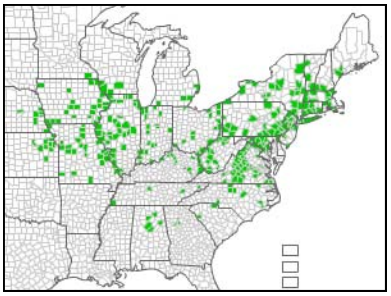

Image courtesy of EDDMapS

Description:

Japanese hops is an annual, climbing or trailing vine that can grow up to 35 feet in length in one growing season. Leaves are opposite along the vine and have an average of five lobes with toothed margins and a rough surface. The stem is covered with prickles (*see photo below*). Female flowers appear in mid summer as cone-shaped clusters that hang down (called hops), while male flowers are upright and stem-like.

Photo: Chris Evans, River to River CWMA, www.invasive.org

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Habitat:

Disturbed habitats like scoured river banks, roadsides and rights-of-way are prime habitat, although it will also colonize forest edges and fields. It prefers moist soil and full sun. It will grow in sandy, loamy or clay soils.

Biology and Spread:

This vine spread vegetatively by its fast growth rate and through abundant small seeds that can be spread by rivers and streams. The seed bank lasts approximately three years.

Ecological Threat:

Japanese hops can form dense patches that outcompete and smother native vegetation.

Photo: Leslie Mehrhoff, U. of Connecticut, www.invasive.org

How to Control this Species:

Manual and Mechanical

The plants may be pulled in late spring and early summer, before they flower and set seed, typically prior to August. Be sure to wear gloves as protection from the hooked hairs that may cause blistering of the skin. When pulling, remove as much of the roots as possible, as the plant may resprout. Bag and discard all plant material.

Repeated cutting or mowing close to the ground may also be used, however its effectiveness is limited as vines quickly re-grow from cut stems.

Chemical

A pre-emergent herbicide, which kills weed seeds as they germinate, may be used on Japanese hops. This will reduce the impact to other vegetation.

Combining a pre-emergent with later application of a glyphosate herbicide may provide longer-lasting control. The herbicide should be applied to the leaves, ideally when the rootstock is accumulating energy reserves (July through September).

Look-A-Likes:

Common hop (*Humulus lupulus*) has five varieties, three of which are native to the U.S. (vars. *lupuloides, neomexicanus* and *pubescens*). The other two are native to Europe (var. *lupulus*) and eastern Asia (var. *cordifolius*), respectively. Common hop leaves have either no lobes or three lobes, as opposed to Japanese hops' five or more lobes.

Japanese hops may also resemble the native bur cucumber (*Sicyos angulatus*), but that plant lacks prickles, has tendrils and the lobes are less pronounced.

Photo: Charlie McDonald, US Forest Service, www.fs.fed.us

Photo: Theodore Webster, USDA, www.forestryimages.org

References:

Center for Invasive Species and Ecosystem Health: http://www.invasive.org/browse/subinfo.cfm?sub=10091

Invasive Exotic Plant Tutorial for Natural Lands Managers: http://www.dcnr.state.pa.us/forestry/invasivetutorial/japanese_hops.htm

USDA Forest Service Weed of the Week: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/japanese-hop.pdf

Plant Conservation Alliance's Least Wanted List: http://www.nps.gov/plants/alien/fact/huja1.htm

Photo: Leslie Mehrhoff, U. of Connecticut, www.invasive.org

Invasive Plants in Pennsylvania

Japanese Stilt Grass

Microstegium vimineum

James H. Miller, USDA Forest Service
www.forestryimages.org

Background:

Japanese stilt grass was first documented in Tennessee in 1919. Its introduction into the United States was accidental, likely a result of its use as a packing material for porcelain.

Range:

Native to Asia, this successful invasive has colonized most of the eastern United States, as far west as Texas.

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Description:

Japanese stilt grass is an annual that typically grows one to three feet in height. Despite its branching, sprawling, mat-like manner, it resembles a small, delicate bamboo. Leaves are narrow and lance-shaped with a distinctive, pale, silvery stripe of reflective hairs on the upper surface. Flower spikes appear in September.

James H. Miller & Ted Bodner, SWSS
www.forestryimages.org

Habitat:

Japanese stilt grass occurs in a variety of habitats, including moist ground of open woods, floodplain forests, wetlands, uplands, fields, thickets, roadsides, and ditches. It readily invades areas subject to regular disturbance. Stilt grass appears to prefer moist, acidic to neutral soils that are high in nitrogen.

Biology and Spread:

Stilt grass reproduces exclusively by seed. One plant may produce 100 to 1,000 seeds that typically fall close to the parent plant. Seeds may be carried by water during heavy rains or move about in contaminated hay, soil or mud stuck in footwear. Stilt grass seeds remain viable in the soil for five or more years and germinate readily.

Ecological Threat:

When Japanese stilt grass invades a site, it can quickly crowd out native plant species. Invasions can also change soil nutrient cycling processes, inhibit tree survival and growth, and reduce light availability. After it dies back in late fall, it forms a thick layer of smothering thatch that is slow to decompose. Because stilt grass is relatively unpalatable, it may encourage heavier deer browsing on native plant species.

Chris Evans, River to River CWMA
www.forestryimages.org

How to Control this Species:

Physical

Japanese stilt grass is quite shallow-rooted and can be easily pulled by hand, especially when the soil is moist. Pulling is easiest in late summer when plants are mature. Stilt grass can also be mowed. Follow up monitoring and treatment will be necessary for years.

Hand pulling and mowing should be done in late summer when the plants are just about to flower. Performing these activities earlier in the summer months encourages flowering and early seed dispersal.

Chemical

For extensive infestations, a systemic herbicide can be used quite effectively. Using an herbicide leaves the plants and soil in place, minimizing the likelihood of additional germination of stilt grass seed.

Grass-specific herbicides, such as quizalofop, limit damage to native plants.

Be careful when treating stilt grass in wetland sites. Make sure you use an herbicide suitable for wetlands.

Chris Evans, River to River CWMA
www.forestryimages.org

Look-A-Likes:

The native perennial Virginia cutgrass (*Leersia virginica*) is quite similar. Japanese stilt grass may also be confused with some smartweeds (*Persicaria* sp.).

Leslie Mehrhoff, U. of Connecticut
www.discoverlife.org

References:

Plant Conservation Alliance's Alien Plant Working Group: http://www.nps.gov/plants/alien/fact/mivi1.htm

Purdue University Cooperative Extension Service: http://www.btny.purdue.edu/weedscience/2011/Microstegium-01.pdf

Wisconsin Department of Natural Resources: http://dnr.wi.gov/invasives/fact/japanstgrass.htm

For More Information:

DCNR Invasive Species Site: http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

DCNR Invasive Exotic Plant Tutorial for Natural Lands Managers: http://www.dcnr.state.pa.us/forestry/invasivetutorial/Japanese_stiltgrass.htm

Invasive Plants in Pennsylvania

Jimsonweed

Datura stramonium L.

Photo: Patrick J. Alexander, USDA-NRCS PLANTS Database

Background:

Jimsonweed or "Jamestown weed" was documented in that Virginia colony in 1676 when local soldiers ate its leaves, resulting in hallucinogenic poisoning. Native Americans used this plant and a closely related Mexican species for medicinal and religious purposes leading to another common name: Indian-apple.

Range:

Jimsonweed is widespread in warm temperate regions around the earth, so its origins are uncertain. Some varieties are probably native North America while others are Asian. Daturas grow throughout the U.S. and across Pennsylvania.

Description:

An annual plant reaching one to five feet tall, branching in two equal forks. Stems are smooth, green to purplish with alternate, simple, coarsely toothed leaves three to eight inches long. The flowers form white or pinkish, flaring, five-pointed trumpets three to four inches long and two inches wide from August to October. The fruits are short prickly capsules about one inch in diameter.

The plant has a very pungent odor when crushed. All parts of the plant are poisonous if ingested. Poisonings have been reported from accidental overdose of the herbal medicine Stramonium U.S.P. or by intentional ingestion for illicit drug use.

Habitat:

Datura stramonium is a common weed in cultivated fields along roadsides and disturbed ground.

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Biology and Spread:

D. stramonium overwinters only as seeds. Plants produce from three capsules (about 1,500 seeds) to 50 or more capsules with 30,000 or more seeds. Seeds are dispersed three to twelve feet from the dry capsules. Dispersal is also accomplished by water, on farm machinery or as an impurity in crop seeds, hay and feed grains. Seeds can remain viable in the soil for decades.

Photo: Howard F. Schwartz, Colorado State University, www.bugwood.org

Ecological Threat:

Datura stramonium is listed as a noxious weed in Pennsylvania due to its poisonous tropane alkaloids. Most animals avoid the plant due to its odor but livestock poisonings occur due to contaminated hay or feed. Jimsonweed is not typically found in undisturbed native plant communities.

How to Control this Species:

Preventing infestation is important. Buy clean seed and clean all equipment after working in an infested field. Remove *Datura* plants before they flower and produce seed.

Jimsonweed seedlings emerge intermittently during the growing season, so monitoring and repeated pulling may be required. Once an area is infested, new seedlings will spring up for several years. If individual plants are pulled, wear gloves to avoid plant contact with skin and eyes.

It is a violation of the Noxious Weed Control Law to sell, transport, plant or otherwise propagate *Datura stramonium* within the Commonwealth.

Jimsonweed is controlled in agricultural crops with pre-emergence and post-emergence herbicides.

Patrick J. Alexander, USDA-NRCS
PLANTS Database

Look-A-Likes:

Datura inoxia Mill. (D. meteloides DC.), from Mexico and *D. metel*, a hairy Eurasian species with entire or singly toothed leaves, are sold as ornamentals called "angel's trumpets" and occasionally escape to railroad tracks or waste ground. All are toxic.

Photo: K. R. Robinson

References:

Weed Circular No.12, Jimsonweed, *Datura stramonium* L. by Wilber L. Mountain. Pennsylvania Department of Agriculture Bureau of Plant Industry. Spring 1987

For More Information:

Center for Invasive Species and Ecosystem Services: www.invasive.org

DCNR Invasive Species Site: www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

Plant Invaders of Mid-Atlantic Natural Areas: www.nps.gov/plants/alien/pubs/midatlantic/midatlantic.pdf

Invasive Plants in Pennsylvania

Kudzu

Pueraria montana var. lobata

Photo: Greg Czarnecki, DCNR

Background:

Kudzu, referred to as "the vine that ate the South," is a native to Asia. It was first introduced into the U.S. in 1876 at the Philadelphia Centennial Exposition. It was widely planted throughout the eastern U.S. for erosion control and livestock feed.

Range:

Found as far north as Massachusetts and throughout the east coast over to the Midwest. Kudzu can also be found in Hawaii and parts of Oregon.

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Description:

Kudzu is a climbing, deciduous vine that can reach lengths of over 100 feet. Leaves are alternate, compound (with three lobed leaflets), hairy and up to five inches in length. Clusters of purple, fragrant flowers appear in midsummer. Fruits are green to brown, hairy, flat seed pods that are roughly three inches in length and contain three to 10 seeds.

Photo: Greg Czarnecki, DCNR

Habitat:

This vine prefers open, disturbed areas like roadsides, rights-of-way, forest edges and old fields. In Pennsylvania most of the sites are old homesteads or industrial sites that were planted with kudzu to prevent erosion.

Biology and Spread:

Kudzu can grow up to a foot a day. Its spread is limited to vegetative means: roots and rhizomes. It is unknown whether the seeds are viable this far north. Kudzu tap roots are substantial in size, some weighing as much as 400 pounds, making their removal difficult. As many as 30 vines may grow from one root crown.

Ecological Threat:

This vine kills other plants by smothering them, girdling woody stems and trunks, and uprooting entire trees by the force of its weight.

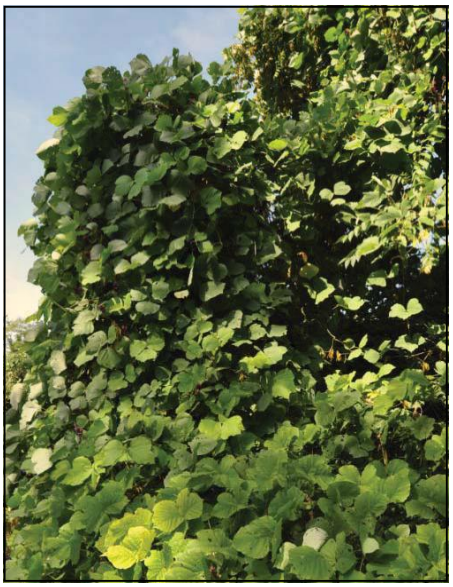

Photo: Greg Czarnecki, DCNR

How to Control this Species:

For successful long-term control of this vine, the extensive root system must be destroyed, which will take many years. Any surviving root crowns can lead to reinfestation.

Manual and Mechanical

Repeated cutting every month of the growing season may be effective at reducing the stored energy in the roots, but it can take up to 10 years in well-established stands. Cut vines can be fed to livestock or bagged and sent to a landfill. Root removal is not recommended as they may be up to 12 feet deep under ground.

Chemical

When vines have grown into trees, the cut stump method is suggested. Cut the stem two inches above the ground and immediately apply a 25 percent glyphosate or triclopyr and water solution to the stem.

For large populations of kudzu the foliar spray method is recommended. Apply either a two percent solution of glyphosate or triclopyr and water solution to the leaves. A 0.5 percent non-ionic surfactant added to the herbicide is recommended to help penetrate the leaf surface. Air temperatures should be above 65 degrees F.

If You Find This Plant:

Kudzu is on the Pennsylvania Noxious Weed Control List. It is illegal to sell, plant or transport this species. If you believe that you have found a new population of this plant, please contact Melissa Bravo, PA Dept. of Agriculture, at 717-787-7204.

Photo: Greg Czarnecki, DCNR

References:

Center for Invasive Species and Ecosystem Health:
http://www.invasive.org/browse/subinfo.cfm?sub=2425

Invasive Exotic Plant Tutorial for Natural Lands Managers:
http://www.dcnr.state.pa.us/forestry/invasivetutorial/kudzu.htm

For More Information:

To learn more about invasive plants in Pennsylvania and the northeast, here are some useful resources:

Plant Invaders of Mid-Atlantic Natural Areas, National Park Service:
http://www.nps.gov/plants/alien/pubs/midatlantic/midatlantic.pdf

Invasive Plants Field and Reference Guide, U.S. Forest Service:
http://na.fs.fed.us/pubs/misc/ip/ip_field_guide.pdf

Leafy Spurge (*Euphorbia esula*)

A plant profile for this species can be found at the United States Department of Agriculture website at the following link:

http://plants.usda.gov/core/profile?symbol=euese

Invasive Plants in Pennsylvania

Lesser Celandine

Ranunculus ficaria

Leslie J. Mehrhoff, University of Connecticut
www.forestryimages.org

Background:

Lesser celandine was introduced into the United States as an ornamental plant. It is still commercially available. All varieties should be assumed to be invasive.

Range:

Native to Eurasia, lesser celandine can now be found in the Northeast and Pacific Northwest regions of the United States.

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Description:

Lesser celandine is a perennial herbaceous plant that forms low-growing mats. Plants consist of a basal rosette of dark green, kidney-shaped leaves. The bright yellow flowers are borne singly on stalks that rise above the leaves. Abundant, finger-like tubers are produce by the roots.

Leslie J. Mehrhoff, University of Connecticut
www.forestryimages.org

Habitat:

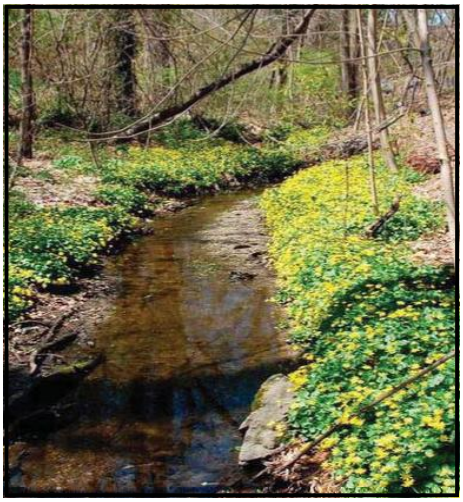
Lesser celandine is characteristic of moist alluvial soils in forested floodplains. It can also be found in low open woods, meadows, roadsides and waste places. It seems to prefer moist, sandy soils. Less frequently, it will invade drier soils.

Biology and Spread:

Lesser celandine spreads primarily through vegetative means. Its abundant tubers and bulblets may be unearthed and scattered by animals, well-meaning weed pullers and flood events.

Ecological Threat:

An exotic vernal plant, lesser celandine is aggressive and emerges earlier than most native species. It easily displaces native spring ephemerals with its thick carpet of vegetation. This, in turn, negatively affects native pollinators, which rely on spring ephemerals for nectar and pollen during a time when other food sources are scarce.



John M. Randall, The Nature Conservancy
www.forestryimages.org

How to Control this Species:

Physical

Lesser celandine is very difficult to control. Persistence is key.

Small infestations may be pulled up by hand or dug up with a trowel. Be sure to remove all bulblets and tubers. Deal with small infestations early before things get out of control.

Physical removal causes soil disturbance, which can lead to further infestation by lesser celandine and other invasives. Keep this in mind when dealing with high-quality natural areas.

Chemical

The window of opportunity for the chemical control of lesser celandine is very small. Herbicide should be applied in late winter to early spring (March through May) in order to minimize impacts to native wildflowers. Be careful to apply the herbicide to lesser celandine only, and be aware of the site's proximity to breeding amphibians.

Use a wetland-approved concentration of glyphosate, which is a systemic herbicide that will kill the roots.

Native Alternatives:

Many beautiful native spring-flowering plants are available.

Rob Routledge, Sault College
www.forestryimages.org

Wendy VanDyk Evans
www.forestryimages.org

Look-A-Likes:

Lesser celandine closely resembles marsh marigold (*Caltha palustris*), a native wetland plant. Please take steps to ensure proper identification before any treatment is initiated.

Joseph O'Brien, USDA Forest Service
www.forestryimages.org

References:

D&R Greenway Land Trust: http://www.drgreenway.org/documents/Invasives/Lesser%20celandine%20fact%20sheet.pdf

Plant Conservation Alliance's Alien Plant Working Group: http://www.nps.gov/plants/alien/fact/rafi1.htm

For More Information:

DCNR Invasive Species Site: http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

DCNR Invasive Exotic Plant Tutorial for Natural Lands Managers: http://www.dcnr.state.pa.us/forestry/invasivetutorial/Lesser_Celandine.htm

Invasive Plants in Pennsylvania

Mile-a-Minute

Persicaria perfoliata

Photo: Leslie Mehrhoff, U. of Connecticut, www.invasive.org

Background:

Also known as devil's tear-thumb, mile-a-minute has been introduced into the U.S. from the Philippines several times between the late 1800s and the 1930s. It arrived in Pennsylvania in contaminated nursery stock in York.

Range:

A native of eastern Asia, this vine is not yet widespread in the U.S. but is very common is the southern two-thirds of Pennsylvania, as well as parts of WV, VA, MD, DE, NJ, NY, CT, MA, RI and NH.

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Description:

This is an herbaceous, annual vine with delicate, highly branched stems that are covered by small, curved spines. The alternate leaves are triangular, light green, one to three inches wide and barbed on the underside. Round leaf-like structures called ocreae surround the stem. It is from there that the inconspicuous flowers and fruits arise. From mid-July though the first frost, green fruits appear, turning a metallic blue color as the season goes on.

Photo: Jessica Sprajcar, DCNR

Habitat:

This plant readily colonizes disturbed areas along forest edges, wetlands, stream banks and roadsides. It needs regular sunlight to thrive and prefers high soil moisture.

Biology and Spread:

Its fast growth is one way that the plant spreads, but its seeds are the primary means. Birds and other wildlife eat the fruits and spread the seeds in their droppings. Seeds are also buoyant for up to nine days in water and can be spread by streams and floods.

Ecological Threat:

Because this plant can grow up to six inches a day, it can quickly smother native vegetation and climb into the tree canopy where it restricts light availability to plants below. It can be a pest plant on tree farms and for horticultural crops where the soil is not regularly tilled.

Photo: Leslie Mehrhoff, U. of Connecticut, www.invasive.org

How to Control this Species:

Manual and Mechanical
Hand-pulling of vines is possible, especially when the soil is wet, but be sure to wear thick gloves. Removal should be done prior to fruit formation. Repeated mowing will prevent the plant from flowering and thus reduce or eliminate fruit and seed production. Monitor the site for several years to ensure no seeds germinate.

Chemical
A systemic herbicide like glyphosate will work on mile-a-mine, especially when used with a surfactant that will help to penetrate the leaves' waxy coating. Apply the herbicide in the summer, before fruits appear.

Biocontrol
A weevil, *Rhinocominus latipes*, is being used on various test plots in Pennsylvania and elsewhere to control mile-a-minute. These small insects feed on the leaves and bore into the stems. While they will not completely eliminate the plant they help keep it in check and reduce fruit production.

Rhinocominus latipes

Photo: NJ Dept. of Agriculture

Look-a-Likes:

There are several other vines with triangular-shaped leaves that may be confused with mile-a-minute, including halbard-leaved tearthumb (*Polygonum arifolium*), climbing false buckwheat (*Polygonum scandens*), wild morning glory (*Ipomoeae pupurea*) and hedge bindweed (*Calystegia sepium*). The presence of spines and ocreae will let you know that it is indeed mile-a-minute.

Photo: Theodore Webster, USDA, www.forestryimages.org

References:

Center for Invasive Species and Ecosystem Health: http://www.invasive.org/browse/subinfo.cfm?sub=3065

Invasive Exotic Plant Tutorial for Natural Lands Managers: http://www.dcnr.state.pa.us/forestry/invasivetutorial/mile_a_minute.htm

University of Delaware, College of Agriculture & Natural Resources, Biological Control of Mile-a-Minute Weed: http://ag.udel.edu/enwc/research/biocontrol/mileaminute.htm

Massachusetts Introduced Pests Outreach Project: http://massnrc.org/pests/mamreport.aspx

For More Information:

Plant Invaders of Mid-Atlantic Natural Areas, National Park Service: http://www.nps.gov/plants/alien/pubs/midatlantic/midatlantic.pdf

Invasive Plants Field and Reference Guide, U.S. Forest Service: http://na.fs.fed.us/pubs/misc/ip/ip_field_guide.pdf

Invasive Plants in Pennsylvania

Moneywort

Lysimachia nummularia L.

Photo: Richard Old, www.invasive.org

Background:

This plant goes by many common names including creeping Jenny, creeping Charlie, creeping Joan, running Jenny, wandering Jenny and wandering sailor.

It was introduced from Europe and southwest Asia as an ornamental ground cover.

Range:

This plant can now be found through much of the U.S. particularly the east and west coats and the Midwest (see *map on right*).

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Description:

This herbaceous, low-growing perennial plant is part of the primrose family. It has ever-green to semi-evergreen leaves. The creeping stems can grow up to two feet long and form a mat-like growth. Leaves are opposite and oval in shape, resembling coins, hence its name. Small yellow flowers with small dark red spots bloom from June to August, but may not bloom at all.

Habitat:

This plant can grow in a variety of habitats but it grows best and poses the biggest threat in moist areas like wet meadows, swamps, stream banks and roadside ditches. It prefers rich, shaded soils.

Map courtesy of USDA PLANTS Database

Biology and Spread:

This plant spreads vegetatively by its creeping stems, as well as by small seeds that are located within capsular fruits. These fruits are likely dispersed by flood waters and stormwater runoff. How much this plant's seeds are spread by animals is not fully known, but it is likely.

Photo: Les Mehrhoff, IPANE

Ecological Threat:

Not much is known about its direct impacts to the environment but there is concern that dense mats of this plant may take over habitat for more desirable native plant species.

How to Control this Species:

Prevention

The easiest way to prevent the spread of this species is to stop planting it, manage existing infestations and minimize disturbance to forests, wetlands and other habitats. When prevention fails, there are two control options:

Manual

The plant can be hand pulled, but all stems and stem fragments should be removed to prevent the stems from re-rooting . Planting native grasses can help to shade out this plant. Mowing is not effective since moneywort grows so close to the ground.

Chemical

Several herbicides are effective in controlling moneywort. Because this plant usually grows in or near wetlands, make sure that the herbicide is approved for use in wetlands. Rodeo is one such herbicide that may be effective. Be sure to follow all label directions and state requirements when using any herbicide.

Reference:

USDA Forest Service: Weed of the Week factsheet for Moneywort:
http://www.na.fs.fed.us/fhp/invasive_plants/weeds/monewort.pdf

For More Information:

To learn more about invasive plants in Pennsylvania and the northeast, here are some useful resources:

DCNR Invasive Species Site:
http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

Plant Invaders of Mid-Atlantic Natural Areas, National Park Service: http://www.nps.gov/plants/alien/pubs/midatlantic/midatlantic.pdf

Invasive Plants Field and Reference Guide, U.S. Forest Service: http://na.fs.fed.us/pubs/misc/ip/ip_field_guide.pdf

Photo: Richard Old, www.invasive.org

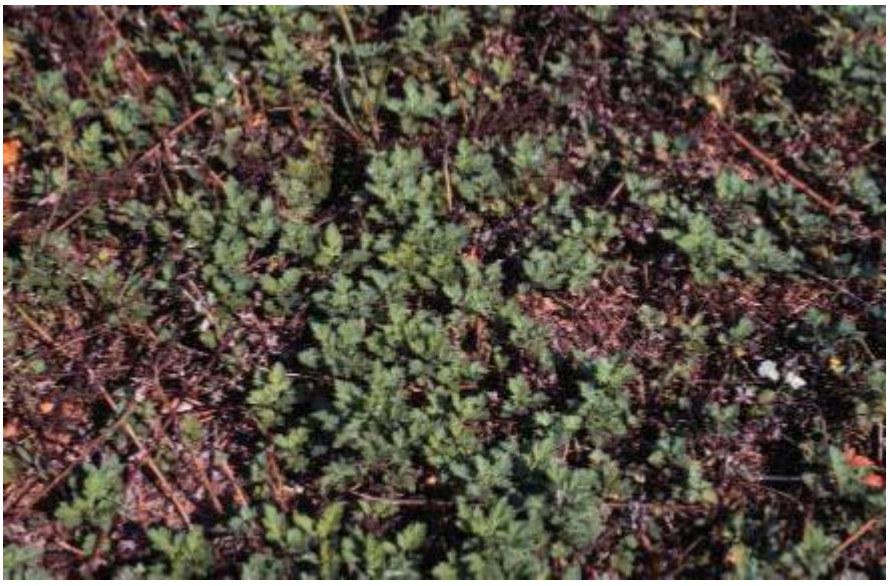
Virginia Tech Weed Identification Guide Select a Resource...

Mugwort: *Artemisia vulgaris*

Weed Description: Perennial weed with persistent rhizomes that may be spread or transported by cultivation equipment, or also in burlaped nursery stock infested with rhizomes. Found throughout the eastern United States.

Seedling: Viable seed are rarely produced in North America. Cotyledons egg-shaped, without petioles.

Stems: May reach 5 ft in height, often reddish-brown in color, and become woody with age.



Leaves: Leaves are 2-4 inches long, 1-3 inches wide, simple, alternate, deeply lobed, and have a distinctive aroma. Leaves on the upper portions of the plant are more deeply lobed and may lack petioles. Leaf undersides are covered with soft, white to gray hairs, while upper leaf surfaces may be smooth to slightly hairy.

Flowers: **Inconspicuous and occur in clusters at the top of the plants. Individual heads are 2.5-3 mm wide and on short stalks.**

Fruit: **An achene that encloses the seed. However, viable seeds are rarely produced in North America.**

Roots: **Rhizomes.**

Identifying Characteristics: **Mugwort is similar in appearance to the garden chrysanthemum commonly grown in flowerbeds and landscapes. Common Ragweed (*Ambrosia artemisiifolia*) seedlings are similar to mugwort, but have more deeply dissected leaves and lack the distinctive aroma typical of mugwort.**

Invasive Plants in Pennsylvania

Multiflora Rose

Rosa multiflora

Leslie J. Mehrhoff, U. of Connecticut
www.forestryimages.org

Background:

Multiflora rose was introduced into the United States as ornamental rootstock from Japan in 1866. Beginning in the 1930s, the U.S. Soil Conservation Service promoted it for use in erosion control and livestock fencing. It was also encouraged in wildlife plantings and as a crash barrier along highways. Recognition of its tenacious and unstoppable growth habitat came too late, and it is now considered a noxious weed in many states.

Range:

Native to Asia, multiflora rose now occurs throughout most of the United States, especially the eastern half.

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Description:

Multiflora rose is a dense, thorny shrub, reaching up to 15 feet in height, with arching canes (stems) that are capable of rambling up trees. Its leaves are pinnately compound, divided into seven to nine leaflets, and finely serrate. Clusters of fragrant white to pink flowers appear in May or June. Small bright red hips (fruit) develop during the summer and remain on the plant through winter.

James H. Miller, USDA Forest Service
www.forestryimages.org

Habitat:

This invasive shrub has a wide tolerance for various soil, moisture and light conditions. It can be found in dense woods, along stream banks and roadsides, and in open fields and prairies.

Biology and Spread:

It is estimated that a single plant may produce a million seeds per year, which may remain viable in the soil for up to 20 years. The hips are readily eaten by birds, which are the primary seed dispersers. New plants can also be formed by rooting from the tips of canes touching the ground.

Ecological Threat:

Multiflora rose forms impenetrable thickets that exclude native plant species. This shrub grows very prolifically in riparian areas, where its inedible leaf litter can change the composition of the aquatic macroinvertebrate community. Its occasional habitat of climbing can weigh down trees, making them susceptible to breakage.

James H. Miller, USDA Forest Service
www.forestryimages.org

How to Control this Species:

Physical

Frequent cutting or mowing, three to six times per growing season, for two to four years, is effective in achieving high mortality. Be careful—the strong thorns have been known to puncture rubber tires.

Scattered populations may be eliminated by complete removal of the plants. Be sure to remove all root material because this shrub readily re-sprouts.

In areas where multiflora rose is detected early, prescribed fire may limit its establishment.

Chemical

Application of herbicides, such as glyphosate or triclopyr, on freshly cut stems is an effective control method since it destroys the root system and prevents re-sprouting. This may be done during the dormant period, which reduces the likelihood of damaging desirable species.

A foliar spray of fosamine can be used from July through September, but die-back will not be apparent until the following summer. Fosamine will only affect woody species.

Biological

Biological control is currently under investigation. Rose-rosette disease, a native viral pathogen, is spread by a mite, and is slowly spreading eastward from the west. The European rose chalcid, a seed-infesting wasp, promises to reduce seed viability. Unfortunately, both of these measures have the potential to impact native rose species.

Leslie J. Mehrhoff, U. of Connecticut
www.forestryimages.org

Look-A-Likes:

Multiflora rose could easily be confused with other rose species (both native and non-native), especially when not in bloom. This is a concern, since some native species are of conservation interest.

Catherine Herms, Ohio State University
www.forestryimages.org

References:

Plant Conservation Alliance's Alien Plant Working Group:
http://www.nps.gov/plants/alien/fact/romu1.htm

Wisconsin Department of Natural Resources:
http://dnr.wi.gov/invasives/fact/rose.htm

For More Information:

DCNR Invasive Species Site: http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

DCNR Invasive Exotic Plant Tutorial for Natural Lands Managers:
http://www.dcnr.state.pa.us/forestry/invasivetutorial/Multiflora_rose.htm

Invasive Plants in Pennsylvania

Narrowleaf Bittercress

Cardamine impatiens L.

Photo: Leslie Mehrhoff, IPANE

Background:

Also known as bushy rock-cress, this plant in the mustard family is native to Europe. No one is quite sure how it arrived in the U.S. but it was first recorded in New Hampshire in 1916. More recent reports are from the 1990s.

Range:

This plant can now be found in the U.S. from Maine south to North Carolina and west to Minnesota, in scattered locations.

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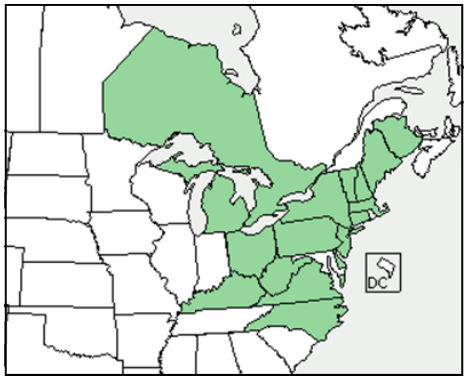
Description:

Narrowleaf bittercress is an herbaceous annual or biennial that can grow up to two feet in height. Each plant has six to twenty pinnately divided leaves on the stem. The basal leaves have three to eleven leaflets with rounded lobes. The plant's small white flowers bloom from May to September.

Photo: Leslie Mehrhoff, IPANE



Map courtesy of USDA PLANTS Database

Habitat:

Narrowleaf bittercress grows well in woods with patchy shade and along forest edges. This plant also does well in moist soils in herbaceous wetlands and stream banks. It is also found along roadsides, in vacant lots and in backyard gardens.

Biology and Spread:

This plant is able to spread easily due to its seed-shooting ability. Each flower contains ten to 24 seeds. Seeds are also spread by water and can stick to clothing and animals.

Ecological Threat:

Narrowleaf bittercress can form dense stands that out-compete native species.

Photo: Leslie Mehrhoff, IPANE

How to Control this Species:

Prevention

This is the most important step in minimizing the spread of this plant. Clean all boots, clothing and equipment before leaving an infested area.

Manual and Mechanical

Small infestations can be pulled by hand easily. Monitor the site and remove plants during the spring, summer and fall to prevent seed production. Plants with flowers and seed heads should be bagged and disposed of in a landfill. Hand pulling is not recommended for large infestations as it might cause disturbance that will result in more seed germination.

Chemical

There is little information available for chemical control of this plant. However, treatment protocols for biennials like garlic mustard may be effective. A systemic herbicide like glyphosate or triclopyr may be applied to the leaves at any time of the year, as long as the temperature is above 50 degrees Fahrenheit and it is not expected to rain for at least eight hours.

Look-A-Likes:

This species also resembles sand bittercress (*Cardamine parviflora*), Pennsylvania bittercress (*C. pensylvanica* Muhl. ex Willd.) and hairy bittercress (*C. hirsuta*). The most important distinguishing characteristic is the leaf base of narrowleaf bittercress.

Photo: Dan Tenaglia, Missouriplants.com, www.forestryimages.org

References:

Invasive Plant Atlas of New England: http://nbii-nin.ciesin.columbia.edu/ipane/icat/browse.do?specieId=44

Minnesota Department of Agriculture: http://www.mda.state.mn.us/plants/badplants/bittercress.aspx

For More Information:

To learn more about invasive plants in Pennsylvania and the northeast, here are some useful resources:

Plant Invaders of Mid-Atlantic Natural Areas, National Park Service: http://www.nps.gov/plants/alien/pubs/midatlantic/midatlantic.pdf

Invasive Plants Field and Reference Guide, U.S. Forest Service: http://na.fs.fed.us/pubs/misc/ip/ip_field_guide.pdf

Invasive Plants in Pennsylvania

Norway Maple

Acer platanoides

Photo: Leslie Mehrhoff, U. of Connecticut, www.forestryimages.org

Background:

Norway maple was originally introduced into North America by John Bartram of Philadelphia, who received seedlings from London in 1756. Bartram began offering this plant to nurseries and Norway maple subsequently became a popular tree for city plantings. This species is naturalized throughout the state, but is more common in the southern half.

Range:

Norway maple is the most widespread maple in Europe where it occurs from Norway and Sweden to Turkey and northern Iran. Norway maples are widely planted in the U.S., from the Canadian border south to the Carolinas.

Description:

Norway maple is a large, deciduous tree with a broad, rounded crown. It can readily be distinguished from other maples because the leaves and twigs ooze milky sap when cut or torn; however, this may be difficult to detect late in the season. This species grows up to 65 feet in height with up to a seven foot trunk diameter. Norway maple leaves are dark green and are about six inches wide and five inches long, with five to seven lobes. The bark is smooth and gray-brown, twigs are stout, brown with green buds with over-lapping bud scales (*see photo on right*).

Photo: Paul Wray, Iowa State U., www.forestryimages.org

Habitat:

Norway maple is usually planted in urban and suburban settings but commonly invades deciduous forests adjacent to suburban areas.

Biology and Spread:

Norway maple reproduces by seed, which each tree produces in large amounts. The winged fruits are spread by the wind. The seeds germinate readily, even in dense shade, and grow quickly when young.

Photo: John Randall, The Nature Conservancy, www.forestryimages.com

Ecological Threat:

This species is a frequent invader of urban and suburban forests. Its extreme shade tolerance allows it to penetrate deep within an intact forest canopy. Recent research has shown that forests invaded by Norway maple have less wildflower diversity compared with forests dominated by native Sugar maple (*Acer saccharum*).

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How to Control this Species:

Manual and Mechanical

Norway maple seedlings are easy to pull when the soil is moist. For larger plants, dig them out, making sure to get all the roots. Cut down large trees and grind out the stump, or clip off re-growth. Girdle the tree by cutting through the bark and growing layer (cambium) all around the trunk. Girdling is most effective in spring.

Chemical

Norway maple can be controlled effectively by using an herbicide such as glyphosate or triclopyr. Trees up to four inches in diameter can be controlled by applying triclopyr mixed with a horticultural oil to the bark, a foot from the base of the trunk. This can be done in early spring or from June 1 to September 30. The cut stump method may also be used—cut the tree and immediately apply the herbicide around the outer ring of the stump.

Look-A-Likes:

Norway maple is similar to the native sugar maple. However, Norway maple can be readily distinguished from other maples because the leaves and twigs ooze milky sap when cut or torn. It is the only maple in our region with that characteristic.

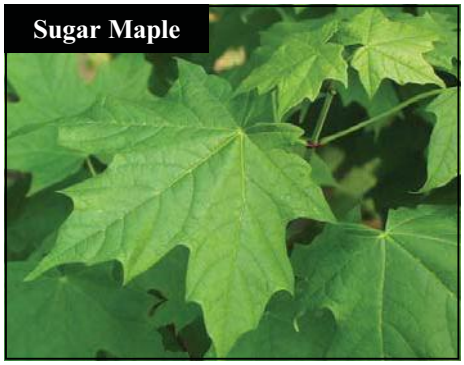


Photo: Paul Wray, Iowa State U., www.forestryimages.org

Native Alternatives:

There are many native trees that make great alternatives. Sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), American basswood (*Tilia americana*), red oak (*Quercus rubra*), white ash (*Fraxinus americana*) and tuliptree (*Liriodendron tulipifera*) are just a few examples.

Photo: Bill Cook, Michigan State U., www.forestryimages.org

References:

Center for Invasive Species and Ecosystem Health: http://www.invasive.org/browse/subinfo.cfm?sub=3002

U.S. Forest Service Weed of the Week: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/norway-maple.pdf

Invasive Exotic Plant Tutorial for Natural Lands Managers: http://www.dcnr.state.pa.us/forestry/invasivetutorial/norway_maple_M_C.htm

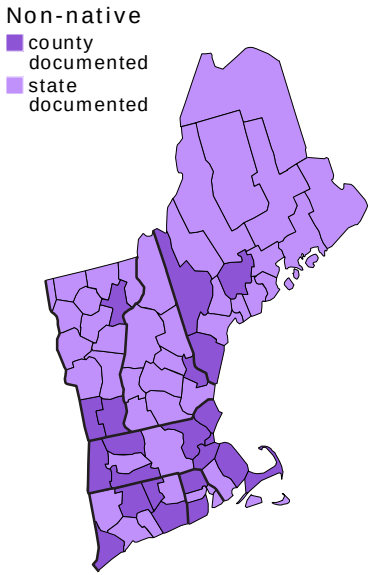
For More Information:

Plant Invaders of Mid-Atlantic Natural Areas: http://www.invasive.org/eastern/midatlantic/acpl.html

Invasive Plants Field and Reference Guide, U.S. Forest Service: http://na.fs.fed.us/pubs/misc/ip/ip_field_guide.pdf

New England Distribution

Adapted from BONAP data

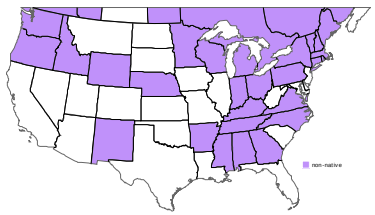


about the labels on this map

Found this plant? Take a photo and post a sighting.

North America Distribution

Adapted from BONAP data



Nasturtium microphyllum Boenn. ex Reichenb.

one-rowed water-cress

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Facts About

One-rowed water-cress, native to Europe, is introduced in much of the rest of the world, due to its popularity as a salad green. It is persistent in small bodies of water such as streams, ditches and seeps.

Habitat

Anthropogenic (man-made or disturbed habitats), riverine (in rivers or streams)

No enlarge

Sometimes Confused With

Nasturtium officinale

Rorippa aquatica

Family

Brassicaceae

Genus

Nasturtium

Need Help? GET HELP

Characteristics

Habitat	aquatic, wetlands
New England state	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont
Flower petal color	white
Leaf type	• the leaves are compound (made up of two or more discrete leaflets • the leaves are simple (lobed or unlobed but not separated into leaflets)
Leaf arrangement	alternate: there is one leaf per node along the stem
Leaf blade edges	• the edge of the leaf blade has teeth • the edge of the leaf blade is entire (has no teeth or lobes)
Flower symmetry	there are two or more ways to evenly divide the flower (the flower is radially symmetrical)
Number of sepals, petals or tepals	there are four petals, sepals, or tepals in the flower
Fruit type (general)	the fruit is dry and splits open when ripe

Show All Characteristics

Wetland Status

Occurs only in wetlands. (Wetland indicator code: OBL)

New England Distribution and Conservation Status

Distribution

Connecticut	present, invasive, prohibited
Maine	present
Massachusetts	present
New Hampshire	present
Rhode Island	present
Vermont	present

Conservation Status

None

Information from Dichotomous Key of Flora Novae Angliae

1. *Nasturtium microphyllum* Boenn. *ex* Reichenb. E

one-rowed water-cress. *Nasturtium officinale* Ait. f. var. *microphyllum* (Boenn. *ex* Reichenb.) Thellung; *Rorippa microphylla* (Boenn. *ex* Reichenb.) Hyl. *ex* A. & D. Löve • CT, MA, ME, NH, RI, VT. Streams, ditches, outlets.

1×2. *Nasturtium microphyllum* × *Nasturtium officinale* → *Nasturtium* ×*sterile* (Airy-Shaw) Oefel. is a rare water-cress hybrid in New England known from CT, NH. It is recognized by its sterile siliques, which do not produce well-formed seeds.

The Go Botany project is supported in part by the National Science Foundation.
www.nsf.gov

Invasive Plants in Pennsylvania

Oriental Bittersweet

Celastrus orbiculatus Thunb.

Photo: Jessica Sprajcar, DCNR

Background:

Also known as round-leaved and Asiatic bittersweet, this vine was introduced from China into the U.S. around 1860 as an ornamental.

Range:

Oriental bittersweet can be found throughout New England and the Mid-Atlantic states, down to Louisiana and up through the Midwest as far north as Wisconsin. It is not known to occur further west than that.

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Description:

Oriental bittersweet is a deciduous, climbing, woody vine that can grow up to 60 feet in length. Vines can grow up to four inches in diameter. The alternate, elliptical leaves are light green in color, finely toothed and two to five inches in length. Fruits are round and yellow, splitting to reveal bright red berries through the fall and winter months.

Photo: Leslie Mehrhoff, U. of Connecticut, www.invasive.org

Habitat:

Commonly found on old home sites, in fields and forest edges, and along roadsides and train tracks. While it prefers open, sunny sites it can tolerate shade.

Biology and Spread:

Birds and other wildlife readily consume the large number of berries, spreading seeds far and wide. Humans also spread the seed through the use of bittersweet vines and berries for craft projects. The plant also spreads vegetatively through rhizomes and root suckers.

Ecological Threat:

This vine is able to girdle and kill trees or break their branches off from the weight of the vines. When it grows into the canopy it can shade out natives. Oriental bittersweet has also been shown to hybridize with the American bittersweet, leading to a loss of genetic identity.

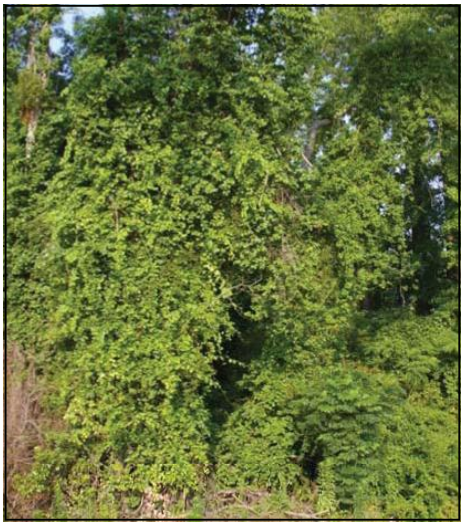

Photo: Nancy Loewenstein, Auburn U., www.invasive.org

How to Control this Species:

Manual and Mechanical

Because the seeds of bittersweet are so numerous and can remain viable in the soil for several years, all control efforts will require multiple years to be effective.

Small populations, especially of vines not high up in canopy, can be pulled by hand or dug out prior to fruiting. If fruits are present, all material should be bagged and disposed of.

Vines in trees can be cut close to the ground. The vines will re-sprout, however, unless and herbicide is immediately applied to the cut stump.

Weekly mowing will prevent the vines from fruiting, but less frequent mowing will promote root sprouts.

Chemical

Because Oriental bittersweet looks so much like the native American bittersweet, be absolutely sure you have properly identified the species before doing any control work.

Systemic herbicides like glyphosate and triclopyr can successfully manage bittersweet. It is most effective when stems are cut or mowed and the herbicide is applied to the cut area immediately.

For cut stump applications, a two percent solution of glyphosate and water can be applied as long as the air temperature is above 40 degrees F. A 25 percent solution of triclopyr and water can be applied when the air temperature is above 60 degrees F.

For foliar application, a two percent solution of glyphosate or triclopyr and water, plus a 0.5 percent non-ionic surfactant, can be sprayed on the leaves when the air temperature is above 65 degrees F.

References:

Center for Invasive Species and Ecosystem Health:
http://www.invasive.org/browse/subinfo.cfm?sub=3012

Invasive Exotic Plant Tutorial for Natural Lands Managers:
http://www.dcnr.state.pa.us/forestry/invasivetutorial/Oriental_bittersweet.htm

For More Information:

Plant Invaders of Mid-Atlantic Natural Areas, National Park Service:
http://www.nps.gov/plants/alien/pubs/midatlantic/midatlantic.pdf

Invasive Plants Field and Reference Guide, U.S. Forest Service:
http://na.fs.fed.us/pubs/misc/ip/ip_field_guide.pdf

Look-A-Likes:

Oriental bittersweet closely resembles the native American bittersweet (*Celastrus scandens*), but American bittersweet has flowers and fruits at the ends of its branches, rather than in the axils of the leaves, like the Oriental variety.

Photo: Chris Evans, River to River CWMA, www.forestryimages.org

Ornamental Jewelweed (*Impatiens glandulifera*)

A plant profile for this species can be found at the United States Department of Agriculture website at the following link:

http://plants.usda.gov/core/profile?symbol=IMGL

Invasive Plants in Pennsylvania

Pale and Black Swallow-worts

Cynanchum louiseae and *C. rossicum* (previously *Vincetoxicum spps.*)

Photo: Leslie Mehrhoff, www.invasive.org

Background:

Swallow-worts were likely introduced for ornamental purposes into New York, Massachusetts and Illinois. Records of occurrences include Pennsylvania in 1927. Indications of naturalized populations include records of collections from roadsides and natural areas in New York State in the 1800s and 1900s.

Range:

Originally from Europe and Eurasia, it is now established in CT, IN, MA, MI, MO, NH, NJ, NY, PA and WI.

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Description:

Black and pale swallow-worts are perennial, twining herbaceous vines, three to six feet high. The leaves are opposite, oval shaped with pointed tips. Pale swallow-wort leaves are 2.5 to 4.5 inches long and the flowers are star shaped with reddish colored petals each twice as long as wide, born in clusters. Black swallow-wort has darker green leaves three to four inches long, dark purple flowers with the five pointed petals nearly triangular, about as long as wide. Plants tend to grow in clumps of several to many stems, forming extensive patches.

Habitat:

Swallow-worts prefer lime-stone based soils, are drought tolerant and will thrive in a wide range of soil, moisture and light conditions, with the exception of extremely wet soils. Populations growing under dense wooded canopy may have inadequate resources to produce flowers or seeds. Swallow-wort dies back to the ground every winter. Its root crown fragments support dormant buds that readily sprout if not destroyed.

Biology and Spread:

The fruits are slender tapered pods, often paired, two to three inches long by about ¼ inch wide, that turn from green to light brown as they mature. When ripe, the fruits open along a seam and release flattened seeds equipped with a downy parachute that aids in wind dispersal (*see photo on right*). In contrast to its invasive relative the black swallow-wort (*C. louiseae*), pale swallow-wort does not have rhizomes.


Photo: Leslie Merhoff

Ecological Threat:

Related to milkweeds, swallow-worts are extremely toxic to livestock and monarch butterfly larvae, which are sometimes fooled into laying their eggs on this plant. Pale swallow-wort can form extensive patches that crowd out native plant species and have various impacts on native wildlife. In some instances, old-field habitats occupied by goldenrods and grasses are replaced almost exclusively by swallow-wort, disrupting natural succession and completely altering the physical structure of those habitats.

How to Control this Species:

To prevent seed dispersal, mechanical removal of the pods must be completed before they open. Hand pulling roots is labor intensive and rarely successful since the stem base is brittle.

Herbicides should be applied when plants are actively growing, after flowering has begun. DO NOT SPRAY TOO SOON. Avoid the temptation to spray the plants as soon as they emerge in May.

Only when the plants flower will they be large enough to receive enough spray on the exposed leaf surface to deliver a killing dose to the roots. Plants sprayed before pods form will probably not produce a viable seed crop that season.

Systemic herbicides do not cause a "burn down" of plants like contact herbicides do. Within one to two weeks the plants will look sick. There may be dead tissue spots on most leaves, with many yellowing leaves.

Do not waste herbicide, money or effort by spraying plants twice. Sick plants cannot effectively absorb the herbicide through the leaf surface or move the herbicide to the roots. Swallow-wort control may take a few years and it is important not to use more herbicide than is necessary.

Photo: Leslie Mehrhoff, www.invasive.org

Look-A-Likes:

There are many native species of *Cynanchum*, including honeyvine (*Cynanchum laeve*) which occurs throughout the eastern U.S. and could be confused with pale swallow-wort. Honeyvine has white flowers, and its leaves have a distinct heart-shaped base.

Photo: Leslie Merhoff, www.invsive.org

References:

DiTommaso, A., Lawlor, F. M. and Darbyshire, S. J. 2005. The Biology of Invasive Alien Plants in Canada

Cynanchum rossicum (Kleopow) Borhidi [= *Vincetoxicum rossicum* (Kleopow) Barbar.] and *Cynanchum louiseae* (L.) Kartesz & Gandhi [= *Vincetoxicum nigrum* (L.) Moench]. Can. J. Plant Sci. 85: 243–263

Swearingen, J. 2009. WeedUS Database of Plants Invading Natural Areas in the United States: Pale Swallow-wort (*Cynanchum rossicum*) http://www.invasive.org/weedus/subject.html?sub=4260

Weeds Gone Wild: Alien Plant Invaders of Natural Areas: www.nps.gov/plants/alien

Invasive Plants in Pennsylvania

Parrot Feather Watermilfoil

Myriophyllum aquaticum

John M. Randall, TNC
www.forestryimages.com

Description:

This species can be found floating on the surface or submerged. Both submersed and emergent leaves are whorled and finely pinnate with 10 to 18 segments on either side.

Biology and Spread:

This species spreads vegetatively either from whole plants or portions of plants. These fragments can be dispersed by people or often by animals.

Graves Lovell, AL DCNR

Background:

This species was introduced to the U.S. first in the Washington, D.C. area in the 1890s as an aquarium and aquatic landscaping plant, and has since spread to much of the U.S.

Ecological Threat:

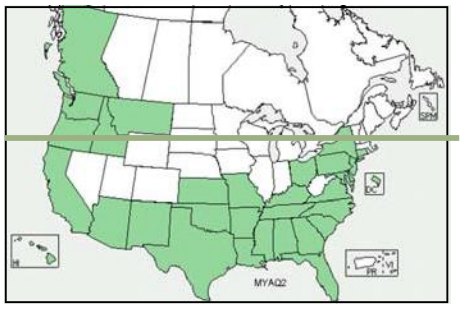
As with many aquatic invasives, *M. aquaticum* can form dense mats which makes recreational use difficult. In addition, these dense mats often out compete and limit native aquatic plant populations.

Range:

Originally native to South America, this species can now be found along both the Atlantic and Pacific coasts as well as across the southwest and southeast U.S. (*see map on right*). In Pennsylvania, it is known to exist in southeast counties as well as Lackawanna, Bedford and Adams counties.

Habitat:

This species prefers slow-moving, freshwater habitats including ponds, lakes and canals. It prefers open, high-nutrient aquatic systems.



Map courtesy of USDA PLANTS Database

Richard Old
www.forestryimages.com

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How to Control this Species:

Manual or mechanical control is not recommended for this species due to its ability to spread vegetatively. Any cutting or mowing can result in the spread of fragments that can establish new populations.

Similarly, herbicides have limited effectiveness due to a waxy cuticle that protects this species against most chemicals. Extreme care must be taken in applying herbicides to aquatic habitats. Be sure to use herbicides that readily break down in water and are not harmful to other aquatic plants or animals.

Some research suggests draining ponds or small water bodies can provide some control.

Currently, biological control agents for *M. aquaticum* are still being researched, including flea beetles, weevils and fungal control options.

See http://www.ecy.wa.gov/programs/wq/plants/weeds/aqua003.html for more information.

Native Alternatives:

American lotus
(*Nelumbo lutea*)

Graves Lovell, Alabama DCNR
www.forestryimages.com

Pond weed
(*Potamogeton nodosus*)

Hermann Falkner,
www.freeimagefinder.com

Look-A-Likes:

Another non-native, invasive plant looks very similar: *Myriophyllum spicatum* (Eurasian water-milfoil). This species does not have lobed leaves occurring below the flowers.

Alison Fox, University of Florida
www.invasive.org

References:

USDA PLANTS Database:
http://plants.usda.gov/java/profile?symbol=MYAQ2

Center for Invasive Species:
http://www.invasive.org/browse/subinfo.cfm?sub=3054

Plant Invaders of Mid-Atlantic Natural Areas: http://www.nps.gov/plants/alien/pubs/midatlantic/myaq.htm

Rhoads, A.F. & Block, T.A. 2007. *The Plants of Pennsylvania: An Illustrated Manual*. 2nd ed. University of Pennsylvania Press: Philadelphia, PA.

For More Information:

To learn more about invasive species in Pennsylvania, check out the following site:

DCNR Invasive Species Site: http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

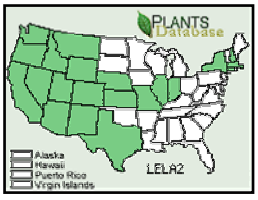
Perennial Pepperweed *Lepidium latifolium* L.

Common Names: tall whitetop, giant whiteweed, perennial peppergrass, slender perennial peppercress, broadleaf or broadleaved pepperweed, ironweed and other names

Native Origin: southeastern Europe and southwestern Asia

Description: A herbaceous perennial in the Mustard family (Brassicaceae). Plants are multiple stemmed and grow in stiffly erect masses 3 to 8 feet tall. Leaves are lanceolate, bright green to gray green, and entire or toothed. Basal leaves are stalked, up to 1 foot long and 3 inches wide and have serrate margins. Leaf size decreases up the stem. Flowering occurs from early summer to fall. Abundant small white 4-petaled flowers are borne in dense clusters near the stem tips. The fruits are small, flattened pods about 1/10th inch long, each containing 2 seeds (1 per chamber). Fruits remain on the plant, dropping irregularly throughout the winter. The base of the stem is semi-woody. The creeping roots enlarge at the soil line, forming a woody crown. The plant mainly propagates clonally from its brittle rhizome-like roots that grow to a length of up to 6 feet.

Habitat: Perennial pepperweed occurs in riparian (stream) areas, coastal wetlands, marshes, roadsides, railways, ditches, hay meadows, pastures, cropland, and waste places.



Distribution: It occurs in a few states along the eastern seaboard, in several Midwestern states, and in all far western states. Infestations have been reported in coastal, intermountain and mountainous areas in New England, all the states west of the Rocky Mountains. It also occurs in Canada and Mexico.

Ecological Impacts: Perennial pepperweed a highly invasive plant that alters the ecosystem it grows in. It can invade a wide range of habitats including riparian areas, wetlands, marshes, and floodplains. It adapts readily to natural and disturbed wetlands. It may occur as spotty, scattered populations, or as large, dense, nearly monospecific stands. These dense stands have potential to displace native plants and animals, threatened and endangered species, decrease plant diversity, and reduce nesting frequency of waterfowl in or near wetlands.

Control and Management: Deep-seated rootstocks make pepperweed difficult to control.

- Manual- Physical and mechanical control methods such as mowing and disking are unlikely to control perennial pepperweed because new plants quickly regenerate from roots and root crowns. Very small patches can be controlled by hand removal if the process is repeated often for several years and plants are not allowed to mature.
- Chemical- Foliar application methods have been effective (Telar®- a selective herbicide or a glyphosate such as Roundup® - nonselective herbicide)

Natural Enemies- Several general herbivorous insects are feed on perennial pepperweed (e.g. *Lygus* spp) and a white rust *(Albugo sp.)* infects large numbers of flowers and limits seed production, but do not prevent the clonal expansion of the creeping root system.

References: www.fs.fed.us/database/feis/plants/forb/leplat/all.html, http://plants.usda.gov
www.nps.gov/plants/alien/fact/lela1.htm,
ELEMENT STEWARDSHIP ABSTRACT-http://tncweeds.ucdavis.edu/esadocs/documnts/lepilat.html

Produced by the USDA Forest Service, Forest Health Staff, Newtown Square, PA. WOW 08-14-05
Invasive Plants website: http://www.na.fs.fed.us/fhp/invasive_plants

Callitriche stagnalis Scop.

pond water-starwort

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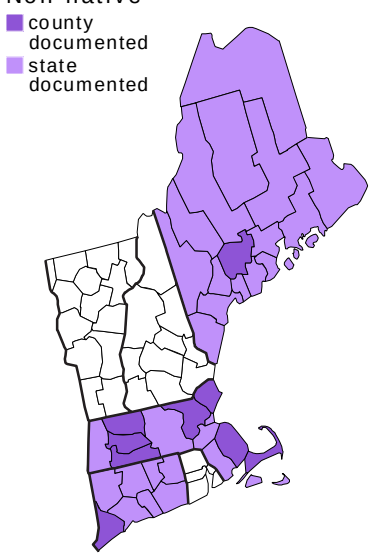
New England Distribution

Adapted from BONAP data

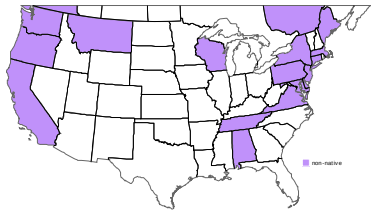


about the labels on this map

Found this plant? Take a photo and post a sighting.

North America Distribution

Adapted from BONAP data



Facts About

Pond water-starwort, a widespread old-world species, entered North America at seaports in New York, New Jersey and Oregon, and was well-established on the east coast by 1920. It has since spread about 500 miles from these entry points, and enters New England in Connecticut, Massachusetts and Maine. Water starworts (Callitriche) are remarkable for having flowers able to be pollinated by wind when emergent (anemophily), by water when floating at the surface (epihydrophily), as well as when submerged (hypohydrophily).

Habitat

No enlarge

Sometimes Confused With

Callitriche palustris

Callitriche hermaphroditica

Family

Plantaginaceae

Genus

Callitriche

Need Help? GET HELP

Brackish or salt marshes and flats, lacustrine (in lakes or ponds), riverine (in rivers or streams)

Characteristics

Habitat	aquatic
New England state	Connecticut, Massachusetts
Leaf position	• some of the leaves are floating at the surface of the water • the leaves are all submerged underwater
Leaf arrangement	opposite: there are two leaves per node along the stem
Leaf blade length	Up to 20 mm
Petal or sepal number	NA
Petal color	NA
Specific leaf type	the leaf is not divided, rather the blade is made up of one segment
Floating leaf shape	the leaf blade is obovate (egg-shaped, but with the widest point above the middle of the leaf blade)
Fruit type (general)	the fruit is dry but does not split open when ripe

Show All Characteristics

Wetland Status

Occurs only in wetlands. (Wetland indicator code: OBL)

New England Distribution and Conservation Status

Distribution

Connecticut	present, invasive, prohibited
Maine	present
Massachusetts	present
New Hampshire	absent
Rhode Island	absent
Vermont	absent

Conservation Status

Exact status definitions can vary from state to state. For details, please check with your state.

Massachusetts unranked (S-rank: SNR)

Information from Dichotomous Key of Flora Novae Angliae

4. *Callitriche stagnalis* Scop. E

pond water-starwort. CT, MA, ME. Shallow water of lakes and brackish-tidal rivers. Philbrick et al. (1998) have documented the spread of *C. stagnalis* in the United States.

New England Wild Flower Society
180 Hemenway Road, Framingham, MA 01701

The Go Botany project is supported in part by the National Science Foundation.
www.nsf.gov

Fact Sheet: Porcelain-berry

Porcelain-berry

Ampelopsis brevipedunculata (Maxim.) Trautv.
Grape family (Vitaceae)

NATIVE RANGE

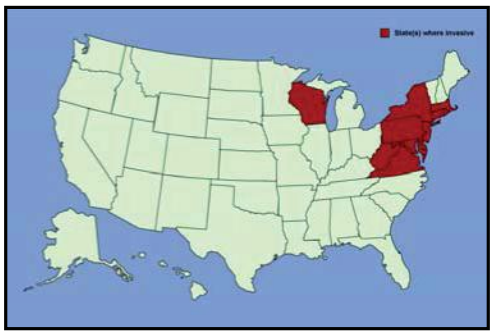
Northeast Asia - China, Korea, Japan, and Russian Far East

DESCRIPTION

Porcelain-berry is a deciduous, woody, perennial vine. It twines with the help of non-adhesive tendrils that occur opposite the leaves and closely resembles native grapes in the genus Vitis. The stem pith of porcelain-berry is white (grape is brown) and continuous across the nodes (grape is not), the bark has lenticels (grape does not), and the bark does not peel (grape bark peels or shreds). The leaves are alternate, broadly ovate with a heart-shaped base, palmately 3-5 lobed or more deeply dissected, and have coarsely toothed margins. The inconspicuous, greenish-white flowers with "free" petals occur in cymes opposite the leaves from June through August (in contrast to grape species that have flowers with petals that touch at tips and occur in panicles. The fruits appear in September-October and are colorful, changing from pale lilac, to green, to a bright blue. Porcelain-berry is often confused with species of grape (Vitis) and may be confused with several native species of Ampelopsis -- *Ampelopsis arborea* and *Ampelopsis cordata*.

ECOLOGICAL THREAT

Porcelain-berry is a vigorous invader of open and wooded habitats. It grows and spreads quickly in areas with high to moderate light. As it spreads, it climbs over shrubs and other vegetation, shading out native plants and consuming habitat.



DISTRIBUTION IN THE UNITED STATES

Porcelain-berry is found from New England to North Carolina and west to Michigan (USDA Plants) and is reported to be invasive in twelve states in the Northeast: Connecticut, Delaware, Massachusetts, Maryland, New Jersey, New York, Pennsylvania, Rhode Island, Virginia, Washington D.C., West Virginia, and Wisconsin.

HABITAT IN THE UNITED STATES

Porcelain-berry grows well in most soils, especially forest edges, pond margins, stream banks, thickets, and waste places, where there is full sunlight to partial shade, and where it is not permanently wet. Porcelain-berry appears to be less tolerant of heavily shaded areas, such as that found in mature forest interiors.

BACKGROUND

Porcelain-berry was originally cultivated around the 1870s as a bedding and landscape plant. In spite of its aggressiveness in some areas, it is still used in the horticultural trade (for example, the ornamental *A. brevipedunculata* 'Elegans' is often recommended as a landscape plant with a cautionary note that "care must be taken to keep it from overtaking and shading out small plants"). The same characteristics that make porcelain-berry a desirable plant for the garden -- its colorful berries, good ground coverage, trellis-climbing vines, pest-resistance, and tolerance of adverse conditions -- are responsible for its presence in the United States as an undesirable invader.

BIOLOGY & SPREAD

Porcelain-berry spreads by seed and through vegetative means. The colorful fruits, each with two to four seeds, attract birds and other small animals that eat the berries and disperse the seeds in their droppings. The seeds of porcelain-berry

germinate readily to start new infestations. Porcelain-berry is often found growing in riparian areas downstream from established patches, suggesting they may be dispersed by water also. The taproot of porcelain-berry is large and vigorous. Resprouting will occur in response to cutting of above-ground portions.

MANAGEMENT OPTIONS

Because porcelain-berry vines can grow up to 15 ft. in a single growing season, especially when rainfall is abundant, and seed may be viable in the soil for several years, effective control requires dedicated followup. Treatment measures often must be repeated during the growing season and for several years afterwards to fully eradicate the plant. Prevention of flowering, fruiting and production of mature seeds will help reduce its spread.

Manual

Hand pulling of vines in the fall or spring will prevent flower buds from forming the following season. Where feasible, plants should be pulled up by hand before fruiting to prevent the production and dispersal of seeds. If the plants are pulled while in fruit, the fruits should be bagged and disposed of in a landfill. For vines too large to pull out, cut them near the ground and either treat cut stems with systemic herbicide or repeat cutting of regrowth as needed.

Chemical

Chemical control in combination with manual and mechanical methods is effective and likely to be necessary for large infestations. The systemic herbicides triclopyr (e.g., Garlon® 3A and Garlon® 4) and glyphosate (e.g., Roundup® and Rodeo®) have been used successfully by many practitioners.

Foliar applications

The most effective control has been achieved using triclopyr formulations. From summer to fall, apply a water-based solution of 2.5% Garlon® 3A (triclopyr amine) to foliage or cut plants first, allow time for regrowth and then apply the mixture. Smaller infestations can be controlled to some extent with spot applications of glyphosate to leaves, used sparingly to avoid contact of desirable plants with spray. Cut the vines back during the summer and allow to resprout before applying herbicide, or apply glyphosate to leaves in early autumn, just prior to senescence.

Basal bark applications

Apply a mixture of 20-30% Garlon® 4 (triclopyr ester) mixed with commercially available basal oil, horticultural oil, diesel fuel, No. 1 or No. 2 fuel oil, or kerosene, to 2 - 3 ft. long sections of stem near the base of the vines.

USE PESTICIDES WISELY: Always read the entire pesticide label carefully, follow all mixing and application instructions and wear all recommended personal protective gear and clothing. Contact your state department of agriculture for any additional pesticide use requirements, restrictions or recommendations.

NOTICE: mention of pesticide products on this page does not constitute endorsement of any material.

CONTACT

For more information on the management of Porcelainberry, please contact:

- Lisa Jameson, National Park Service, National Capital Region, Exotic Plant Management Team, Washington, DC, 20007; Lisa_Jameson at nps.gov
- Susan Salmons, National Park Service, Rock Creek Park, Washington, DC; Sue_Salmons at nps.gov; 202-426-6834, ext. 33
- Jil Swearingen, National Park Service, Center for Urban Ecology, Washington, DC; Jil_Swearingen at nps.gov

SUGGESTED ALTERNATIVE PLANTS

Many lovely non-invasive vines are available. Some native substitutes to consider include trumpet honeysuckle (*Lonicera sempervirens*), trumpet creeper (*Campsis radicans*), American wisteria (*Wisteria frutescens*)*, Virginia creeper (*Parthenocissus quinquefolia*), and goldflame honeysuckle (*Lonicera heckrottii*). In the southeast, several species of

native Ampelopsis occur and should be considered if the habitat is appropriate. Please consult the native plant society in your state for more suggestions and information on sources of native plants.

*NOTE: If you wish to plant wisteria, make certain that it is the native species. Two commonly planted ornamental wisterias, Chinese wisteria (*Wisteria sinensis*) and Japanese wisteria (*Wisteria floribunda*), are exotic and aggressive invaders.

OTHER LINKS

- http://www.invasive.org/search/action.cfm?q=Ampelopsis%20brevipedunculata
- http://nbii-nin.ciesin.columbia.edu/ipane/icat/browse.do?specieId=38

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PHOTOGRAPHS

Jil M. Swearingen, National Park Service, Washington, DC

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USDA, NRCS. 2009. The PLANTS Database (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Virginia Native Plant Society. Invasive Alien Plant Species of Virginia: Porcelain-berry (*Ampelopsis brevipedunculata* (Maxim.) Trautv.).

Invasive Plants in Pennsylvania

Privets

(Japanese, Border, Chinese and Common)

Ligustrum japonicum, L. obtusifolium, L. sinense and *L. vulgare*

Photo: Troy Evans, www.bugwood.org

Background:

These four species of privets were originally imported for use in landscaping around 1860. They are still often used in hedges and landscaping.

Range:

The various privets are originally from Japan, China and Europe. They have spread through the eastern United States, from New Hampshire and Michigan in the north to Florida and Texas in the south.

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Description:

Privets are deciduous or semi-evergreen shrubs that often form dense thickets. They have opposite or whorled stems that are brown to gray with slightly rough bark. Privets produce white flowers from April to June, which are followed by green drupes from July to March. These fruit gradually ripen to a dark purple or black color in the winter. It is often difficult to differentiate between the four privets to the species level, particularly when they are not flowering.

Photo: Rebekah Wallace, U. of Georgia, www.invasive.org

Habitat:

Privets are often found in bottom-land forests, fence-rows, fields and rights-of-way. They seem to prefer disturbed areas with rich soil.

Biology and Spread:

Privets mainly spread to new areas via their seeds. Often-times, these are distributed by birds, which have eaten the fruit. Once introduced to an area, privet can regenerate from root and stump sprouts, making it difficult to eradicate.

Ecological Threat:

Privets can form dense thickets, which reduce light and moisture availability for native shrubs and wild-flowers. This decreases plant diversity and impacts the animals which depend on them for food and shelter.

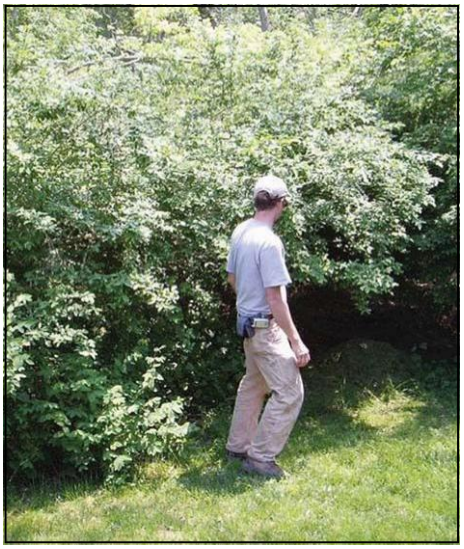

Photo: Leslie Mehrhoff, U. of Connecticut, www.invasive.org

How to Control this Species:

Once established in an area, privet can be difficult to control or remove.

With smaller populations, hand removal can be used. However, fragments of root that are left behind in the ground can re-sprout.

Larger areas can also be treated with herbicides such as glyphosate. Herbicide can be applied to the leaves, or painted on cut stems or stumps. Once the herbicide is applied, disturbances to the privet should be avoided for approximately one year, in order for the herbicide to travel through the privet's root systems.

No biological controls are currently known for privet. Studies show that controlled burning does not appear to have a lasting effect on privet populations, so it is not recommended as a control option.

Look-A-Likes:

There are a large variety of shrub-sized, berry-producing, deciduous alternatives to privets for landscaping purposes. These include species such as spicebush (*Lindera benzoin*), dogwoods (*Cornus* spp.) and chokeberry (*Aronia* spp.). These species will all provide food and cover for wildlife.

Photo: Jessica Sprajcar, DCNR

Photo: Chris Vans, River to River CWMA, www.forestryimages.org

Photo: Richard Webb, www.forestryimages.org

References:

USDA Plant Guide:
http://plants.usda.gov/plantguide/pdf/pg_lisi.pdf

University of Connecticut Plant Database:
http://www.hort.uconn.edu/plants/index.htm

Center for Invasive Species and Ecosystem Health: www.invasive.org

For More Information:

Plant Invaders of Mid-Atlantic Natural Areas, National Park Service:
http://www.nps.gov/plants/alien/pubs/midatlantic/midatlantic.pdf

Invasive Plants Field and Reference Guide, U.S. Forest Service:
http://na.fs.fed.us/pubs/misc/ip/ip_field_guide.pdf

Invasive Plants in Pennsylvania

Purple Loosestrife

Lythrum salicaria

Richard Old, XID Services, Inc.
www.forestryimages.org

Background:

Purple loosestrife was intentionally introduced into North America in the early 1800s as an ornamental, as well as accidentally by way of discarded ship ballast. It is now banned as a noxious weed in most states.

Range:

Native to Eurasia, purple loosestrife can now be found throughout much of the United States, especially in the northern and western regions.

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Description:

Purple loosestrife is a perennial herb with square, woody stems, which may grow anywhere from four to 10 feet high, depending on conditions. Its lance-shaped leaves occur in opposite or whorled arrangements. Magenta-colored flower spikes are present throughout much of the summer.

Eric Coombs, Oregon Dept. of Ag.
www.forestryimages.org

Habitat:

Purple loosestrife prefers open wetlands, and is capable of invading freshwater wet meadows, tidal and non-tidal marshes, river and stream banks, pond edges, reservoirs and ditches. It is a hardy plant that can tolerate a range of soil pH, as well as drought.

Biology and Spread:

With an extended flowering season, from June to September, and an unusually high number of flowering stems, each purple loosestrife plant is capable of producing two to three million seeds per year. Research has shown that cultivars, advertised as sterile, are capable of producing viable seed. This plant can also reproduce vegetatively by underground stems at a rate of one foot per year.

Ecological Threat:

An enthusiastic invader of wetlands, purple loosestrife outcompetes native plants, including some federally endangered orchids, forming dense homogeneous stands. These monocultures reduce habitat for waterfowl, clog waterways, disrupt nutrient cycling and collect debris, eventually displacing the entire wetland.

Agriculture and Agri-Food Canada
www.forestryimages.org

How to Control this Species:

Prevention

Early detection and prevention are the best approaches to managing purple loosestrife. Monitoring watersheds yearly to identify new infestations is critical, and can be most easily conducted in late July and August when the plant is in full bloom.

Clean seed and plant parts from animals, equipment and clothing before entering wetland areas.

Prevent nearby infestations from going to seed. Use native competitors as barriers.

Physical

Hand-pulling is only effective for seedlings with small roots.

Mowing is not recommended, but may reduce the production of seeds.

Flooding kills seedlings; established plants must be inundated for weeks. Unfortunately, this also kills desirable vegetation.

The site may need to be replanted with native, competitive vegetation.

Chemical

Glyphosate is effective against purple loosestrife. Be sure to use an herbicide permitted for wetland use. Herbicides can be applied directly to cut stems to reduce collateral damage.

Biocontrol

Although they will not eradicate purple loosestrife, biocontrols can reduce the severity of an infestation. Four species of beetles from Europe, which are fairly host-specific on purple loosestrife, are currently available for control efforts.

Look-A-Likes:

From a distance, purple loosestrife may resemble some native flowering plants, such as blazing star (*Liatris* sp.) and obedient plant (*Physostegia virginiana*). These also make great native garden alternatives.

John D. Byrd, Mississippi State University
www.forestryimages.org

References:

Center for Invasive Species and Ecosystem Health:
http://www.invasive.org/browse/subinfo.cfm?sub=3047

Plant Conservation Alliance's Alien Plant Working Group:
http://www.nps.gov/plants/alien/fact/lysa1.htm

University of Nevada Cooperative Extension:
http://www.unce.unr.edu/publications/files/nr/2002/

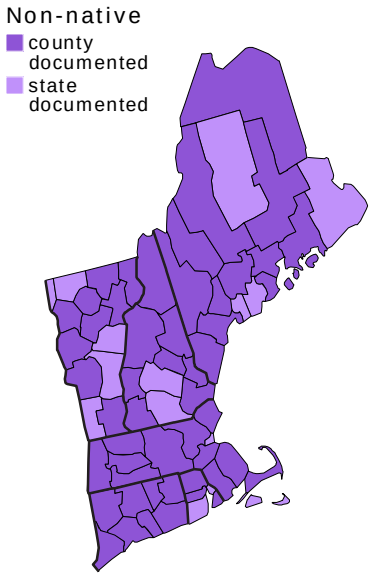
For More Information:

DCNR Invasive Species Site: http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

DCNR Invasive Exotic Plant Tutorial for Natural Lands Managers:
http://www.dcnr.state.pa.us/forestry/invasivetutorial/Purple_loosestrife.htm

New England Distribution

Adapted from BONAP data



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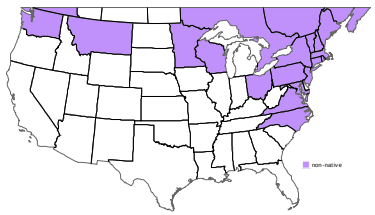
Adapted from BONAP data



Lychnis flos-cuculi L.

ragged robin lychnis

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Facts About

Ragged robin lychnis was introduced from Europe into New England most likely by planting in gardens. However, it was also reported from ships ballast in 1880, a common method of unintentional introduction. While not a major invasive species in New England, it is reported to have increased in recent years and can form large monospecific patches.

No enlarge

Synonyms

Coronaria flos-cuculi (L.) A. Braun

Silene flos-cuculi (L.) Clairville

Family

Caryophyllaceae

Genus

Lychnis

Notes on Subspecies and Varieties in New England

Our subspecies is *Lychnis flos-cuculi* L. ssp. *flos-cuculi.*

Need Help? GET HELP

Habitat

Anthropogenic (man-made or disturbed habitats), floodplain (river or stream floodplains), meadows and fields

Characteristics

Habitat	terrestrial, wetlands
New England state	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont
Flower petal color	• pink to red • white
Leaf type	the leaves are simple (lobed or unlobed but not separated into leaflets)
Leaf arrangement	opposite: there are two leaves per node along the stem
Leaf blade edges	the edge of the leaf blade is entire (has no teeth or lobes)
Flower symmetry	there are two or more ways to evenly divide the flower (the flower is radially symmetrical)
Number of sepals, petals or tepals	there are five petals, sepals, or tepals in the flower
Fusion of sepals and petals	the petals or the sepals are fused into a cup or tube
Stamen number	10
Fruit type (general)	the fruit is dry and splits open when ripe
Fruit length	6–10 mm

Show All Characteristics

Wetland Status

Usually occurs in non-wetlands, but occasionally in wetlands. (Wetland indicator code: FACU)

New England Distribution and Conservation Status

Distribution

Connecticut	present, prohibited
Maine	present
Massachusetts	present

New Hampshire	present
Rhode Island	present
Vermont	present

Conservation Status

Exact status definitions can vary from state to state. For details, please check with your state.

Massachusetts unranked (S-rank: SNR)

Information from Dichotomous Key of Flora Novae Angliae

3. *Lychnis flos-cuculi* L. ssp. *flos-cuculi* E

ragged robin lychnis. *Coronaria flos-cuculi* (L.) A. Braun; *Silene flos-cuculi* (L.) Clairville • CT, MA, ME, NH, RI, VT. Low fields and pastures, ditches, riverside meadows.

New England Wild Flower Society
180 Hemenway Road, Framingham, MA 01701

The Go Botany project is supported in part by the National Science Foundation.
www.nsf.gov

Invasive Plants in Pennsylvania

Reed Canary Grass

Phalaris arundinacea

Leslie J. Mehrhoff, U. Connecticut
www.forestryimages.org

Background:

Both Eurasian and native ecotypes of reed canary grass are thought to exist in the United States. Invasive populations may be descendants of non-native cultivars or ecotypes, although this is not clear. Aggressive strains have been planted throughout the United States since the 1800s for forage and erosion control.

John M. Randall, The Nature Conservancy www.forestryimages.org

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www.dcnr.state.pa.us

Description:

Reed canary grass is large and coarse, reaching up to nine feet in height. Its flat, blue-green leaves are roughly textured. In June and July, large flower plumes are produced, which are green with a purplish tinge, eventually becoming light tan in color. The stems do not remain standing though the winter.

John M. Randall, The Nature Conservancy www.forestryimages.org

Habitat:

Reed canary grass can be found growing in most types of wetlands, including marshes, alluvial meadows, stream and river banks, shores and ditches. This plant does best in fertile, moist, organic soils in full sun. It has been known to occasionally grow in dry soils in partial shade in upland habitats.

Range:

This wetland grass is native to temperate regions of Europe, Asia and North America. Non-native strains have become naturalized throughout much of the northern half of the United States, and are still being planted on steep slopes and created wetlands.

Biology and Spread:

Although it produces few viable seeds, which are wind, water, animal and machine-dispersed, reed canary grass manages to colonize new sites quite easily. Once established in a wetland, it spreads aggressively by way of rhizomes.

Ecological Threat:

Reed canary grass forms large, monotypic stands that harbor few other plant species and are little use to most native wildlife. It constricts waterways by promoting silt deposition, yet may also encourage erosion of soil beneath its dense mats in places where water flows rapidly. Overtime, it builds up a tremendous seed bank that will erupt when sites are treated for this invasive.

How to Control this Species:

Physical

Small patches may be effectively dug up or hand pulled. They may also be covered by black plastic for at least one growing season. Be watchful of rhizomes spreading beyond the edge of the plastic.

Mowing twice yearly (early to mid-June and early October) can help control dense stands.

Disrupting the roots every two to three weeks weakens established plants and depletes the seed bank.

Chemical

In small populations, glyphosate can be applied directly to cut stems to avoid collateral damage to native plants nearby.

Herbicide is best applied in early spring when most native species are dormant.

Before applying herbicide, remove dead leaves from the previous year to maximize growing shoot exposure. Use a formulation of glyphosate designed for wetlands.

Native Alternatives:

Many native grasses and monocots are available for wetland restoration.

Dave Powell, USDA Forest Service
www.forestryimages.org

James H. Miller & Ted Bodner, SWSS
www.forestryimages.org

Look-A-Likes:

Reed canary grass could be confused with many grasses, including the non-native orchard grass (*Dactylis glomerata*) and native bluejoint grass (*Calamagrostis canadensis*).

Dave Powell, USDA Forest Service
www.forestryimages.org

References:

Center for Invasive Species and Ecosystem Health:
http://www.invasive.org/browse/subinfo.cfm?sub=6170

Global Invasive Species Database:
http://www.issg.org/database/species/ecology.asp?si=394

Wisconsin Department of Natural Resources:
http://dnr.wi.gov/invasives/fact/reed_canary.htm

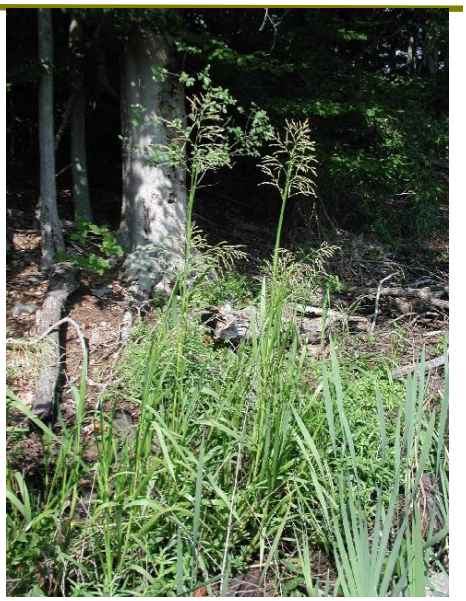
For More Information:

DCNR Invasive Species Site: http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

DCNR Invasive Exotic Plant Tutorial for Natural Lands Managers:
http://www.dcnr.state.pa.us/forestry/invasivetutorial/reed_canary_grass.htm

Reed Mannagrass

Glyceria maxima (Hartman) Holmb.



Common Names: reed mannagrass, tall mannagrass, reed sweetgrass, great mannagrass, sweet mannagrass, English water grass

Native Origin: Europe and Asia

Description: A perennial, rhizomatous grass in the grass family (*Poaceae*) that grows from un-branched stems that can reach 8.25 feet in height. Leaf sheaths have prominent midribs, visible transverse veins, and are closed to near the top. The leaf sheaths are rough in texture and have a reddish-brown band at the junction with the leaf. The un-lobed, membranous ligules are smooth and obtuse in shape. Leaf blades are flat, 8-12 inches long and 0.75 inches wide. The leaf blades are shallowly grooved with prominent midribs. The leaf margins have short, stiff hairs that are rough to the touch. The plants are bisexual. Flowers appear from June to August. At maturity, the inflorescence is an open panicle that rises above the subtending foliage. The small dark brown seeds are 0.07 inches long, smooth in texture, and egg-shaped with a deep narrow central furrow. It reproduces and spreads primarily by means of rhizomes. The foraging activities of muskrats and beavers may cause uprooted plants or cut rhizomes to disperse and re-establish along stream courses.

Habitat: It grows best in sunny, wetland habitats, but can tolerate the partial shade of adjacent wooded wetlands. It thrives during prolonged periods of flooding, and can develop mat-like root systems suspended in water.

Distribution: This species is reported from states shaded on Plants Database map. It is banned in Massachusetts. Connecticut reports it to be potentially invasive and banned. It also occurs in Canada.

Ecological Impacts: It has the ability to form large, dense mono-specific stands that are capable of crowding out native wetland vegetation. It can reduce plant species diversity. Being a poor food source and a poor nesting substrate for wetland wildlife, it has a potential to negatively affect wetland habitat dynamics. Dense stands may restrict access to waterways, impede water flow, cause flooding, and accelerate silt build up.

Control and Management:

- Manual- Manual removal works best with small plants. Dig up, removing all pieces of the root to prevent re-sprouting; use black plastic on smaller stands, use plastic gallon milk jugs, filled with water from a nearby source, to hold the plastic down. Black plastic works best during the heat of summer, in the absence of standing water. Let the plastic work for at least 5 or 6 weeks. Since this plant grows in water during much of the growing season, cutting is often ineffective.
- Chemical- It can be effectively controlled using any of several readily available general use herbicides such as glyphosate in summer. Follow label and state requirements.

References: http://plants.usda.gov, http://tncweeds.ucdavis.edu/alert/alrtglyc.html, Invasive Plant Atlas of New England- http://webapps.lib.uconn.edu/ipane/browsing.cfm?descriptionid=54, www.dpiwe.tas.gov.au/inter.nsf/WebPages/RPIO-4ZV7D8?open, www.botany.wisc.edu/wisflora/scripts/detail.asp?SpCode=GLYMAX

Invasive Plants in Pennsylvania

Russian and Autumn Olive

Elaeagnus angustifolia and *E. umbellata*

James H. Miller, USDA Forest Service
www.forestryimages.org

Background:

Both Russian and autumn olive were introduced into the United States in the 1800s. Prized for their silvery foliage, hardiness and plentiful berries, these shrubs were planted as ornamentals, for erosion control and wind-breaks, and in wildlife food plots.

Range:

Russian olive, native to Eurasia, can be found scattered throughout the eastern U.S. and is a problem further west. Native to east Asia, autumn olive has naturalized extensively throughout the eastern half of the United States. Autumn olive is the more common of the two species in Pennsylvania.

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Description:

Russian and autumn olive are large, multi-stemmed shrubs that can reach upwards of 20 feet in height. Their most distinctive characteristic is a dusting of silvery scales covering young stems, leaves, flowers and fruit. Small yellow or white flowers become edible fruits in late summer and fall, which are red in autumn olive and orange in Russian olive.

Leslie J. Mehrhoff, U. of Connecticut
www.forestryimages.org

Habitat:

Both species are found along streams, fields, roadsides, sparse woodlands, disturbed sites and open areas. Russian olive does particularly well in sandy floodplains. Neither species does well in densely forested areas.

Biology and Spread:

Both species are spread by birds and other wildlife that feed on the fruit. These shrubs grow rapidly and are able to produce fruit as early as three years of age.

Ecological Threat:

These shrubs are highly competitive against native species, shading out shorter plants. Their nitrogen-fixing capabilities may adversely affect the nitrogen cycle of native communities that depend on infertile soils. Although Russian and autumn olive provide a plentiful source of berries for birds, their fruits are actually quite low in nutrients. Ecologists have found that bird species richness is higher in riparian areas dominated by native vegetation.

Leslie J. Mehrhoff, U. of Connecticut
www.forestryimages.org

How to Control this Species:

Physical

Young seedlings can be pulled by hand when the soil is moist enough to ensure complete removal of the root system.

Small saplings can be pulled sufficiently with a weed wrench. Larger individuals can be cut at ground level or girdled.

Cutting is an initial control measure and should be followed by herbicidal treatment to prevent re-sprouting.

Chemical

Use a systemic herbicide, such as glyphosate or triclopyr.

Herbicide should be applied immediately to cut stumps to prevent regeneration. It can also be applied to girdle wounds or directly to the lower bark using the basal bark method.

Large thickets, where risk to non-target species is minimal, can be controlled by the foliar spray method.

Look-A-Likes:

Russian and autumn olive may be confused with invasive bush-honeysuckles (*Lonicera* spp.) or native deciduous hollies (*Ilex* spp.)

The Dow Gardens Archive
www.forestryimages.org

Native Alternatives:

Many native shrubs are available for re-vegetation projects. Native plants are the best option for wildlife food plots.

Jerry A. Payne, USDA ARS
www.forestryimages.org

The Dow Gardens Archive
www.forestryimages.org

References:

Global Invasive Species Database: http://www.issg.org/database/species/ecology.asp?fr=1&si=262

Plant Conservation Alliance's Alien Plant Working Group: http://www.nps.gov/plants/alien/fact/elan1.htm

For More Information:

DCNR Invasive Species Site: http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

DCNR Invasive Exotic Plant Tutorial for Natural Lands Managers: http://www.dcnr.state.pa.us/forestry/invasivetutorial/russian_autumn_olive.htm

Scotch thistle
Onopordum acanthium L.

BUGWOOD Wiki Article

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Jump to: Resources | Selected Images | Maps | Invasive List Sources | Taxonomy | Other System Links | References

Overview

Appearance

Onopordum acanthium is an herbaceous biennial plant that can grow up to about 6.5 ft. (2 m) in height. The plant is coarse, many-spined and is highly branched. The stems of *O. acanthium* are winged. The whole plant is densely tomentose, giving it a bluish-white appearance.

Foliage

The leaves are oblong and prickly, being toothed or slightly lobed along the margins. The apex of the leaf is acute. The leaves are mostly sessile, with some of the lower leaves having petioles. The blades of the lower leaves can measure up to 1 ft. (30 cm) long. Since this plant is a biennial, only the basal rosette of leaves is present in the first year of its growth.

Flowers

The flower heads are purple and measure 1-2 in. (2.5-5 cm) in diameter. All of the bracts of the involucre are tipped with flat, pale, orange-colored spines. Flowering occurs from July to October.

Fruit

The seeds of this plant are 0.2 in. (4-5 mm) long. They are gray in color, and attached to a brown-colored pappus that can be two times as long as the seed.

Ecological Threat

O. acanthium is a major agricultural weed in western United States. With enough moisture, it can resprout from roots cut up during cultivation. This plant spreads easily because each plant can produce over 20,000 wind dispersed seeds. The seeds can also be dispersed by water or by being caught in the fur of animals.

Resources

- Invasive Plant Atlas of New England - University of Connecticut
- Weed of the Week - USDA Forest Service

- Weed Field Guide - USDA Forest Service

Image Sets

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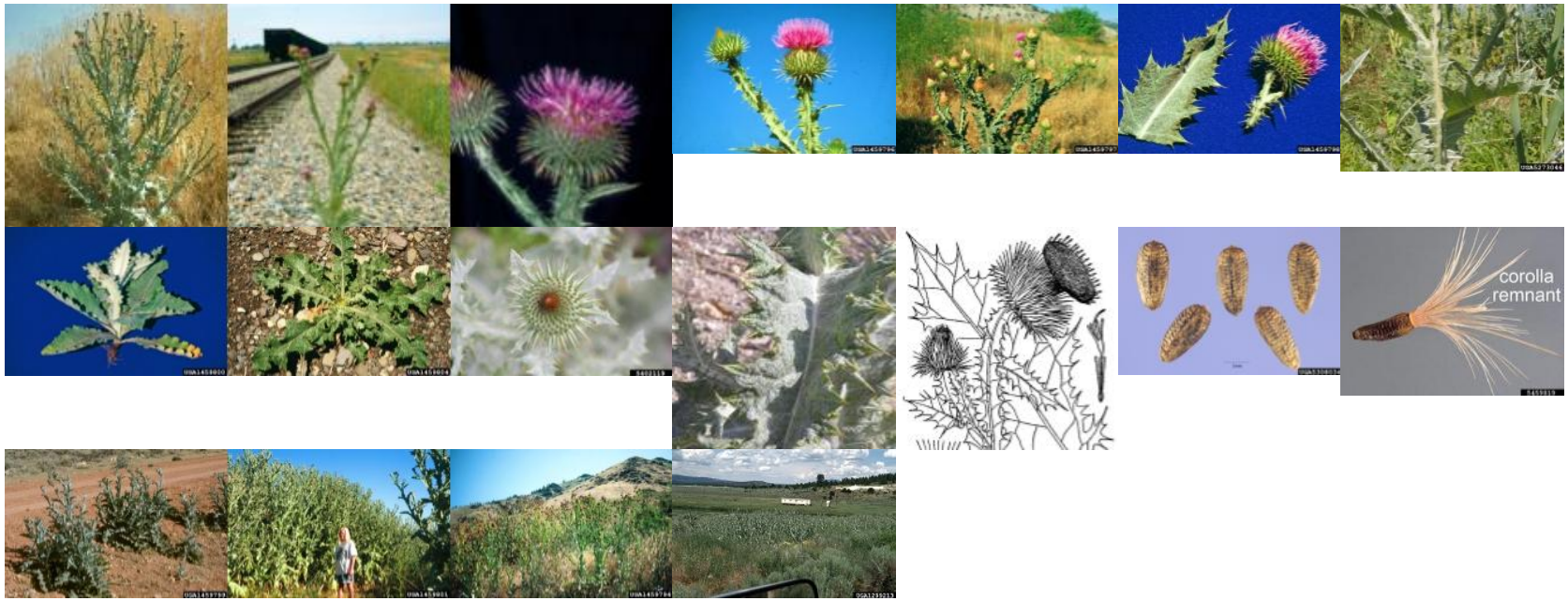
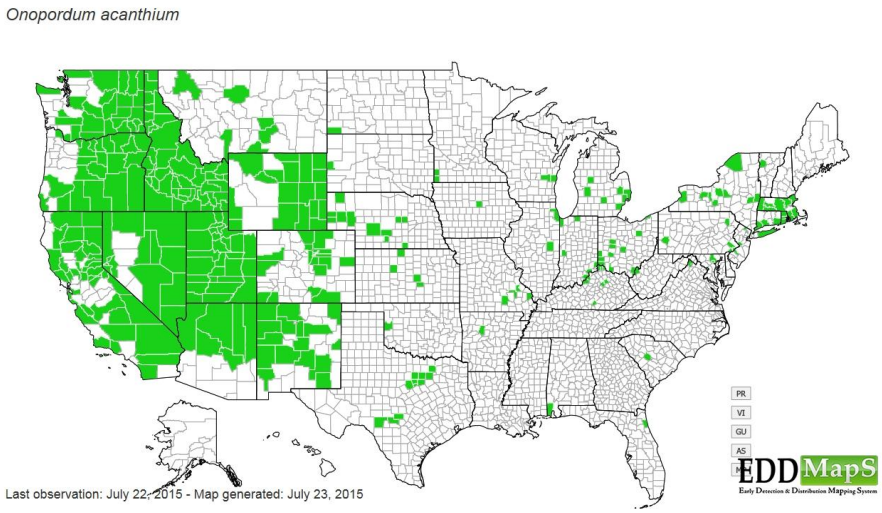
Selected Images for Scotch thistle (Onopordum acanthium) in WSSA WeedList

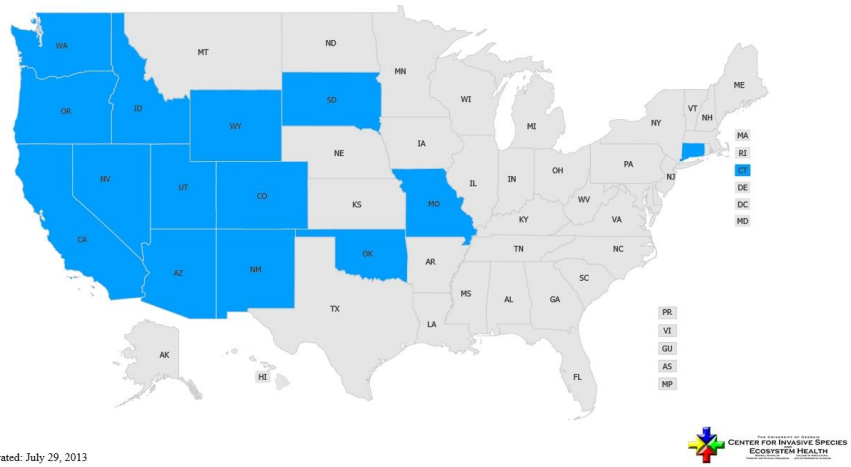


Maps

EDDMapS Distribution - This map is incomplete and is based only on current site and county level reports made by experts, herbaria, and literature. For more information, visit www.eddmaps.org



State Invasive List - This map identifies those states that list this species on their invasive species list. For more information, visit Invasive.org



Invasive Listing Sources

- Arizona Noxious Weeds
- California Invasive Plant Council
- California Noxious Weeds
- Connecticut Invasive Plant List
- Faith Campbell, 1998
- Great Lakes Early Detection Network
- Idaho Noxious Weeds
- Jil M. Swearingen, Survey of invasive plants occurring on National Park Service lands, 2000-2007
- John Randall, The Nature Conservancy, Survey of TNC Preserves, 1995.
- Missouri Department of Conservation,
- Missouri Noxious Weeds
- Nevada Noxious Weeds
- New Mexico Noxious Weeds
- Nonnative Invasive Species in Southern Forest and Grassland Ecosystems
- Oklahoma Noxious Weeds
- Oregon Noxious Weeds
- Pacific Northwest Exotic Pest Plant Council, 1998
- South Dakota Noxious Weeds
- Utah Noxious Weeds
- Washington Noxious Weeds

- WeedUS - Database of Plants Invading Natural Areas in the United States
- Wyoming Noxious Weeds

Taxonomic Rank

Kingdom: Plantae
Phylum: Magnoliophyta
Class: Magnoliopsida
Subclass: Asteridae
Order: Asterales
Family: Asteraceae
Genus: Onopordum

Other System Links

Plants: ONAC
Bayer: ONRAC
GRIN: 104466
ITIS: 38140
NPDN Pest: PBFCNBA
NPDN Host: 36437

Synonyms and Other Names

Other Common Names:
Scottish thistle, cotton thistle, heraldic thistle, Scotch cottonthistle

Related Scientific Names:

Onopordum acanthium ssp. acanthium L. **(*Synonym*)**

Categories

Category: Forbs/Herbs

References

Common Name Reference: Weed Science Society of America Common Names List

Scientific Name Reference: USDA, NRCS. 2010. The PLANTS Database. National Plant Data Center, Baton Rouge, LA, USA.

Invasive.org is a joint project of the Center for Invasive Species and Ecosystem Health and USDA APHIS PPQ, with additional support from USDA National Institute of Food and Agriculture and USDA Forest Service.
The University of Georgia - Warnell School of Forestry and Natural Resources and College of Agricultural and Environmental Sciences

Last updated on Tuesday, May 04, 2010 at 02:41 PM

Invasive Plants in Pennsylvania

Shrub Honeysuckles

(Amur, Morrow's, Bells, Standish, and Tartarian)

Lonicera maackii, L. morrowii, L. x bella, L. standishii, and *L. tatarica*

Chuck Bargeron, University of Georgia, www.bugwood.org

Background:

Shrub or bush honeysuckles were introduced to North America for use in landscaping, erosion control and wildlife cover. Unfortunately, these plants then spread throughout much of the country.

Range:

The nonnative bush honeysuckles are native to eastern Asia, Europe and Japan. Currently, they can be found in a variety of habitats from the Great Plains to southern New England, and south to Tennessee.

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Description:

Nonnative bush honeysuckles grow to heights of six to 20 feet. Their stems are thornless with a hollow brown pith. Their leaves are opposite and egg-shaped. Their flowers, which bloom from May to June, are fragrant, tubular and less than an inch long. They range in color from white to yellow to pink to red. The berries are small and red or yellow.

Leslie J. Merhoff, University of Connecticut, www.bugwood.org

Habitat:

Nonnative bush honeysuckles are relatively shade-intolerant, and often occur in disturbed woods or edges, roadsides and abandoned fields where more light is available. Morrow's and Bell's honeysuckles are capable of invading bogs, fens, lakeshores and sandplains.

Biology and Spread:

Nonnative bush honeysuckles produce large numbers of small fruits, particularly when growing in open sunlight. These are eaten by birds, which then spread the seeds in their droppings. Once a population establishes, vegetative sprouting continues the spread of these plants.

Ecological Threat:

These invasive species compete with native plants for sunlight, moisture and pollinators. And while birds eat the fruit, it is poorer in fats and nutrients than fruits from native plants, so the birds do not get enough nutrients to help sustain long flights during migrations.

Leslie J. Merhoff, University of Connecticut, www.bugwood.org

How to Control this Species:

The two main methods of controlling nonnative bush honeysuckles are mechanical and chemical. Smaller populations can be removed by hand, making sure to include the roots. Larger populations should be cut to ground level at least once per year, in either early spring or late fall.

Glyphosate can be sprayed onto the leaves, or could also be applied to cut stems in order to kill the root system.

No biological controls are known that would target solely nonnative bush honeysuckle species. In open areas, prescribed fire may help to eradicate this species. In order to optimize this approach, however, the burn should be conducted prior to late summer in order to prevent seed dispersal.

Look-A-Likes:

Native bush honeysuckles exist throughout North America. The natives generally have solid stems, as opposed to the hollow pith of the invasive ones. Be very cautious when buying so-called "native" honeysuckles from a nursery or online.

Native Alternatives:

There are a large variety of shrub-sized, berry-producing, deciduous alternatives for landscaping purposes. These include species such as spicebush (*Lindera benzoin*), dogwoods (*Cornus* spp.) and chokeberry (*Aronia* spp.). These species will all provide food and cover for wildlife.

Photo: Jessica Sprajcar, DCNR

Photo: Chris Vans, River to River CWMA, www.forestryimages.org

Photo: Richard Webb, www.forestryimages.org

References:

Invasive Exotic Plant Tutorial for Natural Lands Managers: http://www.dcnr.state.pa.us/forestry/invasivetutorial/bush_honeysuckles.htm

University of Wisconsin, Invasive Plants of Wisconsin: http://www.uwgb.edu/biodiversity/herbarium/invasive_species/lonxbe01.htm

Plant Conservation Alliance's Least Wanted List: http://www.nps.gov/plants/alien/fact/loni1.htm

University of Connecticut Plant Database: http://www.hort.uconn.edu/plants/index.html

Robert W. Freckmannn Herbarium: http://wisplants.uwsp.edu/scripts/detail.asp?SpCode=LONTAT

Slender Snakecotton (*Froelichia gracilis*)

A plant profile for this species can be found at the United States Department of Agriculture website at the following link:

http://plants.usda.gov/core/profile?symbol=FRGR3

Invasive Plants in Pennsylvania

Small Carpetgrass

Arthraxon hispidus

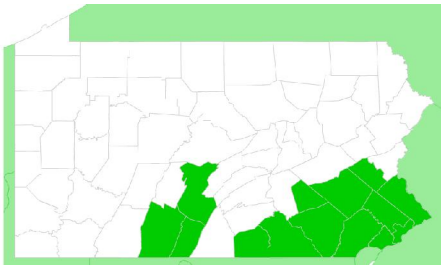
Photo: Leslie Mehrhoff, U. of Connecticut, www.invasive.org

Background:

Also known as joint-head grass, this annual grass was introduced into the U.S. from Japan and eastern Asia. Earliest reports of the plant come from the early 1970s.

Range:

It can be found throughout the eastern half of the U.S. from New York to Florida, all the way to Kansas and Texas.



Map courtesy of www.eddmaps.org

Description:

This grass grows up to one and a half feet tall and has oval to lance-shaped leaves that are one to three inches in length with heart-shaped bases. The leaf margins have conspicuous hairs. Flowers are contained in one to several three-inch long spikes and bloom in early fall.

Photo: Leslie Mehrhoff, U. of Connecticut, www.invasive.org

Habitat:

This grass grows in wet areas such as stream banks, shorelines, flood plains and wet meadows. It prefers sunny, moist areas.

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Biology and Spread:

Small carpetgrass produces small, slender yellowish seeds that can be dispersed by flowing water.

Photo: Steve Hurst, USDA NRCS, www.invasive.org

Ecological Threat:

This grass can form dense stands, particularly along shorelines, threatening native vegetation. Small carpetgrass often occurs alongside another highly invasive annual grass species, Japanese stilt grass (*Microstegium vimineum*).

Photo: Leslie Mehrhoff, U. of Connecticut, www.invasive.org

How to Control this Species:

Manual

Small carpetgrass may be pulled or mowed before it produces seeds.

Chemical

It can be also effectively controlled using any of several readily available general-use herbicides approved for wetlands. Repeat applications may be necessary to reduce plant density. Be sure to follow the label and all state herbicide requirements.

Look-A-Likes:

Small carpetgrass looks similar to deertongue grass (Dicanthelium clandestinum). Deertongue grass is slightly larger, covered with stiff hairs and the leaves are typically longer and more lanceolate in shape.

Photo: John Cardina, OSU, www.forestryimages.org

Native Alternatives:

There are many drought-tolerant native warm season grasses, such as (1) big bluestem (*Andropogon gerardii*), (2) little bluestem (*Schizachyrium scoparium*), indiangrass (*Sorgastrum nutans*) and (3) switchgrass (*Panicum virgatum*).

Photo: Chris Evans, River to River CWMA, www.forestryimages.org

Photo: Howard Schwartz, Colorado State U., www.forestryimages.org

Photo: Howard Schwartz, Colorado State U., www.forestryimages.org

References:

Invasive Plant Atlas of New England: http://www.eddmaps.org/ipane/ipanespecies/grass/Arthraxon_hispidus.htm

Center for Invasive Species and Ecosystem Management: www.invasive.org

U.S. Forest Service Weed of the Week: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/jointhead-grass.pdf

For More Information:

DCNR Invasive Species Site: http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

US Forest Service Invasive Plant Field Guide: http://na.fs.fed.us/pubs/misc/ip/ip_field_guide.pdf

National Park Service Plant Invaders of Mid-Atlantic Natural Areas: http://www.nps.gov/plants/alien/pubs/midatlantic/midatlantic.pdf

Fact Sheet: Spotted Knapweed

Spotted Knapweed

Centaurea stoebe L. *ssp. micranthos* (Gugler) Hayek
Sunflower family (Asteraceae)

NATIVE RANGE

Central Europe, east to central Russia, Caucasia, and western Siberia

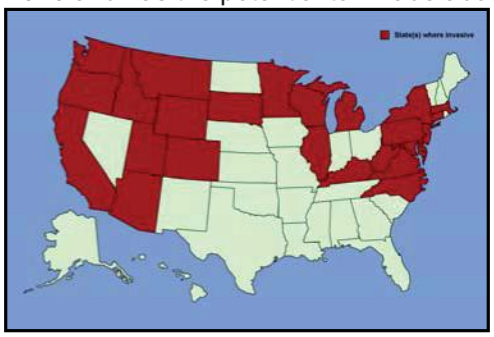
DESCRIPTION

Spotted knapweed, previously known as *Centaurea biebersteinii*, is a biennial or short-lived perennial. Its name is derived from the spots formed by black margins on the flower bract tips. Spotted knapweed typically forms a basal rosette of leaves in its first year and flowers in subsequent years. Rosette leaves are approximately 8 inches long by 2 inches wide, borne on short stalks, and deeply lobed once or twice on both sides of the center vein, with lobes oblong and wider toward the tip. The taproot is stout and deep. Flowering stems are erect, 8 to 50 inches tall, branched above the middle, and sparsely to densely hairy. Stem leaves alternate along the stem, are unstalked, and may be slightly lobed, or linear and unlobed. Leaf size decreases towards the tip of the stem.

Flowers are purple to pink, rarely white, with 25 to 35 flowers per head. Plants bloom from June to October, and flower heads usually remain on the plant. Flower heads are oblong or oval shaped, ¼ inch wide and ½ inch across, and are single or borne in clusters of two or three at the branch ends. Leaf like bracts surrounding the base of the flower head are oval and yellow green, becoming brown near the base. The margins of these bracts have a soft spine like fringe, with the center spine being shorter than the lateral spines. The brown, oval seeds are 1/16 to 1/8 inch long, with pale longitudinal lines and a short fringe on one end.

ECOLOGICAL THREAT

Spotted knapweed infests a variety of natural and semi-natural habitats including barrens, fields, forests, prairies, meadows, pastures, and rangelands. It outcompetes native plant species, reduces native plant and animal biodiversity, and decreases forage production for livestock and wildlife. Spotted knapweed may degrade soil and water resources by increasing erosion, surface runoff, and stream sedimentation. It has increased at an estimated rate of 27% per year since 1920 and has the potential to invade about half of all the rangeland (35 million acres) in Montana alone.



DISTRIBUTION IN THE UNITED STATES

Spotted knapweed is a widely distributed species reported to occur throughout Canada and in every state in the U.S. except Alaska, Georgia, Mississippi, Oklahoma and Texas. It has been designated as a noxious weed in Arizona, California, Colorado, Idaho, Minnesota, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming.

It has been identified as invasive in natural areas by eighteen organizations in twenty-six states (Arizona, California, Colorado, Connecticut, Delaware, Kentucky, Idaho, Illinois, Massachusetts, Maryland, Michigan, Minnesota, Montana, North Carolina, New Jersey, New York, Oregon, Pennsylvania, South Dakota, Tennessee, Utah, Virginia, Washington, Wisconsin, West Virginia, and Wyoming). Fifteen national parks also identify spotted knapweed as an invasive plant and a threat to natural habitats.

HABITAT IN THE UNITED STATES

Spotted knapweed is found at elevations up to and over 10,000 feet and in precipitation zones receiving 8 to 80 inches of rain annually. Spotted knapweed prefers well-drained, light-textured soils that receive summer rainfall, including open forests dominated by ponderosa pine and Douglas fir, and prairie habitats dominated by Idaho fescue, bluebunch

wheatgrass, and needle-and-thread grass. Disturbance allows for rapid establishment and spread; however, spotted knapweed is capable of invading well managed rangelands. Spotted knapweed does not compete well with vigorously growing grass in moist areas. In seasonally dry areas, spotted knapweed's taproot allows it to access water from deep in the soil, beyond the reach of more shallowly rooted species.

BACKGROUND

Spotted knapweed was introduced to North America from Eurasia as a contaminant in alfalfa and possibly clover seed, and through discarded soil used as ship ballast. It was first recorded in Victoria, British Columbia in 1883 and spread further in domestic alfalfa seeds and hay before it was recognized as a serious problem.

BIOLOGY & SPREAD

Spotted knapweed plants in North America generally live 3 to 7 years but can live up to nine years or longer. Plants regrow from buds on the root crown. Reproduction is by seed, and plants are capable of producing 500- 4,000 seeds per square foot per year. About 90% of the seeds are viable at the time of dispersal, and they can remain viable in the soil for 5-8 years. Most seeds are dispersed near the parent plant but can be transported by people, wildlife, livestock, vehicles, and in soil, crop seed, and contaminated hay. Gravel pits, soil stockpiles, powerlines, grain elevators, railroad and equipment yards are important seed distribution points.

MANAGEMENT OPTIONS

The most cost effective management strategy for spotted knapweed is to prevent its spread to non-infested areas. Spread by seed can be minimized by avoiding travel through infested areas; by cleaning footwear, clothing, backpacks, and other items after hiking through infested areas; by not grazing livestock when ripe seeds are present in the flower heads; and by using weed free hay.

Manual and Mechanical

Small infestations of spotted knapweed can be controlled by persistent hand-pulling done prior to seed set. Gloves should be worn because of the possibility of skin irritation. Because spotted knapweed can regrow from the base, care must be taken to remove the entire crown and taproot.

Biological

A variety of natural enemies are used as biological control agents for large infestations of spotted knapweed. Most biocontrol techniques use insect larvae to damage the root, stem, leaf, or flower. Two species of seed head flies, *Urophora affinis* and *U. quadrifasciata*, are well-established on spotted knapweed. The larvae of these species reduce seed production by as much as 50% by feeding on spotted knapweed seed heads and causing the plant to form galls. Three moth species (*Agapeta zoegana*, *Pelochrista medullana*, and *Pterolonche inspersa*) and a weevil (*Cyphocleonus achates*) that feed on spotted knapweed roots have also been released.

The collective stress on the plant caused by these insects reduces seed production and may lead to reduced competitiveness. Biological control agents may be more effective when combined with other control methods such as herbicides, grazing, and revegetation with desirable, competitive plants.

Chemical

Control of spotted knapweed infestations using three chemical herbicides (2,4-D, clopyralid, and picloram) has been reported but is problematic. Existing plants can be killed with 2,4-D but it needs to be reapplied yearly to control new plants germinating from seed stored in the soil. Picloram is a more persistent herbicide and has controlled knapweed for three to five years when applied at 0.25 lb/acre at any stage of plant growth; or with clopyralid (0.24 lb/acre) or clopyralid (0.2 lb/acre) plus 2,4-D (1 lb./acre) applied during bolt or bud growth stage. In the absence of desirable native grasses, longevity of control may be increased by revegetating with competitive grasses and forbs. Picloram may pose a risk of groundwater contamination where soils are permeable, particularly where the water table is shallow.

Other

Long-term grazing by sheep and goats has been found to control spotted knapweed. Burning, cultivation, and fertilization typically are not effective on spotted knapweed unless combined with other methods of control.

USE PESTICIDES WISELY: Always read the entire pesticide label carefully, follow all mixing and application instructions and wear all recommended personal protective gear and clothing. Contact your state department of agriculture for any additional pesticide use requirements, restrictions or recommendations.

NOTICE: mention of pesticide products on this page does not constitute endorsement of any material.

CONTACTS

For more information on the management of spotted knapweed, please contact:

- Michael Carpinelli, USDA-ARS, Burns, OR (541-573-8911, michael.carpinelli at oregonstate.edu)
- Steve Dewey's Weed Web (http://www.ext.usu.edu/ag/weeds/index.htm)
- Peter Rice, Montana Noxious Weed Trust (http://invader.dbs.umt.edu/)

OTHER LINKS

- http://www.invasive.org/species/subject.cfm?sub=3013
- http://nbii-nin.ciesin.columbia.edu/ipane/icat/browse.do?specieId=45

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Washington State Noxious Weed Control Board

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Invasive Plants in Pennsylvania

Star-of-Bethlehem

Ornithogalum nutans & O. umbellatum

Leslie J. Mehrhoff, U. of Connecticut
www.forestryimages.org

Background:

Star-of-Bethlehem, a name that refers to two commonly cultivated and similar species, was likely introduced into New England as a horticultural plant. The exact date of introduction is unknown.

Range:

O. nutans is native to Asia, while *O. umbellatum* ranges across Europe and North Africa. Both species can be found across much of the United States, with *O. umbellatum* being more common and wide-ranging.

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Description:

Both species are herbaceous plants that grow from bulbs and have narrow, linear, grass-like leaves formed into dense tufts. The leaves have a distinct white midrib and are often folded in *O. nutans*. The showy, white flowers exist in a spike-like raceme in *O. nutans*, and appear more umbel-like in *O. umbellatum*.

Dan Tenaglia
www.missouriplants.com

Habitat:

Star-of-Bethlehem prefers moist to wet habitats along the banks of rivers and streams, and in disturbed situations in early successional forests, forest edges, floodplain forests, wet meadows, yards and gardens.

Biology and Spread:

Star-of-Bethlehem spreads mainly through the dispersal of its bulbs, which can travel by water or careless gardener. Its ability to disperse by seed is currently unclear.

Ecological Threat:

This plant is a potential threat to native vegetation. It can form dense stands along the edges of rivers and streams, traveling rapidly downstream to new locations. Since it is still being used in horticulture, it will likely continue to spread beyond its current range. Star-of-Bethlehem is poisonous to livestock, as well as to curious children.

Mike Frey, The Presidio Trust
www.forestryimages.org

How to Control this Species:

Physical

Small infestations may be eliminated by digging up entire plants, being sure to remove and dispose of all bulb material. The bulbs may be extremely deep.

Chemical

Chemical control of star-of-Bethlehem is difficult since the plant is non-responsive to several herbicides and often regenerates following herbicide injury.

Mike Frey, The Presidio Trust
www.forestryimages.org

Native Alternatives:

Many delicate native wildflower alternatives to star-of-Bethlehem exist, such as rue anemone (*Thalictrum thalictroides*), bloodroot (*Sanguinaria canadensis*) and liverleaf (*Hepatica nobilis*).

Wendy VanDyk Evans
www.forestryimages.org

Look-A-Likes:

The flowers and leaves of star-of-Bethlehem look similar to some other spring-flowering herbaceous bulbous plants, such as our native spring beauty (*Claytonia virginica*).

Joseph O'Brien, USDA Forest Service
www.forestryimages.org

References:

University of Delaware Cooperative Extension: http://kentcoopextension.blogspot.com/2008/02/turf-and-landscape-star-of-bethlehem.html

USDA Forest Service: http://na.fs.fed.us/fhp/invasive_plants/weeds/star-of-bethlehem.pdf

For More Information:

DCNR Invasive Species Site: http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

DCNR Invasive Exotic Plant Tutorial for Natural Lands Managers: http://www.dcnr.state.pa.us/forestry/invasivetutorial/star_of_bethlehem.htm

Invasive Plants in Pennsylvania

Sycamore Maple

Acer pseudoplatanus L.

Photo: Gil Wojciech, Polish Forest Research Institute, www.invasive.org

Background:

Sycamore maple is native to Europe and western Asia. It was brought to New England and the Mid-Atlantic region in the 1870s for horticultural purposes, where it was used as a street and park tree.

Range:

This tree is found from Maine to Michigan and south to North Carolina.

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Description:

This deciduous tree can reach up to 100 feet in height. The bark has irregular scales and regularly flakes off. The three to six inch wide palmate leaves have a leathery texture that is unlike most maples. Leaves have five lobes and are dark green above and lighter green below. Leaf margins are coarsely toothed but do not have sharp tips.

Small, yellowish-green flowers appear in May. Fruits are roughly an inch long and have broad samaras (wings) that are at angles of 60 to 90 degrees from each other.

Biology and Spread:

The abundant winged seeds are spread by the wind.

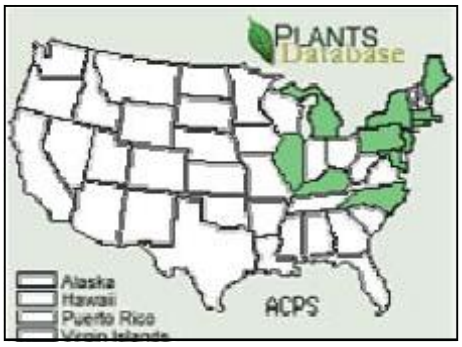

Image courtesy of USDA PLANTS database

Photo: Gil Wojciech, Polish Forest Research Institute, www.invasive.org

Habitat:

This tree grows well in disturbed sites like abandoned fields, roadsides, vacant lots and yards. It also frequently colonizes early successional forest edges. It is shade intolerant but tolerant of pollution, salt and soil extremes. It does very well in coastal habitats.

Ecological Threat:

Each tree can produce a large number of young, giving rise to dense stands of trees that may crowd out native species.

Photo: Leslie Mehrhoff, U. of Connecticut, IPANE

How to Control this Species:

Specific management information for this species is not available; however, control options for Norway maple may work for this species.

Manual and Mechanical

Seedlings are easy to pull when the soil is moist. For larger plants, dig them out, making sure to get all the roots. Cut down large trees and grind out the stump, or clip off re-growth. Girdle the tree by cutting through the bark and growing layer (cambium) all around the trunk. Girdling is most effective in spring.

Chemical

Invasive maples can be controlled effectively by using an herbicide such as glyphosate or triclopyr. Trees up to four inches in diameter can be controlled by applying triclopyr mixed with a horticultural oil to the bark, a foot from the base of the trunk. This can be done in early spring or from June 1 to September 30. The cut stump method may also be used—cut the tree and immediately apply herbicide around the outer ring of the stump.

Native Alternatives:

There are many native trees that make great alternatives. Sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), American basswood (*Tilia americana*), red oak (*Quercus rubra*), white ash (*Fraxinus americana*) and tuliptree (*Liriodendron tulipifera*) are just a few examples.

Photo: Bill Cook, Michigan State U., www.forestryimages.org

Look-A-Likes:

Sycamore maple resembles our native red maple (*Acer rubrum*) and sugar maple (*Acer saccharum*), along with the invasive Norway maple (*Acer platanoides* L.). The dark green, wavy leaves and flaking bark are the most distinct characteristics of sycamore maple.

Photo: Rob Routledge, Sault College, www.forestryimages.org

References:

Invasive Exotic Plant Tutorial for Natural Lands Managers: http://www.dcnr.state.pa.us/forestry/invasivetutorial/sycamore_maple.htm

U.S. Forest Service Weed of the Week: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/sycamore_maple.pdf

For More Information:

Plant Invaders of Mid-Atlantic Natural Areas: http://www.invasive.org/eastern/midatlantic/acpl.html

Invasive Plants Field and Reference Guide, U.S. Forest Service: http://na.fs.fed.us/pubs/misc/ip/ip_field_guide.pdf

Center for Invasive Species and Ecosystem Health: www.invasive.org

Senecio jacobaea (herb) 简体中文 正體中文

Taxonomic name: *Senecio jacobaea* L.
Synonyms: *Jacobaea vulgaris* Gaertn
Common names: erva-lanceta-do-Canadá (Portuguese-Brazil), jakobs-greiskraut (German), Jakobskruiskruid (Dutch), Landøyda (Norwegian), ragwort (English), séneçon Jacobée (Spanish), St. James'-wort (English), Starzec Jakubek (Polish), stinking willie (English), tansy ragwort (English-USA)
Organism type: herb

Senecio jacobaea is a highly invasive, noxious weed which is known to invade pastoral land. It has detrimental impacts on livestock, due its highly toxic alkaloid content.

Description
Senecio jacobaea is categorised as a biennial plant. However, several studies have found it to demonstrate annual and perennial properties depending on environmental factors (Wardle, 1987). In the first year of its biennial stage, *S. jacobaea* is in the rosette stage. It has dark green, basal leaves which are typically 5-20cm in length and 4-6cm in width with whitish, slightly hairy underside. The blunt toothed lobes of the leaves contribute to the ruffled appearance of the rosette. Seeds of outer (ray) florets are hairless and are normally 2mm long, while those from the inner (disc) florets have fine bristles up to 5mm in length. In the second year, flowering takes place with one or several stems, growing up to 1.2m. Leaves on the flowering stems are sessile, occurring in an alternating pattern. The flower head itself has a daisy-like appearance, consisting of disc florets as well as ray florets and is usually 2.5cm across in diameter. One of the more notable characteristics of the ray flowers is its 11-15 yellow petals, each being 5 – 10mm long. *S. jacobaea* has a fibrous taproot and is typically associated with a large rootstock (NWCB, 2008).

Similar Species
Senecio aquaticus, Senecio sylvaticus, Tanacetum vulgare
More

Occurs in:
agricultural areas, ruderal/disturbed

Habitat description
Senecio jacobaea invades disturbed sites including roadsides, pastures and forest clearings (Macdonal & Russo, 1989). Records show that the distribution of the species is unlikely to be affected by extreme weather, although some cases have noted that a decrease in its population may be correlated with dry summers (Harper and Wood, 1957). Additionally, *S. jacobaea* distribution may be influenced by soil moisture, but not by soil acidity or texture (Sharrow *et al*, 1988).

General impacts
In most introduced regions, *Senecio jacobaea* is considered to be an agricultural pest. It contains a highly potent pyrrolizidine alkaloid which is severely toxic to livestock, especially cattle and horses and to a lesser extent, sheep (Wardle, 1987). Also, *S. jacobaea* is known to invade disturbed native forests and woodlands, where it threatens biodiversity (DPI, 2007). Its high mortality rate after flowering leaves open bare patches on the pasture, allowing invasion of other noxious weeds which may further disrupt the ecological balance (DPIW, 2008).

Uses
The juice of the plant is cool and astringent and is traditionally used as a wash for burns, sores, cancerous ulcers and eye inflammations (Grieve, 1987). Additionally, green and yellow dyes can be made from the leaves and the flowers of the plant respectively.

Geographical range
Native range: *Senecio jacobaea* is native to Europe and western Asia, ranging from Norway to as far as Asia Minor, and from Great Britain to Siberia (Sharrow *et al*, 1988).
Known introduced range: The extensive European migration in the 1800s saw the introduction of *S. jacobaea* to a number of countries around the globe. These include USA, Canada, New Zealand, Australia, Argentina and South Africa (Sharrow *et al*, 1988).

Introduction pathways to new locations
Natural dispersal: It is reported that the dispersal pattern of *Senecio jacobaea* seeds is approximately elliptical, with the centre of the ellipse a few metres downwind from the source (Wardle, 1987).

Local dispersal methods
On animals: Birds may act as a dispersal vector, carrying *Senecio jacobaea* seeds on their feathers.
Water currents: Water currents may partly contribute to *Senecio jacobaea* dispersal as seeds are sometimes found on the lower stream beds (Wardle, 1987)

Management information
Management of *Senecio jacobaea* is tackled *via* an integrated approach, whereby a number of different preventative and control measures are used in conjunction with one another.

The Ragwort Control Guide outlines all the Do's and Don'ts of ragwort control, including all the control and management options. The Herbicides for Ragwort control page lists all the herbicides that can be used for ragwort control, including application methods and concentrations.

Preventative measures: A wide range of preventative measures can be utilised to control further spread of ragwort. For example, ensuring that seed for planting is not contaminated with the seeds of *S. jacobaea*; using thoroughly cleaned vehicles, machinery and equipment; quarantine of heavily infested areas and careful disposal of plant seeds or flowers (DPI, 2007).

Physical: The most commonly adopted method is handpulling or grubbing, with the primary objective being preventing the plant from producing seed. Due to the plant's regenerative properties, manual control must ensure that the entire crown and roots of the plants are removed. Cultivation of the soil should be carried out systematically to reduce regrowth. For example, the soil should be cultivated to a depth of at least 15cm in spring, with timed seasonal cropping programmes coupled with pasture improving regimes (DPI, 2007). Additionally, in Australia DPI (2007) suggests that afforestation with radiata pine or eucalyptus plantation can effectively suppress the spread of *S. jacobaea via* competition as well as acting as a windbreak and limiting seed dispersal (DPI, 2007).

Chemical: The best time for application is during the active growth phase of the plant, such that the pesticide is taken up by the crown and the root which is situated deep beneath the surface. A programme requires re-application and should primarily be targeted at the seedlings and rosettes during autumn and spring. It may be more effective to use herbicides that are selective for broadleaf weeds, so that other vegetation is left to compete with remaining ragwort. *S. jacobaea* can be chemically controlled *via* the use of 2,4-D and/or dicamba. In order for this method to be effective, the herbicides should be applied during certain developmental stages. For example, 2,4-D nets the best results when applied to seedlings and first year rosettes. A combination of 2,4-D and dicamba is shown to be successful just after the bolting phase (Macdonal & Russo, 1989).

Biological: Sheep appear to be less susceptible to the alkaloid toxicity and thus, heavy grazing can be an effective form of prevention, although it has been shown that even after extensive grazing, regrowth can rapidly occur after the removal of the stock. Thus animal grazing should be used as supplementary scheme only. In its native range, *S. jacobaea* has a number of natural predators, namely the cinnabar moth (*Tyria jacobaeae*), tansy ragwort seed fly (*Pegohylemyia seneciella*) and tansy ragwort flea beetle (*Longitarsus jacobaea*). The absence of these insects in the introduced range is thought to be directly responsible for its establishment in the respective regions. As a result, the introduction of these natural predators has shown to be an effective means of keeping the population of ragwort in balance (Macdonal & Russo, 1989).

Nutrition
Research indicates that *Senecio jacobaea* seeds requires light for germination, while maximum germination (92.5%) occurs during 15°C and 29% soil moisture content (Wardle, 1987).

Reproduction
Senecio jacobaea is known to be highly variable with regards to its reproductivity. For example, one study in Ruakura, New Zealand, showed that plants produced 1,000 to 2,500 capitula per season, with each capitulum containing 55 seeds. Whereas in the United Kingdom, *S. jacobaea* produced between 68 to 2,489 capitula per year and 70 seeds per capitulum (Wardle, 1987). Additionally, *S. jacobaea* is capable of reproducing vegetatively. The underlying mechanism is thought to be by basal branching, whereby the root connection with the parent plant decays, allowing each stem to form a new plant (Wardle, 1987).

Lifecycle stages
The production of the seed is typically followed by the death of the individual plant (Sharrow , 1988). The majority of the seeds germinate in autumn, though delayed germination in spring can occur (Harper and Wood, 1957). Under favourable conditions, ragwort seeds are capable of a lengthy dormancy period of up to 8 years. Even after this period, the seed viability remains considerably high, especially when it is buried at lower depths (Wardle, 1987). It is likely that *S. jacobaea* utilises at least two distinct strategies for germination. This follows from the fact that disc achenes demonstrated greater dispersal in space than ray achenes. In addition, the disc achenes were more successful in germination compared to ray achenes under the same conditions (Warlde, 1987).

Compiled by: IUCN/SSC Invasive Species Specialist Group (ISSG) with support from ASB Community Trust, New Zealand
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To contribute information, please contact Shyama Pagad.

Last Modified: Monday, 4 October 2010

Invasive Plants in Pennsylvania

Tree of Heaven

Ailanthus altissima

Photo: Jessica Sprajcar, DCNR

Background:

Also known as Chinese sumac, stinking sumac and tree of hell, this tree is native to China. It was brought to Philadelphia in 1784 by an amateur gardener. By 1840 it was commonly available from nurseries. Ailanthus is the subject of the well known book, "A Tree Grows in Brooklyn," by Betty Smith.

Range:

Tree of heaven is very common in the northeast and Midwest, through parts of the southeast, southwest and west coast.

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Description:

This rapidly growing tree can reach a height of 80 feet, with up to a six-foot diameter trunk. Leaves are pinnately compound with 10 to 41 leaflets with smooth leaf margins. When crushed, the leaves and other plant parts have a rancid smell like cat urine or burnt peanut butter.

Photo: Chuck Bargeron, U. Of Georgia, www.invasive.org

Flowering occurs in early summer, when large clusters of yellowish flowers develop above the leaves, Fruit produced on the female trees are tan to reddish, single winged, papery seeds, called samaras. They may remain on the tree throughout late fall.

Habitat:

Ailanthus is extremely tolerant of poor soils and will even grow through cracks in pavement. Trees are not shade tolerant. They will quickly colonize forest edges, fields and roadsides.

Biology and Spread:

Tree of heaven spreads by hundreds of thousands of seeds per tree and through vegetative sprouting. A cut or injured ailanthus tree may send up dozens of root suckers and resprouts, creating large clonal colonies.

Ecological Threat:

This tree produces chemicals in its roots that prevent the establishment of other plant species nearby. Its fast growth limits habitat for other species. Its root system may be extensive and has been known to cause damage to sewer lines and building foundations.

Photo: Leslie Mehrhoff, U. of Connecticut, www.invasive.org

Look-A-Likes:

The native trees most likely to be confused with ailanthus are the sumacs (*Rhus* spp.). One way to tell them apart is the small glands on the underside of ailanthus leaves (*see photo below*). Staghorn sumac leaves do not have this gland, but have toothed leaf margins, while ailanthus' leaf edges are smooth. Sumac fruits are fuzzy and red.

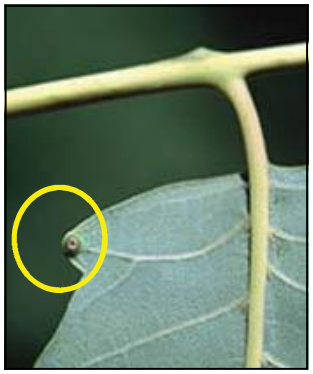


Photo: James Miller, USDA Forest Service, www.invasive.org

Young ailanthus may also be confused with black walnut (*Juglans nigra*) because of the compound leaves and shield-shaped leaf scars. However, the flowers, seeds and smell of ailanthus should give it away.

Photo: John Cardina, The Ohio State University, www.forestryimages.org

How to Control this Species:

Elimination of this species is difficult and time consuming, due to its abundant seed, high germination rate, and frequent root sprouts.

Manual and Mechanical

While young seedlings could be pulled or dug up, the chance of getting all root fragments is difficult and can lead to re-sprouts. Seedlings can be confused with root suckers, which would be nearly impossible to remove effectively by hand.

Cutting is not recommended, as the trees will send up large numbers of root sprouts and suckers, creating a bigger problem than before.

Chemical

The most effective way to treat ailanthus is with herbicides. Foliar application of triclopyr or glyphosate, mixed with water and a non-ionic surfactant, is effective on smaller trees when applied between June and late August.

For larger trees, application of triclopyr or glyphosate with the basal bark, hack and squirt, injection or cut stump method should work effectively. Application rates may vary—see the references below for more specific information.

Follow-up monitoring and treatment are very important. Regardless of the control method used, treated areas should be checked one or more times a year.

References:

Plant Conservation Alliance's Least Wanted List:
http://www.nps.gov/plants/alien/fact/aial1.htm

Center for Invasive Species and Ecosystem Health:
http://www.invasive.org/browse/subinfo.cfm?sub=3003

Virginia Cooperative Extension:
http://pubs.ext.vt.edu/420/420-322/420-322_pdf.pdf

For More Information:

Penn State University Vegetation Management Publications:
http://horticulture.psu.edu/research/labs/vegetative-management/publications

Twoleaf Watermilfoil (*Myriophyllum heterophyllum*)

A plant profile for this species can be found at the United States Department of Agriculture website at the following link:

http://plants.usda.gov/core/profile?symbol=MYHE2

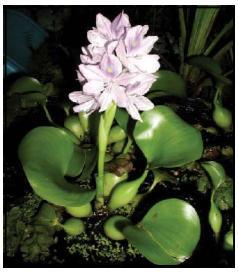
RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

FACT SHEET

Office of Water Resources December 2010

Freshwater Invasive Species in Rhode Island

Water Hyacinth



Purple flowers arise from the center stalk [1]

Thick, glossy leaves radiate from center of plant[2]

Inflated stems act as buoys enabling plants to float[3]

Inside of its thick stem looks like styrofoam[1]

Plant growth can quickly cover entire lakes[5]

Species Description and General Information

Water hyacinth (*Eichhornia crassipes*) is a large aquatic plant with thick, glossy, oval-shaped leaves. The plants freely float on the surface of the water and leaves can stand 1 to 3.5 feet up above the water. The curled leaves are 4-8 inches across and branch out from the center of the plant on modified stems. The enlarged stems are spongy, bulbous stalks called petioles that contain light, air-filled tissues that keep the plant afloat. When flowering, water hyacinth has a tall stalk in the center that supports several purple flowers with six petals each. Its long, feathery roots dangle in the water, hanging from the underside of the center and are dark purple or black with small, white root-hairs like a pipe cleaner. Water hyacinth reproduces by way of runners or stolons to form new daughter plants and also through seeds. When large quantities of its seeds are produced, they may be viable for up to 30 years. When not in bloom, water hyacinth may be mistaken for frog's-bit (*Limnobium spongia*), another glossy, floating invasive aquatic plant, but frog's bit does not have bulbous petioles like water hyacinth and its leaves generally lay flat on top of the water's surface.

Why is Water Hyacinth Considered an Invasive Species?

Water hyacinth is considered invasive throughout the world because it grows rapidly and can spread easily over vast expanses of water. It has been known to double its population within two weeks and infest large areas. After establishing in Africa's Lake Victoria in 1989, water hyacinth eventually grew to cover approximately 77 square miles of the water body!

Water hyacinth grows in mats and populations covering large areas can cause a variety of environmental and economic problems. Thick layers of water hyacinth on the surface shade out native aquatic plants below, and reduce nutrient availability to native species. The plant mats reduce light and oxygen in the water column, changing water chemistry, degrading plant and animal habitat and harming fish populations. Large infestations also cause practical problems for boating, fishing, or swimming through dense plant masses. This not only dampens fun recreational activities but also depresses local tourism and in other countries has threatened the heath of subsistence fishermen that depend on clear access to open water and thriving fish populations. Plants may also clog intake pipes for the supply of drinking water, hydropower or irrigation causing further economic damage. Because the large plants have ample surface area, lake water levels may decrease due to evapo-transpiration, when water evaporates from the lake surface and is lost through plant leaves as vapor. Globally, water hyacinth is considered a serious threat to biodiversity and human health, creating prime habitat for mosquitoes which carry a variety of infectious diseases including Eastern Equine Encephalitis Virus ("triple E") and West Nile Virus.

Photo credits (L-R): [1] Leslie J. Mehrhoff, University of Connecticut, IPANE; [2] Katie DeGoosh, RIDEM; [3] Ted Center, http://www.ars.usda.gov/is/graphics/photos/mar00/k8801-2.htm [4] Karen Brown, University of Florida, Bugwood.org

How Did Water Hyacinth Become Established in Rhode Island?

Water hyacinth originated in South America and has been introduced as an ornamental water garden plant to all parts of the world except Europe. It was first introduced to North America in 1884 and has since spread to most areas of the United States including Rhode Island, likely planted here as an ornamental. Although accustomed to more tropical climates and often considered intolerant of freezing weather conditions, water hyacinth appears to be adapting to the climate in southern New England and surviving mild winters. Over-wintering populations have been found living in Connecticut, and as winter temperatures rise due to climate change it is more likely than previously expected to become established in Rhode Island.

What Methods Are Currently Being Used to Control Water Hyacinth?

Since water hyacinth can spread rapidly and produces a copious amount of seeds, it is very difficult to control once it becomes fully established. Thus constant monitoring to detect small infestations early before they become established is essential to avoiding a long term battle with this invasive plant. An infestation is seldom completely eradicated and must be continually managed.

Management techniques to control populations in other areas have included coordinating manual beach cleanup efforts in the local community to remove plants before they produce seeds. However, in order to ensure protection of native or rare wetland plants and animals, this type of project requires approval from the RIDEM Office of Water Resources Wetlands Permitting Program. By law in Rhode Island, the manual removal of aquatic vegetation is restricted to that area adjacent to, but no more than fifteen feet from existing or permitted docks, beaches or swimming areas under the RI Fresh Water Wetlands Regulations (Rule 6.02). Manual plant removal outside this area or physical control of larger patches via mechanical cutting or harvesting requires a DEM wetlands permit (or special permission from the Water Quality and Wetlands Restoration Team, see contact info below). Other states have also introduced insects into the lake ecosystem to eat the plant. Introducing insects as a form of biological control must be approved by the RIDEM Department of Fish and Wildlife to ensure that introducing the new species will not threaten other parts of the ecosystem.

Chemical control of plants using herbicides may be effective for large populations but has not been used for water hyacinth in Rhode Island as of 2011. Each herbicide treatment requires a specific permit from the DEM Division of Agriculture to ensure the federally-regulated chemicals are used properly to treat invasive plants. Additionally, due to the volatile nature of herbicides, they can only be applied by a person properly licensed by the DEM Division of Agriculture. An herbicide treatment plan designed specifically to target the invasive plant should be developed by a certified lake manager or licensed herbicide applicator who is knowledgeable about the invasive. Consulting a certified lake manager or licensed herbicide applicator is appropriate to estimate associated treatment costs, outline the possible control options, comply with regulations, ensure environmental impacts are avoided, and complete the project safely. To develop this type of comprehensive strategy to treat invasive species in a lake a more detailed survey of the entire water body will likely be needed to assess the severity of the infestation and develop the most effective and cost efficient long-term management plan.

Please Help Prevent the Spread of Water Hyacinth in Rhode Island!

Prevention is key to stopping the spread of water hyacinth to other water bodies. It is important to avoid planting or disposing it from water gardens. Learn to identify invasive plant species and be on the lookout for new plants in your lake. It is much easier to manage a small patch of invasive plants than an entire lake covered with plants, so early detection is key! Identification resources are available on the RIDEM website at http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/aisindex.htm.

For more information also see:

- Guide to Understanding Freshwater Aquatic Plants, RIDEM http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/pdfs/aquaplnt.pdf
- Aquatic Invasive Species in Rhode Island http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/aisindex.htm
- RI DEM Herbicide permit application http://www.dem.ri.gov/programs/bnatres/agricult/pesticide.htm
- RI DEM Water Quality and Wetland Restoration Team http://www.dem.ri.gov/programs/benviron/water/wetlands/pdfs/wqwrteam.pdf
- RI DEM Wetlands permit application http://www.dem.ri.gov/programs/benviron/water/permits/fresh/index.htm
- The URI Watershed Watch Program www.uri.edu/ce/wq/ww
- The Rhode Island Natural History Survey http://www.rinhs.org/
- Center for Invasive Species and Ecosystem Health http://www.invasive.org/

PISTIA STRATIOTES L.

Araceae/Arum Family

Common Name: Waterlettuce
Synonymy: None
Origin: Africa or South America

Botanical Description: Floating herb in rosettes of gray-green leaves, rosettes occurring singly or connected to others by short stolons. Roots numerous, feathery. Leaves often spongy near base, densely soft pubescent with obvious parallel veins, slightly broader than long, widest at apex, to 15 cm (6 in) long. Flowers inconspicuous, clustered on small fleshy stalk nearly hidden in leaf axils, with single female flower below and whorl of male flowers above. Fruit arising from female flower as a many-seeded green berry.

Ecological Significance: May have been introduced to North America by natural means or by humans (Stoddard 1989). Seen as early as 1774 by William Bartram, in "vast quantities ... several miles in length, and in some places a quarter of a mile in breadth" in the St. Johns River (Van Doren 1928). Has been suggested that trade via St. Augustine, founded in 1565, may have provided an early avenue for introduction into the St. Johns watershed (Stuckey and Les 1984). Capable of forming vast mats that disrupt submersed plant and animal communities and interfere with water movement and navigation (Bruner 1982, Attionu 1976, Sharma 1984, Holm *et al.* 1977); also serves as host for at least 2 genera of mosquitoes (Holm *et al.* 1977). Considered a serious weed in Ceylon, Ghana, Indonesia, and Thailand and at least present as a weed in 40 other countries (Holm *et al.* 1979). A target of management research and control in Florida for at least 2 decades.

KAL

Flowering spathe

Distribution: Now one of the most widely distributed hydrophytes in the tropics (Holm *et al.* 1977). In North America, occurs in peninsular Florida and locally westward to Texas (Godfrey and Wooten 1979). Also found persisting in coastal South Carolina (Nelson 1993). Occurred in 68 public water bodies in Florida by 1982 and in 128 water bodies by 1989, but total abundance reduced by half over same time period as a result of a statewide management program (Schardt and Schmitz 1990).

Life History: Reproduces rapidly by vegetative offshoots formed on short, brittle stolons. Varies seasonally in density of rosettes, from less than 100 to over 1,000 per m^2 in south Florida (Dewald and Lounibos 1990). Seed production, once thought not to occur in North America, now considered important to reproduction and dispersal (Dray and Center 1989). Not cold tolerant (Holm *et al.* 1977). Can survive for extended periods of time on moist muck, sandbars, and banks (Holm *et al.* 1977).

KAL

Leaf rosette

United States Department of Agriculture
Forest Service

Finger Rock Trail

Silver Lake Loop Trail

Plant of the Week

Watercress (*Nasturtium officinale*)

By Dave Moore

Watercress is an aquatic or semi-aquatic perennial herb with bright white flowers that resemble the shape of a cross; hence, an old name (*Cruciferae*) for the mustard family, to which watercress belongs. Watercress is commonly found in cold, alkaline waters of springs, spring runs, and similar streams throughout the State of Missouri, as well as the majority of the North American continent.

Nasturtium officinale range map. USDA PLANTS Database.

Watercress is also distributed worldwide. It is usually considered an introduced species in North and South America, Australia, South Africa, and New Zealand. In the United States, it is listed by 46 states as noxious and invasive.

Watercress is a member of the mustard family, which includes many well-known leafy and tuberous vegetables such as collared greens, kale, turnips, and radishes, as well as many problematic weeds such as garlic mustard. It is widely cultivated and is the same watercress commonly used as a salad green. It is also used as a garnish for meats and other dishes where a

Plant of the Week

Orange-Fruited Horse Gentian (*Triosteum aurantiacum*)

Plant of the Week Gallery

Wildflower Links

Contact Information

U.S. Forest Service
Rangeland Management
Botany Program
1400 Independence Ave., SW, Mailstop Code: 1103
Washington DC 20250-1103

Contact Us

peppery or pungent flavor is desired (Steyermark 1963).

The pungent, spicy, and/or peppery taste of members of the Mustard family is due to a defense system known as the glucosinolate-myrosinase system. When tissue damage, due for example to herbivory, mechanical damage, or pathogen attack, occurs, the mechanism isolating the two compounds (glucosinolate and myrosinase) within the plant tissues breaks down and results in the production of several mustard oils that have a variety bioactive properties (Newman, et al 1992). This arrangement is known as “the myrosinase-glucosinolate bomb.” This “bomb” is thought to be active against herbivores, fungi, viral and bacterial pathogens, nematodes, and even other plants. Thus, the distinctive flavors of many members of the Mustard family are due to the types and amounts of hydrolyzed glucosinolate products released.

Watercress (*Nasturtium officinale*). Photo by Dan Tenaglia, Missouriplants.com.

Watercress (*Nasturtium officinale*). Photo by Dan Tenaglia, Missouriplants.com.

With watercress, the glucosinolate-myrosinase system is employed as a defensive mechanism against herbivory by various aquatic herbivores such as caddis flies, amphipods, and snails. However, yellowed leaves of watercress are more readily consumed by these same aquatic herbivores due to the low levels of glucosinolate and myrosinase in the leaf tissues.

Plants collected from the wild should be washed carefully prior to consumption to avoid accidental ingestion of microscopic parasites, such as the protozoan *Giardia*, that may be present in untreated water (Yatskievych 2006). Ducks, muskrats, and deer eat the leaves of watercress, and the plants serve as shelter for small aquatic life.

For More Information

PLANTS Profile - *Nasturtium officinale*, watercress

References

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Plant Conservation Alliance's Alien Plant Working Group

LEAST WANTED

White Poplar

Populus alba L.

Willow family (Salicaceae)

Download PDF version formatted for print (100 KB)

FACT SHEET LINKS

- Photographic List
- ⊞ Complete List
- ⊞ Aquatics
- ⊞ Herbaceous Plants
- ⊞ Shrubs
- ⊞ Trees
- ⊞ Vines

NATIVE RANGE

Central and southern Europe to western Siberia and central Asia

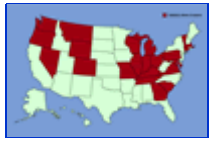
DESCRIPTION

White poplar, also known as silver-leaved or silverleaf poplar, is a tall tree that, at maturity, may reach 70 feet or more in height and 2 feet in diameter. The smooth, greenish-white bark becomes dark and rough on older trees. Young green or brown twigs are coated with dense woolly hair, especially near the tip. A cross-section of the stem reveals a five-pointed, star-shaped pith. The 2 to 5-inch long leaves are oval to maple-leaf in shape with 3-5 broad teeth or lobes, and are dark green above and covered with dense white hair below. Male and female flowers are borne in catkins on separate trees and appear sometime in March and April. The small seeds are adorned with cottony fluff that is easily blown by the wind in late spring, and is a bane to many landscape maintenance workers.

ECOLOGICAL THREAT

White poplar outcompetes many native tree and shrub species in mostly sunny areas, such as forest edges and fields, and interferes with the normal progress of natural community succession. It is an especially strong competitor because it can grow in a variety of soils, produce large seed crops, and resprouts easily in response to damage. Dense stands of white poplar prevent other plants from coexisting by reducing the

amount of sunlight, nutrients, water and space available.



DISTRIBUTION IN THE UNITED STATES
White poplar is found in forty-three states throughout the contiguous U.S.

HABITAT IN THE UNITED STATES
White poplar seems to grow best in full sun habitats such as fields, forest edges and wetland fringes.

BACKGROUND
White poplar was first introduced to North America in 1748 and has a long history in cultivation. It is chiefly planted as an ornamental for its attractive leaves of contrasting color (i.e., green above, white below). It has escaped and spread widely from many original planting sites. Because it is susceptible to a wide variety of pest insects and diseases, and is easily damaged by storms and wind, the ornamental value of white poplar is low.

BIOLOGY & SPREAD
Local spread of white poplar is primarily by vegetative means, through root suckers. Root suckers arise from adventitious buds on the extensive lateral root system. Large numbers of suckers from a single tree can quickly develop into a dense colony. Suckering can occur naturally or as a result of damage or other disturbance to the parent plant. Mature white poplar trees produce thousands of wind-dispersed seeds that may be carried long distances. However, seed germination of white poplar appears to be very low in the U.S.

MANAGEMENT OPTIONS
White poplar can be controlled using a variety of physical and chemical controls. Removal of seedlings and young plants by hand will help prevent further spread or establishment. Plants should be pulled as soon as they are large enough to grasp. The entire root system, or as much of it as possible, should be removed to prevent resprout from fragments. Hand removal of plants is best achieved after a rain, when the soil is loose.

Trees of any size may be felled by cutting at ground level with power or manual saws. Because resprouts are common after cutting, this process may need to be repeated many times until the reserves of the tree are exhausted. Girdling, which kills the tree by severing tissues that conduct water and sugars, also may be effective for large trees, especially if accompanied by application of a systemic herbicide to the cut area. A hatchet or saw is used to make a cut through the bark encircling the base of the tree, approximately six inches above the ground and deep into the bark. Girdling will kill the parent tree but may require follow-up cutting or treatment of sprouts with an herbicide.

Chemical
Chemical control of white poplar seedlings and small trees has been achieved by applying a 2% solution of

glyphosate (e.g., Roundup®) or triclopyr (e.g., Garlon® 3) and water plus a 0.5% non-ionic surfactant to the foliage until the leaves are thoroughly wet. Use of low pressure and a coarse spray with large droplet size will reduce spray drift and damage to non-target plants.

NOTE: Because glyphosate is a non-selective systemic herbicide, it may kill other grasses, broad-leaved herbaceous and woody plants that it contacts. Triclopyr kills broadleaf (dicotyledonous) plants but causes little or no damage to grasses and is useful for areas where desirable grasses are to be maintained.

Cut stump application
The cut stump herbicidal method should be considered when treating individual trees or where the presence of desirable species precludes the use of foliar herbicides. Stump treatments can be made at any time of year as long as the ground is not frozen. After cutting the tree near ground level, a 25% solution of glyphosate or triclopyr and water is applied to the stump by spray bottle or brush, making sure to cover the outer 20% of the stump. Basal bark herbicidal treatment is also effective throughout the year, as long as the ground is not frozen, and does not require cutting of the tree. A mixture of 25% triclopyr in an ester formulation (e.g., Garlon 4) and 75% horticultural oil is applied to the bark in a wide band around the base of the tree to a height of 12-15 inches from the ground. Thorough wetting is necessary for good control; spray until run-off is just noticeable at the ground line, but not running off-site.

USE PESTICIDES WISELY: ALWAYS READ THE ENTIRE PESTICIDE LABEL CAREFULLY, FOLLOW ALL MIXING AND APPLICATION INSTRUCTIONS AND WEAR ALL RECOMMENDED PERSONAL PROTECTIVE GEAR AND CLOTHING. CONTACT YOUR STATE DEPARTMENT OF AGRICULTURE FOR ANY ADDITIONAL PESTICIDE USE REQUIREMENTS, RESTRICTIONS OR RECOMMENDATIONS.

NOTICE: MENTION OF PESTICIDE PRODUCTS ON THIS WEB SITE DOES NOT CONSTITUTE ENDORSEMENT OF ANY MATERIAL.

CONTACTS
For more information on the management of White Poplar, please contact:

- Kris Johnson, Great Smoky Mountains National Park, Gatlinburg, TN

SUGGESTED ALTERNATIVE PLANTS
Hundreds of native tree species are available that can be used in place of white poplar. A few examples, for parts of the eastern U.S. only, include white oak (*Quercus alba*), red maple (*Acer rubrum*), American holly (*Ilex opaca*), persimmon (*Diospyros virginiana*), and sweetgum (*Liquidambar styraciflua*). Check with your local native plant society for further suggestions on trees native to your area and where you can purchase

them.

OTHER LINKS

- Photos at invasive.org
- Invasive Plant Atlas of New England

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PHOTOGRAPHS
Tom Remaley, Great Smoky Mountains National Park, Gatlinburg, TN

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Plant Conservation Alliance, Alien Plant Working Group.

FACT SHEET LIST | APWG HOME PAGE

http://www.nps.gov/plants/alien/fact/poal1.htm
Last updated: 07-Jul-2009

Invasive Plants in Pennsylvania

Wineberry

Rubus phoenicolasius Maxim.

Photo: John Randall, The Nature Conservancy, www.invasive.org

Background:

Also known as wine raspberry, this shrub from eastern Asia was introduced into the U.S. in 1890 as breeding stock for new raspberry cultivars. It is still used today by berry breeders.

Range:

This shrub is found mostly along the Appalachian ridge from Massachusetts to Tennessee, with scattered patched in New York, the Carolinas and parts of the Midwest.

pennsylvania
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
www.dcnr.state.pa.us

Description:

This is a multi-stemmed shrub that can grow up to nine feet tall under favorable conditions. The entire plant is covered in tiny, reddish hairs and sharp spines. The compound leaves are made up of three heart-shaped, toothed leaflets. The leaves alternate along the stem and are green on top, white on the under-side. White, five-petaled flowers appear in the spring and later give way to red, raspberry-like fruits in June and July.

Photo: Tuscarora State Forest

Habitat:

This shrub prefers moist, open areas like fields, roadsides and forest edges.

Biology and Spread:

The berries of this shrub are eaten by a variety of wildlife and humans, thus contributing to its spread. It also reproduces vegetatively through root nodes. New plants can also form as the branches touch the ground and root.

Ecological Threat:

This plant can form extensive, dense thickets that displace native vegetation and restrict light to lower growing vegetation. Wineberry is also host to several viruses that can affect raspberries, like raspberry yellow spot.

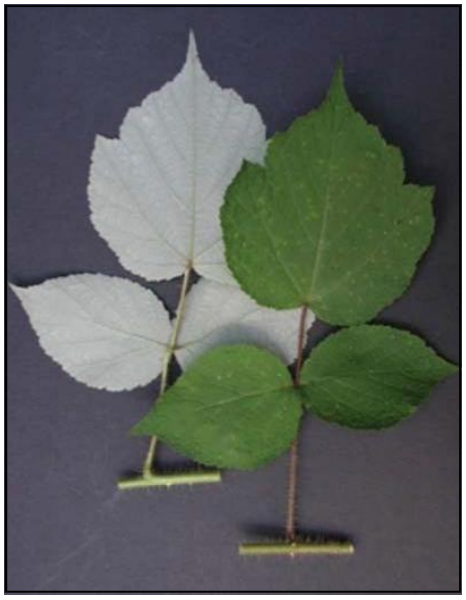

Photo: Leslie Mehrhoff, U. of Connecticut, www.invasive.org

How to Control this Species:

Manual

Plants can be removed by hand pulling with thick gloves or by using a four-prong spading fork, especially when the soul is moist. All roots and branches must be removed to prevent re-sprouting.

Chemical

Use of a systemic herbicide like glyphosate or triclopyr is also effective at controlling this species. Herbicide can be sprayed on the leaves, or the plant can be cut near the base and the herbicide painted on the exposed stump.

Look-A-Likes:

There are two native *Rubus* shrubs that might be confused with wineberry. Neither has the abundant reddish hairs and thorns (*see photo on right*) that mark wineberry.

Common blackberry
(*Rubus allegheniensis*)

Photo: Britt Slattery, USFWS

Flowering raspberry
(*Rubus odoratus*)

Photo: Sten, http://en.wikipedia.org

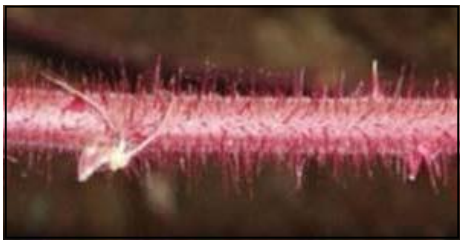

Photo: Leslie Mehrhoff, U. Of Connecticut, www.invasive.org

Native Alternatives:

In addition to the look-a-alike *Rubus* species shown below, there are other native shrubs that provide good food for wildlife, including red chokeberry (*Aronia arbutifolia*), spicebush (*Lindera benzoin*), American beautyberry (*Callicarpa americana)* and common winterberry (*Ilex verticillata*), shown below).

Photo: Dow Gardens Archive, www.forestryimages.org

References:

Center for Invasive Species and Ecosystem Health: http://www.invasive.org/browse/subinfo.cfm?sub=3072

Invasive Exotic Plant Pest Tutorial: http://www.dcnr.state.pa.us/forestry/invasivetutorial/wineberry.htm

Plant Invaders of Mid-Atlantic Natural Areas: http://www.nps.gov/plants/alien/pubs/midatlantic/midatlantic.pdf

For More Information:

To learn more about invasive species in Pennsylvania, visit:

DCNR Invasive Species Site: http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

Invasive Plants in Pennsylvania

Yellow Flag Iris

Iris pseudacorus L.

Photo: Nancy Loewenstein, Auburn University, www.invasive.org

Background:

This showy flower was originally used as an ornamental wetland plant, but was also promoted for erosion control and to remove metals and nutrients from sewage treatment plant effluent.

Range:

Originally from Europe, western Asia and northern Africa, this plant is now reported throughout the east, Midwest, south and west coast of the U.S.

pennsylvania
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
www.dcnr.state.pa.us

Description:

An herbaceous perennial that grows to a height of three to four feet. The leaves grow to a length of one to three feet and are green with a grayish-blue tint. Flowers are usually yellow, although they may also be cream-colored.

Habitat:

This plant can survive a wide range of conditions, from fresh to brackish water and even low oxygen habitats. Wetlands, stream banks, ponds and ditches are places you may see this plant. Yellow iris tolerates high soil acidity and needs high levels of nitrogen for optimum growth.

Map courtesy of http://plants.usda.gov

Biology and Spread:

Each fruit capsule contains roughly 120 seeds (*top image*) that are buoyant and can float long distances in water. The plant can also spread vegetatively through pieces of its rhizome/roots (*bottom image*).

Photo: Steve Hurst, USDA, www.invasive.org

Photo: Leslie Mehrhoff, U. of Connecticut, ww.invasive.org

Ecological Threat:

Widely planted as a pond ornamental in the past, this plant has escaped cultivation. It can form dense colonies in fresh or brackish water, altering habitat and displacing native plant and animal species. All parts of the plant are poisonous.

Photo: Jessica Sprajcar, DCNR

How to Control this Species:

Manual

Be careful when removing by hand: resin from the leaves and roots of this plant can cause skin irritation.

At a minimum, remove seed pods and flowers to help slow this plant's spread.

Small infestations can be dug up but the entire rhizome system must be removed or the plants will return. Limit soil disturbance as much as possible.

Chemical

For most large-scale infestations, some form of herbicide will be needed. Several readily available herbicides can be effectively used to treat this plant, including a glyphosate that is labeled for use in wetland habitats.

Because of the extensive root system, multiple applications of herbicide over multiple years will probably be needed for eradication.

Always follow all of the herbicide label's instructions and state requirements.

Native Alternatives:

These plants are native to the northeast and don't have invasive tendencies.

Blue flag iris, *Iris versicolor*

Photo: Judy Slater, www.forestryimages.org

Swamp rose mallow, *Hibiscus moscheutos*

Photo: North Carolina DOT

Blue vervain, *Verbena hastata*

Photo: Jessica Sprajcar, DCNR

References:

USDA Forest Service, Forest Health Staff: Weed of the Week: http://www.na.fs.fed.us/fhp/invasive_plants

Oregon State University Extension Service: http://extension.oregonstate.edu/gardening/node/1008

Photo: Nancy Loewenstein, Auburn University, www.invasive.org

For More Information:

DCNR Invasive Species Site: http://www.dcnr.state.pa.us/conservationscience/invasivespecies/index.htm

Plant Invaders of Mid-Atlantic Natural Areas, National Park Service: http://www.nps.gov/plants/alien/pubs/midatlantic/midatlantic.pdf

Invasive Plants Field and Reference Guide, U.S. Forest Service: http://na.fs.fed.us/pubs/misc/ip/ip_field_guide.pdf

Gardening Help

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Nymphoides peltata

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★★★☆☆, See Comments

More Images

Tried and Trouble-free
Recommended by 1 Professionals

Common Name: yellow floating heart

Type: Herbaceous perennial

Family: Menyanthaceae

Native Range: Europe, Asia

Zone: 5 to 10

Height: 0.25 to 0.50 feet

Spread: 1.00 to 3.00 feet

Bloom Time: May to September

Bloom Description: Yellow

Sun: Full sun

Water: Wet

Maintenance: Low

Suggested Use: Annual, Water Plant, Naturalize, Rain Garden

Flower: Showy

Invasive: Where is this species invasive in the US?

Garden locations

Culture

Best grown in 1-2' of still water in organically rich sandy bottom loams or in containers

Determine Your Growing Zone

Plant Finder

placed at the bottom of the water body. Plants grow best in full sun. Plants spread by runners. Although plants may be propagated by seed, the easiest method is by dividing off plantlets. Plants will overwinter in the St. Louis area at the bottom of a pond in somewhat the same manner as do hardy water lilies. In areas with mild winter conditions, plants can spread somewhat aggressively to the point of crowding out native species.

Noteworthy Characteristics

Yellow floating heart (also called water-fringe) is a rhizomatous, floating-leaf, aquatic perennial that looks like a small water lily (*Nymphoides* means resembling *Nymphea*). It is native to Europe and Asia, but has naturalized in a number of states in the U. S. from New England to Texas plus Arizona, California and Washington. It features ovate to rounded, flat, heart-shaped, medium green leaves (to 4") that cover the water surface somewhat like water lily. Plants spread rapidly by underwater stems (runners).
Star-shaped bright yellow flowers (to 3/4" across) with five-lobed corollas bloom on long stalks 2-3" above the leaves in summer. Flower lobes are fringed. Flowers last only one day. Yellow floating heart also resembles *Hydrocleys* (see *Hydrocleys nymphoides*).

Problems

No serious insect or disease problems.

Garden Uses

Floating water lily-like plant that fits well into ponds or water gardens.

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

ATTACHMENT N10

SOIL PROTECTION AND SUBSOIL DECOMPACTION MITIGATION PLAN

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1.0 INTRODUCTION

Tennessee Gas Pipeline Company, L.L.C. ("Tennessee" or "TGP") has filed 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"). The Environmental Report (:ER") is submitted in support of the application. 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 proposed Project will include construction of approximately 420 miles of pipeline (new pipeline, looping pipeline segments, and laterals) in Pennsylvania, New York, Massachusetts, New Hampshire, and Connecticut. Additionally, as part of the Project, Tennessee proposes to construct new compressor and meter stations and modify existing compressor and meter stations along its proposed and existing pipeline system. There also will be construction of appurtenant facilities, including mainline valves ("MLVs"), cathodic protection, and pig facilities through the Project area.

The Soil Protection and Subsoil Decompaction Mitigation Plan ("SPSDM Plan") outlines the special soil protection and subsoil mitigation measures and best management practices ("BMPs") to be employed by Tennessee during construction of the Project on agricultural and residential properties. The Project's on-site Environmental Inspector ("EI") is responsible for ensuring that Tennessee's construction contractor ("Contractor") implements the measures and procedures outlined in this SPSDM Plan. The responsibilities of these inspectors are described in Tennessee's Upland Erosion Control, Revegetation and Maintenance Plan (Attachment N14) and Tennessee's Wetland and Waterbody Construction and Mitigation Procedures (Attachment N15).

2.0 OVERVIEW OF PROCEDURES

This section provides and overview of the soil protection and subsoil mitigation measures and BMPs to be employed by Tennessee during construction of the Project on agricultural and residential properties.

2.1 AGENCY COORDINATION

During Project planning, construction, restoration, and monitoring; agency coordination will be conducted to allow for effective communication and to properly prepare and implement this SPSDM Plan for the mitigation of adverse impacts to soils. Tennessee's agency coordination will include:

- Continue to coordinate with the appropriate agencies regarding:
  - Drain tile and irrigation systems;
  - Grazing deferment; and
  - Soils.
- Obtain written recommendations from the Regional Conservation District regarding erosion control and revegetation specifications, both temporary and permanent:

- Incorporate recommendations from these or other applicable regulatory agencies for erosion control and revegetation specifications into Connecticut's Environmental Construction Plan ("ECP"); and

2.2 TOPSOIL SEGREGATION

- Topsoil segregation will be performed in all agricultural and residential[1] areas, including:
  - Annually cultivated or rotated agricultural lands or developed improved pasture lands;
  - Hayfields; and
  - Land enrolled in U.S. Department of Agriculture ("USDA") Conservation Reserve Program ("CRP") and maintained for return to tillable use, and other areas at the landowners request.
- Tennessee will prevent mixing of topsoil with subsoil in agricultural lands by removing and segregating topsoil from the full work area to a maximum depth of 12 inches, as determined by the EI.
- In deep agricultural soils (more than 12 inches of topsoil), Tennessee will segregate the topsoil to a minimum depth of 12 inches.
- Segregate topsoil from over the trench on stream banks and wetlands (unless they are saturated or inundated) to facilitate re-stabilization at stream crossings.

2.3 DRAIN TILES

All drainage tiles encountered will be marked, maintained during construction, and restored or replaced to existing or better condition upon completion of construction, in consultation with landowner. Tiles will be referenced and flagged with stakes located adjacent to the trench and the temporary construction right-of-way ("ROW") edges (outer perimeter).

Additional details regarding drain tile maintenance, repair, and replacement are provided in Sections 4.0 and 5.0 of Connecticut's ECP. All drain tile replacement pipes that consist of plastic will conform to the AASHTO M.242 specification.

2.4 SOIL COMPACTION MITIGATION

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.

[1] In residential areas, topsoil replacement (i.e., importation of topsoil) is an acceptable alternative to topsoil segregation.

3.0 DETAILED PROCEDURES

3.1 TOPSOIL SEGREGATION

- Use topsoil segregation methods in the following areas:
  - Residential;
  - Annually cultivated or rotated agricultural lands;
  - Hayfields, improved pastures[2]; and
  - Other areas at the landowners' request.
- Prevent the mixing of topsoil with subsoil by stripping topsoil from either the full work area or the trench and subsoil storage area and limit excavating, spoil stockpiling, and traffic/equipment to only the area stripped of topsoil. Note: Less than the full available width of construction ROW may be used if the topsoil and subsoil are segregated and all traffic/equipment and subsoil storage are able to fit within the area stripped of topsoil.
- Stockpile both the spoil and topsoil in a manner that prevents pooling of water behind the soil piles (i.e., prevents excessive saturation of the soil). This will be accomplished by leaving a gap between soil piles to allow water travel around the piles and across the ROW.
- In deep agricultural soils (more than 12 inches of topsoil) segregate the topsoil to a minimum depth of 12 inches. In soils with less than 12 inches of topsoil the entire topsoil layer and 1 to 2 inches of friable subsoil, will be segregated.
- At stream crossings, only segregate topsoil from the pipe trench on stream banks to facilitate re-stabilization. The remainder of the actual bank will not be disturbed. Agricultural topsoil stripping will proceed out to the field's fringe, near, but not beyond, the edge of the stream's riparian strip.

3.2 SOIL COMPACTION MITIGATION: TWO PHASES

3.2.1 First Phase: Deep-ripping the Exposed Subsoil

The Contractor will deep-rip the exposed construction surface subsoil with deep tillage devices such as a heavy duty ripping chisel or ripping chisel-plow (e.g., V-frame or straight-frame ripper; or a heavy duty Paratill®) in all agricultural sections of the ROW where topsoil is stripped.

The subsoil will be thoroughly deep-ripped and rock picked prior to the replacement of segregated topsoil. The subsoil will be deep-ripped to a depth of 18 to 22 inches.

Note: Due to the spacing between ripping legs (approximately 24 to 30 inches) a series of staggered, overlapping "parallel rips" will be employed to help ensure thorough breakup of the compacted mass of subsoil material. "Kittering" or a broad "S" series of cross rips will immediately follow for sites where the former "parallel" technique is inadequate for breakup of larger chunks into smaller clods.

[2] Improved pastures: land of generally tillable quality, used predominantly for grazing but largely open (i.e., free of trees, brush, and boulders).

- All stones 4 inches in diameter or greater that are brought to the surface during the decompaction process will be removed from the subsoil area.
- The segregated topsoil will be uniformly replaced, preferably using a light to moderate weight, Low ground pressure ("LGP") wide-track bulldozer.
- All of the first phase deep-ripping and rock picking activities, as well as topsoil replacement and second phase decompaction activities, will be conducted only during periods of relatively low soil moisture (i.e., not in a state of plastic consistency), as verified by the Atterberg field test, to ensure the desired mitigation and prevent additional soil profile compaction. Additional technical details are provided in the Soil Moisture (Workability) section.
- Once the deep-ripping phase begins, further use of the ROW by any construction traffic will be limited.

3.2.2 Second Phase: Following Topsoil Replacement

A Paratill®, or equivalent machinery, that contains a deep angled-leg subsoiler, will be used within the ROW so the soil profile will be loosened to a depth of 20 to 22 inches to achieve the necessary shattering of the subsoil. Paratill®, and equivalent machinery, is designed such that it will not mix topsoil and subsoil during decompaction.

- Deep soil profile shattering, by Paratill® or other approved deep tillage implement, includes the entire width of the temporary construction ROW (i.e., all areas where topsoil was stripped and replaced plus the area where the topsoil berm was stored).
- Deep soil profile shattering tools with angled legs include the 3 to 5 leg Paratill®.
- Alternative deep sub-soiling tools include, but are not limited to, the straight leg Unverferth Zone Builder® with 5 legs or 3 leg parabolic shanks for narrower ROWs or limited horsepower ("hp") tractors, and a heavy duty subsoiler (either straight frame or V-frame). Manufacturers' include, but are not limited to, John Deere® and Brillion®.
- As noted for deep-ripping, at least 40 hp of pull should be available per leg of implement for full depth effectiveness.
- If subsequent construction and restoration activities result in further compaction, additional deep subsoiling of the agricultural soil profile will be performed as needed.

3.3 SUBSOIL PROTECTION (SHALLOW DEPTH TO BEDROCK)

Construction through agricultural soils dominated by a shallow depth to bedrock can result in a significant loss of, or permanent damage to, the subsoil and corresponding damage to the soil profile. The structure and thickness of the thin layer of remaining subsoil over bedrock can be adversely impacted as a result of grading, construction traffic, and trench excavation, as well as backfilling involving bedrock material. The actual need for subsoil protection, as well as the method to be used will be based on site-specific factors including depth to bedrock and the thickness of the subsoil. The measures that will be utilized to help to minimize subsoil damage include:

- Stripping and separately stockpiling the "B" horizon of the ROW up to a depth of 12 inches or to the top of the bedrock, whichever is shallower; or stripping and separately stockpiling the "B" horizon from the full top width of the trench and spoil pile zone;
- Removing excavated bedrock materials from the site at the time of excavation; and
- Backfilling the work trench with imported subsoil material that is approved by the landowner.

3.4 TRENCH CROWNING AND MITIGATION OF TRENCH SETTLING

Ripped or blasted bedrock or concentrated volumes of excavated stone or rock material may be used for trench backfill, prior to trench crowning, in areas of cropland including rotation hayland, permanent hayland, and improved pastureland. However, rock will not be installed closer than 24 inches in mesic soils nor 30 inches in frigid soils from the exposed working construction surface of the ROW. Excess rock not utilized as trench backfill will be hauled away or stock-piled as approved in writing by the landowner.

The remaining backfill materials will consist of suitable subsoil over the rock fill material. Trench crowning will occur during the backfill operation of the construction phase, using subsoil materials over the trench to allow for trench settling. The segregated topsoil will be spread over the entire impacted ROW after the initial ripping of the exposed subsoil and rock cleanup activities have been completed. 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 depressions. Imported topsoil will be used to fill each area where trench settling occurs after the segregated topsoil has been used. Attempts will be made to identify sources of topsoil free of weeds, including soliciting input from landowners of potential sources.

Note: If construction backfilling occurs between early autumn through winter, agricultural restoration will not be initiated until relatively drier soil conditions are present in late spring or early summer. The majority of the trench settling will have occurred by mid-spring, giving the opportunity to compensate for trench settling using surplus, on-site subsoil material immediately before restoration.

3.5 SOIL MOISTURE (WORKABILITY) DURING RESTORATION, COMPACTION TESTING DURING MONITORING AND REMEDIAL ACTION

3.5.1 Soil Moisture

Check the soils for not exceeding friable, workable, moisture content using the following procedures during restoration activities (Atterberg field test for plastic soil consistency):

Exposed construction surface subsoil:

- Take a sample with a soil auger at a depth of 16 inches; and
- Roll the soil (Worm Method) to a diameter of approximately 1/8 inch diameter, and if the soil remains intact, in increments beyond 3/8 inch long, the soil is too wet (or “plastic”). If it breaks (crumbles) apart into 3/8 inch or shorter sections, the moisture content is correct (workable for deep-ripping).

Topsoil stockpile (berm):

- Take samples from vicinity of the berms’ lower outside and inside slopes, 9 inches deep, and from the berms’ inner core (at least 24 inches inside of the berm);

- Administer the same test (worm method) for each individual sample of topsoil material. If all sample tests are acceptable (friable), topsoil replacement may proceed as long as favorable soil conditions remain; and
- If the topsoil is too wet, break open the topsoil stockpile (berm) and rough spread the soil partially across the ROW, allow it to air dry, and then conduct re-tests until it is friable.

3.5.2 Compaction Testing during the Post Restoration Monitoring and Maintenance

Once the moisture of the restored soil profile on the affected ROW is at or near equilibrium with the adjacent off ROW land, soil profile compaction testing will be conducted using an appropriate soil penetrometer or other soil compaction-measuring device in the early spring following the year of initial restoration.

3.5.3 Cone-type Soil Penetrometer

A 0.75-inch-diameter cone, or similar cone-type soil compaction measuring tool, capable of withstanding applications of at least 400 pounds per square inch, gauge ("psig") will be used. When the readings inside the ROW are less than, equal with, or no more than 20 percent greater than the subsoil density readings outside the ROW, the subsoil decompaction/shattering restoration is satisfactory.

3.5.4 Test for Soil Compaction

Readings will be taken at every 3-inch vertical interval from surface to 21 inches, or to the point of resistance (300 psig), through the topsoil and subsoil, across the Project ROW in agricultural and residential areas. These cross-section tests will be conducted at ROW inter-spacing (not to exceed 200 feet) sufficient to determine the need for remedial measures. Tests will be done on the same soil type under the similar moisture conditions and should include the following areas:

- Temporary stockpile areas;
- The trenched zone;
- Soil from undisturbed areas;
- The work area; and
- Any traffic areas related to the Project.

There will be five to eight soil density tests taken from within a 30-inch circle at a sampling site. The single highest and single lowest mechanical samples of the complete soil profile, per test site, will be discounted as anomalies and will not be used in the calculations. The remaining test samples, which are to be recorded in 3-inch increments, are used to calculate the soil profile's average density per 3-inch increment.

The soil profile compaction test results from within the ROW will be compared with those of the adjacent, off ROW portion of the affected agricultural land to determine the level of decompaction needed. Additional deep shattering will be performed as required based on the soil density profile tests. All deep shattering will be performed in the same manner and under the same conditions as previously noted in this SPSDM Plan.

3.6 GENERAL MONITORING AND REMEDIATION

General ROW conditions to be monitored include topsoil thickness, relative content of rock and large stones, trench settling, crop production, drainage, repair of severed fences, etc. Impacts will be identified through on-site monitoring of all agricultural areas along the ROW and through contact with respective farmland operators, the Connecticut Department of Agriculture and Regional Conservation Districts.

Topsoil deficiency and trench settling will be mitigated with imported topsoil that is consistent with the quality of topsoil on the affected site. Excessive amounts of rock and oversized stone material will be determined by a visual inspection of the ROW and periodic probes of the trench area. Results will be compared to portions of the same field located outside of the ROW. Included in the determination of relative rock and large stone content is the ROW's condition subsequent to farm plowing/tillage and the relative concentration of such materials within the ROW as compared to off the ROW.

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ATTACHMENT N11

ORGANIC FARM PROTECTION PLAN

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1.0 INTRODUCTION

Tennessee Gas Pipeline Company, L.L.C. ("Tennessee" or "TGP") has filed 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"). The Environmental Report ("ER") is submitted in support of the application. 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 proposed Project will include construction of approximately 420 miles of pipeline (new pipeline, looping pipeline segments, and laterals) in Pennsylvania, New York, Massachusetts, New Hampshire, and Connecticut. Additionally, as part of the Project, Tennessee proposes to construct new compressor and meter stations and modify existing compressor and meter stations along its proposed and existing pipeline system. There also will be construction of appurtenant facilities, including mainline valves ("MLVs"), cathodic protection, and pig facilities through the Project area.

The Organic Farm Protection Plan ("OFPP") outlines the special procedures and best management practices ("BMPs") to be employed by Tennessee during construction of the Project on identified farms that are organic certified or farms that are in active transition to become organic certified. This OFPP is intended to address the unique management and certification requirements of these organic farm operations. These special procedures may be implemented and used in conjunction with other plans, procedures, and BMPs Tennessee has specified for use on the Project, as applicable.

The provisions of this OFPP will apply to certified organic agricultural land for which the landowner or tenant has provided Tennessee proof of certification for organic farming within the affected property. Tennessee recognizes that certified organic agricultural land is a unique feature on the landscape and will treat this land with the same level of care as other sensitive environmental features.

DEFINITIONS

Terms used in this OFPP have been defined by the National Organic Program Standards ("NOPS"), Federal Regulations (7 Code of Federal Regulations "[CFR"] Part 205), and have the meanings indicated below.

The Act refers to the Organic Foods Production Act of 1990, as amended (7 United States Code ["USC"] 6501 et seq.).

Certifying agent is defined as any entity accredited as a certifying agent for the purpose of certifying a production or handling operation as a certified production or handling operation (7 CFR Part 205.2).

Decertified or decertification is the loss of organic certification (7 CFR Part 205.2).

Organic certified refers to any agricultural product that is sold, labeled, or represented as "100 percent organic," "organic," or "made with organic (ingredients or food group[s])" and must be:

- Produced in accordance with the requirements specified in Section 205.101 or Subsections 205.202 through 205.207 or Subsections 205.236 through 205.240 and all other applicable requirements of part 205; and
- Handled in accordance with the requirements specified in Section 205.101 or Subsections 205.270 through 205.272 and all other applicable requirements Part 205 (7 CFR Part 205.102).

Certified organic agricultural land consists of any field or farm parcel from which harvested crops are intended to be sold, labeled, or represented as "organic," and must:

- Have been managed in accordance with the provisions of Subsections 205.203 through 205.206;
- Have had no prohibited substances (as listed in Section 205.105) applied to it for a period of 3 years immediately preceding harvest of the crop; and
- Have distinct, defined boundaries and buffer zones, such as runoff diversions, to prevent the unintended application of a prohibited substance to the crop or contact with a prohibited substance applied to adjoining land that is not under organic management (7 CFR Part 205.202).

A list of organic farms crossed by the Project in Connecticut is included in Table 1.0-1. Tennessee will continue to work with landowners to identify organic farms crossed by the Project in Connecticut.

Table 1.0-1
Organic Farms Crossed by Pipeline Facilities in Connecticut

Crop Type	County	Township/ Town	Tract Number	Segment	Milepost of Parcel		Approx. Acreage Impacted (acres)	
					Enter	Exit	Construction	Operation
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Source: Survey Data.
N/A = There are no organic farms crossed by the pipeline in the state of Connecticut.

Organic buffer zone consists of an area located between a certified production operation, or portion of a production operation and an adjacent land area that is not maintained under organic management. A buffer zone must be sufficient in size or other features (e.g., windbreaks or diversion ditches) must be in place to prevent the possibility of unintended contact by prohibited substances applied to adjacent land areas with an area that is part of a certified operation (7 CFR Part 205.2).

Organic System Plan ("OSP") is a plan of management of an organic production or handling operation that has been agreed to by the producer or handler and the certifying agent. The OSP includes written plans concerning all aspects of agricultural production or handling described in the Act and the regulations (7 CFR Part 205.2).

Prohibited substance is defined as a substance use of which is prohibited in any aspect of organic production or handling or not provided for in the Act or the regulations of this part and includes:

- Ash from manure burning;
- Arsenic;

- Calcium chloride - brine is prohibited for use, except as a foliar spray to treat a physiological disorder associated with calcium uptake, in this case the calcium chloride must be from a pure source, not a mixture or by-product;
- Lead salts;
- Potassium chloride - unless derived from a mined source and applied in a manner that minimizes chloride accumulation in the soil;
- Sodium fluoaluminate (mined);
- Sodium nitrate - unless use is restricted to no more than 20 percent of the crop's total nitrogen requirement;
- Strychnine;
- Tobacco dust (nicotine sulfate) (7 CFR Part 205.2 and 205.602); and
- All other substances prohibited in 7 CFR 205.105 (including, but not limited to, any synthetics, genetically engineered seed/crops, sewage sludge, and irradiation.

2.0 ORGANIC SYSTEM PLAN

Tennessee recognizes the importance of the individualized OSP to the organic certification process, understands that OSPs are proprietary in nature, and will respect the need for confidentiality. Tennessee will work with the landowner or tenant, the landowner's or tenant's certifying agent, and/or a mutually acceptable third-party organic consultant to identify site-specific construction measures to minimize the potential for decertification as a result of construction activities. Possible measures may include, but are not limited to:

- Pre- and post-construction equipment cleaning requirements;
- The use of drop cloths and clean-up procedures during welding and coating activities;
- Procedures for topsoil segregation, storage, and restoration;
- The planting of a deep-rooted cover crop in-lieu of mechanical decompaction. Seed used for this planting should be organic, or untreated if organic is not available;
- Providing applications of composted manure or rock phosphate. Rock phosphate must be from a natural source (pure mined);
- Prohibiting tobacco use while working on certified organic agricultural land to prevent the introduction of disease vectors (such as tomato mosaic virus);
- Prohibiting use of prohibited substances, as defined in Section 1.0, within certified agricultural land;
- Maintenance of appropriate organic buffer zones to eliminate drift and runoff of prohibited substances to certified organic agricultural land;
- Restricting use of prohibited substances in organic buffers zones to instances where the use and application of these substances will not result in contact with adjacent certified land (Section 3.0). Use of OMRI Listed® products in organic buffer zones as an alternative where contact with adjacent certified land may be unavoidable;
- Restoration and replacement of beneficial bird and insect habitat;
- The maintenance of organic buffer zones and use of organic seeds approved under the individual OSP for any cover crop;
- Locating access roads in a manner that causes the least amount of disruption to certified land; and
- Placement of fencing (untreated posts only) to prevent organic livestock from accessing the work area; and

- Vehicles, equipment, and materials (including equipment mats) will be inspected for remnant soils, vegetation, and debris, and will be cleaned of these materials before they are brought onto organic farmland. If required, a wash station may be set up outside the organic buffer zone and equipment will be power-washed with clean water (no soaps or chemicals). During dry periods, equipment will be cleaned using blown air.

3.0 PROHIBITED SUBSTANCES

Tennessee will not apply herbicides, pesticides, fertilizers, treated wood, or seed unless requested and approved by the landowner. No fuel or lubricant storage, or routine equipment maintenance will be allowed on certified organic agricultural land. Equipment will be checked by the Environmental Inspector ("EI") prior to entry into the property, and washed if necessary, to ensure that fuel, hydraulic, and lubrication systems are functioning properly before working on certified organic agricultural land. If prohibited substances, as defined in Section 1.0, are to be used on land adjacent to certified organic agricultural land, Tennessee will evaluate field conditions to ensure adequate buffers are maintained.

4.0 SOIL HANDLING, EROSION CONTROL, AND MITIGATION OF NATURAL RESOURCE IMPACTS

During construction, Tennessee's construction contractors ("Contractors") will implement Tennessee's Upland Erosion Control, Revegetation and Maintenance Plan (Attachment N14) and Tennessee's Wetland and Waterbody Construction and Mitigation Procedures (Attachment N15).

Topsoil and subsoil layers that are removed during construction on certified organic agricultural land will be stored separately and replaced in the proper sequence after the pipeline is installed. Unless otherwise specified in the site-specific OSP described above, Tennessee will not use this soil for other purposes. No topsoil or subsoil (other than incidental amounts associated with the movement of construction equipment) may be removed from certified organic agricultural land. Likewise, certified organic agricultural land will not be used for storage of soil from non-organic agricultural land.

On certified organic agricultural land, Tennessee will, to the extent practicable, implement erosion control methods consistent with the landowner or tenant's OSP and the Project ECP. On land adjacent to certified organic agricultural land, Tennessee's BMPs will be designed so that sediment from adjacent non-organic agricultural land will not be transported along the ROW and deposited on certified organic agricultural land. Treated lumber, non-organic hay bales, and non-approved metal fence posts will not be used for erosion control structures on certified organic agricultural land.

5.0 WATER IN TRENCHES AND WEED CONTROL

During construction, Tennessee will install trench plugs (as detailed in the ECP) at the boundaries of certified organic agricultural land to prevent water migration within the trench from adjacent land onto certified organic agricultural land. Likewise, Tennessee will not allow trench dewatering from adjacent land to be discharged or flow onto certified organic agricultural land. Additionally, all trench dewatering operations on certified organic agricultural land will be performed in accordance with Tennessee's ECP.

On certified organic agricultural land, Tennessee will, to the extent practicable, implement weed control methods consistent with the landowner's or tenant's OSP. In the case that all requirements of the OSP cannot be met, Tennessee will implement weed control methods consistent with the NOPS (7 CFR Part 205). Prohibited substances will not be used in weed control on certified organic agricultural land. In addition, Tennessee will not use prohibited substances to promote weed control on land adjacent to certified organic agricultural land in a manner that will potentially compromise the certified organic agricultural land.

6.0 MONITORING

In addition to the responsibilities of the EI described in the ECP, the following monitoring procedures will apply on certified organic agricultural land:

- An Independent Organic Inspectors Association ("IOIA")-trained EI or a USDA-approved organic certifier retained by Tennessee will monitor construction and restoration activities on certified organic agricultural land to ensure compliance with the provisions of this OFPP and will document and identify activities that could potentially result in decertification. Tennessee will pay for the cost of such monitoring;
- Instances of non-compliance will be documented according to the IOIA protocol and will be made available to the Connecticut Department of Agriculture ("CTDA"), the landowner, the tenant, the landowner's or tenant's certifying agent, and Tennessee; and
- If the EI is responsible for monitoring activities on certified organic agricultural land, he/she will be trained in organic inspection by the IOIA at Tennessee's expense, unless the EI has received such training during the previous 3 years.

7.0 COMPENSATION FOR DAMAGES RESULTING FROM CONSTRUCTION OR DECERTIFICATION

The settlement of damages to certified organic agricultural land will be based on crop yield and the need for additional restoration measures, all in accordance with the terms of the Easement Agreement. Following completion of construction Tennessee will be responsible for the cost of soil sampling, testing, and additional restoration activities, if dictated by the sampling results.

Should any portion of certified organic agricultural land be decertified as a result of construction activities by Tennessee, then Tennessee will be liable for those damages to the landowner or tenant for the duration of the decertification period, so long as a good faith effort is made by the landowner or tenant to regain certification.

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ATTACHMENT N12

WINTER CONSTRUCTION PLAN

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1.0 INTRODUCTION

Tennessee Gas Pipeline Company, L.L.C. ("Tennessee" or "TGP") has filed 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"). The Environmental Report ("ER") is submitted in support of the application. 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 proposed Project will include construction of approximately 420 miles of pipeline (new pipeline, looping pipeline segments, and laterals) in Pennsylvania, New York, Massachusetts, New Hampshire, and Connecticut. Additionally, as part of the Project, Tennessee proposes to construct new compressor and meter stations and modify existing compressor and meter stations along its proposed and existing pipeline system. There also will be construction of appurtenant facilities, including mainline valves ("MLVs"), cathodic protection, and pig facilities through the Project area.

Tennessee has developed this Winter Construction Plan ("WCP") to outline the special procedures and best management practices ("BMPs") that will be implemented during the winter season construction period for installation of the Project facilities, should the need for winter construction become necessary. These special procedures and BMPs should be considered additions to the other plans, procedures, and BMPs Tennessee has specified for use on the Project and will be used in conjunction with those plans, procedures, and BMPs, as applicable.

This WCP will be considered to be in effect when any of the following conditions occur:

- The ground is frozen and plating of topsoil occurs;
- Equipment slippage occurs from operating on frozen ground or vehicles risk sliding outside established right-of-way ("ROW") clearing limits;
- Snow becomes too deep to safely conduct construction activities;
- Road crossings cannot be adequately compacted;
- Backfill material freezes to the extent that adequate compaction becomes difficult; and/or
- Topsoil stockpiles are frozen and cannot be uniformly redistributed across disturbed areas or separated from the sub-grade material.

2.0 SNOW MANAGEMENT

If a snow event is followed immediately by a period of melting and runoff, the typical erosion and sedimentation control BMPs specified in Tennessee's Environmental Construction Plans ("ECPs") for stormwater management will apply, and no special measures will be necessary. If a significant (greater than 6 inches) snowfall event occurs and is followed by an extended period of freeze, the following procedures will be implemented:

- Tennessee will minimize snow clearing activities by only clearing in active work areas.
- Plowing equipment used for snow removal operations will be equipped with 6-inch shoes to ensure blades do not remove topsoil or vegetation.
- Snow removal equipment will consist mainly of plowing equipment, such as bulldozers, loaders, utility trucks, dump trucks, or any construction vehicle that can be equipped with a plow and 6-inch shoes, and may include, but is not limited to, other equipment (e.g., snow blowers and hand shovels).
- Snow removal operators will blade no lower than a height sufficient for construction vehicles to safely navigate the ROW.
- Snow removal operators will adjust blade height in areas of slope changes to ensure that contact with the ground is minimized to the greatest extent practicable.
- If practical, snow removed from other parts of the ROW will be stored over the trench line prior to excavation to prevent deep frost penetration along the trench line. Prior to topsoil removal and trenching activities, this snow will be stockpiled within an outer 10-foot strip on the working side of the construction ROW that is reserved for snow storage.
- Alternatively, snow may be removed from the construction ROW and placed adjacent to spoil pile storage. Tennessee will not disturb the ground surface while removing the snow from within the ROW. Tennessee will work with the FERC and individual landowners on a site-specific basis where snow storage adjacent to the ROW is required.
- To permit access to the construction ROW, snow may be cleared from access roads ("ARs") by pushing or throwing the snow to the side of the road. Intersections, driveways, and other private roads will not be blocked by plowed or stockpiled snow. Removed snow will not mix with sidecast stored soils.
- If necessary to improve driving conditions, snow may be bladed level along the travel lane on the construction ROW, rather than removed.
- Snow generally will not be removed from soil storage areas until just prior to backfilling the pipe trench or the replacement of topsoil. Snow that could interfere with trench backfilling operations will be removed to create a safe work area. Care will be taken to avoid mixing of snow and soil during snow removal. Snow may be left on the stored topsoil pile while replacing subsoil to minimize the mixing of the two. A separation will be placed between stored soil piles to further ensure that mixing of subsoil and topsoil does not occur during the snow removal.
- Snow removal equipment will be confined within the limits of the workspace boundaries and ARs; up to 25 feet of additional temporary workspace ("ATWS") adjacent to the temporary workspace ("TWS") boundary may be used as needed and will be identified in compliance with Tennessee's Upland and Erosion Control, Revegetation, and Maintenance Plan ("Plan", Attachment N14).
- Heavy saturated snow may be pushed, lifted, dumped, and stored adjacent to the ROW, provided that equipment stays within the workspace boundaries, property is not damaged or encumbered by the snow, no soil or vegetation is removed, no cultural resources or rare species habitat are adversely impacted, and breaks are left in windrowed piles to allow for drainage and wildlife passage. Tennessee will work with individual landowners on a site-specific basis where snow storage adjacent to the ROW is required.
- In heavy snow, or in areas of significant snow drifts, snow may be stockpiled off the ROW using equipment mounted to construction vehicles within the ROW limits.
- Snow and ice will be removed from inside the pipe joints prior to alignment and welding.

3.0 FROZEN SOIL HANDLING

In warm weather conditions, all construction activities (topsoil removal and segregation, grading, trenching, pipe installation, backfilling, restoration, and clean-up) will be conducted in accordance with Tennessee's Upland Erosion Control Revegetation and Maintenance Plan ("Plan", Attachment N14) and Wetland and Waterbody Crossing Construction and Mitigation Procedures ("Procedures", Attachment N15) and Tennessee's ECPs, as appropriate. The following alternative methods will be implemented in frozen or partially frozen soil conditions, defined as the presence of frozen soils to a depth of 2 inches, or more, below the surface:

- Frozen topsoil stripping activities will be limited to the equipment capable of accurately stripping variable depths of topsoil; rippers mounted on a machine may be necessary to achieve depth penetration. If segregation of subsoil and topsoil cannot be accomplished without mixing, the topsoil salvage operation will cease until soil conditions improve and segregation requirements can be met.
- Tennessee will minimize the amount of open trench to reduce the amount of snow that will have to be removed.
- Tennessee will install highly visible construction fence around any open trenches in areas where the pipeline intersects known paths used for snowmobiling, hiking, or other activities.
- Where topsoil or soil stockpiles remain in place during the winter, breaks in the stockpiles at drainage crossings will be created to allow runoff and snowmelt to be diverted off the ROW. In areas where sites are not cleaned up by October 15, mulch or other methods of topsoil conservation, as described in Section 5.20 of the ECP, will be used to prevent loss of topsoil during the winter and throughout the spring melt. If requested by landowners, these stockpiles will be marked with high-visibility poles to alert snowmobilers and others of their presence.
- The Environmental Inspector ("EI") will suspend final clean-up activities and topsoil placement if topsoil cannot be evenly distributed. If the topsoil is frozen, the topsoil will be spread and allowed to thaw in the sun. Frozen topsoil will not be returned to the ROW if it cannot be graded evenly.
- If topsoil placement is suspended due to frozen conditions, normal temporary ROW stabilization procedures will be applied as ground conditions permit. The final clean-up schedule will vary, depending on ground conditions and time of construction. Where final clean-up and restoration have not been completed, the ROW will be left in a roughened condition to reduce the potential for erosion during snowmelt. In upland areas, a slight crown may be left over the pipeline to account for settling as backfilled soils thaw.
- To reduce the possibility of the trench spoil freezing, and if practicable, Tennessee's construction Contractor ("Contractor") may choose to excavate the trench after the pipeline has been welded.
- Prior to backfilling, frozen stockpiled subsoil will be skimmed to remove the frozen surface layer and expose unfrozen material. The unfrozen material will be used to backfill immediately over the pipeline to prevent damage to the coating of the pipeline.
- Final clean-up will occur once the ground is fully thawed when weather and ROW conditions are favorable, and the topsoil stockpiled over the winter has dried sufficiently. The schedule for final clean-up will be determined based on the specific site conditions and will be conducted in accordance with Tennessee's ECPs.
- The EI may halt work if it is determined that muddy conditions are too severe.

4.0 TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES

During construction and prior to any winterization plan being implemented, all temporary and permanent erosion control and stabilization methods will be implemented in accordance with Tennessee's ECPs. Tennessee will monitor erosion control structures and stabilization efforts closely during periods of snowmelt. It is Tennessee's intent that all temporary erosion control measures will be fully operational for the duration of the winter and will be able to withstand spring thaw and snowmelt periods. Tennessee's EIs will verify that the erosion control measures are appropriate for the weather conditions and are fully functional. The following measures may be implemented during construction:

- Temporary erosion controls will be properly maintained during Project construction and reinstalled, as necessary, until permanent erosion controls are constructed. Erosion control devices will be inspected by the EIs and repaired, as necessary.
- Temporary slope breakers will be installed as described in the Project ECPs. If frozen ground prevents the installation of slope breakers, other erosion control methods will be utilized, and slope breakers will be installed prior to the spring thaw.
- Erosion control devices requiring repair or installation during frozen conditions will be temporarily repaired/constructed using sandbags until conditions dictate that they can be installed as described in the Project ECPs.
- Haybales that can be properly replaced without retrenching, during frozen conditions, will be staked using steel rebar.
- In cultivated lands, temporary slope breakers will be placed across the ROW. Breaks will be installed in snow and topsoil piles where they are intersected by the temporary slope breakers to promote water flow off of the ROW during the spring thaw.
- Appropriate erosion controls, as described in Section 5.18 of the ECP, will be used to stabilize topsoil and subsoil piles. Special care will be taken when installing erosion control measures to account for the volume and direction of flow expected during spring melt and heavy spring rains.
- Mulching will be used to stabilize soil surfaces and on stockpiled topsoil, where appropriate. In cases where significant snow cover exists, EIs will determine whether mulch should be applied. Where required, mulch will be applied in accordance with the ECPs.
- If necessary, temporary bridges and equipment mats may be removed for the winter season and stored within the ROW in an upland storage area. Any crossings remaining in place will be engineered to handle maximum predicted spring runoff flows and will be approved by the applicable regulatory agencies.
- In areas with sensitive fisheries, Tennessee will utilize temporary measures, as described in the ECPs and/or required by the applicable regulatory agency.
- If stream crossings are required outside of the dictated construction windows, prior to any activity, Tennessee will obtain approval from the applicable regulatory agency for each specific crossing.

5.0 LOWERING-IN AND BACKFILL

The following requirements and/or recommendations will be implemented during lowering-in and backfilling activities during the winter season:

- Prior to lowering-in of the pipe, the pipe trench will be cleared of snow to the greatest extent practicable.
- During backfill operations, precautions will be taken to limit the mixing of snow with spoil material, although it is recognized that some mixing of snow and soil is unavoidable during this process.
- The trench will be backfilled with unfrozen soils. If necessary, the first several inches of frozen backfill will be removed from the spoil piles to access unfrozen soils for backfilling. The segregated frozen spoil material, to be used as backfill once thawed, will be stabilized until the soils in the trench have thawed and any settling has occurred. This remaining spoil material will be used as backfill to make up for any settling after the soils in the trench have fully thawed.
- Backfilling activities will follow lowering-in activities immediately to prevent the infill of snow over the lowered-in pipe.

6.0 HYDROSTATIC TESTING/DEWATERING

The following requirements and/or recommendations will be implemented during hydrostatic testing activities that occur during the winter season:

- The temperature of the hydrostatic test water will be monitored continuously at the intake and discharge. The test manifolds will be insulated and a temporary shelter will be constructed around the test area. Portable heaters will be used inside the shelter to prevent the test manifolds from freezing.
- Hydrostatic test water discharge locations will be monitored for icing and effectiveness.
- Hydrostatic test dewatering will be conducted in accordance with Tennessee's ECPs, as appropriate. During the winter season, dewatering structures may need to be sized to handle more volume and may need to be located further away to avoid runoff back toward the trench due to decreased infiltration rates of frozen ground.
- No anti-freeze or additives to reduce the test water's freezing point will be used during hydrostatic testing.

7.0 WINTER AND SPRING INSPECTIONS AND MONITORING

Tennessee's EIs will continue to inspect the condition of erosion control devices on a daily basis during active construction or within 24 hours of a 0.5-inch rain event, if safely accessible and weather permitting, to ensure that the erosion control devices remain in place and are effective. Winter construction monitoring of the ROW will identify the following:

- Erosion control structures requiring maintenance and repair;
- Areas along the ROW with slope instability; and
- Areas where significant levels of erosion are occurring along the ROW.

Inspectors will pay particular attention to areas with steep slopes, wetlands, waterbody crossings, and sensitive habitats.

The Contractor will attempt to complete repairs of damaged erosion control devices at the end of each working day. Tennessee will stockpile erosion control materials within designated staging areas during the winter season to ensure they are available for installation and repairs.

Site inspections will be completed in accordance with the Project ECPs. Tennessee will prepare weekly status reports for areas undergoing winter construction, as well as for previously disturbed areas where no construction is occurring during the winter season. These reports will identify areas where erosion control issues have been identified and corrected, along with areas where final resolution and repair will be deferred until spring due to inaccessibility or the likelihood of more significant damage resulting from attempts to effect repairs.

8.0 SPRING THAW CONDITIONS AND EROSION CONTROL MEASURES

Tennessee may implement the following procedures when working during spring thaw conditions:

- Contractors may use equipment best suited to existing ground conditions (i.e., low ground pressure equipment).
- Contractors may install equipment mats along the travel lane where soils are excessively wet and rutting is occurring to prevent mixing of topsoil and subsoil.
- Contractors may use frost driving measures, such as snow packing, to increase the load bearing capacity of the ground where necessary to remove equipment from the ROW.
- In excessively wet areas, construction activities will be postponed until early morning or evening when the ground is frozen.
- Equipment mats or geotextiles may be installed in excessively wet areas, as needed, to minimize rutting.
- Runoff water will be controlled by implementing Tennessee's ECPs.
- Erosion control measures will be inspected and repaired in accordance with the ECPs.
- Work will be suspended by the EI if it is determined that the area is excessively wet and rutting is occurring.

9.0 TRAINING AND REPORTING

Tennessee will conduct safety and specialized training for its EIs and general environmental awareness training for construction personnel and Contractors regarding proper field implementation of Tennessee's Plan and Procedures, the ECPs, regulatory conditions, and other restoration and mitigation measures. Tennessee will include copies of permits and related drawings in the Environmental Permit Package.

Tennessee's Operation and Maintenance Plan will include copies of pertinent permits, with particular reference to long-term permit conditions.

Tennessee will be preparing weekly status reports regarding Project activities for submittal to FERC and other agencies for the duration of the Project, or as required by the FERC. Tennessee will include discussions of winter construction activities in the weekly FERC status reports to keep all involved agencies informed about the progress of winter construction activities, other winter ROW issues, and any corrective actions taken or scheduled.

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ATTACHMENT N13

GENERAL TRAIL CROSSING PLAN

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LIST OF ACRONYMS and ABBREVIATIONS

Acronym	Full Name
Act	Omnibus Public Land Management Act of 2009 (PL 111-11)
AMC	Appalachian Mountain Club - Connecticut Chapter
AR	access road
ATWS	additional temporary workspace
CFR	Code of Federal Regulations
CI	Chief Inspector
Commission or FERC	Federal Energy Regulatory Commission
Crossing Plan	General Trail Crossing Plan
CFPA	Connecticut Forest and Park Association
CL&P	Connecticut Light & Power
ECP	Environmental Construction Plan
EI	Environmental Inspector
GIS	Geographic Information Systems
GPO	Government Printing Office
LEI	Lead Environmental Inspector
MLV	mainline valve
MP	milepost
NED or Project	Northeast Energy Direct
NET	New England National Scenic Trail
NPS	National Park Service
PADUS	Protected Areas Database of the United States
PHMSA	USDOT's Pipeline and Hazardous Materials Safety Administration
ROW	right-of-way
Tennessee or TGP	Tennessee Gas Pipeline Company, L.L.C.
TWS	temporary workspace
USACE	U.S. Army Corps of Engineers
U.S.	United States
USDOT	U.S. Department of Transportation
USGS	U.S. Geological Survey

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1.0 INTRODUCTION

Tennessee Gas Pipeline Company, L.L.C. ("Tennessee" or "TGP") has filed 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"). The Environmental Report ("ER") is submitted in support of the application. 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 proposed Project will include construction of approximately 420 miles of pipeline (new pipeline, looping pipeline segments, and laterals) in Pennsylvania, New York, Massachusetts, New Hampshire, and Connecticut. Additionally, as part of the Project, Tennessee proposes to construct new compressor and meter stations and modify existing compressor and meter stations along its proposed and existing pipeline system. There will also be construction of appurtenant facilities, including mainline valves ("MLVs"), cathodic protection, and pig facilities through the Project area.

The Project proposes to cross eight trails in the state of Connecticut including the New England Trail ("NET") in the Town of Bloomfield, Hartford County, which is designated as National Scenic Trail. Some trails are crossed multiple times, including the NET, which is crossed six separate times. All trail crossings are detailed in Table 1.0-1 and on Figure 1-1, Trails Crossed by the Project in Connecticut (Attachment A).

Tennessee has developed the following General Trail Crossing Plan ("Crossing Plan") in support of Tennessee's application for a certificate of public convenience and necessity from the FERC for the Project, as well as other federal and state permit approvals and authorizations. Additionally, this Crossing Plan serves to establish protocols to protect trail recreational users during construction and avoid or minimize impacts to preserve the integrity of the trails and the user experience. The purpose of this Crossing Plan is to:

- Minimize adverse effects to hiking trails and the environment;
- Maintain the trail experience for hikers to the extent practicable;
- Maintain the safety of hikers during construction; and
- Facilitate coordination with stakeholders throughout the regulatory process.

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Table 1.0 1
Trails Crossed by the Project in Connecticut

Facility Name	County	Segment[1]	Nearest Milepost	Name of Area	Land Ownership/ Management	Existing Land Uses Crossed[2,3]	Direction from Pipeline	Distance from Pipeline[4] (ft)	Crossing Length (ft)	Area Affected (acres)[5,6]	
										Construction	Operation
300 Line CT Loop	Hartford	S	0.11	New England Trail	Appalachian Mountain Club (“AMC”)/National Park Service (“NPS”)	UF, OL/ROW, RD	Crossed by Pipeline	0	20	0.07	0.02
300 Line CT Loop	Hartford	S	0.14	New England Trail	AMC/NPS	UF, OL/ROW, RD	Crossed by Pipeline	0	20	0.26	0.07
300 Line CT Loop	Hartford	S	0.35	New England Trail	AMC/NPS	UF, OL/ROW, PEM	Crossed by Pipeline	0	20	0.05	0.02
300 Line CT Loop	Hartford	S	0.92	New England Trail	AMC/NPS	UF, OL/ROW	Crossed by Pipeline	0	20	0.07	0.02
300 Line CT Loop	Hartford	S	2.94	New England Trail	AMC/NPS	UF, OL/ROW	Crossed by Pipeline	0	20	0.11	0.02
300 Line CT Loop	Hartford	S	5.42	New England Trail	AMC/NPS	UF, OL/ROW	Crossed by Pipeline	0	20	0.05	0.02
300 Line CT Loop	Hartford	S	5.44	Old Metacomet Trail	CT Forest And Park Association	UF, OL/ROW	Crossed by Pipeline	0	20	0.06	0.02
300 Line CT Loop	Hartford	S	5.46	Old Metacomet Trail	CT Forest And Park Association	UF, OL/ROW	Crossed by Pipeline	0	20	0.12	0.03
									Total	**0.79**	**0.22**

Source: Based on data collected during field surveys in 2014 and 2015, available state-level landuse-landcover GIS data, and interpretation of aerial photography.

[1] Each segment is associated with its own set of mileposts (“MPs”) beginning at MP 0.00.
[2] Land use is provided only for federal and state and recreational lands impacted by the project.
[3] RD = Roadways/Railroads; RE = Residential; UF = Upland Forest; CI = Commercial/Industrial; OL/ROW= Open Land; PEM/PFO/PSS = Wetland; AG = Agricultural; WB/OW= Waterbody; OTHER = Special Land Use; WETLAND = wetland type not classified by NWI as PEM, PSS, or PFO.
[4] Distance from pipeline is the shortest distance from the nearest edge of applicable property boundary to the pipeline; a value of 0 ft indicates that the pipeline traverses the land.
[5] For area affected, all trails crossed by the pipeline were assumed to have a width of 20 feet for quantifying impacts.
[6] This table quantifies federal and state recreational land impacts for the construction and operation of the pipeline facilities. This includes workspace for the pipeline, cathodic protection along the pipeline, hydrostatic testing for the pipeline and meter/compressor stations along the pipeline. This does not include workspace for access roads (“ARs”) or contractor yards, or facilities (meter and compressor stations) located on an existing TGP pipeline.

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1.1 REQUIRED PERMITS

Tennessee will obtain all necessary permits, licenses, and clearances relating to the installation of the pipeline through any sites or places that require a governmental license or permit. Tennessee will include copies of relevant environmental permit approvals and conditions in the construction bid packages and contracts.

The Contractor will be required to comply with all permits and licenses obtained by Tennessee and comply with all the requirements related to the construction of the Project, as well as restoration of any areas disturbed by the construction of the Project. Table 1.1-1 includes a list of approvals required by federal, state, and local agencies for the Project facilities in Connecticut, as well as information relative to the permit/approval status.

Table 1.1-1
Permits, Licenses, Approvals, and Certificates Required for Construction, Operation, and Maintenance of the Project in Connecticut

Permit/Approval	Administering Agency	Status
Federal		
Certificate of Public Convenience and Necessity	Federal Energy Regulatory Commission	Certificate application to be submitted in the fourth quarter of 2015
Section 404/Individual Permits Section 10 Permits	U.S. Army Corps of Engineers-Baltimore District	Applications to be submitted in the fourth quarter of 2015
	U.S. Army Corps of Engineers-New York District	
	U.S. Army Corps of Engineers-Buffalo District	
	U.S. Army Corps of Engineers-New England District	
Endangered Species Act Section 7 Clearance, Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act	U.S. Fish and Wildlife-Pennsylvania Field Office	Consultations in Progress
	U.S. Fish and Wildlife-New York Field Office	
	U.S. Fish and Wildlife-New England Field Office	
National Oceanic and Atmospheric Administration	Northeast Region	Consultation in Progress
Right-of-Way Grant Temporary Use Permit	U.S. Department of Interior-Bureau of Land Management	Application(s) to be submitted in November 2015 (if necessary)

Table 1.1-1
Permits, Licenses, Approvals, and Certificates Required for Construction, Operation, and Maintenance of the Project in Connecticut

Permit/Approval	Administering Agency	Status
Connecticut		
Clean Water Act 401 Water Quality Certificate	Connecticut Department of Energy and Environmental Protection-Bureau of Water Protection	Application to be submitted in the fourth quarter of 2015
General Permit for Hydrostatic Discharges	Connecticut Department of Energy and Environmental Protection-Bureau of Water Protection	Application to be submitted in the first quarter of 2016
General Permit for Stormwater and Dewatering Wastewater from Construction Sites	Connecticut Department of Energy and Environmental Protection-Bureau of Water Protection	Application to be submitted in the second quarter of 2016
Water Diversion Permit	Connecticut Department of Energy and Environmental Protection-Bureau of Water Protection	Application to be submitted in the first quarter of 2015
State Species Consultation	Connecticut Natural Diversity Database	Consultations in Progress
Inland Wetlands and Watercourses	Connecticut Town Inland Wetland Commissions	Applications to be submitted in the first quarter of 2016
Section 106, National Historic Preservation Act Consultation	Connecticut State Historic Preservation Office	Consultations in Progress

2.0 GENERAL TRAIL CONSTRUCTION PLAN

This section details specific plans for crossing hiking trails, which includes notifications and coordination with any trail partners, trail specific construction procedures, restoration, revegetation and monitoring procedures, as well as operation and maintenance of the right-of-way ("ROW"). Tennessee's general construction procedures, including those for clearing, grading, fencing, erosion and sediment control, construction methods, restoration, revegetation, monitoring, and operation and maintenance, are outlined in the Environmental Construction Plan ("ECP").

2.1 NOTIFICATIONS AND COORDINATION WITH TRAIL PARTNERS

2.1.1 Pre-Construction Notification

Tennessee will notify landowners prior to the anticipated start of construction, or any planned surface disturbing activities, at hiking trail crossings. Tennessee considers the landowner as the primary contact and the landowner will facilitate notification with any additional trail partners.

Section 3.1.2 discusses the notification for the NET.

2.1.2 Construction Status Reports

During active construction of the Project, Tennessee will be required to submit a weekly status report to the FERC, prepared by Tennessee's Lead Environmental Inspector ("LEI"). Tennessee will provide the project status reports until restoration and initial permanent seeding/planting is completed for the Project.

2.1.3 Coordination with Landowners, Inspection, and Issue Resolution

Tennessee will provide relevant contact information for the Environmental Inspector ("EI") and Chief Inspector ("CI") on the Project, who will have day-to-day knowledge of schedule, construction status and compliance with the Crossing Plan. Any landowner or trail partner wishing to access the site for inspection or any other activities will need to receive Tennessee's mandatory Project Safety and Environmental Awareness Training.

Tennessee's Environmental Project Manager or designated individual will be the primary point of contact with the trail landowners. In the event an issue arises while constructing along any trails, the landowner will be contacted by the Environmental Project Manager or the LEI to resolve the issue in a timely manner.

2.2 TRAIL SPECIFIC PROCEDURES

2.2.1 Safety Procedures and Access for Trail Visitors

Tennessee recognizes that hiking trails in Connecticut are highly utilized by the public for recreational purposes. As a result, Tennessee will minimize disruption to trail use by maintaining access during construction to the extent practicable. Based on the construction activity, Tennessee will utilize the methods detailed below for maintaining access to all trails:

- Unescorted – During site preparation, periods of inactivity and post-construction monitoring activities, Tennessee will utilize signs and construction exclusion fencing to demarcate any trails and allow safe, unescorted passage through the work area;
- Escorted – During construction activities utilizing heavy equipment operation, Tennessee will require hikers to be escorted through the work area by safety personnel; and
- Alternative Route – When available, Tennessee will temporarily divert hiker traffic to available public looping trails as an alternate route during discrete periods or during construction activities utilizing heavy equipment operation.

Table 2.2-1 summarizes Tennessee's specific construction activities in chronological order and their respective trail access methods. Timing of construction activities is discussed in further detail in Section 2.2.3.

Table 2.2-1
Summary of Construction Activities and Access Methods At Trail Crossings

Activity[1]	Activity Type	Access Method	Approximate Duration
Surveying and flagging of limit of construction	Site preparation	Unescorted	Not applicable
Installation of construction exclusion fencing along the trails	Site preparation	Unescorted	Not applicable
Installation of signs identifying upcoming construction activities	Site preparation	Unescorted	Not applicable
Tree felling	Discrete period	Escorted	1 day
Tree and vegetation clearing of workspace[2]	Discrete period	Escorted	1-day
Installation of erosion control devices	Site preparation	Unescorted	Not applicable
Grading of workspace[2]	Discrete period	Escorted	1-2 days
Stringing of pipe	General construction	Escorted	1 day
Blasting[2,3]	Discrete period	Escorted	2 days
Trenching up to trails	General construction	Escorted	1 day
Trenching across trails, lowering-in, welding, weld inspection, pipe coating, backfill	Discrete period	Escorted	1-2 days
Restoration of ROW/planting activities	General construction	Escorted	1-2 days
Post-construction monitoring	Post-construction	Unescorted	Not applicable

[1] Activities are listed in a general chronological order, although actual activities may occur out of sequence.
[2] Timing of discrete periods is dependent largely on site conditions encountered at the trail crossing at the start of construction.
[3] Timing of blasting activities may result in a momentary interruption of trail access.

2.2.1.1 Work Area Access

At all trail crossings, construction of the new pipeline facilities will be sequenced to avoid interrupting use of the trails to the extent practicable:

- During site preparation activities and all other periods of inactivity, Tennessee will utilize signs and construction exclusion fencing to demarcate trails and allow safe, unescorted passage of hikers through the work area;
- During construction activities, Tennessee will staff high-traffic trail crossings with safety personnel to inform hikers of the construction and safely escort pedestrian traffic across the construction ROW:
    - If construction activity does not allow for safe passage at a trail crossing, pedestrian traffic will be directed through a cordoned-off area along the edge of the workspace to a crossing of the construction ROW set up a safe distance away;
    - When necessary, construction may momentarily be suspended to allow for safe passage of pedestrian traffic across the construction ROW;
    - If necessary, a temporary crossing of the trench will be installed to allow safe passage across the workspace;
- During post-construction monitoring activities, Tennessee will utilize signs to demarcate all trails and allow safe, unescorted passage through the work area.

2.2.1.2 Safety Concerns

During construction, specific safety requirements will be necessary to maintain safe conditions for the public and construction personnel. These requirements will include measures to notify trail users of the construction activities, protect the public, and allow safe passage across or around the construction ROW. The following safety measures will be maintained throughout the construction process at the trail crossings:

- Appropriate safety/exclusion fencing and signs will be installed across the ROW along the trails prior to the initiation of construction activities at the trail crossings;
- Signs will also be placed along the trails approximately 150 feet in either direction of the construction area;
- Information on the location and duration of the construction will be provided to the landowners such that notices can be posted at trail heads, park headquarters, and published on internet websites, as necessary;
- If blasting activities are required, within and in the vicinity of the trails, Tennessee will establish a 1,000-foot safety zone within which all non-essential personnel, including hikers, will not be permitted during blasting (Attachment N8 to the ECP, Blasting Management Plan):
    - During discrete blasting activities, access to the trails within the work area may be momentarily interrupted. Tennessee will post safety personnel along the trails in each direction to assure that no hikers enter the exclusion zone during blasting activities. To allow for safe passage of pedestrian traffic across the construction ROW, when necessary, hikers may be instructed to wait while blasting activities are momentarily suspended or are completed. Tennessee will avoid interrupting the use of the trails to the extent practicable;
    - Information on the location and duration of blasting will be coordinated closely with landowners on specific time periods when trail access may be temporarily interrupted such that notices can be posted at trail heads, park headquarters, and published on internet websites, as necessary;
- During active construction, safe access and utilization of the trails for visitors during overnight periods or periods of inactivity will be maintained by posting signs and demarcating the trails with construction exclusion fencing and, if necessary, a temporary crossing of the trench;
- Construction areas will be maintained in a sanitary condition at all times; waste materials (including but not limited to human waste, trash, garbage, refuse, oil and petroleum products, and ashes) will

be disposed of in accordance with Tennessee's Waste Management Plan (Attachment N4 to the ECP).

- During the crossing of the trails, Tennessee's construction Contractor will store equipment within the construction ROW, in the evenings and potentially during non-working periods. Once construction is complete across the trails and restoration of the land is finalized, all equipment will be removed.
- Alternative trail routes will be clearly signed at the points where the trails intersect on both sides of the construction ROW and the closed trail will be cordoned off with orange construction fence.
- All intersections of ARs and hiking/biking trails will be clearly signed at the point of intersection to allow hikers/bikers safe passage across the AR.

2.3 RESTORATION, RE-VEGETATION AND MONITORING

This section details Tennessee's specific restoration, re-vegetation and monitoring plans, which include permanent restoration measures, re-vegetation and seeding procedures, and monitoring procedures. Tennessee's general restoration, re-vegetation and monitoring procedures are outlined in the Connecticut ECP.

Vegetation within the entire width of the operational ROW will be maintained in an herbaceous state. Tree clearing and maintenance within the operational ROW will result in the permanent conversion of upland forest to an herbaceous and low-shrub vegetation cover type within the new operational ROW.

2.3.1 Permanent Restoration Measures

- Final grading at the trail crossings will be completed and permanent erosion control measures will be installed within 10 days after backfilling the trench, weather permitting.
- Construction debris will be removed from the ROW and the ROW will be graded so that the soil is left in the proper condition for planting.
- The ROW will be graded to pre-construction contours, as practicable.

2.3.2 Re-vegetation and Seeding

- The ROW will be limed, fertilized, seeded, and mulched in accordance with the specific requirements listed in Tables 10.4-1 and 10.4-2 of the ECP, unless otherwise requested by the landowners or land managing agencies.
- Erosion control matting or netting will be applied to slopes steeper than 3:1 to prevent erosion and facilitate germination and revegetation.
- Slopes steeper than 3:1 will be stabilized immediately after final grading in accordance with recommended seeding dates, weather permitting.

2.3.3 Restoration Monitoring

- Tennessee will file annual activity reports with the landowners documenting problems at the trail crossings and corrective actions taken for 3 years following construction.
- Tennessee will conduct follow-up inspections during the first three growing seasons after seeding to determine the success of re-vegetation. Re-vegetation will be considered successful if vegetation is similar in density to adjacent undisturbed lands, based on representative random sampling in the

field (e.g., visual survey). If vegetative cover is not successful, a qualified agronomist will be used to determine the need for additional restoration measures.

3.0 NATIONAL SCENIC TRAILS

This section details the NET national scenic trail crossed by the Project and discusses the regulatory frameworks in place to formally recognize the trail, the ownership and management, existing conditions and crossing procedures unique to the NET.

3.1 NEW ENGLAND NATIONAL SCENIC TRAIL

The proposed Wright to Dracut Pipeline Segment S of the Project crosses the NET at six locations in the Towns of Bloomfield, West Hartford and Farmington, Hartford County, Connecticut at approximate MP 0.11, MP 0.14, MP 0.35, MP 0.92, MP 2.94 and MP 5.42, all located on NPS properties (New England Trail 2015; U.S. Geological Service ["USGS"] 2012), see Figure 3-1, New England National Scenic Trail Crossings (Attachment A). The NET in these areas is managed and maintained by the Connecticut Forest and Park Association ("CFPA") in partnership with the AMC and NPS (New England Trail 2015).

3.1.1 Regulatory Setting

This section details the statutes and regulatory frameworks in place to formally recognize the NET, implement the administration and management of the NET, and regulate activities potentially affecting the NET. This section also details the ownership and management at the proposed crossing location to identify the proper administering agency for review and authorization.

3.1.1.1 Omnibus Public Land Management Act of 2009

Section 5202 of the Omnibus Public Land Management Act of 2009 (PL 111-11) ("Act") amends the National Trails System Act to include the NET and directs the Secretary of the Interior, in cooperation with the NPS, Secretary of Agriculture and state and local governments, and private citizens, to protect and administer the NET. The Act designates the 'Metacomet Monadnock Mattabesset Trail System National Scenic Trail Feasibility Study and Environmental Assessment', prepared by the NPS and dated spring 2006, as the framework or "Trail Management Blueprint" for management and administration of the NET. The Secretary is authorized to enter into cooperative agreements with the State of Connecticut (and its political subdivisions), and other regional, local, and private organizations deemed necessary and desirable to accomplish cooperative trail administrative, management, and protection objectives consistent with the Trail Management Blueprint (Government Printing Office ["GPO"] 2015).

3.1.2 Pre-Construction Notification

Tennessee will notify the NPS at least 30 days prior to the anticipated start of construction, or any planned surface disturbing activities, on NPS property. Table 3.1-1 lists the contact information for all Trail Partners.

Table 3.1-1
New England National Scenic Trail Management Partner's Contact Information

Trail Partner	Contact	Information
CFPA	Eric Hammerling – Executive Director	Connecticut Forest and Park Association 16 Meriden Rd, Rockfall, CT 06481 Tel: (860) 346-2372
NPS	Charlie Tracy	National Park Service Northeast Regional Office 15 State Street Boston, MA 02109-3572 Tel: (617) 223-5200

Sources: GPO 2015; New England Trail 2015.

3.1.3 Existing Conditions

Segment S crosses the NET six times at MP 0.11, MP 0.14, MP 0.35, MP 0.92, MP 2.94 and MP 5.42 in the Towns of Bloomfield, West Hartford and Farmington, see Figure 3-1, New England National Scenic Trail Crossings (Attachment A). The NET in a general north to south direction and is crossed by the existing Connecticut Light & Power ("CL&P") powerline ROW, as well as an existing Tennessee Gas Pipeline easement. To minimize impacts along the proposed Project route in this area, Tennessee has co-located the Project with the CL&P powerline from MP 0.00 through MP 0.62 and MP 4.42 through MP 5.46; and the existing Tennessee gas pipeline easement from MP 0.62 through MP 4.42. Tennessee is currently negotiating survey permission on NPS property that is crossed by the Project. As of the date of this plan Tennessee has not had access to the NET crossing. A site characterization has been performed using publicly available data.

3.1.3.1 Vegetation

The major cover type traversed by the Project within the NET crossings is upland forest, based on aerial mapping. Open land/ROW is also present at the crossings. Vegetation community types in the vicinity of the crossings will be identified by MP as part of an environmental survey, once Tennessee is granted site access. General descriptions of the community types are included in the following sections.

Upland Forests

Upland forests are present at the NET proposed pipeline crossing locations. A description of the general forest type and specific vegetation present will be included here once survey access is granted.

Open Lands

Open land at the NET crossings consist of CL&P's existing powerline facilities, which is maintained in an herbaceous/shrub cover. Specific vegetation present within the maintained CL&P powerline corridor will be described here once a detailed site characterization has been performed.

3.1.4 Aesthetics

A detailed description of the aesthetics will be included once Tennessee is granted site access.

Tennessee has co-located Segment S with the existing CL&P powerline ROW and existing Tennessee gas pipeline easement (thus following existing forest edges), which minimizes the acreage of forest lands crossed. An additional 50 feet of new maintained ROW to accommodate the Segment S pipeline at the NET crossing locations will be required during post-construction operation of the facilities.

Following construction, all workspaces will be stabilized and re-vegetated in accordance with the ECP.

3.1.5 Specific Crossing Procedures

In addition to the crossing procedures outlined in Section 2.0, this section outlines crossing details and procedures that are unique to the NET crossing.

3.1.5.1 Temporary Workspace and Post Construction ROW

Tennessee proposes to co-locate the proposed Segment S pipeline with CL&P's existing powerline ROW and an existing Tennessee pipeline easement. By routing the Project in this manner, Tennessee will minimize the amount of new disturbance associated with the installation of the new pipeline.

The construction ROW at the crossings of the NET, are generally 95 feet in width, utilizing 10 feet of existing maintained ROW associated with the CL&P's powerline and 85 feet of new ROW associated with the new Segment S pipeline facilities (see Appendix B – Plans 3-2, A-C, New England National Scenic Trail Crossing Plan).

3.1.5.2 Affected Land

NET Crossings at MP 0.11 and 0.14

During construction, the proposed Project will temporarily affect a total of approximately 0.33 acres of land at the MP 0.11 and 0.14 crossings. Of the 0.33 acre, approximately 0.09 acre will consist of the new permanent ROW required for operation of the new pipeline, and 0.24 acre will consist of temporary workspace ("TWS") and additional temporary workspace ("ATWS") (see Appendix B – Plan 3-1, New England National Scenic Trail Crossing Plan).

NET Crossing at MP 0.35

During construction, the proposed Project will temporarily affect a total of approximately 0.05 acre of land at the MP 0.35 crossing. Of the 0.05 acre, approximately 0.02 acre will consist of the new permanent ROW required for operation of the new pipeline, and 0.03 acre will consist of TWS and ATWS (see Appendix B – Plan 3-1, New England National Scenic Trail Crossing Plan).

NET Crossing at MP 0.92

During construction, the proposed Project will temporarily affect a total of approximately 0.07 acre of land at the MP 0.92 crossing. Of the 0.07 acre, approximately 0.02 acre will consist of the new permanent ROW required for operation of the new pipeline, and 0.05 acre will consist of TWS and ATWS (see Appendix B – Plans3-1, New England National Scenic Trail Crossing Plan).

NET Crossing at MP 2.94

During construction, the proposed Project will temporarily affect a total of approximately 0.11 acre of land at the MP 2.94 crossing. Of the 0.11 acre, approximately 0.02 acre will consist of the new permanent ROW required for operation of the new pipeline, and 0.09 acre will consist of TWS and ATWS (see Appendix B – Plan 3-1, New England National Scenic Trail Crossing Plan).

NET Crossing at MP 5.42

During construction, the proposed Project will temporarily affect a total of approximately 0.05 acre of land at the MP 5.42 crossing. Of the 0.05 acre, approximately 0.02 acre will consist of the new permanent ROW required for operation of the new pipeline, and 0.03 acre will consist of TWS and ATWS (see Appendix B – Plan 3-1, New England National Scenic Trail Crossing Plan).

3.1.5.3 Access

During construction, Tennessee will utilize the ROW, as well as temporary AR NED-TAR-S-0100 (TAR-0100), to access the NET crossing locations. During construction, Tennessee will use signs and safety/exclusion fencing to cordon off the AR area from the NET to allow hikers safe passage along the AR area and across the construction ROW.

3.1.5.4 Cultural Resources Protection

To minimize the potential for the accidental discovery of cultural resources, Tennessee will conduct a detailed archaeological reconnaissance of the proposed Project area at the NET crossings, once site access is granted. To ensure that Tennessee maintains full and complete compliance with all federal and state regulations concerning the protection of cultural resources, a Plan for Unanticipated Discoveries of Cultural Resources and Human Remains (Attachment N6 to the ECP) has been prepared for the Project.

4.0 OPERATIONS AND MAINTENANCE

The Project will be owned, operated, and maintained by Tennessee. Tennessee will operate and maintain the newly constructed pipeline facilities in the same manner as it currently operates and maintains its existing interstate pipeline facilities in accordance with the requirements of the Commission, the U.S. Department of Transportation's ("USDOT's") Pipeline and Hazardous Materials Safety Administration ("PHMSA") pursuant to 49 Code of Federal Regulations ("CFR") Part 192, and industry-proven practices and techniques.

The facilities will be operated and maintained in a manner that pipeline integrity is protected to ensure that a safe and continuous supply of natural gas reaches its ultimate destination. Maintenance activities will include regularly scheduled gas-leak surveys and measures necessary to repair any potential leaks. The latter may include repair or replacement of pipe segments. All fence posts, signs, marker posts, aerial markers, and decals will be maintained to ensure that the pipeline locations are visible from the air and ground. The pipeline and aboveground facilities will be patrolled on a routine basis, and personnel qualified to perform both emergency and routine maintenance on interstate pipeline facilities will handle maintenance.

The Project facilities will be patrolled on a periodic basis, as are Tennessee's existing facilities. This will provide information on possible leaks, construction activities, erosion, exposed pipe, population density, possible encroachment, and any other potential problems that may affect the safety and operation of the pipeline. In addition, Tennessee is a participant in both the "Call Before You Dig" system for Connecticut and the National "811" call system. Under these systems, anyone planning excavation activities must call a dedicated telephone number to alert all utility companies. Representatives of the utility companies that may be affected then visit the site and mark their facilities so that the excavation can proceed with relative certainty as to the location of all underground lines. In addition, Tennessee employs damage prevention personnel responsible for monitoring, inspecting, and assessing all third-party activities near Tennessee's pipeline facilities.

Other maintenance functions will include:

- Periodic seasonal vegetation management of the Project ROW in accordance with the timing restrictions outlined in Tennessee's Project-specific ECPs for each state;
- Terrace repair, backfill replacement, and drain tile repair as necessary;
- Periodic inspection of water crossings; and
- Maintenance of a supply of emergency pipe, leak repair clamps, sleeves, and other equipment needed for repair activities.

Erosion problems on the pipeline ROW will be reported to the local operations supervisor. These reports may originate from landowners or company personnel performing routine patrols. Corrective measures will be conducted as needed.

5.0 REFERENCES

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GPO. 2015. Omnibus Public Land Management Act of 2009 (Public Law 111-11). [Online WWW]. Available URL: http://www.gpo.gov/fdsys/pkg/PLAW-111publ11/pdf/PLAW-111publ11.pdf . [Accessed October 8, 2015].

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Attachment A

FIGURES

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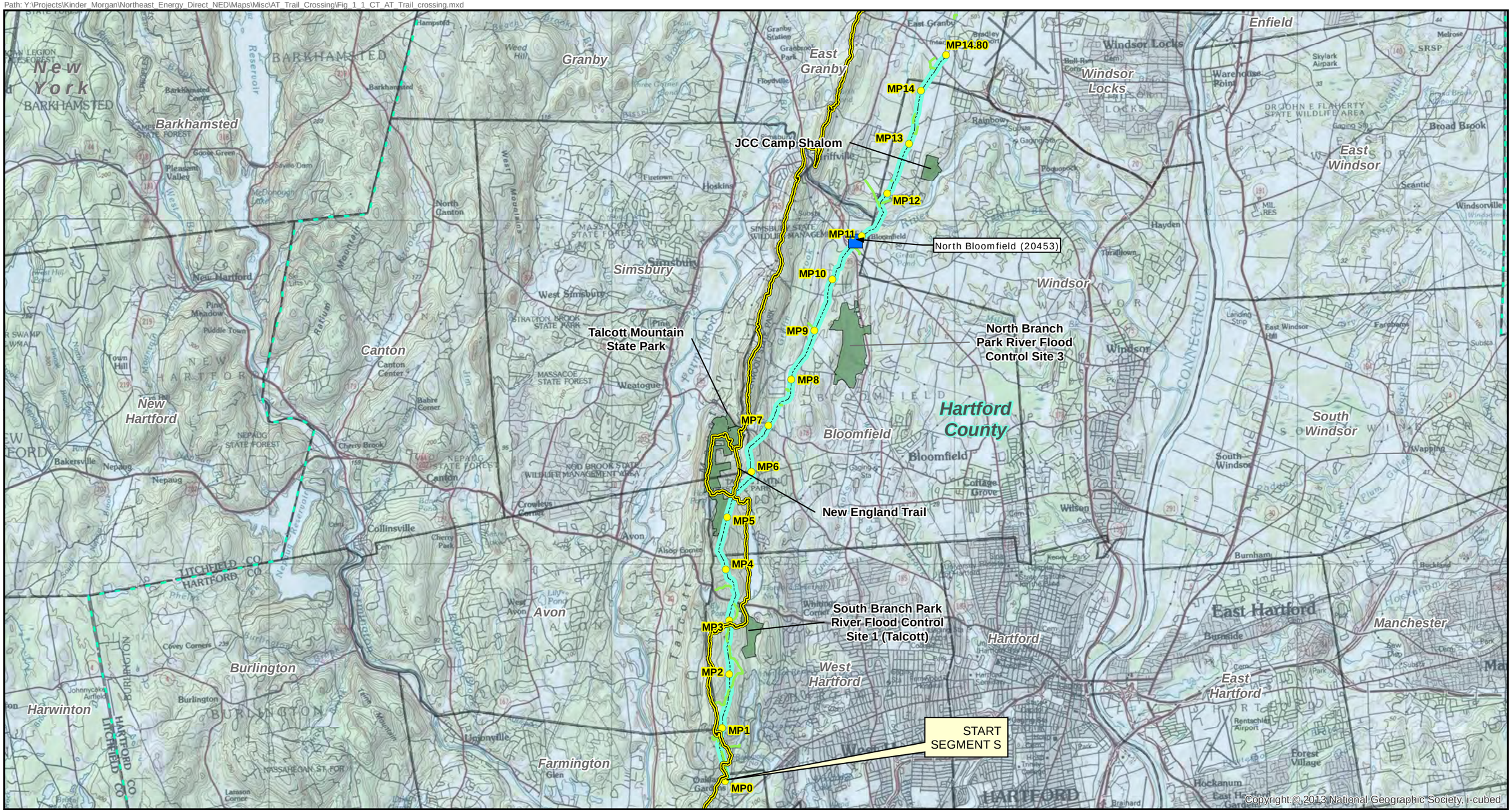

Index Map

Legend

- Milepost (MP)
- NED 300 Line CT Loop
- Access Road
- Compressor Station
- Meter Station
- County Boundary
- State Boundary
- Town Boundary
- Trails
- Federal and State Recreational Lands

N
W E
S

Tennessee Gas Pipeline Company, L.L.C.

Northeast Energy Direct Project

Trails Crossed by the Project in Connecticut

0 0.5 1 2 Miles

1 inch = 9,000 feet

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

November 2015

FIGURE 1-1

Map Projection: NAD83 UTM18N Ft.

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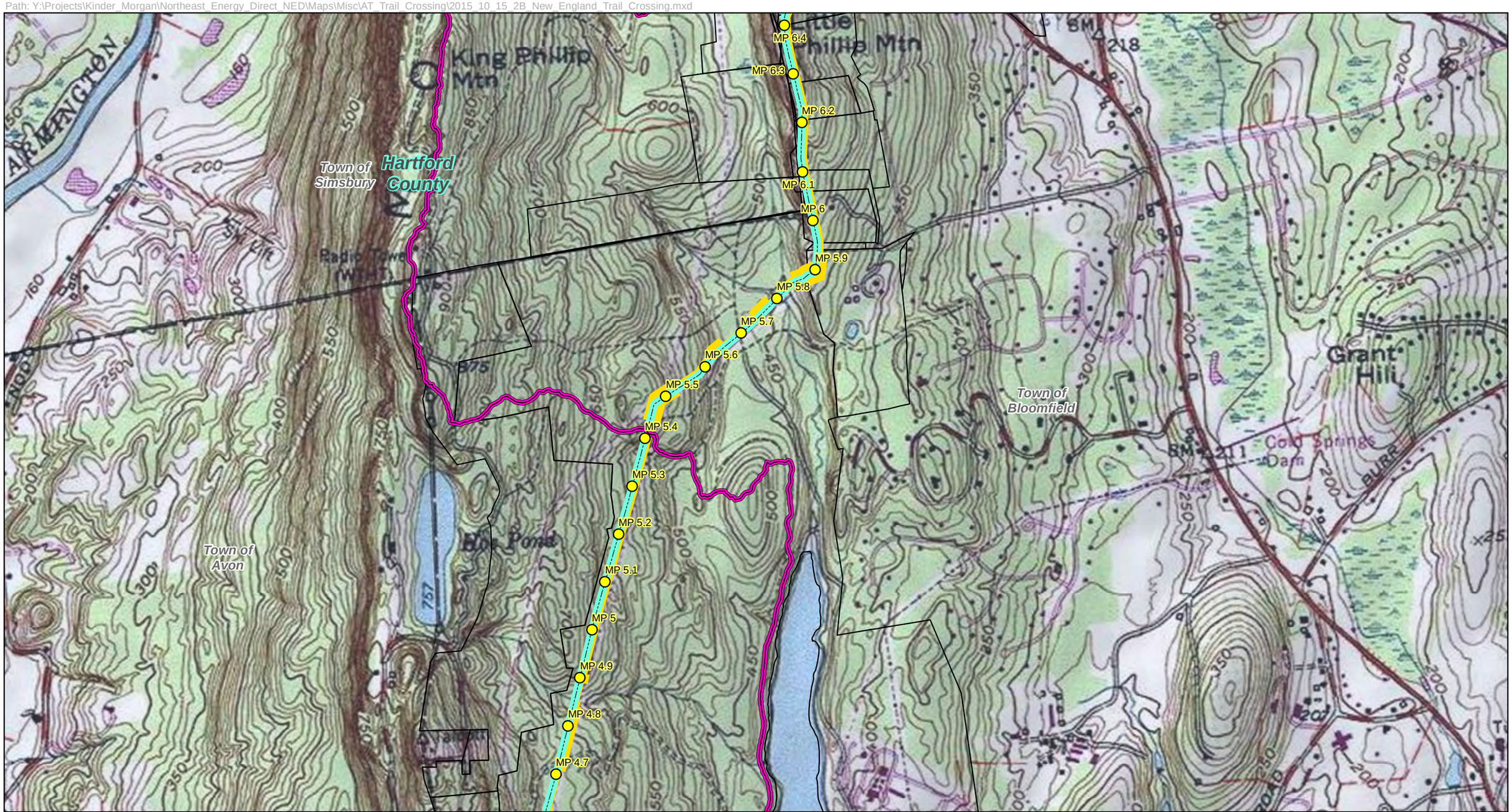
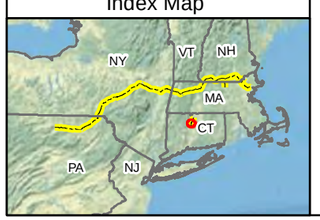


Index Map



Legend

- Mileposts
- NED 300 Line CT Loop
- Access Roads
- Construction Footprint
- NewEnglandTrail
- Parcel Boundary
- Town Boundary
- County Boundary
- State Boundary

N
W E
S

Tennessee Gas Pipeline Company, L.L.C.

Northeast Energy Direct Project

New England Trail Crossing
Hartford County, Connecticut

0 500 1,000 2,000 Feet

1 inch = 1,000 feet

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

AECOM

November 2015

Figure 3-1A

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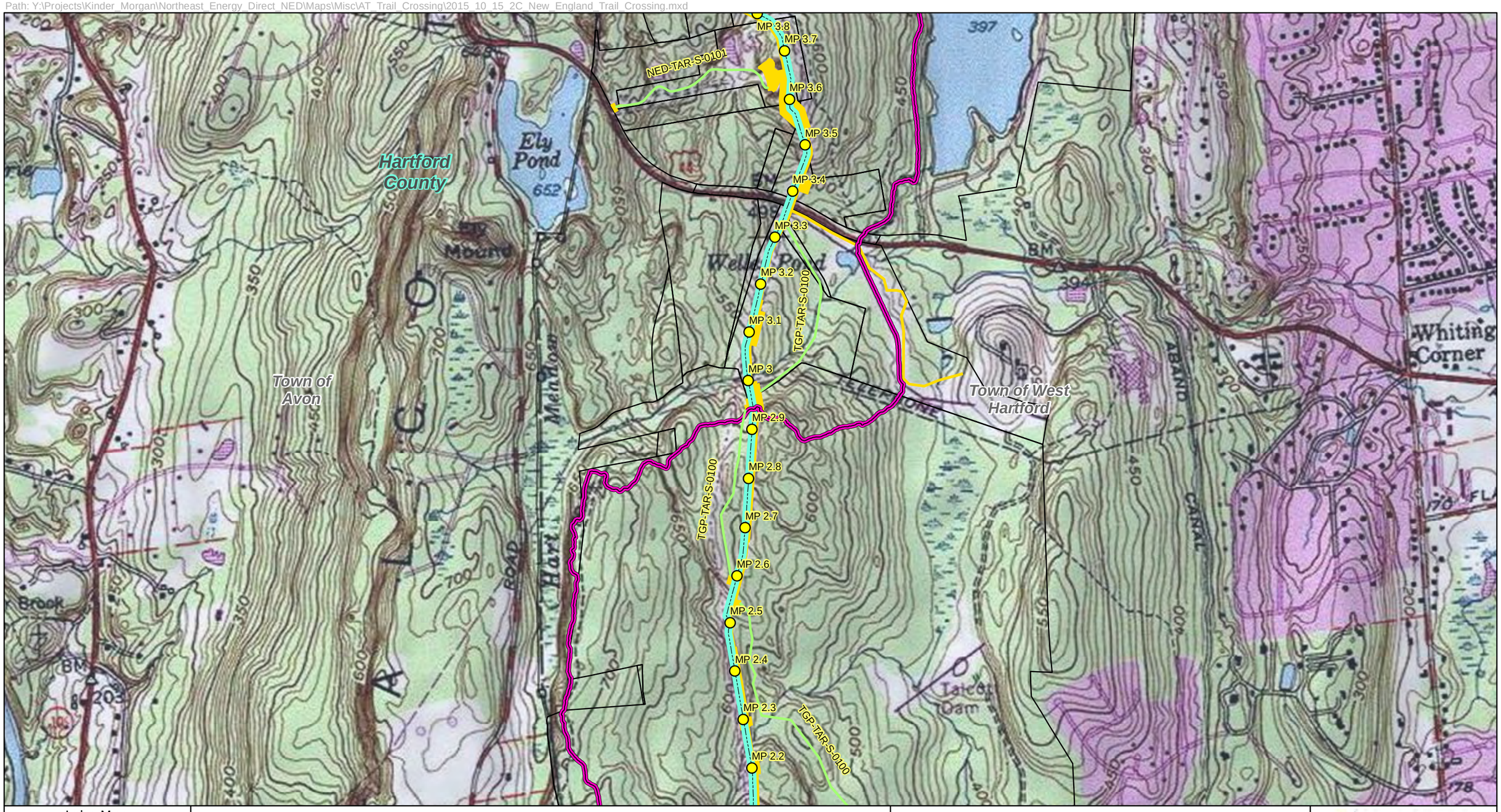
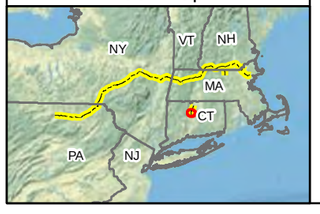


Index Map



Legend

- Mileposts
- NED 300 Line CT Loop
- Access Roads
- Construction Footprint
- NewEnglandTrail
- Parcel Boundary
- Town Boundary
- County Boundary
- State Boundary

N
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S

Tennessee Gas Pipeline Company, L.L.C.

Northeast Energy Direct Project

New England Trail Crossing
Hartford County, Connecticut

0 500 1,000 2,000 Feet

1 inch = 1,000 feet

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

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November 2015

Figure 3-1B

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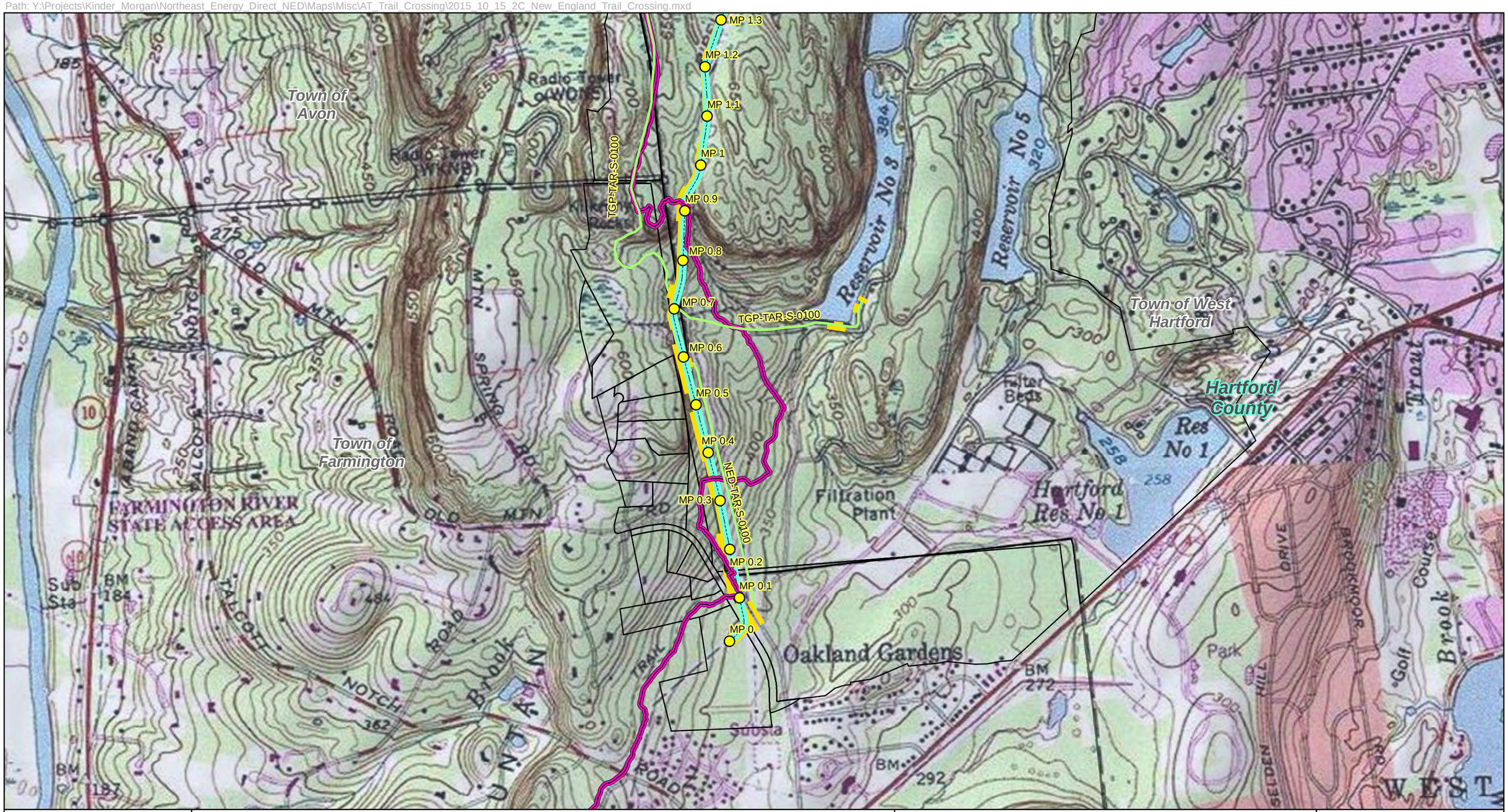

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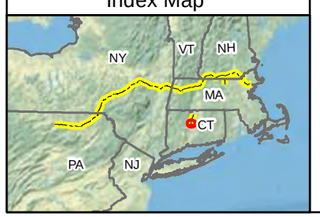

Legend

- Mileposts
- NED 300 Line CT Loop
- Access Roads
- Construction Footprint
- NewEnglandTrail
- Parcel Boundary
- Town Boundary
- County Boundary
- State Boundary

N
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S

Tennessee Gas Pipeline Company, L.L.C.

Northeast Energy Direct Project

New England Trail Crossing
Hartford County, Connecticut

0 500 1,000 2,000 Feet

1 inch = 1,000 feet

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

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November 2015

Figure 3-1C

Attachment B

PLANS

Plan 3-1 New England National Scenic Trail Crossing Plans

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Legend:

- Centerline New England National Scenic Trail
- Impacts to 20 foot Wide Trail Corridor
- Property Parcel Boundaries
- Centerline of Proposed Pipeline (300 Line CT Loop Segment S)
- Access Roads
- Permanent Workspace
- Temporary Workspace
- ATWS Workspace
- Mile Markers
- Construction Fence

Summary of Impacts Within the New England National Scenic Trail Corridor for Segment S of the Northeast Energy Direct Project

Facility[1]	Land Affected During Construction (acres)[2]	Land Affected During Operation (acres)[3]
New England National Scenic Trail Corridor	0.33	0.09

1: The width of the New England Scenic Trail is 20-feet.

2: Land Affected During Construction includes all temporary impacts within the New England National Scenic Trail Corridor, including Land Affected During Operation.

3: Land Affected During Operation includes only new permanent ROW within the New England National Scenic Trail Corridor.

50 0 100

1" = 100'

AECOM

PROJECT

NORTHEAST ENERGY
PIPELINE COMPANY, L.L.C.

New England National Scenic Trail
Crossing
Hartford County, Connecticut

PREPARED FOR

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

Tennessee Gas Pipeline Company, L.C.C.
P.O. Box 2511
Houston, Texas 77252-2511

PREPARED BY

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www.aecom.com

DATE

November 2015

PROJECT NUMBER

60328763

SHEET TITLE

Plan 3-1
New England National Scenic Trail Crossing Plan - Connecticut Crossing #1

SHEET NUMBER

1 of 6

Legend:

- Centerline New England National Scenic Trail
- Impacts to 20 foot Wide Trail Corridor
- Property Parcel Boundaries
- Centerline of Proposed Pipeline (300 Line CT Loop Segment S)
- Access Roads
- Permanent Workspace
- Temporary Workspace
- ATWS Workspace
- Mile Markers
- Construction Fence

Summary of Impacts Within the New England National Scenic Trail Corridor for Segment S of the Northeast Energy Direct Project		
Facility[1]	Land Affected During Construction (acres)[2]	Land Affected During Operation (acres)[3]
New England National Scenic Trail Corridor	0.05	0.02

1: The width of the New England Scenic Trail is 20-feet.

2: Land Affected During Construction includes all temporary impacts within the New England National Scenic Trail Corridor, including Land Affected During Operation.

3: Land Affected During Operation includes only new permanent ROW within the New England National Scenic Trail Corridor.

50 0 100

1" = 100'

AECOM

PROJECT

NORTHEAST ENERGY
PIPELINE COMPANY, L.L.C.

New England National Scenic Trail
Crossing
Hartford County, Connecticut

PREPARED FOR

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

Tennessee Gas Pipeline Company, L.C.C.
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DATE

November 2015

PROJECT NUMBER

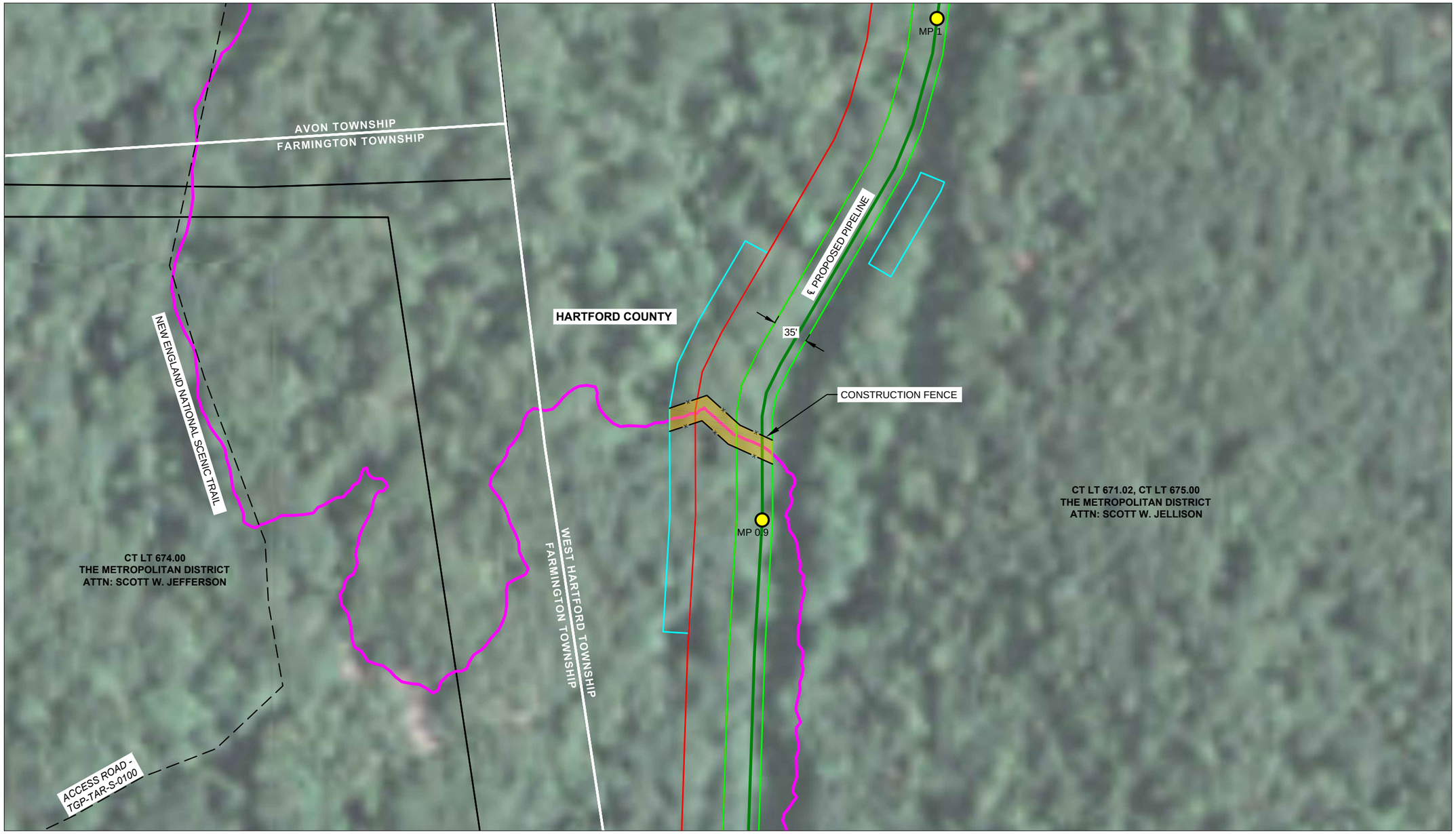
60328763

SHEET TITLE

Plan 3-1
New England National Scenic Trail Crossing Plan - Connecticut Crossing #2

SHEET NUMBER

2 of 6



Legend:

- Centerline New England National Scenic Trail
- Impacts to 20 foot Wide Trail Corridor
- Property Parcel Boundaries
- Centerline of Proposed Pipeline (300 Line CT Loop Segment S)
- Access Roads
- Permanent Workspace
- Temporary Workspace
- ATWS Workspace
- Mile Markers
- Construction Fence

Summary of Impacts Within the New England National Scenic Trail Corridor for Segment S of the Northeast Energy Direct Project		
Facility[1]	Land Affected During Construction (acres)[2]	Land Affected During Operation (acres)[3]
New England National Scenic Trail Corridor	0.07	0.02

1: The width of the New England Scenic Trail is 20-feet.

2: Land Affected During Construction includes all temporary impacts within the New England National Scenic Trail Corridor, including Land Affected During Operation.

3: Land Affected During Operation includes only new permanent ROW within the New England National Scenic Trail Corridor.

50 0 100

1" = 100'

AECOM

PROJECT

NORTHEAST ENERGY
PIPELINE COMPANY, L.L.C.

New England National Scenic Trail Crossing
Hartford County, Connecticut

PREPARED FOR

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

Tennessee Gas Pipeline Company, L.C.C.
P.O. Box 2511
Houston, Texas 77252-2511

PREPARED BY

AECOM
701 Corporate Center Drive,
Suite 475
Raleigh, North Carolina 27607
919.854.6200 tel
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www.aecom.com

DATE

November 2015

PROJECT NUMBER

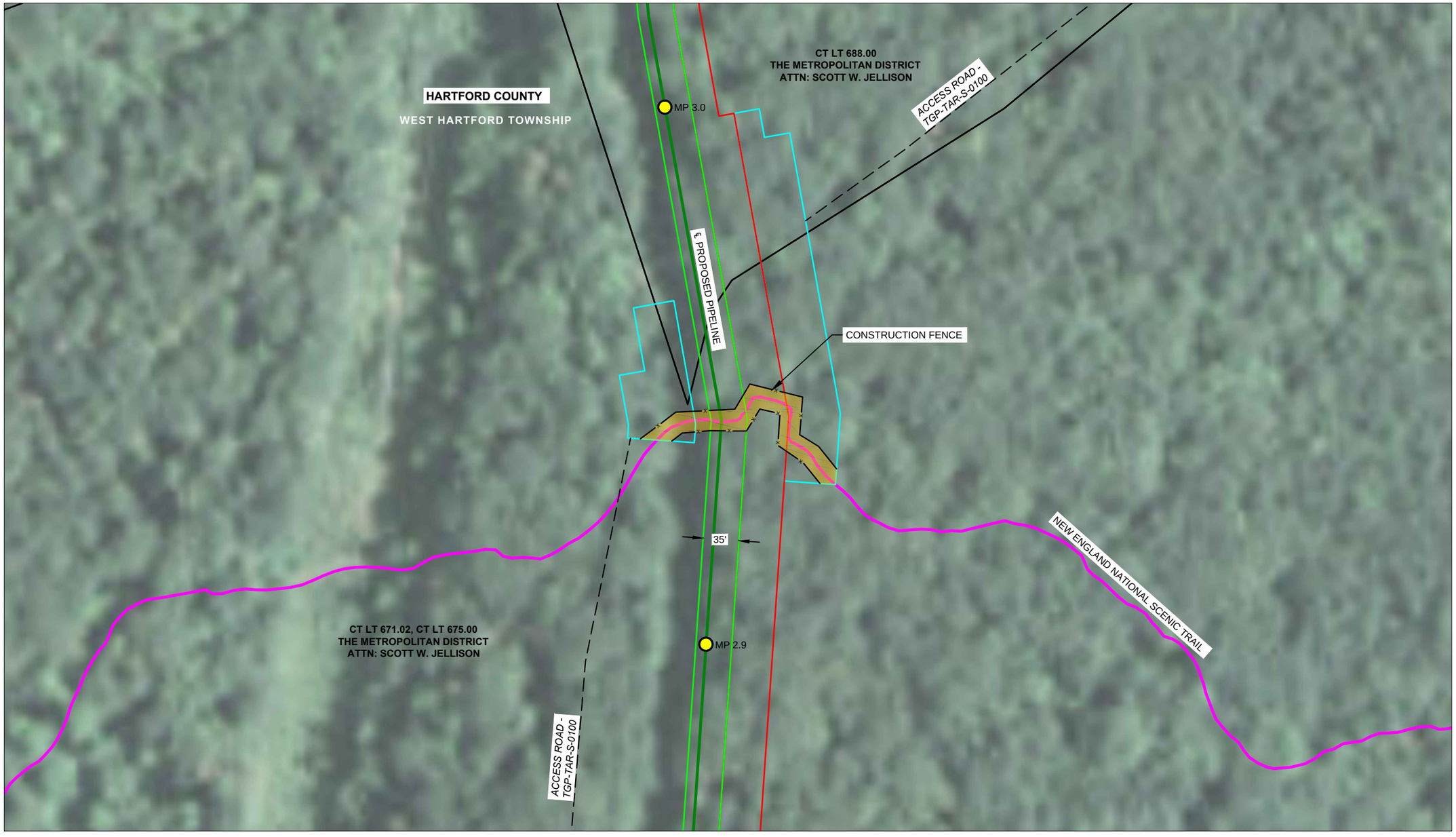
60328763

SHEET TITLE

Plan 3-1
New England National Scenic Trail Crossing Plan - Connecticut Crossing #3

SHEET NUMBER

3 of 6



Legend:

- Centerline New England National Scenic Trail
- Impacts to 20 foot Wide Trail Corridor
- Property Parcel Boundaries
- Centerline of Proposed Pipeline (300 Line CT Loop Segment S)
- Access Roads
- Permanent Workspace
- Temporary Workspace
- ATWS Workspace
- Mile Markers
- Construction Fence

Summary of Impacts Within the New England National Scenic Trail Corridor for Segment S of the Northeast Energy Direct Project		
Facility[1]	Land Affected During Construction (acres)[2]	Land Affected During Operation (acres)[3]
New England National Scenic Trail Corridor	0.11	0.02

1: The width of the New England Scenic Trail is 20-feet.

2: Land Affected During Construction includes all temporary impacts within the New England National Scenic Trail Corridor, including Land Affected During Operation.

3: Land Affected During Operation includes only new permanent ROW within the New England National Scenic Trail Corridor.

50 0 100

1" = 100'

AECOM

PROJECT

NORTHEAST ENERGY PIPELINE COMPANY, L.L.C.

New England National Scenic Trail Crossing
Hartford County, Connecticut

PREPARED FOR

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

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DATE

November 2015

PROJECT NUMBER

60328763

SHEET TITLE

**Plan 3-1
New England National Scenic Trail Crossing Plan - Connecticut Crossing #4**

SHEET NUMBER

4 of 6

Legend:

- Centerline New England National Scenic Trail
- Impacts to 20 foot Wide Trail Corridor
- Property Parcel Boundaries
- Centerline of Proposed Pipeline (300 Line CT Loop Segment S)
- Access Roads
- Permanent Workspace
- Temporary Workspace
- ATWS Workspace
- Mile Markers
- Construction Fence

Summary of Impacts Within the New England National Scenic Trail Corridor for Segment S of the Northeast Energy Direct Project		
Facility[1]	Land Affected During Construction (acres)[2]	Land Affected During Operation (acres)[3]
New England National Scenic Trail Corridor	0.05	0.02

1: The width of the New England Scenic Trail is 20-feet.

2: Land Affected During Construction includes all temporary impacts within the New England National Scenic Trail Corridor, including Land Affected During Operation.

3: Land Affected During Operation includes only new permanent ROW within the New England National Scenic Trail Corridor.

N

50 0 100

1" = 100'

AECOM

PROJECT

NORTHEAST ENERGY
PIPELINE COMPANY, L.L.C.

New England National Scenic Trail Crossing
Hartford County, Connecticut

PREPARED FOR

Tennessee Gas Pipeline Company, L.L.C.
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PROJECT NUMBER

60328763

SHEET TITLE

Plan 3-1
New England National Scenic Trail Crossing Plan - Connecticut Crossing #5

SHEET NUMBER

5 of 6

New England National Scenic Trail Crossing Plan Drawing "Construction Notes":

1. Tennessee will provide the NPS with notification 30 days prior to the anticipated start of construction and notification at least 10 days prior to entry onto NPS lands for the commencement of construction.

2. Proposed workspace limits will be clearly marked in the field prior to construction to prevent inadvertent clearing of unauthorized areas.

3. Appropriate safety/exclusion fencing, and signs will be installed along the New England National Scenic Trail across the ROW and at intersecting access roads prior to the initiation of construction activities within the New England National Scenic Trail Corridor.

4. Signs notifying hikers of construction will be placed along the New England National Scenic Trail approximately 150 feet to either side of the construction ROW and intersecting access roads.

5. During periods of construction activities requiring an alternative trail route to be employed, signs will be posted at the intersections of the New England National Scenic Trail and the alternate trail, which will identifying the temporary closure and location of reroute. Temporary safety/exclusion fencing will be installed across the entrance to the closed portion of each trail.

6. During construction activities across the New England National Scenic Trail requiring hikers to be escorted across the construction ROW, Tennessee will assess the volume of hiker traffic during construction and if necessary, staff the New England National Scenic Trail crossing with safety personnel to inform hikers of the construction and safely escort pedestrian traffic across the workspace.

7. Depending on the construction activity and when construction activity at the New England National Scenic Trail footpath crossing would necessitate, pedestrian traffic will be escorted along the edge of the workspace to a cordoned-off crossing of the construction ROW set up a safe distance away.

8. If necessary, a temporary crossing of the trench will be installed to allow pedestrian traffic to safely cross the construction ROW.

9. During discrete blasting activities, Tennessee will establish a 1,000-foot exclusion zone for safety within which all non-essential personnel, including hikers, will not be permitted.

10. During discrete blasting activities, Tennessee will post safety personnel at both the north and south intersections of the New England National Scenic Trail and the 1,000-foot exclusion zone to assure that no hikers enter the exclusion zone during discrete blasting activities.

11. Restoration and re-seeding/re-planting of disturbed areas in the New England National Scenic Trail Corridor will be conducted in accordance with Tennessee's Northeast Energy Direct -Environmental Construction Plan for Connecticut.

Summary of Construction Activities and Access Methods At Trail Crossing

Activity[1]	Activity Type	Access Method	Approximate Duration
Surveying and flagging of limit of construction	Site Preparation	Unescorted	Not Applicable
Installation of construction exclusion fencing along the trails	Site Preparation	Unescorted	Not Applicable
Installation of signs identifying upcoming construction activities	Site Preparation	Unescorted	Not Applicable
Tree Felling	Discrete Period	Escorted	1 - Day
Tree and vegetation clearing of workspace[2]	Discrete Period	Escorted	1 - Day
Installation of erosion control devices	Site Preparation	Unescorted	Not Applicable
Grading of workspace[2]	Discrete Period	Escorted	1 - 2 Days
Stringing of pipe	General Construction	Escorted	1 - Day
Blasting[2,3]	Discrete Period	Escorted	2 - Days
Trenching up to trails	General Construction	Escorted	1 - Day
Trenching across trails, lowering-in, welding, weld inspection, pipe coating, backfill	Discrete Period	Escorted	1 - 2 Days
Restoration of ROW / planting activities	General Construction	Escorted	1 - 2 Days
Post-construction monitoring	Post-Construction	Unescorted	Not Applicable

1. Activities are listed in a general chronological order, although actual activities may occur out of sequence.
2. Timing of discrete periods is dependent largely on site conditions encountered at the trail crossing at the start of construction.
3. Timing of blasting activities may result in a momentary interruption of trail access.

AECOM

PROJECT

NORTHEAST ENERGY
PIPELINE COMPANY, L.L.C.

New England National Scenic Trail
Crossing Plan
Franklin County, Massachusetts

PREPARED FOR

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

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November 2015

PROJECT NUMBER

60328763

SHEET TITLE

Plan 3-1
New England National Scenic Trail Crossing Plan - Construction Notes and Activities Connecticut

SHEET NUMBER

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

ATTACHMENT N14

TENNESSEE'S UPLAND EROSION CONTROL, REVEGETATION, AND MAINTENANCE PLAN

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TABLE OF CONTENTS

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Tennessee's Upland Erosion Control, Revegetation, and Maintenance Plan document ("Plan") is based in its entirety on the Federal Energy Regulatory Commission's *Upland Erosion Control, Revegetation and Maintenance Plan* (May 2013 version) ("Commission's Plan"). Tennessee has identified certain modifications to the provisions of the Commission's Plan and is requesting approval of these modifications, specific to the Northeast Energy Direct Project as part of the Environmental Report submitted for the Project. Justifications for these requested modifications are set forth in Tennessee's Project-Specific Environmental Construction Plans for each state, and are identified in bold text below.

I. APPLICABILITY

A. The intent of this Plan is to assist project sponsors by identifying baseline mitigation measures for minimizing erosion and enhancing revegetation. Project sponsors shall specify in their applications for a new FERC authorization and in prior notice and advance notice filings, any individual measures in this Plan they consider unnecessary, technically infeasible, or unsuitable due to local conditions and fully describe any alternative measures they would use. Project sponsors shall also explain how those alternative measures would achieve a comparable level of mitigation.

Once a project is authorized, project sponsors can request further changes as variances to the measures in this Plan (or the applicant's approved plan). The Director of the Office of Energy Projects (Director) will consider approval of variances upon the project sponsor's written request, if the Director agrees that a variance:

1. Provides equal or better environmental protection;
2. Is necessary because a portion of this Plan is infeasible or unworkable based on project-specific conditions; or
3. Is specifically required in writing by another federal, state, or Native American land management agency for the portion of the project on its land or under its jurisdiction.

Sponsors of projects planned for construction under the automatic authorization provisions in the FERC's regulations must receive written approval for any variances in advance of construction.

Project-related impacts on wetland and waterbody systems are addressed in the staff's Wetland and Waterbody Construction and Mitigation Procedures (Procedures).

II. SUPERVISION AND INSPECTION

A. ENVIRONMENTAL INSPECTION

1. At least one Environmental Inspector is required for each construction spread during construction and restoration (as defined by section V). The number and experience of Environmental Inspectors assigned to each construction spread shall be appropriate for the length of the construction spread and the number/significance of resources affected.

2. Environmental Inspectors shall have peer status with all other activity inspectors.
3. Environmental Inspectors shall have the authority to stop activities that violate the environmental conditions of the FERC's Orders, stipulations of other environmental permits or approvals, or landowner easement agreements; and to order appropriate corrective action.

B. RESPONSIBILITIES OF ENVIRONMENTAL INSPECTORS

At a minimum, the Environmental Inspector(s) shall be responsible for:

1. Inspecting construction activities for compliance with the requirements of this Plan, the Procedures, the environmental conditions of the FERC's Orders, the mitigation measures proposed by the project sponsor (as approved and/or modified by the Order), other environmental permits and approvals, and environmental requirements in landowner easement agreements.
2. Identifying, documenting, and overseeing corrective actions, as necessary to bring an activity back into compliance;
3. Verifying that the limits of authorized construction work areas and locations of access roads are visibly marked before clearing, and maintained throughout construction;
4. Verifying the location of signs and highly visible flagging marking the boundaries of sensitive resource areas, waterbodies, wetlands, or areas with special requirements along the construction work area;
5. Identifying erosion/sediment control and soil stabilization needs in all areas;
6. Ensuring that the design of slope breakers will not cause erosion or direct water into sensitive environmental resource areas, including cultural resource sites, wetlands, waterbodies, and sensitive species habitats;
7. Verifying that dewatering activities are properly monitored and do not result in the deposition of sand, silt, and/or sediment into sensitive environmental resource areas, including wetlands, waterbodies, cultural resource sites, and sensitive species habitats; stopping dewatering activities if such deposition is occurring and ensuring the design of the discharge is changed to prevent reoccurrence; and verifying that dewatering structures are removed after completion of dewatering activities;
8. Ensuring that subsoil and topsoil are tested in agricultural and residential areas to measure compaction and determine the need for corrective action;
9. Advising the Chief Construction Inspector when environmental conditions (such as wet weather or frozen soils) make it advisable to restrict or delay construction activities to avoid topsoil mixing or excessive compaction;
10. Ensuring restoration of contours and topsoil;
11. Verifying that the soils imported for agricultural or residential use are certified as free of noxious weeds and soil pests, unless otherwise approved by the landowner;
12. Ensuring that erosion control devices are properly installed to prevent sediment flow into sensitive environmental resource areas (e.g., wetlands, waterbodies, cultural resource sites, and sensitive species habitats) and onto roads, and determining the need for additional erosion control devices;
13. Inspecting and ensuring the maintenance of temporary erosion control measures at least:
    a. On a daily basis in areas of active construction or equipment operation;
    b. On a weekly basis in areas with no construction or equipment operation; and
    c. Within 24 hours of each 0.5 inch of rainfall;

14. Ensuring the repair of all ineffective temporary erosion control measures within 24 hours of identification, or as soon as conditions allow if compliance with this time frame would result in greater environmental impacts;
15. Keeping records of compliance with the environmental conditions of the FERC's Orders, and the mitigation measures proposed by the project sponsor in the application submitted to the FERC, and other federal or state environmental permits during active construction and restoration;
16. Identifying areas that should be given special attention to ensure stabilization and restoration after the construction phase; and
17. Verifying that locations for any disposal of excess construction materials for beneficial reuse comply with section III.E.

III. PRECONSTRUCTION PLANNING

The project sponsor shall do the following before construction:

A. CONSTRUCTION WORK AREAS

1. Identify all construction work areas (e.g., construction right-of-way, extra work space areas, pipe storage and contractor yards, borrow and disposal areas, access roads) that would be needed for safe construction. The project sponsor must ensure that appropriate cultural resources and biological surveys are conducted, as determined necessary by the appropriate federal and state agencies.
2. Project sponsors are encouraged to consider expanding any required cultural resources and endangered species surveys in anticipation of the need for activities outside of authorized work areas.
3. Plan construction sequencing to limit the amount and duration of open trench sections, as necessary, to prevent excessive erosion or sediment flow into sensitive environmental resource areas.

B. DRAIN TILE AND IRRIGATION SYSTEMS

1. Attempt to locate existing drain tiles and irrigation systems.
2. Contact landowners and local soil conservation authorities to determine the locations of future drain tiles that are likely to be installed within 3 years of the authorized construction.
3. Develop procedures for constructing through drain-tiled areas, maintaining irrigation systems during construction, and repairing drain tiles and irrigation systems after construction.
4. Engage qualified drain tile specialists, as needed to conduct or monitor repairs to drain tile systems affected by construction. Use drain tile specialists from the project area, if available.

C. GRAZING DEFERMENT

Develop grazing deferment plans with willing landowners, grazing permittees, and land management agencies to minimize grazing disturbance of revegetation efforts.

D. ROAD CROSSINGS AND ACCESS POINTS

Plan for safe and accessible conditions at all roadway crossings and access points during construction and restoration.

E. DISPOSAL PLANNING

Determine methods and locations for the regular collection, containment, and disposal of excess construction materials and debris (e.g., timber, slash, mats, garbage, drill cuttings and fluids, excess rock) throughout the construction process. Disposal of materials for beneficial reuse must not result in adverse environmental impact and is subject to compliance with all applicable survey, landowner or land management agency approval, and permit requirements.

F. AGENCY COORDINATION

The project sponsor must coordinate with the appropriate local, state, and federal agencies as outlined in this Plan and/or required by the FERC's Orders.

1. Obtain written recommendations from the local soil conservation authorities or land management agencies regarding permanent erosion control and revegetation specifications.
2. Develop specific procedures in coordination with the appropriate agencies to prevent the introduction or spread of invasive species, noxious weeds, and soil pests resulting from construction and restoration activities.
3. Develop specific procedures in coordination with the appropriate agencies and landowners, as necessary, to allow for livestock and wildlife movement and protection during construction.
4. Develop specific blasting procedures in coordination with the appropriate agencies that address pre- and post-blast inspections; advanced public notification; and mitigation measures for building foundations, groundwater wells, and springs. Use appropriate methods (e.g., blasting mats) to prevent damage to nearby structures and to prevent debris from entering sensitive environmental resource areas.

G. SPILL PREVENTION AND RESPONSE PROCEDURES

The project sponsor shall develop project-specific Spill Prevention and Response Procedures, as specified in section IV of the staff's Procedures. A copy must be filed with the Secretary of the FERC (Secretary) prior to construction and made available in the field on each construction spread. The filing requirement does not apply to projects constructed under the automatic authorization provisions in the FERC's regulations.

H. RESIDENTIAL CONSTRUCTION

For all properties with residences located within 50 feet of construction work areas, project sponsors shall: avoid removal of mature trees and landscaping within the construction work area unless necessary for safe operation of construction equipment, or as specified in landowner agreements; fence the edge of the construction work area for a distance of 100 feet on either side of the residence; and restore all lawn areas and landscaping immediately following clean up operations, or as specified in landowner agreements. If seasonal or other weather conditions prevent compliance with these time frames, maintain

and monitor temporary erosion controls (sediment barriers and mulch) until conditions allow completion of restoration.

I. WINTER CONSTRUCTION PLANS

If construction is planned to occur during winter weather conditions, project sponsors shall develop and file a project-specific winter construction plan with the FERC application. This filing requirement does not apply to projects constructed under the automatic authorization provisions of the FERC's regulations.

The plan shall address:

1. Winter construction procedures (e.g., snow handling and removal, access road construction and maintenance, soil handling under saturated or frozen conditions, topsoil stripping);
2. Stabilization and monitoring procedures if ground conditions will delay restoration until the following spring (e.g., mulching and erosion controls, inspection and reporting, stormwater control during spring thaw conditions); and
3. Final restoration procedures (e.g., subsidence and compaction repair, topsoil replacement, seeding).

IV. INSTALLATION

A. APPROVED AREAS OF DISTURBANCE

1. Project-related ground disturbance shall be limited to the construction right-of-way, extra work space areas, pipe storage yards, borrow and disposal areas, access roads, and other areas approved in the FERC's Orders. Any project- related ground disturbing activities outside these areas will require prior Director approval. This requirement does not apply to activities needed to comply with the Plan and Procedures (i.e., slope breakers, energy-dissipating devices, dewatering structures, drain tile system repairs) or minor field realignments and workspace shifts per landowner needs and requirements that do not affect other landowners or sensitive environmental resource areas. All construction or restoration activities outside of authorized areas are subject to all applicable survey and permit requirements, and landowner easement agreements.
2. The construction right-of-way width for a project shall not exceed 75 feet or that described in the FERC application unless otherwise modified by a FERC Order. However, in limited, non-wetland areas, this construction right-of- way width may be expanded by up to 25 feet without Director approval to accommodate full construction right-of-way topsoil segregation and to ensure safe construction where topographic conditions (e.g., side-slopes) or soil limitations require it. Twenty-five feet of extra construction right-of-way width may also be used in limited, non-wetland or non-forested areas for truck turn-arounds where no reasonable alternative access exists.

   Project use of these additional limited areas is subject to landowner or land management agency approval and compliance with all applicable survey and permit requirements. When additional areas are used, each one shall be identified and the need explained in the weekly or biweekly construction reports to the FERC, if required. The following material shall be included in the reports:

a. The location of each additional area by station number and reference to previously filed alignment sheets, or updated alignment sheets showing the additional areas;
b. Identification of the filing at FERC containing evidence that the additional areas were previously surveyed; and
c. A statement that landowner approval has been obtained and is available in project files.

Prior written approval of the Director is required when the authorized construction right-of-way width would be expanded by more than 25 feet.

B. TOPSOIL SEGREGATION

1. Unless the landowner or land management agency specifically approves otherwise, prevent the mixing of topsoil with subsoil by stripping topsoil from either the full work area or from the trench and subsoil storage area (ditch plus spoil side method) in:
   a. Cultivated or rotated croplands, and managed pastures;
   b. Residential areas;
   c. Hayfields; and
   d. Other areas at the landowner's or land managing agency's request.
2. In residential areas, importation of topsoil is an acceptable alternative to topsoil segregation.
3. Where topsoil segregation is required, the project sponsor must:
   a. Segregate at least 12 inches of topsoil in deep soils (more than 12 inches of topsoil); and
   b. Make every effort to segregate the entire topsoil layer in soils with less than 12 inches of topsoil.
4. Maintain separation of salvaged topsoil and subsoil throughout all construction activities.
5. Segregated topsoil may not be used for padding the pipe, constructing temporary slope breakers or trench plugs, improving or maintaining roads, or as a fill material.
6. Stabilize topsoil piles and minimize loss due to wind and water erosion with use of sediment barriers, mulch, temporary seeding, tackifiers, or functional equivalents, where necessary.

C. DRAIN TILES

1. Mark locations of drain tiles damaged during construction.
2. Probe all drainage tile systems within the area of disturbance to check for damage.
3. Repair damaged drain tiles to their original or better condition. Do not use filter-covered drain tiles unless the local soil conservation authorities and the landowner agree. Use qualified specialists for testing and repairs.
4. For new pipelines in areas where drain tiles exist or are planned, ensure that the depth of cover over the pipeline is sufficient to avoid interference with drain tile systems. For adjacent pipeline loops in agricultural areas, install the new pipeline with at least the same depth of cover as the existing pipeline(s).

D. IRRIGATION

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

E. ROAD CROSSINGS AND ACCESS POINTS

1. Maintain safe and accessible conditions at all road crossings and access points during construction.
2. If crushed stone access pads are used in residential or agricultural areas, place the stone on synthetic fabric to facilitate removal.
3. Minimize the use of tracked equipment on public roadways. Remove any soil or gravel spilled or tracked onto roadways daily or more frequent as necessary to maintain safe road conditions. Repair any damages to roadway surfaces, shoulders, and bar ditches.

F. TEMPORARY EROSION CONTROL

Install temporary erosion controls immediately after initial disturbance of the soil. Temporary erosion controls must be properly maintained throughout construction (on a daily basis) and reinstalled as necessary (such as after backfilling of the trench) until replaced by permanent erosion controls or restoration is complete.

1. Temporary Slope Breakers
   a. Temporary slope breakers are intended to reduce runoff velocity and divert water off the construction right-of-way. Temporary slope breakers may be constructed of materials such as soil, silt fence, staked hay or straw bales, or sand bags.

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 than the Commission's Plan.

   b. Install temporary slope breakers on all disturbed areas, as necessary to avoid excessive erosion. Temporary slope breakers must be installed on slopes greater than 5 percent where the base of the slope is less than 50 feet from waterbody, wetland, and road crossings at the following spacing (closer spacing shall be used if necessary):

Slope (%)	Spacing (feet)
5 - 15	300
>15 - 30	200
>30	100

   c. Direct the outfall of each temporary slope breaker to a stable, well vegetated area or construct an energy-dissipating device at the end of the slope breaker and off the construction right-of-way.
   d. Position the outfall of each temporary slope breaker to prevent sediment discharge into wetlands, waterbodies, or other sensitive environmental resource areas.
2. Temporary Trench Plugs
   Temporary trench plugs are intended to segment a continuous open trench prior to backfill.
   a. Temporary trench plugs may consist of unexcavated portions of the trench, compacted subsoil, sandbags, or some functional equivalent.

b. Position temporary trench plugs, as necessary, to reduce trenchline erosion and minimize the volume and velocity of trench water flow at the base of slopes.

3. Sediment Barriers
   a. Sediment barriers are intended to stop the flow of sediments and to prevent the deposition of sediments beyond approved workspaces or into sensitive resources.
   b. Sediment barriers may be constructed of materials such as silt fence, staked hay or straw bales, compacted earth (e.g., driveable berms across travelways), sand bags, or other appropriate materials.
   c. At a minimum, install and maintain temporary sediment barriers across the entire construction right-of-way at the base of slopes greater than 5 percent where the base of the slope is less than 50 feet from a waterbody, wetland, or road crossing until revegetation is successful as defined in this Plan. Leave adequate room between the base of the slope and the sediment barrier to accommodate ponding of water and sediment deposition.
   d. Where wetlands or waterbodies are adjacent to and downslope of construction work areas, install sediment barriers along the edge of these areas, as necessary to prevent sediment flow into the wetland or waterbody.
4. Mulch
   a. Apply mulch on all slopes (except in cultivated cropland) concurrent with or immediately after seeding, where necessary to stabilize the soil surface and to reduce wind and water erosion. Spread mulch uniformly over the area to cover at least 75 percent of the ground surface at a rate of 2 tons/acre of straw or its equivalent, unless the local soil conservation authority, landowner, or land managing agency approves otherwise in writing.
   b. Mulch can consist of weed-free straw or hay, wood fiber hydromulch, erosion control fabric, or some functional equivalent.
   c. Mulch all disturbed upland areas (except cultivated cropland) before seeding if:
      1) Final grading and installation of permanent erosion control measures will not be completed in an area within 20 days after the trench in that area is backfilled (10 days in residential areas), as required in section V.A.1; or
      2) Construction or restoration activity is interrupted for extended periods, such as when seeding cannot be completed due to seeding period restrictions.
   d. If mulching before seeding, increase mulch application on all slopes within 100 feet of waterbodies and wetlands to a rate of 3 tons/acre of straw or equivalent.
   e. If wood chips are used as mulch, do not use more than 1 ton/acre and add the equivalent of 11 lbs/acre available nitrogen (at least 50 percent of which is slow release).
   f. Ensure that mulch is adequately anchored to minimize loss due to wind and water.
   g. When anchoring with liquid mulch binders, use rates recommended by the manufacturer. Do not use liquid mulch binders within 100 feet of wetlands or waterbodies, except where the product is certified environmentally non-toxic by the appropriate state or federal agency or independent standards-setting organization.
   h. Do not use synthetic monofilament mesh/netted erosion control materials in areas designated as sensitive wildlife habitat, unless the product is specifically designed to minimize harm to wildlife. Anchor erosion control fabric with staples or other appropriate devices.

V. RESTORATION

A. CLEANUP

1. Commence cleanup operations immediately following backfill operations. Complete final grading, topsoil replacement, and installation of permanent erosion control structures within 20 days after backfilling the trench (10 days in residential areas). If seasonal or other weather conditions prevent compliance with these time frames, maintain temporary erosion controls (i.e., temporary slope breakers, sediment barriers, and mulch) until conditions allow completion of cleanup.
   If construction or restoration unexpectedly continues into the winter season when conditions could delay successful decompaction, topsoil replacement, or seeding until the following spring, file with the Secretary for the review and written approval of the Director, a winter construction plan (as specified in section III.I). This filing requirement does not apply to projects constructed under the automatic authorization provisions of the FERC's regulations.
2. A travel lane may be left open temporarily to allow access by construction traffic if the temporary erosion control structures are installed as specified in section IV.F and inspected and maintained as specified in sections II.B.12 through 14. When access is no longer required the travel lane must be removed and the right-of-way restored.
3. 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 construction debris, unless approved for use as mulch or for some other use on the construction work areas by the landowner or land managing agency.
4. Remove excess rock from at least the top 12 inches of soil in all cultivated or rotated cropland, managed pastures, hayfields, and residential areas, as well as other areas at the landowner's request. The size, density, and distribution of rock on the construction work area shall be similar to adjacent areas not disturbed by construction. The landowner or land management agency may approve other provisions in writing.
5. Grade the construction right-of-way to restore pre-construction contours and leave the soil in the proper condition for planting.
6. Remove construction debris from all construction work areas unless the landowner or land managing agency approves leaving materials onsite for beneficial reuse, stabilization, or habitat restoration.
7. Remove temporary sediment barriers when replaced by permanent erosion control measures or when revegetation is successful.

B. PERMANENT EROSION CONTROL DEVICES

1. Trench Breakers
   a. Trench breakers are intended to slow the flow of subsurface water along the trench. Trench breakers may be constructed of materials such as sand bags or polyurethane foam. Do not use topsoil in trench breakers.
   b. An engineer or similarly qualified professional shall determine the need for and spacing of trench breakers. Otherwise, trench breakers shall be installed at the same spacing as and upslope of permanent slope breakers.
   c. In agricultural fields and residential areas where slope breakers are not typically required, install trench breakers at the same spacing as if permanent slope breakers were required.

d. At a minimum, install a trench breaker at the base of slopes greater than 5 percent where the base of the slope is less than 50 feet from a waterbody or wetland and where needed to avoid draining a waterbody or wetland. Install trench breakers at wetland boundaries, as specified in the Procedures. Do not install trench breakers within a wetland.

2. Permanent Slope Breakers
   a. Permanent slope breakers are intended to reduce runoff velocity, divert water off the construction right-of-way, and prevent sediment deposition into sensitive resources. Permanent slope breakers may be constructed of materials such as soil, stone, or some functional equivalent.
   b. Construct and maintain permanent slope breakers in all areas, except cultivated areas and lawns, unless requested by the landowner, using spacing recommendations obtained from the local soil conservation authority or land managing agency.
      In the absence of written recommendations, use the following spacing unless closer spacing is necessary to avoid excessive erosion on the construction right-of-way:

Slope (%)	Spacing (feet)
5 - 15	300
>15 - 30	200
>30	100

   c. Construct slope breakers to divert surface flow to a stable area without causing water to pool or erode behind the breaker. In the absence of a stable area, construct appropriate energy-dissipating devices at the end of the breaker.
   d. Slope breakers may extend slightly (about 4 feet) beyond the edge of the construction right-of-way to effectively drain water off the disturbed area. Where slope breakers extend beyond the edge of the construction right-of-way, they are subject to compliance with all applicable survey requirements.

C. SOIL COMPACTION MITIGATION

1. Test topsoil and subsoil for compaction at regular intervals in agricultural and residential areas disturbed by construction activities. Conduct tests on the same soil type under similar moisture conditions in undisturbed areas to approximate preconstruction conditions. Use penetrometers or other appropriate devices to conduct tests.
2. Plow severely compacted agricultural areas with a paraplow or other deep tillage implement. In areas where topsoil has been segregated, plow the subsoil before replacing the segregated topsoil. If subsequent construction and cleanup activities result in further compaction, conduct additional tilling.
3. Perform appropriate soil compaction mitigation in severely compacted residential areas.

D. REVEGETATION

1. General
   a. The project sponsor is responsible for ensuring successful revegetation of soils disturbed by project-related activities, except as noted in section V.D.1.b.

b. Restore all turf, ornamental shrubs, and specialized landscaping in accordance with the landowner's request, or compensate the landowner. Restoration work must be performed by personnel familiar with local horticultural and turf establishment practices.

2. Soil Additives
   Fertilize and add soil pH modifiers in accordance with written recommendations obtained from the local soil conservation authority, land management agencies, or landowner. Incorporate recommended soil pH modifier and fertilizer into the top 2 inches of soil as soon as practicable after application.
3. Seeding Requirements
   a. Prepare a seedbed in disturbed areas to a depth of 3 to 4 inches using appropriate equipment to provide a firm seedbed. When hydroseeding, scarify the seedbed to facilitate lodging and germination of seed.
   b. Seed disturbed areas in accordance with written recommendations for seed mixes, rates, and dates obtained from the local soil conservation authority or the request of the landowner or land management agency. Seeding is not required in cultivated croplands unless requested by the landowner.
   c. Perform seeding of permanent vegetation within the recommended seeding dates. If seeding cannot be done within those dates, use appropriate temporary erosion control measures discussed in section IV.F and perform seeding of permanent vegetation at the beginning of the next recommended seeding season. Dormant seeding or temporary seeding of annual species may also be used, if necessary, to establish cover, as approved by the Environmental Inspector. Lawns may be seeded on a schedule established with the landowner.
   d. In the absence of written recommendations from the local soil conservation authorities, seed all disturbed soils within 6 working days of final grading, weather and soil conditions permitting, subject to the specifications in section V.D.3.a through V.D.3.c.
   e. Base seeding rates on Pure Live Seed. Use seed within 12 months of seed testing.
   f. Treat legume seed with an inoculant specific to the species using the manufacturer's recommended rate of inoculant appropriate for the seeding method (broadcast, drill, or hydro).
   g. In the absence of written recommendations from the local soil conservation authorities, landowner, or land managing agency to the contrary, a seed drill equipped with a cultipacker is preferred for seed application.
      Broadcast or hydroseeding can be used in lieu of drilling at double the recommended seeding rates. Where seed is broadcast, firm the seedbed with a cultipacker or roller after seeding. In rocky soils or where site conditions may limit the effectiveness of this equipment, other alternatives may be appropriate (e.g., use of a chain drag) to lightly cover seed after application, as approved by the Environmental Inspector.

VI. OFF-ROAD VEHICLE CONTROL

To each owner or manager of forested lands, offer to install and maintain measures to control unauthorized vehicle access to the right-of-way. These measures may include:

a) Signs;
b) Fences with locking gates;
c) Slash and timber barriers, pipe barriers, or a line of boulders across the right-of-way; and
d) Conifers or other appropriate trees or shrubs across the right-of-way.

VII. POST-CONSTRUCTION ACTIVITIES AND REPORTING

A. MONITORING AND MAINTENANCE

1. Conduct follow-up inspections of all disturbed areas, as necessary, to determine the success of revegetation and address landowner concerns. At a minimum, conduct inspections after the first and second growing seasons.
2. Revegetation in non-agricultural areas shall be considered successful if upon visual survey the density and cover of non-nuisance vegetation are similar in density and cover to adjacent undisturbed lands. In agricultural areas, revegetation shall be considered successful when upon visual survey, crop growth and vigor are similar to adjacent undisturbed portions of the same field, unless the easement agreement specifies otherwise.
   Continue revegetation efforts until revegetation is successful.
3. Monitor and correct problems with drainage and irrigation systems resulting from pipeline construction in agricultural areas until restoration is successful.
4. Restoration shall be considered successful if the right-of-way surface condition is similar to adjacent undisturbed lands, construction debris is removed (unless otherwise approved by the landowner or land managing agency per section V.A.6), revegetation is successful, and proper drainage has been restored.
5. Routine vegetation mowing or clearing over the full width of the permanent right-of-way in uplands shall not be done more frequently than every 3 years. However, to facilitate periodic corrosion/leak surveys, a corridor not exceeding 10 feet in width centered on the pipeline may be cleared at a frequency necessary to maintain the 10-foot corridor in an herbaceous state. In no case shall routine vegetation mowing or clearing occur during the migratory bird nesting season between April 15 and August 1 of any year unless specifically approved in writing by the responsible land management agency or the U.S. Fish and Wildlife Service.
6. Efforts to control unauthorized off-road vehicle use, in cooperation with the landowner, shall continue throughout the life of the project. Maintain signs, gates, and permanent access roads as necessary.

B. REPORTING

1. The project sponsor shall maintain records that identify by milepost:
   a. Method of application, application rate, and type of fertilizer, pH modifying agent, seed, and mulch used;
   b. Acreage treated;
   c. Dates of backfilling and seeding;
   d. Names of landowners requesting special seeding treatment and a description of the follow-up actions;
   e. The location of any subsurface drainage repairs or improvements made during restoration; and
   f. Any problem areas and how they were addressed.
2. The project sponsor shall file with the Secretary quarterly activity reports documenting the results of follow-up inspections required by section VII.A.1; any problem areas, including those identified by the landowner; and corrective actions taken for at least 2 years following construction.

The requirement to file quarterly activity reports with the Secretary does not apply to projects constructed under the automatic authorization, prior notice, or advanced notice provisions in the FERC's regulations.

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

ATTACHMENT N15

TENNESSEE'S WETLAND AND WATERBODY CROSSING CONSTRUCTION AND MITIGATION PROCEDURES

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Tennessee's Wetland and Waterbody Construction and Mitigation Procedures document ("Procedures") is based in entirety on the Federal Energy Regulatory Commission's *Wetland and Waterbody Construction and Mitigation Procedures* (May 2013 version) ("Commission's Procedures"). Tennessee has identified certain modifications to the provisions of the Commission's Procedures and is requesting approval of these modifications, specific to the Northeast Energy Direct Project as part of the Environmental Report submitted for the Project. Justifications for these requested modifications are set forth in Resource Reports 2 and 8, and are identified in bold text below.

I. APPLICABILITY

A. The intent of these Procedures is to assist project sponsors by identifying baseline mitigation measures for minimizing the extent and duration of project-related disturbance on wetlands and waterbodies. Project sponsors shall specify in their applications for a new FERC authorization, and in prior notice and advance notice filings, any individual measures in these Procedures they consider unnecessary, technically infeasible, or unsuitable due to local conditions and fully describe any alternative measures they would use. Project sponsors shall also explain how those alternative measures would achieve a comparable level of mitigation.

Once a project is authorized, project sponsors can request further changes as variances to the measures in these Procedures (or the applicant's approved procedures). The Director of the Office of Energy Projects (Director) will consider approval of variances upon the project sponsor's written request, if the Director agrees that a variance:

1. Provides equal or better environmental protection;
2. Is necessary because a portion of these Procedures is infeasible or unworkable based on project-specific conditions; or
3. Is specifically required in writing by another federal, state, or Native American land management agency for the portion of the project on its land or under its jurisdiction.

Sponsors of projects planned for construction under the automatic authorization provisions in the FERC's regulations must receive written approval for any variances in advance of construction.

Project-related impacts on non-wetland areas are addressed in the staff's Upland Erosion Control, Revegetation, and Maintenance Plan (Plan).

B. Definitions

1. "Waterbody" includes any natural or artificial stream, river, or drainage with perceptible flow at the time of crossing, and other permanent waterbodies such as ponds and lakes:
   a. "minor waterbody" includes all waterbodies less than or equal to 10 feet wide at the water's edge at the time of crossing;
   b. "intermediate waterbody" includes all waterbodies greater than 10 feet wide but less than or equal to 100 feet wide at the water's edge at the time of crossing; and

c. "major waterbody" includes all waterbodies greater than 100 feet wide at the water's edge at the time of crossing.

2. "Wetland" includes any area that is not in actively cultivated or rotated cropland and that satisfies the requirements of the current federal methodology for identifying and delineating wetlands.

II. PRECONSTRUCTION FILING

A. The following information must be filed with the Secretary of the FERC (Secretary) prior to the beginning of construction, for the review and written approval by the Director:

1. Site-specific justifications for extra work areas that would be closer than 50 feet from a waterbody or wetland; and
2. Site-specific justifications for the use of a construction right-of-way greater than 75 feet wide in wetlands.

B. The following information must be filed with the Secretary prior to the beginning of construction. These filing requirements do not apply to projects constructed under the automatic authorization provisions in the FERC's regulations:

1. Spill Prevention and Response Procedures specified in section IV.A;
2. A schedule identifying when trenching or blasting will occur within each waterbody greater than 10 feet wide, within any designated coldwater fishery, and within any waterbody identified as habitat for federally-listed threatened or endangered species. The project sponsor will revise the schedule as necessary to provide FERC staff at least 14 days advance notice. Changes within this last 14-day period must provide for at least 48 hours advance notice;
3. Plans for horizontal directional drills (HDD) under wetlands or waterbodies, specified in section V.B.6.d;
4. Site-specific plans for major waterbody crossings, described in section V.B.9;
5. A wetland delineation report as described in section VI.A.1, if applicable; and
6. The hydrostatic testing information specified in section VII.B.3.

III. ENVIRONMENTAL INSPECTORS

A. At least one Environmental Inspector having knowledge of the wetland and waterbody conditions in the project area is required for each construction spread. The number and experience of Environmental Inspectors assigned to each construction spread shall be appropriate for the length of the construction spread and the number/significance of resources affected.

B. The Environmental Inspector's responsibilities are outlined in the Upland Erosion Control, Revegetation, and Maintenance Plan (Plan).

IV. PRECONSTRUCTION PLANNING

A. The project sponsor shall develop project-specific Spill Prevention and Response Procedures that meet applicable requirements of state and federal agencies. A copy must be filed with the Secretary prior to construction and made available in the field on each construction spread. This filing requirement does not apply to projects constructed under the automatic authorization provisions in the FERC's regulations.

1. It shall be the responsibility of the project sponsor and its contractors to structure their operations in a manner that reduces the risk of spills or the accidental exposure of fuels or hazardous materials to waterbodies or wetlands. The project sponsor and its contractors must, at a minimum, ensure that:
   a. All employees handling fuels and other hazardous materials are properly trained;
   b. All equipment is in good operating order and inspected on a regular basis;
   c. Fuel trucks transporting fuel to on-site equipment travel only on approved access roads;
   d. All equipment is parked overnight and/or fueled at least 100 feet from a waterbody or in an upland area at least 100 feet from a wetland boundary. These activities can occur closer only if the Environmental Inspector determines that there is no reasonable alternative, and the project sponsor and its contractors have taken appropriate steps (including secondary containment structures) to prevent spills and provide for prompt cleanup in the event of a spill;
   e. Hazardous materials, including chemicals, fuels, and lubricating oils, are not stored within 100 feet of a wetland, waterbody, or designated municipal watershed area, unless the location is designated for such use by an appropriate governmental authority. This applies to storage of these materials and does not apply to normal operation or use of equipment in these areas;
   f. Concrete coating activities are not performed within 100 feet of a wetland or waterbody boundary, unless the location is an existing industrial site designated for such use. These activities can occur closer only if the Environmental Inspector determines that there is no reasonable alternative, and the project sponsor and its contractors have taken appropriate steps (including secondary containment structures) to prevent spills and provide for prompt cleanup in the event of a spill;
   g. Pumps operating within 100 feet of a waterbody or wetland boundary utilize appropriate secondary containment systems to prevent spills; and
   h. Bulk storage of hazardous materials, including chemicals, fuels, and lubricating oils have appropriate secondary containment systems to prevent spills.
2. The project sponsor and its contractors must structure their operations in a manner that provides for the prompt and effective cleanup of spills of fuel and other hazardous materials. At a minimum, the project sponsor and its contractors must:
   a. Ensure that each construction crew (including cleanup crews) has on hand sufficient supplies of absorbent and barrier materials to allow the rapid containment and recovery of spilled materials and knows the procedure for reporting spills and unanticipated discoveries of contamination;
   b. Ensure that each construction crew has on hand sufficient tools and material to stop leaks; and
   c. Know the contact names and telephone numbers for all local, state, and federal agencies (including, if necessary, the U. S. Coast Guard and the National Response Center) that must

be notified of a spill; and excavating and disposing of soils or other materials contaminated by a spill, and in collecting and disposing of waste generated during spill cleanup.

B. Agency Coordination

The project sponsor must coordinate with the appropriate local, state, and federal agencies as outlined in these Procedures and in the FERC's Orders.

V. WATERBODY CROSSINGS

A. NOTIFICATION PROCEDURES AND PERMITS

1. Apply to the U.S. Army Corps of Engineers (COE), or its delegated agency, for the appropriate wetland and waterbody crossing permits.
2. Provide written notification to authorities responsible for potable surface water supply intakes located within 3 miles downstream of the crossing at least 1 week before beginning work in the waterbody, or as otherwise specified by that authority.
3. Apply for state-issued waterbody crossing permits and obtain individual or generic section 401 water quality certification or waiver.
4. Notify appropriate federal and state authorities at least 48 hours before beginning trenching or blasting within the waterbody, or as specified in applicable permits.

B. INSTALLATION

1. Time Window for Construction
   Unless expressly permitted or further restricted by the appropriate federal or state agency in writing on a site-specific basis, instream work, except that required to install or remove equipment bridges, must occur during the following time windows:
   a. Coldwater fisheries - June 1 through September 30; and
   b. Coolwater and warmwater fisheries - June 1 through November 30.
2. Extra Work Areas
   a. Locate all extra work areas (such as staging areas and additional spoil storage areas) at least 50 feet away from water's edge, except where disturbed land.

Tennessee, to the extent practicable, has located extra work areas at least 50 feet away from water's edge. Extra work areas (ATWS) that cannot feasibly be located 50 feet away from water's edge due to other constraints are identified in a table (refer to Project-specific ECPs for each state and Resource Report 8) with the locations and justifications. Aerial alignment sheets illustrate all waterbody crossings, which provide equal or greater resource protection than the Commission's Procedures in the identified areas.

   b. The project sponsor shall file with the Secretary for review and written approval by the Director, site-specific justification for each extra work area with a less than 50-foot setback from the water's edge, except where the adjacent upland consists of cultivated or rotated cropland or other disturbed land. The justification must specify the conditions that will not permit a 50-foot setback and measures to ensure the waterbody is adequately protected.

c. Limit the size of extra work areas to the minimum needed to construct the waterbody crossing.

3. General Crossing Procedures
   a. Comply with the COE, or its delegated agency, permit terms and conditions.
   b. Construct crossings as close to perpendicular to the axis of the waterbody channel as engineering and routing conditions permit.
   c. Where pipelines parallel a waterbody, maintain at least 15 feet of undisturbed vegetation between the waterbody (and any adjacent wetland) and the construction right-of-way, except where maintaining this offset will result in greater environmental impact.
   d. Where waterbodies meander or have multiple channels, route the pipeline to minimize the number of waterbody crossings.
   e. Maintain adequate waterbody flow rates to protect aquatic life, and prevent the interruption of existing downstream uses.
   f. Waterbody buffers (e.g., extra work area setbacks, refueling restrictions) must be clearly marked in the field with signs and/or highly visible flagging until construction-related ground disturbing activities are complete.
   g. Crossing of waterbodies when they are dry or frozen and not flowing may proceed using standard upland construction techniques in accordance with the Plan, provided that the Environmental Inspector verifies that water is unlikely to flow between initial disturbance and final stabilization of the feature. In the event of perceptible flow, the project sponsor must comply with all applicable Procedure requirements for "waterbodies" as defined in section I.B.1.
4. Spoil Pile Placement and Control
   a. All spoil from minor and intermediate waterbody crossings, and upland spoil from major waterbody crossings, must be placed in the construction right-of-way at least 10 feet from the water's edge or in additional extra work areas as described in section V.B.2.
   b. Use sediment barriers to prevent the flow of spoil or silt-laden water into any waterbody.
5. Equipment Bridges
   a. Only clearing equipment and equipment necessary for installation of equipment bridges may cross waterbodies prior to bridge installation. Limit the number of such crossings of each waterbody to one per piece of clearing equipment.
   b. Construct and maintain equipment bridges to allow unrestricted flow and to prevent soil from entering the waterbody. Examples of such bridges include:
      (1) Equipment pads and culvert(s);
      (2) Equipment pads or railroad car bridges without culverts;
      (3) Clean rock fill and culvert(s); and
      (4) Flexi-float or portable bridges.

      Additional options for equipment bridges may be utilized that achieve the performance objectives noted above. Do not use soil to construct or stabilize equipment bridges.
   c. Design and maintain each equipment bridge to withstand and pass the highest flow expected to occur while the bridge is in place. Align culverts to prevent bank erosion or streambed scour. If necessary, install energy dissipating devices downstream of the culverts.
   d. Design and maintain equipment bridges to prevent soil from entering the waterbody.
   e. Remove temporary equipment bridges as soon as practicable after permanent seeding.
   f. If there will be more than 1 month between final cleanup and the beginning of permanent seeding and reasonable alternative access to the right-of-way is available, remove temporary equipment bridges as soon as practicable after final cleanup.

g. Obtain any necessary approval from the COE, or the appropriate state agency for permanent bridges.

6. Dry-Ditch Crossing Methods
   a. Unless approved otherwise by the appropriate federal or state agency, install the pipeline using one of the dry-ditch methods outlined below for crossings of waterbodies up to 30 feet wide (at the water's edge at the time of construction) that are state-designated as either coldwater or significant coolwater or warmwater fisheries, or federally designated as critical habitat.
   b. Dam and Pump
      (1) The dam-and-pump method may be used without prior approval for crossings of waterbodies where pumps can adequately transfer streamflow volumes around the work area, and there are no concerns about sensitive species passage.
      (2) Implementation of the dam-and-pump crossing method must meet the following performance criteria:
         (i) Use sufficient pumps, including on-site backup pumps, to maintain downstream flows;
         (ii) Construct dams with materials that prevent sediment and other pollutants from entering the waterbody (e.g., sandbags or clean gravel with plastic liner);
         (iii) Screen pump intakes to minimize entrainment of fish;
         (iv) Prevent streambed scour at pump discharge; and
         (v) Continuously monitor the dam and pumps to ensure proper operation throughout the waterbody crossing.
   c. Flume Crossing
      The flume crossing method requires implementation of the following steps:
      (1) Install flume pipe after blasting (if necessary), but before any trenching;
      (2) Use sand bag or sand bag and plastic sheeting diversion structure or equivalent to develop an effective seal and to divert stream flow through the flume pipe (some modifications to the stream bottom may be required to achieve an effective seal);
      (3) Properly align flume pipe(s) to prevent bank erosion and streambed scour;
      (4) Do not remove flume pipe during trenching, pipelaying, or backfilling activities, or initial streambed restoration efforts; and
      (5) Remove all flume pipes and dams that are not also part of the equipment bridge as soon as final cleanup of the stream bed and bank is complete.
   d. Horizontal Directional Drill
      For each waterbody or wetland that would be crossed using the HDD method, file with the Secretary for the review and written approval by the Director, a plan that includes:
      (1) Site-specific construction diagrams that show the location of mud pits, pipe assembly areas, and all areas to be disturbed or cleared for construction;
      (2) Justification that disturbed areas are limited to the minimum needed to construct the crossing;
      (3) Identification of any aboveground disturbance or clearing between the hdd entry and exit workspaces during construction;
      (4) A description of how an inadvertent release of drilling mud would be contained and cleaned up; and
      (5) A contingency plan for crossing the waterbody or wetland in the event the hdd is unsuccessful and how the abandoned drill hole would be sealed, if necessary.

      The requirement to file HDD plans does not apply to projects constructed under the automatic authorization provisions in the FERC's regulations.

Tennessee is proposing to 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. Following this guidance provides greater resource protection than the Commission's Procedures, as discussed in more detail in Resource Report 2.

7. Crossings of Minor Waterbodies
   Where a dry-ditch crossing is not required, minor waterbodies may be crossed using the open-cut crossing method, with the following restrictions:
   a. Except for blasting and other rock breaking measures, complete instream construction activities (including trenching, pipe installation, backfill, and restoration of the streambed contours) within 24 hours.
      Streambanks and unconsolidated streambeds may require additional restoration after this period;
   b. Limit use of equipment operating in the waterbody to that needed to construct the crossing; and
   c. Equipment bridges are not required at minor waterbodies that do not have a state-designated fishery classification or protected status (e.g., agricultural or intermittent drainage ditches). However, if an equipment bridge is used it must be constructed as described in section v.b.5.
8. Crossings of Intermediate Waterbodies
   Where a dry-ditch crossing is not required, intermediate waterbodies may be crossed using the open-cut crossing method, with the following restrictions:
   a. Complete instream construction activities (not including blasting and other rock breaking measures) within 48 hours, unless site-specific conditions make completion within 48 hours infeasible;
   b. Limit use of equipment operating in the waterbody to that needed to construct the crossing; and
   c. All other construction equipment must cross on an equipment bridge as specified in section v.b.5.
9. Crossings of Major Waterbodies

   Before construction, the project sponsor shall file with the Secretary for the review and written approval by the Director a detailed, site-specific construction plan and scaled drawings identifying all areas to be disturbed by construction for each major waterbody crossing (the scaled drawings are not required for any offshore portions of pipeline projects). This plan must be developed in consultation with the appropriate state and federal agencies and shall include extra work areas, spoil storage areas, sediment control structures, etc., as well as mitigation for navigational issues. The requirement to file major waterbody crossing plans does not apply to projects constructed under the automatic authorization provisions of the FERC's regulations.

   The Environmental Inspector may adjust the final placement of the erosion and sediment control structures in the field to maximize effectiveness.

10. Temporary Erosion and Sediment Control

    Install sediment barriers (as defined in section IV.F.3.a of the Plan) immediately after initial disturbance of the waterbody or adjacent upland.

Sediment barriers must be properly maintained throughout construction and reinstalled as necessary (such as after backfilling of the trench) until replaced by permanent erosion controls or restoration of adjacent upland areas is complete. Temporary erosion and sediment control measures are addressed in more detail in the Plan; however, the following specific measures must be implemented at stream crossings:

a. Install sediment barriers across the entire construction right-of-way at all waterbody crossings, where necessary to prevent the flow of sediments into the waterbody. Removable sediment barriers (or driveable berms) must be installed across the travel lane. These removable sediment barriers can be removed during the construction day, but must be re-installed after construction has stopped for the day and/or when heavy precipitation is imminent;
b. Where waterbodies are adjacent to the construction right-of-way and the right-of-way slopes toward the waterbody, install sediment barriers along the edge of the construction right-of-way as necessary to contain spoil within the construction right-of-way and prevent sediment flow into the waterbody; and
c. Use temporary trench plugs at all waterbody crossings, as necessary, to prevent diversion of water into upland portions of the pipeline trench and to keep any accumulated trench water out of the waterbody.

11. Trench Dewatering

Dewater the trench (either on or off the construction right-of-way) in a manner that does not cause erosion and does not result in silt-laden water flowing into any waterbody. Remove the dewatering structures as soon as practicable after the completion of dewatering activities.

C. RESTORATION

1. Use clean gravel or native cobbles for the upper 1 foot of trench backfill in all waterbodies that contain coldwater fisheries.
2. For open-cut crossings, stabilize waterbody banks and install temporary sediment barriers within 24 hours of completing instream construction activities. For dry-ditch crossings, complete streambed and bank stabilization before returning flow to the waterbody channel.
3. Return all waterbody banks to preconstruction contours or to a stable angle of repose as approved by the Environmental Inspector.
4. Install erosion control fabric or a functional equivalent on waterbody banks at the time of final bank recontouring. Do not use synthetic monofilament mesh/netted erosion control materials in areas designated as sensitive wildlife habitat unless the product is specifically designed to minimize harm to wildlife. Anchor erosion control fabric with staples or other appropriate devices.
5. Application of riprap for bank stabilization must comply with COE, or its delegated agency, permit terms and conditions.
6. Unless otherwise specified by state permit, limit the use of riprap to areas where flow conditions preclude effective vegetative stabilization techniques such as seeding and erosion control fabric.
7. Revegetate disturbed riparian areas with native species of conservation grasses, legumes, and woody species, similar in density to adjacent undisturbed lands.
8. Install a permanent slope breaker across the construction right-of-way at the base of slopes greater than 5 percent that are less than 50 feet from the waterbody, or as needed to prevent

sediment transport into the waterbody. In addition, install sediment barriers as outlined in the Plan.

In some areas, with the approval of the Environmental Inspector, an earthen berm may be suitable as a sediment barrier adjacent to the waterbody.

9. Sections V.C.3 through V.C.7 above also apply to those perennial or intermittent streams not flowing at the time of construction.

D. POST-CONSTRUCTION MAINTENANCE

1. Limit routine vegetation mowing or clearing adjacent to waterbodies to allow a riparian strip at least 25 feet wide, as measured from the waterbody's mean high water mark, to permanently revegetate with native plant species across the entire construction right-of-way. However, to facilitate periodic corrosion/leak surveys, a corridor centered on the pipeline and up to 10 feet wide may be cleared at a frequency necessary to maintain the 10-foot corridor in an herbaceous state. In addition, trees that are located within 15 feet of the pipeline that have roots that could compromise the integrity of the pipeline coating may be cut and removed from the permanent right-of-way. Do not conduct any routine vegetation mowing or clearing in riparian areas that are between HDD entry and exit points.
2. Do not use herbicides or pesticides in or within 100 feet of a waterbody except as allowed by the appropriate land management or state agency.
3. Time of year restrictions specified in section VII.A.5 of the Plan (April 15 – August 1 of any year) apply to routine mowing and clearing of riparian areas.

VI. WETLAND CROSSINGS

A. GENERAL

1. The project sponsor shall conduct a wetland delineation using the current federal methodology and file a wetland delineation report with the Secretary before construction. The requirement to file a wetland delineation report does not apply to projects constructed under the automatic authorization provisions in the FERC's regulations.

   This report shall identify:

   a. By milepost all wetlands that would be affected;
   b. The National Wetlands Inventory (NWI) classification for each wetland;
   b. The crossing length of each wetland in feet; and
   c. The area of permanent and temporary disturbance that would occur in each wetland by NWI classification type.

   The requirements outlined in this section do not apply to wetlands in actively cultivated or rotated cropland. Standard upland protective measures, including workspace and topsoiling requirements, apply to these agricultural wetlands.

2. Route the pipeline to avoid wetland areas to the maximum extent possible. If a wetland cannot be avoided or crossed by following an existing right-of-way, route the new pipeline in a manner that minimizes disturbance to wetlands. Where looping an existing pipeline, overlap the existing

pipeline right-of-way with the new construction right-of-way. In addition, locate the loop line no more than 25 feet away from the existing pipeline unless site-specific constraints would adversely affect the stability of the existing pipeline.

3. Limit the width of the construction right-of-way to 75 feet or less. Prior written approval of the Director is required where topographic conditions or soil limitations require that the construction right-of-way width within the boundaries of a federally delineated wetland be expanded beyond 75 feet. Early in the planning process the project sponsor is encouraged to identify site-specific areas where excessively wide trenches could occur and/or where spoil piles could be difficult to maintain because existing soils lack adequate unconfined compressive strength.

Tennessee, to the extent practicable, has reduced the construction right-of-way to 75 feet or less in wetlands. Areas of workspace greater than 75 feet in wetlands are identified in a table (refer to Project-specific ECPs for each state and Resource Report 2), with locations and justifications for each area. Aerial alignment sheets illustrate each wetland crossing, which will provide equal or greater resource protection than the Commission's Procedures in the identified areas.

4. Wetland boundaries and buffers must be clearly marked in the field with signs and/or highly visible flagging until construction-related ground disturbing activities are complete.
5. Implement the measures of sections V and VI in the event a waterbody crossing is located within or adjacent to a wetland crossing. If all measures of sections V and VI cannot be met, the project sponsor must file with the Secretary a site-specific crossing plan for review and written approval by the Director before construction. This crossing plan shall address at a minimum:
   a. Spoil control;
   b. Equipment bridges;
   b. Restoration of waterbody banks and wetland hydrology;
   c. Timing of the waterbody crossing;
   d. Method of crossing; and
   e. Size and location of all extra work areas.
6. Do not locate aboveground facilities in any wetland, except where the location of such facilities outside of wetlands would prohibit compliance with U.S. Department of Transportation regulations.

B. INSTALLATION

1. Extra Work Areas and Access Roads
   a. Locate all extra work areas (such as staging areas and additional spoil storage areas) at least 50 feet away from wetland boundaries, except where the adjacent upland consists of cultivated or rotated cropland or other disturbed land.

Tennessee, to the extent practicable, has located extra work areas at least 50 feet away from wetland boundaries. Extra work areas (ATWS) that cannot feasibly be located 50 feet away from wetland boundaries due to other constraints are identified in a table (refer to Project-specific ECPs for each state and Resource Report 8) with the locations and justification. Aerial alignment sheets illustrate each wetland crossing, which will provide equal or greater resource protection than the Commission's Procedures in the identified areas.

   b. The project sponsor shall file with the Secretary for review and written approval by the Director, site-specific justification for each extra work area with a less than 50-foot setback from wetland boundaries, except where adjacent upland consists of cultivated or rotated

cropland or other disturbed land. The justification must specify the site-specific conditions that will not permit a 50-foot setback and measures to ensure the wetland is adequately protected.

c. The construction right-of-way may be used for access when the wetland soil is firm enough to avoid rutting or the construction right- of-way has been appropriately stabilized to avoid rutting (e.g., with timber riprap, prefabricated equipment mats, or terra mats).
   In wetlands that cannot be appropriately stabilized, all construction equipment other than that needed to install the wetland crossing shall use access roads located in upland areas. Where access roads in upland areas do not provide reasonable access, limit all other construction equipment to one pass through the wetland using the construction right-of-way.
d. The only access roads, other than the construction right-of-way, that can be used in wetlands are those existing roads that can be used with no modifications or improvements, other than routine repair, and no impact on the wetland.

2. Crossing Procedures
   a. Comply with COE, or its delegated agency, permit terms and conditions.
   b. Assemble the pipeline in an upland area unless the wetland is dry enough to adequately support skids and pipe.
   c. Use "push-pull" or "float" techniques to place the pipe in the trench where water and other site conditions allow.
   d. Minimize the length of time that topsoil is segregated and the trench is open. Do not trench the wetland until the pipeline is assembled and ready for lowering in.
   e. Limit construction equipment operating in wetland areas to that needed to clear the construction right-of-way, dig the trench, fabricate and install the pipeline, backfill the trench, and restore the construction right-of-way.
   f. Cut vegetation just above ground level, leaving existing root systems in place, and remove it from the wetland for disposal.
      The project sponsor can burn woody debris in wetlands, if approved by the COE and in accordance with state and local regulations, ensuring that all remaining woody debris is removed for disposal.
   g. Limit pulling of tree stumps and grading activities to directly over the trenchline. Do not grade or remove stumps or root systems from the rest of the construction right-of-way in wetlands unless the Chief Inspector and Environmental Inspector determine that safety-related construction constraints require grading or the removal of tree stumps from under the working side of the construction right-of-way.
   h. Segregate the top 1 foot of topsoil from the area disturbed by trenching, except in areas where standing water is present or soils are saturated. Immediately after backfilling is complete, restore the segregated topsoil to its original location.
   i. Do not use rock, soil imported from outside the wetland, tree stumps, or brush riprap to support equipment on the construction right-of-way.
   j. If standing water or saturated soils are present, or if construction equipment causes ruts or mixing of the topsoil and subsoil in wetlands, use low-ground-weight construction equipment, or operate normal equipment on timber riprap, prefabricated equipment mats, or terra mats.
   k. Remove all project-related material used to support equipment on the construction right-of-way upon completion of construction.

3. Temporary Sediment Control

Install sediment barriers (as defined in section IV.F.3.a of the Plan) immediately after initial disturbance of the wetland or adjacent upland. Sediment barriers must be properly maintained throughout construction and reinstalled as necessary (such as after backfilling of the trench). Except as noted below in section VI.B.3.c, maintain sediment barriers until replaced by permanent erosion controls or restoration of adjacent upland areas is complete. Temporary erosion and sediment control measures are addressed in more detail in the Plan.

a. Install sediment barriers across the entire construction right-of-way immediately upslope of the wetland boundary at all wetland crossings where necessary to prevent sediment flow into the wetland.
b. Where wetlands are adjacent to the construction right-of-way and the right-of-way slopes toward the wetland, install sediment barriers along the edge of the construction right-of-way as necessary to contain spoil within the construction right-of-way and prevent sediment flow into the wetland.
c. Install sediment barriers along the edge of the construction right-of- way as necessary to contain spoil and sediment within the construction right-of-way through wetlands. Remove these sediment barriers during right-of-way cleanup.

4. Trench Dewatering

Dewater the trench (either on or off the construction right-of-way) in a manner that does not cause erosion and does not result in silt-laden water flowing into any wetland. Remove the dewatering structures as soon as practicable after the completion of dewatering activities.

C. RESTORATION

1. Where the pipeline trench may drain a wetland, construct trench breakers at the wetland boundaries and/or seal the trench bottom as necessary to maintain the original wetland hydrology.
2. Restore pre-construction wetland contours to maintain the original wetland hydrology.
3. For each wetland crossed, install a trench breaker at the base of slopes near the boundary between the wetland and adjacent upland areas. Install a permanent slope breaker across the construction right-of-way at the base of slopes greater than 5 percent where the base of the slope is less than 50 feet from the wetland, or as needed to prevent sediment transport into the wetland. In addition, install sediment barriers as outlined in the Plan. In some areas, with the approval of the Environmental Inspector, an earthen berm may be suitable as a sediment barrier adjacent to the wetland.

Tennessee proposes that permanent slope breakers may not always be appropriate for installation at wetland boundaries. At the discretion of the EI, 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 that permanent slope breakers are not used. Following this guidance provides greater long-term protection for the resource. More information to support this modification request may be found in Tennessee's Project-specific ECPs for each state (Volume II, Appendices J, K, L, M, and N).

4. Do not use fertilizer, lime, or mulch unless required in writing by the appropriate federal or state agency.
5. Consult with the appropriate federal or state agencies to develop a project- specific wetland restoration plan. The restoration plan shall include measures for re-establishing herbaceous and/or woody species, controlling the invasion and spread of invasive species and noxious weeds (e.g., purple loosestrife and phragmites), and monitoring the success of the revegetation and weed control efforts. Provide this plan to the FERC staff upon request.
6. Until a project-specific wetland restoration plan is developed and/or implemented, temporarily revegetate the construction right-of-way with annual ryegrass at a rate of 40 pounds/acre (unless standing water is present).
7. Ensure that all disturbed areas successfully revegetate with wetland herbaceous and/or woody plant species.
8. Remove temporary sediment barriers located at the boundary between wetland and adjacent upland areas after revegetation and stabilization of adjacent upland areas are judged to be successful as specified in section VII.A.4 of the Plan.

D. POST-CONSTRUCTION MAINTENANCE AND REPORTING

1. Do not conduct routine vegetation mowing or clearing over the full width of the permanent right-of-way in wetlands. However, to facilitate periodic corrosion/leak surveys, a corridor centered on the pipeline and up to 10 feet wide may be cleared at a frequency necessary to maintain the 10-foot corridor in an herbaceous state. In addition, trees within 15 feet of the pipeline with roots that could compromise the integrity of pipeline coating may be selectively cut and removed from the permanent right-of-way. Do not conduct any routine vegetation mowing or clearing in wetlands that are between HDD entry and exit points.
2. Do not use herbicides or pesticides in or within 100 feet of a wetland, except as allowed by the appropriate federal or state agency.
3. Time of year restrictions specified in section VII.A.5 of the Plan (April 15 – August 1 of any year) apply to routine mowing and clearing of wetland areas.
4. Monitor and record the success of wetland revegetation annually until wetland revegetation is successful.
5. Wetland revegetation shall be considered successful if all of the following criteria are satisfied:
   a. The affected wetland satisfies the current federal definition for a wetland (i.e., soils, hydrology, and vegetation);
   b. Vegetation is at least 80 percent of either the cover documented for the wetland prior to construction, or at least 80 percent of the cover in adjacent wetland areas that were not disturbed by construction;
   c. If natural rather than active revegetation was used, the plant species composition is consistent with early successional wetland plant communities in the affected ecoregion; and
   d. Invasive species and noxious weeds are absent, unless they are abundant in adjacent areas that were not disturbed by construction.
6. Within 3 years after construction, file a report with the Secretary identifying the status of the wetland revegetation efforts and documenting success as defined in section VI.D.5, above. The requirement to file wetland restoration reports with the Secretary does not apply to projects constructed under the automatic authorization, prior notice, or advance notice provisions in the FERC's regulations.

   For any wetland where revegetation is not successful at the end of 3 years after construction, develop and implement (in consultation with a professional wetland ecologist) a remedial

revegetation plan to actively revegetate wetlands. Continue revegetation efforts and file a report annually documenting progress in these wetlands until wetland revegetation is successful.

VII. HYDROSTATIC TESTING

A. NOTIFICATION PROCEDURES AND PERMITS

1. Apply for state-issued water withdrawal permits, as required.
2. Apply for National Pollutant Discharge Elimination System (NPDES) or state-issued discharge permits, as required.
3. Notify appropriate state agencies of intent to use specific sources at least 48 hours before testing activities unless they waive this requirement in writing.

B. GENERAL

1. Perform 100 percent radiographic inspection of all pipeline section welds or hydrotest the pipeline sections, before installation under waterbodies or wetlands.
2. If pumps used for hydrostatic testing are within 100 feet of any waterbody or wetland, address secondary containment and refueling of these pumps in the project's Spill Prevention and Response Procedures.
3. The project sponsor shall file with the Secretary before construction a list identifying the location of all waterbodies proposed for use as a hydrostatic test water source or discharge location. This filing requirement does not apply to projects constructed under the automatic authorization provisions of the FERC's regulations.

C. INTAKE SOURCE AND RATE

1. Screen the intake hose to minimize the potential for entrainment of fish.
2. Do not use state-designated exceptional value waters, waterbodies which provide habitat for federally listed threatened or endangered species, or waterbodies designated as public water supplies, unless appropriate federal, state, and/or local permitting agencies grant written permission.
3. Maintain adequate flow rates to protect aquatic life, provide for all waterbody uses, and provide for downstream withdrawals of water by existing users.
4. Locate hydrostatic test manifolds outside wetlands and riparian areas to the maximum extent practicable.

D. DISCHARGE LOCATION, METHOD, AND RATE

1. Regulate discharge rate, use energy dissipation device(s), and install sediment barriers, as necessary, to prevent erosion, streambed scour, suspension of sediments, or excessive streamflow.
2. Do not discharge into state-designated exceptional value waters, waterbodies which provide habitat for federally listed threatened or endangered species, or waterbodies designated as public water supplies, unless appropriate federal, state, and local permitting agencies grant written permission.