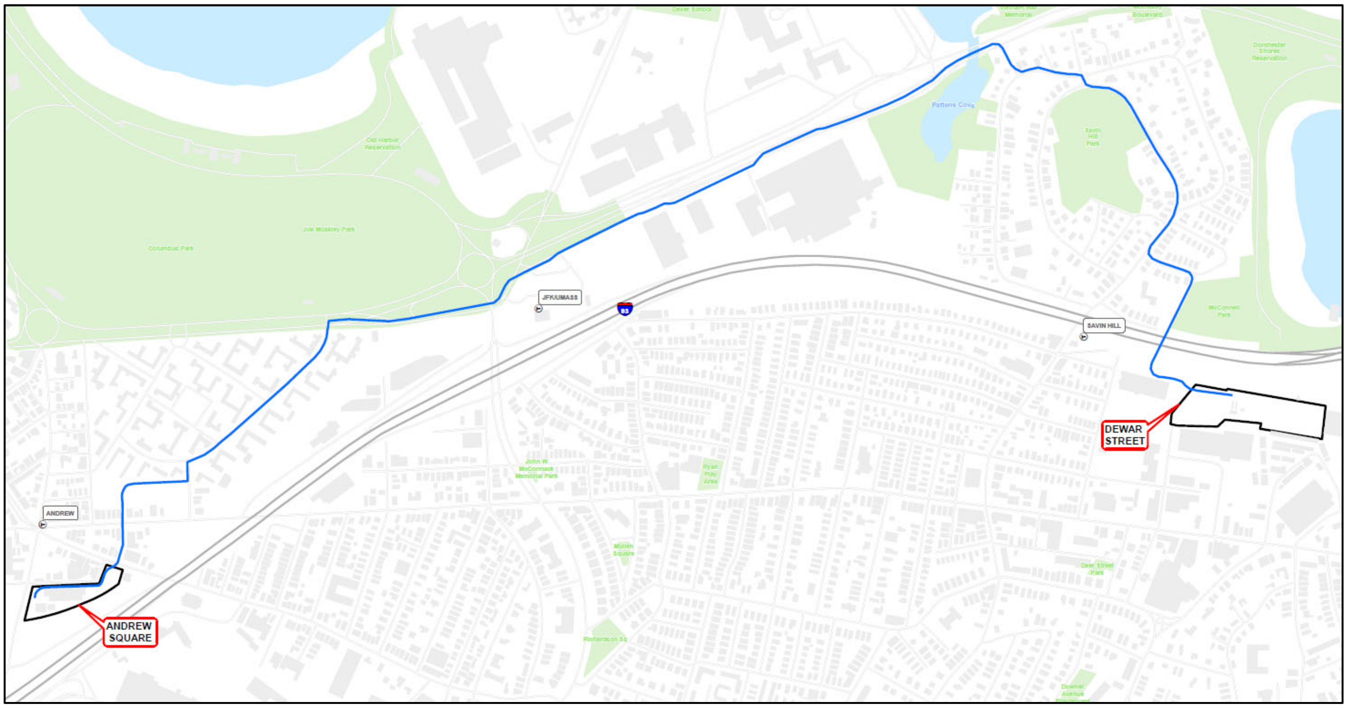
Analysis to Support Petitions before the Energy Facilities Siting Board

EFSB 19-03 / D.P.U. 19-15

Andrew Square to Dewar Street Reliability Project



Submitted to:
Energy Facilities Siting Board
One South Station
Boston, Massachusetts 02114

Submitted by:
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247 Station Drive
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March 2019

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GLOSSARY OF ACRONYMS

ABR	Automatic Bus Restoral
AIS/GIS	Air Insulated Switchgear/Gas Insulated Switchgear
APCC	Air Pollution Control Commission
AUL	Activity and Use Limitation
BES	Bulk Electric System
BHA	Boston Housing Authority
BMPs	Best Management Practices
BLSF	Bordering Land Subject to Flooding
BPA	Bonneville Power Administration
BVW	Bordering Vegetated Wetland
BWSC	Boston Water and Sewer Commission
CEII	Critical Energy Infrastructure Information
Chapter 91	The Massachusetts Public Waterfront Act, G.L. Chapter 91
dBA	Decibels
DCR	Massachusetts Department of Conservation and Recreation
Department	Department of Public Utilities
DR	Demand Response
EE	Energy Efficiency
EJ	Environmental Justice
EMF	Electric and Magnetic Fields
EOEEA	Massachusetts Executive Office of Energy and Environmental Affairs
FHWA	Federal Highway Administration
GHG	Greenhouse Gas
GWSA	Global Warming Solutions Act
HDD	Horizontal Directional Drilling
HDPE	High Density Polyethylene
Hz	Hertz
I-93	Interstate 93
ICES	International Committee on Electromagnetic Safety
ICNIRP	International Commission on Non-Ionizing Radiation Protection
ISD	Inspectional Services Department
ISO-NE	Independent System Operator-New England
kcmil	A unit of area, equal to the area of a circle with a diameter of one mil (one thousandth of an inch)
kV	Kilovolt
LF	Linear Feet
LSCSF	Land Subject to Coastal Storm Flowage
LSP	Licensed Site Professional
MACRIS	Massachusetts Cultural Resources Inventory System

MassDEP	Massachusetts Department of Environmental Protection
MassDOT	Massachusetts Department of Transportation
MassGIS	Massachusetts Bureau of Geographic Information
MBTA	Massachusetts Bay Transportation Authority
MCP	Massachusetts Contingency Plan
mG	Units of milligauss (or one-thousandth of 1 gauss)
M.G.L.	Massachusetts General Law
MHC	Massachusetts Historical Commission
MOU	Memorandum of Understanding
MUTCD	Manual on Uniform Traffic Control Devices
MVA	megavolt amperes
MW	megawatt
NEP	New England Power Company d/b/a National Grid
NERC	North American Electric Reliability Corporation
NPCC	Northeast Power Coordinating Council, Inc.
NPDES	National Pollutant Discharge and Elimination System
NTAs	Non-transmission alternatives
OHM	Oil or Hazardous Material
OSHA	Occupational Safety and Health Administration
PIC	Public Improvement Commission
PTF	Pool Transmission Facilities
PV	photovoltaic
PVC	Polyvinyl Chloride
RAO	Response Action Outcome
ROW	right-of-way
RTN	Release Tracking Number
SF_6	Sulfur Hexafluoride
Siting Board	Massachusetts Energy Facilities Siting Board
Sq ft	Square Feet
SWPPP	Stormwater Pollution Prevention Plan
TMP	Traffic Management Plan
TPH	Total Petroleum Hydrocarbons
TRC	TRC Environmental Corporation
ULSD	Ultra-low sulfur diesel
URAM	Utility Related Abatement Measure
USEPA	United States Environmental Protection Agency
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
XLPE	Cross-linked Polyethylene

EXECUTIVE SUMMARY

NSTAR Electric Company d/b/a Eversource Energy ("Eversource" or the "Company") proposes to construct a new, approximately 2.0-mile, 115-kilovolt ("kV") underground electric transmission line primarily within existing streets in the City of Boston (the "New Line"). This project, referred to herein as the Andrew Square to Dewar Street Transmission Reliability Project (the "Project"), is located in the Boston neighborhoods of Dorchester, South Boston and Roxbury (the "Project Area"), and will connect Eversource's Andrew Square Substation to its Dewar Street Substation. The Project consists of the New Line and necessary modifications at the Andrew Square and Dewar Street Substations to connect the New Line.

The Company's transmission system is an integral part of the bulk electric system ("BES") delivering electricity to customers in New England. The transmission lines that supply the Andrew Square and Dewar Street Substations are part of the local transmission system that serves a number of critical customers including hospitals and other medical facilities, schools, government agencies and departments, museums, large commercial customers and high rise buildings. If the local transmission system does not have sufficient capability to reliably serve forecasted load under certain contingency conditions, the Company must plan and implement system additions and upgrades to address the identified performance issues. In this instance, the Andrew Square and Dewar Street Substations are each supplied from two radial transmission lines from the Company's K Street Substation #385 ("K Street Substation"). The local transmission system in the Project Area must be strengthened to address a contingency event consisting of loss of these transmission lines.

After analyzing various approaches to resolving the identified need, the Company determined that the Project is the best solution and will provide the infrastructure needed to support the load requirements in the Project Area, as well as ensure the reliability of transmission service to this area. Without the Project, loss of two lines from K Street to either Andrew Square or Dewar Street Substations (an "N-1-1" contingency) would mean the Company would be unable to maintain supply for up to 53,000 customers in the South Boston, Roxbury and Dorchester neighborhoods of the City of Boston, including numerous critical customers. The Project provides the critical link needed to reliably serve the customers in these neighborhoods and interconnects these substations with an alternative source of supply from the K Street Substation.

Eversource considered several geographically distinct routes for the Project. The Company conducted extensive community outreach, participating in numerous working meetings with State and City of Boston representatives, government officials, residents and other stakeholders. After carefully considering and analyzing the input received, the Company's analysis demonstrated the clear advantages of constructing the Project along the selected route that includes Morrissey Boulevard and the Mary Ellen McCormack Housing Community. The Company determined the selected route will best balance the goals of minimizing cost and environmental impacts while meeting the identified needs.

Moreover, the Project design provides Eversource the opportunity to partner with the Massachusetts Department of Conservation and Recreation ("DCR") and the Mary Ellen McCormack Housing Community by coupling construction of the Project with the reconstruction of Morrissey Boulevard and redevelopment occurring in the Mary Ellen McCormack Housing Community. The coordination of projects will benefit the public, and the Commonwealth as a whole, by reducing construction time in the area and associated impacts on commuters, recreational users and the surrounding environment. The Company is working in cooperation with the City of Boston, DCR and Mary Ellen McCormack Community to facilitate the Project as proposed by the Company.

Accordingly, the Company seeks authority to construct and operate the Project to ensure the safe and reliable transmission of electric power to its customers. As described in greater detail in the remaining sections of this Analysis, the Project meets the Energy Facilities Siting Board's ("Siting Board") standards on need, alternatives, routing and minimization of environmental impacts under G.L. c. 164, § 69J and, therefore, should be approved.

1.0 PROJECT OVERVIEW

1.1 Siting Board Jurisdiction

NSTAR Electric Company d/b/a Eversource Energy ("Eversource" or the "Company") submits this analysis (the "Analysis") to the Siting Board in support of its pursuant to G.L. c. 164, § 69J, petition for authority to construct, operate and maintain a new approximately 2.0-mile 115-kV underground transmission line ("New Line") between its existing Andrew Square Substation #106 ("Andrew Square Substation") located in South Boston and its existing Dewar Street Substation #483 ("Dewar Street Substation") located in Dorchester, along with associated ancillary modifications at each substation. This project, referred to herein as the Andrew Square to Dewar Street Transmission Reliability Project (the "Project") consists of the New Line and necessary modifications at the Andrew Square and Dewar Street Substations to connect the New Line.

Construction of the Project will serve the public interest by increasing the reliability of the local electric transmission system supplying customers in the Dorchester, South Boston and Roxbury neighborhoods of the City of Boston (the "Project Area"). Consistent with the Siting Board's standards, the Project will provide a reliable energy supply for the Commonwealth with minimum impact on the environment at the lowest possible cost.

The proposed route of the 115-kV line between the Andrew Square and Dewar Street Substations is shown on a United States Geological Survey ("USGS") quadrangle base map (see Figure 1-1, USGS Locus Map). Figure 1-2 shows the proposed route on a Massachusetts Bureau of Geographic Information ("MassGIS") aerial photo. The New Line will be located entirely in the City of Boston. The Company selected this proposed route as its Preferred Route. All the reviewed routes have similar obstacles and challenges. When compared in isolation, some alternative routes may be scored comparably based on a review of the typical objective criteria used to determine impacts to the public and the surrounding environment. Since the Company plans to couple construction of its Project with other planned projects along the Preferred Route, namely the City of Boston's planned reconstruction of Morrissey Boulevard that will be managed by the Massachusetts Department of Conservation and Recreation ("DCR") and the reconstruction of the Mary Ellen McCormack Housing Community managed by Winn Development Company, LP ("Winn Development Company"), the incremental impacts to the public and the surrounding environment are much less. The coordination of the various projects will benefit the public, and the Commonwealth as a whole, by reducing the construction period in the area impacting commuters, recreational users, and the surrounding environment.

The balance of Section 1 presents an overview of the Project. The remaining sections of this Analysis provide detailed information to support the Project; specifically, an explanation of the need for the Project (Section 2), a comparison of Project alternatives (Section 3), a description of the route selection process that was used to identify the Preferred Route and Noticed Alternative Route (Section 4), a comparative analysis of impacts, cost and reliability of the Preferred and Noticed Alternative Routes (Section 5), and an analysis of the Project's consistency with the health, environmental protection, resource use and development policies of the Commonwealth of Massachusetts (Section 6).

1.2 Project Need

The Company must ensure adequate transmission capacity exists to meet current and projected load requirements to maintain the integrity of its transmission system and deliver electricity to customers. If the area transmission system does not have sufficient capability to serve forecasted load under contingency conditions, the Company must plan and implement system additions and upgrades to address the identified performance issues.

The transmission lines that supply the Andrew Square and Dewar Street Substations are radial in nature and considered part of the local transmission system. The regional planning entity, the Independent System Operator of New England ("ISO-NE"), does not plan for these local transmission system facilities. As the transmission provider for this area, the Company has established its own planning criteria for the local system to ensure consistent and reliable service to all of its customers. The Company's planning criteria ensure that a consistent design approach is applied across the Company's transmission system and that the system is also designed consistent with the regional transmission reliability standards.

In establishing its reliability criteria, the Company takes into consideration the duration of the potential outage, the customer impact, and the potential to implement alternative supply measures. The Company's criteria is more stringent for the loss of load impacts to areas served by substations that are supplied by two radial underground transmission lines in densely populated urban areas, than for similar supplies to stations served by overhead transmission lines. This is because underground cable failures typically require more time to locate the source of the problem and conduct repairs, resulting in outage durations that can extend for many months. These stations typically serve a considerable number of customers that would potentially experience an extended outage duration if there were a loss of both transmission lines serving the station. The need for the Project is particularly acute given the nature of the customer mix in the affected area. In the Project Area, there are over a dozen hospitals and other medical facilities; schools including the University of Massachusetts, Boston and Roxbury Community College; government agencies and departments (including the Suffolk County House of Corrections and the Boston Police Department headquarters); institutions such as the JFK Library and the Franklin Park Zoo; large commercial customers such as South Bay Mall and the Ink Block; and high rise buildings with elevator loads. Based on this unique customer mix in the highly populated urban center of Boston, a prolonged outage would have serious public health and safety consequences. Alternatives for transferring load to other stations or connecting emergency supplies are limited.

In this instance, the Andrew Square and Dewar Street Substations are each supplied from two radial transmission lines from the Company's K Street Substation #385 ("K Street Substation"). Without the Project, loss of two lines from K Street to either Andrew Square or Dewar Street Substations (an "N-1-1" contingency) would mean the Company would be unable to maintain supply for up to 53,000 customers in the South Boston, Roxbury and Dorchester neighborhoods of the City of Boston. The Project provides the critical link needed to reliably serve the customers in these neighborhoods and interconnects these substations with an alternative source of supply from the K Street Substation.

1.3 Project Alternatives

In accordance with Siting Board precedent, the Company evaluated a series of Project alternatives for the potential to meet the need identified in the Project Area to determine the approach that best balances reliability, cost and environmental impact. Section 3, Project Alternatives, contains the detailed analyses used to identify and evaluate alternative means of meeting the identified need. These include a no-build alternative, a transmission alternative, a distribution transfer switching alternative and non-transmission alternatives ("NTAs"). The Company dismissed the no-build alternative because it would not address the identified need for the Project. Distribution transfer switching is not a viable alternative to restore the affected outage customers. For transmission alternatives, the Company considered the proposed Project as well as two 115-kV underground transmission lines, one between the K Street Substation and the Andrew Square Substation, and the other between the K Street Substation and Dewar Street Substation. As described in greater detail in Section 3, the Project was determined to be the superior transmission alternative.

Lastly, the Company considered a wide variety of technologies in assessing possible NTAs to address the load loss that results from the N-1-1 contingencies discussed in Section 1.2 above. To address the loss of load risk, any NTA would need to be able to support the full load at either Andrew Square Substation or Dewar Street Substation (depending on the location of the contingency), without support from the existing transmission system, for the entire duration of the contingency event. As such, the Company determined that most NTA technologies that would rely on support from the transmission system to some degree – including battery storage systems, photovoltaic ("PV"), solar facilities, demand side programs such as energy efficiency ("EE") and demand response ("DR"), and distributed generation – are not capable of supplying the entire load at either the Andrew Square Substation or the Dewar Street Substation because they can only reduce the load loss. The only type of NTA that could feasibly support either Andrew Square Substation or Dewar Street Substation for a long-term outage event would be conventional generation,[1] likely located at each substation. There are currently no generation projects in the Project Area proposed in the ISO-NE interconnection queue, so the most likely NTA solution would be to build at least two new fast-start combustion turbines, with at least one at each substation. Even if such a generation alternative were technically feasible, the Company determined that the costs and environmental impacts of such an alternative would be significantly greater than those associated with the proposed Project.

As described in Section 3, in consideration of cost, environmental and community-impacts, reliability and constructability, the Company's analyses confirm that construction of the transmission solution associated with the proposed Project is the best approach to meet the identified need.

[1] Conventional generation is a power plant that converts heat energy by burning fuel (such as natural gas, oil, or coal), typically using steam or combustion gas itself to drive a turbine.

1.4 Preferred Route and Noticed Alternative Route

After determining that the transmission solution associated with the proposed Project was the superior alternative for meeting the identified need, Eversource undertook a thorough and objective analysis to identify the preferred route for a transmission line between the Andrew Square and Dewar Street Substations. Section 4 of this Analysis presents this routing analysis. The iterative route selection process entailed:

- Identifying a geographic study area;
- Identifying an array of initial route corridors and candidate routes;
- Evaluating developed and natural resource environment impacts, constructability, reliability and cost of the candidate routes;
- Seeking input and feedback from federal, state and municipal officials, residents/businesses and other stakeholders; and
- Selecting the Preferred Route and a Noticed Alternative Route based on the established evaluation criteria.

As described in Section 4, the Company's selection of the Preferred Route balances established environmental criteria, cost and reliability to reflect the standards of the Siting Board. The Preferred Route is approximately 2.0 miles long. Generally following Morrissey Boulevard, this route would exit the Andrew Square Substation east on Ellery Street, turn south on Boston Street, turn east on Songin Way, continue on to O'Connor Way, then turn east onto Kemp Street, south on to O'Callaghan Way until the intersection of Old Colony Avenue. The route would then continue south on Old Colony Avenue on to William T Morrissey Boulevard after Kosciuszko Circle, at which point it would turn south onto Savin Hill Avenue, and down Grampian Way. The route would then turn south on Playstead Road, west on Springdale Street, under the Massachusetts Bay Transportation Authority ("MBTA") tracks and Interstate 93 ("I-93") and into Dewar Street Substation.

The Noticed Alternative Route is approximately 1.6 miles long and generally follows Sydney Street. This route would exit the Andrew Square Substation east on Ellery Street, turn south on Boston Street, east on Howell Street, south on Dorchester Avenue, east on Locust Street, south on Buttonwood Street, and east on Mount Vernon Street, at which point the route would cross Columbia Road and travel south on Sydney Street to Dewar Street Substation. The Preferred Route identified for the Project and the Noticed Alternative Route are shown on Figure 4-7.

In addition to the New Line, the Project will include certain associated upgrades to the Andrew Square and Dewar Street Substations. These substations are shown on the locus map provided as Figure 1-1. The improvements at the Andrew Square and Dewar Street Substations are described in Section 5. All improvements to the Andrew Square Substation and the Dewar Street Substation will be installed within the existing fence lines.

Section 5 of the Petition describes the methodology by which the Project will be constructed, assesses the potential for environmental impacts, and describes potential mitigation measures. It also provides a detailed comparison of the Preferred and the Noticed Alternative Routes based on environmental factors, cost and reliability. Based on this comparison, the Company determined that, while each would offer comparable reliability, the Preferred Route is superior to the Noticed Alternative Route on balance of cost, reliability and potential for environmental impacts.

Section 6 provides an analysis of the Project's consistency with the health, environmental protection and resource use and development policies of the Commonwealth.

1.5 Summary of Project Schedule and Cost

Assuming receipt of all necessary permits and approvals, construction of the transmission line is anticipated to commence in the Spring of 2020. Construction is anticipated to occur over a 20-month period, and to be completed by the end of 2022. The current cost estimate for the Project is approximately $68.3 million (2019 dollars), estimated at a planning grade level (-25%/+25%).

1.6 Agency and Community Outreach

The Company is committed to working with municipal officials, businesses and residents along the Project route and providing proactive and transparent communications throughout the life of the Project. The Company's initial outreach efforts have been aimed at briefing local officials and other stakeholders on the need for the Project, consulting with numerous stakeholders on the route selection, detailing the overall Project schedule and explaining the permitting and siting processes, including opportunities for public input. The Company will continue these efforts during the siting and permitting process and will maintain a focused communications program throughout construction, including outreach to municipalities and local businesses along the route regarding construction staging and laydown plans and Traffic Management Plans ("TMPs"), as such details become available. This outreach program is designed to engage the community, foster public participation and solicit feedback from stakeholders.

Key elements of the Company's outreach program, as well as its outreach efforts to date, are described below.

The Company has partnered with DCR and the Winn Development Company, the company selected by the Boston Housing Authority ("BHA") to redevelop the Mary Ellen McCormack Housing Community in South Boston, to coordinate scope and construction schedules. The Company emphasizes these stakeholders' input because of DCR's ownership of several roadways near the JFK/UMass MBTA Station and Winn Development Company's position as the entity redeveloping the Mary Ellen McCormack Housing Community, a large public housing development near the Project route. The Company met with the DCR and Winn Development Company and presented the Company's possible routes, received input and addressed questions. Through these consultations, the Company has continued to refine and adjust the route to address major concerns and accommodate these stakeholders' input.

Municipal and Stakeholder Briefings: The Company has met regularly with municipal officials and other stakeholders in Boston; including, as noted above, DCR and the Winn Development Company. A list of outreach meetings with the municipalities, regulatory agencies and other officials is provided in Table 1-1 below.

Open Houses: The Company held Open Houses to provide the public with opportunities to interact with Project subject matter experts, ask questions and share concerns. At the Open Houses, the Company provided information on the need for and benefits of the Project, described the siting process, explained the route selection process and provided detail on Project design and location, schedule and construction activities. The Open Houses were held at St. Monica's Parish in South Boston on October 10, 2018 and at Carson's Place in Dorchester on October 11, 2018. The Company mailed invitations to property owners within a quarter-mile of the Andrew Square and Dewar Street Substations and 300 feet from the route of the New Line, identified through City of Boston assessors lists, and to municipal officials within the City of Boston. The Company conducted door-to-door outreach to all properties within the proposed Project route to personally invite property owners, tenants, business owners and employees to learn more about the proposed Project. Newspaper advertisements for the Open Houses were published in the Dorchester Reporter, Mattapan Reporter, South Boston Today and Metro Daily.

Website: A website has been developed for this Project. The website provides basic Project information, maps, regular updates and contact resources. This website will be kept up-to-date for the duration of the Project. For more information about the Andrew Square to Dewar Street Reliability Project, visit https://www.eversource.com/content/ema-c/about/projects-infrastructure/projects/massachusetts-transmission-projects/andrew-square-to-dewar-street-reliability-project.

Project Hotline: A toll free number has been created as the Project Hotline. The Project Hotline number is listed in all Project outreach materials, including fact sheets, subsequent mailings, the website and at all community events. Eversource is committed to responding promptly to all inquiries. For more information about the Andrew Square to Dewar Street Reliability Project, call 800-793-2202.

Project E-mail: An email address has been created and listed in all Project outreach materials, including fact sheets, subsequent mailings, the website and at all community events. Similar to the Hotline, Eversource is committed to responding promptly to all inquiries. For more information about the Andrew Square to Dewar Street Reliability Project, send an email to Transmissioninfo@eversource.com

Construction Community Outreach Plan: Eversource will execute a comprehensive construction community outreach plan to keep property owners, businesses and municipal officials including fire, police and emergency personnel, up-to-date on planned construction activities. The Company will notify abutting property owners and municipal officials of its planned construction start and work schedule prior to commencing construction and will work closely with both to limit construction impacts. Once the construction schedule is finalized, the Company will notify direct abutters of the hours of construction and address any concerns raised. All notifications will occur as soon as it is practicable. Typically, notification one to two weeks in advance of construction has proven to be sufficient on previous projects.

In consultation with property owners and local officials, the Company will also develop a TMP and will secure police details as necessary to control traffic and maintain safety along the construction route. The Company will provide a construction schedule to the City of Boston for publication on the City's webpage (and/or provide a link to the Project webpage). Additionally, the Company will work with the local chamber of commerce, neighborhood services, neighborhood groups and local business groups to ensure that Project updates and information will be available throughout the Project's duration. As needed, Project personnel will arrange for specific notifications to route abutters that might be adversely affected or have need for advice of specific Project activities. The Company will distribute fliers directly to abutter addresses, as needed. The Company will attempt to schedule optimum construction hours along the route to minimize the adverse impacts to residents and businesses. Construction schedules (day, evening and/or early morning construction hours) will be coordinated to minimize adverse impacts to abutters and ensure optimal vehicle and truck traffic flow. If access to a property will be limited, specific arrangements will be made to avoid affecting abutter activities. If a lane closure or detour is deemed necessary for the underground line construction, this information will be posted on the Project website and local abutters will receive a flier advising of the alternate route and the expected duration and police details will be employed.

Table 1-1: Summary of Project Outreach Meetings

Date	Group	Topic
December 12, 2017	City of Boston	Introduction of Proposed Project
December 19, 2017	DCR	Introduction of Proposed Project
January 11, 2018	Massachusetts Department of Transportation ("MassDOT")	Introduction of Proposed Project
January 25, 2018	Boston Water and Sewer Commission ("BWSC")	Introduction of Proposed Project
March 27, 2018	MassDOT	Routing Discussion
June 26, 2018	DCR	Routing Discussion
June 26, 2018	BWSC	Routing Discussion
July 12, 2018	MBTA	Introduction of Proposed Project
July 25, 2018	MassDOT	Discussed bridge impacts along the proposed routes
August 7, 2018	Winn Development Company	Introduction of Proposed Project
August 17, 2018	Morningside Group and Samuels and Associates	Provide routing feedback as it relates to 65 Bay Street
August 22, 2018	City of Boston: Public Improvement Commission ("PIC")	Routing Discussion/ Next Steps
September 7, 2018	City of Boston – Neighborhood Services, Dorchester and South Boston Contacts	Outreach Discussion
September 10, 2018	DCR	Partnership Discussion
September 17, 2018	Massachusetts Elected Officials	Discussed outreach efforts along proposed project route
October 10, 2018	South Boston Open House	Introduction of Proposed Project
October 11, 2018	Dorchester Open House	Introduction of Proposed Project
November 1, 2018	BWSC	Engineering Discussion
November 5, 2018	Savin Hill Civic Association	Introduction of Proposed Project
November 9, 2018	Winn Development Company, and BHA	Routing Discussion
November 14, 2018	Andrew Square Civic Association	Introduction of Proposed Project
December 18, 2018	Inspectional Services Department ("ISD")	Comprehensive zoning relief discussion

1.7 Project Team

The Company has assembled an experienced team of planners, engineers, environmental scientists, attorneys and project outreach specialists for the Project. The team's principal organizations are outlined below.

NSTAR Electric Company d/b/a Eversource Energy (Project Proponent)
NSTAR Electric Company is a Massachusetts corporation and a wholly-owned subsidiary of Eversource Energy, which operates New England's largest energy delivery system. The Company transmits and delivers energy to approximately 3.7 million electric and natural gas customers in Connecticut, Massachusetts and New Hampshire. In Massachusetts, Eversource Energy's electric service territory includes 140 municipalities, including Boston, covering an area of approximately 3,192 square miles.

Tighe & Bond (Environmental Consultants)
Tighe and Bond is an engineering and environmental consulting firm based in Westfield, Massachusetts. Tighe and Bond's engineers, scientists, planners and regulatory specialists have completed environmental assessment, modeling, licensing and permitting for multiple large-scale energy infrastructure projects throughout the Northeast. Tighe & Bond conducted the routing analysis and the assessment of environmental impacts for the Project and is providing local, state and federal environmental permitting support.

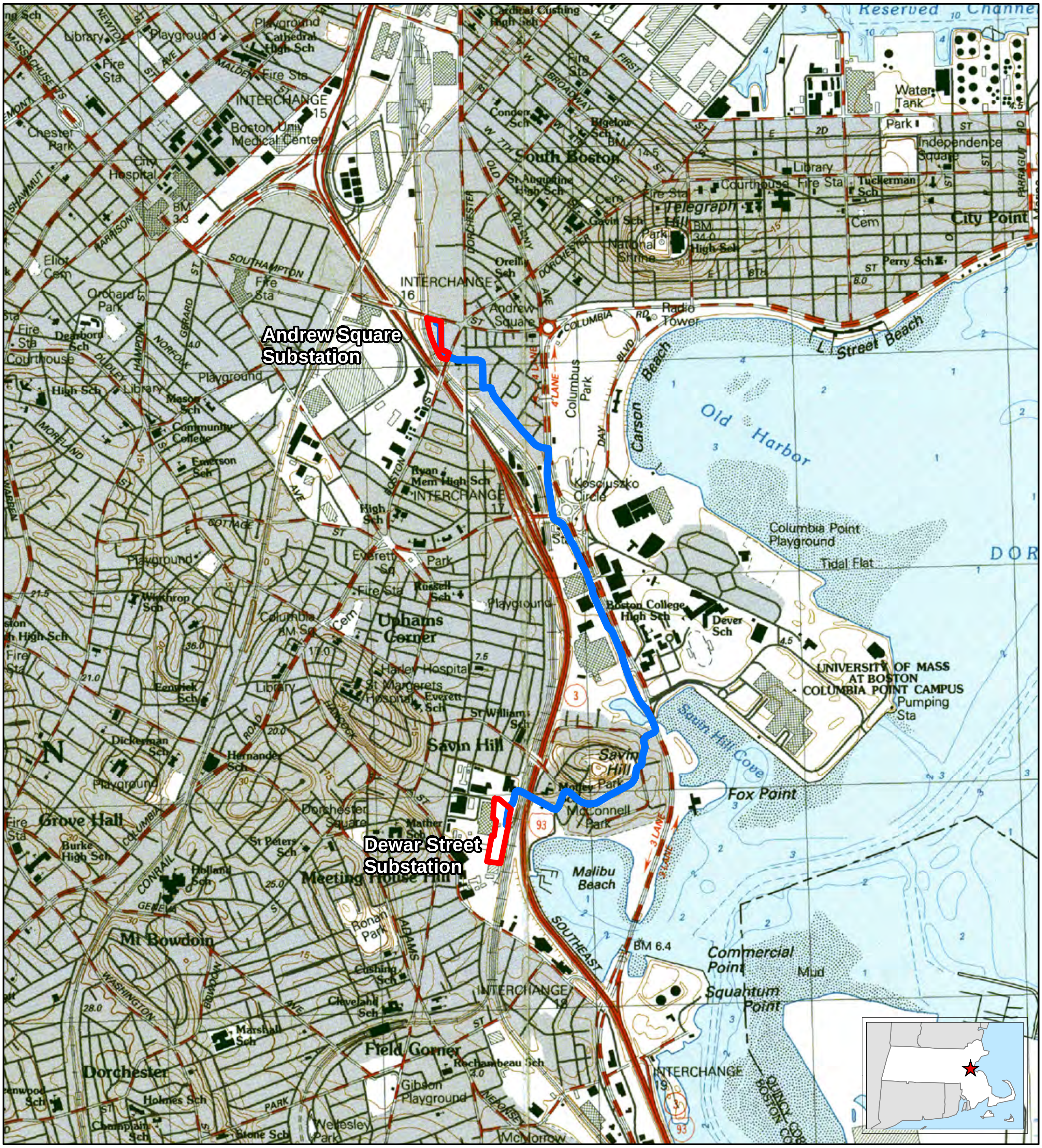
Keegan Werlin LLP (Outside Counsel)
Keegan Werlin LLP, based in Boston, serves as regulatory counsel for the Project on siting, permitting and licensing matters. The firm specializes in representing clients in all aspects of energy, environmental and regulatory processes. Keegan Werlin's attorneys include former utility regulators and attorneys from energy, environmental and resource management agencies. Attorneys in the firm have represented transmission companies and project developers in numerous applications to the Siting Board, Department of Public Utilities and other permitting agencies for approval to construct electric transmission lines, bulk generating facilities and natural gas pipelines.

Exponent, Inc. (EMF Consultants)
Exponent Inc., based in New York City, is a multidisciplinary organization of scientists, physicians, engineers and business consultants that performs in-depth investigations including evaluation of complex human health and environmental issues. Exponent Inc. has been contracted to assess the effect of the Project on electric and magnetic fields ("EMF") levels at the edge of the roadway and Project vicinity. The analysis also addresses the potential health effects of exposure to EMF and includes an assessment of Project compliance with exposure guidelines and regulatory guidance documents.

POWER Engineers, Inc. (Transmission Engineers)
POWER Engineers, Inc. ("PEI"), is an international, multidiscipline engineering firm and a leader in the design and implementation of power delivery systems – from overhead and underground transmission lines and substations, wind, solar and gas power generation, to electrical system studies, testing and energization, utility automation, program management and environmental services.

1.8 Conclusion

The Project will address critical reliability issues affecting the Company's existing transmission system. The Company seeks authority to construct the Project to fulfill its obligation to ensure the safe and reliable transmission of power to its customers. The Company will meet this objective through construction and operation of the Project. For the reasons described in greater detail in the subsequent sections of this Analysis, the Project meets all Siting Board standards on need, alternatives, routing and minimization of environmental impacts and costs under G.L. c. 164, § 69J, and therefore should be approved by the Siting Board.



Legend

- Preferred Route
- Substation

1. Based on USGS Topographic Map for Boston South, Massachusetts. Revised 1987. Contour Interval Equals 3 meters.

0 1,000 2,000
Feet

1:24,000

N W E S

Tighe&Bond
Engineers | Environmental Specialists

EVERSOURCE ENERGY

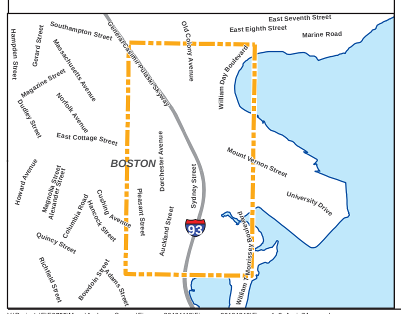
FIGURE 1-1
SITE LOCATION

Andrew Square to Dewar Street Reliability Project

Boston, Massachusetts

January 2019

INDEX MAP



Legend

Preferred Route

Substation

Map Notes:
Basemap: 2014 Orthophotographs, MassGIS

0 250 500 1,000 Feet
1:6,000

Figure 1-2

Orthophotograph

Andrew Square to Dewar Street Reliability Project

Boston, Massachusetts

EVERSOURCE ENERGY

Tighe&Bond
Engineers | Environmental Specialists

January 2019

2.0 PROJECT NEED

2.1 Introduction

The proposed Project will result in an integrated, long-term solution that addresses existing transmission system deficiencies. Specifically, the Project will provide the infrastructure needed to support the load requirements in the Project Area and to maintain a reliable supply to as many as 58,000 customers that are served by the Company in this area of Boston under certain contingency operating conditions. The area of exposure, the Project Area, is shown in Figure 2-1.

As described above in Section 1, the Project involves the installation of a 115-kV underground transmission line located within public ways between the Andrew Square and Dewar Street Substations, including minor modifications at both substations. Andrew Square and Dewar Street Substations are each supplied via radial transmission lines from the Company's K Street Substation. The Project will interconnect these substations and provides both with an alternative source of supply from K Street Substation.

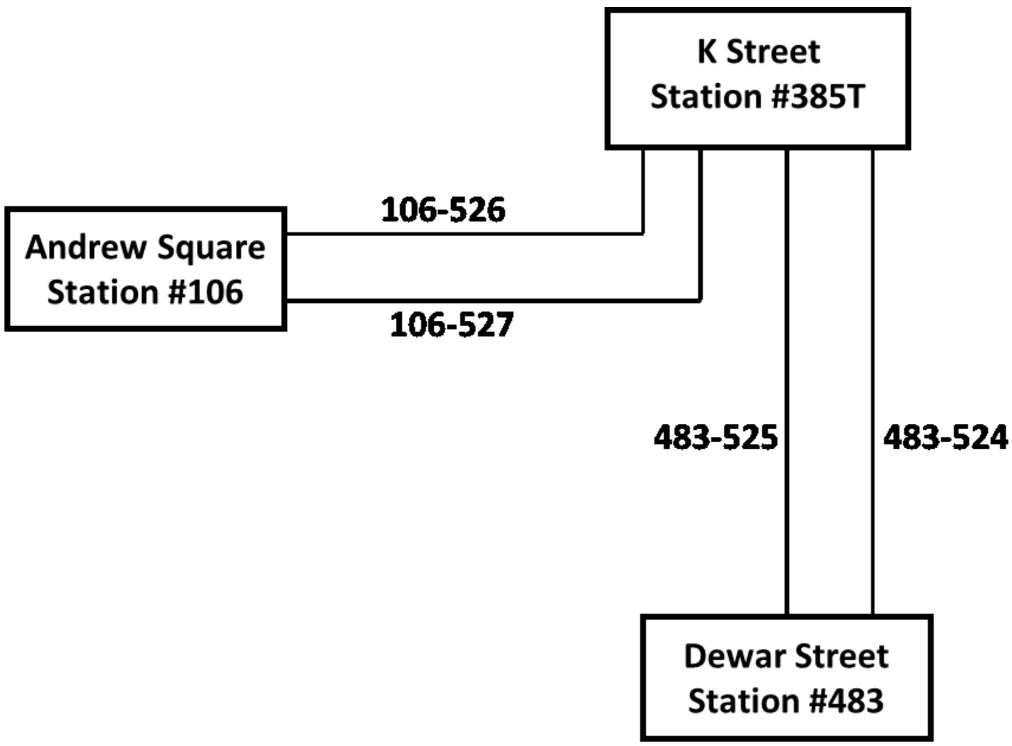
As further described below, the Project is designed to address a reliability need under certain contingency conditions, loss of transmission supply from the K Street Substation to either Andrew Square of Dewar Street Substations, that would result in loss of service to customers in the Project Area served by one of these Substations.

Figure 2-1: Geographic Depiction of the South Boston, Roxbury and Dorchester Supply Area

2.2 Description of the Existing South Boston, Roxbury, and Dorchester Area Transmission System Supply

The Project Area is supplied by the Company's Andrew Square and Dewar Street Substations. These substations are, in turn, supplied from four Company-owned and operated 115-kV lines, Lines 106-526, 106-527, 483-524 and 483-525. These four 115-kV lines emanate from the Company's K Street Substation. Figure 2-2 depicts the present transmission system in the Project Area.

Figure 2-2: Project Area Transmission Lines and Substations



2.2.1 Andrew Square Substation

The Andrew Square Substation supplies over 34,000 customers in portions of South Boston, the South End and Roxbury and has four 115/14-kV step-down transformers, each with a 44.5 megavolt ampere ("MVA") top nameplate rating. The Andrew Square 115/14-kV transformers do not have any overload/long-time emergency capability. The total capacity of the four transformers is 178 MVA.

The Andrew Square Substation has four sections of 14-kV switchgear. The four 14-kV bus sections are supplied by four 115/14-kV transformers (Transformers 110A, 110B, 110C and 110D). There is a 14-kV Automatic Bus Restoral ("ABR") system at Andrew Square Substation. Upon the loss of Transformer 110A, 110B, 110C or 110D, the bus tie breakers will close automatically so that all the load at Andrew Square will be supplied via the remaining three in-service transformers. Andrew Square Substation's firm capacity, based on the loss of one transformer, is 133.5 MVA.

2.2.2 Dewar Street Substation

The Dewar Street Substation supplies approximately 58,000 customers in Dorchester and portions of Jamaica Plain and Roxbury. The Dewar Street Substation has two 115/14-kV step-down transformers (Transformers 110A and 110B), with a 140 MVA top nameplate rating. The total capacity of the two transformers is 280 MVA. The Dewar Street Substation has four sections of 14-kV switchgear. There is a 14-kV ABR system at Dewar Street Substation and upon the loss of Transformer 110A, or 110B, the bus tie breakers will close automatically so that all the load at Dewar Street will be supplied via the remaining in-service transformer. The Dewar Street Substation's firm capacity based on the loss of one transformer is 150 MVA.

2.3 Methodology for Analyzing System Reliability

2.3.1 Eversource Planning Standards for Local Transmission Facilities

The Company's transmission system is an integral part of the power system delivering electricity to customers in the Project Area of Boston. To maintain the integrity of the power system in this area, the Company must ensure that adequate transmission resources are available to reliably meet the projected load requirements or that distribution system alternatives can be readily implemented.

ISO-NE plans and operates the transmission lines within the regional power system in New England. The regional transmission lines are classified as: (1) pool transmission facilities ("PTF") by ISO-NE; (2) part of the Bulk Electric System ("BES") governed by North American Electric Reliability Corporation ("NERC"); and in some cases, (3) part of the BES by Northeast Power Coordinating Council Inc. ("NPCC"). Thus, such transmission lines are planned and operated in accordance to ISO-NE, NERC and NPCC criteria.

The portions of the Eversource transmission system consisting of *radial* transmission lines (i.e., lines that are the sole transmission source serving a load) are part of the *local* power system. These local transmission lines are not considered as PTF, nor as part of the BES. Specifically, the K Street to Andrew Square 115-kV Lines 106-526 and 106-527, which supply the Andrew Square Substation and the K Street to Dewar 115-kV Lines 483-524 and 483-525, which supply the Dewar Street Substation, are radial lines and, therefore, are considered part of the local transmission system. Both the Andrew Square and Dewar Street Substations are non-PTF stations.

As the transmission provider for this area, the Company strives to serve all its customers reliably and consistently by designing and constructing its non-PTF facilities (including the transmission lines and substations in the Project Area) to ensure that adequate transmission resources are available to serve forecasted load under various conditions and contingencies. If Eversource non-PTF transmission facilities are unable to reliably serve load, the Company plans and implements system additions and upgrades to address the identified inadequacies. The Company gives special consideration to load served by substations that are supplied by two underground transmission lines, as are the Andrew Square and Dewar Street Substations. These stations serve a considerable number of customers in densely populated urban areas. The underground transmission lines are used in these densely populated areas to supply large customer loads that in most situations cannot be transferred across the distribution system due to system and/or physical limitations. Furthermore, an underground cable failure typically requires more time to locate the source of the problem and conduct required repairs, resulting in outage durations that can extend for a prolonged duration (e.g., potentially many days, weeks or months). Following an underground cable failure while the damaged line is out of service for an extended period of time, the remaining elements of the system must continue to operate reliably within their normal ratings. When the amount of load interrupted results in a consequential load loss in the affected area and load transfer capability within the distribution network is insufficient or does not exist, the Company assesses the outage impacts, and evaluates the cost, and feasibility of potential measures to mitigate or eliminate the duration and/or impact of such events.[2]

The Company evaluates its local transmission system to determine whether it has sufficient capability to serve the forecasted load under normal conditions (all facilities in-service), and under specified contingencies where one (N-1) or multiple (N-1-1) lines are out of service. For underground transmission lines such as those serving the Andrew Square and Dewar Street Substations, the Company's review is triggered when its studies identify greater than 50 megawatts ("MW") of consequential customer load loss in the event of an N-1-1 contingency.

The Company has set forth the above-described planning criteria in SYS PLAN-015, "Consequential Load Loss Guideline" ("SYS PLAN-015"), a copy of which is provided in Appendix 2-1. SYS PLAN-015 describes how the Company conducts transmission system planning assessments of consequential load loss and develops solutions for the Eversource transmission system. Special consideration is given to load served by substations that are supplied by two underground cables. Whenever practical, the load transfer capability within the distribution network will be considered to reduce or eliminate the consequential load loss within the Eversource system.

2.3.2 Results of the Eversource Project Area Transmission System Analysis

2.3.2.1 Current System Under N-1 Conditions

In June 2016, Eversource completed construction of the South Boston Reliability Project, which was approved by the Department of Public Utilities ("Department") in D.P.U. 13-86. As part of the Project, the Company energized and placed in service two new underground transmission lines in South Boston, Lines 106-526 and Line 106-527, between the K Street Substation and a connection point on Columbia Road in South Boston. The transmission line work split the former wye joints on Columbia Road so that two 115-kV cables would supply the Andrew Square Substation and two cables would supply Dewar Street Substation. As a result of that project, the Andrew Square and Dewar Street Substations are each supplied by two 115-kV lines, as show in Figure 2-2, above.

[2] Consequential load loss refers to the load that is no longer served by the transmission system as a result of transmission facilities being removed from service by a protection system operation designed to isolate the fault.

The normal rating of each of the transmission lines is greater than the 2018-2028 Eversource substation load forecast for Andrew Square and Dewar Street Substations. Accordingly, as a result of the South Boston Reliability Project, the existing transmission system has sufficient capacity under N-1 contingencies should one cable to either the Andrew Square or Dewar Street Substations fail and be out-of-service for an extended period of time.

2.3.2.2 Current System Under N-1-1 Conditions

Using detailed system models, the Company examined the existing transmission system within the Project Area and determined that, during an N-1-1 contingency, at existing and projected peak load levels, the existing 115-kV supply would not provide sufficient capacity to reliably serve the area.

The 2018-2028 Eversource substation load forecast projected a summer peak load for the Andrew Square Substation of 121.6 MVA in 2018 increasing to 128.3 MVA by 2028.[3] An N-1-1 contingency involving multiple facilities in the area would result in the loss of supply to Andrew Square Substation. To respond to the loss, Eversource identified 27 MVA of emergency transfer switching to the neighboring K Street, Dewar Street, Colburn Street and Hyde Park Substations as follows:

- Andrew Square to K Street transfer switching is 16.7 MVA.
- Andrew Square to Dewar Street transfer switching is 2.3 MVA
- Andrew Square to Colburn Street transfer switching is 2.3 MVA.
- Andrew Square to Hyde Park transfer switching is 5.7 MVA.

This distribution transfer switching would not be sufficient to restore power to all the affected outage customers served by the Andrew Square Substation. The above-described contingency would result in the loss of supply to the Andrew Square Substation of more than 94.6 MVA in 2018 and would increase to 111.3 MVA of unserved load by 2028. Post emergency transfer switching, there would be approximately 30,000 customers supplied from the Andrew Square Substation that could not be restored. Table 2-1 shows the N-1-1 impact at Andrew Square Substation post emergency distribution transfer switching.

Table 2-1: N-1-1 Impacts at Andrew Square Substation

Year →	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Andrew Square Substation Load Forecast	121.6	126.2	130.7	130.4	130.2	129.9	129.6	129.3	128.9	128.6	128.3
Emergency Distribution transfer switching	27	26	25	24	23	22	21	20	19	18	17
Unserved Load (MVA)	94.6	100.2	105.7	106.4	107.2	107.9	108.6	109.3	109.9	110.6	111.3

[3] The actual summer peak load in 2018 for Andrew Square Substation was 114.4 MVA.

Similarly, the loss of one transmission circuit followed by the loss of a second transmission circuit in the area would result in the total loss of supply to the Dewar Street Substation.

The 2018-2028 Eversource substation load forecast projected a summer peak load for the Dewar Street Substation of 124.7 MVA in 2018, decreasing to 121.6 MVA by 2028 as the result of implementation of additional EE.[4] The above-described contingency would result in the loss of supply to the Dewar Street Substation. To respond to the loss, Eversource identified 15.1 MVA of emergency transfer switching to the neighboring Andrew Square, Hyde Park and Colburn Street Substations as follows:

- Dewar Street to Andrew Square transfer switching is 7.2 MVA.
- Dewar Street to Colburn Street transfer switching is 3.8 MVA.
- Dewar Street to Hyde Park transfer switching is 4.1 MVA.

This distribution transfer switching would not be sufficient to restore power to all the affected outage customers served by the Dewar Street Substation. The loss of one transmission circuit followed by the loss of a second transmission circuit would result in the loss of supply to the Dewar Street Substation of more than 109.6 MVA in 2018 and would increase to 111.8 MVA of unserved load by 2028. Post-emergency transfer switching there would be approximately 53,000 customers supplied from the Dewar Street Substation that could not be restored. Table 2-2 shows the N-1-1 impact at Dewar Street Substation post emergency distribution transfer switching.

Table 2-2: N-1-1 Impacts at Dewar Street Substation

Year →	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Dewar Street Substation Load Forecast	124.7	125.0	124.5	124.2	123.9	123.6	123.3	122.9	122.5	122.2	121.8
Emergency Distribution transfer switching	15.1	14.5	13.9	13.4	12.8	12.3	11.8	11.3	10.9	10.5	10.0
Unserved Load (MVA)	109.6	110.5	110.6	110.8	111.1	111.3	111.5	111.6	111.6	111.7	111.8

Thus, based upon the above, in the event of an N-1-1 contingency on either set of lines, there would be substantial unserved load for the affected substation. Failures of underground transmission cables typically require extensive repairs, resulting in long outage durations. The duration could last weeks, or perhaps even months, depending upon the nature of the failure and location of the necessary repair. During such an extended duration outage of underground facilities, the affected customers could remain out service and there would be no means to either resupply or restore their electrical service until the failure could be repaired. Such loss of load to not only residential, commercial and industrial customers, but also to critical institutional customers, is not an acceptable planning solution.

[4] The actual summer peak load in 2018 for Dewar Street Substation was 121.0 MVA.

2.4 Summary of Project Need

The need for the Project is based upon conditions and analyses studied by the Company and Eversource's obligation to reliably serve its customers, in compliance with its planning standards. As demonstrated above, the Company has identified significant transmission system reliability concerns within the Project Area. Either the Andrew Square or Dewar Street Substations would be unserved in the event of an N-1-1 contingency. Accordingly, it is necessary to mitigate the consequences of the N-1-1 contingency in order to ensure reliable service to customers.

Table 2-3. Summary of Project Need

Contingency N-1-1	Year of Need	MVA Loss
Loss of source to Dewar Street Substation	2018	109.6 MVA
Loss of source to Andrew Square Substation	2018	94.6 MVA

The proposed new Andrew Square to Dewar Street 115-kV line that will connect the Andrew Square Substation and the Dewar Street Substation will result in an integrated, long-term solution that addresses the potential loss of radial supply to either station. Moreover, the capability of the New Line with a 150 MVA summer normal rating, will ensure the supply to both Andrew Square and Dewar Street Substations is supported throughout the ten-year planning horizon.

A new Andrew Square-Dewar Street 115-kV line is therefore immediately needed to adequately support the load to reliably serve customers in the Project Area.

3.0 PROJECT ALTERNATIVES

3.1 Introduction

This section describes the process used to identify and evaluate alternative means of addressing the identified electric system reliability need in the Project Area. As discussed in Section 2, viable alternatives must address consequential load loss that results from N-1-1 contingencies within the Project Area's 115-kV transmission system.

Eversource evaluated the following alternatives ("Project Alternatives") to meet the identified need:

i. A No-Build Alternative
ii. Transmission Project Alternatives: The Company assessed two transmission alternatives to address the identified transmission reliability needs. These alternatives include the construction of a new underground 115-kV transmission line between Andrew Square and Dewar Street Substations (i.e., the proposed Project), and the installation of two new, 115-kV transmission lines; one from K Street Substation to Andrew Square Substation and one from K Street Substation to Dewar Street Substation.
iii. Distribution transfer switching to neighboring substations.
iv. NTAs: The Company assessed NTAs, including new generation, either alone or supplemented by EE, DR programs and energy storage technologies.

The Company compared the identified Project Alternatives with the goal of selecting the solution that best meets the identified need with the least environmental and construction impacts, the greatest degree of reliability and at the lowest possible cost. The analysis presented in this section demonstrates that the proposed Project, on balance, meets this standard.

3.2 Assessment Factors for the Project Alternatives

The Company assessed each of the identified Project Alternatives to determine whether it could effectively address the identified need (i.e., the N-1-1 transmission loss of supply to either the Andrew Square or Dewar Street Substations). The Project Alternatives that were determined to adequately address the need were further analyzed by the Company to determine the comparative electrical capacity, constructability, cost, environmental impact and reliability that would be associated with each. The Project Alternatives are described in the following sections.

3.3 No-Build Alternative

Under the No-Build Alternative, no improvements would be made to the existing electric supply system serving Eversource's electric customers in the Project Area. The Company would not pursue the addition of any new facilities or resources, but instead would continue to rely upon the existing transmission system configuration. This approach was dismissed from further consideration because it would not address the identified transmission reliability needs within the Project Area. Leaving the identified needs unaddressed would expose the Project Area to significant loss of load that would affect a significant number of customers and result in the Company being out of compliance with its established reliability standards. The No-Build Alternative was rejected by the Company because it would not provide a solution to the identified transmission reliability needs in the Project Area.

3.4 Transmission Project Alternatives

3.4.1 Transmission Alternatives

The Company evaluated two transmission alternatives to address the identified transmission reliability needs shown in Figure 3-1: (1) the construction of an underground 115-kV line between the Andrew Square and Dewar Street Substations; and (2) the construction of one new underground 115-kV line between the K Street and Andrew Square Substations and the construction of another new underground 115-kV line between the K Street and Dewar Street Substations. The two transmission alternatives are described in more detail below.

Transmission Alternative No. 1: One New 115-kV Underground Transmission Line from Andrew Square to Dewar Street Substations (the Preferred Transmission Alternative)

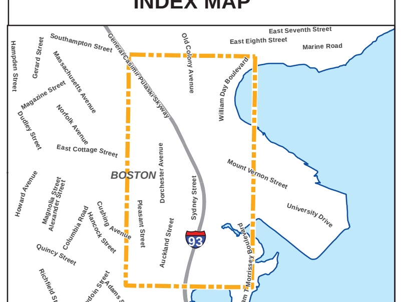
This Transmission Alternative would involve the installation of a new solid dielectric cable from the Andrew Square Substation to the Dewar Street Substation. Approximately 2.0 miles of duct bank would be installed to support the following conduits[5]:

- 4 - 8” conduits
- 2 - 4” conduits (communications)
- 2 - 2” conduits (communications)
- 8 - 22’x7’x8’ cable splice vaults (manholes)
- 8 - 4'x4’x4’ communication hand-holes

The cable size for the Andrew Square to Dewar Street Substations 115-kV line would be 3,500 kcmil, which would support the firm capacity of both the Andrew Square Substation (134 MVA) and the Dewar Street Substation (150 MVA). A diagram (Figure 3-2) illustrates the transmission connection of the proposed Andrew Square to Dewar Street 115-kV line.

5 Additional spare conduits may be added.

INDEX MAP



Legend

Alternative 1: Andrew Square to Dewar Street Substations

Alternative 2:

K Street to Andrew Square Substations

K Street to Dewar Substations

Map Notes:
Basemap: 2014 Orthophotographs, MassGIS
Data source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs.

Parcels downloaded from Boston Open Data Portal: 2016

The information/data provided in this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation or parcel level analysis. The maps should not be used for construction purposes.

0 200 400 800 Feet
1:4,800

Figure 3-1

Transmission Alternatives

Andrew Square to Dewar Street Reliability Project

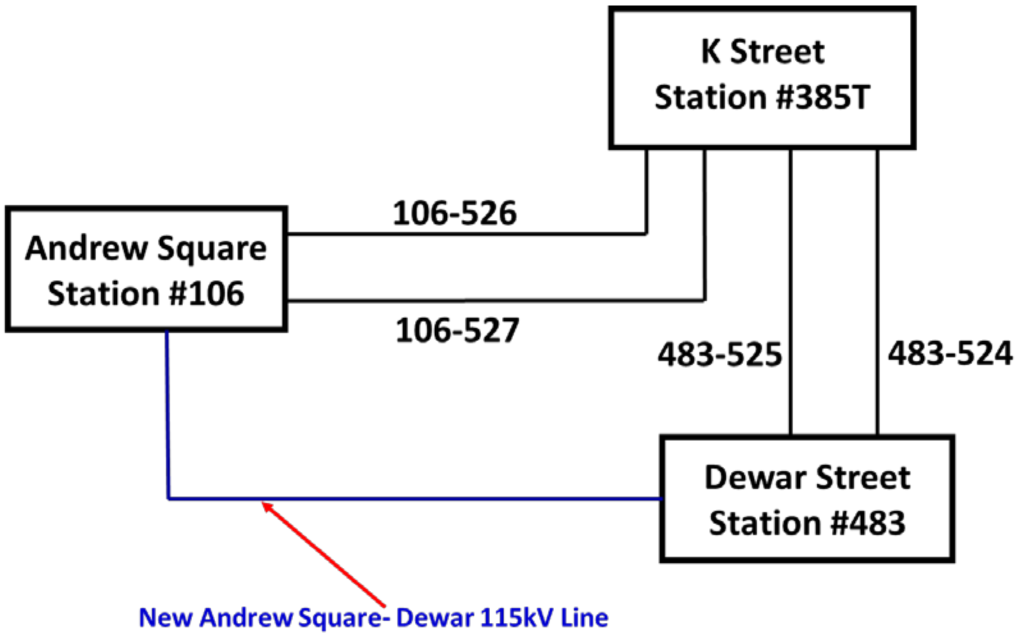
Boston, Massachusetts

EVERSOURCE ENERGY

Tighe&Bond
Engineers | Environmental Specialists

January 2019

Figure 3-2:
Transmission Alternative No. 1 (the Project)



At the Andrew Square Substation, the Company will install a hybrid air-insulated switchgear/gas insulated switchgear ("AIS/GIS") module consisting of two 115-kV breakers in series, two source terminals, a common load terminal and all associated switches, arresters, instrument transformers and interconnecting bus between each of the existing 115-kV Lines 106-526 and 106-527 to the new hybrid AIS/GIS, as depicted in Figures 3-3 and 3-4, located in Appendix 3-1.[6] The Company will install the control panels to support the relaying and controls for the new hybrid AIS/GIS module and associated lines. There will be controls for two new 115-kV breakers, a line terminal control cabinet, and two new relay cabinets for the protection of the New Line.

At the Dewar Street Substation, the Company will install another hybrid AIS/GIS module consisting of two 115-kV breakers in series, two source terminals, a common load terminal and all associated switches, arresters and instrument transformers, and interconnecting bus between each of the existing 115-kV Lines 483-524 and 483-525 to the new hybrid AIS/GIS module. The hybrid AIS/GIS module control will be located above the 14-kV switchgear at the station. The Company will install control panels to support the relaying and controls for the new hybrid AIS/GIS module and associated lines. There will be

6 Appendix 3-1 has been redacted for the public record in order to avoid disclosure of Critical Energy Infrastructure Information ("CEII"). Unredacted copies have been provided to the Siting Board under seal and subject to a Motion for Protective Treatment and will be provided to eligible parties who execute a CEII Non-Disclosure Agreement.

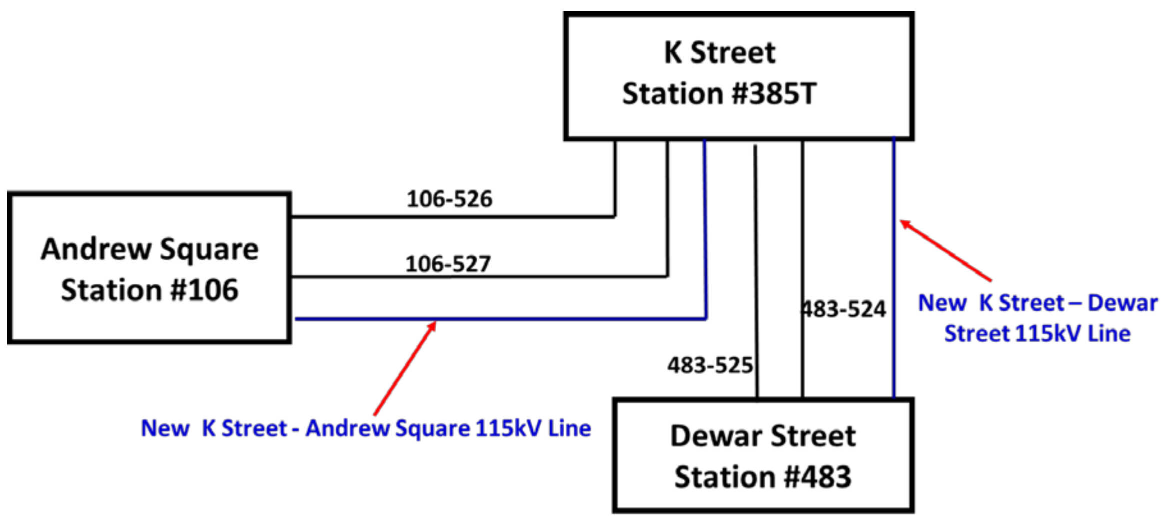
controls for two new 115-kV breakers, a line terminal control cabinet and two new relay cabinets for the protection of the New Line.[7]

At the K Street Substation, the protective relays associated with the existing supply lines to the Andrew Square and Dewar Street Substations will be reprogrammed.

Transmission Alternative No. 2: New 115-kV Underground Transmission Lines from K Street to Andrew Square Substations and from K Street to Dewar Street Substations

This Project Alternative would involve the installation of two new 115-kV solid dielectric transmission lines from K Street Substation – one to the Andrew Square Substation and one to the Dewar Street Substation (see Figure 3-5). The installation of the two new 115-kV transmission lines would establish a third transmission supply to both the Andrew Square and Dewar Street Substations.

Figure 3-5:
Transmission Alternative No.2



The first part of this alternative would include the installation of a new solid dielectric cable from K Street Substation to Andrew Square Substation. Approximately 1.4 miles of duct bank would be installed, depending on the final routing, to support the following conduits (see also Figure 3-6):

- 4 - 8” conduits
- 2 - 4” conduits (communications)
- 2 - 2” conduits (communications)
- 5 - – 22’x7’x8’ cable splice vaults (manholes)
- 5 - 4'x4’x4’ - communication hand-holes

7 The Company plans to construct a new control house at both Andrew Square and Dewar Street Substations prior to commencement of Project construction to modernize the control and protection associated with these substations.

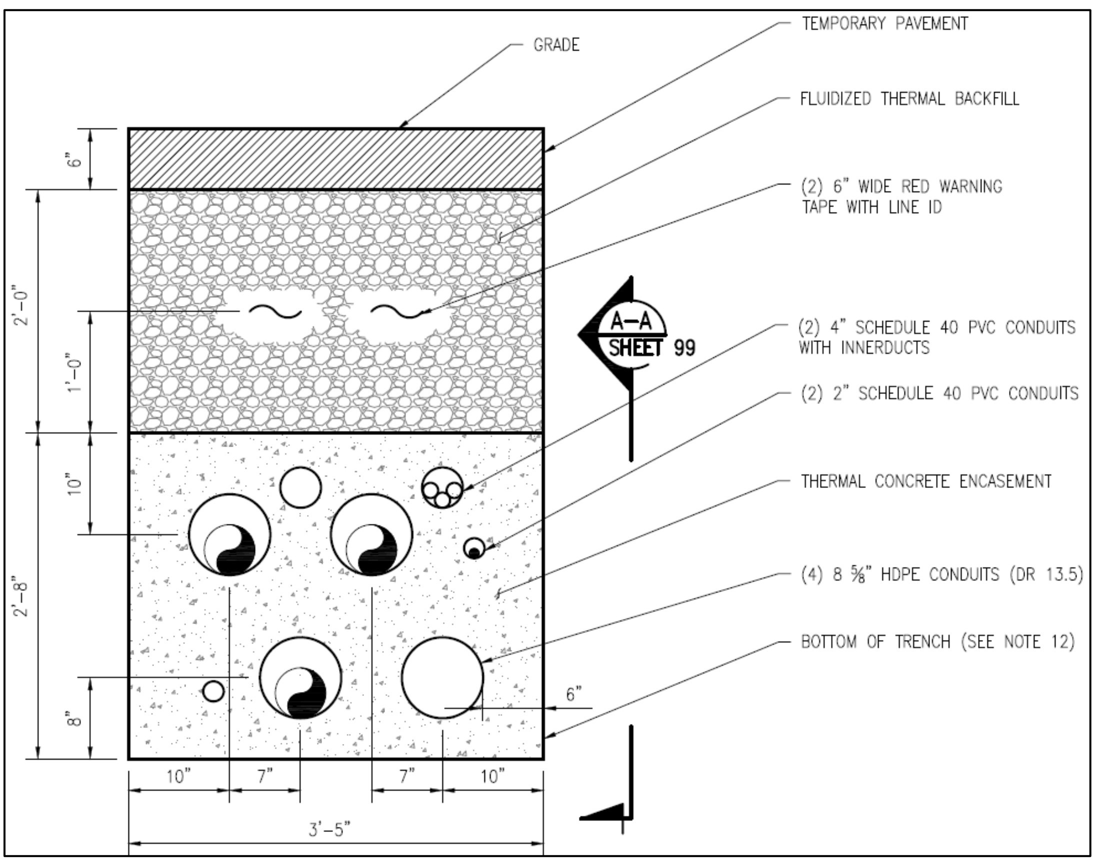
The second part of this alternative would include the installation of a new (solid dielectric cable) from K Street Substation to Dewar Street Substation. Approximately 3.1 miles of duct bank would be installed, depending on the final routing, to support the following conduits (see also Figure 3-6):

- 4 - 8” conduits
- 2 - 4” conduits (communications)
- 2 - 2” conduits (communications)
- 11 - 22’x7’x8’ cable splice vaults (manholes)
- 11 - 4'x4’x4’ communication hand-holes

To connect the two new 115-kV lines at K Street Substation, the Company would terminate the new K Street to Andrew Square 115-kV line into an existing spare board position between 115-kV breakers #10 and #22. The new K Street to Dewar Street 115-kV Line would be bifurcated into the board position for the K Street Substation 385D Transformer 110A; between 115-kV breakers #7 and #8.

The required work to interconnect each new line at its respective station, the Andrew Square and Dewar Street Substations, would be the same as with the Transmission Alternative 1. The typical duct bank trench will be four feet wide and five feet deep; a typical trench diagram is provided as Figure 3-6, Typical Trench Cross Section.

Figure 3-6: Typical Trench Cross Section



3.4.2 Assessment of Transmission Alternatives

This section assesses the two transmission alternatives with respect to their cost, reliability and environmental impact.

Cost

The Company prepared conceptual grade cost estimates (-25%/+50%) for the two transmission alternatives, including the transmission lines and associated station work. The cost for Transmission Alternative No. 2, installing transmission lines between K Street and Andrew Square and K Street and Dewar Street, is estimated to be $140.5 million. The estimated cost for Transmission Alternative No. 1, installing a new Andrew Square-Dewar Street 115-kV line, is $68.3 million. Table 3-1 summarizes the Company's assessment of the Transmission Alternatives.

Table 3-1: Conceptual Cost Estimates for Transmission Alternatives

	Transmission Costs ($ in millions)	Substation Costs ($ in millions)	Total ($ in millions)
Transmission Alternative 1	$52.0	$16.3	$68.3
Transmission Alternative 2	$122.0	$18.5	$140.5

Transmission Alternative No. 1 is superior in terms of cost because it requires the least amount of transmission line and substation construction. Specifically, it requires the installation of approximately 2 miles of conduit and cable. Alternative No. 2 would require installation of two transmission lines and a significantly greater amount of conduit and cable than Alternative No. 1 (4.5 miles). The higher cost anticipated by the Company for Alternative No. 2 is due principally to this additional transmission line infrastructure plus the station work that would be required at K Street Substation.

Conclusion on Cost: For the reasons discussed above, Alternative No. 1, is preferable to Alternative No. 2 as it has the lower cost.

Reliability

A comparative summary of the two Transmission Alternatives, with respect to reliability is as follows:

- Alternatives No. 1 and No. 2 would both add sufficient transmission capacity to the system. Each alternative would establish a third transmission source to both Andrew Square and Dewar Street Substations to fully supply all the customers served by these Substations.
- For Alternative No. 2, there are two new 115-kV lines to be established from the K Street Substation. The new K Street to Andrew Square 115-kV line would be terminated at the remaining spare 115-kV switching position. The new K Street to Dewar Street 115-kV Line would share the 115-kV switching position for the K Street Substation Transformer 110A to support the termination of the new K Street to Dewar Street 115-kV Line. This approach would degrade the reliability of this interconnection. An outage of the K Street Substation 385D Transformer 110A

could result in loss of the new K Street to Dewar Street 115-kV Line; which reduces the reliability of the 115-kV supply to the Dewar Street Substation.[8]

Conclusion on Reliability: Transmission Alternative No. 1 provides a higher level of reliability.

Environmental Impacts

The Company also compared the Transmission Alternatives on the basis of the potential for environmental impact. Transmission Alternatives No. 1 and 2 both include construction of underground transmission, but Transmission Alternative No.1 would be approximately 2 miles in length, and require upgrades at two existing substations, while Transmission Alternative No. 2 would involve 4.5 miles of transmission line work, as well as proposed upgrades at three substations. Thus, the potential for environmental impact is less for Transmission Alternative No. 1 compared to Transmission Alternative No. 2, as Transmission Alternative 2 requires a longer length of new 115-kV cable installation. Furthermore, the impact from Transmission Alternative No 2 with work at three stations would be greater than the work at only Andrew Square and Dewar Street Substations.

Table 3-2 presents a desktop analysis of key environmental elements for both Transmission Alternatives as displayed in Figure 3-7. As shown in Table 3-2, Transmission Alternative No. 1 has less potential environmental impacts for ten of the twelve environmental parameters that were compared. As compared to Transmission Alternative No. 1, Transmission Alternative No. 2 would result in construction of approximately 9,295 feet more of 115-kV transmission main; impact approximately 165 more residential properties; impact approximately 23 more commercial/industrial properties; and impact approximately 5,621 more linear feet of public transportation routes. Based on this comparison, the Company concluded that Transmission Alternative No. 1 is superior to Transmission Alternative No. 2 based on the potential for environmental impact.

8 While an outage of the New Line would result in the loss of the K Street Substation 385D Transformer 110A, there is no adverse impact as the K Street Substation 385D has sufficient station firm capacity and an ABR system that would result in no loss of customer load.

Table 3-2: Transmission Alternatives Potential Environmental Impact Comparison Summary

	Transmission Alternative No.1	Transmission Alternative No. 2
Description	One Transmission Line (Andrew Square to Dewar Street Substations)	Two Transmission Lines (K Street to Dewar Street Substations and K Street to Andrew Square Substations)
Total Length (Linear Feet)	10,454	19,750
Residential (total parcels adjacent to ROW limits)	99	265
Commercial/Industrial (total parcels adjacent to ROW limits)	18	41
Sensitive Receptors (total parcels adjacent to ROW limits)	9	11
Park/Conservation Land (linear feet adjacent to ROW)	3,811	3,217
Cultural Resources (MHC MACRIS data)	61	47
Public Transit (linear feet along ROW)	1,405	7,026
Hazardous Waste Sites/Potential to Encounter Subsurface Contamination (total sites within 500 ft. of ROW)	9	15
Highway Crossings	1	2
Railroad Crossings	1	1
Major Bridge Crossings	1	2
Shade Trees	44	98

3.4.3. Conclusion on Transmission Alternatives

Both alternatives considered by the Company would meet the identified need. As described in the previous sections, Transmission Alternative No. 2 is a less reliable solution and, since it requires the construction of an additional 2.5 miles of 115-kV transmission main, is more costly and has greater environmental and land use impacts. Furthermore, for an approximate length of 1,750 linear feet, two transmission lines would need to be located within the same urban roadways already congested with subsurface utilities. Traffic impacts would be increased in these locations due to the additional construction time needed to install two separate transmission mains.

Transmission Alternative No. 1 is less costly and more reliable than Transmission Alternative No. 2. Transmission Alternative No. 1 is the superior alternative and is the transmission solution that best meets the identified need and reflects a balancing of established environmental and land use criteria, cost and reliability. Therefore, Transmission Alternative No. 1 was selected as the Preferred Transmission Alternative.

3.5 Distribution Alternatives

3.5.1 Increase Emergency Distribution Transfers to Neighboring Stations

The Company also evaluated the ability of increased distribution emergency transfer switching to mitigate the impact of the N-1-1 conditions for both the Andrew Square and Dewar Street Substations. The implementation of available emergency transfer switching would not fully address the concern. Based on the Company's 2018 station load forecast, distribution load transfers would reduce the outage at Andrew Square to 94.6 MVA and at Dewar Street to 109.6 MVA.[9] Furthermore, the load exposure after emergency transfer switching is forecasted to grow to 111.3 MVA at Andrew Square and 111.8 MVA at Dewar Street by 2028.

In addition, Eversource evaluated the possibility of increasing the emergency distribution transfer switching beyond the levels currently available (see Section 2.3.2.2). Figure 2-1 illustrates supply regions for the Andrew Square and Dewar Street Substations and neighboring substations.

The Dewar Street, K Street, Colburn Street and Hyde Park Substations are near the Andrew Square Substation and present the theoretical possibility of providing additional levels of distribution transfer switching to reduce the load at risk at Andrew Square Substation. Though the Scotia Street, Carver Street and Kingston Street Substations are also near Andrew Square Substation, these substations are secondary network substations. There are no interconnections between the network substations and neighboring substations. These secondary network stations have no transfer switching capability to adjacent stations.

Table 3-3 summarizes the impact on substation load, using the load forecast for 2018, after the implementation of both existing distribution emergency transfer switching and the theoretical increased transfer switching from Andrew Square Substation to neighboring substations.

As shown in Table 3-3, the existing distribution system could support only a slight increase of 13.2 MVA in emergency distribution transfer switching because there is either limited available station capacity or limited spare 14-kV board positions at neighboring stations to support the installation of new distribution feeders. 81.4 MVA of load would remain at risk at Andrew Square Substation. This amount of consequential load loss in a dense urban area is unacceptable to the Company due to prolonged restoration periods.

9 Based upon 2018 actual summer peak loads, the load at risk post emergency transfer switching was 87.4 MVA for Andrew Square Substation and 105.9 MVA for Dewar Street Substation.

Table 3-3: Andrew Square Substation – Transfer Switching to Neighboring Stations

Substation	2018 Station Load Forecast (MVA)	Existing Emergency Transfer Switching Identified in Section 2.3.2.2 (MVA)	Substation Loading post switching (MVA)	Station Normal Capacity (MVA) (See Note A)	Station Available 14-kV Board Positions	Available Station Capacity to Support Increased Transfer Switching (MVA)	Station load after additional potential Transfer Switching (MVA)
Andrew Square	121.6	-27	94.6	133.5	0	-13.2 (See Note B)	81.4
Dewar Street	124.7	+2.3	127.0	210	0	0 (See Note B)	127.0
K Street	157.7	+16.7	174.4	187.5	2	+13.1	187.5
Colburn Street	185.1	+2.3	187.4	187.5	7	+0.1	187.5
Hyde Park	143.0	+5.7	148.7	210	0	0 (See Note B)	148.7

Note A: Station Normal Capacity reflects that each station transformer cannot exceed 75% of the transformer's top nameplate rating.
Note B**:** No spare 14-kV board positions are available to install feeders to use the available station capacity.[10]

The Andrew Square, Colburn Street and Hyde Park Substations are near Dewar Street Substation and present the theoretical possibility of providing an increase in distribution transfer switching to reduce the load at risk at Dewar Street Substation.

Table 3-4 summarizes the impact on substation load, based on the 2018 load forecast, after the implementation of both the existing distribution emergency transfer switching and the theoretical increased transfer switching from Dewar Street and to neighboring substations.

As shown in Table 3-4, there is no opportunity to achieve additional reduction in the load at risk at Dewar Street Substation because there is both limited available station capacity at neighboring stations or no spare 14-kV board positions at Dewar Street Substation to support the installation of new distribution feeders; thus 109.6 MVA of load would remain at risk at Dewar Street Substation. This amount of consequential load loss in a dense urban area is unacceptable to the Company due to prolonged restoration periods.

10 To reduce the load at the Andrew Square Substation would require installing new distribution feeders from the neighboring substations to Andrew Square. The new distribution feeders would supply portions of the Andrew Square supply region. These new distribution feeders would be terminated into spare 14-kV board positions at the neighboring stations. If there are no spare 14-kV board positions available at a neighboring substation, then the distribution feeders cannot be terminated to this neighboring substation and the neighboring substation cannot supply any of the load presently supplied from the Andrew Square Substation.

Table 3-4: Dewar Street Substation - Transfer Switching to Neighboring Stations

Substation	2018 Station Load Forecast (MVA)	Existing Emergency Transfer Switching Identified in Section 2.3.2.2 (MVA)	Substation Loading post switching (MVA)	Station Normal Capacity (MVA) (See Note A)	Station Available 14kV Board Positions	Available Station Capacity to Support Increased Transfer Switching (MVA)	Station load after additional potential Transfer Switching (MVA)
Dewar Street	124.7	-15.1	109.6	210	0	0 (See Note B)	109.6
Andrew Square	121.6	+7.2	128.8	133.5	0	4.7 (See Note B)	128.8
Colburn Street	185.1	+3.8	188.9	187.5	7	0	187.5
Hyde Park	143.0	+4.1	147.1	210	0	0 (See Note B)	148.8

Note A: Station Normal Capacity reflects that each station transformer cannot exceed 75% of the transformer's top nameplate rating.
Note B: No spare 14-kV board positions are available to install feeders to use the available station capacity[11]

Theoretically, there is potentially available station capacity at neighboring substations to support increased distribution transfer switching to reduce the loading of Andrew Square and Dewar Street Substations. However, the existing distribution systems would support only a limited increase in additional transfer switching. Moreover, there are major challenges to expanding the distribution system's ability to support additional transfer switching:

1. In transferring load from Andrew Square or Dewar Street Substations to nearby stations, the loading of these neighboring stations must not exceed the station's normal capacity.
   a. Additional emergency distribution transfer switching from Andrew Square Substation to Colburn Street and K Street Substations would exceed the normal capacity of these adjacent stations.
   b. Additional emergency distribution transfer switching from Dewar Street Substation to Andrew Square and Colburn Street Substations would exceed these stations' normal capacity.
2. Extensive new underground conduit and manhole systems for new distribution feeders from the adjacent substations would need to be installed within the distribution network in the city streets to increase the transfer of load from Andrew Square and Dewar Street Substations to nearby stations.

11 To reduce the load at the Dewar Street Substation would require installing new distribution feeders from the neighboring substations to Dewar Street. The new distribution feeders would supply portions of the Dewar Street supply region. These new distribution feeders would be terminated into spare 14kV board positions at the neighboring stations. If there are no spare 14kV board positions available at a neighboring substation, then the distribution feeders cannot be terminated to this neighboring substation and the neighboring substation cannot supply any of the load presently supplied from the Dewar Street Substation.

3. There are no available breaker positions in the existing distribution switchgear to support new distribution feeders at either Andrew Square or Dewar Street Substations, nor do they have space to install additional sections of distribution switchgear. Therefore, it is not possible to transfer additional capacity from either Andrew Square or Dewar Street Substations.
4. The Hyde Park Substation does not have any spare 14-kV breaker positions in the existing distribution switchgear and there are land constraints at the station that preclude the installation of new distribution switchgear. Accordingly, it is not possible to use the available station capacity at Hyde Park substation.

Because of these challenges, it was determined that it would not be feasible to increase the amount of distribution emergency transfer switching to relieve Andrew Square and Dewar Street Substations.

As shown in Tables 3-3 and 3-4, emergency transfer switching is insufficient to address the identified need. Increasing distribution transfer switching was rejected as an alternative by the Company because it would not provide a solution to the identified transmission reliability needs in the Project Area. As a result, the identified consequential load loss would be unresolved.

3.5.2 New Distribution Substation

The construction of a new 115/14-kV substation adjacent to the Andrew Square and Dewar Street supply regions could provide sufficient station capacity and adequate distribution capacity to relieve Andrew Square and Dewar Street Substations. Based upon the recent construction of Electric Avenue Station #315 and Seafood Way Station #99, it is estimated that the cost of a new 115/14-kV substation would exceed $100 million. In addition, the lack of transmission lines in the region to support a new substation's interconnection would significantly increase the cost of this approach. To supply a new 115/14-kV substation, the Company would need to install upwards of three to four miles of new transmission lines, which would increase the cost of a new substation to significantly more than $150 million. The cost to construct a new distribution station is significantly greater than the cost of the proposed Project ($68.3 million). Due to the cost, the development of a new substation was rejected as an alternative by the Company to address the identified transmission reliability needs in the Project Area.

3.6 Description and Assessment of Non-Transmission Alternatives

3.6.1 Non-Transmission Alternatives to the New Line

The Company considered a wide variety of technologies in assessing possible NTAs to address the identified need. Because viable NTA technologies must address the load loss that results from N-1-1 contingencies as discussed in Section 2, the NTA technologies must be capable of supplying the entire load at either Andrew Square or Dewar Street Substation without support from the regional transmission system for a long-term event affecting the two underground transmission lines supplying Andrew Square and Dewar Street Substations. These stations serve a considerable number of customers in densely populated urban areas, and an underground cable failure typically results in outage durations that can extend for many months.

Emergency distribution transfer switching could reduce some of the load, as discussed in Section 3.5; however, this would still leave most of the load unserved in a post-contingency situation (approximately 111.3 MVA and 111.8 MVA at Andrew Square and Dewar Street Substations, respectively). This remaining load would have no other source of supply once all transmission sources are lost to Andrew Square or Dewar Street Substation. Most NTA technologies are ineffective in this scenario because they can only support the load temporarily or reduce the load. Therefore, as described below, the Company's NTA analysis focused on conventional generation. The Company also considered whether conventional generation in combination with other technologies would be feasible or cost effective.

3.6.2 Non-Transmission Alternatives Dismissed Due to Technical Limitations and Feasibility Issues

The Company evaluated several NTA technologies. Because of technical limitations, these technologies were not suitable alternatives to address the identified need.

Battery storage systems can charge from the grid and store the electricity for later use. In this application, battery storage is technically infeasible by itself because it would be unable to charge from the grid in a post-contingency situation and would be limited to only the hours of energy on hand. Commercially-available storage systems have typically been sized to operate at full capacity for four hours or less without recharging. Battery storage would therefore be able to cover only a short portion of one day, which would be insufficient for a longer-term outage associated with an underground cable.

PV solar facilities convert sunlight into electricity and are highly intermittent and non-dispatchable because, they only produce electricity during hours of the day when there is sunlight available. Therefore, PV can only support the load temporarily and would also not be an effective solution for a long-term outage. PV also requires a significant amount of land compared to other technologies, even when paired with battery storage. It would require at least 2,500-3,000 acres[12] (or about 4-5 square miles) to build enough solar panels to generate enough energy to be stored to support the load for a long-term event. This would be unreasonable given that it would require undeveloped land similar in size to the entire neighborhood of Dorchester, which is not available as a practical matter.

Demand-side programs and distributed generation are also not suitable alternatives in this instance.

EE programs are principally designed to save electric energy by increasing efficiency for equipment. Some EE programs can also reduce peak loads. DR resources are designed to encourage end users to make short-term reductions in energy demand in response to a price signal from the wholesale electricity market, or a trigger initiated by the electricity grid operator. Distributed generation (primarily small solar PV facilities and combined heat and power facilities) can also provide small reductions in the load. However, demand-side

[12] The Company made several simplifying assumptions and actual land requirements would likely be higher.

reductions such as EE, DR and distributed generation can only reduce the load and cannot serve load by themselves in an isolated manner. Additionally, the amount of load that can be reduced by these technologies is insufficient compared to the overall load at both Andrew Square and Dewar Street Substations. For example, EE is currently reducing the load at Andrew Square by approximately 2%.

3.6.3 Consideration of Conventional Generation

Certain types of conventional generators are the only NTA technology that could feasibly support either Andrew Square or Dewar Street Substation for a long-term event. There are currently no conventional generation projects proposed in the Project Area in the ISO-NE interconnection queue, so the most likely NTA solution would be the construction of at least two new, fast-start combustion turbines. To address the potential loss of the two transmission lines feeding either Andrew Square Substation or Dewar Street Substation, at least one combustion turbine would need to be located at each station. Based on ISO-NE data, the cost to install a single 112 MW fast-start unit would be approximately $206 million; therefore, the cost for two combustion turbines would be approximately $412 million. This is significantly greater than the cost of the proposed Project ($68.3 million). Depending on the configuration and the design, additional units at each substation could also be required to provide a reliable backup supply.

The Company also considered whether NTA technologies that are insufficient by themselves could be used in combination with a combustion turbine and determined that none of these NTA technologies would be available at a size that would materially change the size of the generator required and associated cost.

To implement the combustion turbine alternative, the Company would also need to overcome challenges associated with the availability of land in South Boston and limitations on the interconnection of generation at the Andrew Square and Dewar Street Substations. Land acquisition and interconnection challenges would add costs to an already cost-prohibitive alternative.

Data from recent similarly-sized projects in New England indicate land requirements of 5-10 acres for a generator of the required size. The Company identified no land for sale in the vicinity of Andrew Square and Dewar Street Substations that would be suitable for a generator. Even if land were to become available, the Company estimated that land costs alone could add at least $50 million to the cost of each generator.

Interconnecting the generators into the Andrew Square and Dewar Street Substations would require expansion of both substations with scope and cost similar to the substation upgrades associated with the proposed Project, plus the additional cost of the generator and land requirements. Interconnecting the generator using distribution lines would have even higher costs. Furthermore, numerous downtown Boston substations (including K Street Substation) have been found to have fault current limitations.[13] It is unlikely that a generator of sufficient size located at Andrew Square Substation or Dewar Street Substation would be able to operate without exceeding the fault interrupting capability of

[13] See, e.g. *Greater Boston Area Transmission Solutions Study*, ISO New England, August 12, 2015

circuit breakers at some substations. Therefore, at a minimum, a generator at either Andrew Square or Dewar Street Substation would be able to run only after the contingency loss of one or more cables (i.e., in a post-contingency) situation.

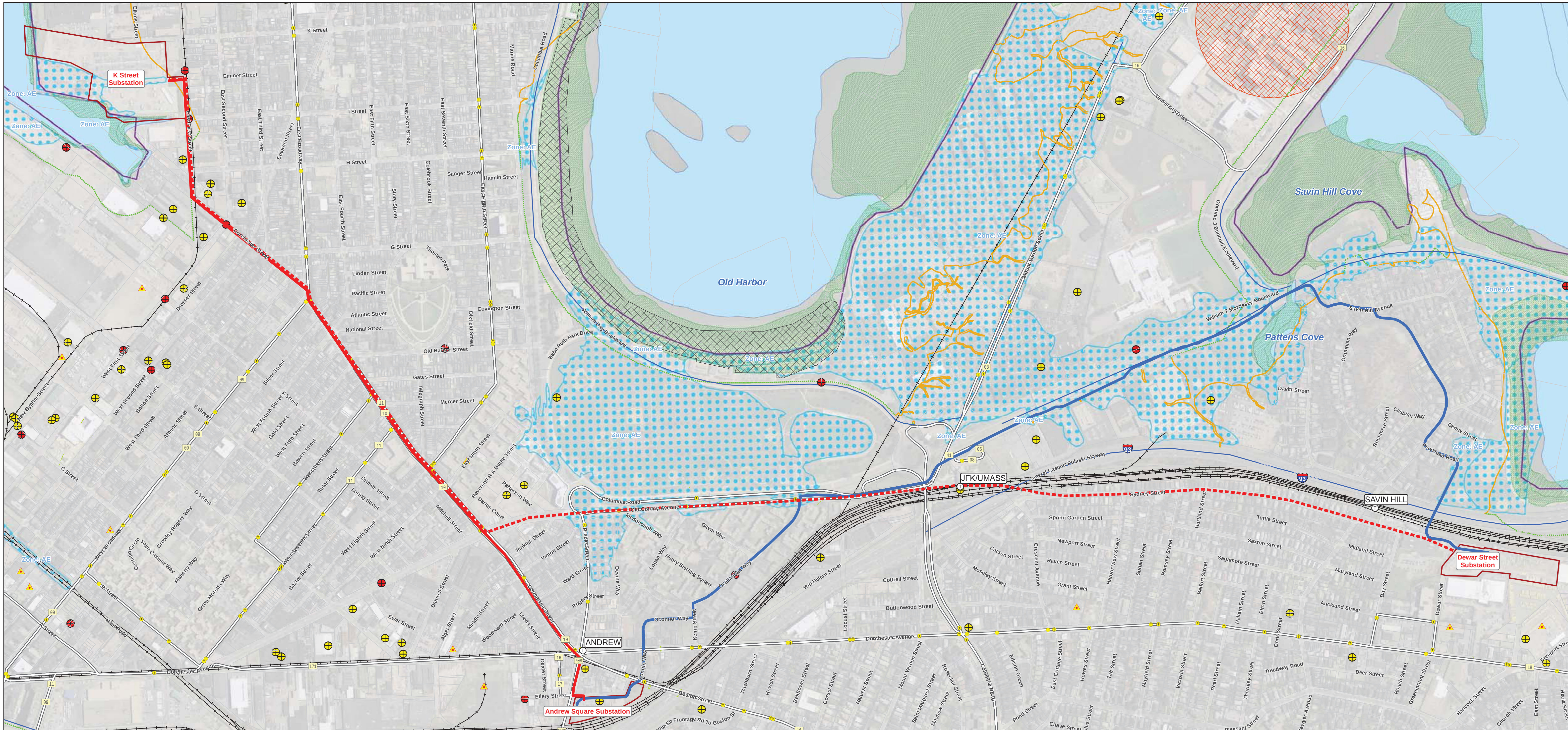
Aside from costs, combustion turbines are susceptible to fuel supply shortages and would likely require dual-fuel capability and on-site storage for oil. Installing combustion turbines and storing fuel locally would also require additional costs and land. Each generator would also need to complete the ISO-NE interconnection process as well as extensive regulatory siting and permitting requirements to address issues such as air emissions, noise and visual impacts. Furthermore, combustion turbines would emit greenhouse gasses ("GHG"), which would be inconsistent with the Commonwealth's environmental goals.

3.7 Conclusion on Project Alternatives

Eversource's Project Alternative analysis demonstrates that the proposed Andrew Square-Dewar Street 115-kV transmission line (Transmission Alternative No. 1) will best address the need to improve reliability to the Project Area. Relative to the other substation and transmission alternatives studied, the proposed Project best meets the need with the least environmental and construction impacts at the lowest possible cost.

No feasible or practical NTAs to the various needs were identified. The Company's analysis showed that new generation would be impractical and costly. It was not feasible to increase distribution transfer switching.

Accordingly, the installation of an Andrew Square to Dewar Street 115-kV Line was the solution carried forward to the routing analysis presented in Section 4 of this Analysis.



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Map Notes:
Basemap: 2014 Orthophotographs, MassGIS
Data source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs.

Parcels downloaded from Boston Open Data Portal: 2016

The information/data provided in this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation or parcel level analysis. The maps should not be used for construction purposes.

0 200 400 800 Feet

Figure 3-7

Transmission Alternatives Environmental Resources

Andrew Square to Dewar Street Reliability Project

Boston, Massachusetts

EVERSOURCE ENERGY

Tighe&Bond
Engineers | Environmental Specialists

January 2019

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4.0 ROUTING ANALYSIS

4.1 Introduction and Overview

As presented in Section 3, the Company's proposed solution to address the electrical system need identified in Section 2 involves the construction of a new 115-kV underground transmission line between the existing Eversource Andrew Square Substation and the existing Dewar Street Substation, with associated modifications at each substation. This Section describes the process by which the Company identified and evaluated possible routes which led to a determination of the Preferred Route for the Project and a Noticed Alternative Route.

4.1.1 Standard of Review

The Siting Board has a statutory mandate to implement the policies of G.L. c. 164, §§ 69J-69Q to provide a reliable energy supply for the Commonwealth with a minimum impact on the environment at the lowest possible cost (G.L. c. 164, §§ 69H, 69J). Further, Section 69J requires the Siting Board to review alternatives to planned projects, including "other site locations." In implementing this statutory mandate, the Siting Board requires a petitioner to demonstrate that it has considered a reasonable range of practical project and siting alternatives and that the proposed facilities are sited at locations that minimize costs and environmental impacts while ensuring supply reliability. NSTAR Electric Company d/b/a Eversource Energy, EFSB 16-02/D.P.U. 16-77, at 21 (2018) ("Eversource Needham"); NSTAR Electric Company d/b/a Eversource Energy and New England Power Company d/b/a National Grid, EFSB 15-04/D.P.U. 15-140/15-141, at 34-35 (2018) ("Eversource Woburn-Wakefield"); NSTAR Electric Company d/b/a Eversource Energy, EFSB 15-03/D.P.U. 15-64/15-65, at 26 (2017) ("Eversource Mystic-Woburn").

To do so, an applicant must satisfy a two-pronged test and demonstrate that it has: (1) developed and applied a reasonable set of criteria to identify and evaluate alternative routes in a manner that ensures that no routes were overlooked or eliminated that, on balance, are clearly superior to the proposed route; and (2) identified at least two noticed sites or routes with some measure of geographic diversity. Eversource Needham at 21; Eversource Woburn-Wakefield at 34-35; Eversource Mystic-Woburn at 26.

The following subsections describe the route selection process developed by the Company in accordance with the above-cited requirements.

4.1.2 Routing Analysis Overview

The Company's methodology for siting new electric transmission lines, referred to as a "routing analysis," is an adaptive and iterative approach to identify and evaluate possible routes for the proposed new transmission line in accordance with requirements described above. The routing analysis identified the route for the Project as the option that best balances minimization of environmental impacts (including developed and natural environment impacts and constructability constraints) and reliability. The analysis also identified a Noticed Alternative Route that provides a geographically distinct alternative to the Project, while also attempting to strike a balance of the aforementioned factors.

The routing analysis methodology presented herein uses previously established approaches for evaluating electric transmission routing options and is a standard process implemented by the Company and consistent with Siting Board precedent. In initiating the routing analysis, the Company first established routing objectives (described in more detail in the following subsections).

4.1.3 Routing Analysis Objectives

The goal of the Company's routing analysis was to identify a technically feasible route that achieved the required transmission system reliability improvements by interconnecting the specified substations. Additional consideration was given to the potential impacts the candidate solutions may have on the developed and natural environment. These objectives included:

- Comply with all applicable statutory requirements, regulations and state and federal siting agency policies;
- Achieve a reliable, operable and cost-effective solution;
- Maximize the reasonable, practical and feasible use of existing linear corridors (e.g., transmission line, highway, railroad, or pipeline rights-of-way ("ROWs"));
- Minimize the need to acquire property rights; and
- Maximize the potential for direct routing options over circuitous routes.

4.1.4 Methodology

Consistent with the Company's standard methodology, the routing analysis for the new line consisted of the following steps, discussed in more detail in subsequent sections:

- **Identification of Project Study Area:** Focused the routing analysis within the region of the existing Andrew Square and Dewar Street Substations in the South Boston and Dorchester neighborhoods of the City of Boston, respectively.
- **Development of Universe of Routes:** Identified numerous routing options and associated design variations in the Project Study Area to develop a set of potential routes.
- **Identification of Potential Candidate Routes:** Identified and described the viable routes from the Universe of Routes (collectively referred to herein as "Candidate Routes") that met the need for the Project and were consistent with the objectives of the Company's routing analysis.
- **Candidate Route Analysis:** Compared the potential for natural environment and built environment impacts and technical constructability constraints along the Candidate Routes.
- **Cost Analysis:** Compared the estimated costs for the Candidate Routes.
- **Reliability Analysis:** Compared the reliability of the Candidate Routes.

- **Selection of Routes:** Evaluated the results of the above analyses and identified a Preferred Route and a Noticed Alternative Route that best balance reliability, minimization of environmental impacts, constructability constraints and cost.

4.1.5 Stakeholder Input

In addition to the steps associated with route selection, Company representatives met with federal, state and municipal officials, residents, business owners and other stakeholders to discuss the Universe of Routes under consideration for the New Line and to obtain input on these routing options. This process began in December 2017 and, as of the date of this filing, has included more than 22 meetings (see Section 1 for a detailed list of the meetings). The following table summarizes the input regarding route selection at these meetings.

Table 4-1: Stakeholder Input Used to Develop/Supplement Routing Analysis (see Note A)

Date	Participants	Input Received
December 12, 2017	City of Boston	The Mary Ellen McCormack site will be redeveloped within the next few years.
December 19, 2017	DCR	There may be Article 97 issues along Morrissey Boulevard that require further assessment and consideration.
January 11, 2018	MassDOT	Time restrictions will be put in place along the I-93 route (4 hours daily; 11PM to 3AM). Manholes must be bolted down. I-93 is a narrow, well-traveled route, which raises concerns.
January 25, 2018	BWSC	There is a large gas line along the Sydney Street Route, close to Mt. Vernon Street. There is a sewer system along the Dorchester Avenue Route and will require jacking underneath expressway and MBTA. BWSC has experienced frustrated abutters on Sydney Street and therefore, push back may be experienced if this route was selected.
March 27, 2018	MassDOT	During construction, MassDOT will only allow a single lane of traffic to be closed on I-93. The use of plates on I-93 is prohibited; the roadway must be restored nightly for the morning commute following “super pave” specifications. Northbound time restrictions are 6 hours daily (10PM to 4AM).
June 26, 2018	DCR	Article 97 is not required if the transmission line will be sited between the curb lines of the ROW. DCR would prefer manholes to be sited outside of the travel way.
June 26, 2018	BWSC	Provided feedback on the routes and identified specific locations along the Sydney Street Route that would be difficult or where BWSC would need additional slots for future projects.
July 12, 2018	MBTA	Provided feedback on what should be considered when working near the Andrew Square Station.

Date	Participants	Input Received
July 25, 2018	MassDOT	If work is proposed on bridges, a detailed analysis will need to be provided to MassDOT for approval.
August 7, 2018	Winn Development Company (Mary Ellen McCormack)	Provided proposed layout of the redevelopment, including new street ROWs.
August 17, 2018	Morningside Group and Samuels and Associates	Provided feedback on routing at 65 Bay Street.
August 22, 2018	City of Boston: PIC	Provided feedback on how to proceed with outreach to various stakeholders.
September 7, 2018	City of Boston - Neighborhood Services, Dorchester and South Boston Contacts	Provided feedback on how to coordinate with the communities adjacent to the Project.
September 10, 2018	DCR	Discussed Morrissey Boulevard reconstruction schedule, and design requirements. The redesign will add pedestrian and bicycle improvements.
September 17, 2018	Massachusetts Elected Officials	Provided feedback on how to proceed with outreach to various stakeholders.
October 10, 2018	South Boston Open House	Received generally positive feedback on the Preferred Route.
October 11, 2018	Dorchester Open House	Winn Development Company and BHA provided feedback on their phasing as it relates to the Preferred Route.
November 1, 2018	BWSC	BWSC to review Preferred Route for potential conflicts and would provide team with information on their pipe jacking records in this area.
November 5, 2018	Savin Hill Civic Association	Information meeting to provide a project overview.
November 9, 2018	Winn Development Company and BHA	Winn Development Company and BHA provided additional information on the schedule and phasing of the Mary Ellen McCormack redevelopment and thoughts on mitigation measures.
November 14, 2018	Andrew Square Civic Association	Information meeting to provide a project overview.
December 18, 2018	City of Boston ISD	Reviewed plans for Eversource to pursue comprehensive zoning relief, along with individual zoning requirements.

Note A: This table is an overview and does not provide details regarding all items discussed at the meetings listed. In addition, this table may have omitted additional meetings where some of the same routing related topics were discussed and/or conveyed to the Company.

4.2 Identification of Project Study Area

Following the establishment of the routing objectives, the Company reviewed the region between the existing Andrew Square and Dewar Street Substations and demarcated a geographic "Project Study Area," as depicted in Figure 4-1, within which to concentrate the investigation of potential routes.

The entirety of the Project Study Area is located within the South Boston and Dorchester neighborhoods of the City of Boston. The eastern edge of the Project Study Area is generally defined by Massachusetts Bay. The western boundary of the Project Study Area is generally defined by Boston Street and Pleasant Street. The existing Andrew Square and Dewar Street substations define the north and south limits of the Project Study Area, respectively. Significant existing linear corridors in the Project Study Area include the MBTA ROW and I-93, which both run north-south through the eastern part of the Project Study Area.

The Project Study Area consists of a densely developed, urban neighborhood that includes residential, commercial and some industrial areas. There are numerous MBTA public transportation routes and sensitive receptors within the Project Area, as well as the potential to encounter subsurface contamination and high existing utility density, as expected in developed, urban environments. Patten's Cove and the floodplain associated with Massachusetts Bay are the only wetland resource areas located within the Project Study Area. There are several areas of protected open space (land protected by Article 97) within the Project Study Area, including Old Harbor Reservation, Dorchester Shores Reservation, and Sharon Park.

4.3 Development of Routes

After defining the Project Study Area, the Company initially identified and conducted a screening assessment of the Universe of Routes, eliminating any routes that did not fully meet the routing objectives. The Company considered existing linear corridors (e.g., existing rail, gas and electric ROWs and public roadway corridors) that appeared to be feasible to facilitate construction of the New Line and could provide a reasonably direct route between the two substations. Following the screening process, the remaining routes were developed into complete and distinct Candidate Routes for further investigation and scoring under a number of criteria. The outcome of the routing analysis was the identification of the routes that best balance minimization of environmental impacts, constructability constraints and feasibility. Each of these steps in the routing analysis is discussed more fully below.

4.3.1 Identification of Universe of Routes

Using the Company's routing objectives and in consideration of stakeholder input (including from the public and City of Boston officials), the Company reviewed USGS maps, MassGIS data and aerial photography and completed field reconnaissance to develop the Universe of Routes that could support a new underground line between the two substations. The Universe of Routes is shown on Figure 4-2. Because of the nature of the street layout in Dorchester, there were many potential options for routing the New Line that could weave through existing narrow streets; however, the Universe of Routes aimed to compile the more direct routes between the two substations within the Project Study Area. Table 4-2 provides an overview of the length, roads crossings and other features along each route. A summary of the Universe of Routes is presented below:

- ***MBTA Route*** - The route would exit the Andrew Square Substation onto the MBTA ROW where it would continue south under Boston Street, Dorchester Avenue, Columbia Road and I-93. The route would deviate from the MBTA ROW near the Savin Hill MBTA-Station to arrive at Dewar Street Substation.
- ***I-93 Route*** - The route would exit the Andrew Square Substation onto the MBTA ROW where it would continue south under Boston Street to reach the I-93 ramp, at which point it would continue south along I-93 and then cross the MBTA tracks into Dewar Street Substation.
- ***Morrissey Boulevard*** - The route would exit the Andrew Square Substation east on Ellery Street, turn south on Boston Street, turn east on Songin Way, continue on O'Connor Way, then turn east onto Kemp Street, south on O'Callaghan Way until the intersection of Old Colony Avenue. The route would then continue south on Old Colony Avenue then onto William T Morrissey Boulevard after Kosciuszko Circle, at which point it would turn south onto Savin Hill Avenue, and down Grampian Way. The route would then turn south on Playstead Road, west on Springdale Street, under the MBTA tracks and I-93 and into Dewar Street Substation. Several variations of the Morrissey Boulevard route were initially considered. The variations included siting the route in the following locations:
    - Devine Way – This variation was not pursued following coordination with BHA and Winn Development identifying concerns with construction coordination with the Mary Ellen McCormack Housing Development and with crossing the MBTA tracks
    - Logan Way – This variation was not pursued following coordination with BHA and Winn Development Company identifying concerns with the construction sequencing with both Projects
    - Savin Hill Bridge – This variation was not pursued due to concerns regarding the bridge's ability to support the proposed infrastructure
- ***Sydney Street Route*** - The route would exit the Andrew Square Substation east on Ellery Street, turn south on Boston Street, east on Howell Street, south on Dorchester Avenue, east on Locust Street, south on Buttonwood Street, and east on Columbia Road, at which point the route would travel south on Sydney Street to Dewar Street Substation. Several variations of the Sydney Street route were initially considered. The variations included siting the route in the following locations:
    - Potential trenchless crossing on Frontage Road – This variation was not pursued but is a potential variation if the Boston Street bridge cannot support the proposed interconnections.
    - Other options within small, restricted roads such as Buttonwood Street and Crescent Avenue – These variations were not pursued in order to limit the number of hard angles along the route.
- ***Dorchester Avenue Route*** - The route would exit the Andrew Square Substation east on Ellery Street, turn south on Boston Street, and east on Songin Way, at which point it would follow Dorchester Avenue south until the intersection with Dewar Street. The route would then travel east on Dewar Street into Dewar Street Substation.

- ***Pleasant Street Route*** - The route would exit the Andrew Square Substation east on Ellery Street, turn south on Boston Street and continue until the intersection with Columbia Road, at which point it would travel east on Columbia Road and then south east on Pond Street, turn south on Pleasant Street, turn east on Reach Street, south on Dorchester Avenue, and east on Dewar Street into Dewar Street Substation.

Table 4-2: Universe of Route Summary

Candidate Route	Route Length (miles)	Streets	Major Waterbody Crossing	Major Conservation Areas
MBTA	1.5	MBTA ROW	None	Old Harbor Reservation
I-93	1.5	MBTA ROW, I-93	None	None
Morrissey Boulevard	2.0	Ellery Street, Boston Street, Songin Way, O'Connor Way, Kemp Street, O'Callaghan Way, Old Colony Ave, William T Morrissey Boulevard, Savin Hill Avenue, Grampian Way, Playstead Street, Springdale Street	Pattens Cove/Savin Hill Cove	Old Harbor Reservation, Dorchester Shores Reservation, Vietnam War Memorial
Sydney Street	1.6	Ellery Street, Boston Street, Howell Street, Dorchester Ave, Locust Street, Buttonwood Street, Mount Vernon Street, Columbia Road, Sydney Street	None	Sharon Park
Dorchester Avenue	1.6	Ellery Street, Boston Street, Songin Way, Dorchester Avenue, Dewar Street	None	Ryan Play Area
Pleasant Street	1.7	Ellery Street, Boston Street, Columbia Road, Pond Street, Pleasant Street, Reach Street, Dorchester Avenue, Dewar Street	None	Richardson Square

4.3.2 Screening Methodology

The Universe of Routes identified by the Company, with input from stakeholders, consisted of six different route options that were advanced for screening. The initial screening process included reviewing publicly available data to consider existing abutting land uses and the presence of natural resources such as wetlands, waterways and rare species habitat. In addition, traffic experts conducted field investigations to confirm general traffic patterns and volumes as applicable to the route. The Company also reviewed the routes for constructability constraints, such as difficult bends or existing underground utility congestion. The Company also considered information received from various meetings with municipal and state agency staff members and stakeholder groups. Route options were eliminated from further consideration if they were found to be unsuitable for transmission line development.

By means of this screening process, the Company determined that two of these routes, MBTA and I-93, were inappropriate for further consideration as Candidate Routes and the remaining four routes were advanced for more detailed evaluation as Candidate Routes. The following section summarizes the routes that were eliminated.

4.3.2.1 Summary of Eliminated Routes

As previously stated, the Company initially identified a Universe of Routes for consideration and review. Based on the screening process described above, the Company eliminated the MBTA and I-93 route options because they could not support the Project objectives of providing reliable infrastructure in a timely and cost-effective manner due to construction feasibility constraints.

Regarding the MBTA Route option, the entirety of the MBTA ROW associated with the MBTA Route is a major public transportation route for commuters to and from the Boston area. The ROW includes both commuter and local rail, and also includes several active rails that extend across the ROW. Space between rails is limited and the majority of the ROW is too narrow to support the Project's required width for the duct bank construction. As a result, the MBTA route was eliminated from further consideration.

Regarding the I-93 Route option, I-93 is a major highway that serves a primary commuter roadway for Boston and, as such, has high volumes of daily traffic. Based on discussions with MassDOT, construction along this corridor would need to incorporate several limitations including, but not limited to, restricted weekday and weekend work hours to avoid peak traffic and significant roadway restoration requirements. Based on the work time restrictions and the requirement to restore the roadway to MassDOT standards before the end of each construction period, the available time to install the duct bank would limit installation to approximately 10 linear feet a day. At that rate, construction would be expected to take a minimum of 2.5 years, which does not take into account weather delays that could increase the construction time period even further. Because the need for the Project is immediate, as discussed in Section 2, and this route would delay implementation by at least 1 year and potentially much longer as compared to the other routes considered, the I-93 Route was eliminated from further consideration.

4.3.3 Identification of Candidate Routes

The Company reviewed the four remaining Candidate Routes for detailed analysis and ranking, as described below and presented in Figure 4-3. All Candidate Routes would travel underground in existing public roadways, and cross highways and MBTA corridors. The four Candidate Routes are identified below.

- ***Candidate Route:*** Morrissey Boulevard
- ***Candidate Route:*** Sydney Street
- ***Candidate Route:*** Dorchester Avenue
- ***Candidate Route:*** Pleasant Street

4.4 Analysis of Candidate Routes

To identify and evaluate potential routes, the Company next scored each of the Candidate Routes based on several criteria that compare the relative levels of potential environmental, technical, and human built/developed impacts, and constructability constraints.

The other two steps of the process to identify the best routes include a cost analysis and a reliability analysis.

Section 4.4 presents details regarding the scoring analysis completed for the Candidate Routes. Sections 4.5 and 4.6 present the cost analysis and the reliability analysis completed for the Candidate Routes, respectively.

4.4.1 Criteria and Weight Assessment

The Company evaluated and compared the Candidate Routes using a set of 14 criteria. The criteria were developed to reflect the defined routing objectives, public feedback, and environmental and constructability factors. The scoring criteria were grouped into the following subcategories:

- Natural Environment Criteria compare existing conditions of potential impacts to the natural environment.
- Technical Criteria compare route location and design factors that may add complexity to construction.
- Built Environment Criteria compare existing conditions of potential impacts to the developed factors and surrounding population.

The Company assigned the individual criteria weights based upon an assessment of the potential for temporary and permanent impacts and to reflect stakeholder input (including both municipality and public feedback as documented from the meetings identified in Table 4-1). The weighting scale ranges from 1 to 5, with 1 being the lowest weight and 5 being the highest weight that could be applied to a particular criterion.

The 14 criteria identified by the Company to evaluate and compare each Candidate Route are outlined in Section 4.4.3.

4.4.2 Criteria Evaluation Methods

After identifying the criteria to assess each route and assigning weights for each criterion, the Company completed a scoring evaluation for each Candidate Route. The Company scored, weighted and ranked each Candidate Route to reflect its ease of constructability and its potential for impacts to the developed and natural environment. After gathering data for each Candidate Route, the Company assessed each criterion and identified the Candidate Route that had the largest number for that criterion. All other routes were then compared against this number to arrive at a "ratio score" for each Candidate Route on a scale of 0 to 1.

For example, if Candidate Route X had 5 trees to be removed, Candidate Route Y had 10 trees, and Candidate Route Z had 15 trees, the ratio scores would be calculated as shown in the following table.

Table 4-3: Criteria Evaluation Summary

Candidate Route	Number of Trees	Ratio Score
Candidate Route X	5	5 ÷ 15 = 0.33
Candidate Route Y	10	10 ÷ 15 = 0.66
Candidate Route Z	15	15 ÷ 15 = 1.00

The lowest ratio score would equate to the route with the lowest potential for impact. For each criterion, the ratio score was then multiplied by its assigned weight to produce a weighted score that scaled the criterion by its relative importance.

The ratio and weighted scores for each criterion were added to arrive at "total ratio scores" and "total weighted scores." The total weighted scores were then sorted in order from low to high, to identify a given Candidate Route's "rank." The lowest weighted score would equate to the lowest potential for impact with emphasis on certain criterion as previously described in this section. The ranks developed in this routing analysis are based on the total weighted scores.

4.4.3 Criteria, Technical Criteria, and Built Environment Criteria Description

Natural Environment Criteria

Although the Project Study Area is located primarily in a dense urban or built environment, there are natural resource land-use areas including wetland resources. Sources of information used to evaluate the natural resource environment criteria were existing map resources such as USGS topographic maps, MassGIS databases and recent aerial photography.

Three natural environmental criteria were included in the analysis:

- Public Shade Trees
- Wetland Resources
- Potential for Subsurface Soil Contamination

While these resources are present in the Project Study Area and can be important differentiators in route selection if affected during construction, the associated potential impacts will be limited. Environmental resources in the area are shown in Figure 4-4.

Public Shade Trees

In consideration of the potential for cutting or affecting shade trees along the Candidate Routes during the construction process, public shade trees within the public way, as defined by Massachusetts General Law ("M.G.L.") Chapter 87, were counted along the Candidate Routes. A field reconnaissance was conducted to count all trees within the public way along the route regardless of diameter at breast height or distance from proposed trench. The scoring ratio for this criterion was calculated based on the total number of shade trees counted for each Candidate Route divided by the highest number of shade trees found along all candidate routes. This criterion was assigned a weight of 3.

Wetland Resource Areas, Buffer Zone Crossings and Tidelands

The evaluation of wetland resources incorporates: river crossings, wetland resource area crossings (including the Riverfront Area and Land Subject to Coastal Storm Flowage ("LSCSF")) and The Massachusetts Public Waterfront Act, G.L. Chapter 91 ("Chapter 91") jurisdiction limits. The evaluation of the river crossing criterion involved reviewing MassGIS databases and conducting field reconnaissance to determine the number of rivers or waterbodies each Candidate Route would cross. In evaluating Candidate Routes, river crossing evaluations require consideration of crossing methods, including open trenching and trenchless methods, as well as options for available road bridge crossings. The evaluation of wetland crossings involved reviewing MassGIS and conducting field reconnaissance to determine the number of state-regulated resource areas, as defined in the Massachusetts Wetlands Protection Act regulations (310 C.M.R. 10.00 *et seq.*), including Bordering Vegetated Wetland ("BVW") and River Bank and their associated 100-foot buffers, Bordering Land Subject to Flooding ("BLSF")/LSCSF (100-year floodplain) and 200-foot Riverfront Area, that the proposed route would cross. The evaluation of Chapter 91 jurisdictional areas involved reviewing MassGIS data layers developed under M.G.L. c. 91. Approximate Chapter 91 jurisdiction was obtained by using a combination of contemporary high water, historic high water and landlocked tidelands to form the landward and seaward boundaries of landlocked tidelands. The ratio score was calculated by dividing the total number of wetland resource areas for each Candidate Route by the highest number of wetland resource area found along all Candidate Routes. This criterion was assigned a weight of 2.

Potential to Encounter Subsurface Contamination

Trench excavation in urban areas poses a potential to encounter contaminated soil and groundwater that can affect worker safety and requires special soil and water management and disposal procedures under federal and state hazardous material regulations. Releases of oil and/or hazardous material to the environment are required to be reported to the Massachusetts Department of Environmental Protection's ("MassDEP") Bureau of Waste Site Cleanup in accordance with M.G.L. Chapter 21E and procedures established in the Massachusetts Contingency Plan ("MCP") (310 C.M.R. 40.0000). MassDEP categorizes Oil or Hazardous Material ("OHM") sites based on the level of contamination present and the level of remediation completed. Eversource's route evaluation considered several groups of OHM sites that may have the potential to affect the Project based on their current status.

An online search of the MassDEP Waste Site List in combination with a review of MassGIS databases was performed to determine the potential for each Candidate Route to encounter subsurface contamination from historical releases or former land development practices. The MassDEP online database was used to collect information on listed MassDEP sites within 500 feet of the Candidate Routes with a release tracking number ("RTN").

Sites included in the search are: Active Tier Classified Tier I and Tier II sites, Activity and Use Limitation ("AUL") sites closed with ongoing maintenance conditions, Utility Related Abatement Measure ("URAM") sites and Class C temporary solution sites.

The following define each site category:

- *Tier Classified Sites:* The MassDEP Tier Classified OHM sites datalayer is a statewide point dataset containing the approximate location of OHM sites that have been: (1) reported; and (2) Tier Classified under M.G.L. Chapter 21E and the MCP. Location types featured in this datalayer include the approximate center of a site, the center of a building on the property where the release occurred, the source of contamination, or the location of an on-site monitoring well. This datalayer does not include: (1) contaminated sites that have not been reported to MassDEP; or (2) sites for which a Response Action Outcome ("RAO") has been submitted to MassDEP. Tier Classified sites are broken down into Tier I and Tier II sites as follows:
    - Tier I: Any disposal site which meets the criteria under 310 C.M.R. 40.0520(2) at the time of Tier Classification
    - Tier II: Any disposal site which meets the criteria under 310 C.M.R. 40.0520(4) at the time of Tier Classification.
- *AUL*: The MassDEP OHM sites with AUL datalayer is a statewide point dataset containing the approximate location of OHM sites where an AUL has been filed. An AUL provides notice of the presence of oil and/or hazardous material contamination remaining at the location after a cleanup has been conducted pursuant to Chapter 21E and the MCP. The AUL is a legal document that identifies activities and uses of the property that may and may not occur, as well as the property owner's obligation and maintenance conditions that must be followed to ensure the safe use of the property. Location types featured in this data layer include the approximate center of an AUL site, the center of a building on the property where the release occurred, the approximate center of the lot and source of contamination.
- *Class C RAO*: These are sites where there has been a temporary cleanup. Although the site does not present a "substantial hazard," it has not reached a level of no significant risk. The site must be evaluated every five years to determine whether a Class A or Class B RAO is possible.
- *URAM* : Sites subject to utility related abatement measures.

Each Candidate Route was assessed with regard to the number of these active sites located on property parcels within 500 feet of the Candidate Route. The raw scores for this criterion were determined based on the total number of these mapped active sites and the ratio score was calculated by dividing the total found for each individual route by the highest number of these sites found along the four Candidate Routes. This criterion was assigned a weight of 4.

Technical Criteria

Sources of information used to evaluate design/construction criteria included recent aerial photography, field reconnaissance, and engineering and construction expertise. In general, narrow roads can contribute to unavailable or tight space for the proposed pipe trench and manholes, which can constrict construction and increase open-trench and manhole excavation durations and traffic disruptions with lane and road closures. The number of turns or bends required for a route can significantly affect design and construction, especially in complex road intersections with dense underground utilities, causing delays and increasing costs as well as the possibility of requiring new property acquisitions. Requirements for installing the infrastructure using horizontal directional drilling ("HDD") can significantly impact cost and schedule. Four criteria were established to assess design and construction opportunities and constraints when evaluating the Candidate Routes, as follows:

- Existing Road Width;
- Existing Utility Density;
- Existing Transmission Lines; and
- High Impact Crossings.

Existing Road/ROW Width

The existing roadway width determines the available workspace above grade to perform the primary construction activities (i.e., divert traffic, set up equipment, excavate trench and manhole areas, install pipe, backfill the trench and restore paving). A narrow roadway width of less than or equal to 30 feet generally has a greater probability of affecting traffic flow due to reduced lane widths and/or full closure of one or both lanes in the roadway. Road widths were estimated along the Candidate Routes by road-segment length using MassGIS maps and field reconnaissance. Additionally, for railroad rights-of-way, the width of the available ROW that is not covered by existing tracks was identified. Lengths of ROW that provide less than 30 feet of open area were estimated using MassGIS maps.

The linear lengths of narrow road or railroad rights-of-way segments were recorded. The ratio score was calculated by dividing the total length of narrow road or railroad rights-of-way segment determined for each Candidate Route by the highest total length of all candidate routes. This criterion was assigned a weight of 2.

Existing Utility Density

The number of existing underground pipelines, utility conduits and related features such as manholes and catch basins, and the depth of these facilities in the roadway, affect the available space below grade to physically install the proposed transmission conduits and manhole system. Extensive utility density can significantly constrain available space, complicate the construction process, and increase construction duration, traffic disruption and costs. Utility density was assessed along candidate routes using survey data. The survey data were compiled from available records as provided by utility companies, including BWSC, and were up-to-date as of September 2018. Utility density was only assessed horizontally, as vertical data was not available at the time of analysis. The score for Existing Utility Density was calculated based on the following criteria: Usable Corridor Width, Utility Crossings and Heat Generating Sources. Due to the specifics related to the nature of the utility density, proximity to heat generation was an important consideration and included in this criteria. Useable Corridor Width assessed the maximum available underground space horizontally within each Candidate Route. Utility Crossings include utilities that perpendicularly intersect each Candidate Route, regardless of type, size or depth. Heat Generating Sources include electric and steam utilities perpendicularly intersecting each Candidate Route, regardless of size or depth. The route options were first separately scored for each of the three criteria. A weighted ratio was then assigned to the calculated score based on its relative significance to the overall estimate of utility density. The weighted scores for all factors were then added up for each route to develop a single "utility density" score for the route. This criterion was assigned a weight of 5.

Existing Transmission Lines

The installation of a new transmission line in close proximity (i.e., within 10 feet) to an existing transmission line for any appreciable length impacts the performance of the existing line and the design basis for the new line. As a result, proximity to an existing transmission line is an important consideration in the design of underground cable systems. If the lines are close to each other, mutual heating of the lines would reduce the rated current carrying capability of existing transmission facilities (derating the existing lines) and require an increase in the size of the conductor for the new line to achieve required ratings. As the separation between transmission lines decreases, the mutual heating and associated negative thermal impacts increase. In addition, further separation by installing transmission lines in geographically diverse corridors avoids the potential for a single contingency event to cascade and cause the failure of multiple transmission lines. To account for this concern, the ratio score for this criterion was calculated by dividing the distance that a Candidate Route would parallel an existing transmission line by the longest measured distance a new line would run parallel to an existing line across all Candidate Routes. This criterion was assigned a weight of 5.

High Impact Crossings

High impact crossings are the more significant transportation corridor crossings where, because of the amount of traffic and traffic patterns, greater consideration of alternative construction methods such as HDD. High impact crossings were defined as a Candidate Route crossing over or under a bridge, railroad or highway. The ratio score for this criterion was calculated based on the total length of high impact crossings found along each individual route divided by the highest length of high impact crossings found along the four Candidate Routes. This criterion was assigned a weight of 5.

Built Environment Criteria

Built environment criteria compare existing conditions of, and potential impacts to, the developed environment and surrounding population. The six built environment criteria included in the scoring analysis are:

- Residential Land Uses
- Commercial/Industrial Land Uses
- Sensitive Receptors
- Public Transportation Facilities
- Historic and Archaeological Resources
- Traffic Impacts

Sources of information used in the built environment criteria evaluations were existing map resources (i.e., MassGIS, USGS topographic maps and aerial photography), technical expertise and field reconnaissance. The built environment land uses described in the following paragraphs, including residential, commercial and industrial land uses, and public transportation routes and facilities.

Land uses (residential, commercial/industrial) in the vicinity of the Candidate Routes are shown in Figure 4-5. Cultural resources are shown in Figure 4-6.

Residential Land Uses

Residents along a Candidate Route could be subject to temporary access and traffic disruption, street closings, sound level increases and dust during construction. This criterion assesses the density of residences (single-family, multi-family, condominiums and mixed commercial and residential) on both sides of roadways along each route. The number of residential structures along street segments was counted using MassGIS mapping, parcel data, Google Street View imagery, aerial photography and field verification. The "unit" attribute information included in the parcel layer was used to assign a unit count to each identified residential structure. Internet searches were used to find or verify unit counts for some large multiple unit apartment or condominium complexes (such as the Mary Ellen McCormack Housing Community). Parcel and building information changes continually so there is an inherent degree of time-based inaccuracy in addition to any data creation or data entry errors already present in the source data. A ratio score was calculated based on the total number of individual residences determined for each route divided by the highest number of residences found along the four Candidate Routes. This criterion was assigned a weight of 4.

Commercial/Industrial Land Uses

Similar to residences, commercial and industrial businesses along a Candidate Route could be affected by temporary construction impacts such as access and traffic disruption, street closings, sound level increases and potential dust. This criterion assessed the density of commercial and industrial businesses along each route by counting the number of buildings adjacent to the route roadway. The number of commercial/industrial buildings along the route were counted using MassGIS mapping, parcel data, aerial photography, Google Street View imagery and/or field verification to determine the number of units along each route. The ratio score for this criterion was determined based on the total number of individual commercial/industrial building units determined for each route divided by the highest number of commercial/industrial building units found along the Candidate Routes. This criterion was assigned a weight of 4.

Sensitive Receptors

Sensitive receptors could be affected by temporary construction impacts such as access and traffic disruption, road closings, sound level increases and potential dust. The number of sensitive receptors along the route were counted using MassGIS databases, aerial photography, Internet searches, Google Street View and field verification. The following sensitive receptors were identified for each Candidate Route: police and fire stations, hospitals, schools, nursing homes/elder care (long term care), funeral homes, places of worship, daycares, district court buildings and parks and recreational facilities. Police and fire stations, hospitals, schools, long-term care and parks and recreation facilities were determined using applicable MassGIS datalayers. Funeral homes, places of worship and district court buildings were identified using the latest available aerial imagery, internet searches and Google Street View. Daycare facilities were identified using the Massachusetts Early Education Search tool available through the Executive Office of Education's website. A ratio score was calculated based on the total number of sensitive receptors determined for each route divided by the highest number of sensitive receptors found along the four Candidate Routes. This criterion was assigned a weight of 3.

Public Transportation Facilities

Temporary construction has the potential to disrupt the operation of public bus and trolley routes. Public transportation facilities including MBTA railroad stations, MBTA T-Stations, MBTA bus stops and bus routes were identified using MassGIS datalayers, aerial photography and field verification. This criterion was broken up into two sub-criteria: Bus Stops/T Stations and Length of Public Transit route along the Candidate Route. When two bus stops were listed at a single location - indicating one stop for each direction of travel - only a single point was counted. The ratio score for Bus Stops/T Stops was calculated based on the total number of individual T stations and bus stops determined for each Candidate Route divided by the highest number of units found along all of the routes. The ratio score for Length of Public Transit Route along the route was calculated based on the total linear feet of shared public transportation route for each individual route divided by the longest length found along all four of the Candidate Routes. This criterion was assigned a weight of 3.

Traffic Impacts

The potential for in-street trench construction to cause traffic related congestion was evaluated for each Candidate Route. The evaluation was based on information obtained from MassGIS, aerial photography, relevant traffic and signal data from municipal agencies, some new traffic counts, field reconnaissance and the Company's familiarity and experience with the traffic flow and operations in the general area.

Impacts can be caused by several factors, some of which can be anticipated and quantified (such as the effect of reducing travel lanes, eliminating a bus stop or closure of a sidewalk) and some factors that are temporary/unanticipated, such as weather conditions, crashes, other construction activity/detours in the area, and congestion on I-93 that may reroute regional traffic onto local roadways. The analysis provides a relative comparison of the different routes using factors that are directly attributable to the congestion that could be caused by the construction activity. Presenting the review in the form of a relative comparison between routes using only pertinent factors removes the effect of temporary/unanticipated factors from the route selection process. Specifically, the typical multi-modal factors that were used in the review include functional classification of the roadways, roadway and intersection traffic volumes, roadway cross-sectional elements (such as width, number of travel lanes, on-street parking, shoulders, sidewalks and the types of uses they serve), bus routes and ridership data from the MBTA, the number of major and minor traffic signals along the route, need to maintain loading/unloading areas for business deliveries and whether construction on a roadway segment would cause just lane closures or require detours via other streets. The Company collected information from sources including the MBTA and MassDOT – Highway Division, and conducted field reconnaissance along each route to observe the general conditions along the routes. This information was evaluated to determine the potential for traffic congestion and parking and public transportation impacts for each route. Key factors considered included existing traffic volumes (where available), classification of major commuting routes, roadway width, number of travel lanes, existence of parking lanes and the presence of public transportation (bus routes or MBTA railway stations). More specifically, the following criteria, and assumptions behind them, represent the factors the Company used to evaluate the potential for traffic and other transportation impacts during construction:

- Road width: This criterion has a direct impact on traffic because on very wide roads, construction may proceed without a road closure or detour, whereas for medium-width roads, construction may require closure of a single lane, but not a road closure. For narrow roads, construction could potentially require a full road closure and associated detour. For example, Morrissey Boulevard is a wide road and, therefore, can accommodate construction needs without a complete closure.
- Number of lanes: Roadways with multiple lanes (in each direction) are more likely to support construction without road closures, and are more likely to support "normal" traffic flow. Single lane roads are more likely to require a lane closure and alternating traffic, which leads to congestion. Roadways with single lanes received a higher impact score than multiple lane roadways due to the potential need for full roadway closures and detours during construction. For example, Sydney Street received a higher impact score than Morrissey Boulevard in this category.
- Number of intersections: Routes with fewer intersections/turns were assumed to be more likely to avoid traffic flow disruptions. Because of the geometry of the construction envelope, routes with a greater number of intersections are likely to cause more traffic congestion than routes with fewer intersections. Note that this criterion describes actual route turns, and does not count intersections passed where the route remains straight. Furthermore, routes that travel through more signalized intersections than others can lead to more potential traffic impacts due to the need to address additional construction issues related to temporary signal modifications and the increased congestion that would result from the reduction of capacity at

signalized locations. For example, the Dorchester Avenue route received a higher score in this category than a route with fewer signalized intersections.

- Sidewalks, Breakdown Lanes, Roadside Parking: The impact to on-street parking, pedestrian facilities, and loading areas were considered in the scoring system. All roadways along the routes have sidewalks and most have parking lanes. Those routes with higher pedestrian activity, parking maneuvers, and curbside loading activity received a higher score due to a larger impact on more pedestrians, parking and commercial loading demand. For example, Dorchester Avenue is a busy commercial corridor with a lot of pedestrian activity and on-street parking demand. Therefore, it was assigned a higher score for this category than side streets with less pedestrian and parking activity.
- One-Way Streets: Streets that have one-way traffic flow require closures and detours and will therefore have a greater impact on traffic congestion than lane shifts on two-way streets. One-way streets are more likely to require closures or detours due to the overall width and the inability to reverse travel patterns. Roadways that require closures or detours received higher impacts scores than those that may only require a lane-shift or can remain open with the closure of a single lane. For example, Father Songin Way is a one-way street and received a higher score in this category than Savin Hill Avenue (a two-way roadway).
- Public Transportation Routes: Streets with public transportation features (bus stops/routes, train stops) require additional effort to avoid impacting mass transit and can require temporary relocation of stops. This affects additional areas of roadway with no benefit to Project construction, and was assumed to exacerbate traffic congestion due to disruption of normal traffic patterns. Routes that contain bus routes and have more bus stops than others received a higher impact score. There will be a need to address pedestrian access and the temporary location of bus stops. There will also be an impact on travel times for buses that travel on any of the proposed construction routes. For example, Dorchester Avenue contains numerous bus stops and MBTA Bus Routes and received a higher score than those roadways that do not have any public transportation routes.
- Commuter Routes: Routes used by commuters were assumed to be more likely to be affected by Project construction due to high traffic volumes during morning and evening commute hours, and often around mid-day (lunch time). Commuter routes were designated based on direct observation, general knowledge of the area, and input from the municipality. Traffic volumes related to busier commuter routes are a factor in determining the overall impact score. Routes with higher traffic volumes were assigned a higher impact score, as more drivers will be affected and there will be more delay and congestion experienced by more people. For example, Morrissey Boulevard is a heavily used commuter route with high traffic volumes and had a higher impact score in this category than the low-volume side streets.

The route options were first separately scored for each of the review factors. A weighted ratio was then assigned to the calculated factor score based on its relative significance to the overall estimate of congestion potential. The weighted scores for all factors were then added up for each route to develop a single transportation impacts score for the route. This criterion was given a weight of 5.

Historic and Archeological Resources

Historic and archeological resources could be affected by temporary construction impacts such as access and traffic disruption, earth movement, street closings, sound level increases and dust. Historical inventory was evaluated using the Massachusetts Cultural Resources Inventory System ("MACRIS") MassGIS datalayer maintained by the Massachusetts Historical Commission ("MHC"). The count for this criterion includes buildings, burial grounds, structures, statues, monuments and local historic areas and districts. Four of the most common historic designation types were included: (1) National Register of Historic Places; (2) local historic district; (3) Preservation Restriction; and (4) inventoried but not designated with one of the previous designations. Archeological resources (i.e., pre-contact and historic archaeological sites and areas) were evaluated using MACRIS as well as the Boston City Archaeology Program. Each Candidate Route was assessed to determine the number of historic places, historic districts and archaeological sites adjacent to the route. The ratio score for this criterion was calculated based on the total number of individual sites found along each individual route divided by the highest number of these sites found along the four Candidate Routes.

The number of cultural resources was derived from the total number of historic and archaeological sites and the number historic districts or areas along each Candidate Route. MHC Inventory points were tallied within parcels that were directly adjacent to the property boundary of the MBTA ROW or public roadways along each Candidate Route. MHC Inventory Areas were quantified by tallying parcels within each area that are directly adjacent to the property boundary of the MBTA ROW or public roadway along each Candidate Route, excluding parcels that also contained historic sites, to avoid double counting. Archaeological points were quantified by tallying sites that are directly adjacent or intersected by the property boundary of the MBTA ROW or public roadway along each Candidate Route. The ratio score was calculated by dividing the total number of cultural resources determined for each Candidate Route by the highest number of cultural resources found among all the Candidate Routes. This criterion was assigned a weight of 1.

A summary of the routing analysis criteria and associated weights are below in Table 4-4.

Table 4-4: Routing Analysis Criteria Weights Summary

	Criterion	Assigned Weight
Natural Environment	Public Shade Trees	3
	Wetland Resource Areas	2
	Potential to Encounter Subsurface Contamination	4
Technical/Constructability	Existing Road/ROW Width (less than 30 feet)	2
	Existing Utility Density	5
	Existing Transmission Lines	5
	High Impact Crossings	5
Built Environment	Residential Land Use	4
	Commercial and/or Industrial Land Use	4
	Sensitive Receptors	3
	Bus Stops/T Stations	3
	Length along Public Transit/MBTA ROW	3
	Historical and Archaeological Resources	1
	Traffic Impacts	5

4.4.4 Environmental Analysis Results

This section presents the results of the environmental scoring analysis completed for each Candidate Route.

4.4.4.1 Candidate Route Analysis Results Summary

Table 4-5 provides an overview of all raw data, total ratio scores and total weighted scores for each Candidate Route.

EVERSOURCE ENERGY

Table 4-5: Andrews Square Candidate Route Evaluation Matrix

	Natural Environment Criteria				Technical Criteria					Built Environmental Criteria								Total Criteria Score	
													Public Transit Facilites						
Candidate Routes	Public Shade Trees	Wetland Resource Areas	Potential to Encounter Subsurface Contamination (AUL, Tier Classified Sites, Class C RAO, URAM)	*Sub-Total Criteria Score*	Existing Road/ROW Width (length in feet along roads with width less than 30 feet)	Existing Transmission Line	Existing Utility Density	High Impact Crossings	*Sub-Total Criteria Score*	Residential Land Uses	Commercial and/or Industrial Land Uses	Sensitive Receptors	Bus Stops/ T Stations	Length along Public Transit Route/ MBTA ROW (ft)	Historical and Archaeological Resources	Traffic Impacts	*Sub-Total Criteria Score*		
Morrissey Blvd	44	3	9		4701	400	1.5	343		635	18	9	4	1405	61	4.5			
Ratio Score	0.4	1.0	0.9	*2.3*	1.0	0.1	0.5	0.5	*2.1*	0.8	0.2	1.0	0.2	0.2	1.0	0.80	*4.2*	8.6	Ratio Score
Weight	3	2	4		2	5	5	5		4	4	3	3	3	1	5			
Weighted Score	1.2	2.0	3.6	*6.8*	2.0	0.5	2.5	2.5	*7.5*	3.2	0.8	3.0	0.6	0.6	1.0	4	*13.2*	**27.5**	Weighted Score
Sydney St	63	0	10		2114	3800	2.4	327		546	28	3	6	2087	30	3.5			
Ratio Score	0.6	0.0	1.0	*1.6*	0.4	1.0	0.8	0.5	*2.7*	0.7	0.2	0.3	0.3	0.3	0.5	0.7	*3.0*	7.3	Ratio Score
Weight	3	2	4		2	5	5	5		4	4	3	3	3	1	5			
Weighted Score	1.8	0.0	4.0	*5.8*	0.8	5.0	4.0	2.5	*12.3*	2.8	0.8	0.9	0.9	0.9	0.5	3.3	*10.1*	**28.2**	Weighted Score
Dorchester Ave	70	0	7		1313	0	3.0	724		538	117	9	20	6978	36	4.9			
Ratio Score	0.6	0.0	0.7	*1.3*	0.3	0.0	1.0	1.0	*2.3*	0.7	1.0	1.0	1.0	1.0	0.6	0.90	*6.2*	9.8	Ratio Score
Weight	3	2	4		2	5	5	5		4	4	3	3	3	1	5			
Weighted Score	1.8	0.0	2.8	*4.6*	0.6	0.0	5.0	5.0	*10.6*	2.8	4.0	3.0	3.0	3.0	0.6	4.5	*20.9*	**36.1**	Weighted Score
Pleasant St	113	0	7		2089	0	2.7	422		764	36	9	11	4055	33	5.3			
Ratio Score	1.0	0.0	0.7	*1.7*	0.4	0.0	0.9	0.6	*1.9*	1.0	0.3	1.0	0.6	0.6	0.5	1.0	*5.0*	8.6	Ratio Score
Weight	3	2	4		2	5	5	5		4	4	3	3	3	1	5			
Weighted Score	3.0	0.0	2.8	*5.8*	0.8	0.0	4.5	3.0	*8.3*	4.0	1.2	3.0	1.8	1.8	0.5	5.0	*17.4*	**31.5**	Weighted Score

Table 4-6 presents a summary of the Candidate Routes ranked by total weighted score. The lowest total weighted score equates to the lowest potential for impact, with the emphasis on certain criteria as previously described in this section.

Table 4-6: Rank by Total Weighted Scores

Candidate Route	Route Length (miles)	Total Weighted Score	Rank
Morrissey Boulevard	2.0	27.5	1
Sydney Street	1.6	28.2	2
Pleasant Street	1.7	31.5	3
Dorchester Avenue	1.6	36.1	4

As shown in Tables 4-5 and 4-6, the Morrissey Boulevard Candidate Route has the lowest weighted score and would result in the lowest potential for impact of all the Candidate Routes evaluated. Sydney Street Candidate Route has the next lowest potential for impact.

4.5 Cost Analysis

The Company evaluated the order of magnitude cost estimates total cost estimate for each Candidate Route in order to rank the various Candidate Routes.

Many factors could affect the actual cost of a transmission line project, including cost and availability of materials and equipment, labor, the presence of contaminated soils and the potential for work hour restrictions imposed by the local community or other entities. Subsurface conditions such as the type and depth of soil and rock that must be excavated in order to place the duct bank could also significantly affect project cost. In addition, the cost is influenced by the proximity of transmission lines and the density of underground utilities.

A summary of the order of magnitude cost estimates is provided below in Table 4-7. Morrissey Boulevard has the lowest projected cost overall. The next lowest projected Candidate Route cost is Sydney Street.

Table 4-7: Candidate Route Cost Estimates

Candidate Route	Substation Cost (millions)	Transmission Cost (millions)	Cost/mile (millions)	Total (millions)[14]	Rank	Percent more than lowest cost option
Morrissey Boulevard	$16.3	$52.0	$26.0	$68.3[15]	1	
Sydney Street	$16.3	$53.3	$33.3	$69.6[16]	2	+2%
Dorchester Avenue	$16.3	$54.5	$34.1	$70.8[17]	3	+4%
Pleasant Street	$16.3	$58.2	$34.2	$74.5	4	+9%

4.6 Reliability Analysis

The Company considered whether there was a difference in the Candidate Routes with regard to reliability. While all Candidate Routes are underground and have relatively small differences in design that would not result in any substantial difference in the level of reliability risk, there are existing transmission lines in the Sydney Street corridor. To improve reliability, where possible, the Company designs the transmission system in such a way to reduce the risk of one single event being the cause of multiple element failures. Whenever practical, the Company works to minimize the length of parallel underground transmission lines. Accordingly, when comparing Candidate Routes, the Sydney Street route is the least desirable from a reliability perspective.

4.7 Selection of Preferred and Noticed Alternative Routes

Table 4-8 provides a comprehensive summary of all Candidate Routes and their relative rankings with respect to the natural environment, technical constructability, built environment, overall score and cost.

Table 4-8: Ranking Summary of Candidate Routes

Candidate Route	Natural Environment	Technical Constructability	Built Environment	Total	Cost (million)
Morrissey Boulevard	6.8	7.5	13.2	27.5	$68.3
Sydney Street	5.8	12.3	10.1	28.2	$69.6
Dorchester Avenue	4.6	10.6	20.9	36.1	$70.8
Pleasant Street	5.8	8.3	17.4	31.5	$74.5

14 The estimate is based upon a 115-kV 3500 kcmil CU XLPE single conductor per phase installation. The estimate does not include costs associated with: contingencies due to adverse weather or system related delays. Labor costs were based upon “typical” contractor work. Additionally, the estimate does not account for non-typical manufacturer back-log.

15 A planning grade estimate (-25%/+25%) was developed for Morrissey Boulevard based on detailed engineering drawings.

16 A conceptual grade estimate (-25%/+50%) was developed for Sydney Street based on preliminary engineering drawings.

17 An order of magnitude estimate (-50%/+200%) was developed for Dorchester Avenue and Pleasant Street based on conceptual engineering drawings.

The Company balanced considerations of environmental impacts, reliability and costs in identifying routes to meet the identified need of the Project. Substantial feedback has been provided to the Company from various agencies reflecting more detailed nuances in route selection that are further articulated in Section 5.

The Preferred Route and Noticed Alternative Route were subject to a detailed engineering assessment and meetings were held with various stakeholders including the City of Boston, DCR, MBTA, BWSC and BHA.

The Morrissey Boulevard Route has the lowest overall scoring rank, the lowest overall cost and was chosen as the Preferred Route and advanced for further analysis in Section 5. The Sydney Street Route has the second lowest overall rank (both on scoring and cost) and maintains a reasonable degree of geographic diversity compared to the Preferred Route. It was identified as the Noticed Alternative Route.

In addition to the environmental, cost and reliability review, the Company considered the following engineering assessments and stakeholder meeting feedback in the route selection:

- Ability to coordinate with other construction projects – Morrissey Boulevard and the Mary Ellen McCormack Housing Community are proposed to be redeveloped within the general timeframe of the proposed project; meetings with DCR and BHA have confirmed the potential for construction project coordination in order to minimize impacts to the environment and adjacent property owners.
- Minimization of impacts to BWSC infrastructure – according to BWSC, the area west of I-93 and north of Columbia Road along the Sydney Street Route contains combined sewers, and BWSC requires that a utility corridor within roads in that area be reserved for future combined sewer separation projects.[18]
- Known ability to trenchless cross under I-93/MBTA tracks at the crossing near Dewar Street Substation – per a meeting with BWSC on June 26, 2018, BWSC provided information that it was able to successfully pipe jack under I-93 and the MBTA tracks in the vicinity of Springdale Street, west of the Dewar Street Substation.

This additional assessment, particularly with respect to the available underground utility corridors, data regarding successful trenchless crossing, and the ability to coordinate with other construction projects, confirmed the selection of the Morrissey Boulevard Route as the Preferred Route.

The Preferred Route and Noticed Alternative Route are shown in Figure 4-7.

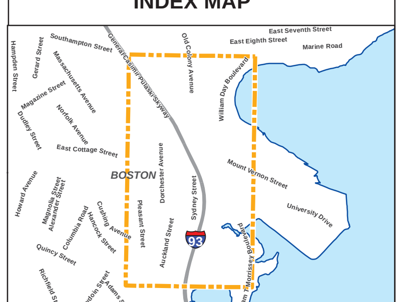
18 During stakeholder meetings, BWSC informed the Company of future combined sewer separation projects located along the Sydney Street Route. Reserving utility slots to accommodate future BWSC projects was not considered in the utility density scoring for the Company's routing analysis.

4.8 Conclusion

In accordance with the Siting Board's standard of review, the Company objectively and comprehensively developed and assessed a wide array of potential routes and design variations within the bounds of the Project Study Area. At the conclusion of this process, the Company identified a Preferred Route and a Noticed Alternative Route that best balance impacts, constructability and costs and enable the Company to meet the identified need.

A more detailed examination and comparison of the Preferred Route and Noticed Alternative Route is presented in Section 5 of this Analysis.

INDEX MAP



Legend

- Limit of Study Area
- Substation

Map Notes:
Basemap: 2014 Orthophotographs, MassGIS
Data source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs.

Parcels downloaded from Boston Open Data Portal: 2016

The information/data provided in this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation or parcel level analysis. The maps should not be used for construction purposes.

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Feet
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Figure 4-1

Project Study Area

Andrew Square to Dewar Street Reliability Project

Boston, Massachusetts

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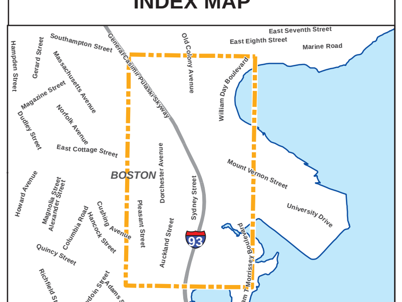
INDEX MAP



Legend

- Dorchester Avenue
- Pleasant Street
- Morrissey Boulevard
- Sydney Street
- I-93
- MBTA
- MBTA Track
- Substation

Map Notes:
Basemap: 2014 Orthophotographs, MassGIS
Data source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs.

Parcels downloaded from Boston Open Data Portal: 2016

The information/data provided in this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation or parcel level analysis. The maps should not be used for construction purposes.

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Figure 4-2

Universe of Routes

Andrew Square to Dewar Street Reliability Project

Boston, Massachusetts

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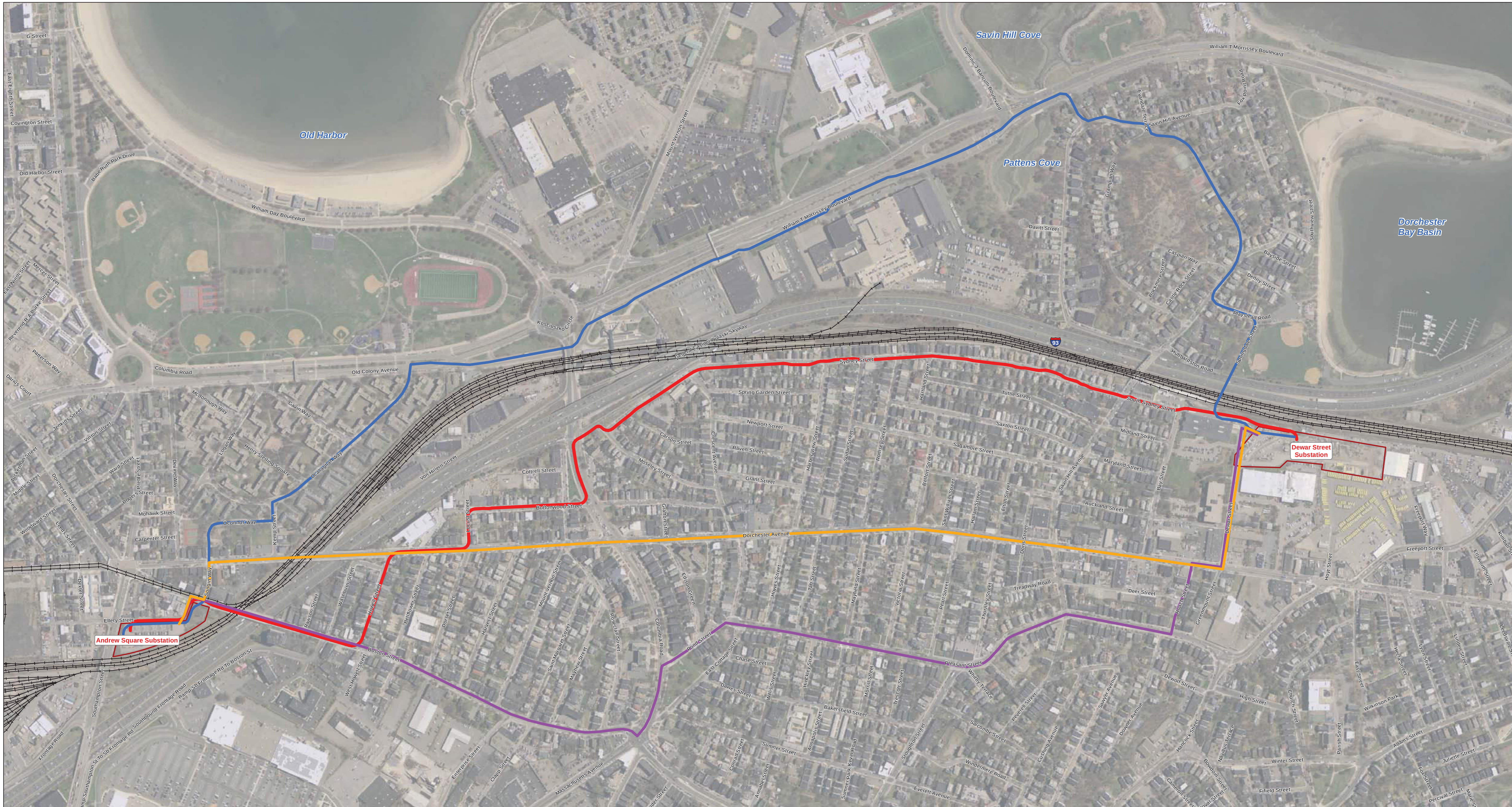

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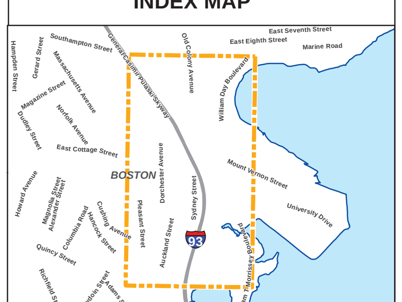

Legend

- Dorchester Avenue
- Pleasant Street
- Morrissey Boulevard
- Sydney Street
- MBTA Track
- Substation

Map Notes:
Basemap: 2014 Orthophotographs, MassGIS
Data source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs.

Parcels downloaded from Boston Open Data Portal: 2016

The information/data provided in this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation or parcel level analysis. The maps should not be used for construction purposes.

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1:3,600

Figure 4-3

Candidate Routes

Andrew Square to Dewar Street Reliability Project

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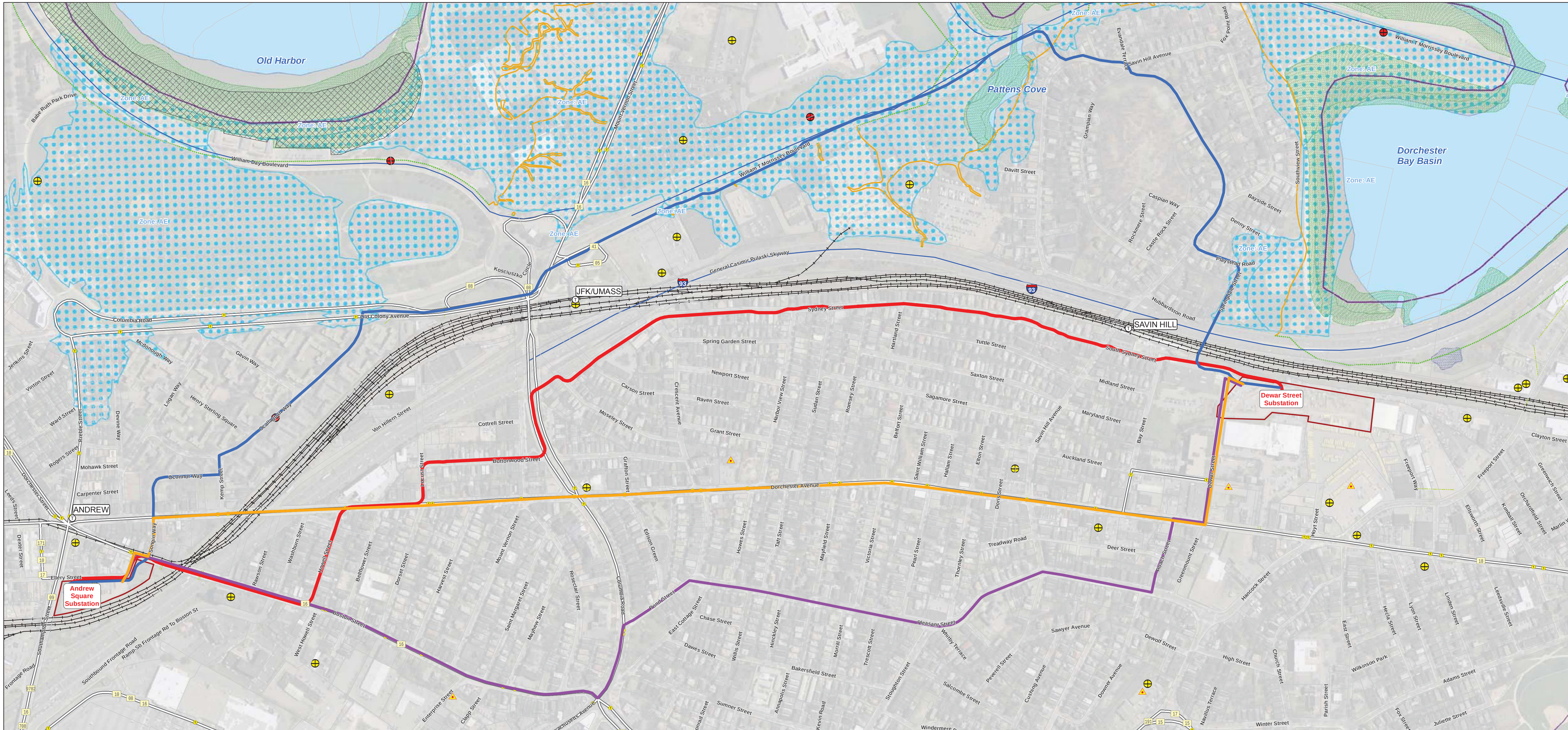
V:\Projects\E\E0750\Maps\Andrews Square\Figures_20181119\Figures_20181218\Figure4_3_CandidateRoutes.mxd



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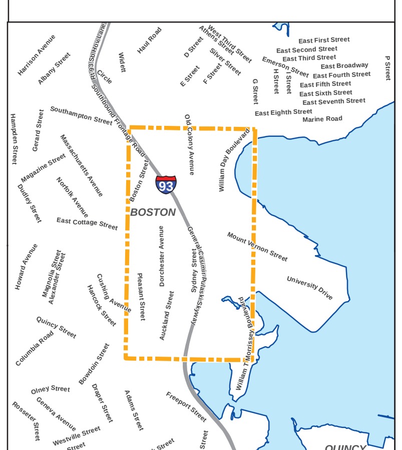

Legend

- T Stations
- Dorchester Avenue
- Pleasant Street
- Morrissey Boulevard
- Sydney Street
- Substation
- MBTA Bus Stops
- MBTA Bus Routes
- NHESP Certified Vernal Pools
- NHESP Potential Vernal Pools
- Community Public Water Supply - Surface Water
- Community Public Water Supply - Groundwater
- Non-Community Non-Transient Public Water Supply
- Non-Community Transient Public Water Supply

Chapter 91 Data

- Public Way
- Marsh Boundary - landward
- Landlocked Tidelands
- Jurisdiction
- Marsh Boundary - seaward
- Contemporary High Water
- Inferred Contemporary High Water
- Inferred Historic High Water
- Aquaducts
- Powerline
- Pipeline
- Track or Trail
- Trains
- Public Surface Water Supply Protection Area (Zone A)
- DEP Approved Wellhead Protection Area (Zone I)
- DEP Approved Wellhead Protection Area (Zone II)
- DEP Interim Wellhead Protection Area (IWPA)
- 100 Year Flood Zone
- Solid Waste Landfill
- Area of Critical Environmental Concern (ACEC)
- NHESP Priority Habitats for Rare Species
- NHESP Estimated Habitats for Rare Wildlife
- EPA Designated Sole Source Aquifer
- Major Drainage Basin
- Sub Drainage Basin
- Hydrologic Connections
- MassDEP Inland Wetlands
- MassDEP Coastal Wetlands
- MassDEP Not Interpreted Wetlands
- Public Surface Water Supply (PSWS)
- Water Bodies
- Stream/Intermittent Stream
- Non-Potential Drinking Water Source Area - High Yield
- Non-Potential Drinking Water Source Area - Medium Yield
- Potentially Productive Medium Yield Aquifer
- Potentially Productive High Yield Aquifer
- MassDEP Oil and/or Hazardous Material Sites (Chapter 21E)
- MassDEP Oil and/or Hazardous Material Sites with AUL
- URAM Site

Map Notes:
Basemap: 2014 Orthophotographs, MassGIS
Data source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs.

Parcels downloaded from Boston Open Data Portal: 2016

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Figure 4-4

Environmental Resources

Andrew Square to Dewar Street Reliability Project

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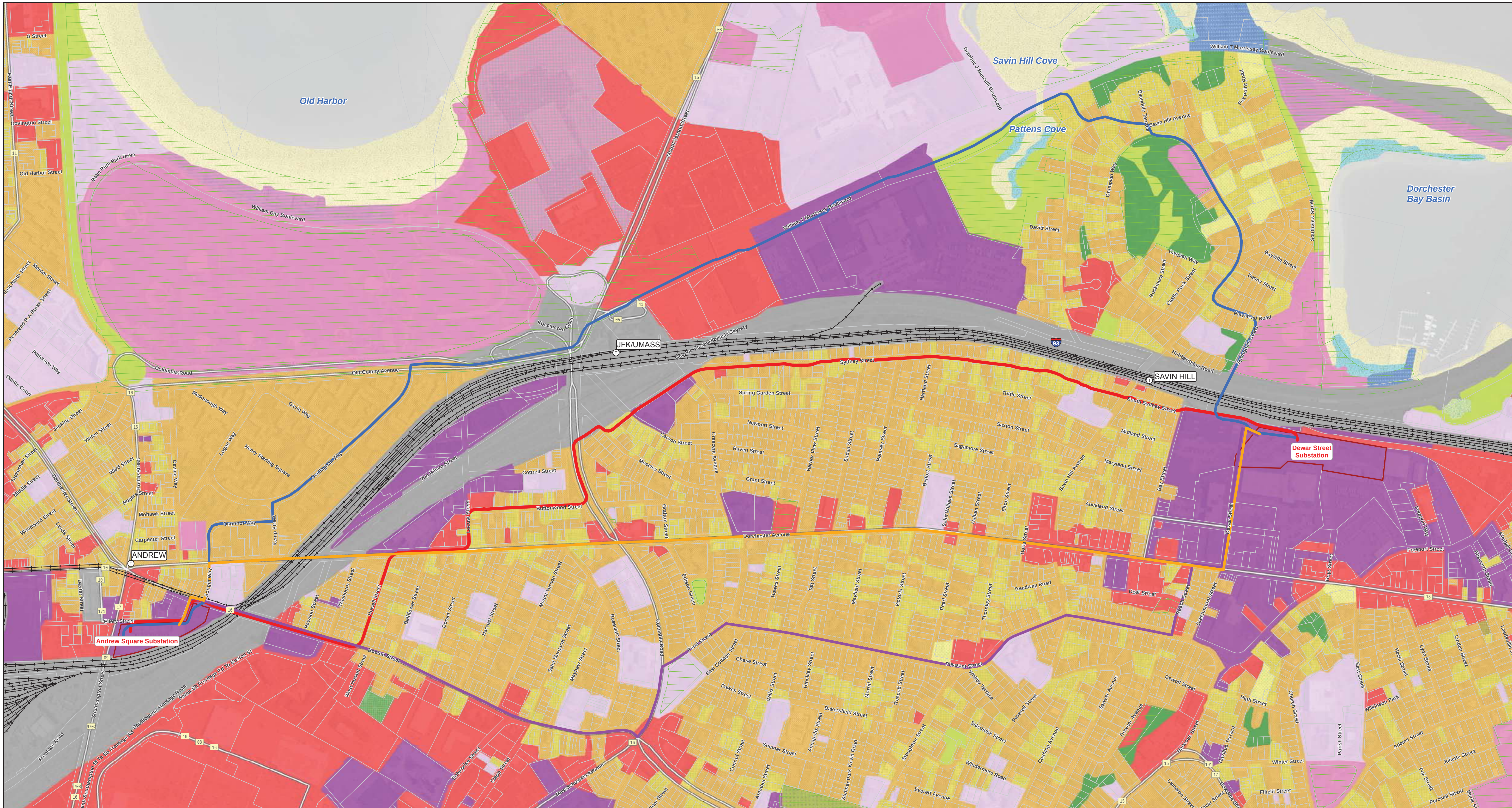
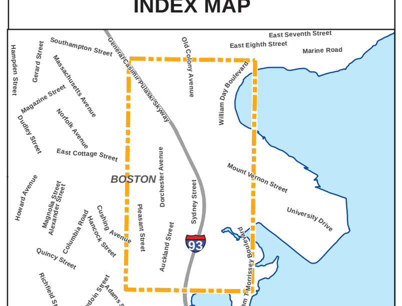


INDEX MAP



Legend

- Stations
- Dorchester Avenue
- Pleasant Street
- Morrissey Boulevard
- Sydney Street
- MBTA Bus Routes
- MBTA Track
- Protected and Recreational Open Space
- Substation
- Parcel Boundary
- Forest
- Open Land
- Non-Forested Wetland
- Salt Water Wetland
- Saltwater Sandy Beach
- Nursery
- Cemetery
- Participation Recreation
- Spectator Recreation
- Water-Based Recreation
- Marina
- Multi-Family Residential
- High Density Residential
- Medium Density Residential
- Urban Public/Institutional
- Commercial
- Industrial
- Transportation
- Junkyard

Map Notes:
Basemap: 2014 Orthophotographs, MassGIS
Data source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs.

Parcels downloaded from Boston Open Data Portal: 2016

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Figure 4-5

Adjacent Land Uses

Andrew Square to Dewar Street Reliability Project

Boston, Massachusetts

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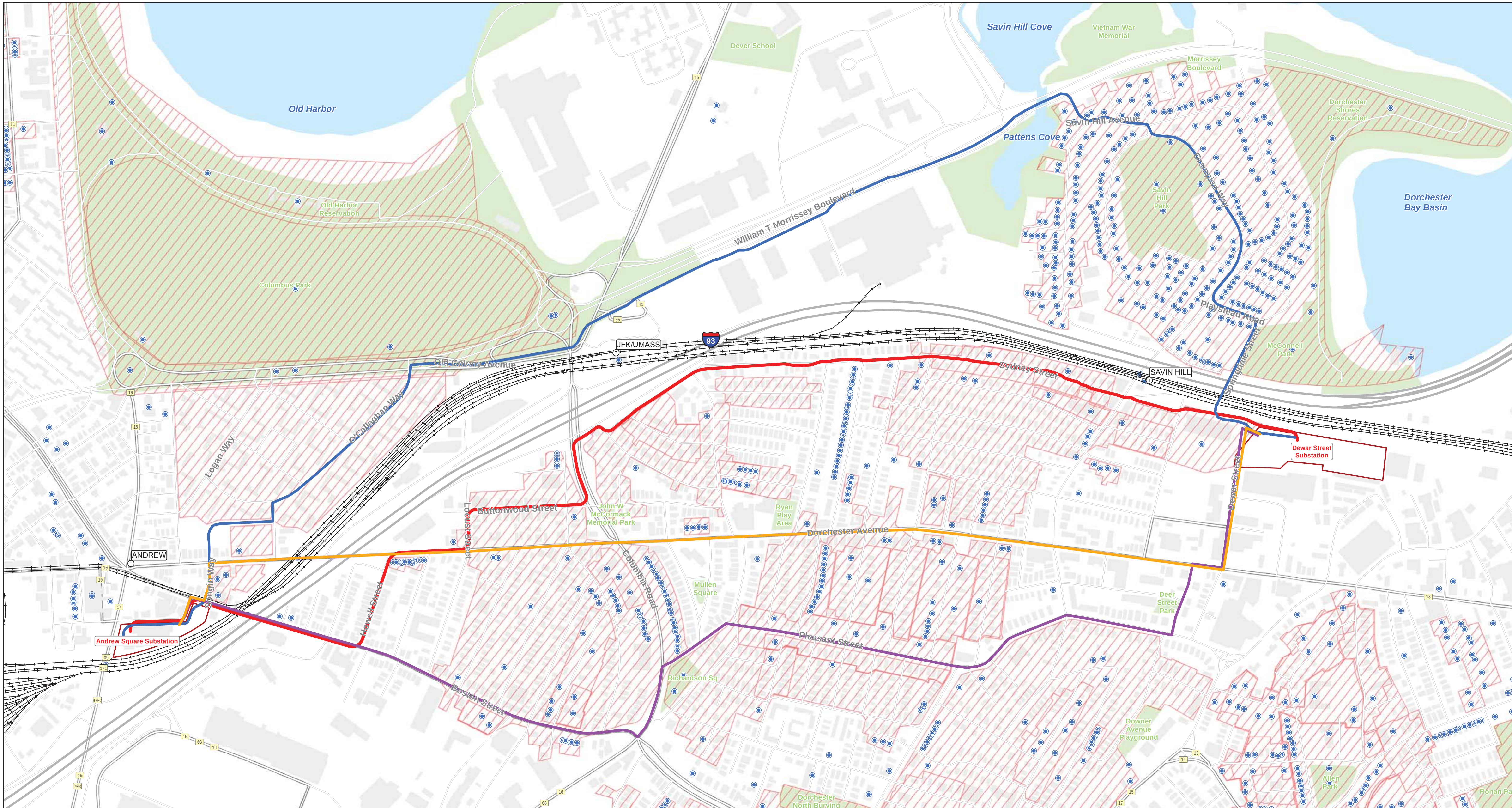

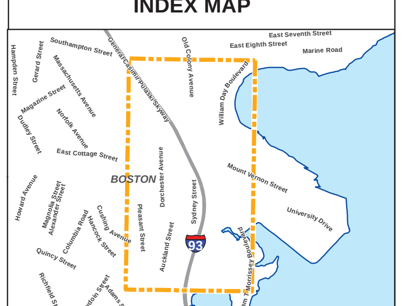

Legend

- Stations
- Dorchester Avenue
- Pleasant Street
- Morrissey Boulevard
- Sydney Street
- MBTA Bus Routes
- MBTA Track
- Substation
- MHC Historic Site
- MHC Historic Area

Map Notes:
Data source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs.

Parcels downloaded from Boston Open Data Portal: 2016

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0 150 300 600 Feet
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Figure 4-6

Cultural Resources

Andrew Square to Dewar Street Reliability Project

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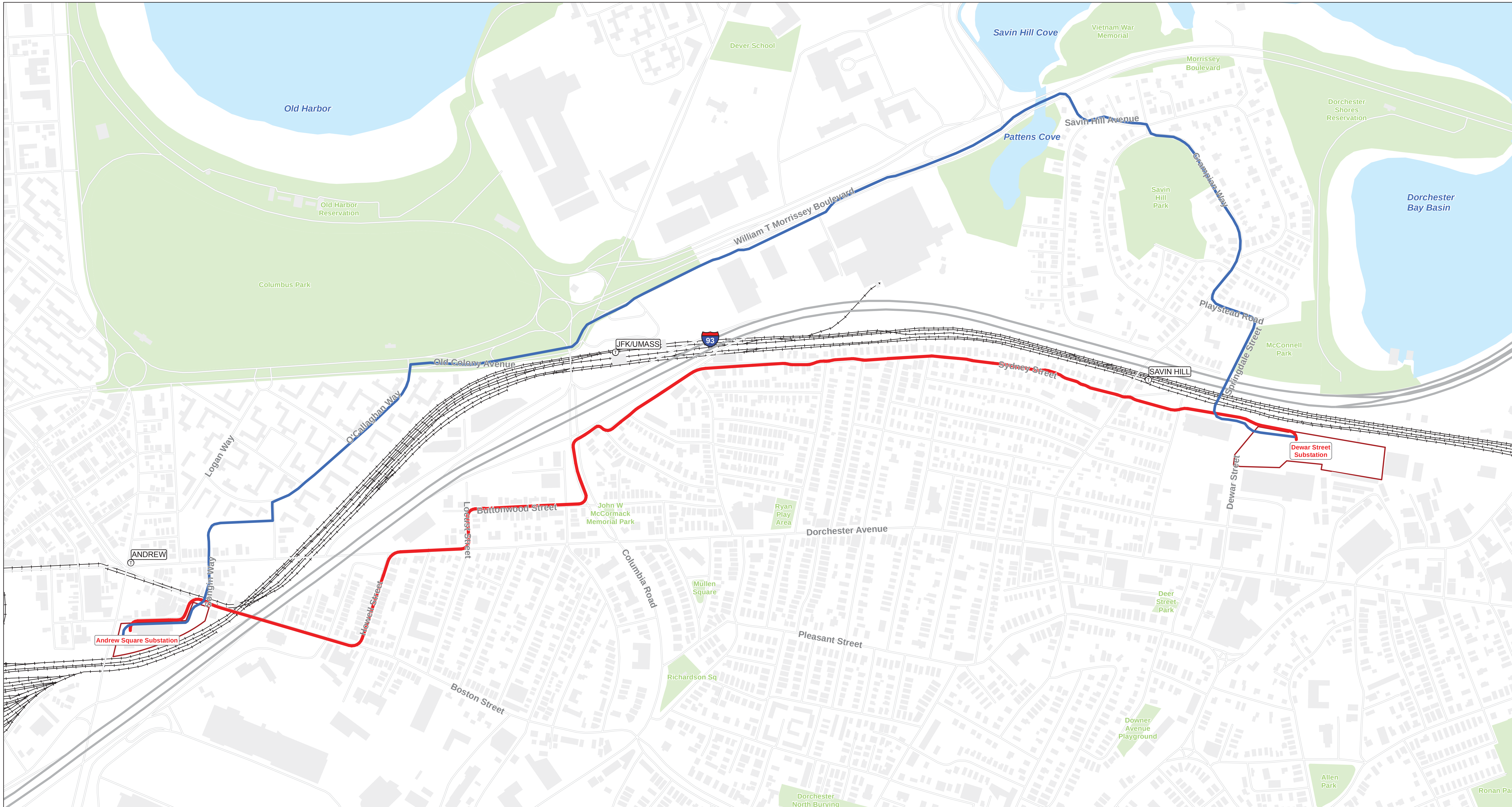

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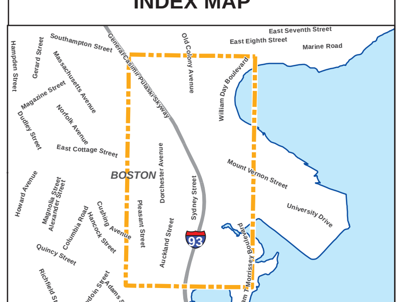

Legend

- Stations
- MBTA Track
- Morrissey Boulevard
- Sydney Street
- Protected and Recreational Open Space
- Substation

Map Notes:
Data source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs.

Parcels downloaded from Boston Open Data Portal: 2016

The information/data provided in this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation or parcel level analysis. The maps should not be used for construction purposes.

0 150 300 600 Feet
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Figure 4-7

Preferred Route and Noticed Alternative Route

Andrew Square to Dewar Street Reliability Project Boston, Massachusetts

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5.0 COMPARISON OF PREFERRED AND NOTICED ALTERNATIVE ROUTES

This section provides a detailed analysis and comparison of the potential environmental impacts and mitigation, costs and reliability of the Preferred Route and Noticed Alternative Route for the Project. The potential for environmental impacts associated with necessary modifications to the Andrew Square and Dewar Street Substations is also provided.

5.1 Route Descriptions

Descriptions of the Preferred Route and the Noticed Alternative Route are provided below.

5.1.1 Preferred Route

The total length of the Preferred Route, the Morrissey Boulevard Route, is 10,454 feet (about 2.0 miles). This route exits Andrew Square Substation east on Ellery Street, turns south on Boston Street, east on Songin Way, continues on O'Connor Way, and then turns east onto Kemp Street, then south on O'Callaghan Way until the intersection of Old Colony Avenue. The route then continues south on Old Colony Avenue and then William T Morrissey Boulevard after Kosciuszko Circle, at which point it turns south onto Savin Hill Avenue, and down Grampian Way. The route then turns south on Playstead Road, west on Springdale Street, under the MBTA tracks and I-93, and into Dewar Street Substation.

The Morrissey Boulevard Route crosses Pattens Cove/Savin Hill Cove and is in the vicinity of several major conservation areas, including the Old Harbor Reservation Parkways. Existing road widths range from 15 feet (Playstead Road) to 60 feet (Columbia Road), with a medium existing utility density. There are five MBTA bus stops and an MBTA Station along the Preferred Route, which crosses the MBTA commuter rail tracks on Springdale Street near the Dewar Street Substation. The Preferred Route requires high impact crossings at Columbia Road/Morrissey Boulevard and at I-93 and the MBTA railroad tracks.

The crossing of I-93 and the MBTA railroad tracks is proposed to occur near Springdale Street, which is a paper street. This crossing is of an eight-lane highway with a raised median and an MBTA commuter railroad with 4 tracks and gravel embankment. The proposed crossing will be installed using a trenchless methodology. The location proposed for this crossing is at a location where the BWSC successfully pipe jacked a 60-inch conduit. In addition, this route will cross the Kosciuszko Circle with open trench construction.

The predominant adjacent land use is residential, with some commercial and industrial, one school, one place of worship and four parks and recreation facilities. A major residential use (Mary Ellen McCormack Housing Community) within the area is proposed for redevelopment and the residents will be relocated out of the area during the redevelopment's phased construction process. The Company plans to coordinate construction of the Project with the timing of this activity to minimize construction-related impacts to the residents as much as possible. Wetland resources in the vicinity of the

Preferred Route include a floodplain, the Patten's Cove area, and Chapter 91 tidelands. Work within wetland resource areas is within developed and previously disturbed areas. There are seven known sites with AULs near the Preferred Route and one URAM site.

Representative photographs taken in 2018 of existing conditions along the Preferred Route and an overview map showing the photograph locations are provided in Appendix 5-1. A description of existing environmental and cultural (historic and archeological) resources and adjacent land uses along the Preferred Route are provided in Section 5.4 and depicted in Figures 5-1, 5-2, and 5-3 using aerial photography and data layers available from ArcGIS Online and MassGIS.

5.1.2 Noticed Alternative Route

The total length of the Noticed Alternative Route, the Sydney Street Route, is 8,448 feet (1.6 miles). This route exits Andrew Square Substation east on Ellery Street, turn south on Boston Street, east on Howell Street, south on Dorchester Avenue, east on Locust Street, south on Buttonwood Street, and east on Mount Vernon Street, at which point the route crosses Columbia Road and travels south on Sydney Street to Dewar Street Substation. The Noticed Alternative Route is a combination of main and side streets and is relatively direct.

The predominant adjacent land use is residential, with some commercial and industrial uses and one school. The Noticed Alternative Route does not cross through any known wetland resource areas and includes one URAM site and nine sites with AULs.

There are no major waterbodies or wetland resource areas in the vicinity of the Sydney Street Route. The only major conservation area near the Noticed Alternative Route is Sharon's Park. The road widths range from 20 feet (Ellery Street) to 60 feet (Columbia Road) and there are six MBTA bus stops along the Notice Alternative Route. The Route crosses the MBTA commuter rail tracks and I-93 (Southeast Expressway) on Boston Street. The overall existing utility density is medium-high.

The crossing of I-93 and the MBTA railroad tracks is proposed to occur at Boston Street. This crossing is of an eight-lane highway with raised median and an MBTA commuter railroad with 4 tracks and gravel embankment. The proposed crossing is via the Boston Street bridges that cross I-93 and the MBTA tracks.

Representative photographs taken in 2018 of existing conditions along the Noticed Alternative Route and an overview map showing the photograph locations are provided as Appendix 5-1. A description of existing environmental and cultural (historic and archeological) resources and adjacent land uses along the Noticed Alternative Route is provided in Section 5.4 and depicted in Figures 5-4, 5-5, and 5-6 using aerial photography and data layers available from ArcGIS Online and MassGIS.

5.2 Substation Modifications

This section discusses the modifications at Andrew Square Substation and Dewar Street Substation that are necessary to accommodate the new transmission line. The locations of the substations are shown on Figures 5-7 and 5-9.

5.2.1 Andrew Square Substation

Eversource's Andrew Square Substation is located on Ellery Street at Southampton Street in South Boston, on 2.02 acres of property owned by Eversource. Andrew Square Substation abuts MBTA tracks to the west and south, Southampton Street to the north, and Boston Street, commercial, and multi-family residential uses to the east. Route I-93 and I-93 Frontage Road are located on the far side of the tracks from Andrew Square Substation, and MBTA Andrew Station (subway and busway) is located across the Southampton Street and Ellery Street intersection. Property uses near Andrew Square Substation are a mix of commercial and multi-family residential uses. An aerial view of the existing Andrew Square Substation, along with environmental resources and land uses within 300 feet, is provided in Figure 5-7.

Proposed Modifications at Andrew Square Substation to Accommodate the Project

For either the Preferred or Noticed Alternative Route, the following equipment would be installed at the existing Andrew Square Substation to accommodate the New Line:

- AIS/GIS module consisting of:
  - Two 115-kV breakers in series
  - Two source terminals
  - Common load terminal
  - Associated switches, arresters, instrument transformers
  - 115-kV bus between each of the existing 115-kV lines and the new hybrid AIS/GIS module
- Relay and control panels within the control house will be installed as follows
  - Relaying and control for two new 115-kV breakers
  - Relaying and controls for the new line
  - Integration with relaying and control for the existing 115-kV lines and bus work

No fence line expansion or removal of existing equipment is required to accommodate these necessary improvements.

Potential Environmental Impacts at Andrew Square Substation from the Project

Land Use

Andrew Square Substation is bordered by tracks for the MBTA commuter rail Greenbush Line, Southampton Street and Boston Street. Nearby land uses are predominantly commercial and multi-family residential, with some industrial and high-density residential uses. A church, Our Lady of Czestochowa Catholic Church, is located southeast of the site, across Boston Street on Father Songin Way.

There will be no changes to land use resulting from the work at Andrew Square Substation as all work will be performed within the existing substation property.

***Use of Sulfur Hexafluoride* (“*SF_6*”)**

Circuit breakers and gas-insulated bus work installed at Andrew Square Substation will contain SF_6. Eversource tracks SF_6 data on a system-wide basis following U.S. Environmental Protection Agency (“USEPA”) guidelines. New equipment installed for the Project will be specified for an annual emission rate of 0. 1%, which is in compliance with the Massachusetts standard of 1.0% per year (310 C.M.R. 7.72).

SF_6 is shipped in cylinders approved by the Department of Transportation and is handled in accordance with the gas and equipment manufacturers' work practices.

New SF_6 equipment is filled by Eversource or by qualified contractor personnel working under Eversource supervision. Eversource personnel have been trained by the equipment manufacturer and follow the equipment filling instruction guide. If equipment needs to be "topped off" once in operation, trained Eversource employees perform this task following the manufacturer's instruction guide. The equipment is filled at installation and will not be opened until maintenance is required, at which time the SF_6 gas is captured into a gas cart. When equipment is retired, the SF_6 gas is recovered and reclaimed by a vendor, minimizing atmospheric releases.

Eversource continues to participate in the SF_6 emissions reduction partnership Memorandum of Understanding (“MOU”) that it entered into with the USEPA in December 2003 and monitors and reports its annual usage and leakage of SF_6 in accordance with the terms of that MOU. Eversource also reports its annual leakage of SF_6 according to the USEPA’s Mandatory Greenhouse Gas Reporting Rule.

Visual Impacts

The proposed equipment improvements to the Andrew Square Substation will be installed along the north and south sides of the Substation, within the existing fence line. The Substation is screened from Southampton Street, Ellery Street and Boston Street by existing vegetation. The six trees within the substation fence line along Ellery Street may need to be removed for the conduit installation. If these trees are removed, they will be replaced to continue to screen the substation along Ellery Street, as a result, there will be minimal visual impacts to abutting property owners, which include the Our Lady of Czestochowa Roman Catholic Church, located to the southeast of the existing Substation, and three residential properties in the vicinity.

Noise

As discussed above, land uses adjacent to the Andrew Square Substation include mixed commercial and multi-family residential. Work at the Andrew Square Substation to interconnect the New Line will take place intermittently over an approximately 20-month period. Construction activities will include site preparation and the installation of new electrical equipment, support structures and foundations. During this time, nearby residences may be affected by temporary elevated noise levels associated with a typical construction site. Construction will comply with the Boston and MassDEP regulations related to noise. To further mitigate construction noise at nearby residences, Eversource plans to:

- Require well-maintained equipment with functioning mufflers;
- Require strict compliance with MassDEP's Anti-Equipment Idling regulations;
- Operate stationary noise generating equipment away from nearby residences;
- Comply with municipal restrictions on construction hours when feasible; and
- Work with the City to schedule construction outside these hours where necessary.

Eversource anticipates that these measures will appropriately minimize construction-related noise impacts in the areas near the Andrew Square Substation and comply with the applicable noise ordinances. No increase in operational noise is anticipated.

The primary sources of noise in the vicinity of the existing substation include I-93, the Southeast Expressway (an eight-lane highway) and the MBTA railroad tracks, both of which are immediately adjacent to the substation area.

Daytime and nighttime noise impacts from the proposed Project and anticipated equipment installations are predicted to fully comply with the applicable City of Boston noise ordinances, Boston Air Pollution Control Commission ("APCC") regulations and MassDEP noise policy.

Traffic

Andrew Square Substation is located near the intersection of Ellery Street and Southampton Street. Although Southampton Street experiences moderate traffic volume, traffic impacts associated with substation improvements are expected to be minor and temporary in nature because the substation property is large enough to accommodate any construction vehicles and staging areas. Traffic mitigation measures are described in Section 5.4.2.

Public Shade Trees

The proposed improvements at Andrew Square Substation are not anticipated to affect public shade trees.

Potential to Encounter Subsurface Contamination

Per MassDEP's Waste Site & Reportable Releases site look-up tool, there is an AUL on the Andrew Square Substation. During subsurface investigations, tetrachloroethene, petroleum, lead and polycyclic aromatic hydrocarbons were identified in soils above the applicable Reportable Concentrations. This release was reported to MassDEP in July 1993 and RTN 3-000492 was assigned. A Class A-3 RAO and Notice of AUL was submitted to MassDEP on September 25, 2002 for the release. Based on the Class A-3 RAO Statement, the AUL encompassed the entire footprint of Andrew Square Substation. The proposed construction activity will be completed in accordance with the AUL and the MCP, which will include submittal of a URAM plan and management of excess soil with disposal at an appropriate facility.

In addition, a former gas station site at 501 Southampton Street was listed as RTN 3-0015510 for a release notification of total petroleum hydrocarbons ("TPH") in September 1997. The former gas station site is located at the intersection of Southampton and Boston Streets, approximately 200 feet east of the Project site. Assessment activities conducted in accordance with a Release Abatement Measure ("RAM") Plan in May 1998 found that old roofing materials and demolition debris buried on-site were the source of the TPH. A RAO and RAM Completion Statement were submitted in July 1998 indicating that there is no release of oil or hazardous material as defined by the MCP. Based on the information in the RAO, the potential to encounter subsurface contamination associated with RTN 3-0015510 is minimal.

Air Quality

The potential for fugitive dust and for emissions from equipment associated with construction activities at Andrew Square Substation will be mitigated as described in Section 5.3.3.

Cultural Resources

Andrew Square Substation is not located within any National or Local Historic Districts or any Inventoried Areas. Inventoried properties and areas adjacent to the Substation area include the (since demolished) Southampton Street Bridge over the MBTA tracks, and the Our Lady of Czestochowa Roman Catholic Church Parish Complex, which includes Saint Mary's Roman Catholic Parochial School/Our Lady of Czestochowa Roman Catholic Church Hall at 46 Boston Street; Our Lady of Czestochowa Roman Catholic Church and Our Lady of Czestochowa Rectory at 655 Dorchester Avenue; Our Lady of Czestochowa Roman Catholic Convent/Felician Sisters Convent at 666 Dorchester Avenue. There are no known archaeological sites near Andrew Square Substation.

5.2.2 Dewar Street Station

Eversource's Dewar Street Substation is located on Dewar Street at Auckland Street in Dorchester, Boston, on 4.36 acres of property owned by Eversource. Dewar Street Substation abuts MBTA tracks to the east, the Boston Public Schools Welcome Center, a school bus parking area, and maintenance areas to the west and south, and Dewar Street to the north. Route I-93 is located on the far side of the MBTA tracks from the Dewar Street Substation, and an industrial property is located on the opposite side of Dewar Street. Property uses in the vicinity of the Dewar Street Substation are primarily industrial and commercial, with one apartment building on Auckland Street. Savin Hill Station (MBTA subway) is located to the north of the industrial property north of Dewar Street Substation. An aerial view of the existing Dewar Street Substation, along with environmental resources and land uses within 300 feet, is provided in Figure 5-8.

Proposed Modifications at Dewar Street Substation to Accommodate the Project

For either the Preferred or Noticed Alternative Routes, the following equipment would be installed at the existing Dewar Street Substation within the existing property to accommodate the Project:

- Hybrid AIS/GIS module on an elevated platform consisting of:
    - Two 115-kV breakers in series
    - Two source terminals
    - Common load terminal
    - Associated switches, arresters, instrument transformers

  - 115-kV bus between each of the existing 115-kV lines and the new hybrid AIS/GIS module
  - 100-foot shielding mast
- Relay and control panels within the control house will be installed as follows
  - Relaying and control for two new 115-kV breakers
  - Relaying and controls for the new line
  - Integration with relaying and control for the existing 115-kV lines and bus work

No fence line expansion or removal of existing equipment is required to accommodate these necessary improvements.

Potential Environmental Impacts at Dewar Street Substation from the Project

Land Use

Dewar Street Substation is bordered by tracks for the MBTA Greenbush Commuter Rail Line and Red Line, Dewar Street, and the Boston Public Schools maintenance facility. Nearby land uses are predominantly industrial and commercial, with McConnell Park, Savin Hill and Malibu Beach, and the Dorchester Bay Basin located on the far side of the Red Line tracks and I-93. An apartment building (Savin Hill Apartments) and several restaurants are located on the north side of Dewar Street.

There will be no changes to land use as a result of the work at Dewar Street Substation, as all work will be performed within the existing substation property.

Use of SF_6

Circuit breakers and gas-insulated bus work installed at the Dewar Street Substation will contain SF_6. Eversource's use and tracking of SF_6 is the same as described in Section 5.2.1.

Visual Impacts

Potentially sensitive abutters to Dewar Street Substation are limited as the area is largely industrial, but include residents of the nearby Savin Hill Apartments building. The proposed equipment improvements to the Substation will be installed along the east side of the Substation, within the existing fence line. In addition, the Substation itself is screened from Dewar Street, the MBTA lines, and the Boston Public Schools maintenance facility by existing vegetation, which will also screen the proposed modifications, to the greatest extent possible. The 100-foot shielding mast will be visible outside of the station.

Noise

As discussed above, land uses adjacent to Dewar Street Substation are primarily industrial, with some commercial and multi-family residential. Work at Dewar Street Substation will take place intermittently over an approximately 20-month period. Construction noise and mitigation will be the same as described in Section 5.2.1.

Traffic

Dewar Street Substation is located at the end of Dewar Street, a dead-end street off of Dorchester Avenue. Dewar Street does not typically experience high traffic volume and any traffic impacts associated with Substation improvements are expected to be minor and temporary in nature because the Substation property is large enough to accommodate construction vehicles and staging areas. Traffic mitigation measures are described in Section 5.4.2.

Public Shade Trees

The proposed work at Dewar Street Substation is not anticipated to affect public shade trees.

Potential to Encounter Subsurface Contamination

Per MassDEP's Waste Site & Reportable Releases site look-up tool, there are no listed sites within the Dewar Street Substation. In the vicinity, the former Waste Management of Massachusetts site at 10 Freeport Street is listed as RTN 3-28368 for a release notification of more than the Reportable Quantity of diesel fuel in March 2009. The former Waste Management of Massachusetts site is located at the intersection of Southampton and Boston Streets, approximately 500 feet southwest of the Project site. Per the March 2010 Class A-2 RAO and Immediate Response Action Completion Statements, based on assessment activities performed at the site, a level of No Significant Risk has been achieved for the site. Based on the information in the RAO, the potential to encounter subsurface contamination associated with RTN 3-0015510 is minimal.

Air Quality

The potential for fugitive dust and for emissions from equipment associated with construction activities at the Dewar Street Substation will be mitigated as described in Section 5.3.3.

Cultural Resources

Dewar Street Substation is not located within any National or Local Historic Districts or any Inventoried Areas. Inventoried properties and areas adjacent to the Substation area include the Savin Hill Flats Area to the north across Dewar Street. The Savin Hill Flats Area includes the now demolished Boston Insulated Wire and Cable Company Mill. There are no known archaeological sites on or in the vicinity of the Dewar Street Substation.

5.3 General Construction Best Management Practices for Preferred and Noticed Alternative Routes

The Preferred and Noticed Alternative Routes both include underground construction within roadways for a distance of approximately 2.0 miles and 1.6 miles, respectively.

This section of the analysis describes the general construction methods and anticipated mitigation measures for the underground cable segment of the Project. The cable will be installed using conventional techniques for the construction of cross-linked polyethylene ("XLPE") underground cables. Additional information describing the sequence of activities and other construction-related topics such as schedule, underground construction work hours and environmental compliance, monitoring and mitigation is provided below.

5.3.1 General Construction Methods for Underground Cable Installation

The proposed underground cable will consist of 3,500 kcmil XLPE-insulated cable in High Density Polyethylene ("HDPE") conduits. The duct bank will consist of four 8 and 5/8-

inch-diameter HDPE conduits, as well as two 4-inch-diameter Polyvinyl Chloride ("PVC") conduits, and two 2-inch-diameter PVC conduits to carry communications lines and ground continuity conductors. The duct bank will be encased in a thermal concrete envelope. The typical duct bank trench will be four feet wide and five feet deep; a typical trench diagram is provided as Figure 3-6, Typical Trench Cross Section.

There are four principal phases of construction for an underground cable project within streets:

1. Manhole/splice chamber installation;
2. Trenching and duct bank installation;
3. Cable pulling, splicing and testing; and
4. Final pavement restoration.

Installation of the underground transmission line will generally require a linear work zone along the construction corridor. It is anticipated that areas where typical open trench excavation will occur will require an approximately 11-foot wide work space area and that deep excavation at some dense utility intersections (as determined during the detailed design phase) may require an approximately 18-foot wide work area. Manhole and splice vault installations typically require an approximately 20-foot wide work area. These work areas will include temporary traffic control devices necessary to guide motorists safely past the work zone.

Eversource anticipates that each trench segment will be 100 to 200 feet in length. It is important to note that trench construction is generally a linear progression, with tasks occurring concurrently or in progressive sequence. Approximate durations for activities anticipated to occur within each trench segment are summarized in Table 5-1 below.

Table 5-1: Approximate Duration of Trench Segment Activities

Activity	Approximate Duration
Survey and Layout	One day
Pavement Cutting	One day
Trench Excavation and Shoring	Two to five days
Conduit Installation	One to three days
Duct Bank Concrete Placement/Curing/Shoring Removal	Three to five days
Backfill/Temporary Pavement Placement	Two to three days

These durations are approximate and subject to change depending on field conditions. Moreover, all phases of construction will not necessarily be completed in one segment prior to advancing to another segment. There may be cases where work on an unfinished segment may be temporarily halted due to unforeseen conditions or to catch up in other areas, and work would continue on other segments. Once the unanticipated conditions are addressed, work would resume on the unfinished segment.

Each of these phases is described in more detail below, together with specialized techniques for construction within a railroad ROW and for trenchless road, railroad and water crossings (where applicable).

Manhole/Splice Chamber Installation

Manholes will be installed along the underground cable route to facilitate cable installation and splicing and allow access for maintenance requirements and future repairs. Manhole size is determined by the space required for the design size of the cable and the area needed to support pulling and splicing. For the Project, each manhole will be approximately 10 feet wide by 12 feet high and 32 feet long (exterior dimensions, see Figure 5-9, Typical Manhole Plan and Figure 5-10, Typical Manhole Section and Detail).

Figure 5-9: Typical Manhole Plan

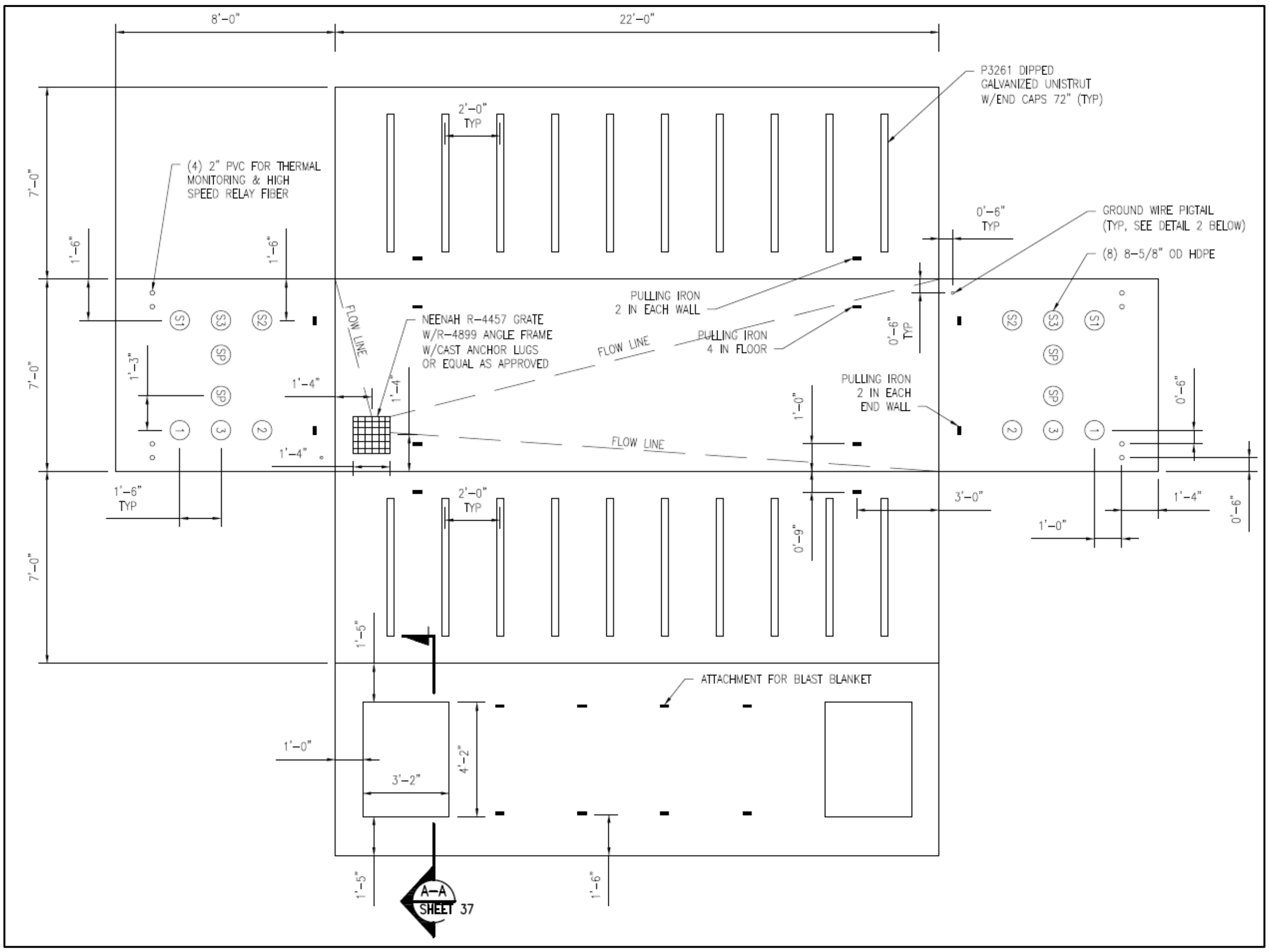
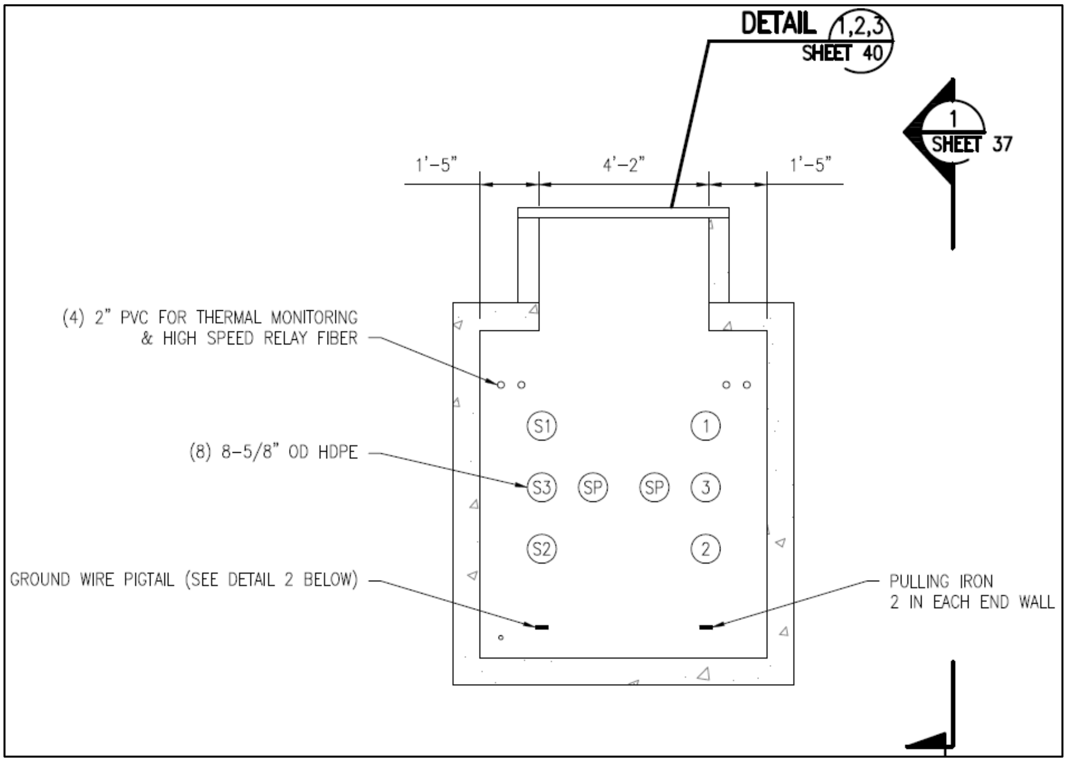
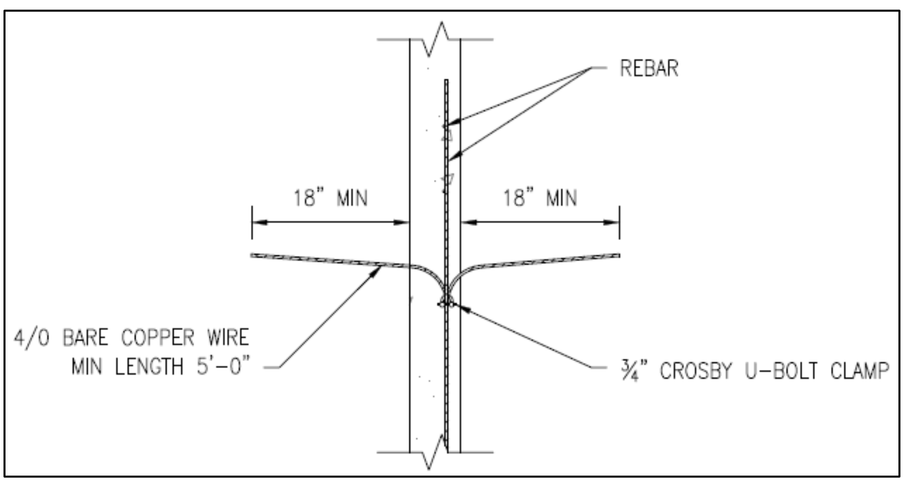


Figure 5-10: Typical Manhole Section and Detail





Manholes for this Project will typically be spaced approximately 1,500 to 1,800 feet apart. Factors contributing to final placement of the manholes include allowable pulling tensions, consideration of sidewall pressure on the cables as they are pulled around a bend, and the maximum length of a cable that can be transported on a reel based on the reel's width, height and weight, and accessibility. For manhole installation, the duration of construction typically takes seven to ten days per location but may take longer if underground utility relocation is necessary. The Company will work with the City of Boston and utility companies regarding these relocations on a case-by-case basis as manhole locations are finalized. Additional time is required for pulling cable (approximately four days) and splicing cable (approximately five days), as explained in further detail in this section.

Following the construction of the new transmission line, manhole inspections will be conducted by Company personnel on a routine basis, normally every three years. During these inspections, operators inspect the condition of cable joint(s), the cable support brackets, the link box connections, and integrity of concrete walls, as well as the junction of conduits as they enter and leave the manhole. The manhole cover is also inspected to determine whether it is stable and flush with the road surface.

Trenching and Duct Bank Installation

The primary method for underground duct bank construction is open-cut trenching. Where construction takes place within roads, the width of the trench will be marked on the street, Dig Safe will be contacted, and the location of the existing utilities will be marked. The pavement will be saw cut. Saw cutting provides a clean break in the pavement and defines the extents of the trench for the next activity.

Following saw cutting, the existing pavement will be removed by pneumatic hammers and loaded into a dump truck with a backhoe. Pavement will be handled separately from soil, and will be recycled at an asphalt batching plant. Subsequently, a backhoe will excavate the trench to the required depth. In some areas, excavation may be done by hand to avoid disturbing existing utility lines and/or service connections. The Company will maintain agreed-upon separation from other utilities to minimize the need to add protective devices. Where required, wood sheeting or temporary mechanical supports, such as strapping, will be employed during construction, particularly when the proposed duct bank is placed under other existing utilities. All such supports will be designed and installed in coordination with the existing utility owner.

The Company does not anticipate any planned disruption to utilities along the proposed route. The route is being designed to avoid utility conflicts, to the extent possible, and test pitting will confirm design assumptions. During construction, unforeseen utility conflicts are always possible and, if they arise, crews will work to address any conflict in the field. For instance, the Company may slightly shift construction locations, if possible. Small branches or services to individual buildings may require relocation. The Company and its contractors would notify and coordinate with the affected resident or business in advance should a disruption be required.

A "clean trench" or "live loading" method will be used for removal of excavated soils, where soil will be loaded directly into a dump truck for temporary off-site stockpiling or hauling to an off-site facility for recycling, re-use or disposal. The soil will not be stockpiled along the edge of the roadway, thus reducing the size of the required work area and reducing the potential for sedimentation and nuisance dust. Rock encountered during excavation will be removed by mechanical means and brought to an off-site facility for recycling, re-use or disposal.[19]

Once excavated, the trench will be sheeted and/or shored as required by soil conditions, Occupational Safety and Health Administration ("OSHA") safety rules, and local and state regulations.[20] Shoring is designed to permit passage of traffic adjacent to the trench and will allow for the trench to be covered with a steel plate to allow traffic over the trench during non-working hours.

Intersections tend to have the greatest concentration of underground utilities. Generally, the street intersection is excavated in advance of the other work areas so obstructions can be precisely identified and the HDPE conduit locations can be determined before the main trenching work crew reaches the intersection. Within intersections and other areas with identified or potentially significant subsurface utility congestion, temporary or permanent relocation of existing utilities may be required to install the cables.

Once the open trench is prepared, the conduits will be assembled and lowered into the trench. The area around the conduits will be filled with thermal concrete (3,000 pounds per square inch). After the concrete is placed in the trench, it will be back-filled with fluidized thermal backfill or native soil,[21] depending on local requirements, and a temporary pavement patch will be installed. Upon Project completion, the road will be restored in accordance with the Department's "Standards to be Employed by Public Utility Operators When Restoring and of the Streets, Lanes and Highways in Municipalities" (D.T.E. 98-22) ("Repaving Standards") and municipal standards.

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19 To evaluate soil management options during construction, a multi-phase soil pre-characterization program will be conducted by the Company along the selected Project route. Depending on the results of the pre-characterization program, during construction, the contractor will determine if the soils will be live loaded and transported direct to the receiving facility for management. Where the contractor determines live loading is not an option due to restrictions (e.g., nighttime work), the soils will be stockpiled and covered with polyethylene sheeting at a Company-owned or contractor-operated facility with appropriate BMPs around each stockpile to prevent mixing and sediment runoff. Soils will be segregated based on soil type, with signage posted indicating each stockpile area.

20 The Project will comply with all applicable federal, state and local safety standards. For example, all construction sites will, at a minimum, adhere to the Federal Highway Administration's Manual to Uniform Traffic Control Devices ("MUTCD") to ensure that both vehicular and pedestrian traffic are safely routed around all street and curbside construction activities. This could include the use of cones, barricades, signage, electronic sign boards, or any combination of the above, as required by the MUTCD. When open trenches are not being actively monitored by on-site construction personnel, the trench will be either backfilled or engineered road plates will be utilized in order to prevent the public from accidentally accessing the trench.

21 Engineered fluidized thermal backfill has distinct thermal characteristics, specifically with respect to thermal resistivity levels at low levels of moisture content, which native soils in this area may not possess. Limited use of native soils may be possible in certain locations around manholes where exceptional thermal performance is not required.

Cable Installation and Testing

Prior to cable installation, each conduit will be tested and cleaned by pulling a mandrel (a close-fitting cylinder designed to confirm a conduit's shape and size) and swab through each of the ducts. When the swab and mandrel have been pulled successfully, the conduit is ready for cable installation.

Three cables will be installed between two adjacent manholes. To install each cable section, a cable reel will be set up at the "pull-in" manhole and a cable puller will be set up at the "pull-out" manhole.

Following the initial pulling of the mandrel and pulling line through each duct, a hydraulic cable pulling winch and tensioner will be used to individually pull cable from the pull-in to the pull-out manhole. This process will be repeated until all cables have been installed.

Once adjacent cable sections are installed, they will be spliced together inside the manholes. Splicing high-voltage solid-dielectric transmission cable is a time-consuming, complex operation. It typically requires 40 to 60 hours to complete the splicing of all three cables at each manhole. The single phase (cable) is spliced continuously. Each of the three phases will be spliced separately. The splicing activities will take place over four or five extended work days at each manhole location. Cable splicing is a 12-hour/day activity completed by specialized contractors. Extended work days for cable splicing would entail multiple work shifts that would extend into evening hours and, in some cases, throughout the night (e.g., three shifts over 24 hours). The splicing operation requires a splicing van and a generator. The splicing van contains all of the equipment and material needed to make a complete splice. At times, an air conditioning unit will be used to control the moisture content in the manhole. The portable generator will provide the electrical power for the splicing van and air conditioning unit and will be muffled to reduce noise. Typically, the splicing van will be located over one manhole access. The air conditioner will be located near the second manhole access and the generator will be located in a convenient area that does not restrict traffic movement around the work zone.

Once the complete cable system is installed, it will be field-tested from the substations. At the completion of successful testing, the line will be energized.

Pavement Restoration

Following installation of the duct bank and splice chambers in public roadways, roadway surfaces will be restored to a condition as good as or better than the pre-construction condition, to meet the standards of the state agencies including the Repaving Standards.

Trenchless Crossing Techniques

Trenchless crossing techniques such as pipe jacking or "HDD" may be required at crossing locations where there is some obstruction to open trenching such as a railroad or wetlands. Sections 5.1.1 and 5.1.2 above discuss the locations of trenchless crossings that are known to the Project team at this time. However, during the test pitting or during construction, the Company may encounter existing unmapped utilities at depths that require the proposed transmission line to be placed underneath them; in such cases, a trenchless crossing will be considered. Additionally, if the Company encounters other significant unanticipated utility obstructions, and/or unidentified culverts, it may consider pursuing a trenchless crossing to avoid such obstructions. These techniques are described in further detail below.

Pipe Jacking

The pipe jacking method is used to install a casing horizontally under a conflicting object where trenching cannot be accommodated or easily accommodated.

This method is typically used for crossings of less than 200 feet and is typically used for crossings under railroads, ditches, streams and streets, and for crossing under shallower existing underground facilities. Due to concerns regarding the potential for settling, the MBTA will require a casing, which is used for pipe jacking. During a pipe jack, the entire excavation is supported by the casing, which would address the MBTA's concerns. A pipe jacking installation is accomplished by digging a bore pit on one side of the feature to be crossed and a receiving pit on the other side. The bore pit houses the auger or other equipment to remove the spoils from within the pipe, and jacking equipment, while the receiving pit receives the pipe on the other side of the feature being crossed.

The casing is then jacked (pushed) in the bore hole as it is being drilled under the feature. Once in place, the casing is cleaned out, and smaller HDPE or PVC pipes are installed inside the casing to contain the cables. When completed, the duct bank will mate up with the casing on each side of the crossing. Prior to cable installation, the casing is filled with thermally designed fluidized fill.

Once the pipe jacking equipment is in place, it must remain in place and the drill pits must remain open until the operation is completed.

Horizontal Directional Drilling

HDD is typically used for comparatively deeper and longer crossings, such as those under interstate highways, major water bodies and railroads. This method commonly involves drilling a hole under a conflicting object from one side to the other, then pulling either a large HDPE casing or several smaller HDPE pipes (in a bundle) back through the bore hole. HDD bores a hole and pumps it full of bentonite slurry, which carries out the waste and supports the opening. The MBTA does not prefer the HDD method due to concerns with settling of the soil that could impact the tracks.[22]

An HDD installation generally requires a larger temporary construction footprint than pipe jacking because the boring equipment is larger, and the supporting equipment requires more space. Once the pullback process begins, it cannot be stopped until the pipes are in place.

5.3.2 Construction Schedule and Hours

As previously noted, assuming receipt of all necessary permits and approvals, construction of the Project is anticipated to commence in Spring, 2020, continuing over a 20-month period, with a target completion by the end of 2022.

22 MBTA "Railroad Operations Directorate Plate II Maintenance and Protection of Railroad Traffic", page 12.

Construction hours will be developed in accordance with local noise ordinances, regulated construction hours (copies of which are provided in Appendix 5-2) as well as coordination with DCR and the City of Boston. The City of Boston limits construction hours to 7:00 AM to 6:00 PM, Monday through Friday. DCR may require alternate construction hours in non-residential areas. The Company will coordinate with the City of Boston and DCR to seek approval when work outside of these hours is necessary. The Company will also coordinate with the City to determine areas where construction hours will be limited (e.g., in front of schools). In certain locations, night work may be proposed to allow advancement of Project construction in areas with traffic congestion or other construction projects being advanced simultaneously.

In areas where manhole installations, cable splicing, and/or culvert crossings are not required, the Company expects to spend approximately three to four days performing construction activities in front of any single abutter's property.

The duration of time spent in front of a specific abutter's property for manhole installation, cable pulling and cable splicing will be 16 to 20 days, broken out for each task as follows:

- Approximately 7 to 10 days for manhole installation;
- Approximately 4 days of pulling activity (two days in each pull direction); and
- Approximately 5 days for splicing.

The actual duration of these activities can vary based on a number of factors, including existing utility conditions and below-grade conditions.

The Company anticipates that it may not be permitted to work within public roads during the winter months due to the winter moratorium for in-street construction. Some activities associated with construction, for example, splicing at manholes, may be allowed under the moratorium.

5.3.3 Construction Mitigation, Compliance and Monitoring

Construction mitigation measures will help minimize the potential for temporary impacts to the human and natural environments. Typical mitigation for stormwater runoff and associated erosion and sedimentation, fugitive dust, construction vehicle emissions and soils and solid waste management are discussed below for underground line construction. Specific discussions of mitigation measures for other environmental impacts are provided in subsequent subsections.

Stormwater Runoff, Erosion and Sedimentation Control

The Company will develop and maintain a Stormwater Pollution Prevention Plan ("SWPPP") for the Project that will identify controls to be implemented to mitigate the potential for erosion and sedimentation from soil disturbance during construction. The SWPPP will include a construction personnel contact list, a description of the proposed work, stormwater controls and spill prevention measures, and inspection practices to be implemented for the management of construction-related storm water discharges from the Project. The SWPPP will be adhered to by the contractor during all phases of Project construction in accordance with the general conditions prescribed in the Project's USEPA Stormwater Construction General Permit.

The Company will require that the construction contractor designate a construction supervisor or equivalent to be responsible for coordinating with the environmental monitor, to conduct regular inspections and to be responsible for compliance with permit requirements. This person will be responsible for providing appropriate training and direction to the other members of the construction crew regarding any aspect of the work as it relates to compliance with Project permits and approvals and construction mitigation commitments.

Additionally, construction personnel will undergo pre-construction training on appropriate environmental protection and compliance obligations prior to the start of construction of the Project. Regular construction progress meetings will be held to reinforce contractor awareness of these mitigation measures.

Periodically, an environmental monitor working on behalf of Eversource will conduct inspections of erosion and sediment controls and ensure compliance with the Company's construction procedures and environmental policies, and with federal, state and local permit requirements and conditions. Documentation identifying deficiencies of erosion control measures and other permit compliance matters will be immediately brought to the attention of the contractor for implementation of corrective measures.

A copy of the Final Order issued by the Siting Board, and copies of all other permits and approvals, will be provided to and reviewed by the Company's project managers and construction supervisors. These documents will also be provided to contractor prior to construction as part of the contract documents. Contractors are required, through their contracts with the Company, to understand and comply with Siting Board and/or Department Orders and conditions or requirements for any other applicable Project permits and approvals. The Company also requires contractors to keep copies of these documents on site and available to all Project personnel during construction. These documents and applicable conditions will also be reviewed during the construction kick-off meeting in the field between Company representatives and contractor personnel.

In roads where work is to be performed adjacent to storm drains and stormwater is directed to a storm drain, the Company will install and maintain filter fabric barriers to prevent sediment from entering the storm drain system. When construction is complete at each location, the storm drain barriers will be removed.

Other measures to mitigate soil erosion will include the prompt removal of soils from the excavated trench. Soils will not be stockpiled along the road(s) but instead will be loaded directly into trucks to be hauled to an offsite disposal/re-use area, or to a temporary construction laydown area. This construction method will limit the potential for soils to be washed with stormwater into nearby storm drains.

In addition to the measures discussed above, the applicable conditions and provisions of the Final Order and other permits and approvals will be reviewed during Project meetings and will be discussed as needed during tailboard meetings, where construction personnel are briefed by their construction supervisor on the upcoming day's work and at that time will be reminded by Company representatives and the supervisor of any related specific compliance conditions.

Air Quality

Dust will be controlled at the construction sites by use of appropriate methods, including the use of dump trucks to move soil out of the construction zone, and by covering temporary soil stockpiles. The Company may also require contractors to place water trucks with misters in or near the work areas during construction activities.

Water trucks and street sweeping will be used in combination within the roadway construction areas. In addition, the Company will direct its contractors to retrofit any diesel-powered non-road construction equipment rated 50 horsepower or above to be used for 30 or more days over the course of the Project with USEPA-verified (or equivalent) emission control devices (e.g., oxidation catalysts or other comparable technologies). The Company uses ultra-low sulfur diesel ("ULSD") fuel in its own diesel-powered construction equipment. ULSD has a maximum sulfur content of 15 parts per million as opposed to low sulfur diesel fuel, which has a maximum sulfur content of 500 parts per million. By using ULSD fuel, there is a 97 percent reduction in the sulfur content as compared to low sulfur diesel fuel. The Company will also require contractors to use ULSD fuel in their diesel-powered construction equipment used for this Project.

The Company and its contractors will also comply with state law (M.G.L. c. 90, § 16A) and MassDEP regulations (310 C.M.R. 7.11(1)(b)), which limit vehicle idling to no more than five minutes. There are exceptions for vehicles being serviced, vehicles making deliveries that need to keep their engines running and vehicles that need to run their engines to operate accessories. There may be other times when idling is permitted as long as the idling is absolutely necessary (e.g., as a matter of safety).

With respect to enforcement of the idling restrictions, it is the responsibility of every person on a job site to be in full compliance with all safety and environmental rules and policies. Supervisors and foremen at job sites are responsible for enforcement of these rules on a continuous basis.

There also will be installation of anti-tracking pads and regular sweeping of the pavement of adjacent roadway surfaces during the construction period to minimize the potential for construction traffic to kick up dust and particulate matter.

Construction Wastes

Waste materials generated along the route during installation of the transmission duct bank and manholes will be promptly removed and re-used or properly disposed of at a suitable facility. The largest quantity of construction waste will likely be from soils excavated from the trench and locations where manholes are installed. This material will be removed from the trench and hauled to an appropriate off-site disposal/re-use location or to a temporary construction laydown area for on-site re-use. Concrete and asphalt will be recycled at a local asphalt plant.

In the event there are contaminated soil or other regulated materials encountered along the route, soils will be managed pursuant to the URAM provisions of the MCP. The Company will contract with a licensed site professional ("LSP") as necessitated by conditions encountered along the Project alignment, consistent with the requirements of the MCP at 310 C.M.R. 40.0460 et seq.

Dewatering Protocols

It is not uncommon to encounter groundwater during construction of underground utility facilities. If feasible based on site-specific conditions, the least costly method when dewatering will typically be to recharge the groundwater back into the adjacent subsurface. This can either be done by discharging back within the open excavation/trench associated with the project/pipe installation or discharging to the nearby ground surface via a filter bag or dewatering corral (if necessary) allowing groundwater to infiltrate back into the soil.

For situations where on-site recharge of groundwater is not an option and manageable (<50,000 gallons) amounts of groundwater are expected to be generated, a vacuum truck can be used to pump out and appropriately dispose/recycle groundwater encountered. Sampling of water will be required to ensure proper disposal/recycling.

For locations where large amounts (>50,000 gallons) of groundwater are encountered and on-site recharge and off-site disposal are not feasible options, discharging into the municipal stormwater and/or sewerage systems may be an option. However, this activity must be coordinated with the municipality and USEPA beforehand and would not occur without written consent from the municipality and the USEPA.

For discharges to surface water for projects greater than one acre in Massachusetts, coverage under the USEPA Construction General Permit is required. For discharges of uncontaminated groundwater to surface water from construction projects less than one acre in Massachusetts, coverage under the USEPA National Pollutant Discharge Elimination System ("NPDES") General Permit for Dewatering Activity Discharges in Massachusetts is required.

Coverage under the USEPA Massachusetts Remediation General Permit would be required for surface water discharge of contaminated groundwater. Permits would also be required for discharges to sanitary or combined sewers (such as municipality and/or Massachusetts Water Resources Authority territory).

5.4 Land Use, Environmental and Cultural Resources Impacts Analysis

As construction will be underground in City streets, there will be no permanent impacts to land use, environmental or cultural resources and the minor temporary impacts will be largely mitigated. Nevertheless, the Company has performed a comparative analysis of adjacent land uses and environmental and cultural resources along the Preferred Route and the Noticed Alternative Route as presented below.

Categories of potential impacts considered include adjacent land use, traffic and transportation, wetlands and water resources, public shade trees, subsurface contamination, visual, electric and magnetic fields and noise. Potential cultural resource analysis considered both historic resources (i.e., above-ground buildings, structures, districts and objects) and archaeological resources (i.e., pre-contact and historic archaeological sites and areas).

5.4.1 Adjacent Land Use

Land use along the Preferred Route and Noticed Alternative Route was assessed using MassGIS 2005 Land Use data as well as MassGIS parcel data. Land use was tabulated in acres within approximately 100 feet of the edge of the existing roadway edge along each segment. Results are listed in Table 5-2 (Land Use within 100 feet Preferred Route and Noticed Alternative Route). MassGIS land-use data are also shown on Figures 5-3 and 5-6 for the Preferred Route and Noticed Alternative Route, respectively.

Table 5-2: Land Use within 100 Feet of Preferred and Noticed Alternative Routes

Land Use Type	Preferred Route (acres)	Noticed Alternative Route (acres)
Commercial	4.57	2.38
Forest	1.03	0
High Density Residential	4.61	7.02
Industrial	10.63	8.18
Medium Density Residential	0.48	0
Multi-family Residential	16.00	18.30
Non-Forested Wetland	0	0
Open Land	1.95	0
Participation Recreation	3.02	0
Powerline/Utility	0	0
Saltwater Beach/Wetland	0.29	0
Transportation	7.03	6.42
Urban Public/Institutional	3.00	0.96
Water	0	0

Preferred Route

The dominant land use proximate to the Preferred Route is residential along the local streets, with approximately 20.61 acres of multi-family/high density residential use within 100 feet of the route. There are approximately 635 residential units adjacent to the Preferred Route. Additional land uses along Morrissey Boulevard include industrial, public/institutional (University of Massachusetts, Boston), recreational and commercial. The routing analysis in Section 4 considered proximity to sensitive receptors, defined as hospitals, police/fire stations, elder care facilities/nursing homes, schools, daycare facilities, district courts, places of worship, parkland, protected open space and funeral homes. There are nine sensitive receptors located along the Preferred Route:

- The Our Lady of Czestochowa Roman Catholic Church Parish Complex, which includes Saint Mary’s Roman Catholic Parochial School and a place of worship

- Boston College High School
- Veterans Park
- Joe Moakley Park/Columbus Park
- McConnell Park
- Savin Hill Park
- Old Harbor Reservation
- Dorchester Shores Reservation
- Vietnam War Memorial

Noticed Alternative Route

The dominant land use proximate to the Noticed Alternative Route is residential, with approximately 25.32 acres of multi-family/high density residential use within 100 feet of the route. There are approximately 543 residential units adjacent to the Noticed Alternative Route. Additional land uses along Sydney Street include commercial and industrial. There are three sensitive receptors located along the Noticed Alternative Route:

- Sharon Park
- Washburn Street Green
- Cristo Rey Boston High School

Comparison

The Preferred Route is longer but is adjacent to more commercial and industrial uses rather than residential uses. On the other hand, the Noticed Alternative is adjacent to more residential uses, with the majority of the route along dense residential neighborhoods. Because construction of the Preferred Route will allow for coordination with other proposed projects including the reconstruction of Morrissey Boulevard and the redevelopment of the Mary Ellen McCormack Housing Community, it offers a unique opportunity to minimize construction-related impacts to adjacent land uses. The Company plans to continue to coordinate construction with the timing of these activities to minimize construction related impacts to the residents as much as possible. Because less of the Preferred Route is adjacent to dense residential neighborhoods and because the Company will be able to coordinate Project construction with other projects, the Preferred Route will have less impacts that the Noticed Alternative.

Impact Mitigation

The potential for the Project to affect adjacent land use is limited. There are no permanent changes to land use associated with construction of the Project along either route. Temporary impacts to residences, businesses and sensitive receptors may include traffic disruption, including road closings and construction noise. Construction hours will be limited in the vicinity of schools and proper construction best management practices ("BMPs") will be in place to reduce noise and air quality impacts.

5.4.2 Traffic and Transportation Impacts

This section evaluates the potential for impacts to traffic, parking and public transportation along the Preferred Route and Noticed Alternative Route. Traffic impacts associated with the underground work in public roads will be temporary in nature and confined to the period necessary to construct the Project. A variety of mitigation measures will be used to minimize traffic disruption during construction. Implementation of a well-designed TMP will reduce the potential for inconvenience to drivers and those using public transportation, as well as any potential secondary effects on local businesses. Access to local businesses and residences will be maintained throughout Project construction.

To compare potential traffic impacts of the Preferred Route and Noticed Alternative Route, the Company reviewed existing traffic and parking conditions, roadway widths, travel lanes, and the presence of public bus service along each route, as well as the options for traffic mitigation along each route.

Preferred Route

The total length of the Preferred Route is approximately 2.0 miles, the majority of which is located within public roads with 210 feet of pedestrian connection. The majority of the roads comprising the Preferred Route can generally be described as medium volume roads with a mix of functional classifications and are predominantly two-way. Morrissey Boulevard is a limited access roadway with two lanes in each direction, so Morrissey Boulevard Southbound is considered one-way. Old Colony Avenue and Morrissey Boulevard are functionally classified as Urban Principal Arterial Roads, and Old Colony Terrace and Savin Hill Avenue are functionally classified as Urban Collector Roads; these segments have higher daily traffic volume than the local roads (Father Songin Way, O'Connor Way, Kemp Street, O'Callaghan Way, Grampian Way, Playstead Road, and Springdale Street). Old Colony Avenue has a bike lane with a buffer.

MBTA Bus Routes 5 (Old Colony Avenue at McDonough Way to City Point Bus Terminal) and 16 (UMass Boston Busway to Forest Hills) coincide with the Preferred Route along Old Colony Avenue; there is one stop along MBTA Bus Route 5 and no stops on MBTA Bus Route 16 along the Preferred Route portion of Old Colony Avenue.

Work within areas of traffic congestion or near certain sensitive receptors will be managed to minimize impacts to traffic and disturbances affecting nearby residences and businesses. A TMP will be prepared and will include active and passive traffic management measures, including the use of police details, at appropriate locations such as those identified above. Night work typically is implemented in areas that have the following characteristics: (1) the segment experiences high traffic volumes and congestion during the day; (2) the adjacent land uses are primarily commercial and/or industrial; and/or (3) the municipality (or DCR or MassDOT, in the case of roads under state jurisdiction, e.g., Morrissey Boulevard and I-93 ramps near Columbia Road) has required the Company to construct at night. The primary advantage of night work is that it can minimize traffic congestion by avoiding hours of peak traffic volumes and avoiding potential business interruptions. Any such work outside of typical construction hours will be closely coordinated with local officials and any necessary local authorizations will be sought by the Company.

Table 5-3: Preferred Route Road Segments

Segment	Approximate Average Road Width (feet)	Existing Traffic and Parking	Public Transportation Route	Daily Traffic Volume*
Father Songin Way	25	• Sidewalks on both sides • On street parking on one side	No	2,000
O'Connor Way	25	• Sidewalks on both sides • On street parking on both sides	No	2,000
Kemp Street	25	• Sidewalks on both sides • On street parking on both sides	No	2,000
O'Callaghan Way	25	• Sidewalks on both sides • On street parking on both sides	No	2,000
Old Colony Avenue	50 (per direction)	• Sidewalks on both sides • On street parking on both sides • Median present	Yes	33,000
Morrissey Boulevard	40	• Sidewalks on both sides • No on street parking	No	12,000 – 33,000
Old Colony Terrace	20	• Sidewalks on both sides • No on street parking	No	2,000 – 5,600
Savin Hill Avenue	30	• Sidewalks on both sides • On street parking on both sides	No	5,600
Grampian Way	30	• Sidewalks on both sides • On street parking on one side	No	2,000
Playstead Road	15	• Sidewalks on both sides • On street parking on both sides	No	2,000
Springdale Street	20	• No sidewalks • No on street parking • Private drive	No	Paper street

* Minor streets were assigned 2,000 vehicles per day due to lack of available data. Based on experience and judgment, streets similar to the ones for which no counts were available (minor collectors and local roadways) would typically experience approximately this level of traffic. Based on Federal Highway Administration ("FHWA") information, minor collectors can range from 1,100 – 6,300 vehicles per day. A uniform average daily traffic volume was selected for these roadways that was considered appropriate for this analysis and that falls within the ranges specified by FHWA.

Noticed Alternative Route

The total length of the Noticed Alternative Route is 1.6 miles, all of which is located in public roads. The majority of the roads comprising the Noticed Alternative Route can generally be described as low to medium volume local roads. The roads are a mix of two-way and one-way streets, and would require a combination of lane shifts and road closures/detours. Dorchester Avenue and Columbia Road are functionally classified as Urban Principal Arterial Roads and Boston Street is functionally classified as an Urban Minor Arterial Road; these segments have higher daily traffic volume, but only a short segment of the proposed work would occur on these sections (approximately 525 feet, 310 feet, and 1,025 feet respectively). Dorchester Avenue is the only segment of the Noticed Alternative Route with bike lanes that would be impacted by the proposed Project.

MBTA Bus Route 17 (Andrew Square to Fields Corner) begins at Andrew Square, and includes two stops along the portion of Boston Street traversed by the Noticed Alternative Route. MBTA Bus Route 18 (Andrew Square to Ashmont) includes two stops along the Preferred Route portion of Dorchester Avenue. The location where MBTA Bus Route 41 (JFK/UMass to 775 Centre Street) is crossed by the Noticed Alternative Route at Columbia Road does not include any stops.

Work within areas of traffic congestion or near certain sensitive receptors would be managed to minimize impacts to traffic and disturbances affecting nearby residences and businesses. A TMP would be prepared and would include active and passive traffic management measures, including the use of police details, at appropriate locations similar to that described above for the Preferred Route.

Table 5-4: Noticed Alternative Route Road Segments

Segment	Approximate Average Road Width (feet)	Existing Traffic and Parking	Public Transportation Route	Daily Traffic Volume*
Boston Street	40	• Sidewalks on both sides • On street parking on both sides	Yes	13,450
Howell Street	25	• Sidewalks on both sides • On street parking on both sides	No	2,000
Dorchester Avenue	45	• Sidewalks on both sides • On street parking on both sides	Yes	14,800
Locust Street	25	• Sidewalks on both sides • On street parking on both sides	No	2,000
Buttonwood Street	25	• Sidewalks on both sides • On street parking on both sides	No	2,000
Mount Vernon Street	45	• Sidewalks on both sides • On street parking on both sides	No	2,000
Columbia Road / I-93 Ramps Intersection	50	• Sidewalks on both sides • No on street parking	Yes	22,100
Moseley Street	20	• Sidewalks on both sides • On street parking on both sides	No	2,000
Sydney Street	40	• Sidewalks on both sides • On street parking on both sides	No	1,200
South Sydney Street	25	• Sidewalks on both sides • On street parking on both sides	No	2,000

* Minor streets were assigned 2,000 vehicles per day due to lack of available data.

Comparison

In order to provide a comparison of traffic impacts along the Preferred Route and Noticed Alternative Route, the Company assessed a number of indicators of potential traffic congestion as described above.

Based on the route evaluation and scoring analysis provided in Section 4 of the Analysis (see Table 4-5), the Noticed Alternative Route scored more favorably for transportation impacts than the Preferred Route, primarily due to the higher volume of traffic on Morrissey Boulevard.

The primary areas of concern include Columbia Road and Moseley Street on the Noticed Alternative Route, which are near the intersection with the I-93 ramps, and Old Colony Avenue and Morrissey Boulevard along the Preferred Route, which have relatively high traffic volume and are near Kosciuszko Circle. The two primary areas of concern are relatively short in length, and construction will likely occur during non-peak traffic hours, in consultation with local officials. Regarding the Preferred Route, the Company is working with DCR to schedule the work with the Morrissey Boulevard redevelopment to minimize traffic impacts.

Each route would require implementation of TMPs and close coordination with the City of Boston, DCR and neighborhood of Dorchester to ensure that traffic delays are minimized. Traffic management measures, including use of police details and implementation of detours and lane closures, would be required regardless of the route selected. While the Noticed Alternative Route scored more favorably in the transportation impact criteria than the Preferred Route for the routing analysis, additional factors were considered in comparing the potential impacts of the Preferred and Noticed Alternative Routes:

- The construction work hours are more flexible along Morrissey Boulevard because there are no residential uses along Morrissey Boulevard.
- Morrissey Boulevard has a greater capacity to absorb the reduction of a lane during construction, and provides more flexibility for transportation management options, versus Sydney Street where there would be significant impacts related to road closures and elimination of parking during construction. This is because Sydney Street is a narrow, one-lane roadway with extensive on-street parking, which would require parking restrictions and travel restrictions during construction that would directly impact residents. Morrissey Boulevard is a wider road with multiple lanes in one direction; therefore, traffic can be redirected around the work area.
- As the Preferred Route is proposed along the southbound side of Morrissey Boulevard, traffic impacts will be limited during peak hours, because the peak time for the southbound route is in the late afternoon/early evening, and construction timing can avoid this peak.
- Work will be conducted outside of travel lanes along Morrissey Boulevard, where possible, as portions of the route will be along the shoulders and median areas.
- I-93 serves as a regional alternative route to avoid construction impacts along Morrissey Boulevard.
- The Company will continue to coordinate with Winn Development to minimize impacts to residents during work on O’Callaghan Way.
- The Company will continue to coordinate with DCR to minimize transportation related impacts along Morrissey Boulevard.

Although the Company is committed to mitigating traffic impacts to the fullest extent possible along either route, there are clear advantages to the Preferred Route with respect to traffic impacts to neighborhoods.

Impact Mitigation

Upon completion of the detailed design work and prior to the start of construction, the Company will work closely with the City and DCR to develop a TMP. Topics to be addressed in the TMP will include:

- Width and lane location of the work zone to minimize impacts to vehicular traffic;
- Work schedule and duration of lane closures, road closures, or detours (where applicable);
- The use of traffic-control devices such as barricades, reflective barriers, advance warning signs, traffic regulation signs, traffic-control drums, flashers, detour signs, and other protective devices to be placed as shown on plans and as approved by the City of Boston and DCR;
- Locations where temporary provisions may be made to maintain access to homes and businesses;
- Routing and protection of pedestrian and bicycle traffic;
- Maintenance of MBTA service and school bus service;
- Communication with adjacent businesses, so critical product deliveries are not interrupted by construction;
- Determination of the impact to roadway level of service due to short-term lane closure(s);
- Notification to municipal officials, local businesses, and the public of the timing and duration of closed curbside parking spaces and travel way restrictions; and
- Coordination between the Company and police and fire departments to ensure that emergency access through the route be provided at all times. In most cases, travel past the work zone will be open to one-way alternating travel under police control. In this circumstance, the police officer(s) will stop all traffic, thereby providing passage of the emergency vehicle. In the rare instance that a roadway is closed temporarily to traffic (i.e., for the installation of a manhole), emergency vehicles would still be permitted to pass through the work zone as all construction activity would cease temporarily and a section of roadway would be cleared of all contractor vehicles and equipment.

The scope of the TMP will include analysis of the roads affected by the transmission line construction. The TMP will be submitted for review and approval by appropriate state and municipal authorities prior to construction. Traffic-control plans will be developed consistent with the FHWA Manual of Uniform Traffic Control Devices for Streets and Highways and the MassDOT publication, "Work Zone Safety". The Company will also closely coordinate with local officials and abutting property owners.

5.4.3 Wetlands and Water Resources

Wetland and water resources include river crossings, wetland crossings, riverfront area and Chapter 91 jurisdiction limits. As described in Section 4 of the Analysis, the evaluation of the river crossing criterion involved reviewing MassGIS databases and conducting field reconnaissance to determine the number of rivers or waterbodies the routes would cross. The evaluation of wetland crossings involved reviewing MassGIS data and conducting field reconnaissance to determine the number of local- and state-regulated resource areas, as defined in the MWPA regulations (310 C.M.R. 10.00 et seq.), including BVW and river Bank and their associated 100-foot buffers, BLSF and 200-foot Riverfront Area, that the proposed routes would cross. The evaluation of Chapter 91 jurisdictional areas involved reviewing MassGIS data layers developed under Chapter 91, using a combination of contemporary high water, historic high water and landlocked tidelands to form the landward and seaward boundaries of landlocked tidelands.

Preferred Route

Table 5-5 summarizes the wetland resource areas, buffer zones and stream crossings associated with the Preferred Route.

Table 5-5: Wetland Resource Areas, Buffer Zones, Riverfront Area, and Chapter 91 Tidelands Crossed by the Preferred Route

Wetland Resource Area	Preferred Route
Linear Feet ("lf") within 100-foot Buffer Zone	488 lf
Waterbody Crossing	Savin Hill Cove/Pattens Cove
Square Feet ("sq ft") within Chapter 91 Jurisdiction (assumes ~ 8-foot wide trench)	14,517sq ft
Square Feet within 100 Year Floodplain/LSCSF (assumes ~8 foot wide trench)	24,212 sq ft

Anticipated wetlands-related permitting includes an Order of Conditions from the Boston Conservation Commission, and a Section 10 Permit from the U.S. Army Corps of Engineers ("USACE"). Regarding the areas within Chapter 91 jurisdiction, a new license is not required. The work is anticipated to be authorized through a minor modification of an existing license.

Given that the underground cable construction associated with the Preferred Route is anticipated to occur within existing paved roadways and disturbed rights of way, no permanent impacts to wetlands or streams are anticipated. With regard to the temporary construction impacts, DCR's proposed reconstruction of Morrissey Boulevard will also have impacts. Dependent upon the scope of the DCR construction, some or all of these temporary impacts would occur even if the Project uses the Noticed Alternative Route. Although not reflected in the scoring, coordination of the Project with the DCR construction may minimize temporary construction impacts.

Noticed Alternative Route

The Noticed Alternative Route is not anticipated to result in any wetlands impacts, river crossings, or impacts to filled or flowed tidelands.

Comparison

Although the Preferred Route will include work within jurisdictional wetland and water resources, the temporary impacts are minor and there will be no permanent impacts. The wetland resource areas along the Preferred Route consist of roadway rights-of-way and an existing culvert, and therefore, the Preferred Route will not alter the values of the resource areas. Moreover, all of the activities proposed in wetland and water resource areas and buffer zones can be designed to conform to applicable local, state and Federal wetlands regulatory programs.

Impact Mitigation

The potential impacts are limited, as noted above, and are within the footprint of previously disturbed areas and areas proposed for redevelopment. Neither underground route in public roads requires any filling or clearing within wetlands. Given that the vast majority of underground cable construction is anticipated to occur within existing paved roadways, no permanent impacts to wetlands or streams are anticipated. To address the potential for erosion and sedimentation within wetland resource areas, a SWPPP will be prepared for the Project that will specify erosion control measures to be implemented. Furthermore, the Eversource BMP manual will be followed and is included as Appendix 5-3.

5.4.4 Public Shade Trees

M.G.L. Chapter 87 defines public shade trees as all trees within a public way or within the boundaries thereof. A field reconnaissance was conducted to count all trees within the public way along the route regardless of diameter at breast height or distance from the proposed cable trench, as described in Section 4 of the Analysis. As is typical for this mostly residential environment, the canopies of certain trees on the Preferred Route and the Noticed Alternative Route extend out over the road. Construction proposed in paved roadways will not require the removal of any trees along either the Preferred Route or the Noticed Alternative Route. No permanent impacts to public shade trees are proposed, however potential temporary impacts include trimming of branches and exposure or cutting of roots.

Preferred Route

There are 44 public shade trees within the public way associated with the Preferred Route. No permanent impacts to public shade trees are anticipated to be required as part of the installation of the underground transmission line within the Preferred Route.

Noticed Alternative Route

There are 63 public shade trees within the public way associated with the Noticed Alternative Route. No permanent impacts to public shade trees are anticipated to be required as part of the installation of the underground transmission line within the Noticed Alternative Route.

Comparison

As noted below, the Company anticipates coordination with the Boston Tree Warden regarding public shade tree protection and replacement where required. Nonetheless, because there is a greater potential for impacts to public shade trees along the Noticed Alternative Route, the Preferred Route is superior with respect to public shade trees.

Impact Mitigation

Typical mitigation measures to protect public shade trees along the underground route segments include:

- Prior to construction, the Company will meet with the local Tree Warden to confirm the location and condition of public shade trees and other trees along the route relative to construction work areas. The Company will review BMPs and finalize a monitoring and mitigation plan for the protection of public shade trees and applicable regulated trees during construction.
- Where trees are encountered within 15 feet of trench edges, they will be protected from bark and limb damage by surrounding them with wire-bound 2x4 lumber to an appropriate height depending on the particular tree. Alternative tree protection may be used if accepted in advance by the property owner(s). Where tree roots are encountered during excavation, mechanical excavation will cease, roots will be exposed by hand (to the least extent possible, see discussion below), and will be kept moist and covered with wet burlap or plastic throughout the exposure period. Thermal backfill will be placed in the trench in a manner to avoid impacting tree roots.
- Erect and maintain a temporary fence around the perimeter of individual tree pits (typically the area between the curb and sidewalk where the tree resides). The temporary fence will remain in place for the duration of construction and will serve to: prohibit the storage of construction materials, debris, or excavated material within tree pit area or on any sidewalks; and, prohibit vehicles, equipment or foot traffic within tree pit area. Although unlikely, if excavation for new construction is required within the tree pit area and/or sidewalk, the Tree Warden will be contacted before any work begins. The Tree Warden will determine whether the contractor on site may commence with the work, or if a qualified arborist must be hired to conduct root pruning. If permission is granted to the contractor to commence with root pruning, the following practices will be implemented: (1) narrow-tine spading forks or compressed air will be used to comb soil to expose roots; (2) roots will be cut cleanly after excavation with clean, sharp tools, to promote callus formation and wound closure; (3) tree routing will be dressed with a hormone compound; (4) the excavation will be backfilled as soon as possible and the soil around the roots will be watered to avoid leaving air pockets. If backfilling immediately is not possible, the exposed roots will be covered with wet burlap and watered regularly to prevent roots from drying out, and backfilling with soil will occur as soon as possible.
- Trees and vegetation will be replaced in a manner approved by the Tree Warden.

5.4.5 Subsurface Contamination

Subsurface excavation associated with the Project has the potential to encounter contaminated soils from historical releases and/or urban fill in the vicinity of both the Preferred Route and Noticed Alternative Route. A review of the MassDEP waste site list on-line database was performed to determine the potential to encounter subsurface contamination along each route at listed sites. The online database was used to collect and review information on MassDEP-listed sites (sites issued an RTN) directly abutting the routes.

Preferred Route

There are seven sites with AULs and two URAM sited within 500 feet of the Preferred Route, as described in Table 5-6.

Table 5-6: MassDEP-Listed Sites within 500 Feet of the Preferred Route

RTN	Location	Description/Status
3-0004392	45 Ellery St	Boston Edison Station 106/RAO-AUL
3-0004210	25 Morrissey Blvd	Commercial Property/RAO-AUL
3-0002656	135 Morrissey Blvd	Boston Globe/RAO-AUL
3-0020339	151 Mt Vernon St	Old Colony Ave Columbia Rd UMass JFK/RAO-AUL
3-0021174	501 Southampton St	Andrew Square/RAO-AUL
3-0013497	35 Morrissey Blvd	No Location Aid/RAO-AUL
3-0019461	40 and 50 Morrissey Blvd	Intersection Mt. Vernon St/RAO-AUL
3-0031002	100 Morrissey Blvd	UMass Boston Campus Redevelopment/URAM
3-0026782	O’Callaghan Way	No Location Aid/URAM

Noticed Alternative Route

There are nine sites with AULs and one URAM site within 500 feet of the Noticed Alternative Route, as described in Table 5-7.

Table 5-7: MassDEP-Listed Sites within 500 Feet of the Noticed Alternative Route

RTN	Location	Description/Status
3-0004392	45 Ellery St	Boston Edison Station 106/RAO-AUL
3-0004151	30 West Howell St	National School Bus Service/RAO-AUL
3-0004210	25 Morrissey Blvd	Commercial Property/RAO-AUL
3-0002623	888 Dorchester Ave	Cumberland Farms/RAO-AUL
3-0020339	151 Mt Vernon St	Old Colony Ave Columbia Rd UMass JFK/RAO-AUL
3-0021174	501 Southampton St	Andrew Square/RAO-AUL
3-0013497	35 Morrissey Blvd	No Location Aid/RAO-AUL
3-0023664	66 Von Hillern St	Port Morris Tile and Marble Corp/RAO-AUL
3-0018865	99 Boston St	No Location Aid/RAO-AUL
3-0023011	Crescent St	No Location Aid/URAM

Comparison

The Preferred Route has one fewer MassDEP listed site within 500 feet of the route than the Noticed Alternative Route; however, five of the sites overlap both routes. The two routes are equal for this criterion.

Impact Mitigation

If contaminated soils are encountered, they will be managed pursuant to URAM provisions of the MCP. The Company will prepare a soil and groundwater management plan, and will contract with an LSP as necessitated by conditions encountered along the Project alignment, consistent with the requirements of the MCP at 310 C.M.R. 40.0460 et seq. All excess soil will be managed in accordance with local, State and Federal regulations.

5.4.6 Visual Assessment

Because the transmission line portion of the Project is underground, the only potential permanent visual impacts associated with the transmission line are those associated with vegetation clearing. As noted below, minimal impact to vegetation is proposed.

Preferred Route

Visual impacts associated with the Preferred Route are anticipated to be minimal, as no public shade trees are anticipated to be directly impacted by the installation of the underground transmission line within the existing paved roadways of the Preferred Route.

Noticed Alternative Route

Visual impacts associated with the Preferred Route are anticipated to be minimal, as no public shade trees are anticipated to be directly impacted by the installation of the underground transmission line within the existing paved roadways of the Noticed Alternative Route.

Comparison

Because the potential for visual impact on both routes relative to underground line construction is similar, the Company determined the routes were comparable for this criterion.

Impact Mitigation

As described in Section 5.4.4, the Company anticipates coordination with the local Tree Warden regarding public shade tree protection and replacement where required.

5.4.7 Electric and Magnetic Fields

The term “electric and magnetic fields” (“EMF”) is used to describe fields created by electric voltage (electric fields) and electric current (magnetic fields). An electric field is present whenever voltage exists on an object and is not dependent on current. Similarly, a magnetic field is present whenever current flows in a conductor and is not dependent on voltage. When an object has voltage and carries current, it produces both an electric and magnetic field.

The Company, like all North American electric utilities, supplies electricity at 60 Hertz (“Hz”) (60 cycles per second). Therefore, the electric utility system, and the equipment connected to it, produce 60-Hz (power-frequency) EMF.

Preferred Route

The Company modeled EMF levels associated with the proposed transmission facilities both within and at the edges of the ROW at sections representative of the post-Project circuit configurations under average annual loading conditions. Magnetic-levels were calculated using computer algorithms developed by the Bonneville Power Administration ("BPA"), an agency of the U.S. Department of Energy (BPA, 1991). The EMF Report is included as Appendix 5-4. These methods have been shown to accurately predict EMF levels measured near transmission lines. The EMF levels were calculated at one meter (3.28 feet) above ground, in accordance with standard protocol. Eversource obtained base-case system power-flow models from ISO-NE, representing the expected New England transmission topology for the year 2021, with all lines in service. These base cases include transmission system changes that already have been approved by ISO-NE and are in their system models. Calculations were performed at average annual loads and during peak loads on the transmission system.

Because the cable will be shielded, there is no external electric field in the vicinity of underground transmission lines. The calculated magnetic fields are found in Table 5-8.

Table 5-8: Calculated Magnetic Field Levels at Annual Average Loads

Section	**Configuration**	**Magnetic Field** milligauss **(mG)**	
		+/- 25 feet	Max Above Cable
Trench	Average Load	1.1	13
	Peak Load	1.4	17
Splice Vault	Average Load	1.8	18
	Peak Load	2.3	22
Flat Section	Average Load	1.8	21
	Peak Load	2.2	27

The reference levels for whole body exposure by the general public to 60-Hz fields is summarized in the following table:

Table 5-9: Reference Levels for Whole Body Exposure by the General Public to 60-Hz Fields

Organization, recommended limit	**Magnetic fields**
International Commission on Non-Ionizing Radiation Protection ("ICNIRP"), reference level	2,000 mG
International Committee on Electromagnetic Safety, maximum permissible exposure	9,040 mG

The calculated EMF levels associated with the Project are many times lower than the health-based guidelines issued by the ICNIRP for continuous public exposure to EMFs (2,000 milligauss [mG]; ICNIRP, 2010). It is reasonable to conclude that the Project will not have a significant effect on EMF.

Noticed Alternative Route

The EMF levels for the Noticed Alternative would be the same as the Preferred Route.

Comparison

Measurements of existing magnetic fields were also taken along the Preferred and Noticed Alternative Routes for context. These measurements were taken on July 12, 2018. Along the Preferred Route, the maximum measured field was 39 mG with an average field measurement of 2.7 mG. Along the Noticed Alternative Route, the maximum measured field was 14 mG with an average field measurement of 1.2 mG. Comparing these figures to the calculated transmission line fields, the fields from the proposed facilities would fall below the existing field strengths within approximately 25 feet of the proposed transmission line.

5.4.8 Noise Impacts

Noise impacts associated with the proposed transmission line are limited to temporary construction noise. As discussed in Section 5.3.1, there are four principal phases of construction for underground cable projects within the streets conducted in sequence at each location.

Several phases of construction will likely be ongoing simultaneously along various sections of the route, such as: manhole placement; roadway cutting; excavation of fill; conduit placement; and backfilling and temporary paving. During later portions of the Project, cable pulling and splicing (electrical) phases may overlap with ongoing civil construction activities.

The potential for noise impacts from Project construction is a function of the specific receptors along the route as well as the equipment used and proposed hours of operation. Construction is anticipated to occur during typical work hours, though in specific instances, at some locations, or at the request of the City, the Company may seek DCR and municipal approval to work at night.

Transmission line construction will generate noise levels that are periodically audible along the Project route, at conductor pulling sites, and at staging areas. The construction equipment to be used will be similar to that used during typical public works projects (e.g., road resurfacing, storm sewer installation, water line installation). In general, the sound levels from construction activity will be dominated by the loudest piece of equipment operating at the time. Therefore, at any given Project location, the loudest piece of equipment will be the most representative of the expected sound levels in the area. Maximum sound levels from typical equipment that will be used during construction of the underground cable are listed in Table 5-8 at a reference distance of 50 feet.[23] These typical sound levels at 50 feet are based on actual field measurements recorded by Eversource

[23] A typical sound level distance of 50-feet from residences, businesses and sensitive receptors is provided herein for discussion purposes as the Company has not yet identified the locations of the proposed duct bank, manholes and splicing locations within the public road alignments. The locations of these activities and structures relative to residences and sensitive receptors will be determined during the detailed design process.

noise consultants at similar projects in October and November 2015. The sound levels provided are the calculated contribution from the construction equipment/activities based on approximations of sound propagation.

Table 5-10: Reference Sound Levels of Construction Equipment at 50 feet

Activity	Type of Equipment	Typical Sound Levels dBA at 50 feet[1, 2]	Familiar Sounds with Similar Noise Levels[3]
Trench Excavation, Pile Install and Pavement Patching	Pavement Saw	57 to 83	Lawn Mower: 90 Snow Blower: 85 Garbage Disposal: 80 Air Conditioner: 60
	Pneumatic Hammer		
	Mounted Impact Hammer (hoe ram)		
	Excavator		
	Dump Truck		
	Pipe Crane		
	Welding Machine/Generator		
	Concrete Batch Truck		
Manhole Installation	Pavement Saw	57 to 83	
	Excavator		
	Manhole Crane		
	Dump Truck		
	Asphalt Paver		
Cable Pulling, Splicing and Testing	Generator	60 to 67	
	Splicing Van		
Final Pavement Restoration	Asphalt Paver	63 to 83	

Notes:

[1] TRC Environmental Corporation ("TRC") conducted noise measurements during the months of October and November 2015 on behalf of the Company during several construction activities associated with underground transmission line installation work. The measurements were primarily taken using a Quest Model 1700 Type II sound level meter equipped with an octave band analyzer and several measurements were taken using a Svantek Model 971 Type I sound level meter. The measurements were hand-recorded in the field.

[2] Numbers rounded up or down to nearest whole decibel.

[3] Thalheimer, E, "Construction Noise Control Program and Mitigation Strategy at the Central Artery/Tunnel Project," Noise Control Eng. Journal 48 (5), 2000 Sep-Oct.2 USEPA, Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances, prepared by Bolt, Baranek and Newman, Report No. NTID300.1, December 31, 1971.

Construction equipment proximity to noise-sensitive land uses will vary along the transmission line routes. Because sound levels from a point source drop off due to geometric divergence (hemispherical spreading) at a rate of 6 dB per doubling of distance, the reference sound levels at 50 feet in Table 5-10 will decrease by 6 decibels ("dBA") for locations 100 feet back from the edge of construction. For example, maximum backhoe sound levels at 100 feet would be expected to be approximately 74 dBA. In a more urbanized area, setbacks may be only 25 feet from construction activity, thus increasing the sound levels from each piece of equipment by 6 dBA. For example, a dump truck at 25 feet would be expected to produce a maximum sound level of 90 dBA. Again, the 84 dBA is the maximum dump truck sound level, while typical levels would be much lower.

Construction equipment is generally not operated continuously, with significant variation in power and usage. Sound levels would fluctuate, depending on the construction activity, equipment type and separation distances between source and receiver. Other factors, such as vegetation, terrain and noise attenuating features, such as buildings, will act to further reduce construction noise levels. Construction activities, including cable installation and testing, are described in detail in Section 5.3.

For perspective, actual field measurements during cable splicing operations, on another Eversource project, were taken on October 30, 2015, as shown in Table 5-10. The sub-surface cable splicing took place beneath an enclosed structure formed by a specialized vehicle placed over the cable splicing location. The primary source of noise during this work was the generator providing power for the operations. The generator was a WhisperWatt 70 kVA diesel-powered AC generator, designed with sound dampening on the diesel exhaust. Sound levels from this operation ranged from 60 to 67 dBA at 50 feet.

Noise impacts are regulated by the City of Boston noise ordinances and Boston APCC, as well as MassDEP. Under the local regulations the max dBA allowed, as measured 50' from the source, is 86 dBA. As noted above, the typical sound levels for transmission construction at 50 feet from the source is 83 dBA. Also, construction noise is limited to 50 dBA at residential property lines between the hours of 6:00 PM and 7:00 AM, unless an off-hours permit is obtained from the Commission of Inspectional Services Department. Should off-hours construction be required, the Company will seek an Off-Hours Permit. Daytime and nighttime noise impacts from the proposed Project and anticipated equipment installations are predicted to fully comply with the applicable City of Boston noise ordinances, Boston APCC regulations and MassDEP noise policy when compared to measured background sound levels at the closest sensitive receptor locations.

Preferred Route

Sensitive receptors along the Preferred Route include park/recreation facilities, a school and a place of worship. In general, the area along the Preferred Route has a greater number and higher density of residences and sensitive receptors than the Noticed Alternative Route and therefore there are greater considerations regarding potential impacts from noise. Daytime and nighttime noise impacts from the proposed Project and anticipated equipment installations are predicted to fully comply with the applicable City of Boston noise ordinances, Boston APCC regulations and MassDEP noise policy when compared to measured background sound levels at the closest sensitive receptor locations. Should off-hours construction be required, the Company will seek an Off-Hours Permit. However, as the Company anticipates coordination with the redevelopment of the Mary Ellen McCormack Housing Development, construction impacts in the vicinity of this high-density residential area will be minimized.

Noticed Alternative Route

The Noticed Alternative Route generally has a lower density of residential uses and more industrial/commercial uses than the Preferred Route. As with the Preferred Route, noise impacts are predicted to fully comply with the applicable City of Boston noise ordinances, Boston APCC regulations and MassDEP noise policy when compared to measured background sound levels at the closest sensitive receptor locations. Should off-hours construction be required, the Company will seek an Off-Hours Permit. However, the degree of construction-related noise generated by the Project is anticipated to be similar for both the Noticed Alternative Route and the Preferred Route, and potential impacts from noise are anticipated to be temporary in nature.

Comparison

The level of construction-related noise associated with underground line construction would be similar along most of the Preferred Route and the Noticed Alternative Route. Moreover, because the Preferred Route will be performed in coordination with other construction projects, including the Mary Ellen McCormack Housing Community and the Morrissey Boulevard redevelopment projects, the Company determined that the Preferred Route is superior to the Noticed Alternative Route from a construction noise perspective because it will be incrementally less impactful and because the Preferred Route is adjacent to more commercial, industrial and institutional land uses, while the Noticed Alternative is located adjacent to more dense residential neighborhoods.

Impact Mitigation

Noise from cable splicing operations would be minimized through use of specialized low-sound equipment such as low-noise generators, and by reducing or eliminating the use of motorized equipment during evening and overnight work. Other potential mitigation measures include use of a low-noise/muffled generator, portable sound walls (temporary noise barriers) as needed, blocking the path of generators, and working with the City to coordinate work.

As the Company anticipates coordination with the redevelopment of the Mary Ellen McCormack Housing Community, construction impacts in the vicinity of this high-density residential area will be minimized.

5.4.9 Cultural Resources

The Company undertook a cultural resource investigation to identify historic and archaeological resources adjacent to the underground segments of the Preferred Route and the Noticed Alternative Route. To be considered significant and eligible for listing on the State or National Registers of Historic Places, a cultural resource must exhibit physical integrity and contribute to American history, architecture, archaeology, technology, or culture.

The Project is subject to review by the MHC in compliance with M.G.L. c. 9, §§ 26-27C as amended by Chapter 254 of the Acts of 1988 (950 C.M.R. 71.00).

Per Commonwealth Heritage Group, Inc.'s consultation of MACRIS, the Preferred Route and the Noticed Alternative Route each intersect the boundary of one or more Inventory Areas and Inventory Points listed as historic or eligible for the State and National Registers of Historic Places and are included in the Inventory of Historic and Archaeological Assets of the Commonwealth. Inventory Areas include areas designated as Inventoried Areas, Local Historic Districts, National Register Listed Districts, and Historic Districts that are both Local and National Register Listed. Inventory Points includes locations designated as Demolished, Inventoried Properties, Local Historic District properties or features, National Register listed properties or features, and properties or features listed in both Local Historic Districts and the National Register. National Register properties are also listed in the State Register.

Table 5-11: Historical and Cultural Resources Near the Preferred Route and Noticed Alternative Route

Historical and Archaeological Resources	Preferred Route	Noticed Alternative Route
Inventory Points adjacent to the route	56	23
Inventory Areas intersected by the route	5*	7
Archaeological Sites within 0.25 miles of the route	1	2
Archaeological Sites intersected by the route	0	0

* Two inventory areas intersected by the Preferred Route are listed in the National Register of Historic Places (Savin Hill Historic District and Old Harbor Reservation Parkways)

Preferred Route

There are 56 historic sites and 5 historic areas long the Preferred Route inventoried within MHC's MACRIS database. Two of the inventory areas intersected by the Noticed Alternative Route (Old Harbor Reservation Parkways and Savin Hill Historic District) are included in the National Register of Historic Places.

Noticed Alternative Route

There are 23 historic sites and 7 historic areas along the Noticed Alternative Route inventoried within MHC's MACRIS database. None of the inventory areas intersected by the Preferred Route is included in the National Register of Historic Places.

Comparison

While the Preferred Route traverses near more inventoried sites, it intersects fewer inventoried historic areas than the Noticed Alternative Route. Two of the historic areas intersected by the Preferred Route are listed in the National Register of Historic Places. However, as the Project involves the underground installation of transmission line within the existing paved limits of roadways, neither route is anticipated to result in impacts to historic areas or points.

Impact Mitigation

As the routes both intersect historic areas inventoried by the MHC and will result in changes to the road surfacing post-underground cable installation, MHC will need to be consulted regarding a determination of the effect. Potential effects, if any, to historic and archaeological resources will be addressed with the MHC through Section 106 of the National Historic Preservation Act and the State Register Review processes.

5.4.10 Land Use, Environmental and Cultural Resources Impacts Analysis Conclusion

Table 5-12 provides a comparison of the route alternatives based on the evaluation of land use, environmental and cultural resources criteria. The Preferred Route and Noticed Alternative Route were determined to be comparable on a number of criteria. The Preferred Route is adjacent to fewer residential properties than the Noticed Alternative

Route. Due to these attributes of the Preferred Route, and the ability to coordinate with other projects along the Preferred Route, the Preferred Route is superior with regard to the Land Use, Potential for Traffic Congestion, and Noise criteria. The Preferred Route is also superior with respect to Public Shade Trees. The Noticed Alternative is superior with regard to the Wetlands and Water Resources criteria. Both routes are comparable with regard to the Cultural Resources, Potential for Subsurface Contamination, Visual, and EMF criteria. The impacts associated with Wetlands and Water Resources along the Preferred Route will be mitigated by limiting work within previously disturbed areas and through the coordination with other proposed construction projects, to the extent practicable, along the route. Therefore, based on this impact assessment, the Preferred Route is superior to the Noticed Alternative.

Table 5-12: Land Use, Environmental and Cultural Resources Impact Comparison of the Preferred Route and Noticed Alternative Route

Evaluation Criteria	Preferred Route	Noticed Alternative Route
Land Use	+	-
Cultural Resources	=	=
Potential for Traffic Congestion	+	-
Public Shade Trees	+	-
Wetlands and Water Resources	-	+
Potential for Subsurface Contamination	=	=
Visual	=	=
EMF	=	=
Noise	+	-
Notes: + Indicates less potential for impact, which means superior for use - Indicates more potential for impact, which means inferior for use = Indicates comparable impacts		

5.5 Cost Comparison

As discussed in Section 4 of the Analysis, the cost estimate is approximately $68.3M (-25%/+25% accuracy) for the Preferred Route and $69.6M (-25%/+50% accuracy) for the Noticed Alternative Route. Even though the Noticed Alternative is a shorter length, the cost estimate is greater due to engineering and construction-related challenges along this route, including proximity to existing transmission facilities and density of underground utilities. Based on the current cost estimates, the Preferred Route is preferable to the Noticed Alternative Route.

5.6 Reliability Comparison

The Preferred Route and Noticed Alternative Route are each reliable means for providing a 115-kV line connection between Andrew Square Substation and Dewar Street Substation.

The Noticed Alternative Sydney Street Route presents a potential single point of failure for three underground transmission lines because the New Line would be installed on significant portions of the same street containing the two existing K Street – Dewar Street

115-kV lines. Future physical road construction, including saw cutting the road or the installation of other gas/sewer/water facilities on this street, could compromise and breach the integrity of the electric transmission infrastructure, resulting in the simultaneous outage of all three 115-kV underground transmission lines supplying the Dewar Street Substation. The outage of these three underground transmission lines would result in a prolonged loss of supply to the Dewar Street Substation. Therefore, it is preferable to route the New Line in a different street than where the existing K Street-Dewar Street 115-kV lines are located. Although not always feasible, routing a new line in a location where there are not existing electric transmission lines provides a substantial improvement in the reliability of transmission supply to substations.

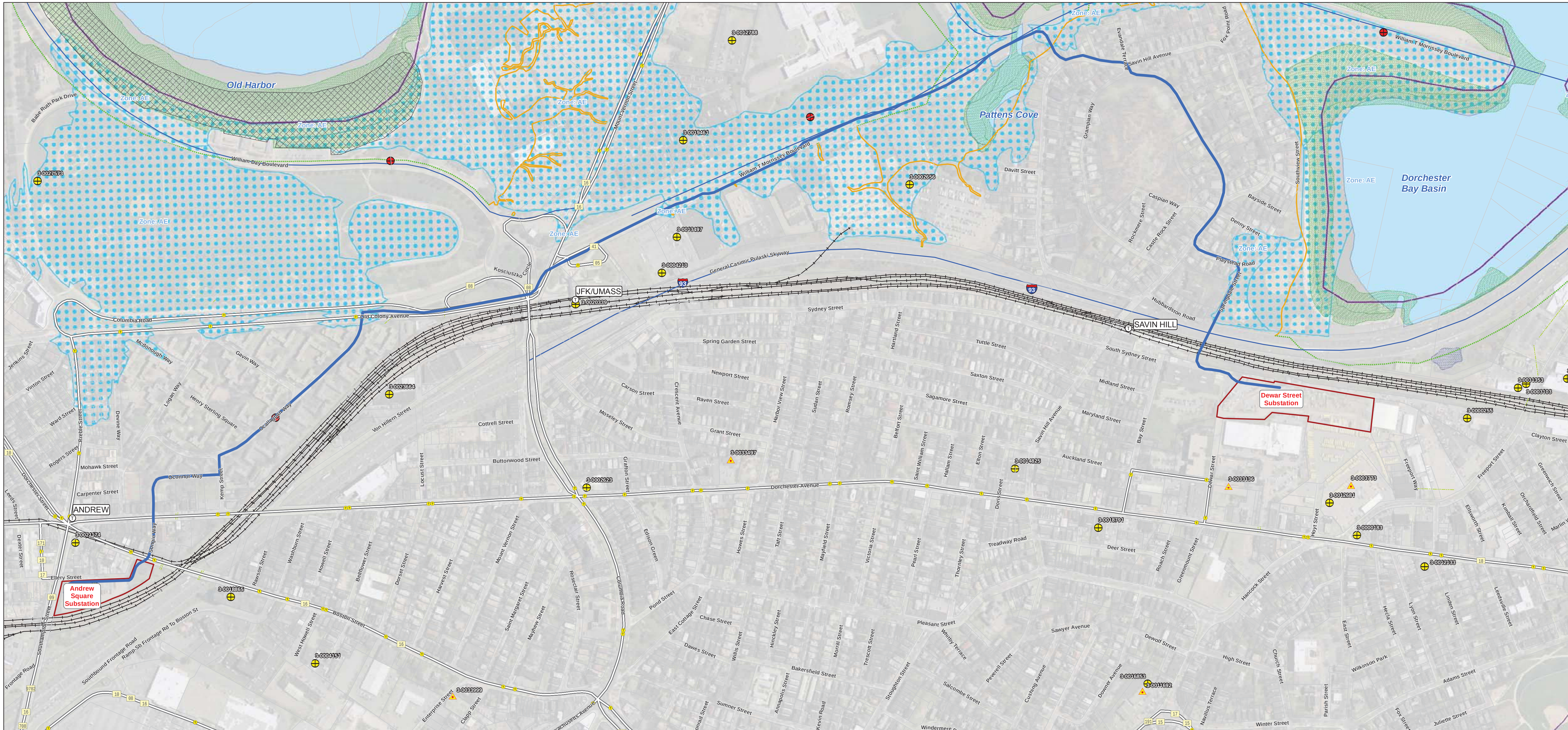
In conclusion, because the Preferred Route provides the opportunity to locate the New Line is a different location from existing in-street transmission lines, it is superior to the Noticed Alternative from a reliability perspective.

5.7 Overall Comparison of Preferred Route and Noticed Alternative Route

All work proposed at the Andrew Square and Dewar Street Substations is the same and creates the same minimal impacts for both the Preferred Route and the Noticed Alternative Route. Therefore, this was not a factor in the Company's route selection. The Preferred Route and the Noticed Alternative Route have similar and relatively minimal environmental effects, and the majority of those effects will be temporary and can be minimized using mitigation measures.

The Preferred Route was determined to be superior to the Noticed Alternative Route on the basis of cost, environmental impacts and reliability. In addition, the Preferred Route is superior based on the potential to coordinate with DCR on the reconstruction of Morrissey Boulevard and Winn Development on the Mary Ellen McCormack Housing Community construction, the known ability to pipe jack under I-93 and the MBTA tracks near the Dewar Street Station and less potential for interference with future infrastructure within the roadways.

The Company will work closely with the City and area neighborhoods to ensure that temporary construction impacts are minimized and that the New Line is installed in the least impactful way possible.



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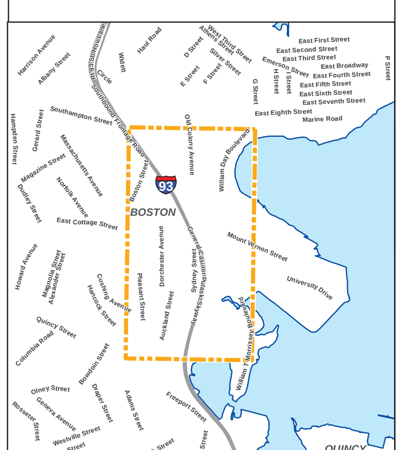

Legend

- T Stations
- Morrissey Boulevard
- Substation
- MBTA Bus Stops
- MBTA Bus Routes
- NHESP Certified Vernal Pools
- NHESP Potential Vernal Pools
- Community Public Water Supply - Surface Water
- Community Public Water Supply - Groundwater
- Non-Community Non-Transient Public Water Supply
- Non-Community Transient Public Water Supply

Chapter 91 Data

- Public Way
- Marsh Boundary - landward
- Landlocked Tidelands
- Jurisdiction
- Marsh Boundary - seaward
- Contemporary High Water
- Inferred Contemporary High Water
- Inferred Historic High Water
- Aquaducts
- Powerline
- Pipeline
- Track or Trail
- Trains
- Public Surface Water Supply Protection Area (Zone A)
- DEP Approved Wellhead Protection Area (Zone I)
- DEP Approved Wellhead Protection Area (Zone II)
- DEP Interim Wellhead Protection Area (IWPA)
- 100 Year Flood Zone
- Solid Waste Landfill
- Area of Critical Environmental Concern (ACEC)
- NHESP Priority Habitats for Rare Species
- NHESP Estimated Habitats for Rare Wildlife
- EPA Designated Sole Source Aquifer
- Major Drainage Basin
- Sub Drainage Basin
- Hydrologic Connections
- MassDEP Inland Wetlands
- MassDEP Coastal Wetlands
- MassDEP Not Interpreted Wetlands
- Public Surface Water Supply (PSWS)
- Water Bodies
- Stream/Intermittent Stream
- Non-Potential Drinking Water Source Area - High Yield
- Non-Potential Drinking Water Source Area - Medium Yield
- Potentially Productive Medium Yield Aquifer
- Potentially Productive High Yield Aquifer
- MassDEP Oil and/or Hazardus Material Sites (Chapter 21E)
- MassDEP Oil and/or Hazardous Material Sites with AUL
- URAM Site

Map Notes:
Basemap: 2014 Orthophotographs, MassGIS
Data source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs.

Parcels downloaded from Boston Open Data Portal: 2016

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Figure 5-1

Preferred Route Environmental Resources

Andrew Square to Dewar Street Reliability Project

Boston, Massachusetts

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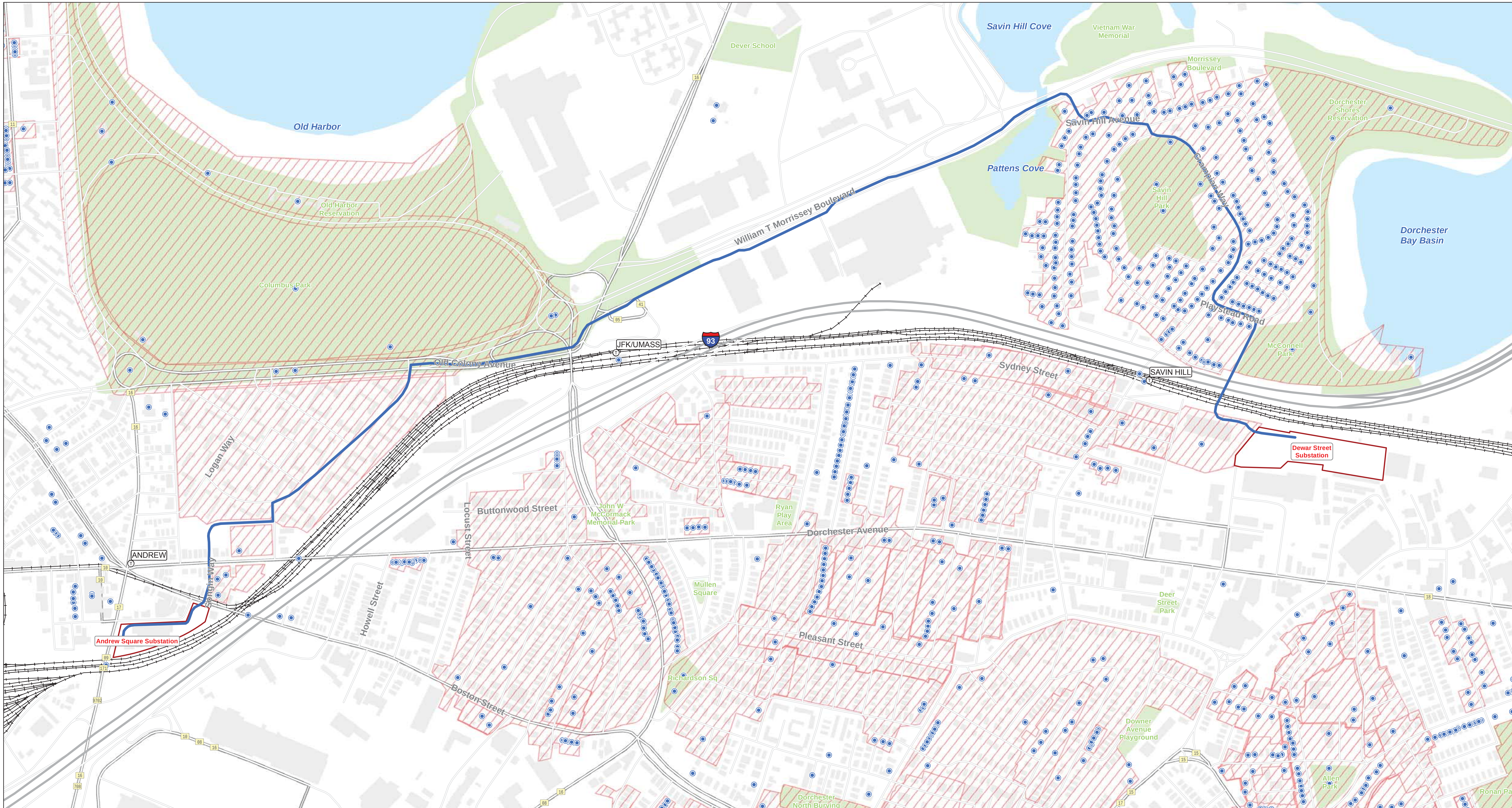

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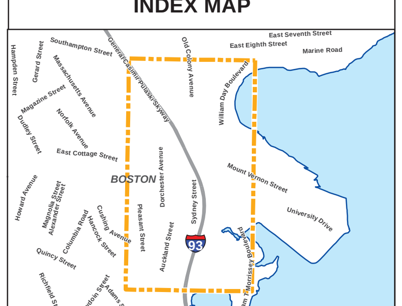

Legend

- Stations
- Morrissey Boulevard
- MBTA Bus Routes
- MBTA Track
- Substation
- MHC Historic Site
- MHC Historic Area

Map Notes:
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Figure 5-2

Preferred Route Cultural Resources

Andrew Square to Dewar Street Reliability Project

Boston, Massachusetts

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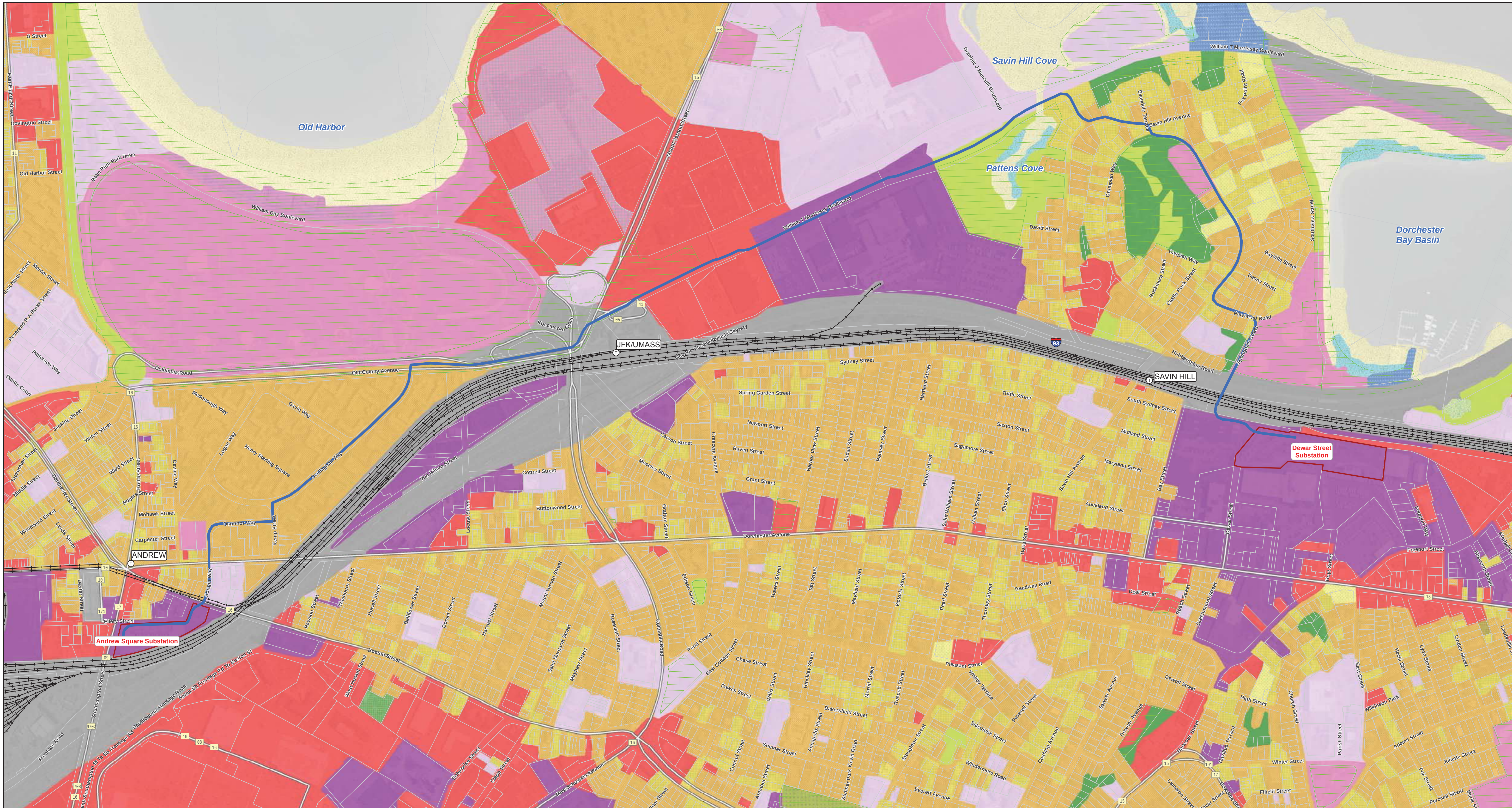

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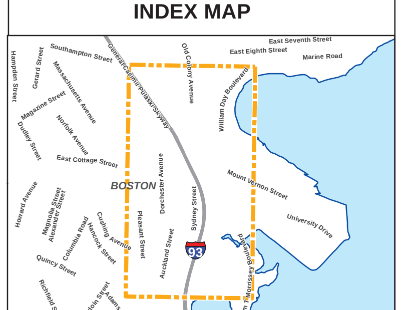

Legend

- Stations
- MBTA Track
- Morrissey Boulevard
- MBTA Bus Routes
- Protected and Recreational Open Space
- Substation
- Parcel Boundary
- Forest
- Open Land
- Non-Forested Wetland
- Salt Water Wetland
- Saltwater Sandy Beach
- Nursery
- Cemetery
- Participation Recreation
- Spectator Recreation
- Water-Based Recreation
- Marina
- Multi-Family Residential
- High Density Residential
- Medium Density Residential
- Urban Public/Institutional
- Commercial
- Industrial
- Transportation
- Junkyard

Map Notes:
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Figure 5-3

Preferred Route Adjacent Land Uses

Andrew Square to Dewar Street Reliability Project

Boston, Massachusetts

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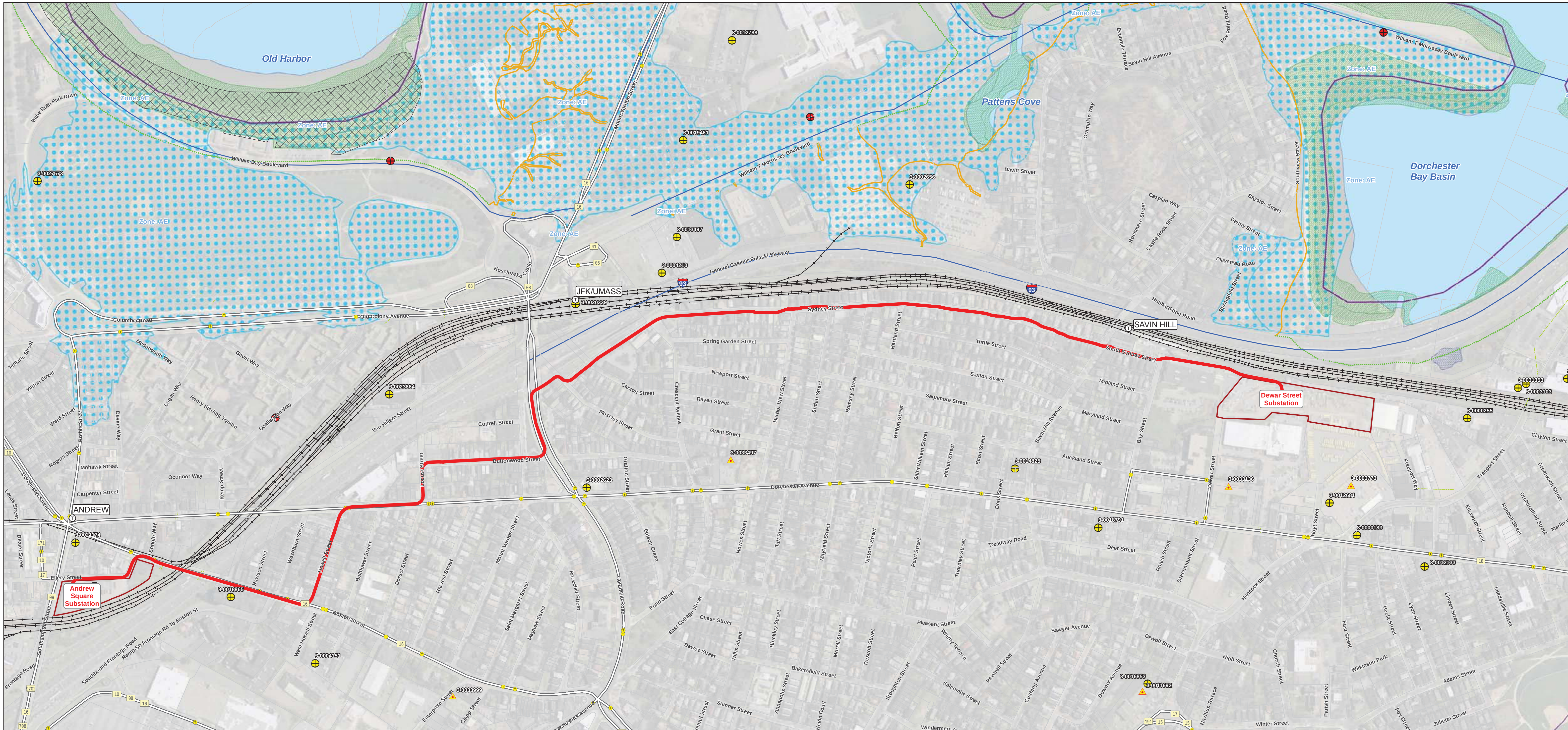

INDEX MAP

Legend

- T Stations
- Sydney Street
- Substation
- MBTA Bus Stops
- MBTA Bus Routes
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- NHESP Potential Vernal Pools
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- Non-Community Non-Transient Public Water Supply
- Non-Community Transient Public Water Supply

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Data source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs.

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0 150 300 600
Feet

Figure 5-4

Alternative Route Environmental Resources

Andrew Square to Dewar Street Reliability Project

Boston, Massachusetts

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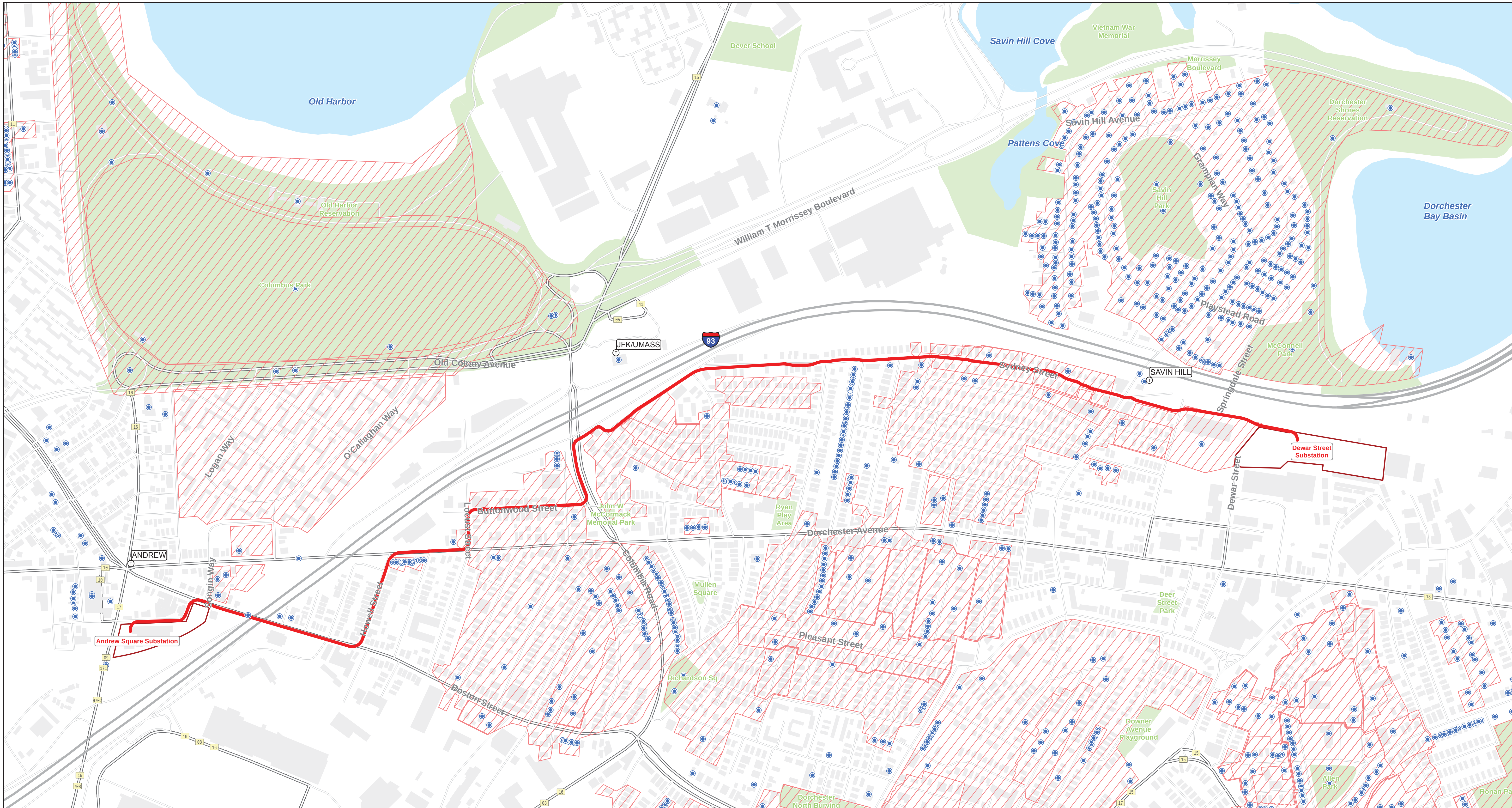

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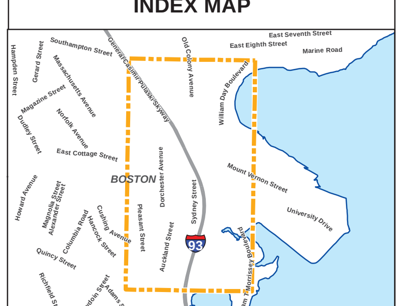

Legend

- Stations
- Sydney Street
- MBTA Bus Routes
- Substation
- MHC Historic Site
- MHC Historic Area

Map Notes:
Data source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs.

Parcels downloaded from Boston Open Data Portal: 2016

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Figure 5-5

Alternative Route Cultural Resources

Andrew Square to Dewar Street Reliability Project

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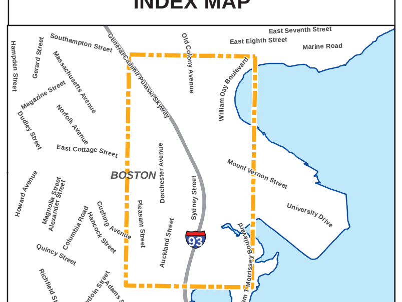

Legend

- Stations
- Sydney Street
- MBTA Bus Routes
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- Substation
- Parcel Boundary
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- Open Land
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- Saltwater Sandy Beach
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- Cemetery
- Participation Recreation
- Spectator Recreation
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- High Density Residential
- Medium Density Residential
- Urban Public/Institutional
- Commercial
- Industrial
- Transportation
- Junkyard

Map Notes:
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Figure 5-6

Alternative Route Adjacent Land Uses

Andrew Square to Dewar Street Reliability Project

Boston, Massachusetts

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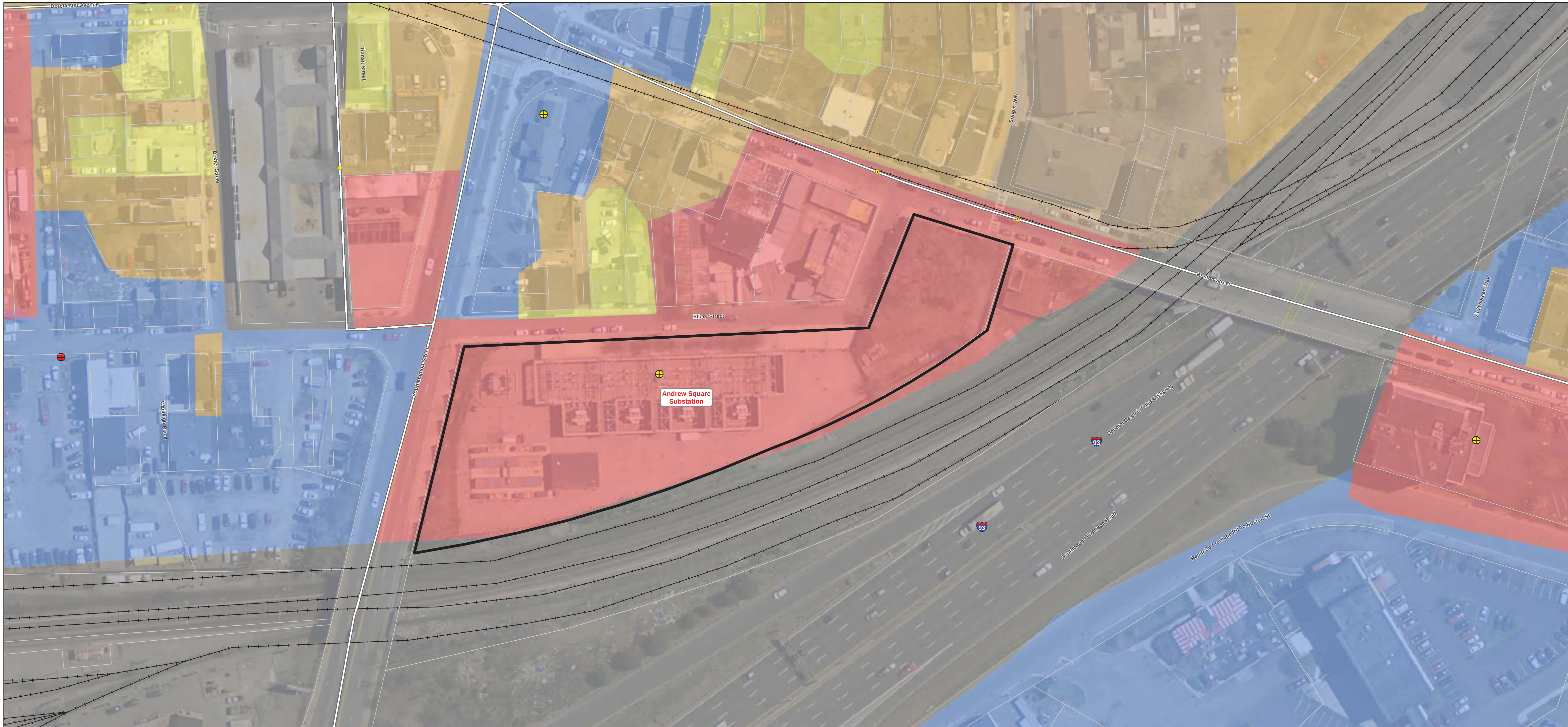
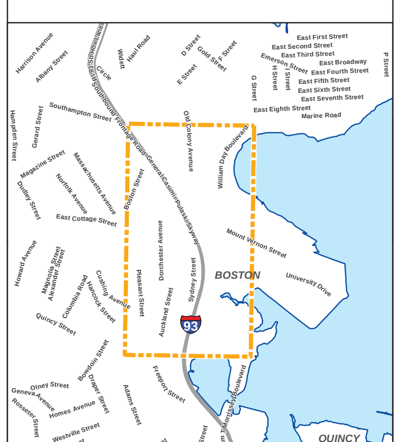


INDEX MAP



Legend

- T Stations
- Substation
- MBTA Bus Stops
- MBTA Bus Routes
- NHESP Certified Vernal Pools
- NHESP Potential Vernal Pools
- Community Public Water Supply - Surface Water
- Community Public Water Supply - Groundwater
- Non-Community Non-Transient Public Water Supply
- Non-Community Transient Public Water Supply

Chapter 91 Data

- Public Way
- Marsh Boundary - landward
- Landlocked Tidelands
- Jurisdiction
- Marsh Boundary - seaward
- Contemporary High Water
- Inferrred Contemporary High Water
- Inferred Historic High Water

- Aquaducts
- Powerline
- Pipeline
- Track or Trail
- Trains
- Public Surface Water Supply Protection Area (Zone A)
- DEP Approved Wellhead Protection Area (Zone I)
- DEP Approved Wellhead Protection Area (Zone II)
- DEP Interim Wellhead Protection Area (IWPA)
- Protected and Recreational Open Space
- 100 Year Flood Zone
- Solid Waste Landfill
- Area of Critical Environmental Concern (ACEC)
- NHESP Priority Habitats for Rare Species
- NHESP Estimated Habitats for Rare Wildlife
- EPA Designated Sole Source Aquifer
- Major Drainage Basin
- Sub Drainage Basin
- Hydrologic Connections
- MassDEP Inland Wetlands

- MassDEP Coastal Wetlands
- MassDEP Not Interpreted Wetlands
- Public Surface Water Supply (PSWS)
- Water Bodies
- Stream/Intermittent Stream
- Non-Potential Drinking Water Source Area - High Yield
- Non-Potential Drinking Water Source Area - Medium Yield
- Potentially Productive Medium Yield Aquifer
- Potentially Productive High Yield Aquifer
- MassDEP Oil and/or Hazardus Material Sites (Chapter 21E)
- MassDEP Oil and/or Hazardous Material Sites with AUL
- URAM Site

Land Use

- Multi-Family Residential
- High Density Residential
- Commercial
- Industrial
- Transportation
- Urban Public/Institutional

Map Notes:
Basemap: 2014 Orthophotographs, MassGIS
Data source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs.

Parcels downloaded from Boston Open Data Portal: 2016

The information/data provided in this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation or parcel level analysis. The maps should not be used for construction purposes.

0 37.5 75 150 Feet

N E S W

Figure 5-7

Existing Andrew Square Substation and Environmental Resources & Land Uses

Andrew Square to Dewar Street Reliability Project

Boston, Massachusetts

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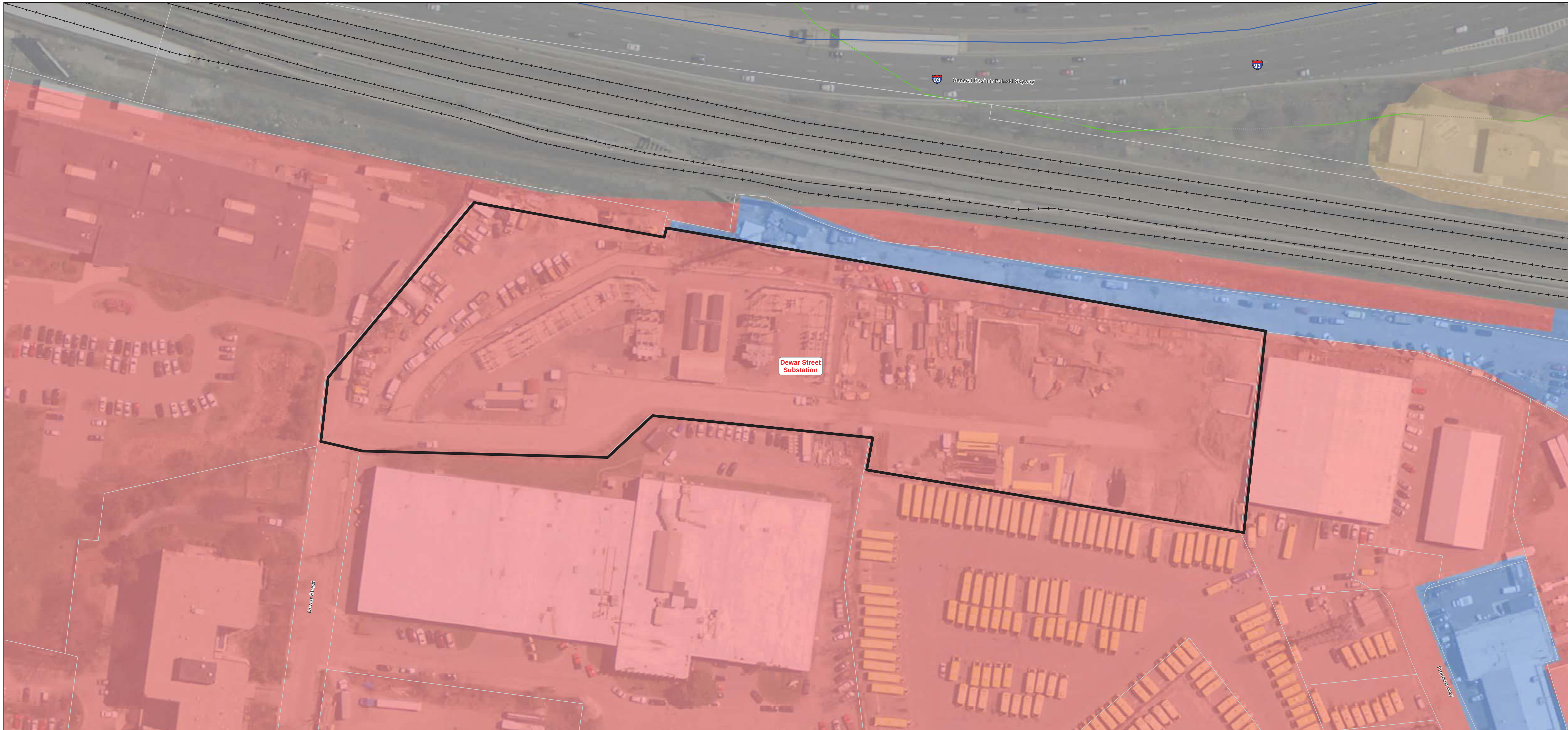
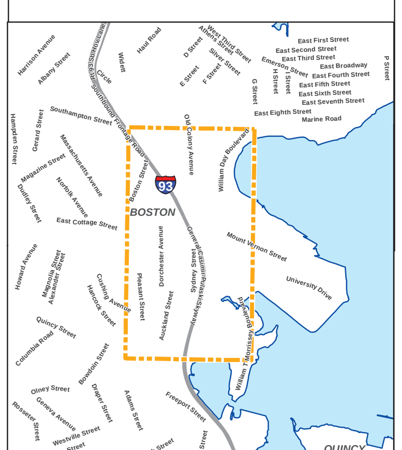


INDEX MAP



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Map Notes:
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Data source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs.

Parcels downloaded from Boston Open Data Portal: 2016

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0 37.5 75 150 Feet

Figure 5-8

Existing Dewar Street Substation and Environmental Resources & Land Uses

Andrew Square to Dewar Street Reliability Project

Boston, Massachusetts

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6.0 CONSISTENCY WITH THE CURRENT HEALTH, ENVIRONMENTAL PROTECTION, AND RESOURCE USE AND DEVELOPMENT POLICIES OF THE COMMONWEALTH

6.1 Introduction

G.L. c. 164, § 69J states, inter alia, that the Siting Board shall approve a petition to construct a facility if it determines that "plans for expansion and construction of the applicant's new facilities are consistent with current health, environmental protection and resource use and development policies as adopted by the commonwealth." As discussed below and in more detail throughout the Analysis, the Project not only satisfies the requirements of this statute, but is also fully consistent with other important state energy policies as articulated in the Electric Utility Restructuring Act of 1997 ("Restructuring Act"), the Green Communities Act (c. 169 of the Acts of 2008), the Global Warming Solutions Act ("GWSA") (c. 298 of the Acts of 2008); and the Energy Diversity Act (c. 188 of the Acts of 2016); and the Energy Diversity Act (c. 188 of the Acts of 2016).

6.2 Health Policies

The Restructuring Act provides that reliable electric service is of "utmost importance to the safety, health and welfare of the Commonwealth's citizens and economy…" (see Restructuring Act, § 1(h)). The Legislature has expressly determined that an adequate and reliable supply of energy is critical to the state's citizens and economy. The Project will be fully consistent with this policy. The Project will enhance the reliability of the electric transmission system in the Dorchester, South Boston and Roxbury neighborhoods of Boston, enabling the Company to continue to ensure the availability of sufficient and reliable electric service to the citizens and businesses of the Commonwealth and the region.

The Company will design, build and maintain the facilities for the Project so that the health and safety of the public are protected. This will be accomplished through adherence to all applicable federal, state and local regulations, and industry standards and guidelines established for protection of the public. As discussed in Section 5, all design, construction and operation activities will be in accordance with applicable governmental and industry standards such as the National Electrical Safety Code and OSHA regulations, and will have no adverse health effects. In addition, because the Project will be consistent with, and promote, the Commonwealth's energy policies as outlined in the Restructuring Act, it will also be consistent with its health policies. The facilities will be designed in accordance with sound engineering practices using established design codes and guides published by, among others, the Department, the Institute of Electrical and Electronic Engineers, the American Society of Civil Engineers, the American Concrete Institute and the American National Standards Institute. Following construction of the facilities, all transmission structures and substation facilities will be clearly marked with warning signs to alert the public to potential hazards.

6.3 Environmental Protection Policies

The Project is consistent with the Commonwealth's environmental protection policies as set forth in Chapter 164 of the General Laws and in other state and local environmental policies as described below.

6.3.1 The Restructuring Act

The Restructuring Act provides that the Company must demonstrate that the Project minimizes environmental impacts consistent with the minimization of costs associated with mitigation, control, and reduction of the environmental impacts of the Project. Accordingly, an assessment of all impacts of a proposed facility is necessary to determine whether an appropriate balance is achieved both among conflicting environmental concerns as well as among environmental impacts, cost and reliability.

A facility that achieves the appropriate balance thereby meets the Chapter 164 requirement to minimize environmental impacts at the lowest possible cost. To determine if a petitioner has achieved the proper balance among environmental impacts, cost and reliability, the Siting Board first determines if the petitioner has provided sufficient information regarding environmental impacts and potential mitigation measures in order to make such a determination. The Siting Board then determines whether environmental impacts are minimized. Similarly, the Siting Board evaluates whether the petitioner has provided sufficient cost information in order to determine if the appropriate balance among environmental impacts, cost and reliability has been achieved.

In Sections 3, 4 and 5 of this Analysis, Eversource demonstrated that it compared a range of alternative projects and proposed specific plans to mitigate environmental impacts associated with the construction, operation and maintenance of the proposed transmission line, consistent with cost minimization. As such, the Project is consistent with the environmental policies of the Commonwealth as set forth in Chapter 164 of the General Laws.

6.3.2 State and Local Environmental Policies

The Company will obtain all environmental approvals and permits required by Federal, state and local agencies and the Project will be constructed and operated to fully comply with Massachusetts' state and local environmental policies. Thus, the Project will contribute to a reliable, low cost and diverse energy supply for the Commonwealth with minimal environmental impact. Table 6-1 below, identifies the anticipated permits, reviews and approvals required for the Project (in addition to the Siting Board's review). By meeting the requirements for acquiring each of these programs and permits, the Project will be in compliance with applicable state and local environmental policies.

In addition, the Project is also consistent with the Commonwealth's Environmental Justice ("EJ") Policy. EJ is the equal protection and meaningful involvement of all people and communities with respect to the development, implementation, and enforcement of energy, climate change, and environmental laws, regulations, and policies and the equitable distribution of energy and environmental benefits and burdens. The EJ Policy was initially promulgated in 2002 by the predecessor to the Executive Office of Energy and Environmental Affairs ("EOEEA"); was in 2014 subsequently updated through Executive Order #552; and most recently, on January 31, 2017, was further updated by the Secretary of EOEEA. The current EJ Policy is imposed on state agencies under the EOEEA, including the Siting Board and the Department, rather than on project applicants *per se*. In turn, project applicants must comply with relevant directives and requirements established by these state agencies. The Project traverses EJ neighborhoods as defined in the EJ Policy. The Company has undertaken, and will continue to undertake, an extensive community outreach effort which may include, at the direction of the EFSB, translators and translation of key documents to facilitate the meaningful opportunity to participate by all. The Company's environmental analysis in this proceeding is designed to minimize the Project's impacts to all populations, including EJ populations. As such, the Project is consistent with the Commonwealth's environmental policies.

6.3.3 The Green Communities Act

On July 2, 2008, then-Massachusetts Governor Deval Patrick signed into law the Green Communities Act. The Green Communities Act is a comprehensive, multi-faceted energy reform bill that encourages energy and building efficiency, promotes renewable energy, creates green communities, implements elements of the Regional Greenhouse Gas Initiative, and provides market incentives and funding for various types of energy generation. The Green Communities Act (as amended and supplemented by St. 2012, c.209, An Act Relative to Competitively Priced Electricity), can be expected to result in greater renewable supplies and substantial new conservation initiatives in future years. The Project's improvements to the transmission system will strengthen and support the load requirements in the Dorchester, South Boston and Roxbury neighborhoods of the City of Boston, as well as ensure the reliability of transmission service to this area under an N-1-1 contingency. The more robust system also will enable a more efficient and flexible operation of the grid consistent with the Green Communities Act.

6.3.4 The Global Warming Solutions Act

On August 7, 2008, then-Massachusetts Governor Patrick signed into law the GWSA, which established aggressive GHG emissions reduction targets of 25% from 1990 levels by 2020 and 80% from 1990 levels by 2050. Pursuant to the GWSA, the Secretary of the EOEEA issued the Clean Energy & Climate Plan for 2020 in December of 2010 and updated the plan in December 2015. Among other provisions, the GWSA obligates administrative agencies such as the Siting Board, in considering and issuing permits, to consider reasonably foreseeable climate change impacts (e.g., additional GHG emissions) and related effects (e.g., sea level rise). The proposed improvements to the transmission system in the Project Area will have no adverse climate change impacts or negative effects on sea levels. In addition, the Project improves reliability and lessens the probability that inefficient emergency generation would be required to maintain electric supply to the area. Consequently, the Project is consistent with the GWSA.

6.3.5 Energy Diversity Act

On August 8, 2016, Governor Charles Baker signed into law An Act to Promote Energy Diversity (the "Energy Diversity Act"). St. 2016, c. 188. The Energy Diversity Act is a multi-faceted energy bill that, among other things, facilitates the procurement and integration of renewable energy generation resources, including new offshore wind energy generation, firm service hydroelectric generation and new Class I RPS eligible resources. St. 2016, c. 188, § 1. The Project will improve reliability in the Project Area and create a more robust transmission system that is better able to accommodate various energy resources that may come online in the future as a result of the Energy Diversity Act. Accordingly, the Project is consistent with the Energy Diversity Act.

6.3.6 Clean Energy Act

On August 9, 2018, Governor Charles Baker signed into law An Act to Advance Clean Energy (the "Clean Energy Act"). St. 2018, c. 227. The Clean Energy Act, among other provisions, amends the Energy Diversity Act to further encourage energy storage efforts. St. 2018, c. 227, § 20. The Clean Energy Act also requires the Department of Energy Resources to investigate the potential for additional clean energy solicitations. St. 2018, c. 227, § 21. As noted above, the Project will improve the reliability of the Company's transmission system in the Project Area, which will, in turn, enhance the Company's ability to accommodate new energy storage units as well as future renewable energy generating resources such as solar in line with the Clean Energy Act. Accordingly, the Project is consistent with the Clean Energy Act.

6.4 Resource Use and Development Policies

The Project, which will contribute to the long-term reliability of the electric transmission system in the Project Area and will be constructed and operated in compliance with Massachusetts' policies regarding resource use and development. For example, in 2007, the EOEEA's Smart Growth/Smart Energy policy established the Commonwealth's Sustainable Development Principles, including: (1) supporting the revitalization of city centers and neighborhoods by promoting development that is compact, conserves land, protects historic resources and integrates uses; (2) encouraging remediation and reuse of existing sites, structures and infrastructure rather than new construction in undeveloped areas; and (3) protecting environmentally sensitive lands, natural resources, critical habitats, wetlands and water resources and cultural and historic landscapes. As described more fully in Section 5, the Project will support these principles because, among other reasons, the Project will be located primarily within existing roadways and will allow the Company, City of Boston, the DCR and Winn Development Company to coordinate the Project's construction, the reconstruction of Morrissey Boulevard, and the Mary Ellen McCormack housing development, and have less potential for interference with existing and future infrastructure within the roadways; thus, the Company has minimized the number of properties that will be substantially affected by the siting, construction or installation of the Project. The Company has committed to a broad range of measures to mitigate the temporary and permanent impacts of the Projects, and with the implementation of those measures, the impacts of the Project will be minimized consistent with considerations of cost. The Project, therefore, is in compliance with, and furthers, the Commonwealth's policies regarding resource use and development.

Table 6-1: Anticipated Permits, Reviews and Approvals

Regulatory Agency	Program/Permit	Status
Federal		
USEPA	Stormwater Construction General Permit (NPDES)	Planned
USACE	Section 10 of the Rivers and Harbors Act	Planned
State		
MassDOT	State Highway Access Permit	Planned
Siting Board	Approval to Construct	Planned
DCR	Construction/Access Permit	Planned
MBTA	Construction Access Permit/License	Planned
MassDEP	Chapter 91 Minor Modification	Planned
MHC	Project Notification Form	Planned
Local		
City of Boston Conservation Commission	Wetlands Protection Act – Order of Conditions	Planned
City of Boston PIC	Construction/Access Permit	Planned
City of Boston Department of Public Works	Street Opening Permits	Planned

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Appendix 2-1

Consequential Load Loss Guideline, SYS PLAN-015

Consequential Load Loss Guideline

SYS PLAN 015 Rev. 0

Approval Signature: George P. Wegh

Process Owner:	George P. Wegh Director, System Planning	Effective Date: April 1, 2018

TABLE OF CONTENTS

I. EXECUTIVE SUMMARY

These Eversource transmission system Consequential Load Loss (CLL) guidelines describe how to conduct transmission system planning assessments of CLL and develop solutions for the Eversource transmission system. These guidelines also describe how Eversource coordinates with the Independent System Operator - New England (ISO-NE) in the development of near term and long term transmission system plans through the regional New England planning process.

These guidelines were developed with the goal of striking a balance between reliability and cost. These considerations allow Eversource to identify and prioritize system violations that have the greatest benefit to improving reliability of service to customers.

Special consideration is given to load served by substations that are supplied by two underground cables within the Eversource system. These stations serve a significant number of customers in densely populated urban areas that could be exposed to outage conditions that may extend as long as one month or more in duration. Whenever practical, factors such as load transfer capability within the distribution network, event impact, cost, and feasibility will be considered while evaluating measures to reduce or eliminate CLL within the Eversource system based on the thresholds defined below.

The recommended Guideline thresholds for Consequential Loss of Load for Eversource are as follows:

- Single event CLL resulting from a loss of a radial, single element should be no greater than 0 MW,
- Single event CLL, resulting from a stuck circuit breaker should be no greater than 100 MW,
- Single event CLL, resulting from a double circuit tower fault should be no greater than 200 MW,
- Multiple events CLL, resulting from the loss of two elements should be no greater than 200 MW,
- Multiple events CLL, resulting from two events causing the loss of three or more elements should be no greater than 300 MW, and
- CLL resulting from the loss of two underground cables serving a substation or a group of substations should be no greater than 50 MW.

II. SCOPE AND APPLICABILITY

These Eversource transmission system CLL guidelines define the minimum design criteria to assure the reliability of the Eversource transmission system through coordination of system planning and design. This guideline applies to the Eversource transmission system when performing assessments of Eversource transmission system facilities. It is acceptable under these reliability standards to enhance and expand the design of the Eversource transmission system if a higher level of system reliability is desirable for a local area.

III. PROCEDURE

The Eversource transmission system shall be designed with sufficient transmission capacity to serve area loads for design contingency events. The contingency events shall be applied to transmission elements and generating resources to examine the potential for the inability to meet the performance criteria as defined in this guideline on the Eversource transmission system. Conditions that are assessed for the design of the transmission system can be classified as: N-0: All-facilities-in, N-1: All-facilities-in followed by a contingency, and N-1-1: Scenarios that have contingency while a single element is out of service. After removal of the single element from service, system adjustments are made in preparation for the next contingency in accordance with ISO-NE rules and procedures. For CLL analyses, only load transfer shall be considered as system adjustment post first contingency (N-1), but before second contingency (N-1-1).

IV. SERVICE EXPECTATIONS

CLL transmission assessment studies will consider the following:

- Future load growth,
- Changes to the ISO-NE load forecast criteria,
- Analysis of load restoration through automatic load transfer, SCADA control and/or manual switching within the Eversource distribution system,
- All applicable NERC, NPCC and ISO-NE transmission reliability standards and,
- Relevant planned and future transmission and distribution projects.

Consequential load loss transmission system assessments shall be performed in two steps. The first step shall be to determine the loss of load in the Eversource system resulting from design contingencies. The second step shall be to determine how much load transfer capability exists within the distribution system for a given contingency or contingency pair.

The threshold for a N-1 consequential loss of load resulting from a loss of a radial, single element serving load is 0 MW. This single event can cause critical loads to be stranded and must be evaluated. Measures should be taken to eliminate or mitigate CLL based on duration, impact, cost and feasibility, when the 0 MW threshold of load interruption is exceeded. Exceptions to this threshold may be allowable based on the size of the typical mobile transformers that may be feasible to deploy as a replacement to prevent long term outages and to maintain service to our customers.

The threshold for a N-1 consequential loss of load resulting from a stuck breaker contingency is 100 MW. This single event can cause the loss of multiple elements and could result in a stranded load until the failed circuit breaker is isolated. Measures should be evaluated to eliminate or mitigate the duration, and/or impact of such events when the amount of load interrupted exceeds the 100 MW threshold. The 100 MW threshold is based on the duration of the load loss exposure and the corresponding negative impact to customer service reliability.

The threshold for an N-1 consequential loss of load resulting from a Double Circuit Tower (DCT) fault is 200 MW. The occurrence of a DCT fault in the Eversource system is predominantly caused by lightning and flashover between phases of adjacent conductors. A DCT could also be the result of a failed tower or towers. This single event causes the loss of two lines and could result in a substantial amount of stranded load. The duration of the load loss can be minimized by automatic reclosing schemes in the case of a flashover or could be lengthy in the case of a tower failure. Measures should be evaluated to eliminate or mitigate the duration, and/or impact of such events when the amount of load interrupted exceeds the CLL threshold.

The threshold for an N-1-1 consequential loss of load resulting from a loss of two transmission lines or elements is 200 MW. The occurrence of this type of event under peak load conditions and the inability to transfer a substantial amount of load through the distribution network will negatively impact load and can leave a substantial number of Eversource customers without power for an extended period. The 200 MW threshold is also consistent with the threshold associated with a DCT which produces the same consequence as a successive loss of two lines.

The threshold for an N-1-1 consequential loss of load resulting from a loss of three or more transmission lines or elements is 300 MW. The occurrence of this type of event under peak load conditions and the inability to transfer a substantial amount of load through the distribution network will negatively impact load and can leave a substantial number of Eversource customers without power for an extended period. The threshold of 300 MW is consistent with ISO-NE practices for identifying needs and proposing solutions to mitigate CLL.

The threshold for the consequential loss of load resulting from the loss of two underground cables supplying radial load is 50 MW. Underground cables are typically used in densely populated areas to supply large customer loads that in some situations cannot be transferred across the distribution system due to system and/or physical limitations. Some of these cables may share a common trench or common oil return pipe. For these reasons, evaluations include the loss of any two underground cables. Additionally, underground cable failures typically require extensive repairs that are long in duration and therefore, the remaining elements of the system should continue to operate reliably within their normal ratings following such events. Measures should be evaluated to mitigate or eliminate the duration and/or impact of such events when the amount of load interrupted exceeds the CLL threshold.

Table 1 is a summary of the CCL planning guidelines described in this document.

Table 1: Summary of Planning Guideline

Contingency	CLL Guidelines Thresholds in MW
N-1 (Radial-Single Element)	0
N-1 Stuck Circuit Breaker	100
N-1 DCT	200
N-1-1 (Single-Single)	200
N-1-1 (Single-Multiple)	300
Two UG Cables Supplying Substation(s)	50

V. MITIGATION OR ELIMINATION

Measures should be evaluated to mitigate or to eliminate the duration, and/or impact of contingency events when the amount of load interrupted exceeds the associated thresholds for the corresponding conditions. Planning solutions should eliminate the CLL condition or as a minimum, significantly reduce the impact and/or duration of the CLL condition. Alternatives which eliminate or mitigate multiple CLL guideline violations should be considered for their broader system benefits and/or cost efficiencies when compared to independent solutions which may mitigate only single CLL guideline violations.

Compliance with the Eversource transmission system CLL guidelines ensures the reliability and efficiency of the Eversource transmission system through the coordination of system planning, design and operation in accordance with good electric utility practice. It may not always be possible to achieve the designed level of reliability due to delays in siting and permitting new transmission system facilities, construction delays, load growth that exceeds predicted levels or delays due to actions taken by others beyond the control of Eversource.

Appendix 3-1

[CEII] Andrew Square Substation and Dewar Street Substation with Andrew Square to Dewar Street 115kV Line Diagram

Figure 3-3 Andrew Square Station #106

With New Andrew Square- Dewar Street 115-kV Line

[redacted]

REDACTED CONFIDENTIAL- CEII

Figure 3-4 Dewar Street Station #483

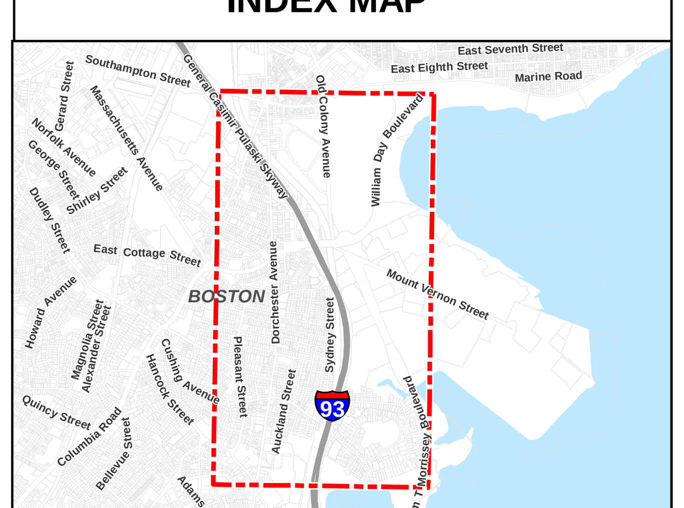
With New Andrew Square-Dewar Street 115-kV Line

[redacted]

Appendix 5-1

Photograph Log of Preferred and Alternative Route

INDEX MAP



Legend

- Photo Location Points
- Morrissey Boulevard
- Sydney Street
- Stations
- Substation

Map Notes:
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0 150 300 600 Feet
1:3,126

E N S W

Andrew Square to Dewar Street Reliability Project

Photo Location Map

Boston, Massachusetts

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January 2019

Photo 1 – Springdale Street facing west. McConnell Park is to the south. (10/10/18)

Photo 2 – Playstead Road facing south. (10/10/18)

Photo 3 – Grampian Way facing east. (10/10/18)

Photo 4 – Savin Hill Avenue facing north. (10/10/18)

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Photo 8 – Morrissey Boulevard facing north from south bound lanes. (10/10/18)

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Photo 10 – O'Callaghan Boulevard facing north. (10/16 Google Earth)

Photo 11 – Songin Way facing east. (10/10/18)

Photo 12 – Ellery Street facing west. (10/10/18)

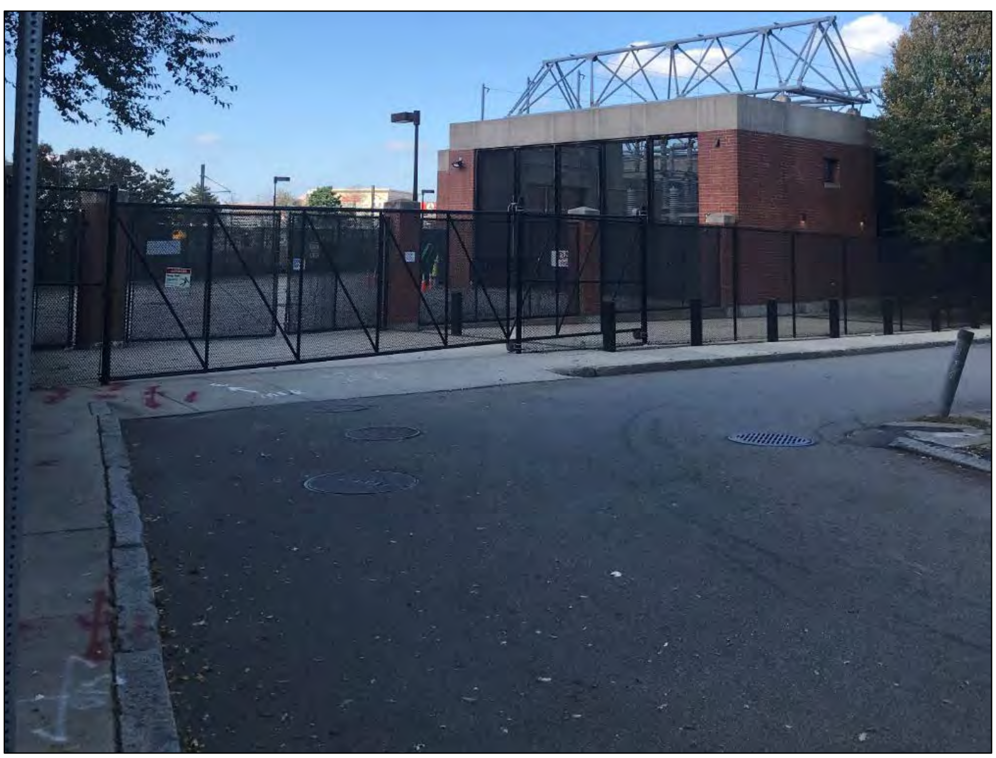

Photo 13 - Andrew Square substation facing west on Ellery Street. (10/10/18)

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Photo 15 – Sydney Street facing south. (10/10/18)

Photo 16 – Sydney Street facing south. Boston Collegiate Charter School is to the left. (10/10/18)

Photo 17 – Sydney Street near the intersection of Moseley Street facing south. (10/10/18)

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Photo 20 – Columbia Road facing northeast. (10/10/18)

Photo 21 – Buttonwood Street facing south. (10/10/18)

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Photo 23 – Dorchester Avenue facing south. (10/10/18)

Photo 24 – Howell Street facing east. (10/10/18)

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Appendix 5-2

City of Boston Municipal Code

and

City of Boston Air Pollution Control Commission Regulations for the Control of Noise in the City of Boston

CITY OF BOSTON
MUNICIPAL CODE

Contains local legislation current through Ord. 2017, c. 9, passed 12-13-17

Published by:
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Cincinnati, Ohio 45202
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Fax: (513) 763-3562
Internet: http://www.amlegal.com

16-26 UNREASONABLE NOISE.

16-26.1 General Prohibition and Definitions.

No person shall make or cause to be made any unreasonable or excessive noise in the City, by whatever means or from whatever means or from whatever source.

As used herein, the following terms shall have the following meanings:

a. *dBa* shall mean A-weighted sound level in decibels, as measured by a general purpose sound level meter complying with the provisions of the American National Standards Institute, "Specifications for Sound Level Meters (ANSI S1.4 1971)", properly calibrated, and operated on the "A" weighting network.

b. *Loud amplification device or similar equipment* shall mean a radio, television, phonograph, stereo, record player, tape player, cassette player, compact disc player, loud speaker, or sound amplifier which is operated in such a manner that it creates unreasonable or excessive noise.

c. *Unreasonable or excessive noise* shall mean

1. Noise measured in excess of 50 dBa between the hours of 11:00 p.m. and 7:00 a.m., or in excess of 70 dBa at all other hours; or

2. In the absence of an applicable noise level standard or regulation of the Air Pollution Control Commission, any noise plainly audible at a distance of three hundred (300') feet or, in the case of loud amplification devices or similar equipment, noise plainly audible at a distance of one hundred (100') feet from its source by a person of normal hearing.

(Ord. 714 § 354; Ord. 1991 c. 4 § 1) Penalty, see subsection 16-32.6

16-26.2 Unreasonable Noise-Making Automobile Safety Devices.

The use, maintenance, installation or keeping of any device whose purpose it is to protect an owner's vehicle from damage and/or theft through the mechanical creation of a noise of sufficient magnitude to be plainly audible at a distance of two hundred (200') feet from such device which does not automatically terminate any such noise within five (5) minutes shall be unlawful. Penalty for violation of this section shall be a fine of fifty ($50.00) dollars. This section shall be deemed a part of the Environment Protection Ordinances, so called, and shall be enforced pursuant to the provisions of Chapter 40, Section 21D of the General Laws.

(Ord. 1984 c. 4; [354a]) Penalty, see subsection 16-32.6

16-26.3 Unreasonable Noise From Automobile Safety Devices.

The use of any device whose purpose it is to protect an owner's vehicle from damage and/or theft through the mechanical creation of a noise of sufficient magnitude to be plainly audible at a distance of two hundred (200') feet from such device which does not automatically terminate any such noise within five (5) minutes shall be declared an unlawful use of a noise making instrument. The penalty for violation of this ordinance shall be fifty ($50.00) dollars and shall be in compliance with the provisions of Chapter 40, Section 21D of the General Laws. This section shall be deemed a part of the Environment Protection Ordinances, so called.

(Ord. 1984 c. 5 § 1 [354b]) Penalty, see subsection 16-32.6

16-26.4 Regulation of Construction Hours.

No erection, demolition, alteration, or repair of any building and excavation in regard thereto, except between the hours of 7:00 a.m. and 6:00 p.m., on weekdays or except in the interest of public safety or welfare, upon the issuance of and pursuant to an Off Hours Permit from the Commissioner, Inspectional Services Department, which may be renewed for one or more periods of not exceeding one week each. Any person violating this section hereof shall be punished by a fine of Three Hundred Dollars ($300.00) for each offense. All fines issued under this section may be recovered by the noncriminal disposition procedures promulgated in G.L. c. 40, s. 21D. Each day shall constitute a new offense.

(Ord. 1984 c.10 § 1 [354c]; Ord. 1991 c. 5 § 38; Ord. 2016 c. 8 §§ 1-4)

Editor's Note:

The Building Department and the Housing Inspection Department were abolished and all powers and duties transferred to the Inspectional Services Department by Ch. 19 of the Ordinances of 1981 (Section 9-9 of this Code).

16-26.5 Noise Levels at Residential Lot Lines.

It shall be unlawful for any person except in emergencies by Public Utility Companies to operate any construction device(s), including but not limited to impact devices, on any construction site if the operation of such device(s) emits noise, measured at the lot line of a residential lot in excess of 50 dBa between the hours of 6:00 p.m. and 7:00 a.m.

(Ord. 1985 c. 3 § 1 [354d]) Penalty, see subsection 16-32.6

16-26.6 Disturbing the Peace.

It shall be unlawful for any person or persons in a residential area within the City of Boston to disturb the peace by causing or allowing to be made any unreasonable or excessive noise, including but not limited to such noise resulting from the operation of any radio, phonograph or sound related producing device or instrument, or from the playing of any band or orchestra, or from the use of any device to amplify the aforesaid noise, or from the making of excessive outcries, exclamations, or loud singing or any other excessive noise by a person or group of persons, or from the use of any device to amplify such noise provided, however, that any performance, concert, establishment, band, group or person who has received and maintains a valid license or permit from any department, board or commission of the City of Boston authorized to issue such license or permit shall be exempt from the provisions of this section. Unreasonable or excessive noise shall be defined as noise measured in excess of 50 dBa between the hours of 11:00 p.m. and 7:00 a.m. or in excess of 70 dBa at all other hours when measured not closer than the lot line of a residential lot or from the nearest affected dwelling unit. The term dBa shall mean the A-weighted sound level in decibels, as measured by a general purpose sound level meter complying with the provisions of the American National Standards Institute, "Specifications for Sound Level Meters (ANSI S1.4 1971)", properly calibrated, and operated on the "A" weighting network.

Any person aggrieved by such disturbance of the peace may complain to the police about such unreasonable or excessive noise. The police, in response to each complaint, shall verify by use of the sound level meter described herein that the noise complained of does exceed the limit described herein and if so, may thereupon arrest and/or make application in the appropriate court for issuance of a criminal complaint for violation of M.G.L. c. 272, S. 53, which sets forth the penalties for disturbing the peace.

(Ord. 1986 c.19 §§ 1, 2 [354e]; Ord. 1991 c. 4 § 2) Penalty, see subsection 16-32.6

16-26.7 Prohibition Against Certain Sound Devices in Motor Vehicles.

a. It shall be unlawful for any person in any area of the City to operate a loud amplification device or similar equipment, as defined in subsection 16-26.1, in or on a motor vehicle which is either moving or standing in a public way.

b. No person shall operate or use on any public right-of-way any electronically operated or electronic sound signal device attached to, on or in a motor vehicle from which food or any other items are sold or offered for sale when the vehicle is stopped, standing, or parked. This subsection shall not apply to sound signal devices used as a safety device, such as but not limited to a car horn or back-up signal that is actually used for its intended purpose. For the purposes of this subdivision the term "stopped" means the halting of a vehicle, whether occupied or not, except when necessary to avoid conflict with other traffic or in compliance with a police officer or other authorized enforcement officer or a traffic control sign or signal. For purposes of this subdivision, the terms "standing" and "parked" shall be as defined in the City of Boston Traffic Rules and Regulations.

(Ord. 1991 c. 4 § 3; Ord. 2008 c. 7) Penalty, see subsection 16-26.11, 16-32.6

16-26.8 Prohibition Against Loud Amplification Devices in Public Ways or Places.

It shall be unlawful for any person in any area of the City to operate a loud amplification device or similar equipment, as defined in subsection 16-26.1, in a public way or in any other public place.

(Ord. 1991 c. 4 § 3) Penalty, see subsection 16-26.11, 16-32.6

16-26.9 Prohibition Against Loud Amplification Devices in or on Residential Premises.

It shall be unlawful for any person in any area of the City to operate a loud amplification device or similar equipment, as defined in subsection 16-26.1, in a dwelling house or on the land or other premises of such dwelling house.

(Ord. 1991 c. 4 § 3) Penalty, see subsection 16-26.11, 16-32.6

16-26.10 Enforcement.

Subsections 16-26.7, 16-26.8, or 16-26.9 may be enforced by any police officer, any special police officer designated by the Commissioner to do so, by any designee of the Air Pollution Control Commission or of the Board of Health and Hospitals or of the Commissioner of Inspectional Services. The Housing Court may enjoin violation of these subsections.

(Ord. 1991 c. 4 § 3; Ord. 1995 c. 5)

16-26.11 Penalties.

a. Any person who violates subsections 16-26.7, 16-26.8, or 16-26.9 shall be fined fifty dollars and no cents ($50.00) for the first violation in any twelve (12) month period, one hundred dollars and no cents ($100.00) and for the second violation in any twelve (12) month period, and two hundred dollars and no cents ($200.00) for the third violation and each subsequent violation in any twelve (12) month period. The enforcing person shall make a record of the complaint, such record to include the following information, to the extent that it is available: (i) name and address of person in violation, (ii) name and address of landlord of person in violation, if applicable, (iii) date of violation, (iv) time of violation, (v) location of violation, (vi) source of violation, and (vii) motor vehicle registration number, if applicable. If the person in violation refuses to provide the above-required information or if any information provided proves to be false, then said person shall be punished by a fine of an additional one hundred dollars and no cents ($100.00).

b. The Air Pollution Control Commission shall keep and make available to the public and all persons authorized to enforce these provisions, and the certification or the information there appearing by an enforcing official to a court shall establish a rebuttable presumption of the accuracy thereof.

No person, being the landlord or person in charge of a residential structure shall permit, allow, or suffer repeated violations of these ordinances after notice thereof and shall be fined at the time of the third such violation and at the time of every violation thereafter within twelve (12) months of the first violation by a fine of one hundred fifty dollars and no cents ($150.00) and by a fine of three hundred dollars and no cents ($300.00) for each violation thereafter. It shall be a defense that the landlord or person in charge of a residential structure has made and documented good faith efforts, including but not limited to the seeking of a court order, to prevent violations.

c. For all other violations of these sections, the penalties for such violations are: (i) for the first violation in any twelve (12) month period, one hundred dollars and no cents ($100.00), (ii) for the second violation in any twelve (12) month period, two hundred dollars and no cents ($200.00), and (iii) for the third violation and each subsequent violation in any twelve (12) month period, three hundred dollars and no cents ($300.00).

d. The enforcing person shall provide a person in violation with a written notice of the violation and fine. If applicable, a copy of each notice of violation shall be sent to the person in violation's landlord and to the school, college, or university at which the person in violation is enrolled.

All fines issued under these sections may be recovered by the noncriminal disposition procedures promulgated in G.L. c. 40, s. 21D, which procedures are incorporated herein by reference; provided, however, that if a person in violation fails to follow the procedures and requirements of G.L. c. 40, s. 21D, then the fine or fines shall be recovered by indictment or by complaint pursuant to G.L. c. 40, s. 41.

(Ord. 1991 c. 4, § 3; Ord. 1995 c. 5; Ord. 2003 c. 19 §§ 1, 2, 3)

16-26.12 Arrest and Seizure of Property.

Notwithstanding the provisions of any other ordinance of the City of Boston, if a person is arrested by a Boston police officer under the authority of the Massachusetts General Laws, including without limitation the provisions of G.L. c. 272, sec. 54 for disturbing the peace under G.L. c. 272, sec. 53, or any applicable Massachusetts General Law, the arresting officer may, pursuant to said General Laws, seize any loud amplification device or similar equipment, as defined in subsection 16-26.1, as evidence. In the event of such seizure for evidence by a Boston police officer incident to such arrest, such amplification device or similar equipment shall be inventoried and held by the Boston Police Department or its agents, and shall be returned to its owner according to the terms of this section, unless a court of competent jurisdiction orders otherwise.

The arresting officer, in addition to any other reports or procedures required of him, shall give the person claiming to be the owner of said loud amplification device or similar equipment a receipt indicating where, when, and for what reason said device or equipment was seized, and for what purpose it is being held. Copies of said receipt shall be filed in the Boston Police Department and shall be made available to the court. No receipt shall be redeemed and no such device or equipment shall be returned to any person unless and until all judicial proceedings that may be held regarding the criminal allegations shall have been finally completed; provided, however, that if a motor vehicle shall be seized incident to an arrest, such motor vehicle may be returned to its registered owner if said loud amplification device or equipment has been duly removed therefrom with the written permission of the registered owner of said motor vehicle. In such cases, the Police Department shall provide said owner with a receipt for the removed device or equipment as herein provided.

(Ord. 1991 c. 4 § 3)

16-26.13 Exemptions.

The following are exempted from the provisions of Section 16-26 and shall not be considered unreasonable or excessive noise for purposes of this section:

a. Noise from law enforcement motor vehicles.

b. Noise from emergency vehicles which is emitted during an actual emergency.

c. Noise which a person is making or causing to be made where such person has received and maintains a valid license or permit therefor from any department, board or commission of the City authorized to issue such license or permit; provided, however, that such noise shall be permitted only to the extent allowed by the license or permit.

(Ord. 1991 c. 4 § 3)

16-26.14 Severability.

If any provision or subsection of this section shall be held to be invalid by a court of competent jurisdiction, then such provision or subsection shall be considered separately and apart from the remaining provisions or subsections of this section, which shall remain in full force and effect.

(Ord. 1991 c. 4 § 4)

CITY OF BOSTON

AIR POLLUTION CONTROL COMMISSION

BOSTON CITY HALL

BOSTON, MASSACHUSETTS 02201

REGULATIONS FOR THE CONTROL OF NOISE IN THE CITY OF BOSTON

The Air Pollution Control Commission of the City of Boston, acting under the authority granted in Chapter 40, Section 21 of the General Laws of the Commonwealth of Massachusetts, and by the City of Boston Code, Ordinances, Title 7, Section 50, hereby adopts the following Regulations for the Control of Noise in the City of Boston.

DEFINITIONS

1. COMMISSION means the Air Pollution Control Commission of the City of Boston, or its successor as may hereinafter be designated.

2. PERSON means an individual, partnership, association, firm, syndicate, company, trust, corporation, department, bureau or agency, or any other entity recognized by law as the subject of rights and duties.

3. NOISE POLLUTION means the presence of that amount of acoustic energy for that amount of time necessary to:

   a) cause temporary or permanent hearing loss in persons exposed;

   b) otherwise be injurious, or tend to be, on the basis of current information, injurious, to the public health or welfare;

   c) cause a nuisance;

   d) interfere with the comfortable enjoyment of life and property or the conduct of business; or

   e) exceed standards or restrictions established herein or pursuant to the granting of any permit by the Commission.

4. Acoustical terminology used throughout these Regulations is that most recently approved as American Standard Acoustical Terminology by the American National Standards Institute (ANSI); except as may be specified otherwise herein.

5. dB is the abbreviation for decibel.

6. Hz is the abbreviation for Hertz, and is equivalent to cycles per second.

7. SOUND PRESSURE LEVEL (SPL) shall be numerically equal to 20 times the logarithm (to the base 10) of the ratio of the sound pressure to the reference sound pressure (the reference sound pressure shall be equal to 20 micropascals.) Unless otherwise stated, the level is understood to be that of a root-mean-square pressure.

8. dBA shall mean the A-weighted sound level in decibels, as measured by a general-purpose sound level meter complying with the provisions of the American National Standards Institute, "Specifications for Sound Level Meters (ANSI S1.4 1983)", properly calibrated, and operated on the "A" weighting network.

9. L_{10} LEVEL shall mean the A-weighted sound level exceeded ten per cent of the time.

10. DAYTIME shall mean the period between the hours of seven *ante meridian* (7:00 AM) and six *post meridian* (6:00 PM) daily except Sunday according to the time system locally in effect.

11. ZONING DISTRICTS shall mean the zoning districts and land uses therein as established by the Zoning Code of the City of Boston.

12. RESIDENTIAL USE shall include Use Items Numbers 1 through 15 inclusive and Number 53 of Section 8-7 of the Boston Zoning Code.

13. INSTITUTIONAL USE shall include Use Items Numbers 16, 17, 18, 20, 21, 22, 23, 24, 25, 29, and 33 of Section 8-7 of the Boston Zoning Code. It shall also include courthouses.

14. BUSINESS USE shall include Use Items Numbers 19, 26, 32, 34 through 52 inclusive, and 61 of Section 8-7 of the Boston Zoning Code.

15. RECREATIONAL USE shall include Use Items Numbers 27 and 28 of Section 8-7 of the Boston Zoning Code.

16. INDUSTRIAL USE shall include Use Items Numbers 68, 69, and 70 of Section 8-7 of the Boston Zoning Code.

17. MOTOR VEHICLE shall be defined as in the General Laws of the Commonwealth, Chapter 90, Section 1, titled Definitions.

18. LIGHT MOTOR VEHICLE shall be defined as all motor vehicles having a gross vehicle weight of 10,000 pounds or less.

19. HEAVY MOTOR VEHICLE shall be defined as all motor vehicles having a gross vehicle weight in excess of 10,000 pounds.

20. MOTORCYCLE shall be defined as in the General Laws of the Commonwealth, Chapter 90, Section 1, titled Definitions.

21. CONSTRUCTION shall mean any and all physical activity necessary or incidental to the erection, placement, demolition, assembling, altering, cleaning, repairing, installing, or equipping of buildings and other structures, public or private highways, roads, premises, parks, utility lines, or other property, and shall include land clearing, grading, excavating, filling, and paving.

22. CONSTRUCTION SITE shall mean that area within which a contractor confines a construction operation. This includes defined boundary lines of the project itself plus any contractor staging area outside those defined boundary lines used expressly for the construction.

23. CONSTRUCTION DEVICE shall mean any powered device or equipment, designed and intended for use in construction. Examples of "construction devices" are: Air compressors, bulldozers, backhoes, trucks, shovels, derricks, and cranes.

24. IMPACT DEVICE shall mean a construction device in which or by which a hammer, meaning a moving mass of hard solid material, is mechanically, by means of a working fluid, caused to repetitively impact upon and transmit kinetic energy to a tool. The tool may be included as part of the device, as in the case of a moil in a paving breaker or the drill steel of a jackhammer, or it may be a mass to which the impact device is temporarily connected as in the case of a pile and a pile driver. Examples of "impact devices" are: Pile drivers, paving breakers and power impact hammers, impact wrenches, riveters and stud drivers.

  a) PAVING BREAKER shall mean any hydraulically or pneumatically powered impact device intended to cut or trench pavement, sub-base macadam, gravel, concrete or hard ground.

  b) PILE DRIVER shall mean an impact device designed or used for the driving of piles, columns and other supports into soil or other material by means of impact, vibrations, pressure or other means.

25. HOMEOWNER'S LIGHT RESIDENTIAL OUTDOOR EQUIPMENT means all engine- or motor-powered garden or maintenance tools intended for repetitive use in residential areas, typically capable of being used by a homeowner. Examples of Homeowner's Light Residential Outdoor Equipment are: Lawn mowers, garden tools, riding tractors, snow blowers, snow plows, etc.

26. COMMERCIAL SERVICE EQUIPMENT means all engine- or motor-powered equipment intended for infrequent service work in inhabited areas, typically requiring commercial or skilled operators. Examples of Commercial Service Equipment are: Chain saws, log chippers, paving rollers, etc.

REGULATIONS FOR THE CONTROL OF NOISE

IN THE CITY OF BOSTON

REGULATION 1: General Prohibition of Noise Emissions

No person or persons owning, leasing, or controlling the operation of any source or sources of noise shall willfully, negligently, or through failure to provide necessary equipment or facilities or to take necessary precautions, permit the establishment of a condition of noise pollution.

REGULATION 2: Noise Restrictions According to Zoning Districts

2.1 This Regulation shall apply to the use or occupancy of any lot or structure thereon and to the noise produced thereby, but shall not apply to the following:

a) The intermittent or occasional use, during the daytime, of homeowner's light residential outdoor equipment or commercial service equipment, provided said equipment and its use complies with other provisions of these Regulations;

b) Construction activities and the associated use of construction devices nor to the noise produced thereby, provided such activities, and such equipment and its use complies with other provisions of these Regulations;

c) The operation of any motor vehicle on any public way, nor to the noise produced thereby.

2.2 Noise in Residential Zoning Districts or Affecting Residential or Institutional Property

No person shall create or cause to be emitted from or by any source subject to Regulation 2, any noise which causes or results in a maximum noise level, measured at any lot line of any lot located in any Residential Zoning District or in residential or institutional use elsewhere in compliance with the Boston Zoning Code, in excess of any level of the "Residential District Noise Standard", Regulation 2.5; provided that if said lot is located in any Industrial Zoning District, the maximum noise level, measured at the lot line, shall not exceed any level of the "Residential-Industrial Noise Standard", Regulation 2.5.

2.3 Noise in Business Zoning Districts

No person shall create or cause to be emitted from any source subject to Regulation 2, any noise which causes or results in a maximum noise level, measured at any lot line of any lot in any Business Zoning District other than a lot in residential or institutional use in conformance with the Boston Zoning Code, in excess of any level of the "Business District Noise Standard", Regulation 2.5.

2.4 Noise in Industrial Zoning Districts

No person shall create or cause to be emitted from or by any source subject to Regulation 2, any noise which causes or results in a maximum noise level, measured at any lot line of any lot in recreational or business use in any Industrial Zoning District in conformance with the Boston Zoning Code, in excess of any level of the "Industrial District Noise Standard", Regulation 2.5.

2.5 Zoning District Noise Standards

Noise standards referred to in these Regulations for the several zoning districts of the City of Boston, as defined in and established pursuant to the Boston Zoning Code, are as established by the following table:

TABLE OF ZONING DISTRICT NOISE STANDARDS

Maximum Allowable Octave Band Sound Pressure Levels

Octave Band Center Frequency of Measurement	Residential		Residential / Industrial		Business	Industrial
(Hz)	Daytime	All Other Times	Daytime	All Other Times	Anytime	Anytime
31.5	76	68	79	72	79	83
63	75	67	78	71	78	82
125	69	61	73	65	73	77
250	62	52	68	57	68	73
500	56	46	62	51	62	67
1000	50	40	56	45	56	61
2000	45	33	51	39	51	57
4000	40	28	47	34	47	53
8000	38	26	44	32	44	50
Single Number Equivalent	60 dBA	50 dBA	65 dBA	55 dBA	65 dBA	70 dBA

REGULATION 3: Restrictions on Noise Emitted from Construction Sites

3.1 Except as provided for in Regulation 3.3 and 3.4, it shall be unlawful for any person to operate any construction device or devices on any construction site if the operation of such device or devices emits noise, measured at the lot line of the affected property, in excess of the values shown below:

Lot Use of Affected Property	L_{10} level	Maximum Noise Level
Residential or Institutional	75 dBA	86 dBA
Business or Recreational	80 dBA	--
Industrial	85 dBA	--

The same level shall apply to any public way as applies to an industrial use. Measurements should not be taken closer than fifteen (15) meters (50 feet) from the nearest active construction device on the construction site. The maximum noise level shall be measured on the sound level meter on "Slow" response.

3.2 The L_{10} level shall be determined in the following manner:

a) Every ten seconds, on the mark, the A-weighted noise level on the sound level meter on "slow" response is recorded until one hundred (100) observations have been made. If, during any of these observations, a measurement is substantially affected by any source outside the construction site (such as an aircraft overflight), measurements made during these periods will not be considered. However, the observation period shall be extended until 100 valid measurements are obtained. The L_{10} level will be that level that is equal to the tenth highest level recorded.

b) If, in the estimation of the person taking the measurements, outside noise sources contribute significantly to the noise level, the above procedure shall be repeated (with the same outside noise source contributions) when construction is inactive, in order to determine the existing background L_{10} level. The L_{10} level during construction must exceed the background L_{10} level by five (5) dBA to be considered a violation of Regulation 3.1.

3.3 Except as provided for in Regulation 3.4, it shall be unlawful to operate a construction device at any street excavation, grading or repair, utility street work installation or repair, which produces a noise level exceeding 86 dBA at a distance of fifteen meters (50 feet) from the device.

The provisions of Regulation 3.1 shall not apply to any construction site covered by Regulation 3.3. The provisions of Regulation 3.3 will not be applicable to any construction device used in emergency service work that is necessary to return utility service to an area, provided that within 24 hours such device is brought into compliance with Regulation 3.3, or is not reused within the City until it does comply.

3.4 The provisions of Regulations 3.1 and 3.3 shall not be applicable to impact devices.

REGULATION 4: Restrictions on Noise Emitted by New Motor Vehicles

No person shall sell or lease a new motor vehicle that produces a maximum noise level, in dBA, exceeding the following limits (measured at a distance of fifteen (15) meters (50 feet) from the center-line of travel, in accordance with procedures established by the Commission), provided that at such time as the United States Environmental Protection Agency (USEPA) shall promulgate noise emission regulations or standards covering any class of motor vehicles, this regulation shall automatically be amended to prescribe noise emission limits identical to those of the USEPA for the class or classes of vehicles involved, without, however, in any way affecting the limits for vehicles for which the USEPA has not established regulations or standards. The preceding proviso is intended to satisfy the requirements of Section 6 (e) (1) (A) of the Noise Control Act of 1972.

Date of Manufacture of Vehicle	Light Motor Vehicle	Heavy Motor Vehicle	Motorcycle
After January 1, 1970	--	88	88
Before January 1, 1973	86	--	--
After January 1, 1973	84	86	86
After January 1, 1975	80	84	84
After January 1, 1978	--	83	--
After January 1, 1982	--	80	75

REGULATION 5: Restriction on Noise Emitted from New Outdoor Powered Equipment for Sale or Lease – Other than Pile Drivers

No person shall sell or lease any new outdoor powered equipment that produces a maximum noise level, in dBA, exceeding the following limits (measured at a distance of fifteen (15) meters (50 feet), under test procedures established by the Commission); provided that at such time as the United States Environmental Protection Agency (USEPA) shall promulgate noise emission regulations or standards covering any product covered by this Regulation, this Regulation shall automatically be amended to prescribe noise emission limits identical to those of the USEPA for the product or products involved, without, however, in any way affecting the limits for other products for which the USEPA has not established regulations or standards. The preceding proviso is intended to satisfy the requirements of Section 6 (e) (1) (A) of the Noise Control Act of 1972.

Date of Manufacture of Equipment	Homeowner's Light Residential Outdoor Equipment	Commercial Service Equipment and Construction Devices (other than Pile Drivers)
After January 1, 1973	74	88
After January 1, 1975	70	85
After January 1, 1978	65	--
After January 1, 1980	--	80

REGULATION 6: Permits - General

6.1 A permit shall constitute permission to use or to allow the use of a device or to engage in an activity to which reference has been made in these Regulations or in the Ordinances of the City of Boston.

6.2 All applications for permits shall be made to the Air Pollution Control Commission in such form as it shall prescribe. Such application shall not relieve any person from otherwise complying with the provisions of these Regulations or any other law or ordinance.

6.3 Such permit shall include such provisions and conditions as the Commission may deem necessary to protect the public health, welfare and comfort.

6.4 Any permit required by these Regulations shall be displayed to any police officer or employee of the Air Pollution Control Commission upon request.

6.5 Any permit issued by the Air Pollution Control Commission under the provisions of these Regulations may be revoked for violation of any of the terms and conditions of such permit.

REGULATION X: Conflict with other Regulations

The noise regulations shall not relieve any person from complying with other laws, statutes, codes, regulations, or ordinances of the Commonwealth or the City of Boston.

REGULATION Y: Variances

The Commission may grant variances after public hearing or may reject applications on review without a hearing. Variances thus granted may be effective for no longer than one year.

REGULATION Z: Severability

Each of these Regulations shall be construed as separate to the end that if any Regulation or section, sentence, clause or phrase thereof shall be held invalid for any reason, the remainder of these Regulations shall continue in full force.

Appendix 5-3

Best Management Practices Manual for Massachusetts and Connecticut

Construction & Maintenance
Environmental Requirements

Best Management Practices Manual for Massachusetts and Connecticut

Prepared For:

Eversource Energy Environmental Licensing and Permitting Group
107 Selden Street
Berlin, CT

September 2016

Tighe&Bond

Section 1 Introduction

Section 2 Project Planning

Section 3 Construction Considerations

Section 4 Inspection and Maintenance

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Table TOC-1
Best Management Practices Summary Table

	Area/Activity	Applicable BMPs	Tab	Tab Section
CONSTRUCTION	Upland	Construction Entrance Track Pad	1	A
	`	Stormwater Management BMPs (includes temporary water bars, drainage swales, and sedimentation basins)		B
	Wetland	Construction mats	2	A
		Permeable Road		B
	Watercourse Crossings	Without bridged crossings	3	A
		Bridged crossings		B
		Culverts		C
		Poled fords		D
	De-Energized	Construction mat workpads, including construction mats and lightweight mats	4	A
	Energized	Construction mat workpads		B
SOIL STOCKPILE MANAGEMENT	All	Soil Stockpile Management	5	A

Table TOC-2
Appendix A: Erosion/ Sedimentation and Water Control Summary Table

Type	Applicable Control	Location
EROSION/ SEDIMENTATION CONTROLS	Preservation of Existing Vegetation	
	Topsoil Segregation for Work in Wetlands and Agricultural Areas	
	Straw (or Hay) Bales*	Section I
	Silt Fence	
	Syncopated Silt Fence	
	Erosion Control Blankets	
	Straw/Compost Wattles	
	Wood Chip Bags	
	Catch Basin Protection	
	Loaming and Seeding	
	Mulching with Hay/Straw/Woodchips	
	Coir Log Use for Bank Stabilization	
	Level Spreader	
	Check Dams	
	Temporary and Permanent Diversions	
	Temporary and Permanent Trench Breaker	
WATER CONTROL	Dewatering Activities	
	- Overland Flow	
	- Frac Tank	
	- Filter Bags and Hay Bale Containment	
	- Discharge Hose Filter Socks	Section II
	Coffer Dam and Stream Bypass via Pumping	
	Coffer Dam and Stream Bypass via Gravity	
	Silt Barriers	

***** Straw bales preferred in wetlands, if allowed by permit, and hay bales in uplands

TABLE TOC-3
List of Acronyms

Acronym	Definition
ATV	All-Terrain Vehicle
BMP	Best Management Practices
ConnDOT	Connecticut Department of Transportation
ACOE	United States Army Corps of Engineers
CT	Connecticut
CTDEEP	Connecticut Department of Energy and Environmental Projection
EBT	Eastern Box Turtle
EPA	United States Environmental Protection Agency
Eversource	Eversource Energy
EL&P	Environmental Licensing and Permitting
FEMA	Federal Emergency Management Agency
HDD	Horizontal Directional Drilling
LGP	Low Ground Pressure
MA	Massachusetts
MassDEP	Massachusetts Department of Environmental Protection
MassDOT	Massachusetts Department of Transportation
MassWPA	Massachusetts Wetlands Protection Act
NDDB	Connecticut Natural Diversity Database
NHESP	Massachusetts Natural Heritage Endangered Species Program
OLISP	Office of Long Island Sound Programs
ORV	Off-Road Vehicle
PSI	Pounds per square inch
RIM	Record Information Management System
ROW	Right of Way
TOC	Table of Contents

Section 1 Introduction

1.1 Purpose

As a matter of Eversource Energy (Eversource) policy regarding environmental stewardship and in accordance with local, state, and federal regulations, all construction and maintenance projects shall use environmentally sound best management practices (BMPs) to minimize or eliminate environmental impacts that may result from construction activities. Regardless of whether a specific permit is needed for the work, construction and maintenance projects must follow internal environmental performance standards, which is the purpose of these BMPs. In many cases, maintenance activities are exempt from regulatory authorization. Permits are usually required for new work. Contractors will be provided with copies of any project specific permits, and will be required to adhere to any and all conditions of the permit(s). Permit conditions that are more detailed than the BMPs outlined in this manual shall always be given priority. However, where certain construction elements are not addressed by permit conditions, or where permitting is not required, or for emergency situations where obtaining a permit before the work occurs may not be an option, these BMPs shall be considered as Eversource's standards. In some cases, and at the discretion of the Eversource Management, the BMPs presented herein may be modified to be more appropriate for site-specific conditions.

1.2 Scope and Applicability

These BMPs primarily address the disturbance of soil, water, and vegetation incidental to construction within on- and off-road utility corridors, substations, including the establishment of access roads and work areas, within rights of way (ROWs) and on private property, in and near wetlands, watercourses, or other sensitive natural areas (such as protected species), including storm drain systems (e.g., catchbasins). Types of construction include, but are not limited to, installation or maintenance of underground and overhead utilities, access road repair/improvement or installation, and upgrades or maintenance of substations and other facilities. Other common construction issues such as noise, air pollution, oil spill procedures, handling of contaminated soils, and work safety rules are addressed in the Eversource Energy Contractor Work Rules and related appendices.

1.3 Definitions

The following definitions are provided to clarify use of common terms throughout this document.

Best Management Practice (BMP): A means to reduce and minimize impact to natural resources.

Casing: A galvanized steel corrugated pipe that serves as the form for a utility structure foundation.

Emergency Projects: Actions needed to maintain the operational integrity of the system or activities necessary to restore the system and affected facilities in response to a sudden and unexpected loss of electric or gas service or events that affect public health and safety.

Embedded Culvert: A culvert that is installed in such a way that the bottom of the structure is below the stream bed and there is substrate in the culvert.

Environmentally Sensitive Areas: An area containing natural features, cultural features or ecological functions of such significance to warrant protection. Some examples are rivers, streams, ponds, lakes, wetlands, rare species habitat, water supply protection areas, cultural sites, parks, and agricultural land.

Erosion Control: A measure to prevent soil from detachment and transportation by water, wind, or gravity.

Existing Access Roads: Previously permitted or grandfathered access roads that are used to access structures that are clearly visible or can be found by mowing or by the presence of road materials in soil cores.

Grubbing: A site preparation method that is used to clear the ground of roots and stumps.

Intermittent Watercourse: An intermittent watercourse is broadly defined as a channel that a flowing body of water follows at irregular intervals and does not have continuous or steady flow. Regulatory definitions for intermittent water courses are:

- Connecticut—Per the Connecticut Inland Wetland and Watercourses Act, intermittent watercourses are delineated by a defined permanent channel and bank and the occurrence of two or more of the following characteristics: (A) Evidence of scour or deposits of recent alluvium or detritus, (B) the presence of standing or flowing water for a duration longer than a particular storm incident, and (C) the presence of hydrophytic vegetation.

- Massachusetts—Under the Massachusetts Wetlands Protection Act (MassWPA), a jurisdictional intermittent watercourse is defined as a body of running water which moves in a definite channel in the ground due to a hydraulic gradient, does not flow throughout the year, and which flows within, into or out of an area subject to protection under the MassWPA. Intermittent watercourses upgradient of any Bordering Vegetated Wetlands are not jurisdictional under the MassWPA. A watercourse can be determined to be intermittent if it meets MassWPA criteria in regards to watershed characteristics found on the Stream Stats website or documented observations of no flow.

Limit of Work/Disturbance: The boundaries of the approved project within regulated areas. All project related activities in regulated areas must be conducted within the approved limit of work/disturbance. The limit of work/disturbance should be depicted on the approved permit site plans, which may require the limits to be identified in the field by flagging, construction fencing, and/or perimeter erosion controls.

Low-Impact Vehicles: Vehicles that have a lesser impact on an environmentally sensitive area due to the vehicle being smaller, lighter, or different in another way than a vehicle which would have a greater impact. Low impact vehicles could include ORVs or

ATVs, tracked vehicles with low ground pressure, or vehicles with oversized balloon-type tires.

Maintenance Projects: Typically consist of activities limited to the repair and/or replacement of existing and lawfully located utility structures and/or facilities where no substantial change in the original structure or footprint is proposed. Maintenance activities also include vegetation management.

Minimization: Causing as little disturbance to an area as practicable during construction.

New Construction: Construction of new transmission or distribution facilities that previously did not exist or construction that substantially modifies existing facilities. All new (and existing) construction projects are required to go through a full permit review by the Eversource Environmental Licensing and Permitting Department.

Pre-Construction Notification (PCN): Project activities that do not qualify for SV or where otherwise required by the terms of the MA and CT GPs must submit a PCN and obtain written verification before starting work in ACOE jurisdiction. Refer to MA and CT GP appendices for PCN thresholds. Projects that cannot be completed under a PCN must file for an Individual Permit with the ACOE. In CT, for coastal projects, notification is provided to ACOE by CT DEEP, Office of Long Island Sound Programs (OLISP) or by applicants as necessary. Written approval from ACOE is required.

Restoration: To return a disturbed area to its former, original or unimpaired condition. A site is considered fully restored when it has returned (as closely as practicable) to its original state. Restoration of disturbed areas should occur as soon as practicable following the completion of activities at that location.

Re-Vegetation: Establishment of plant material for temporary or permanent soil stabilization.

Right of Way: A pathway, road, or corridor of land where Eversource Energy has legal rights (either fee ownership, lease, or easement) to construct, operator, and maintain an electric power line and/or natural gas pipeline.

Self-Verification (SV): Activities that are eligible for SV are authorized under the MA and CT GPs and may commence without written verification from the ACOE provided the prospective permittee has:

i. Confirmed that the activity will meet the terms and conditions of applicable MA and CT GPs

ii. Submitted the Self-Verification Notification Form (SVNF) to the ACOE.

In CT, coastal projects do not require filing of a Self-Verification Notification Form. ACOE relies on CT DEEP and OLISP submittals.

Stabilization: A system of permanent or temporary measures used alone or in combination to minimize erosion from disturbed areas.

Sediment Control: Control of eroded so that it does not wash off and pollute nearby wetland and water resources.

<u>Vehicles with Low Ground Pressure</u>: Vehicles which have tires or tracks that apply less than three pounds per square inch (psi) on the ground surface.

<u>Work</u>: For the purposes of this BMP Manual, the disturbance of soil, water, and vegetation incidental to construction within on- and off-road utility corridors, substations, including but not limited to the establishment of access roads and work areas, in and near wetlands, watercourses, or other sensitive natural areas, including storm drain systems (e.g., catch basins). Types of construction include, but are not limited to installation or maintenance of underground and overhead utilities, substations and other facilities.

1.4 BMP References

The following table lists the public guidance documents utilized during the preparation of this BMP manual. Refer to these documents for additional information.

TABLE 1-2

Document Title
General
Best Management Practices (BMPs) Manual for Access Road Crossings of Wetlands and Waterbodies, EPRI, Palo Alto, CA (2002) 1005188.
Gas Research Institute. Horizontal Directional Drilling Best Management Practices Manual (2002) ENSR Corporation, Westford, MA and Trenchless Engineering Corp., Houston, TX.
Connecticut
Connecticut Department of Transportation (ConnDOT). ConnDOT Drainage Manual (October 2000) http://www.ct.gov/dot/cwp/view.asp?a=1385&Q=260116
Connecticut Standard Specifications for Roads, Bridges and Incidental Construction, FORM 816 (2004) http://www.ct.gov/dot/cwp/view.asp?a=3609&q=430362
Connecticut Department of Energy & Environmental Protection. Connecticut Guidelines for Erosion and Sediment Control. (2002) http://www.ct.gov/deep/cwp/view.asp?a=2720&q=325660&deepNav_GID=1654%20
Connecticut Department of Energy & Environmental Protection, Bureau of Natural Resources, Division of Forestry. Best Management Practices for Water Quality While Harvesting Forest Products (2007) http://www.ct.gov/dep/lib/deep/forestry/best_management_practices/best_practicesmanual.pdf
Massachusetts
Commonwealth of Massachusetts Department of Public Works Standard Specifications for Highways and Bridges (1988) http://www.mhd.state.ma.us/default.asp?pgid=content/publicationmanuals&sid=about
Massachusetts River and Stream Crossing Standards (Revised March 1, 2011) http://www.nae.usace.army.mil/Portals/74/docs/regulatory/StreamRiverContinuity/MA_RiverStreamCrossingStandards.pdf
Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas. Original Print: March 1997. *Reprint: May 2003*. http://www.mass.gov/eea/docs/dep/water/essec1.pdf
The Massachusetts Unpaved Roads BMP Manual (Winter 2001) http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/dirtroad.pdf

Section 2
Project Planning

After undergoing an initial screening review by the department conducting the proposed project, if resources are identified, the project is required to go through a permit review by the Environmental Licensing and Permitting Group. The permit review process is supported by Geographic Information Systems (GIS) or a similar program that references the most current spatial data for the project areas in question. Through the GIS review process various geo-processing tools are used to compose maps and provide a spatial reference to environmentally sensitive areas. In consultation with the Environmental Licensing and Permitting Group, the Project Engineer, permitting specialist, or other project planner should determine regulatory jurisdiction and which (if any) environmental permits or approvals are required before starting any project. Questions regarding which activities may be conducted in regulated areas or within environmentally sensitive areas should be referred to the Environmental Licensing and Permitting Group. Summaries of potentially applicable laws and regulations are provided in Appendices B and C of this document.

2.1 Types of Wetlands

Wetland areas common to New England and common to both Connecticut and Massachusetts include, but are not limited to, the following:

Forested Wetlands

Forested wetlands are wetlands that are dominated by trees that are 20 feet or taller. These wetlands are typically drier with standing water typically occurring during periods of high precipitation, seasonally high groundwater, snowmelt, and runoff (e.g., early spring through mid-summer). Tree species typical of this type of wetland include red maple (*Acer rubrum*) and eastern hemlock (*Tsuga canadensis*). "Pit and mound" topography is common in forested wetlands, where mature trees grow on the higher and drier mounds and obligate wetland species are found in the lower pits.

Scrub-Shrub Wetlands

Scrub-shrub wetlands are dominated by woody vegetation less than 20 feet tall, and may include peat bogs. Typical bog species include leatherleaf (*Chamaedaphne calyculata*), cotton grasses (*Eriophorum* sp.), cranberry (*Vaccinium macrocarpon, V. oxycoccus*), and black spruce (*Picea marina*). Other non-bog scrub-shrub wetlands are characterized by buttonbush (*Cephalanthus occidentalis*), alders (*Alnus* sp.), dogwoods (*Cornus* sp.), and arrowwoods (*Viburnum* sp.).

Marshes

Marshes are dominated by erect, herbaceous vegetation and appear as grasslands or stands of reedy growth. These wetlands are commonly referred to by a host of terms, including marsh, wet meadow, fen. These areas are flooded all or most of the year and, in New England, tend to be dominated by cattails (*Typha* sp.).

Wet Meadows

Typical wet meadow species include grasses such as bluejoint (*Calamagrostis canadensis*) and reed canary grass (*Phalaris arundinacea*), sedges (*Carex* sp.) and rushes (*Juncus* sp.), and various other forbs such as Joe-Pye-weeds (*Eupatorium* sp.) and asters (*Aster* sp.).

Floodplains

A floodplain is generally defined as an area of low-lying ground adjacent to a stream or river that is formed mainly of river sediments and is subject to flooding. State-specific regulatory definitions vary and are described as follows:

- In Connecticut, areas that contain alluvial or floodplain soils are regulated as wetlands. These areas may flood so infrequently or be so freely drained that hydrophytic vegetation and hydric soils are not present. Soils in these areas must be examined carefully to determine whether well drained alluvial or floodplain soils are present.

- In Massachusetts, a floodplain is a type of wetland resource are that floods following storms, prolonged rainfall, or snowmelt. There are three types of floodplain areas protected under the MassWPA: coastal areas, areas bordering rivers and streams, and isolated depressions that flood at least once a year.

Streams

A stream is any natural flowing body of water that empties to any ocean, lake, pond or other river. Perennial streams, or rivers, have flows throughout the year. Intermittent streams do not have surface flows throughout the year, though surface water may remain in isolated pockets.

Vernal Pools

Vernal pools are typically contained basin depressions lacking permanent aboveground outlets. These areas fill with water with the rising water table of fall and winter and/or with the meltwater and runoff of winter and spring snow and rain. The pools contain water for a few months in the spring and early summer. Due to periodic drying cycles, vernal pools do not support breeding fish populations and can thus serve as breeding grounds for a variety of amphibians, including some rare and protected species of frogs and salamanders.

Other Considerations

Other regulated factors taken into consideration during the project planning process include the presence of protected (i.e., threatened, rare or endangered) species, non-native invasive plant species and/or historical and archaeological resources. Special requirements may need to be evaluated as part of new construction and/or some maintenance activities.

2.2 Meetings

A pre-construction meeting is typically held prior to the commencement of all work with the purpose to appoint responsible parties, discuss timing of work, and further consider options to avoid and/or minimize disturbance to sensitive areas. The meeting confirms that there is consensus on work methods and responsibilities, and ensure that tasks will be fulfilled with as little disturbance to the environment as practicable. These meetings can occur on or off-site and should include all the applicable stakeholders (i.e., Eversource, contractors, consultants, inspectors and/or monitors, and regulatory agency personnel). A short and less formal briefing should suffice for smaller maintenance projects.

2.3 Site Staging and Parking

During the project planning and permitting process, locations should be identified for designated crew parking areas, material storage, and staging areas. Where possible, these areas should be located outside of buffer zones, watershed protection areas, and other environmentally sensitive areas. Any proposed locations should be evaluated for all sensitive receptors and for new projects requiring permitting, should be incorporated onto permitting and access plans.

2.4 Construction Monitoring

Construction projects require environmental monitoring, which can be conducted either internally or by consultants. Some permitted projects require oversight by designated and pre-approved compliance monitors. Environmental monitoring is a way to keep a chronological record of pre-construction site conditions, progress, and changes that are made, as well as to document issues and authorized solutions.

If work will occur in a wetland resource area or an area mapped or otherwise designated as rare or endangered species habitat, permit conditions may dictate that construction be monitored by a qualified and pre-approved wetland or wildlife specialist.

2.5 Signage/Limit of Boundaries

Where appropriate, wetland delineation flagging or signage shall be installed that makes clear where critical boundaries (i.e., the limits of jurisdictional wetland resource areas and/or rare species habitat) and setbacks occur, regulatory authorization by agencies, and certain uses on ROWs are prohibited, such as ORV traffic.

Where appropriate, signage shall be installed along sediment and erosion control barriers at appropriate intervals, heights and sizes to ensure that the presence and location of said barriers is clear to construction personnel during deep snow or other low visibility conditions. Inspection and maintenance of this signage shall be conducted on a regular basis to ensure effectiveness.

Photo provided courtesy Tighe & Bond/GSRP.

Photo provided courtesy of Tighe & Bond, Inc./PSg

Examples of signage at wetlands.

Section 3 Construction Considerations

During all project activities (e.g., maintenance, new construction), federal, state, and local regulatory authorities require steps be taken to avoid, minimize, and/or mitigate disturbance to the environment. Wetlands and other sensitive areas should be avoided whenever practicable. However, some work may require entrance into these areas in order to perform work. This section discusses measures that should be taken to minimize disturbance to if work must occur within sensitive areas.

BMPs were developed to aid in this process and should be carefully selected and implemented based on the proposed activities and the nature of sensitive area(s) encountered at each site. Proper selection of BMPs should take into consideration the project goals, permit requirements, and site specific information. Once an assessment of the area is made and requirements of the project are established, all BMPs should be considered and implemented as appropriate.

Tables TOC-1 and TOC-2 summarize BMP types. This section addresses BMPs specific to construction of new access roads, repair of existing access roads, the installation of work pads, structure-related work, and soil stockpile management. Information regarding recommended erosion and sedimentation controls or stormwater controls is also discussed. Please refer to Appendix A for typicals and representative photographs of BMPs used for erosion and sedimentation control and water diversion during construction.

3.1 Avoidance and Minimization

Avoidance and minimization should always be considered before beginning any construction or maintenance project. Take appropriate measures to avoid construction impacts to wetlands, waterways, rare species habitats, known below and above ground historical/archeological resources, and other environmentally sensitive areas. Use existing ROW access whenever practicable. Keep to approved routes and roads and do not widen or deviate from them. Consult with the Environmental Licensing and Permitting Group, when avoidance is not practicable, to determine measures to minimize the extent of construction impacts. Alternate access routes and/or staging areas that will minimize construction impacts to the natural environment may be considered.

3.2 Rare Species Habitat

The Environmental Licensing and Permitting Group coordinates with state and local agencies when work is within areas that are identified as rare species habitat. In Connecticut, the Natural Diversity Database (NDDB) is used to identify rare species habitat and is under the Department of Energy and Environmental Projection (CTDEEP). In Massachusetts, the Natural Heritage Endangered Species Program (NHESP) is consulted to identify rare species habitat, which is under the Department of Fisheries and Wildlife and part of the Natural Heritage network. State regulatory agencies may require crew training and turtle sweeps of work areas, botanist identification of rare plants for avoidance, and protection of vernal pools, prior to starting the work.

3.3 Vernal Pools

Construction within and across wetlands and in proximity to vernal pools should be limited to the extent practicable to avoid working in the periods between April 1st and June 1st. This will allow for obligate vernal pool species to emigrate to the breeding areas, deposit egg masses, and allow for hatching and development of juveniles. Silt fence should be installed at the limits of the construction to prevent individual reptiles and amphibians from entering the workspace, but in a manner that does not impede movement to and from pools from adjacent forested uplands. Consider installing syncopated silt fencing.

Protection Measures

When performing construction activities in proximity to vernal pools, a number protection measures should be implemented.

Vegetation Removal

- Maintain existing scrub-shrub vegetation (consistent with ROW vegetation management requirements) within 25 feet of vernal pools, except in areas where access roads and work pads must be installed.
- Minimize removal of low growing (scrub-shrub) vegetation surrounding vernal pools by utilizing construction matting where access is needed. If vegetation must be cut adjacent to vernal pools, the cut vegetation (slash) should be left in place to serve as recruitment for leaf litter and coarse woody debris.

Erosion and Sedimentation Control

- Install and maintain erosion and sedimentation control measures along construction access roads and work pads to protect water quality and to limit the potential for sediment transport to vernal pools.
- Promptly remove erosion and sedimentation control devices upon final revegetation and stabilization of the ROW.

Access Roads

- Use construction mats, corduroy roads, or clean materials (i.e., clean riprap, gravel, stone or equivalent and rock fords) in locations where existing on-ROW access roads must be improved and are adjacent to vernal pools.
- Man-made depressions along existing on-ROW access roads provide low-quality vernal pool breeding habitat (due to an insufficient hydroperiod). Access roads must be graded and/or improved to accommodate project construction vehicles and may eliminate these depressions and the associated potential for amphibian breeding habitat. Perform improvements to on-ROW access roads outside of the breeding and migration seasons of vernal pool species to avoid direct impacts to amphibians that may breed in the man-made depressions along existing on-ROW access roads.

Scheduling and Site-Specific Considerations

- To the extent practicable (considering circuit outages and other construction timing constraints), schedule access road and work pad installation in and around vernal pool habitats to minimize interference with amphibian breeding and migration seasons.

- For project activities that must occur adjacent to vernal pools during amphibian migration periods, implement measures on a site-specific basis to facilitate unencumbered amphibian access to and from vernal pools. Consider the site-specific conditions including the type of construction activity that will occur in proximity to a vernal pool, the amphibian species known to occur in the vernal pool, and seasonal conditions. Identify appropriate mitigation measures. Options to be evaluated to allow amphibian access to vernal pools may include, but not be limited to: syncopated silt fencing in the immediate vicinity of vernal pools; elevated construction matting; and aligning erosion and sedimentation controls to avoid bifurcating vernal pool habitat.

3.4 Access Roads

Existing construction access roads are unpaved roadways that work crews use to access a site within a ROW. These access roads were generally either permitted previously or constructed prior to the promulgation of regulations and are grandfathered in under past general permits.

3.4.1 New Access Roads

New access roads are generally associated with new or large-scale projects that have separate permitting requirements. Construction of new access roads will be based on plans that are reviewed and approved by applicable federal, state, and local agencies. If a new access road is needed and not associated with a large project, notify the Environmental Licensing and Permitting Group to make a decision on best access routes and identification of the necessary permits and approvals required to construct the new road. **Permit requirements must be followed.**

3.4.2 Existing Access Roads

The travel surface width of access roads in upland areas will not exceed 16 feet. This does not include side slopes. Maintaining existing access roads includes mowing of vegetation, grading, placement/replacement of stone, and the installation/maintenance of erosion control features (e.g., water bars, swales, sedimentation basins).

When access roads are in wetlands, measures should be taken to avoid disturbance to wetlands, waterways, and sensitive areas. If avoidance is not practicable, then measures should be taken to minimize the extent of disturbance. Alternate access routes should always be considered. Below is a list of methods that should be considered where disturbance is necessary:

- Minimize the width of typical access roads through wetlands. If an existing access road is evident in the wetland, the existing width of the access road must be maintained. If unable to ascertain the original width of the access, then do not make the road wider than 16 feet (including side slopes).

- To the extent practicable, use low-impact vehicles and/or vehicles with low ground pressure when driving through wetlands.
- Coordinate the timing of work to cause the least impacts during the regulatory low-flow period under normal conditions, when water/ground is frozen, after the spring songbird nesting season, and, outside of the anticipated amphibian migration window (mid- February to mid-June). The United States Army Corps of Engineers defines the low-flow periods for streams as follows:
    - Connecticut streams—July 1 through September 30
    - Massachusetts non-tidal streams—July 1 through September 30
    - Massachusetts tidal streams—November 16 to February 15
    - New Hampshire streams—July 15 through October 1
- Use construction mats in wetlands to minimize soil disturbance and rutting when work needs to occur during non-frozen ground conditions.
- If practicable, conduct work manually if warranted (decision to be made by Project Team).

Existing access roads that have become part of the wetland are considered previous fill that were either permitted or grandfathered and where it is evident that an access road exists, it is acceptable to place stone over the previously placed fill. Where the existing access road is not evident, Environmental Licensing and Permitting must be consulted to make a determination whether stone can be placed in the wetland. If stone is not evident, through soil cores, hand digging or other methods, construction mats will be used. If permanent access is warranted through the wetland, the new access road will need to have a permitting review and will likely require permits.

The access road in the wetland should not exceed 16 feet in width (unless there is evidence that the road was originally wider than 16 feet).

Over time, existing access roads require maintenance and repair. Travel by construction equipment and general traffic to reach a particular portion of the ROW must be via the designated access road and route. Changes in the location of the access road or the use of alternate roads must be reviewed and approved by the Project Team prior to their construction or use. Access road routes were selected to prevent degradation of the utility corridor, and must be constructed, used, and maintained in accordance with this manual, as well as federal, state, and local requirements, and other project plans.

Though, in some situations, they may be necessary, constructing duplicate access roads should be avoided to the extent practicable. Some appropriate reasons for suggesting alternate routes are:

- Poor site conditions along preferred route because of weather or season.
- Property rights constraints, or property owner's preference.
- Equipment requirements.
- Unanticipated off-site access limitations along existing roads.
- Unanticipated access opportunities (e.g., ice, snow, other developments) which may avoid environmental disturbance and/or reduce cost.

General Design: New and Existing Access Roads

Construction access roads that require new grading and/or filling, or are to be heavily used require the creation of a stable, tractable, load-bearing surface resistant to erosion. If the existing soil and subsoil are not well drained, it may be necessary to import an aggregate road base (i.e., gravel borrow) such as that meeting the requirements of aggregate found in the:

- *Commonwealth of Massachusetts Department of Public Works Standard Specifications for Highways and Bridges*, Section 400

- Connecticut *Standard Specifications for Roads, Bridges and Incidental Construction*, Section M1.02

When the construction access road follows the same route as the permanent design road, constructing the grades and subgrade for the permanent roadway early in the construction sequence is recommended.

The travel surface of construction access roads shall typically not exceed 16 feet in width except for passing points, where necessary. Subgrading shall not extend beyond the space required for the finished road and normal side slopes.

Where practicable, construction access roads should conform to the contours of the land, avoiding grades steeper than 10 percent and creating side slopes no steeper than a ratio of 2:1. If the side slopes are steeper than 2:1, then use of engineered slope stabilization methods may be necessary Consider the volume and type of construction traffic as well as the extent that natural ground must be altered to accommodate the traffic. If no grading is required and the construction traffic is very intermittent (i.e., access roads used to maintain utility lines) the measures used may be limited to water bars, or some top dressing with gravel or stone in areas where the vegetation over soft soil is destroyed by traffic.

During wet weather, these roadways can generate significant quantities of sediment if not constructed with adequate stormwater management and erosion control measures. During an active construction or maintenance activity, inspection of the construction access road and the associated erosion and sedimentation measures should be conducted by the person(s) designated at the pre-construction meeting, should occur regularly while the activity is occurring, and repairs to controls should be made in a timely matter. Repairs may include regrading and/or top dressing the traveled surface with additional aggregate to eliminate ruts, as well as those repairs required by each erosion and sedimentation measure used. When the roadway is no longer needed on a regular basis, the access road should be reviewed to ensure that the road is left in a condition that prevents future erosion and sedimentation (i.e., installation of water bars, gravel, etc.). In some cases, permit conditions may warrant that the access road be removed and that the disturbed area be seeded and mulched as required to match the pre-construction conditions.

Erosion and Sedimentation Controls

Construction personnel are reminded to control erosion and flow conditions during access road construction or maintenance by utilizing the following erosion and sedimentation measures which are described and illustrated further in Appendix A:

- **Outlet protection**, a **level spreader**, a **trench breaker**, a **sediment trap or basin**, or a **stone check dam** may be used to de-energize concentrated flows from diversions and in temporary channels.
- **Geotextile silt fencing**, **compost filter berms**, **straw wattles** and **hay/straw bale barriers** may be utilized to provide protection at the toe of fill slopes and discharges from water bars.
- Side slopes can be protected by installing **erosion control blankets** and **seeding** the area with a fast-growing native or annual grass mix.
- **Dust contro**l should be employed when construction access road conditions create airborne dust.
- **Geotextile fabric** shall be used beneath all new fill and construction entrances, where needed.

3.4.2.1 Best Management Practices – New Access Roads

The following are BMPs that are applicable to new access roads in uplands and are described at the following tabs:

Construction Entrance Track Pad – Tab 1A

Stormwater Management BMPs (includes Water Bars, Drainage Swales, and Sedimentation Basins) – Tab 1B

TAB 1A

Construction Entrance Track Pad

Applications: Erosion and sedimentation control, roadway protection

Limitations:

- Maintenance is required if the pad becomes clogged with soil.
- Muddy conditions may warrant the use of a tire wash station.

Overview:

Where access roads or construction areas connect to paved roads, a stone track pad must be installed at the construction entrance to prevent construction machinery from tracking soil onto paved roadways. Materials appropriate to construction site soil conditions should be employed and/or replenished, as necessary.

Installation:

- Use 3- to 6-inch washed stone to install stone tracking pads at a minimum length of 50 feet and a minimum depth of 12 inches.

- On sites with clayey soils, underlay stone tracking pads with a geotextile liner to prevent the stone from sinking into the soil.

Maintenance:

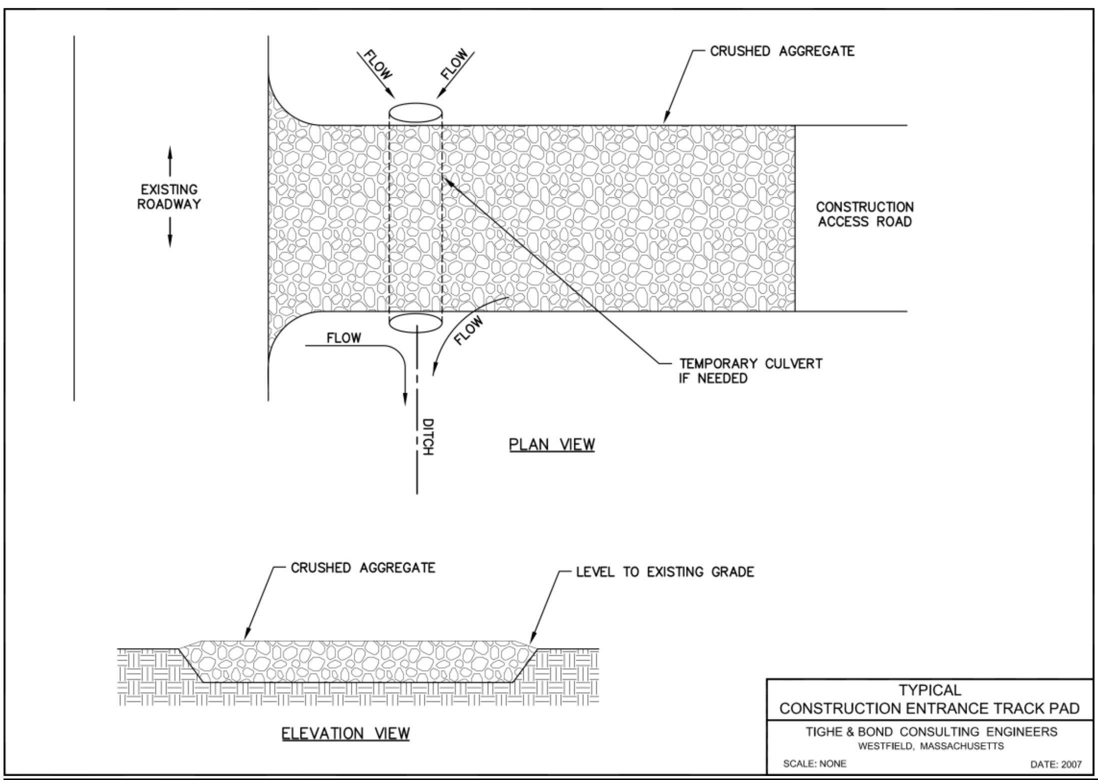
- Periodically inspect the stone in the entrance tack pad. If the pad becomes clogged with soil, remove and refresh and/or clean stone.

Additional Comments:

If muddy conditions warrant the use of a tire wash station, procedures should be established to ensure soils are not tracked off site.

Where appropriate and when safety and environmental conditions are considered, vehicle tires or tracks may be spun quickly (“burn out”) on the track pad to further facilitate the removal of soil.

Construction entrance track pad.



TAB 1B

Water Bar

Applications: Erosion and sedimentation control

Limitations:

- Should never be used to direct a watercourse into another waterbody or to divert unfiltered runoff to a wetland.
- Can impede vehicular movement.
- Damage from vehicle traffic and stormwater flow may require water bars to be reinstalled/reworked at the beginning and end of each construction season.

Overview:

Water bars are linear features built diagonally across access roads or ROWs to redirect waterflow off of the road surface at non-erosive intervals. In general, they consist of a trench dug at least 6 inches below grade followed by an earthen mound at least 6 inches above grade. Use water bars to prevent erosion on sloping roadways less than 100-feet wide. Water bars must be designed to be stable throughout their useful life and meet the criteria in the table below. The maximum capacity should be the peak runoff from a 10-year storm. Permanent diversions (Appendix A) may also be used if water bars are not suitable.

Installation:

- Set water bar direction to utilize stable outlets and do not allow upslope water bar runoff to converge with down slope water bars.
- Construct the bar immediately after vegetation has been cleared on constant or slightly increasing grades, not exceeding 2%. Avoid reverse grades.
- Mark the location and width of the ridge and disk the entire length.
- Fill ridge to above the design height and compact with wheeled equipment to the design cross section.
- Construct sediment traps or outlet stabilization measures, as needed.
- After the area has been permanently stabilized, remove the ridge and channel to blend with the natural ground level.
- Seed and mulch diversions that are intended for use for more than 30 days.

Minimum Cross Section		
Top Width (ft)	**Height (ft)**	**Side Slopes**
0	1.5	4:1
4	1.5	2:1

Maximum Recommended Spacing	
Land Slope (%)	**Spacing (ft)**
1 or less	300
2	200
3 to 5	150
Greater than 5	100

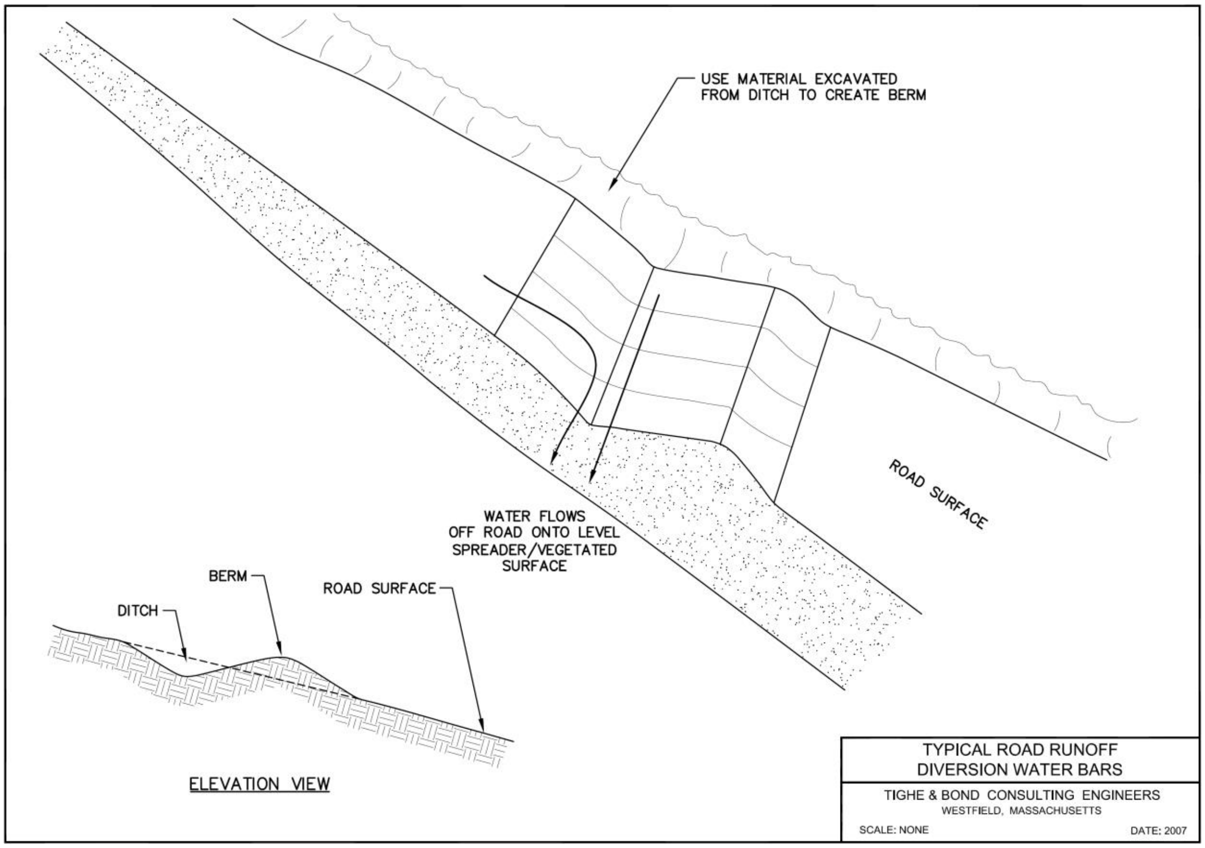
Maintenance:

- Inspect each week and after rain events. Repair damage caused by construction traffic or erosion.
- Remove accumulated sediment and debris from the trench and stabilize outlets.
- If necessary, repair ridge to a positive grade and cross section, and add gravel at crossing areas.
- Use routine inspections to determine if the original spacing is adequate or if additional water bars need to be constructed.

Additional Comments:

Water bars may include the use of hardwood logs to provide structural stability.

Diversion waterbar.


USE MATERIAL EXCAVATED
FROM DITCH TO CREATE BERM
ROAD SURFACE
WATER FLOWS
OFF ROAD ONTO LEVEL
SPREADER/VEGETATED
SURFACE
BERM
DITCH
ROAD SURFACE
ELEVATION VIEW
TYPICAL ROAD RUNOFF
DIVERSION WATER BARS
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: 2007

Drainage Swales

Applications: Convey stormwater away from work area and/or improve water quality and reduce peak runoff.

Limitations:

- Vegetated swales need to have adequately established vegetation before flow is diverted to them.
- Need to have adequate bottom stabilization to prevent scouring.

Overview:

Drainage swales usually consist of a ditch that is either vegetated or lined with rip rap, erosion control blankets, or other materials. They are natural or constructed waterways/outlets that intercept, redirect, and convey stormwater away from the work area to a stable location and are used in areas where concentrated runoff would otherwise cause erosion/flooding. Swales can be used to reduce erosion in uplands and/or prior to discharge of stormwater flows to natural receiving waters (e.g., wetlands or streams). They also help to reduce surface flow velocity and turbidity.

Grass Lined Channels (Stabilized with vegetation)

- Use where vegetative lining will provide sufficient stability, slopes are less than 5%, and space is available for large cross section.

Installation:

- Remove trees, brush and stumps.
- Excavate and shape channel to dimensions on plans. Overcut 0.2 ft for vegetative growth.
- Install temporary liner or riprap at inflows and stabilize outlets.
- Vegetate immediately after construction and divert water until grass establishes. Install matting if flow cannot be diverted.
- Install sod rather than seeding where slopes approach 5%.
- Spread topsoil to a minimum of 4 inches where soil conditions are unfavorable. Seeded channels should be mulched.

Vegetated Swales (Stabilized with dense vegetation)

- Use for water quality improvement and peak runoff reduction. Applicable for small drainage areas with relatively small amount of impervious cover. The grassed waterway is used to convey runoff at a non-erosive velocity. Dense vegetation can be established and a stable outlet constructed.

Installation:

- General design parameters are as follows: minimum capacity 10-year, 24-hour storm; design slopes to prevent erosion during the 2-year storm event; maximum side slopes 3:1; bottom width 2 to 8 feet.
- Vegetate with water resistant grasses and divert flow until established.

Riprap Lined Channels (Contains lining of riprap or stone)

- Use on sites where channel flow velocities exceed those acceptable for grass lined waterway. Applicable where vegetative establishment is not possible or there are steep grades, wetness, highly erodible soils, seepage or prolonged base flow.

Installation:

- Remove trees, brush, and vegetation from channel area.
- Stabilize inlets and install outlet protection.
- Construct channel and install filter and lining as shown on plan.
- Use the maximum stone size for riprap plus thickness of filter.

Maintenance:

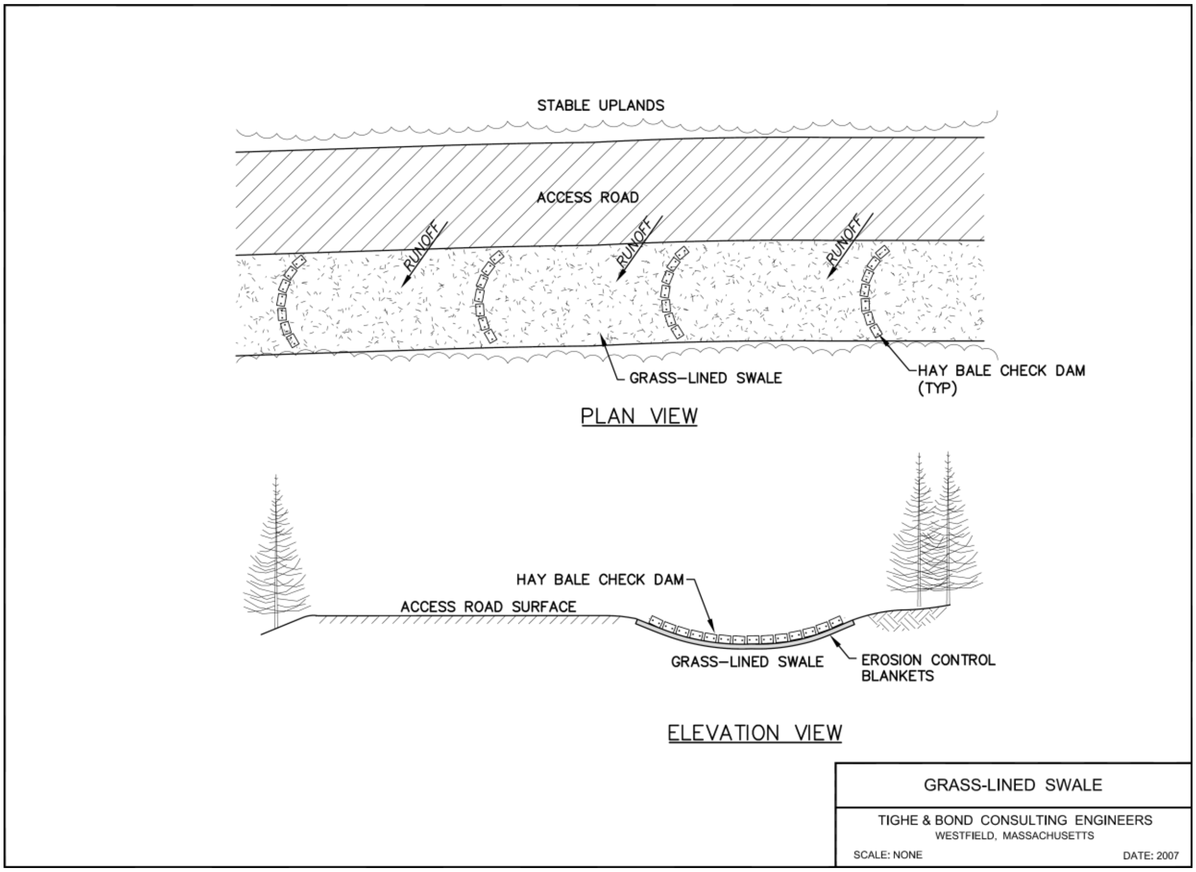
- Swales need to be routinely maintained to prevent brush/sediment buildup. Inspect swale regularly and after every rain event (0.25 inches or greater). Repair and/or re-seed rill or gully erosion. Remove accumulated sediments and brush before it reaches a depth of six inches.

Additional Comments:

- Depth and spacing of swales should be dependent on runoff conditions of the specific site.
- If required, install check dams constructed of rip rap or other materials to slow flows along certain reaches of a swale.
- Remove temporary swales once construction is complete or areas are stabilized. If leaving swales in place will allow for long-term benefits and be compatible with the ultimate use of the site, then they may remain in place.

Photo provided courtesy of Tighe & Bond, Inc.

Grass-lined swale underlain with erosion control blanket and containing hay bale check dams; used to quickly stabilize soils along a construction access road subjected to significant stormwater runoff. Blue arrow indicates direction of flow.



Sedimentation Basins

Applications: Erosion and sedimentation control

Limitations:

- Traps and basins need to be adequately sized based on expected rain events and the contributing drainage area.

Overview:

Sediment traps and basins are used to filter and settle out sediment in stormwater runoff before water is released into a wetland or other unprotected and/or sensitive area. A sediment trap is a temporary measure installed during construction to detain runoff, while a basin is a more permanent measure. Basins are also used where other erosion control measures are not adequate to prevent off-site sedimentation.

A sediment traps and basins should have three components: a forebay, a check dam, and a basin. Debris and some sediments begin to settle out of the water in the forebay. The stone or hay bale check dam filters more sediments as water flows through. The actual basin is a low velocity pool where sediments settle out of the water column before the water is released at the outlet.

Based on the size of the project area, a qualified engineer may be required to calculate the appropriate size of the basin. State-specific guidance for basin sizing can be found in the following locations:

- *Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas* (Page 140); http://www.mass.gov/eea/docs/dep/water/esfull.pdf
- *2002 Connecticut Guidelines for Soil Erosion and Sediment Control* (Section 5-11-1); http://www.ct.gov/dep/cwp/view.asp?A=2720&Q=325660.

Installation:

Drainage area of 5 acres or less

- Install to direct stormwater runoff to the sedimentation trap or basin. Form basin by excavating a depression similar to a small pond or by placing an earthen embankment across an existing drainage swale or naturally low area.
- The ratio between the basin length and width should be greater than 3:1 (L:W). A ratio of 9:1 is recommended.
- Clear, grub, and strip all vegetation and root material from area of embankment and place embankment fill in lifts (<9"/lift, max). Compact fill and construct side slopes 2:1 or flatter. Excavate rectangular outlet section from compacted embankment.
- Filter fabric may be installed on bottom and sides of basin and covered by riprap.
- Extend outlet apron/spillway below toe of dam on level grade until stable conditions are reached (5 feet minimum). Cover inside face of stone outlet section with a 1-foot layer of ½- to ¼-inch aggregate.
- Use permanent or temporary seeding to vegetate embankments, spillways, and disturbed areas downgradient of the basin.

Drainage area of 10 acres or less

- Locate the basin in an easily accessible upland area, not a wetland area.
- Install the basin so that it intercepts the largest possible amount of runoff from the disturbed area.
- Divert sediment-laden water to the upper end of the sediment pool to improve trapping effectiveness.
- Basin should have a minimum volume based on ½-inch of storage for each acre of drainage area.
- Size basin to provide a minimum detention of 12 to 24 hours at the maximum runoff quantity expected for the duration of the basin's use.

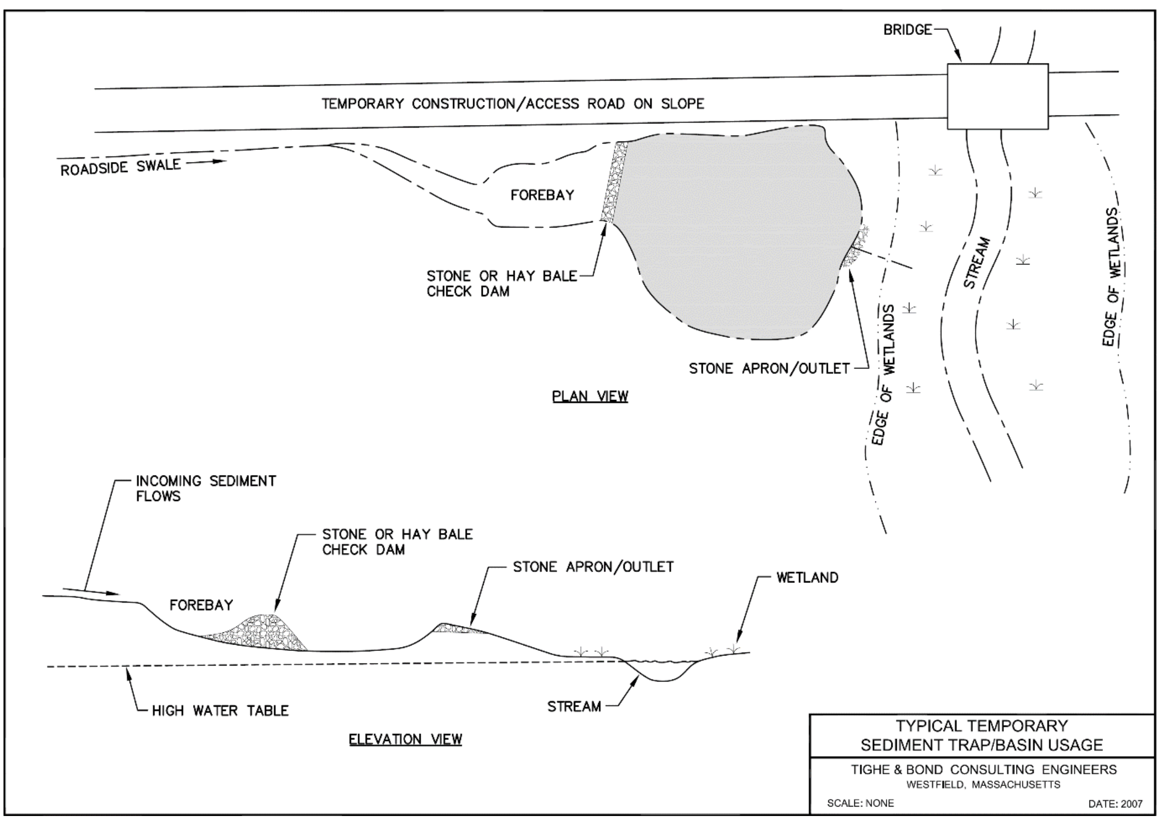
Maintenance:

- Monitor the amount of sedimentation in the trap/basin. Install a stake with a marking at half the design depth. Remove sediment when it reaches this mark.
- Inspect after every rain event.
- Clean or replace the spillway gravel and re-seed/plant vegetation, as needed.
- Monitor embankment, spillway, and outlet for erosion. Repair erosion problems immediately.

Additional Comments:

Construction of sediment traps and/or basins should occur before primary construction on a project begins. They are often a critical stormwater management component for larger construction sites and/or those with poorly drained upland soils. If compatible with the post-construction site use, it may be appropriate to leave sediment basins in place indefinitely.

Sedimentation basin with hay bale filters.



3.4.3 Construction in Wetlands

Access roads that are constructed in or across wetlands require the following considerations in addition to the considerations for access roads in uplands:

- Construction of new access roads in wetlands, whether temporary or permanent, that do not utilize construction mats (e.g., earthen and/or rock fill roads, corduroy roads) require considerable project specific permitting and design. These kinds of projects should comply with project specific permits and plans, while only using this BMP manual as a general reference source. Permits often also require wetlands replication when permanent new access roads are constructed in wetlands.
- Avoid putting the construction access road in a wetland whenever practicable. Explore all feasible and prudent alternatives before determining that a wetland crossing is necessary. When avoidance is not practicable, consider crossings that will result in the least amount of disturbance. This may involve locating the construction access road so that it crosses the wetland at its narrowest width or uses areas previously disturbed for access or other purposes.
- Minimize the width of the temporary construction access road through the wetlands (generally no wider than 16 feet when using construction mats). It is preferable to have a passing point created before and after the wetland crossing, but internal passing points may be needed if the crossing is very long or critical sight line restrictions exist.
- Construct access roads so that wildlife is able to pass under or go through the road. In areas where the road is only one construction mat thick, allow for passageways or "gaps" between construction mats. In locations where the access road is greater than one mat thick, install elevated construction mat road crossings or "bridges." Gaps and/or bridges are to be placed along the access road at intervals no less than 50 feet.
- Consider the soil conditions. Expect deep organic wetland soils to require geotextiles, construction mats, or other materials during use to keep imported road materials separated from wetland soils. In shallow organic or saturated soils, thick plywood sheets or AlturnaMATS® may be sufficient to support a stable travel surface for small, lightweight vehicles. In addition, in areas which are inundated or have deep organic wetland soils, it may be necessary to use more than one layer of construction mats.
- Prevent obstructions to surface and subsurface flow across and through the construction access road. Provide adequate drainage. This may require the use of crushed stone, a layer of log corduroy, construction mat bridges, or multiple cross culverts, particularly if the wetland does not contain a well-defined watercourse channel and/or the wetland crossing is long. If the wetland soils are susceptible to seasonal high groundwater tables or flooding, then give additional consideration for maintaining flows across and/or over the construction access road without causing erosion or siltation during such times.
- Plan in advance how the construction access road will be removed and the wetland restored. A road stabilization geotextile can facilitate the segregation of imported soils and crushed stone and/or log corduroy from the native wetland soils and make wetland restoration easier. However, after the end of an extensive project and a highly traveled crossing, stone removal from the wetland surface will still usually have to occur, even when placed in conjunction with geotextile.

In some cases, access roads may not need to be constructed in a wetland to get access into or through a wetland if the work can be designed such that disturbance to the wetland are avoided or negligible. Options to be considered are presented below.

Equipment Selection and Usage

- **Low ground pressure equipment**. Using equipment that reduces the pressure it exerts on the ground can minimize disturbance to sensitive areas. Employing the use of equipment with wide tires, rubberized tracks, and low ground pressure (<3 psi) can help minimize soil compaction.
- **Wide tires**. Increasing the width of tires will increase traveling surface area and therefore reduce the amount of ground compaction that the equipment will cause. Ultimately, this will reduce rutting, and allow for easier maneuvering of the vehicle. However, wide tires may be costly and will require a wider travel area.
- **Rubberized tracks**. Equipment with rubberized tracks spreads the weight of the vehicle over a much larger surface, reducing ground pressure and enabling the vehicle to move more freely through wet substrates. Each track can be between 1.5 and 3 feet wide, length depending on the width of the vehicle. This can greatly reduce rutting and allow the vehicle to move with less difficulty through wet substrates.
- **Lightweight equipment**. Disturbance in a wetland area can be lessened by reducing the size of equipment (e.g., ORVs, Gator™) used in sensitive areas. This reduces the amount of pressure to the travel surface as well as the necessary width of access ways.


Equipment with rubberized tracks.

Timing of Work

- **Work during frozen conditions**. Activities conducted once wetland areas are frozen can minimize rutting and other disturbance to the surrounding environment. Work during this time also generally reduces disturbance of aquatic and terrestrial wildlife movement by avoiding sensitive breeding and nesting seasons.
- **Work during the "low flow" period**. Conducting work during the low flow period can reduce disturbance to surface water and generally avoids spawning and breeding seasons of aquatic organisms. The United States Army Corps of Engineers defines the low-flow periods for streams as follows:
    - Connecticut streams—July 1 through September 30
    - Massachusetts non-tidal streams—July 1 through September 30
    - Massachusetts tidal streams—November 16 to February 15
    - New Hampshire streams—July 15 through October 1

Alternate Access

- **Manual access.** Consider accessing work areas on foot through terrestrial areas and/or by boat through open water or ponded areas. Smaller projects (e.g., repairs to individual structures or parts of structures) do not categorically require the use of heavy machinery and should be accessed manually to the extent practicable.

- **Limit trips.** Multiple trips through a wetland have shown to increase the potential for damage and requirement for matting. Try to limit trip to one in and one out.

Use of overhead/aerial access (e.g., helicopters)

- Using overhead or aerial equipment can be expensive and is not always feasible, but it may be appropriate in some situations in order to get vehicles and other equipment to a site that may be otherwise very difficult to access. The use of overhead and/or aerial equipment may be beneficial for work in areas where large water bodies, deep crevices, or mountainous areas hinder ground access.

Erosion and Sedimentation Controls

Construction personnel are reminded to control erosion and flow conditions during new access road construction by utilizing the following erosion and sedimentation measures which are described and illustrated further in Appendix A:

- **Straw wattles, Geotextile silt fencing** and **hay/straw bale barriers** may be installed at the edges of earthen roads or construction mat roads to prevent erosion of soil into wetlands from the road fill or tracked soil on construction mats.
- In areas where silt fencing is required for more than one activity season, **syncopated silt fencing** may be installed to permit animal crossings.
- Side slopes of earthen roads can be protected by installing **erosion control blankets** and **seeding** the area with a fast-growing native or annual grass mix.
- **Dust control** should be employed as necessary when construction access road conditions create airborne dust when necessary.

3.4.3.1 Best Management Practices – Construction in Wetlands

The following are BMPs that are applicable to new access roads in wetlands and are described at the following tab:

Construction Mats (includes Elevated Construction Mats and AlturnaMATs) – Tab 2A

Permeable Road- Tab 2B

Dewatering – Appendix A Section II

TAB 2A

Construction Mats (i.e., timber or swamp mats)

Applications: Wetland crossings, rut minimization

- Used for access where the ground surface is unstable due to shallow, standing water, saturated soils, or other substrates not suitable for heavy vehicles.

Limitations:

- Only for temporary use. Generally mats should be removed upon construction completion.
- May float away in high water conditions.
- Need to be installed with heavy machinery.
- AlturnaMATs® limited to smaller vehicles and equipment.
- Equipment operators should remain cautious so as not to drive off or slip off the side of the mats.
- In winter, mats must be plowed and sanded or heated to prevent equipment from sliding off mats. Use of a deicing agent requires approval by the Environmental Licensing and Permitting Group.

Installation:

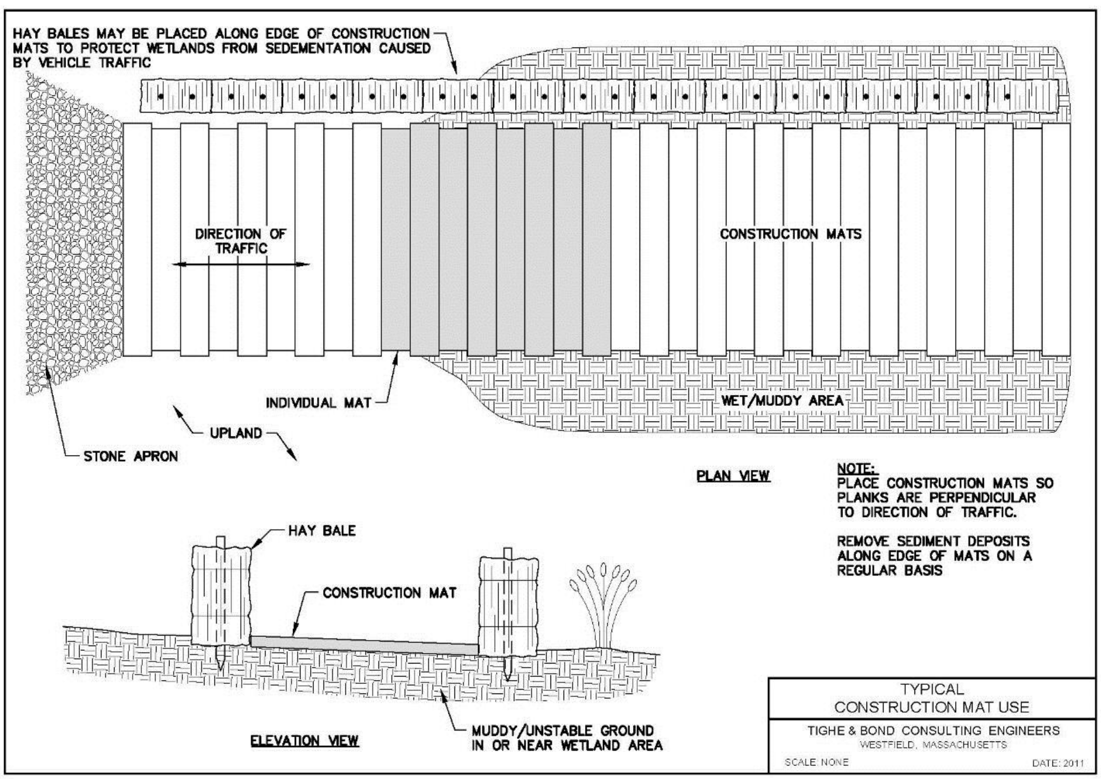
- Place mats along the travel area without any gaps and so that each board is positioned perpendicular to the direction of traffic. Position mats so that they are offset far enough from the resource area so that ruts are not created when equipment enters and exits a sensitive area.
- Remove mats by “backing” out of the site and removing mats one at a time. Regrade soils to pre-existing contours while taking care not to compact soils.
- Clean mats after use to remove any invasive plant species seed stock. Cleaning methods may include, but are not limited to, shaking or dropping mats in a controlled manner with a piece of machinery to knock off attached soil and debris, spraying with water or air, sweeping, or exposing the mats to high temperatures.
- Clean mats that were used in wetlands dominated by invasive species using brooms, shovels, and compressed air, if needed.

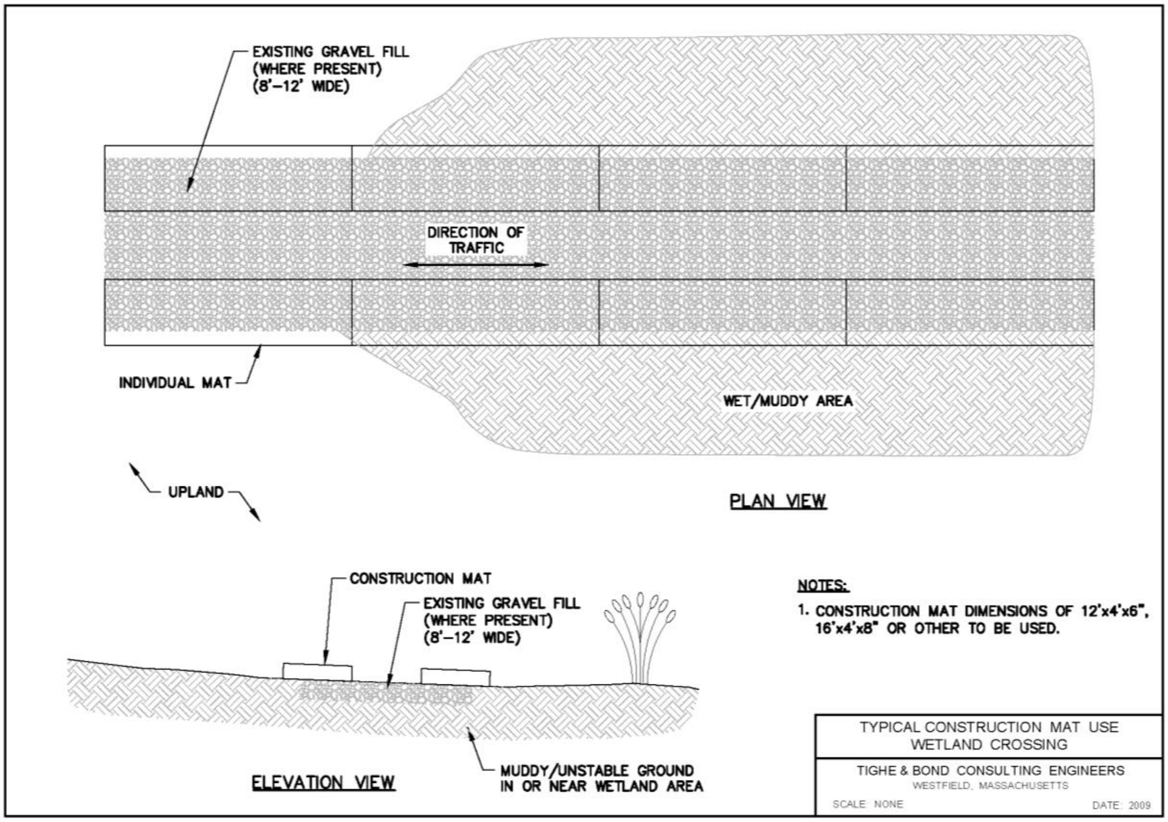
Additional Comments:

Lightweight, easy to maneuver alternatives to traditional mats are available. For example, AlturnaMATS® are half-inch thick polyethylene slip-resistant ground protection mats available in dimensions up to 4 feet by 8 feet and weigh between 21.5 and 86 pounds.

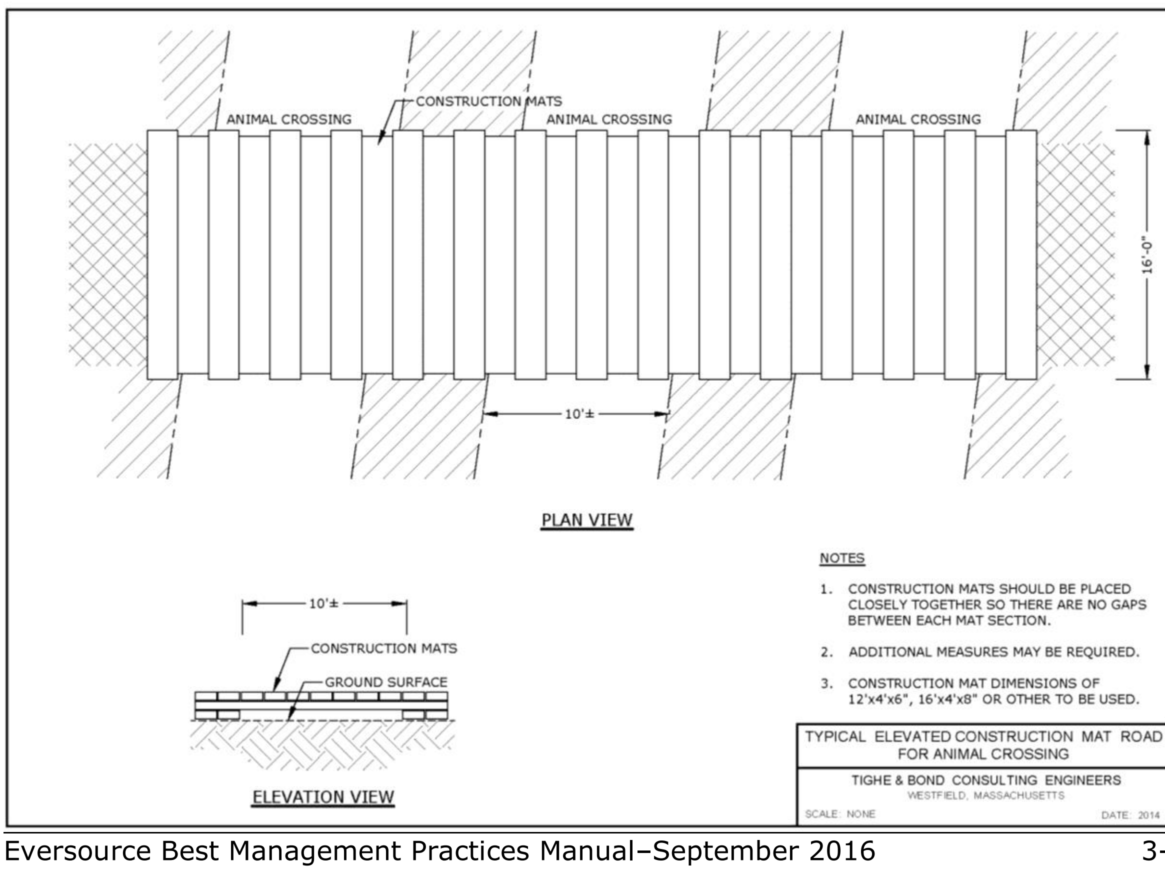
See photograph and typical sheet on following pages.

Construction mat access road.

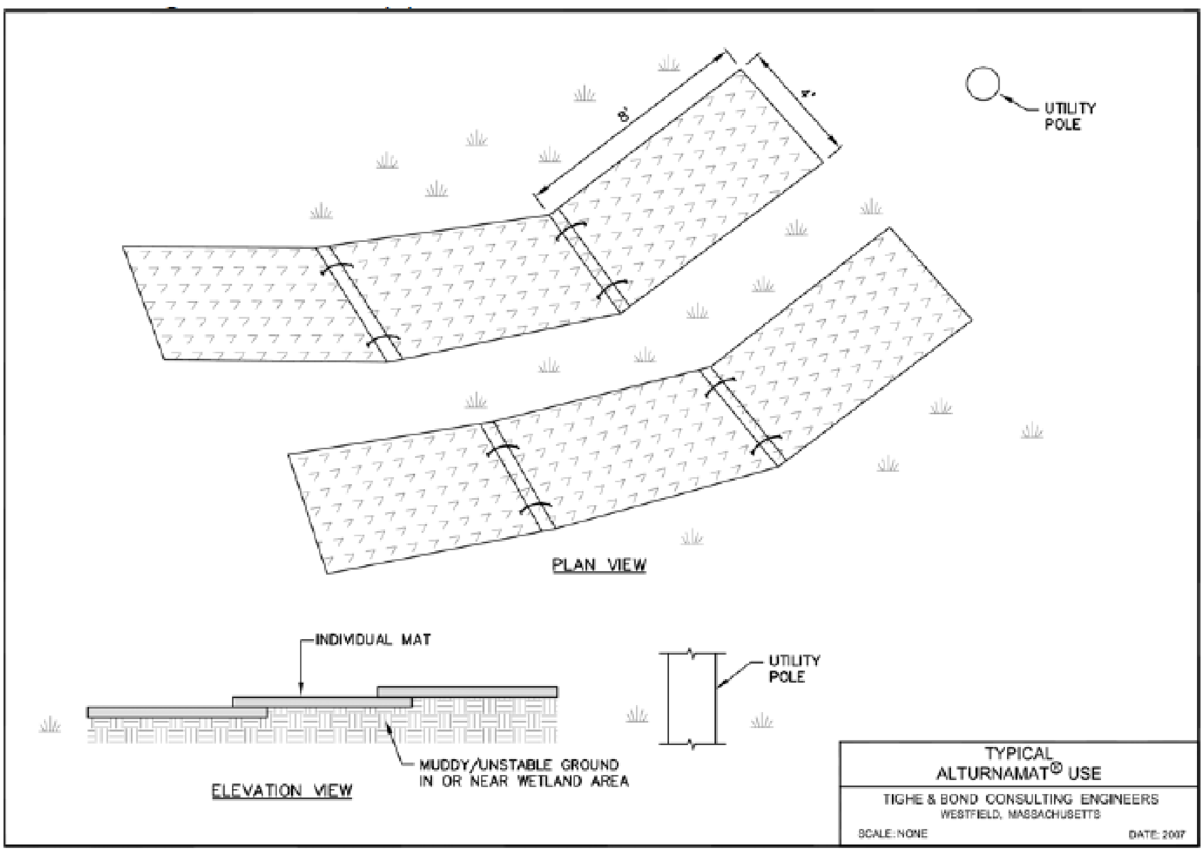



EXISTING GRAVEL FILL
(WHERE PRESENT)
(8'–12' WIDE)
DIRECTION OF
TRAFFIC
INDIVIDUAL MAT
WET/MUDDY AREA
UPLAND
PLAN VIEW
CONSTRUCTION MAT
EXISTING GRAVEL FILL
(WHERE PRESENT)
(8'–12' WIDE)
NOTES:
1. CONSTRUCTION MAT DIMENSIONS OF 12'x4'x6", 16'x4'x8" OR OTHER TO BE USED.
MUDDY/UNSTABLE GROUND
IN OR NEAR WETLAND AREA
ELEVATION VIEW
TYPICAL CONSTRUCTION MAT USE
WETLAND CROSSING
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: 2009

Elevated construction mat road with bridging for animal crossing.



AlturnaMAT® tracks to utility pole in wetland.



TAB 2B

Permeable Road (i.e., rock sandwich, French Mattress, or road with continuous cross-drainage)

Applications: Wetland crossings, rut minimization

Limitations:

- Not appropriate for areas where concentrated, high volume and/or velocity water flow will intersect the road (i.e., stream crossings).
- Need to be installed with heavy machinery.
- Equipment operators should remain cautious so as not to drive or slip off the side of the road.

Overview:

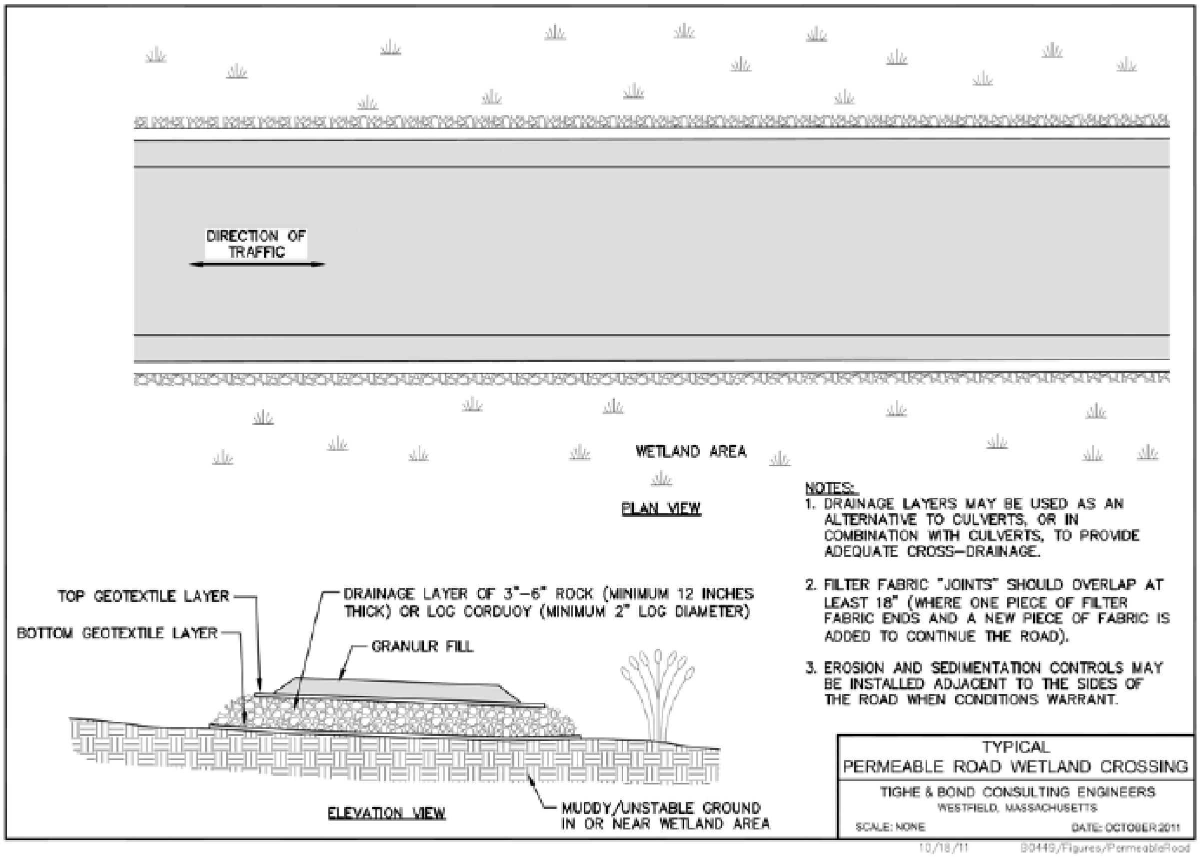
Permeable roads are used for access in situations not suitable for heavy vehicle use often due to unstable ground surfaces with shallow standing water, saturated soils, or other unstable substrate. Installation of a permeable road can also help reduce the potential for frost action and pothole creation by preventing groundwater from wicking up into the road fill material.

Installation:

- Cover existing soil with a geotextile fabric prior to road construction. Excavation of existing soil is generally not recommended in order to minimize impacts to the resource area. Construct road on top of the soil surface, as shown on the typical on the next page. Drainage layer materials include 3- to 6-inch rock (12-inch minimum depth) or log corduroy (2-inch minimum diameter).
- Install the road so that it is offset far enough from the resource area so that ruts are not created when equipment enters and exits a sensitive area.
- Remove road by "backing" out of the site and removing road one section at a time. Regrade soils to pre-existing contours while taking care not to compact soils.

Maintenance:

- Regularly inspect and clean edges of cross-drainage layer along the sides of the road to prevent clogging by debris, leaf litter, sediment, etc.


DIRECTION OF TRAFFIC
WETLAND AREA
PLAN VIEW
NOTES:
1. DRAINAGE LAYERS MAY BE USED AS AN ALTERNATIVE TO CULVERTS, OR IN COMBINATION WITH CULVERTS, TO PROVIDE ADEQUATE CROSS-DRAINAGE.
2. FILTER FABRIC "JOINTS" SHOULD OVERLAP AT LEAST 18" (WHERE ONE PIECE OF FILTER FABRIC ENDS AND A NEW PIECE OF FABRIC IS ADDED TO CONTINUE THE ROAD).
3. EROSION AND SEDIMENTATION CONTROLS MAY BE INSTALLED ADJACENT TO THE SIDES OF THE ROAD WHEN CONDITIONS WARRANT.
TOP GEOTEXTILE LAYER
BOTTOM GEOTEXTILE LAYER
DRAINAGE LAYER OF 3"-6" ROCK (MINIMUM 12 INCHES THICK) OR LOG CORDUOY (MINIMUM 2" LOG DIAMETER)
GRANULR FILL
ELEVATION VIEW
MUDDY/UNSTABLE GROUND IN OR NEAR WETLAND AREA
TYPICAL
PERMEABLE ROAD WETLAND CROSSING
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: OCTOBER 2011
10/18/11
B0449/Figures/PermeableRoad

3.4.4 Watercourse Crossings

There are a number of BMPs that can be used to minimize disturbance to streams. For each application, consider the site and project needs to select a method that is cost effective and will incur the fewest secondary disturbances. Additional erosion and sedimentation controls (e.g., hay or straw bales) may be required in conjunction with the stream crossing BMPs to protect sensitive areas. The stream crossing methodology chosen will depend largely on the equipment required for a particular task, the existing environmental conditions, and the duration of the crossing. In constructing any stream crossing, care should be taken to limit disturbance to the extent practicable within 100 feet of the stream banks (the riparian area). The riparian area provides habitat to a number of species and provides protection and shading to the stream.

Erosion and Sedimentation Controls

Construction personnel are reminded to control erosion and flow conditions during new watercourse crossings by utilizing the following erosion and sedimentation measures which are described and illustrated further in Appendix A:

- **Straw wattles, Geotextile silt fencing** and **hay/straw bale barriers** may be installed at the edges of earthen roads or construction mat roads to prevent erosion of soil into watercourses from the road fill or tracked soil on construction mats. These controls however should generally not be placed within a watercourse.
- Side slopes of earthen roads can be protected by installing **erosion control blankets** and **seeding** the area with a fast-growing native or annual grass mix.

3.4.4.1 Best Management Practices – Watercourse Crossings

The following are BMPs that are applicable to new access roads watercourse crossings and are described at the following tabs:

Stream Crossings without Bridges (includes limiting turbidity and stone crossing) – Tab 3A

Bridged Crossings (includes construction mat bridges and rail car frame bridges) – Tab 3B

Culverts – Tab 3C

Poled Fords – Tab 3D

Dewatering – Appendix A Section II

TAB 3A

<u>Stream Crossings Without Bridges: Limiting Turbidity</u>

<u>Applications</u>: Stream crossing, turbidity control

<u>Limitations</u>:

- Limited to areas where stream banks and bottoms will not be significantly damaged by the crossing.

<u>Overview/Use</u>:

- In some situations, such as routine or emergency maintenance with small ORVs, pickup trucks or tracked equipment, it may be acceptable for equipment to simply travel (perpendicularly) through a stream.
- Crossings are generally considered acceptable in situations where there is an existing or historic access road, a stable rock or sand/gravel stream bottom, and/or the crossing is at a relatively narrow reach of the stream and any adjacent wetlands.
- Cross streams slowly to minimize in-stream turbidity.

<u>Stream Crossings Without Bridges: Stone Crossings</u>

<u>Applications</u>: Stream crossing, turbidity control

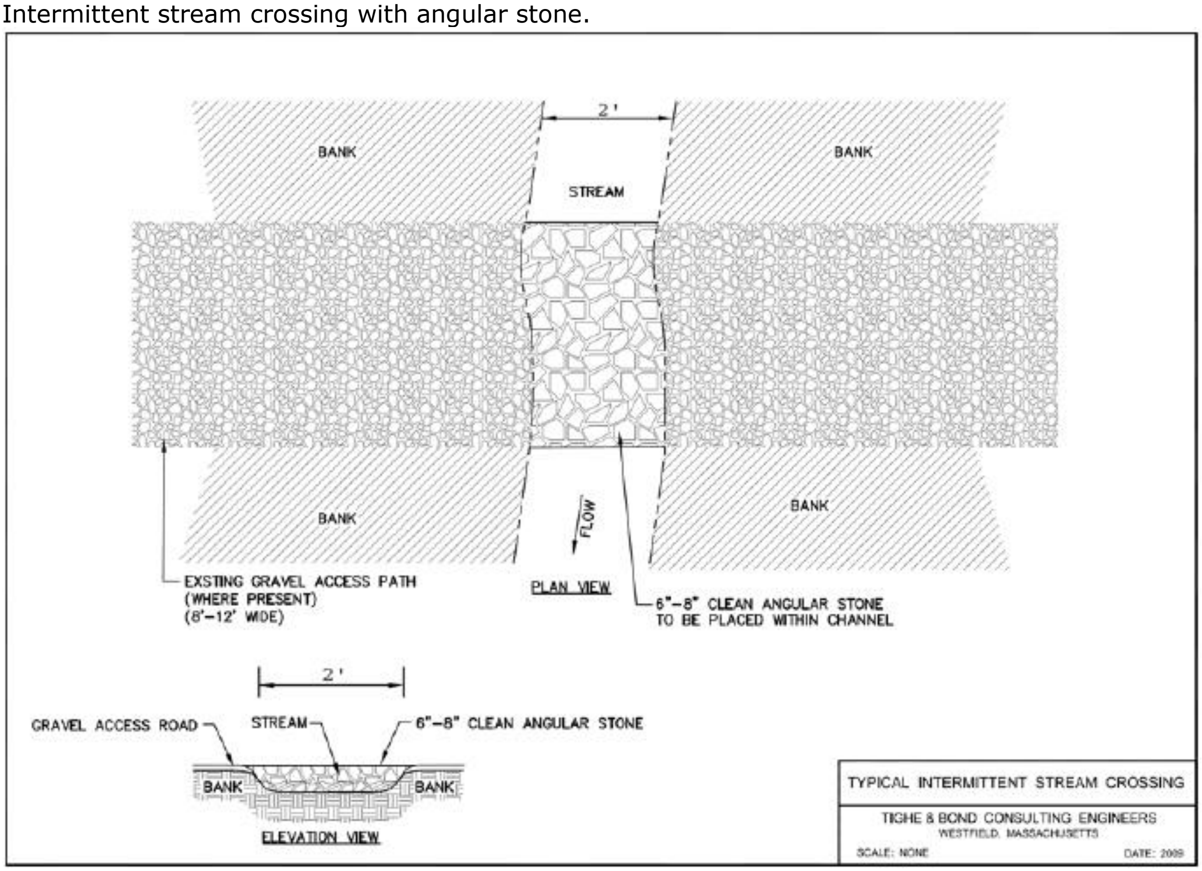
<u>Limitations</u>:

- Only use in small (less than 2-feet wide or braided) intermittent streams which do not appear on USGS topographic maps, and have a downstream section with a gradient greater than 20%.
- Not suitable in areas where there could be a potential for fish passage.
- Stone size should be sufficient to allow for macroinvertebrate passage.
- Not preferred for new access road crossings. Generally is a BMP more suitable for existing access road crossings.

<u>Overview/Use</u>:

- Use to cross small streams with stable stream bottoms.
- Carefully place 6-inch to 8-inch clean angular stone within stream at crossing. Limit width of stone to that needed for widest vehicle/equipment to crossing the stream.
- Drive over stone slowly.
- Leave riprap in intermittent streams for future use. More damage will occur by removing stone.

Intermittent stream crossing with angular stone.



TAB 3B

Bridged Crossings: Construction Mats as Temporary Bridge

Applications: Watercourse crossings

Limitations:

- Installation requires machinery.
- May become unstable under high flows.

Overview/Use:

- Untreated wooden construction mats may be used as a temporary bridge over a stream to allow construction vehicles access to the work site. Construction mat bridging is suitable for crossing intermittent and perennial streams. Before constructing a stream crossing, confirm that the construction mats are capable of supporting the equipment to be used.
- Place small sections of matting on either side of the stream parallel to the flow of water at top of banks to act as supports. Then place mats perpendicular to the stream and resting on top of the initial construction mat supports.
- It may be necessary to place a large steel plate along the top of the construction mats for extra stability and to minimize the amount of sediment that could fall between the spaces of each timber.

Construction mat bridge.

Bridged Crossings: Rail Car Frame as Temporary Bridge

Applications: Watercourse crossings

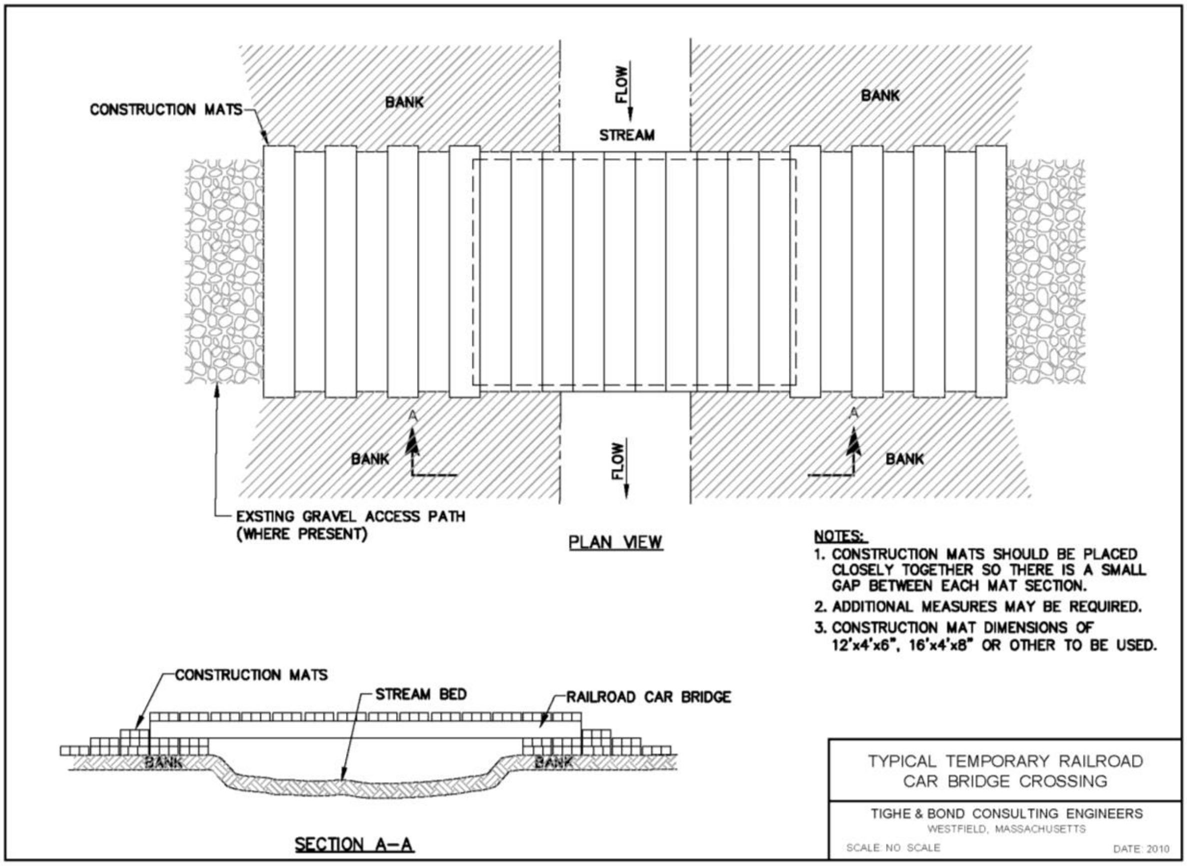
Limitations:

- Requires heavy equipment for transport and installation.
- Expensive.
- Banks must be stable to support heavy loads.

Overview/Use:

- Used rail car frames can be used for crossing larger and deeply incised streams where construction mats are unsuitable.
- Place the rail car frame perpendicular to the stream flow and between opposing banks. Use timber frame footings, if necessary. Next, place construction matting on the rail car frame to provide vehicle access.

Rail car frame bridge crossing.


CONSTRUCTION MATS
BANK
FLOW
STREAM
BANK
A
BANK
FLOW
A
BANK
EXSTING GRAVEL ACCESS PATH
(WHERE PRESENT)
PLAN VIEW
NOTES:
1. CONSTRUCTION MATS SHOULD BE PLACED CLOSELY TOGETHER SO THERE IS A SMALL GAP BETWEEN EACH MAT SECTION.
2. ADDITIONAL MEASURES MAY BE REQUIRED.
3. CONSTRUCTION MAT DIMENSIONS OF 12'x4'x6", 16'x4'x8" OR OTHER TO BE USED.
CONSTRUCTION MATS
STREAM BED
RAILROAD CAR BRIDGE
BANK
BANK
SECTION A-A
TYPICAL TEMPORARY RAILROAD CAR BRIDGE CROSSING
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NO SCALE
DATE: 2010

TAB 3C

Culvert Installation/Repair/Replacement

***Contact Environmental Licensing and Permitting prior to performing any culvert installations or replacements.**

Applications: Stream and wetland crossings

Limitations:

- Permitting and design are required for new culvert installation or expansion of existing culvers over streams and wetlands. Significant regulatory requirements must be followed. Permitting restrictions on time of year use.
- Installation may require in-stream work; dewatering and sedimentation concerns.
- Culverts are susceptible to washouts, sedimentation, erosion, and failure during heavy wet-weather events and flooding.
- Culverts require routine and long-term maintenance because they often become clogged with debris or other obstructions.

Overview:

Culverts are installed to maintain wetlands or streams at road crossings. Hydraulic calculations are required at all crossings to determine the area that will drain to the culvert.

General Design Guidelines:

- Size culverts to handle the maximum expected flow of the wetland or watercourse. It is preferable to one large culvert rather than multiple culverts. Corrugated culverts are favored because they slow the water velocity. Plastic pipes are preferred to metal.
- Design culverts to withstand and accommodate high flows while maintaining existing low flows and not impeding on the movement of indigenous aquatic life. Culverts must be sized to accommodate flows from at least the 100-year storm and preferably 500-year storm.
- The maximum velocity at the culvert outlet should be consistent with the velocity of the natural channel. To mitigate higher velocities, use outlet protection measures, energy dissipation, and channel stabilization, if necessary.
- Refer to state specific stream crossing guidance documents for additional design requirements:
  - Connecticut: Stream Crossing Guidelines, CT DEEP, Inland Fisheries Division Habitat Conservation and Enhancement Program, February 26, 2008, www.ct.gov/deep/lib/deep/fishing/restoration/streamcrossingguidelines.pdf
  - Massachusetts: Massachusetts River and Stream Crossing Standards, River and Stream Continuity Partnership, March 1, 2006, Revised March 1, 2011, www.nae.usace.army.mil/Portals/74/docs/regulatory/StreamRiverContinuity/MA_RiverStreamCrossingStandards.pdf

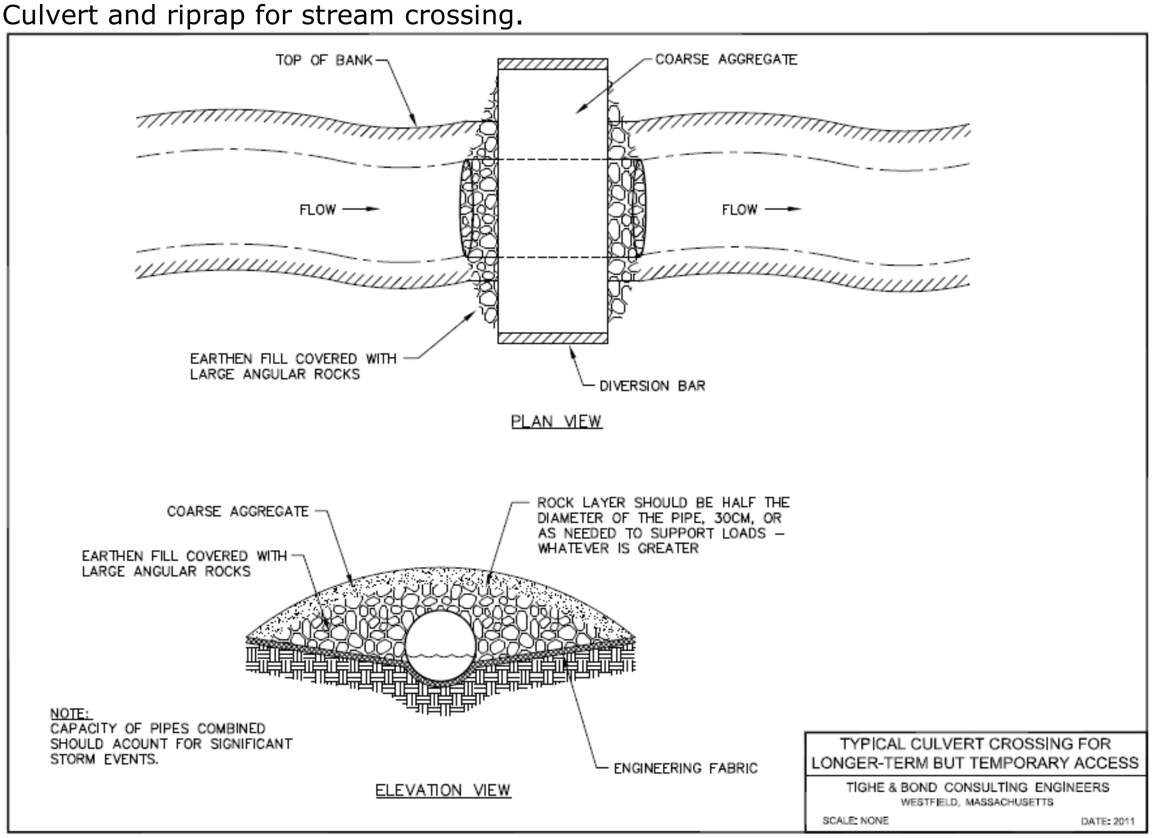
Installation:

- Construction mats may be placed over culverts to provide structural protection from heavy loads.
- Backfill culverts with natural substrate matching the upstream and downstream streambed substrate, even when fish passage is not a concern. Other aquatic organisms rely on natural streambed sediment to aid their movement.
- Strive to install culverts with minimal disruption to the watercourse and riparian buffer zone.
- Culvert length should be as short in length as practicable. Cut culverts to size if they are protruding into the natural streambed.

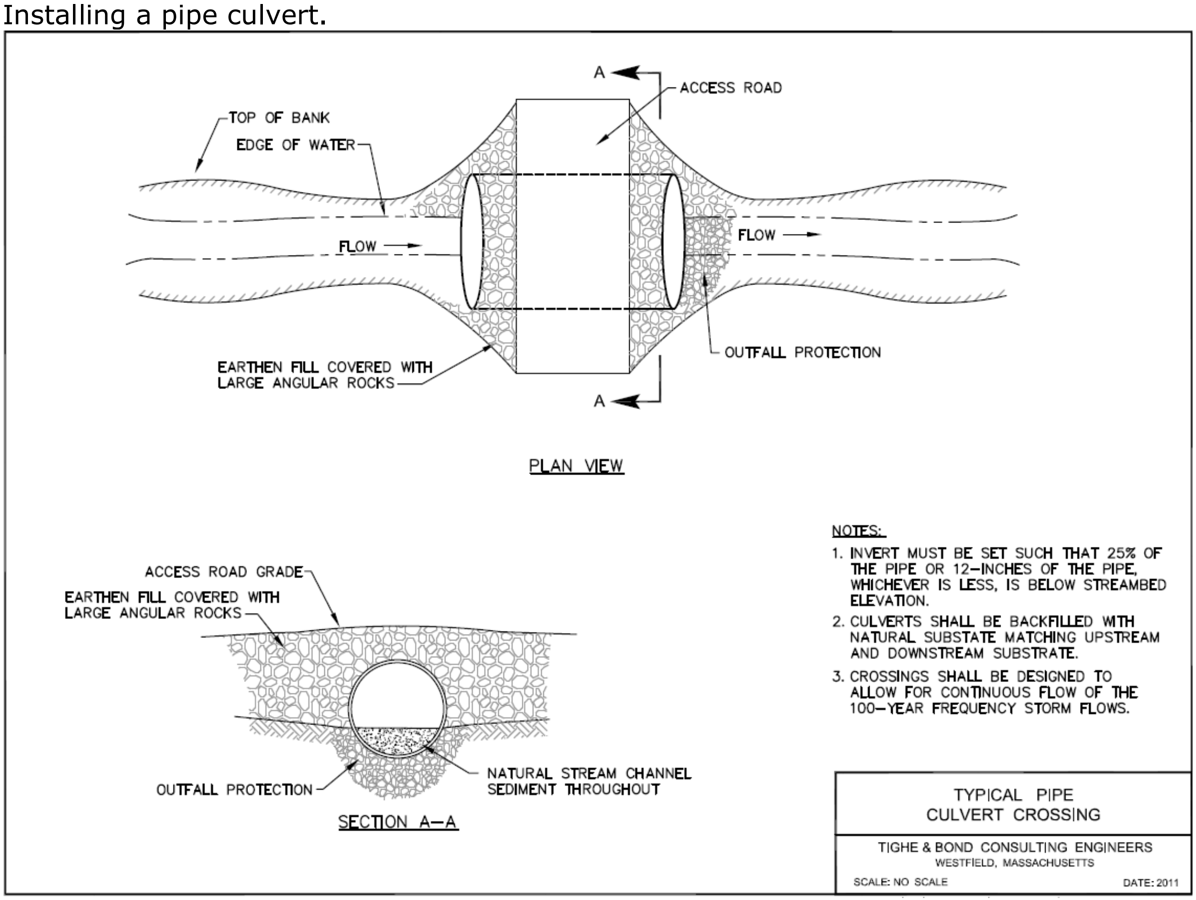
Maintenance:

- Remove debris and sediment from culverts to maintain an open channel for flow. A clogged culvert could result in flooding and washout.

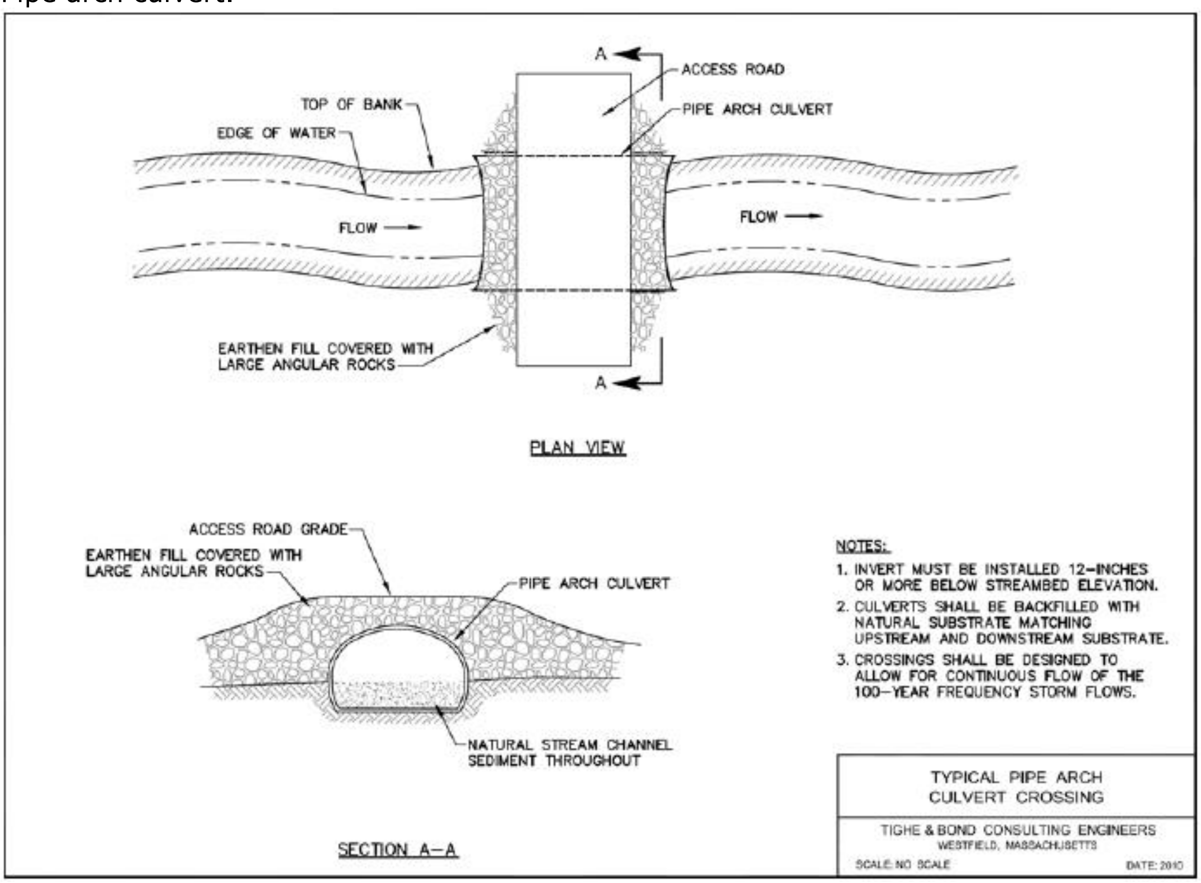
Culvert and riprap for stream crossing.



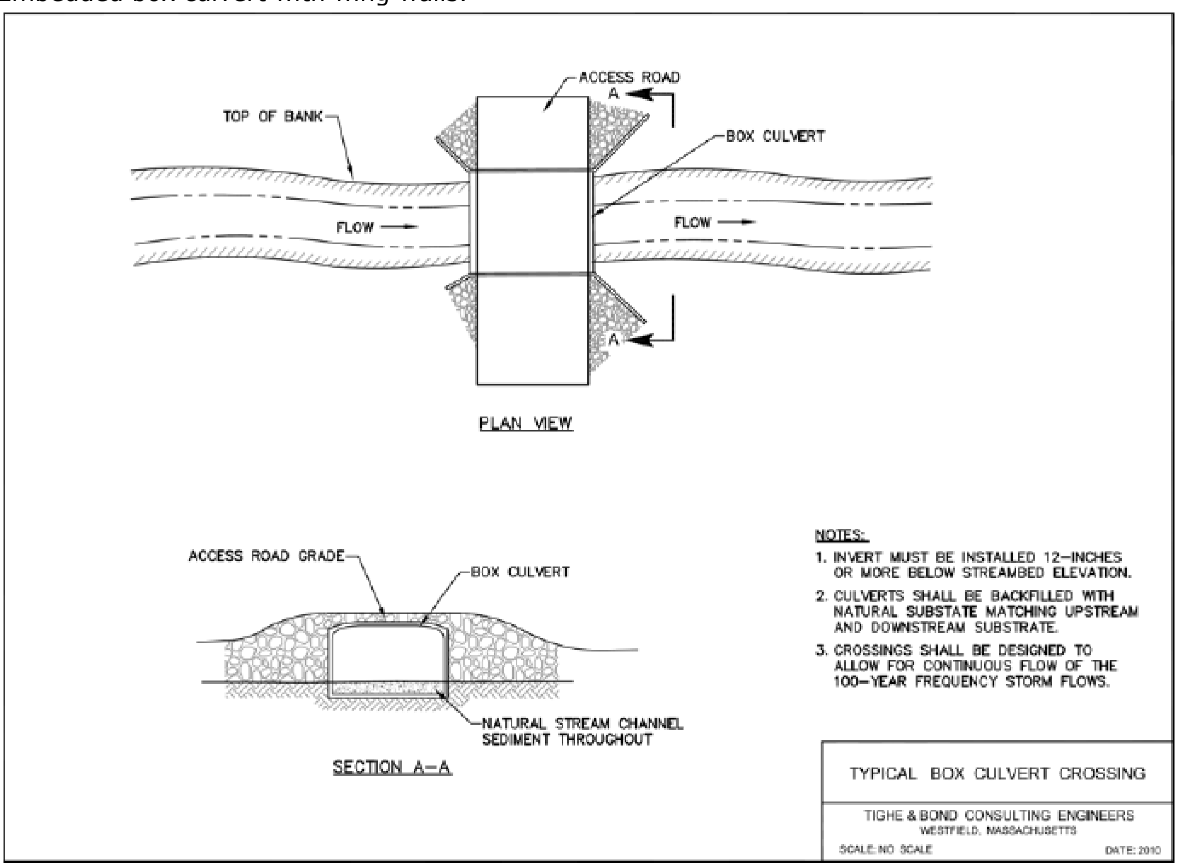
Installing a pipe culvert.



Pipe arch culvert.



Embedded box culvert with wing walls.



TAB 3D

Poled Fords

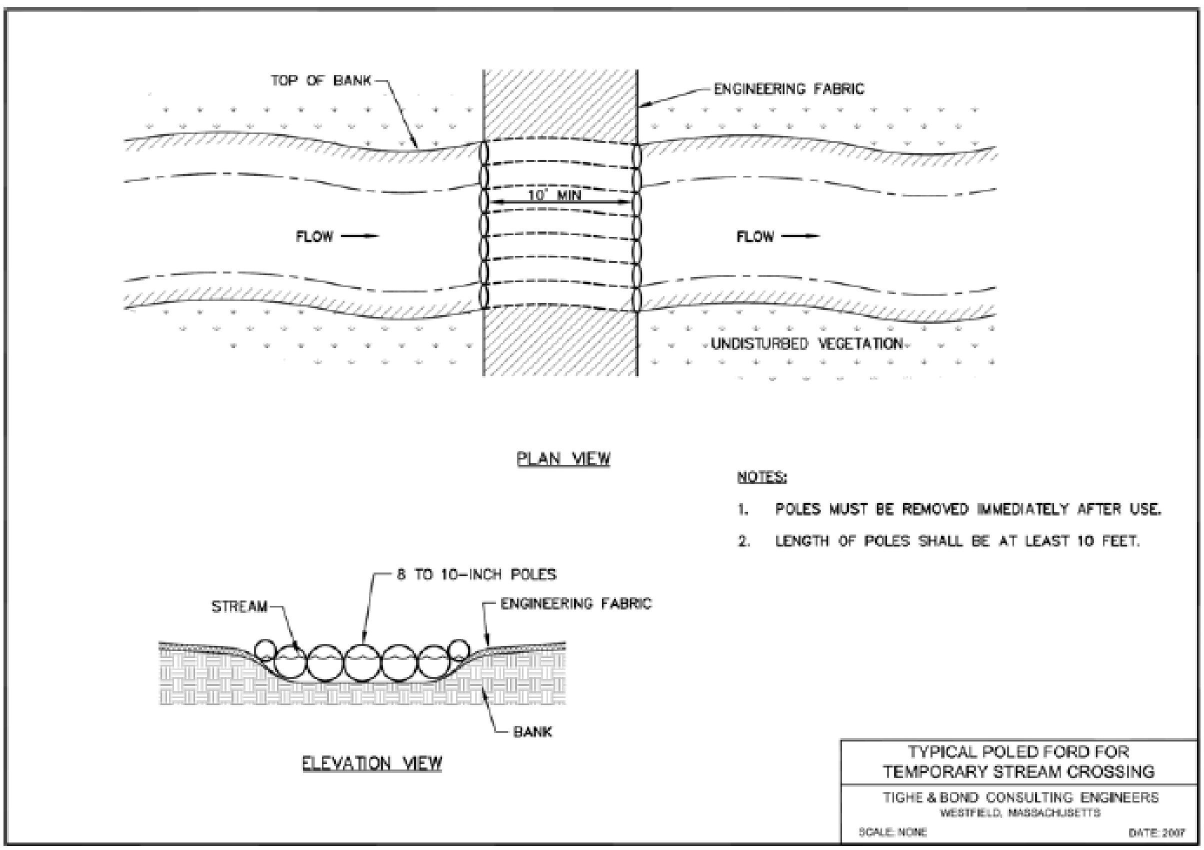
Applications: Stream Crossings

Limitations:

- Limited to streams with gently sloping adjacent land.

Overview/Use:

- Poled fords are used in remote locations where a stream crossing requires a functional BMP, but it is impractical to bring in larger materials. Sufficiently sized wood poles or saw logs of may be laid in the streambed parallel to the flow.
- Gently slope the road to and from the streambed at a maximum ratio of 1:5 (V:H). To limit disturbance to the riparian area, install engineering fabric and cover with an aggregate bed at the approach and exit.
- Use poles with a minimum length of ten feet.
- Remove poles immediately after use.



3.5 Slope Excavation

Engineering designs may be required for any upland changes that could potentially direct or channel water across the face of a terrace escarpment slope. No snow or soil piles, construction materials, or equipment should be stored in the immediate vicinity at the top of the terrace escarpment slope.

3.6 Vegetation Removal and Preservation

Care should be taken to limit disturbance to the extent practicable when removing vegetation. Grubbing is not preferred as it results in considerable erosion and should be avoided to the extent feasible. Utilize grubbing only when all other methods cannot be used to prepare stable and safe work areas. If grubbing is necessary, the area must be covered with seed and mulch to protect it prior to the end of the work day. During mowing and trimming, woody debris greater than two (2) inches in diameter should not be placed in wetlands, and no woody debris should be placed in standing water. All woody debris must be removed from wetlands if required by a permit condition. Mowing must be kept to a minimum, particularly at road crossings.

3.6.1 Right of Way (ROW) Vegetation and Eastern Box Turtle (EBT)

Eastern box turtles (EBT) are often found near small streams and ponds and inhabit old fields, deciduous forests, and logged woodlands. Adults are completely terrestrial, while the young may be semiaquatic and hibernate on land by digging down in the soil between October and April. EBTs have an extremely small home range and can usually be found in the same area year after year. EBT populations have been negatively impacted by the loss of suitable habitat. Some turtles may be killed directly by construction activities, but many more are lost when important habitat areas for shelter, feeding, hibernation, or nesting are destroyed. As remaining habitat is fragmented into smaller pieces, turtle populations can become small and isolated. Therefore, vegetation removal in ROWs should be performed in a manner that minimizes impacts to turtle populations.

Cleared and Maintained ROW—EBTs have been found to use existing ROWs for foraging and nesting. Whenever feasible, perform maintenance mowing in identified habitat during inactive periods (November 1 to April 1). If mowing during the active turtle season (April 1 to November 1) is required, mow vegetation to no lower than seven (7) inches. Use Brontosaurus or Fecon mower heads to minimize the impact to identified habitat areas. Do not used Flail-type mowers during the active season.

Uncleared ROW—When project work requires vegetation removal in an uncleared ROW, cut and mow uncleared portions of EBT habitat during the active season (April 1 to November 1). If clearing must be conducted during hibernation periods, pre-planning will involve conducting a turtle survey and the possible use of telemetry. Consult Environmental Licensing and Permitting before performing work because this activity may not be covered under the Operation and Maintenance Plan and may require a permit.

		Recommended Maintenance Activity if the Existing ROW is:	
Time Period	Turtle Status	Cleared and Maintained	Uncleared
April 1 to November 1	Active	_Perform only if required_—Mow vegetation no lower than seven (7) inches and use recommended mower heads	_Recommended_—Cut and mow uncleared areas
November 1 to April 1	Inactive	_Recommended_—Perform maintenance mowing	_Not recommended_—Requires turtle survey at minimum before removing vegetation

General Construction Recommendations –The following are general construction guidelines for protecting turtles:

- Install silt fencing around the work area prior to construction activity. Consider using syncopated silt fencing (Appendix A).
- Turtle training is required for all contractors. Apprise workers of the possible presence of turtles and provided a description of the species. Include a turtle sweep reminder on the Tail Board.
- Conduct a turtle sweep after installing silt fencing and before conducting work.
- Perform daily turtle sweeps in work areas before performing any work.
- Carefully move any turtles that are discovered to an area immediately outside of the fenced area. Position turtle in the same direction that it was walking.
- Perform work with caution during early morning and evening hours. Take special care not to harm basking or foraging individuals.
- Remove silt fencing after work is completed and soils are stable so that reptile and amphibian movement between uplands and wetlands is not restricted.
- Return temporary cross country access routes to pre-construction grade, seed if adequate root and seed stock are absent, and mulch. Do not seed pre-existing sandy soils that are within mapped rare turtle habitats unless directed by Environmental Licensing and Permitting in order to avoid altering nesting habitat

3.6.2 Preservation of Existing Vegetation

Preserve the existing vegetation (i.e., groundcovers, vines, shrubs, trees) on a site when practicable to improve soil stability and decrease the runoff volume and velocity. Identify and protect specified trees for erosion and sediment control benefits and/or aesthetic purposes. Consider saving trees that provide shading or screening benefits, particularly in residential areas. Preserve existing vegetation by reducing the width of a cleared ROW at stream crossings. See Appendix A for preserving existing vegetation BMP.

3.7 Work Pads

3.7.1 De-Energized and Energized

Applications: Work in wetlands

- Reconnaissance of each workpad area in or adjacent to wetlands should be performed to determine if the construction mat workpad areas could be located outside of wetland resource areas. Wetland disturbances should be avoided or minimized where practicable. Contact Environmental Permitting and Licensing.

Limitations:

- Requires heavy machinery for installation.
- Significant amount of time required for installation and removal.
- Pads for live line work require a considerably larger footprint.
- Several layers of matting may be needed in deep, construction areas.
- Animals may be injured or killed when attempting to cross workpads.
- May not be suitable in deep/open water wetlands.

How to Use:

- Work at structures may require placement of construction mats to provide safe and stable workpad areas for employees and contractors.
- Live line work, which is work that is done while the line is energized, requires a much larger workpad area. Efforts should be made to stay out of wetland areas to the extent practicable.
- Sizes of workpads vary based on the type of work being proposed.
- Workpad areas may extend into wetlands where structures that require maintenance either fall within or are in close proximity to wetlands. In these cases, untreated wooden construction mats shall be used to limit disturbance.
- Install silt fencing around work pads in identified amphibian and reptile priority habitat and where matting is greater than one mat thick. The exclusionary silt fencing will deter animals from moving across workpads and reduce the likelihood of being crushed by heavy equipment.
- Following construction activities all mats at each workpad and vehicle access locations must be removed.
- Remove mats by "backing" out of the site and removing mats one at a time. Regrade soils to pre-existing contours while taking care not to compact soils.
- In areas with invasive species, plant material should be removed from mats following removal from the infested area to prevent the spread of invasive species.

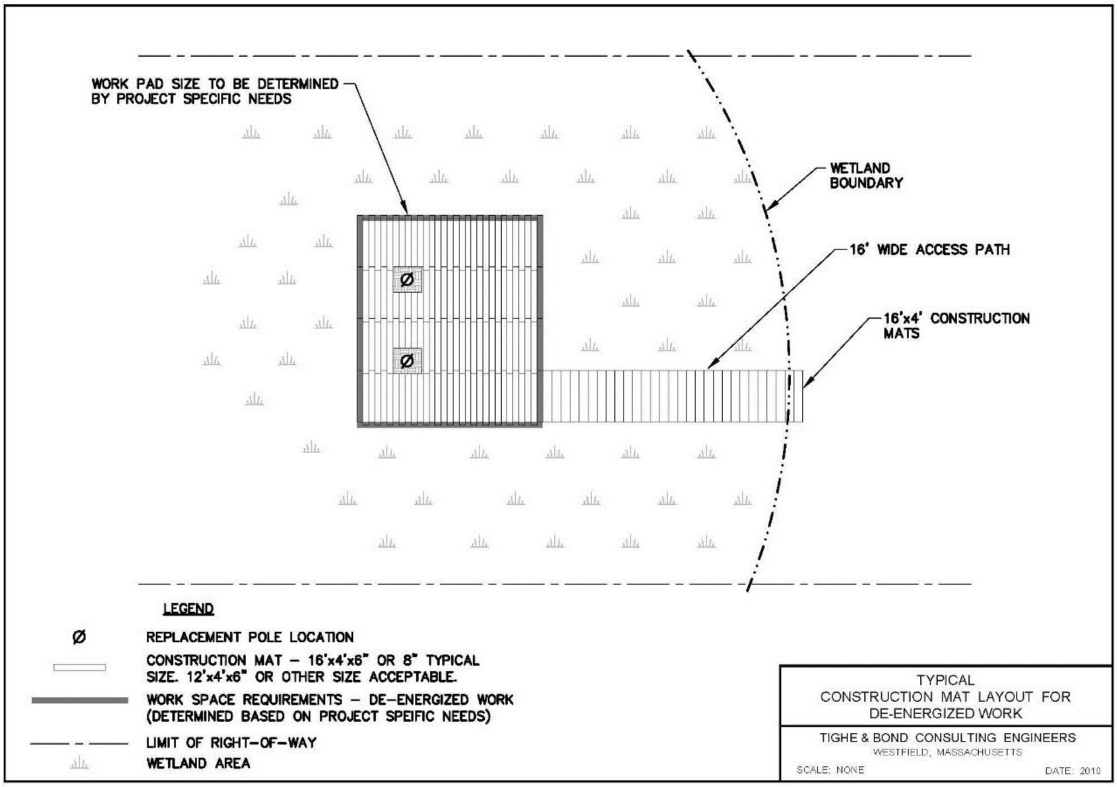
3.7.1.1 Best Management Practices – Work Pads

De-energized work requires small workpad areas, while live line work (i.e., work that is done while the line is energized) requires a much larger workpad areas.

De-energized construction mat workpads – Tab 4A

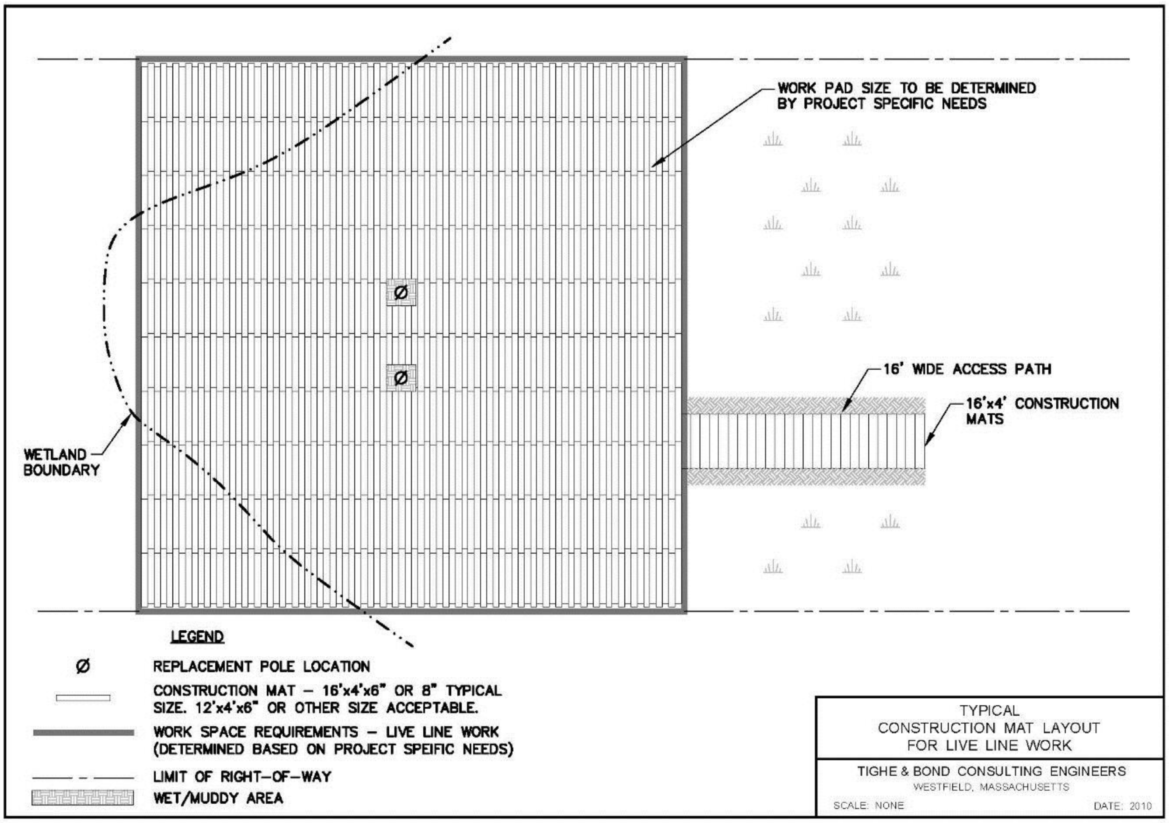
Energized construction mat workpads – Tab 4B

TAB 4A



Construction mat wetland work-pad for de-energized work.

TAB 4B



Construction mat wetland workpad for live line work.

3.8 Structure-Related Work

3.8.1 Wetland

Structure-related activities that may occur in wetlands include structure replacement/ installation (including casing installation), guy wire anchor installation, counterpoise installation, and pole butt removal. Access to these areas and completion of the activities can cause disturbance to wetland vegetation and soils. Therefore, structure-related activities in wetlands should entail use of adequately sized work-pads and proper dewatering methods. Inspection of the construction access and associated dewatering measures should occur daily during construction to ensure that controls are in working order, and repairs to damaged/deteriorating controls are made in a timely matter. Repairs may include regrading the traveled surface to eliminate ruts as well as those repairs required by each erosion and sedimentation measure used.

Structure Replacement/Installation

Structure replacement may require impacts to wetlands to install new poles and their casings. Poles that are significantly damaged must be replaced to comply with engineering and safety standards. Not replacing damaged structures could result in the eventual failure of one or more structures within or adjacent to wetlands.

Replacement structures will often be replaced within a few feet of the original structure to maintain the required distances and line sags between other existing structures. Therefore, options for relocating proposed replacement structures are limited. Pole replacement will also require placement of construction mats in wetlands to provide a safe workpad for the required structure replacement activities. Usually, there are no alternatives to conduct this work from nearby upland areas or to install the replacement structures in upland areas. Each structure replacement area should be assessed to determine the required footprint needed for construction mat workpads. Typical installation is as follows:

- At each pole location, remove wetland topsoil with an excavator and stockpile.
- If a borehole is drilled, collect and dispose of drilling spoils in an upland area.
- A galvanized steel casing is then driven into place at least 12 inches below the ground surface. The new pole is installed within the casing with a crane. The casing is then backfilled with crushed rock and compacted.
- Stockpiled wetland topsoil is placed above the casing to the ground surface. No net fill in wetlands occur, as the original poles are removed.
- Following installation of the new structures, the old structures are removed. Each pole is cut with a chainsaw and allowed to fall to the ground, which in wetland areas is protected by construction mats. Pole butts will remain in place; if removing the pole butt will cause more damage than if left in place.
- Remove the pole and all appurtenant accessories (e.g., cross-arms, insulators) and properly dispose off-site. Remove each pole butt by pulling with an excavator positioned on a construction mat. If it is apparent that pole removal will compromise the integrity of the new pole installation, or that removal will result in additional disturbance to wetland areas, cut off the old pole at least 12 inches below ground level.

Guy Wire Anchor Installation

Guy wire anchors supporting the structures may also require replacing. There are two types of anchors: 1) helical and 2) plate type. The helical anchor is preferred over the plate anchor because the installation of the helical anchor results in less disturbance to the wetland.

- Load test the existing anchor to 15,000 pounds to determine whether it will support the pole structure. In the event the existing anchor cannot be re-used, remove it and install a new anchor.
- Screw in place a special triple helix ("screw type") anchor with 1 ½-inch square rods with an anchor installation rig operated from the matting area. Add rod sections in five foot increments as needed until proper holding capacity of the anchor is achieved.
- Helical anchors are turned into the ground with only the rods protruding. Disturbance to the wetland from the helical anchor is minimal.
- Plate anchors are used in wetlands when proper holding cannot be achieved with screw anchors. To install a plate anchor, a pit is excavated to a sufficient depth and if necessary a concrete footing would be installed several feet below surface grade.
- When excavating to install plate anchors, segregate the top 12 inches of wetland topsoil from the underlying material. When the plate anchor has been set, backfill the excavation with underlying material. Then following the backfilling of underlying material return the segregated topsoil to the surface of the excavation.

Counterpoise Installation/Grounding

To install grounding equipment in wetlands, use hand digging or minimally invasive methods to dig around the structure and restore soil to previous grades. In some cases, grounding rods can be driven directly into the ground with hand tools. Where work is occurring in the vicinity of wetland areas, sedimentation and erosion controls will be used to limit disturbance to wetlands.

Underground facility repair/replacement

Underground facilities such as cables and conduits may be present beneath wetland areas. In the event underground facilities require repair, BMPs are required for both access and construction. Construction mats are used for access where warranted, and sedimentation and erosion controls are used to isolate the work area. During excavation activities, excavate wetland topsoil and store separately from subsurface soils. Dewatering is often required during excavation and repair activities.

An alternative to repairing a subsurface line by excavation would be to install a new line via trenching or horizontal directional drilling. The decision to use one of these alternatives is made on a case by case basis. Consult with Environmental Licensing and Permitting to determine if any permits will be needed.

Pole Butt Removal

When transmission poles are decommissioned or otherwise taken out of service, in most cases the entire pole shall be removed. Treated wood pole butts shall be removed completely from the ground and properly disposed at an off-site location. Locations where the removal of pole butts may cause significant disturbance to wetlands or other sensitive areas will be considered for exception to this practice on a site-by-site basis. The Transmission Line Construction and Maintenance Manager, in consultation with Environmental Licensing and Permitting, will be responsible for determining if a pole butt can be removed if located in a sensitive area.

All pole butt holes must be backfilled and compacted (every 3') with appropriate fill material. Existing material on-site can be reused if it does not include materials that can rot (e.g., vegetation) and cause sink holes.

Disposal

Treated and non-treated wood products owned by the Transmission Group shall be stored in an area(s) designated by the Transmission Line Construction/Contract Field Services Supervisor until collected by an approved disposal vendor.

3.9 Gas Piping-Related Work

Gas piping-related activities will typically occur within roadways or along roadway shoulders. There may be some instances where wetland permitting is required when wetlands are located adjacent to or in the vicinity of roadways. However, when work is performed within the roadway/shoulder, no permitting is typically required. In all cases, BMPs should be followed to ensure environmental compliance.

Roadways and Shoulders

When working in roadways, particularly in residential areas, the following activities should be performed in addition to standard construction BMPs:

- Repave disturbed paved areas and return to original elevations on the same day that construction is performed.
- Restore all non-paved areas to preexisting or better conditions. Replace any sod or other plantings in kind or with an acceptable alternative.
- Employ dust control as necessary to minimize airborne dust.

Under certain circumstances, gas piping must be installed beneath existing culverts within roadways. Take care to ensure that any saturated material excavated from the trench be properly stored and disposed as to not cause sedimentation issues. Implement dewatering methodologies, as required.

There may be cases where a drainage ditch or swale must be crossed to gain construction access from paved roads onto ROWs along the roadway shoulder. Install construction mats, mat bridges, or temporary culverts, as necessary, to facilitate access. Culverts should be for temporary use, sized for peak flow, and removed after construction is complete. Consult with Environmental Licensing and Permitting prior to installation.

Bridges and Culverts

Attachment of gas piping to bridges or culverts is the environmentally preferable method for crossing a wetland or watercourse. Consult with the appropriate people (engineers, the Department of Transportation (DOT), etc.) to determine if attachment to a bridge or culvert is a technically feasible option at the desired crossing location. Environmental Licensing and Permitting should also evaluate the impacts to FEMA flood storage quantities and potential Coast Guard permitting requirements. Ensure that proper erosion and sedimentation controls are in place on either side of the bridge or culvert throughout construction.

Rivers and Streams

There are two primary approaches for crossing a river or stream with a gas pipeline: direct bury (open trenching) and trenchless methods (e.g., horizontal directional drilling, standard bore/pipe jacking).

Direct bury methods involve erecting a coffer dam to isolate the work area and redirecting water flow using gravity or pumping to move water from one side of the work area to the other. Direct bury methods have larger direct environmental impacts than trenchless methods. Typical coffer dam examples are included in Appendix A.

Trenchless methods use specialized equipment to install piping beneath a waterbody (or a major roadway, railroad, etc.). The most common method used for gas piping is horizontal directional drilling (HDD) which uses remote controlled, steerable drilling equipment to install pipe along a long arc alignment. The drilling process can be divided into three steps: pilot, reaming, and pull-in. The first step is to drill a pilot bore-hole. Next, a larger diameter fly cutter is used to enlarge the opening. A specialized bentonite slurry drilling fluid is injected into the bore-hole to stabilize the surrounding soil and to lubricate and cool the drill bit. For the final step, a barrel reamer is used to further enlarge the bore-hole and to pull the pipe into place.

A notable environmental concern with HDD is called "frac-out." This occurs when drilling fluid breaks through the soil surface and into the waterbody. Regulatory agencies may require a "frac-out plan" which details preventative controls and response measures should frac-out occur. A typical frac out plan is included in Appendix D.

3.10 Construction Material along the Right of Way (ROW)

Once a site is prepared by clearing and/or installing erosion and sediment controls, materials may be stored along the ROW prior to the start of construction. Such materials may include the following: piping, poles, cross-arms, cable, insulators, stone, and other engineered backfill materials. In general, the stockpiling of stone and other unconsolidated material on construction mats should be avoided. If it is determined necessary due to access and workpad constraints, the material should be placed on a geotextile fabric and be properly contained with a sedimentation barrier such as straw wattle or hay bales. No construction materials should be placed in wetlands or other sensitive resource areas.

3.11 Winter Construction

3.11.1 Snow Management

Snow should not be stockpiled or disposed in any waterbody or near water supply sources. These include wetlands, rivers/streams, the ocean, reservoirs, ponds, stormwater catch basins, wellhead protection area, in high or medium yield aquifer, or within 200 feet of a private well. In addition to water quality impacts and flooding, snow disposed in surface water can cause navigational hazards when it freezes into ice blocks. Maintain a minimum buffer of 25 feet between any snow disposal area and the high water mark of any surface water. A silt fence or equivalent barrier should be installed between the snow storage area and the high water mark of rivers, streams, ponds, or the ocean. Consult with Environmental L&P regarding any specific state and local snow management requirements.

Avoid disposing of snow on top of storm drain catch basins or in storm water drainage swales or ditches. Snow combined with sand and debris may block a storm drainage system and cause localized flooding. A high volume of sand, sediment, and litter released from melting snow also may be quickly transported through the system into surface water and could also result in fines or a violation.

All debris in a snow storage area should be cleared from the site and properly disposed of no later than May 15th of each year. Care shall be taken not to plow road materials away when removing snow.

3.11.2 De-Icing

Where permitted, calcium chloride is the preferred de-icing agent when applied according to manufacturer's guidelines in upland areas. Sand should be used on construction mats through wetland areas. Consult with Environmental Licensing and Permitting on de-icing agents when working in a facility or substation near resource areas. Many municipalities have specific de-icing agent requirements for work within 100 feet of wetland resources and other sensitive areas.

3.11.3 Snow and Ice Management on Construction Mats

Promptly and properly remove snow from construction mats to avoid ice formation. Remove snow from construction mats before applying sand to avoid forming ice. A round street sweeping brush mounted on the front of a truck may be an effective way to remove snow from construction mats. Propane heaters may also be suitable solutions for snow removal and/or de-icing of construction mats. Sand should be collected from the construction mats and disposed of in an upland area prior to removing construction mats from wetlands. Once construction mats are removed, wetlands shall be inspected for sand buildup that may have fallen through construction mats.

3.12 Dust Control

Dust control measures are used to reduce surface and air movement of dust from exposed soil surfaces during land disturbance, demolition, and construction activities. These practices reduce the amount of dust in the air and decrease the potential for accidents, respiratory problems, and airborne sedimentation. Construction activities should be scheduled appropriately to minimize the amount of site surface exposed at one time in order to reduce the amount of areas requiring dust control. Use dust control measures on disturbed soil surfaces and exposed soil surfaces, especially during hot or dry weather periods and in areas with excessively well-drained soils. Repetitive treatments should be used as needed, or required by permits, and until the surface is permanently stabilized.

Type	Description/Use
Vegetative Cover	• Most effective and practical method. • Use in disturbed areas not subject to traffic. • Follow seeding requirements as directed by local guidelines or permit requirements.
Stone	• Cover soil surface with crushed stone/coarse gravel.
Water/Sprinkling	• Sprinkle exposed soils until wet (Water trucks may be used depending on size of the site). • Do not excessively wet the soil as this causes run-off and also wastes water.
Barriers	• Board fences, wind fences, and sediment fences control air currents and blowing soil. • Wind barriers protect soil downgradient for a distance of ten times the barrier height. • Perennial grasses and stands of existing trees also serve as wind barriers, stressing the importance of planning work phasing properly and minimizing the amount of exposed soil.
Plastic Covering	• Cover soil piles with sheets of plastic/tarp to minimize dust.
Calcium Chloride	• Loose, dry granules of calcium chloride may be applied with a mechanical spreader. • Apply at a rate that keeps the surface moist but not high enough to cause water pollution or plant damage. This method should be done under consultation with an expert in order to maintain this balance and to determine if the site is applicable.

3.13 Soil Stockpile Management

Some projects may involve excavation and stockpiling of soil. Stockpiles should be located outside sensitive areas to the extent practicable and managed to prevent erosion and sedimentation of adjacent areas. Typical measures include the installation of protective measures (e.g., siltation fence and/or hay bales) around the perimeter of the stockpile. The stockpile must be seeded if left in place for more than 30 days. No snow or soil piles, construction materials, or equipment should be stored in the immediate vicinity at the top of a terrace escarpment slope.

When polluted/contaminated soil is encountered, it must be handled in accordance with the appropriate regulatory requirements. In addition to the measures discussed above, contaminated soils should be stockpiled on and covered by polyethylene sheeting. Sheeting used to cover the stockpile should be weighted down to prevent the wind migration of contaminated dust.

For soil stockpiles in substations, contact Environmental Licensing and Permitting. If soil/water must be stored and/or disposed, comply with existing soil and groundwater management guidelines. Coordinate with the Environmental Affairs Department (EAD) to ensure appropriate procedures are followed.

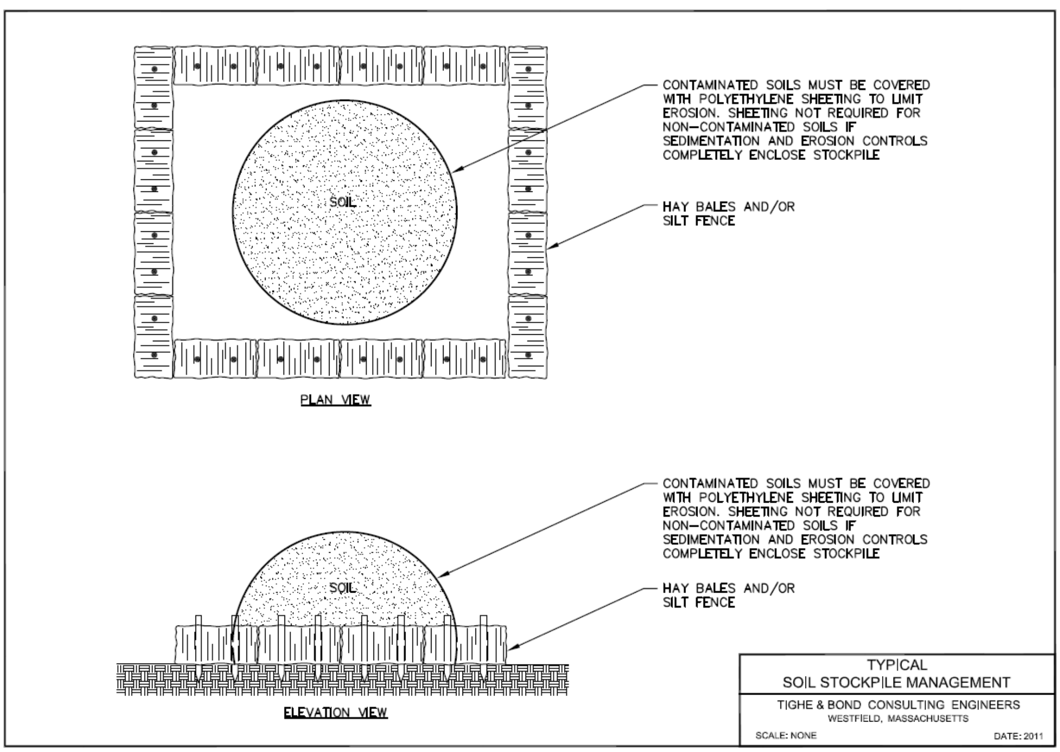
3.13.1 Best Management Practices – Soil Stockpile Management

The following BMP is applicable to soil stockpile management and is described at the following tab:

Soil Stockpile Management – Tab 5A

TAB 5A

Soil stockpile management.



Section 4
Inspection and Maintenance

A pre-construction meeting will be held to discuss how often and who will be checking that all erosion and sedimentation controls are in working order. All BMPs will be inspected at least once per week during construction and at least once per month during restoration. Construction sites will be inspected after major storm events (rainfall events greater than 0.25 inches).

4.1 During Construction

Construction sites, construction access roads, and the associated erosion and sedimentation controls should be inspected by the person(s) designated at the pre-construction meeting, as required by permit conditions. Any damage observed must be repaired in a timely matter, at least within 48 hours of observation. Repairs may include regrading and/or top dressing the surface with additional aggregate to eliminate ruts as well as those repairs required by each erosion and sedimentation measure used.

All inspections will be documented in the project folder.

4.1.1 Maintenance of E&S Controls

Spare erosion and sedimentation control materials such as straw wattles, hay/straw bales and silt fencing should be kept on site or readily available so they may be replaced if they become non-functional due to deterioration or damaged during a storm, extreme water or wind, or other unexpected events.

4.1.2 Rapid Wetland Response Restoration

In the event of unintended discharges of sediment into wetlands, Eversource will quickly control, contain and remove sediment using non- or marginally invasive methods. Responding quickly to unintended discharges minimizes the difficulty and cost of restoration if the sediment is left in place for an extended period of time. Eversource will conduct sediment removal activities at the time of discharge and will notify the appropriate regulators of the discharge and the restoration process.

4.1.3 Vehicle Storage

All storage and refueling of vehicles and other equipment must occur outside of and as far away as practical from sensitive areas such as wetlands, unless specifically agreed by the Project Team and an alternate protocol is developed and approved internally. Refueling for larger, less mobile equipment such as drill rigs or large cranes, may be allowed within wetland resources only with prior approval and if specified precautions and protocols are followed. A proper location for refueling should be identified and designated before site work begins. The recommended minimum distance from wetland areas for storage of fuel and refueling is 100 feet. Additionally, equipment should be checked regularly for evidence of leaks. Construction material storage should also be located at least 100 feet from wetlands.

4.1.4 Spills

Spill kits consist of emergency cleanup and spill containment materials that can be used in the event of a fuel or other chemical spill. Spill kits must be kept on site and accessible at all times in case of an emergency spill. Such kits should generally contain multiple absorbent socks and/or pillows and wipes and temporary disposal bags. Follow the applicable Eversource Contractor Work Rules.

4.1.5 Post Construction

Post-construction inspections of restored areas will be conducted at regular intervals throughout the growing season, as required by any applicable permits, and/or after major storm events. Sites should be inspected for success or failure of revegetation, invasive species colonization, and erosion and sedimentation. In the event additional measures are required to achieve site restoration and stabilization, corrective actions shall be identified and implemented.

All information collected during inspections, regular maintenance, and repair procedures should be documented in project folders. In addition, photographic or diagrammatic logs may be kept to help record certain events and for documentation of project progress and any noteworthy observations.

The construction work is not complete until all areas are restored.

Section 5
Rehabilitation and Restoration

5.1 Restoration

All areas disturbed by construction, repair, and maintenance activities shall be substantially restored to pre-construction conditions. Please refer to Appendix A Section I for photos and typicals for loaming, seeding, and mulching. Prompt restoration minimizes the extent and duration of soil exposure and protects disturbed areas from stormwater runoff. Stabilization should be conducted as soon as practicable. Where appropriate, it is preferable to allow wetlands to naturally revegetate.

5.1.1 Seed Mixes

Several different seed mixes are available for upland and wetland restoration. State-specific comprehensive summaries of seed mixes for both temporary and permanent seeding of disturbed sites can be found within the following documents:

- Massachusetts: Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas, page 157: http://www.mass.gov/eea/docs/dep/water/essec1.pdf

- Connecticut: 2002 Connecticut Guidelines for Soil and Erosion Sediment Control, page 5-3-8: http://www.ct.gov/deep/cwp/view.asp?A=2720&Q=325660

Upland Seed Mix: If significant grading or upland alteration has occurred, annual rye grass seed shall be placed following manufacturer's recommendations after regrading activities.

Wetland Seed Mix: If significant grading or wetland alteration has occurred, a wetland seed mix shall be placed following manufacture's recommendations after regrading activities.

5.1.2 Upland

The following restoration techniques apply to restoration projects in upland areas.

- Soil excavated during construction and not used as backfill must be evenly spread onto disturbed areas to restore grades. Topsoil shall be stripped and separated to the extent practical, for re-use. Permanent soil protection shall be provided for all areas disturbed by construction activities. All areas will be seeded either by Hydro-seeding or broadcast seeding. If areas cannot be seeded due to the time of year, then mulch (hay or straw) is still required prior to the next precipitation event.
- Topsoil removed during construction activities will be replaced, seeded, and mulched.
- All areas that are broadcast seeded shall be treated with a layer of mulch, such as hay, but preferably straw, up to one inch thick to enhance moisture retention, dissipate disturbance from precipitation, and detract birds foraging on broadcast seed.

- Rehabilitation of access routes and other areas must be performed as soon as practicable after construction is completed, including reestablishment of water bars or other BMPs to control erosion of the access road, and the removal and restoration of temporary wetland or waterway crossings.
    - Temporary breaks in construction activities may warrant seeding and mulching of disturbed areas as interim erosion control measures.
- Erosion control measures shall remain in place until soils are clearly stabilized. Once soils are stable, erosion controls – especially silt fence, which presents an obstacle to movement of small animals shall be removed and properly disposed. Stakes should be removed from hay bales and spread as mulch to remove barriers to wildlife movement.
- Straw is preferred over hay to prevent the spread of invasive plant species seed stock.
- If a grading operation at a site shall be suspended for a period of more than 29 consecutive days, the disturbed area shall be stabilized by seeding, mulching, and/or other appropriate means within the first 7 days of the suspension of grading.
- Within 7 days after a final grade is established in any grading operation the disturbed area shall be stabilized by seeding, loaming, and/or other appropriate means.

5.1.3 Wetland/Watercourses

Regrading of Ruts: Upon removal of construction mats, or other BMPs, the wetland resource area should be inspected for rutting or disturbance from eroded upland soils. Any rutting should be regraded to pre-existing contours and upland soils removed from wetland areas while taking care not to compact soils.

The following restoration techniques apply to restoration project in wetlands:

<u>Maintenance, Repair, and Emergency Projects (When No Permit is Required)</u>

- Remove mats by "backing" out of the site and removing mats one at a time. Regrade soils to pre-existing contours while taking care not to compact soils.
- Soils excavated from wetland areas shall be segregated and stockpiled separately (i.e., topsoil/muck apart from mineral subsoil) in a dry/upland area at least 100 feet from wetland boundaries unless other provisions have been made to facilitate restoration activities.
- Excavated wetland soils that have been stockpiled during underground utility installations within wetlands shall be replaced in the same order (i.e., mineral subsoil beneath organic topsoil/muck) to the extent practicable and restored to pre-disturbance grades.
    - Grading activities should include the elimination of ruts within the area to be restored.
- If replacement of soil associated with temporary wetland or watercourse crossings for access roads is necessary, disturbed areas must be restored to pre- disturbance grades, either seeded and mulched, or allowed to revegetate from the natural seed bank.

- Disturbed wetland areas shall generally be allowed to revegetate from the natural seed bank. Measures to discourage the establishment or spread of plant species identified as non-native, invasive species by federal or state agencies shall be utilized. Environmental Licensing and Permitting can evaluate whether to let the wetland vegetate naturally.
- Any restoration plantings or seed mixes used in restoration shall consist of species native to the project area and, if feasible, from local nursery stock.
- Any stream banks and beds damaged shall be restored through use of geotextile erosion control blankets, and/or coir logs.
- All seeded areas shall be treated with a layer of mulch (i.e., hay, but preferably straw) up to one inch thick to enhance moisture retention, dissipate disturbance from precipitation, and detract songbirds foraging on broadcast seed.

5.2 Private Property

5.2.1 Improved Areas

Access to and along the ROW over private property must be improved to the extent necessary to ensure suitable passage for construction equipment, provide erosion control, and maintain proper drainage. Upon completion of construction activities, altered yards, lawns, agricultural areas, and other improved areas must be restored to a condition equal to or better than before their use for the construction project. If access is over a property off the transmission easement, then it is the responsibility of a construction representative to determine if legal access rights are available to cross the property.

5.2.2 Overall Work Site

Construction personnel should remove all work-related trailers, buildings, rubbish, waste soil, temporary structures, and unused materials upon satisfactory completion of work. All areas should be left clean, without any litter or equipment (wire, pole butts, anchors, insulators, cross-arms, cardboard, coffee cups, water bottles, etc.) and restored to a stable condition and close to the original condition. Debris and spent equipment should be returned to the operating facility or contractor staging area for disposal or recycling as appropriate.

5.2.3 Material Storage/Staging and Parking Areas

Upon completion of all work, all material storage yards, staging areas, and parking areas shall be completely cleared of all waste and debris. Unless otherwise directed or unless other arrangements have been made with an off ROW or off-property owner, material storage yards and staging areas shall be returned to the condition that existed prior to the installation of the material storage yard or staging area. Regardless of arrangements made with a landowner, all areas shall be restored to their pre-construction condition or better. Also any temporary structures erected by the construction personnel, including fences, shall be removed by the construction personnel and the area restored as near as possible to its original condition, including seeding and mulching as needed.

5.3 Work in Agricultural Lands

Transmission lines often cross agricultural lands. In some instances, this may affect ongoing agricultural activities in and around the ROWs. If a construction or maintenance project occurs on agricultural lands, Eversource will work closely with landowners, licensees and stakeholders to minimize agricultural impacts. Whenever practical, Eversource will make reasonable efforts to coordinate the schedule of construction-related activities around the growing and harvest seasons to minimize the impacts on agricultural operations. When this is not practical, Eversource will pursue reasonable measures to mitigate any impacts.

Eversource recognizes that disturbed soils, or soils compacted by heavy construction equipment, may affect the soil’s ability to support certain agricultural activities. Eversource will take reasonable steps to avoid or minimize soil compaction, and will restore soils that are compacted by construction equipment. Eversource will also work with affected landowners to determine the appropriate method for restoring the soils, and is open to discussing and implementing the landowners’ alternative restoration suggestions. After the transmission improvement is complete, Eversource will remove all construction-related equipment and debris from the ROW.

APPENDIX A

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Introduction

Section 1 Erosion and Sedimentation Controls

Section 2 Water Control

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Introduction

Adequate erosion and sedimentation control management measures shall be installed and properly maintained to reduce erosion and retain sediment on site during and after construction. These devices shall be capable of preventing erosion, collecting sediment (suspended and floating materials) and filtering fine sediment. Sediments collected by these devices shall be removed and placed in an upland location beyond buffer zones/upland review areas and any other regulatory setbacks preventing later migration into a waterway or wetland. Once work has been completed, all areas shall be stabilized with erosion control blankets and/or robust vegetation and erosion control devices shall then be removed. Erosion and sedimentation controls are provided in Section I of this Appendix. Note that stormwater management is an important part of erosion and sedimentation control. Accordingly, temporary stormwater management measures are outlined in Section II of this Appendix. Please refer to the below table for a complete list of BMP typicals and photos provided in this appendix.

Appendix A

Section I

Section 1
Erosion and Sedimentation Controls

1.1 Preservation of Existing Vegetation

Applications: Erosion and sedimentation control, habitat and aesthetic preservation, reduce landscaping and restoration costs

Limitations:

- Access needs on ROWs.
- Required distances between underground utilities and mature trees.

Overview:

Examine the area to identify vegetation (i.e., groundcovers, vines, shrubs, trees) that may be saved. Focus on preserving vegetation on steep slopes, near drainage ways, and/or drainage swales in order to help increase soil stability and decrease runoff volume and velocity. Use construction phasing to preserve vegetation in areas where activities are not scheduled to occur or will occur at a later time.

Identify and protect specified trees for erosion and sediment control benefits and/or aesthetic purposes. Consider saving trees that provide shading or screening benefits, particularly in residential areas.

Installation:

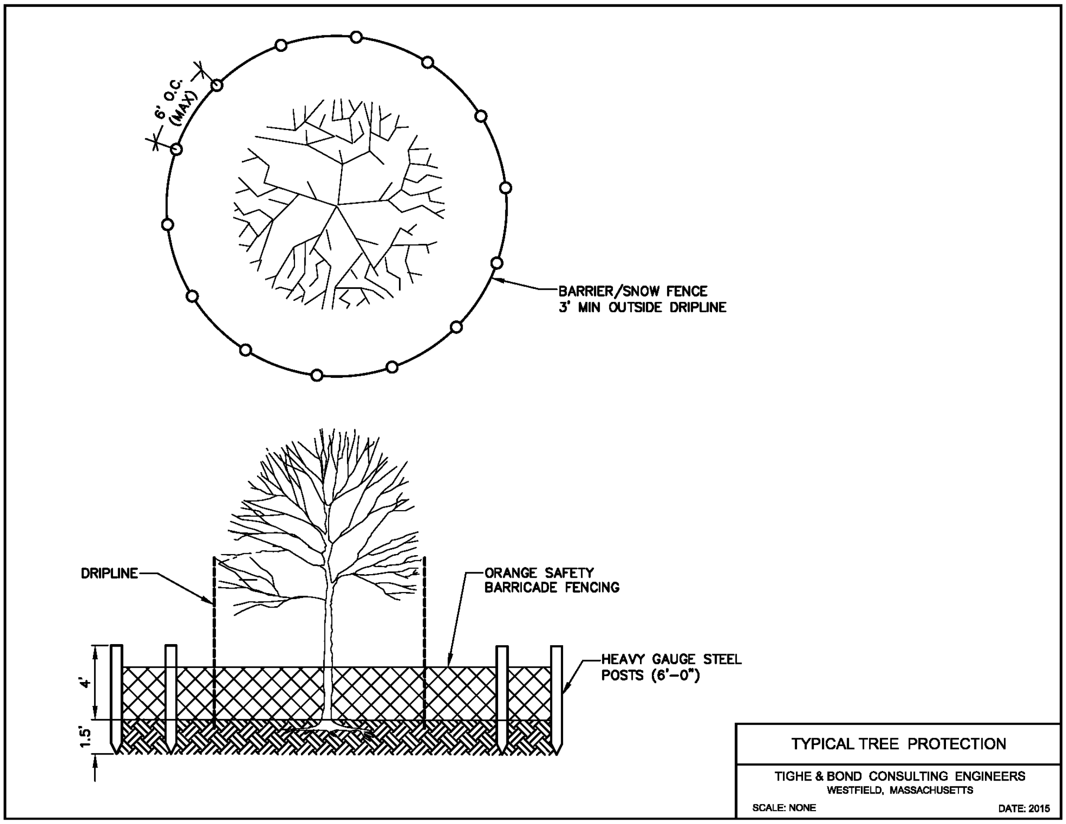
- Select healthy, relatively young trees (less than 40 years old) and vegetation that will not interfere with the installation or maintenance of utilities. Pay attention to the aesthetics of trees along roadways and preserve wherever practicable.
- Place barriers around trees least three feet from the drip line or five feet from the trunk (whichever is greater) using wooden and wire fencing made from scrap lumber or snow fencing. If fencing is not feasible, mark the selected trees with bright flagging.
- Construct the barrier (or place the flags) before heavy equipment arrives to the site and leave in place until the last piece of machinery is gone.
- Dig trenches as far from the trunks and outside of the canopy drip line as practicable. If large roots are encountered, consider trenching under them.
- The width of the ROW will vary depending on the corridor's designated use. Federal guidelines suggest that 15 feet on either side of a buried pipeline should remain clear of mature trees.

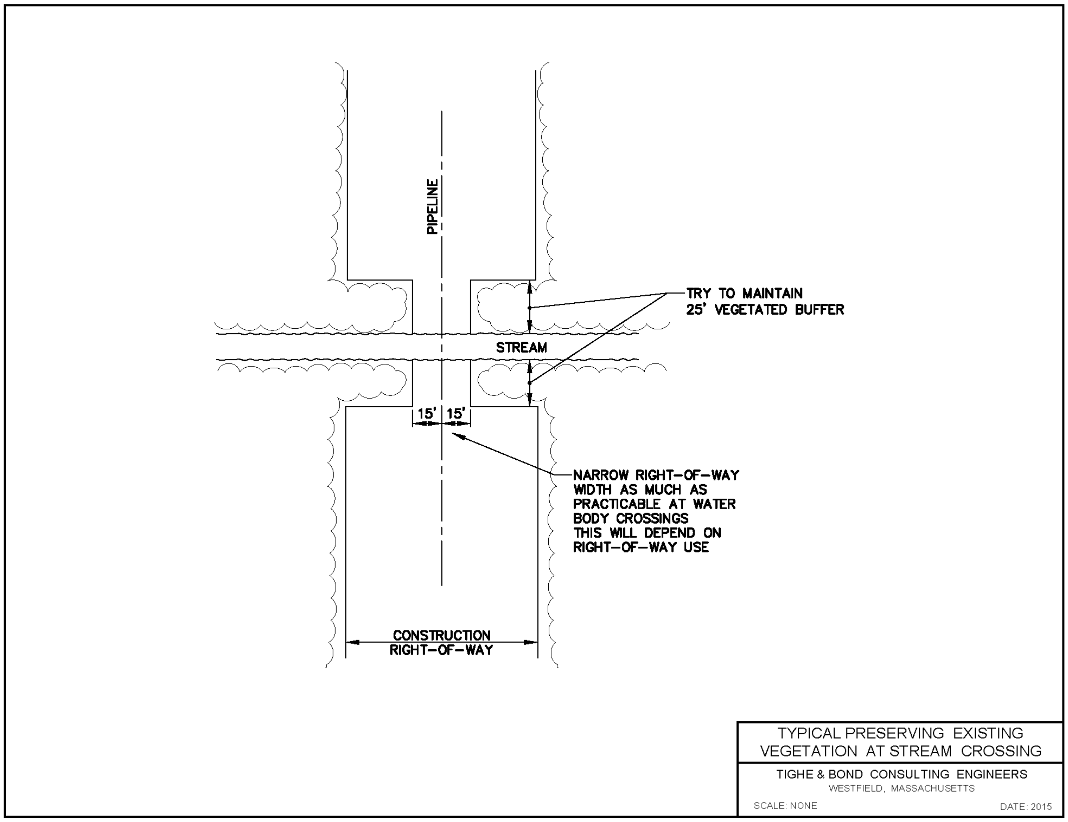
Maintenance:

- Inspect flagged and/or barricaded areas throughout construction. Replace flagging and repair/replace barriers as needed.
- Inspect exposed tree roots. Re-cover or re-seal roots that have been exposed and/or injured by construction activity.

Additional Comments:

When approaching a stream crossing, limit the amount of clearing of the existing stream bank and riparian vegetation to only the areas essential for construction and maintenance. Maintain a 25-foot wide vegetated buffer between the stream bank and the cleared ROW, except in locations where the line is directly installed.




PIPELINE
TRY TO MAINTAIN
25' VEGETATED BUFFER
STREAM
15'
15'
NARROW RIGHT-OF-WAY
WIDTH AS MUCH AS
PRACTICABLE AT WATER
BODY CROSSINGS
THIS WILL DEPEND ON
RIGHT-OF-WAY USE
CONSTRUCTION
RIGHT-OF-WAY
TYPICAL PRESERVING EXISTING
VEGETATION AT STREAM CROSSING
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: 2015

1.2 Topsoil Segregation for Work in Wetlands and Agricultural Areas

Applications: During excavation in wetlands and agricultural areas

Limitations:

- May be site-specific limitations; otherwise none.

Overview:

The top 12 inches of soil are the most important for providing nutrients and a suitable growth medium to the existing vegetative cover in an area, as well as containing the root stock and seed bank of the plant community. Topsoil segregation is recommended for the first 12 inches of soil in all wetlands and agricultural land, but is also a good practice in any area, including uplands in order to provide a suitable growth medium and more rapid revegetation and restoration of the original plant species.

When digging a trench for installation or maintenance of a pipeline or conduit, or excavating for the installation or replacement of the base of a utility pole, it is good practice to segregate the first 12 inches of topsoil and stockpile it separately from the subsoil until the layers can replaced into the excavation in the proper order. In some cases, it may be necessary to strip topsoil off the areas where the subsoil will be stockpiled as well. Additional topsoil can also be brought into an upland or residential area if necessary where the existing soil is too shallow to provide adequate rooting depth, moisture and nutrients, or too much topsoil was lost during construction.

Installation:

- Set up proper erosion control (i.e., hay bales, silt fence) around the work area before beginning any excavation near wetland areas.
- Identify the stockpile locations near the trench or excavation.
- Locate stockpiles from active work areas to the extent practicable.
- Remove the top 12 inches of topsoil from the trench or excavation. If less than 12 inches are available, remove the entire layer of soil.
- Place the topsoil in a separate stockpile than the layers of excavated subsoil.
- Place additional lines of erosion control around the stockpiles to control sedimentation, if necessary.
- Side slopes of soil stockpiles should not exceed 2:1.
- Stabilize stockpiles with temporary seeding or plastic covering if they will remain exposed for more than 21 days.
- Backfill the trench with the proper soil layers, subsoil followed by topsoil, when work activities are completed. Backfilling should take place immediately after activities are completed, and grading and site stabilization should take place within 10 days following backfilling.

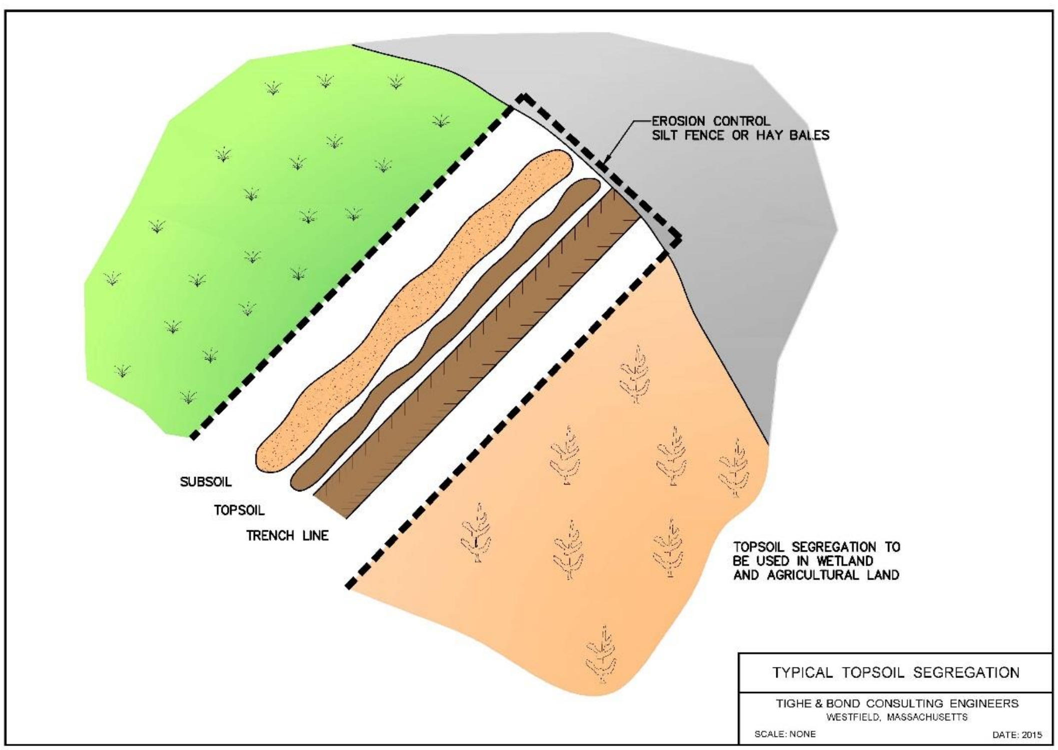
Maintenance:

- Inspect and maintain erosion control on a regular basis and observe the stockpiles for any signs of sedimentation or mixing.
- In residential and agricultural areas, make a reasonable effort to remove all rocks larger than 4 inches in diameter from the topsoil that have been turned up during construction.

Additional Comments:

If the topsoil and subsoil stockpiles are mixing:

- The piles are located too close together. Try placing the separate stockpiles on opposite sides of the trench or work area.
- The topsoil stockpile could also be individually enclosed in hay bales or silt fence. This will help create a barrier, keeping it separate from the subsoil.
- Avoid working with large amounts of trench or excavation open when heavy rains are predicted.
- If polluted/contaminated soil is encountered, handle in accordance with appropriate regulatory requirements. Stockpile contaminated soil on and cover with polyethylene sheeting. Weigh down sheeting covering contaminated soil to prevent the wind migration of contaminated dust.



1.3 Straw (or Hay) Bales

Applications: Erosion and sedimentation control, mulch

Limitations:

- Hay bales degrade quickly.
- Hay bale height can provide an obstacle to movement of smaller wildlife.
- Should not be used as a temporary check dam/ stormwater control within waterways.
- Difficult to install during frozen conditions.
- Generally only effective for 3-6 months (hay) or 6-12 months (straw) before replacement.

Overview:

Hay/straw bales should be placed end-to-end to form a temporary sedimentation control barrier. This barrier should run perpendicular to the slope and direction of runoff, and should be installed downgradient of the disturbed site (i.e., construction area). Hay/straw bales are intended to slow flow velocity and trap sediments to prevent siltation in sensitive areas, specifically downgradient areas with open and/or flowing water. Barriers should be removed once the project is complete and soils are stabilized with erosion control blankets and/or well-established vegetation.

Installation:

- Install hay/straw bales end-to-end lengthwise along the toe of a slope or along a slope contour being sure the bales are butted tightly against each other without gaps between them. The outer ends of the barrier should be turned slightly upslope.
- Entrench to a minimum depth of 4 inches and backfill around the base of the bale. If additional protection is needed, backfill both upslope and downslope to create better ground contact and reduce sediment passage through or beneath hay/straw bales.
- Stake each hay/straw bale into the ground by two stakes each approximately 3 feet long
- If a silt fence is being used with the hay/straw bale barrier, position the silt fence downgradient of the hay/straw bales (hay bales filter first).
- Since hay/straw bales degrade quickly, check barriers often and replace as needed. Routinely remove and dispose of sediment buildup in a stable upland area.
- The hay/straw bale barrier should be as far away from downgradient sensitive areas, and as close to the work areas as construction limitations allow, in order to minimize the total work area and disturb as little area as possible.
- Once the project is complete and soils are stabilized, hay/straw bales should generally be compacted and allowed to decay in place, as their height can provide an obstacle to movement of smaller wildlife. Spreading hay bales around a site as mulch could introduce weed seeds. Using hay/straw as mulch is not generally

problematic if the site is already colonized by invasive species. Plastic bailing twine should be removed from hay/straw bales. Wooden stakes should also be removed.

Maintenance:

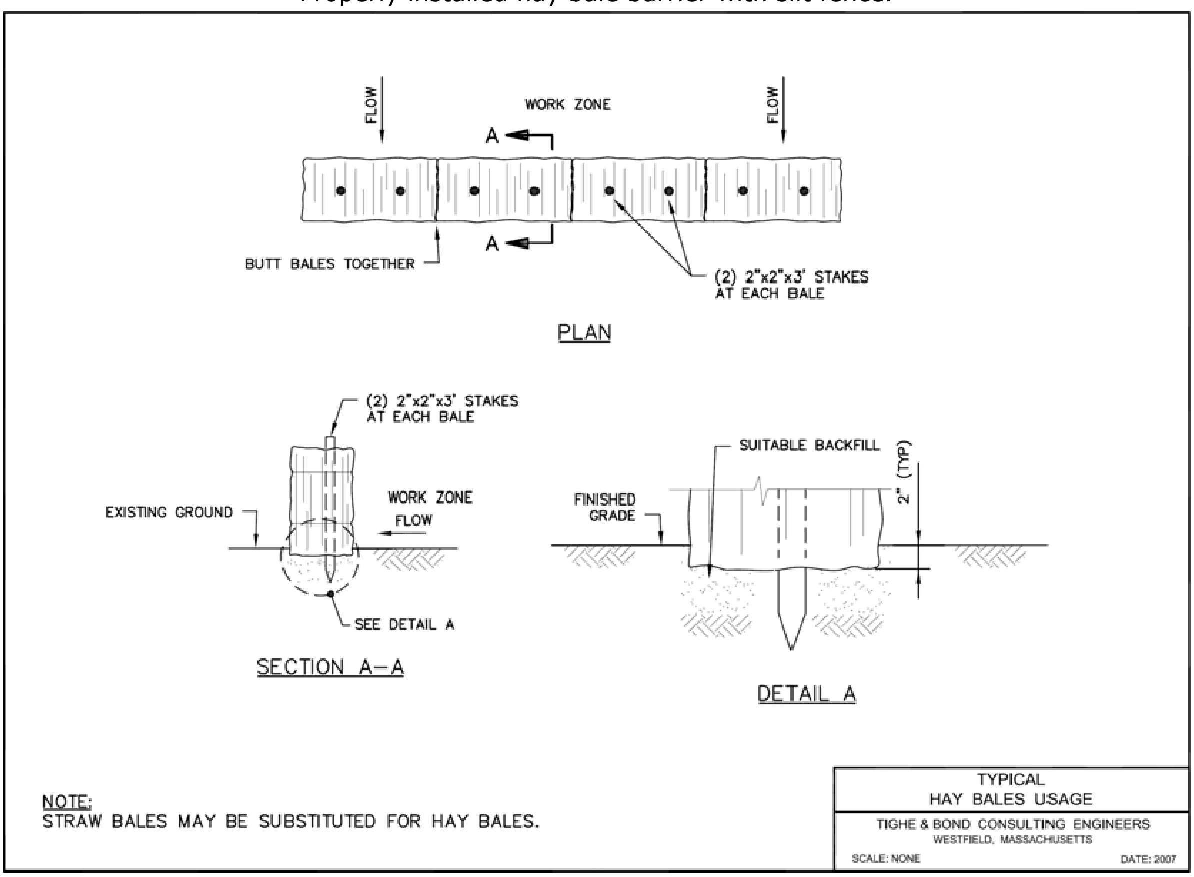
- Inspect before a forecasted storm event and daily during a prolonged rain event.
- Remove accumulated sediment and properly disposed outside sensitive areas when it has reached a thickness of ½ to ⅔ the height of the bale.
- Replace rotted or sediment-covered bales when necessary.

Additional Comments:

Straw bales are favored over hay bales for use as erosion control barriers. Since straw bales are composed of the dried stalks left over after a grain is harvested, they do not contain the plant's seeds and therefore will not spread growth of such species, some of which may be exotic, invasive or otherwise undesirable. Hay bales are generally less expensive, but consist of the seed heads and the upper, thinner portion of the stems which generally decay faster than straw.

Properly installed hay bale barrier with silt fence.

Properly installed hay bale barrier with silt fence.



1.4 Silt Fence

Applications: Sedimentation control, work limits, temporary animal barrier, slows flow on steep slopes

Limitations:

- Frozen or rocky ground (for installing stakes).
- May prevent critical movements of sensitive wildlife species.
- Disposal.

Overview:

Silt fence is constructed of a permeable geotextile fabric secured by wooden stakes driven into the ground. It is installed as a temporary barrier to prevent sediments from flowing into an unprotected and/or sensitive area from a disturbed site. A silt fence should be installed downgradient of the work area. Once the project is complete and soils are stabilized, silt fence materials (i.e., geotextile fabric and wooden stakes) must be removed and properly disposed off-site (see environmental scientist to determine if area is stabilized).

Installation:

- Install silt fence along the toe of a slope or along a fairly level contour with the outermost ends directed upslope. The fabric should be laid into a 6-inch wide by 6-inch deep trench dug on the upslope side of the fence and tamped down with fill material to ensure a sturdy base and so sediments will not flow beneath the fabric. Use of a Ditch Witch® or similar equipment is suggested for this task.
- Drive the silt fence stakes into the ground until secure (≥6 inches below grade).
- If a hay bale or straw bale barrier is being used with the silt fence, position the silt fence downgradient of the bales.
- The silt fence should be as far away from downgradient sensitive areas, and as close to the work areas as construction limitations allow, in order to disturb as little area as possible.

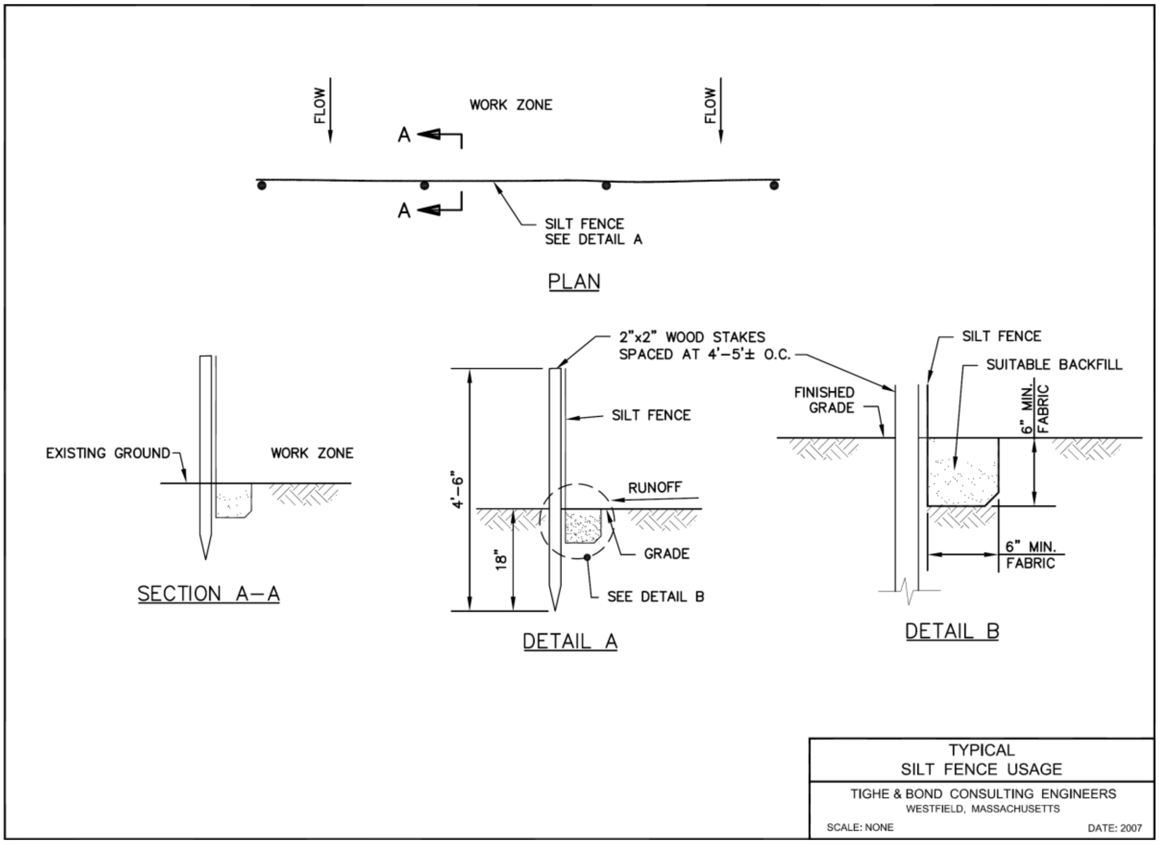
Maintenance:

- Inspect frequently and replace or repair as needed, especially during long-term projects.
- Routinely remove and properly dispose of sediment buildup in a stable upland area, outside of sensitive areas. Remove sediment when it has accumulated to a thickness of ½ the height of the silt fence.

Additional Comments:

A silt fence must be installed in an excavated trench and located where shallow pools can form so sediment can settle. The fence must be placed along the contour. If placed otherwise, water may concentrate to a low point and is likely to flow beneath the fence.

Properly installed and functioning silt fence. Direction of flow indicated by blue arrow.


FLOW
WORK ZONE
FLOW
A
A
SILT FENCE
SEE DETAIL A
PLAN
EXISTING GROUND
WORK ZONE
SECTION A–A
2"x2" WOOD STAKES
SPACED AT 4'–5'± O.C.
SILT FENCE
4'–6"
RUNOFF
18"
GRADE
SEE DETAIL B
DETAIL A
SILT FENCE
SUITABLE BACKFILL
FINISHED
GRADE
6" MIN.
FABRIC
6" MIN.
FABRIC
DETAIL B
TYPICAL
SILT FENCE USAGE
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: 2007

1.5 Syncopated Silt Fence

Applications: Sedimentation control, work limits, slow flows on steep slopes, and permit wildlife movement.

Limitations:

- Frozen or rocky ground (for installing stakes).
- Complex installation compared to standard silt fence.
- Disposal.

Overview:

Syncopated silt fence refers to silt fence that is installed in a specific layout that permits wildlife movement. Many construction projects continue over at least one wildlife activity season, and silt fence may impede the movement of animals. Syncopated silt fencing is to be installed in areas where silt fencing may impede wildlife access to a resource (i.e., vernal pool, wooded area). These areas will be identified when developing wetland protection measures.

Installation:

- The syncopated silt fence layout is shown on the typical below. For every 50 feet of siltation fence installed, allow for a gap of two feet before installing the next section. The gap allows wildlife movement One foot behind the main silt fence line, install a second row of silt fence approximately 20 feet in length and centered at the gap.
- Install silt fence along the toe of a slope or along a fairly level contour with the outermost ends directed upslope. The fabric should be laid into a 6-inch wide by 6-inch deep trench dug on the upslope side of the fence and tamped down with fill material to ensure a sturdy base and so sediments will not flow beneath the fabric. Use of a Ditch Witch® or similar equipment is suggested for this task.
- Drive the silt fence stakes into the ground until secure (≥6 inches below grade).
- If a hay bale or straw bale barrier is being used with the silt fence, position the silt fence downgradient of the bales.
- The silt fence should be as far away from downgradient sensitive areas, and as close to the work areas as construction limitations allow, in order to disturb as little area as possible.

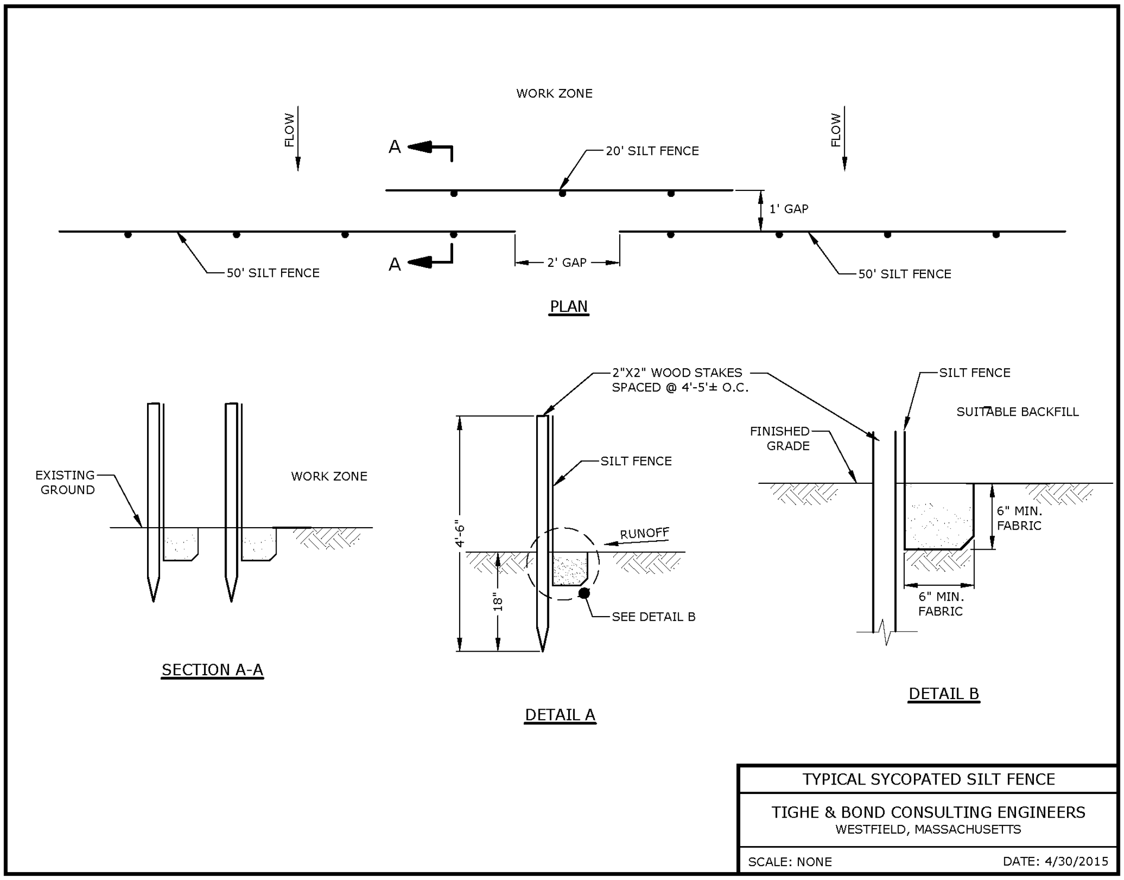
Maintenance:

- Inspect frequently and replace or repair as needed, especially during long-term projects.

- Routinely remove and properly dispose of sediment buildup in a stable upland area, outside of sensitive areas. Remove sediment when it has accumulated to a thickness of ½ the height of the silt fence.

Additional Comments:

A silt fence must be installed in an excavated trench and located where shallow pools can form so sediment can settle. The fence must be placed along the contour. If placed otherwise, water may concentrate to a low point and is likely to flow beneath the fence.



1.6 Erosion Control Blankets

Applications: Slope stabilization, erosion and sedimentation control

Limitations:

- Can be used on steep (i.e. greater than 45°) slopes but not on rocky soils.
- Mulches may be more cost effective on flatter areas.

Overview:

Erosion control blankets are generally composed of biodegradable or synthetic materials and are used as a temporary or permanent aid in the stabilization of disturbed soil on slopes. These blankets are used to prevent erosion, stabilize soils, and protect seeds from foragers while vegetation is recolonized.

Installation:

- Always follow manufacturer's instructions for properly installing erosion control blankets. Different composition blankets are recommended for site-specific conditions (slope grades, contributing watershed areas) and use requirements (biodegradable, photodegradable, non-biodegradable).
- Prior to installation, clear the slope of any rocks, branches, or other debris.
- Rolled out blankets in a downward direction starting at the highest point of installation. Secure blankets above the crest of the slope using a berm tamped down along the top of the disturbed area.
- Tack down blankets with stakes or staples every 11 to 12 inches (or closer) horizontally and every 3 feet (or closer) vertically. Biodegradable staples are preferred.
- Overlap each blanket section horizontally with the next section by approximately 2 or 3 inches. Vertical overlaps should be approximately 6 inches, with the upslope section overlaying that of the down-slope section.

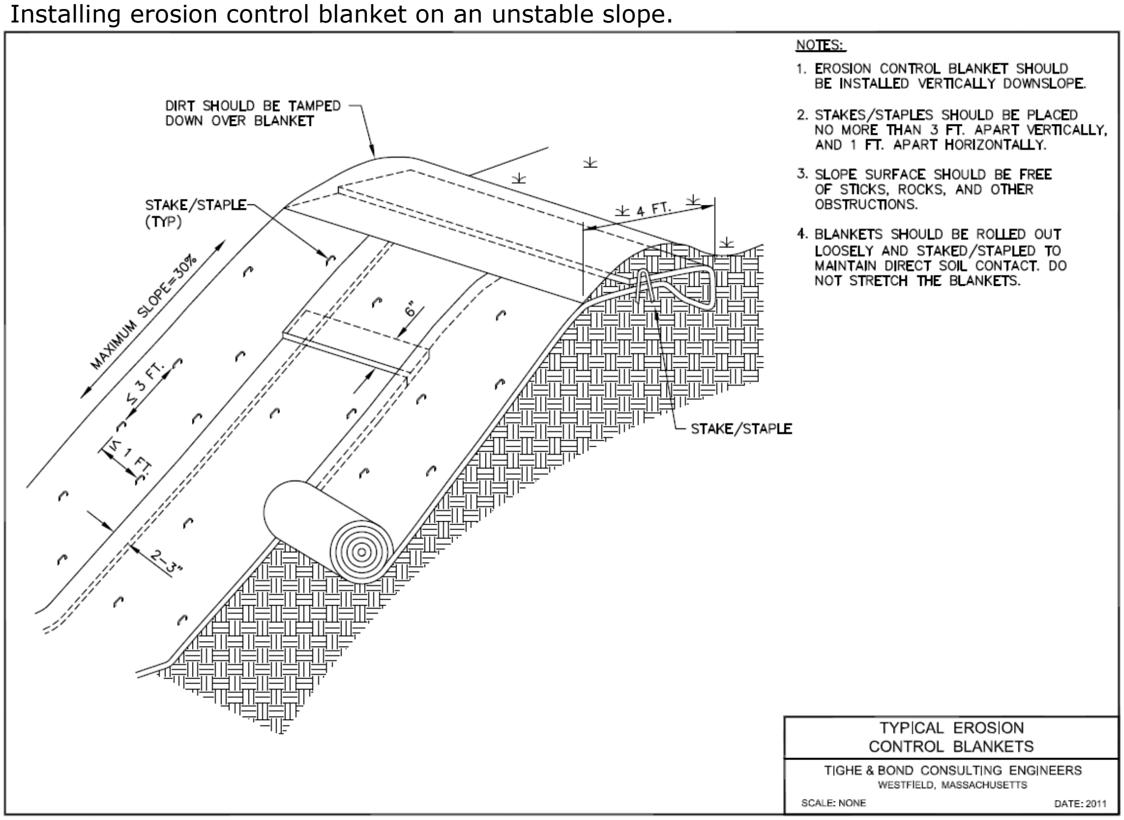
Maintenance:

- Inspect for movement of topsoil or erosion weekly and after major precipitation events. Inspect until vegetation is firmly established.
- Repair surface, reseed, replace topsoil, and install new netting if washout, breakage, or erosion occurs.

Additional Comments:

Additional materials used for erosion control with a continuous sheet or material include Jute Mats (sheets of woven jute fiber) and Turf Reinforcement Matting (geotextile matrix most effective for channels).

Installing erosion control blanket on an unstable slope.



1.7 Straw/Compost Wattles

Applications: Erosion and sedimentation control, work limits

Limitations:

- Not recommended for steep slopes.

Overview:

Straw wattles are used as an erosion control device to slow runoff velocities, entrain suspended sediments, and promote vegetation growth until an area is stabilized. They are not generally intended for steep slopes, but rather, to stabilize low to moderate grades where there is a broad area of disturbance. Straw wattles may also be used along small stream banks to protect areas before vegetation has stabilized the soils. The wattles are constructed from a biodegradable netting sock stuffed with straw and may be left to biodegrade in place once a project is complete.

Wattles should be placed lengthwise, perpendicular to the direction of runoff. The wattles are typically spaced about 10 to 40 feet apart, depending on the slope angle. Additionally, the soil texture should be considered – for soft, loamy soils, wattles should be placed closer together; for coarse, rocky soils, they may be placed further apart.

Installation:

- Install prior to disturbing soil in the upgradient drainage area.
- Install so that the ends of each row of wattles on a slope are slightly turned downhill to prevent ponding behind them.
- Where straw wattles are installed end-to-end, butt the wattles tightly together so as not to allow water/sediments to flow between them.
- Place straw wattles in a shallow trench to assure stabilization and soil should be packed against the wattle on the uphill side.
- Securely stake straw wattles to the ground by driving a stake directly through the wattle approximately every four feet. A portion of each stake should remain approximately 2 to 3 inches above the wattle.
- Use *without* silt fence reinforcement: at the base of shallow slopes, on frozen ground, bedrock, and rooted, forested areas.
- Use *with* silt fence reinforcement: at low points of concentrated runoff, below culvert outlets, at the base of slopes more than 50 feet long, and in places where standalone mulch wattles have failed.

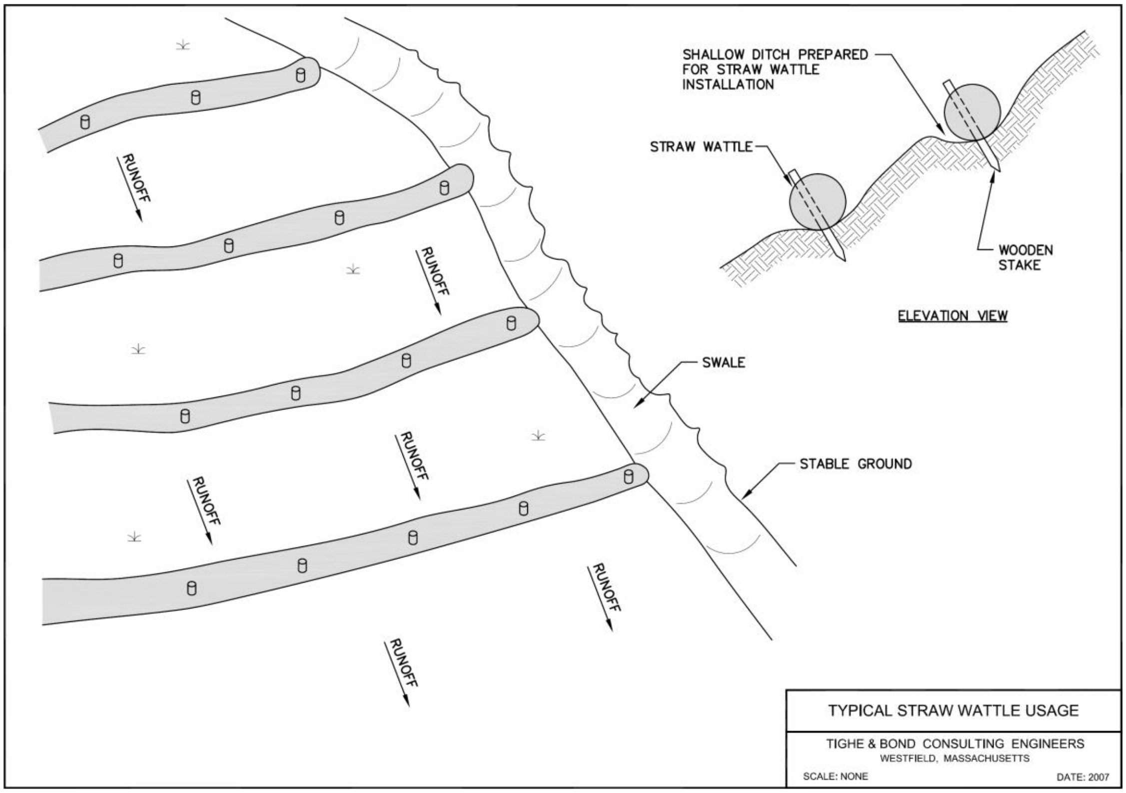
Maintenance:

- Routinely inspect wattles and after rain events. Repair as needed with additional wattles and/or stakes.
- Remove sediment deposits when they reach half the height of the wattle. Repair or reshapes wattles when they have eroded or have become sediment clogged or ineffective.

- If flow is evident around the edges, extend the barriers or evaluate replacing them with temporary check dams.
- Reinforce the berm with an additional sediment control measure, such as silt fence or a temporary rock check dam, if there is erosion or undercutting at the base or sides of the berm or if large volumes of water are being impounded behind the berm.

Additional Comments:

Woody vegetation and tall grasses may need to be removed before installing the berm to prevent voids that allow sediment under the berm. Wattles can also be planted with woody vegetation and seeded with legumes for additional stability.


SHALLOW DITCH PREPARED FOR STRAW WATTLE INSTALLATION
STRAW WATTLE
WOODEN STAKE
ELEVATION VIEW
SWALE
STABLE GROUND
RUNOFF
TYPICAL STRAW WATTLE USAGE
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: 2007

1.8 Wood Chip Bags

Applications: Erosion and sedimentation control, mulch

Limitations:

- Frozen or rocky ground (for installing stakes).
- Can pose a barrier to small animal movements.
- Requires close attention for maintenance and repair.

Overview:

Wood chip bags are perimeter barriers that intercept, filter, and reduce the velocity of stormwater run-off. They may be used separately or in conjunction with hay/straw bales and are installed and maintained in a similar manner. Wood chip bags should be staked in a line around perimeters of disturbed areas, especially those adjacent to wetlands, waterways, roadways or at the base of slopes.

Installation:

- Install wood chip bags end-to-end lengthwise in a single row along the toe of a slope or along a slope contour. Ensure that the bags are butted tightly against each other without gaps between them.
- Entrench to a minimum depth of 4 inches and backfill around the base of the bag.
- Stake each hay/straw bale into the ground using two stakes each that are approximately 3 feet long.

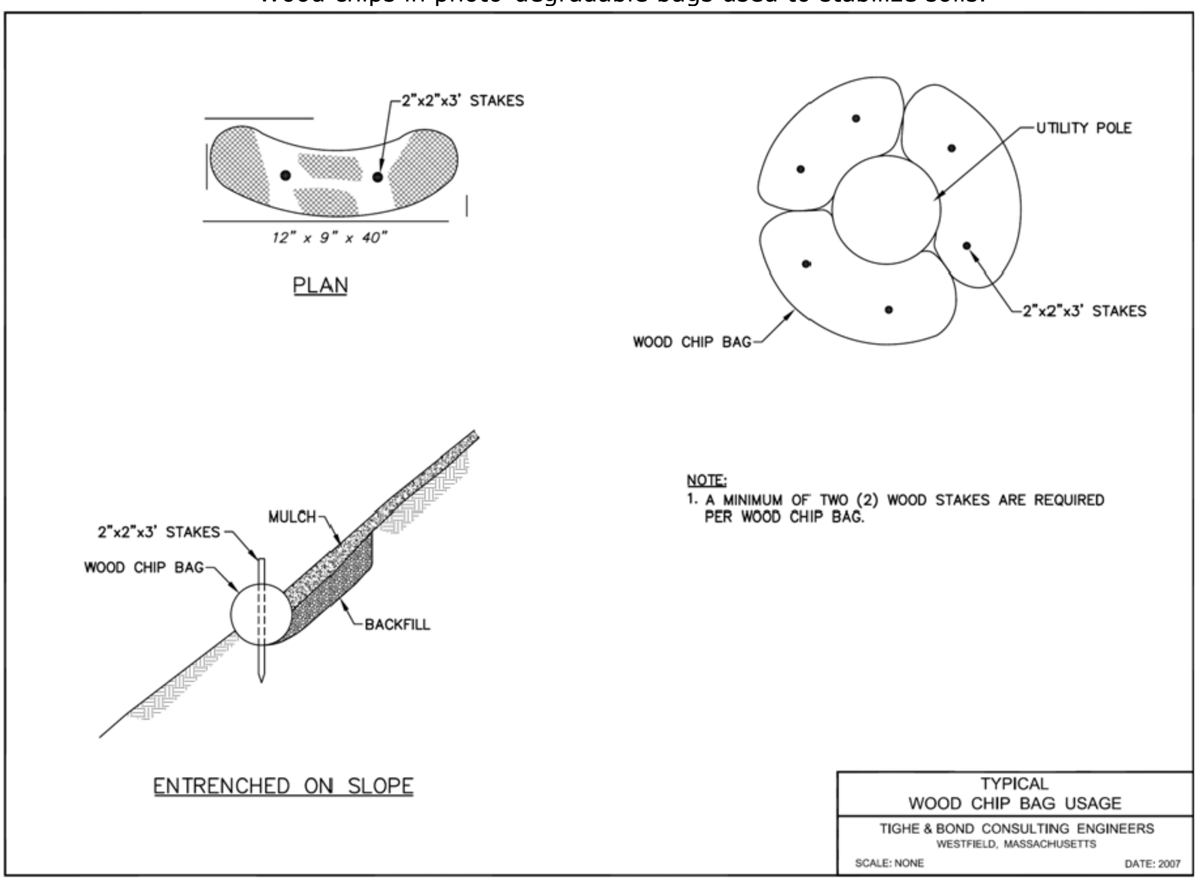
Maintenance:

- Inspect before a forecasted storm event and daily during a prolonged rain event.
- Remove accumulated sediment and properly disposed outside sensitive areas when it has reached a thickness of ½ to ⅔ the height of the bag.
- Replace rotted or sediment-covered bag when necessary.

Additional Comments:

Wood chip bags can stabilize soils in a number of applications. They may be left in place as they eventually photo-degrade, as long as they do not pose a barrier to small animal movements.

Wood chips in photo-degradable bags used to stabilize soils.



1.9 Catch Basin Protection

Applications: Erosion and sedimentation control

Limitations:

- For small quantity and low velocity stormwater flows.
- Hay/straw bales hard to stake into paved areas.
- Ineffective for very silty water.
- May require authorization from local government for discharge to municipal system.
- Fabric drop inlet should be used where stormwater runoff velocities are low and where the inlet drains a small, nearly level area.
- Undercutting and erosion under filter fabric if fabric is not buried at bottom.

1.9.1 Hay/Straw Bales, Filter Fabric, and Filter Baskets

Overview:

Hay bales, filter fabric, and filter baskets are all temporary devices placed around and within existing catch basin inlets to protect the stormwater management system from high sediment loads and high velocities during construction. Use in areas where stormwater runoff is relatively small and velocities are low and where shallow sheets of run-off are expected.

Hay/Straw Bales Installation: Hay/straw bales are recommended for areas which have the storage space to allow temporary ponding since they are one of the least permeable protection methods.

- Installation is similar to perimeter hay/straw bale barriers.
- Use bales that are wire bound or string tied. Place bales so that the bindings are on the sides of the bales rather than against the ground.
- Install hay/straw bales in a box configuration around the drop inlet with the ends of the bales placed tightly against each other.
- If the area is unpaved, anchor bales using two stakes driven through the bale and into the ground.
- Hay bales can be placed around the perimeter of the inlet in order to extend the life of the filter fabric and/or basket by removing much of the sediment beforehand.

Filter Fabric Installation: Filter fabric is used to protect catch basins from excessive sediment.

- Cut fabric from a single roll.
- Place fabric beneath catch basin grate.
- Avoid setting top of fabric too high, which will lead to flow bypassing the inlet.

Filter Baskets/Bags Installation: Install filter baskets/bags within catch basins in combination with hay bales, fabric, stone or sod drop inlets. They may be used alone where drainage area is small with shallow flows.

- Install per manufacturer's instructions.
- Filter baskets typically consist of a porous fabric bag which is fitted under the catch basin grate.
- Sediments are filtered out of the stormwater and accumulate in the basket or bag.

Maintenance:

- Inspect weekly and after each major rain event.
- Remove accumulated sediment on a regular basis.
- Replace or make repairs as needed.
- Remove after area is permanently stabilized.

Additional Comments:

Discharge of clean water into municipal system catch basins may be an option for certain sites. However, this activity must be coordinated with the municipality and shall not occur without their written consent.

1.9.2 Sod or Stone Mound Drop Inlets

Overview:

Sod or stone mound drop inlets are temporary devices placed around and within existing catch basin inlets to protect the stormwater management system from high sediment loads and high velocities. They are used in areas where stormwater run-off is relatively heavy and overflow capacity is necessary. Sod should only be used in well vegetated areas and when the general area around the inlet is planned for vegetation and is well suited for lawns. Stone mounds are well suited for the heaviest flows.

Installation:

- For Sod: Place a mound of permanently vegetated sod around the perimeter of the inlet to a minimum height of 6 inches.
- For Stone: Stone can be used alone or in combination with stacked concrete blocks. Gravel alone will slow drainage time and increase settlement.
- Place wire mesh with ½" openings over the inlet with 1 foot extending on each side. Overlay with filter fabric.
- Surround inlet with mound of gravel, 1" diameter or smaller, to a minimum height of 6", placed over the mesh.
- If blocks are used, stack them around the inlet, between 12 and 24" high, place mesh over the openings and pile the gravel against the outside face of the blocks.

Maintenance:

- Inspect weekly and after each major rain event.
- Remove accumulated sediment when it reaches ½ of the height of the filter mound. Stone especially must be regularly maintained.

- Repair erosion as necessary.
- If the storm flow bypasses inlet and causes erosion, the top of the structure is too high.
- If the trap is not efficient and/or there is sediment overload, the drainage area is too large to handle load. Consider constructing a temporary sediment trap.
- If scour holes develop (if blocks are being used), blocks are not placed snugly against the inlet grate.

Filter Baskets/Silt Bags

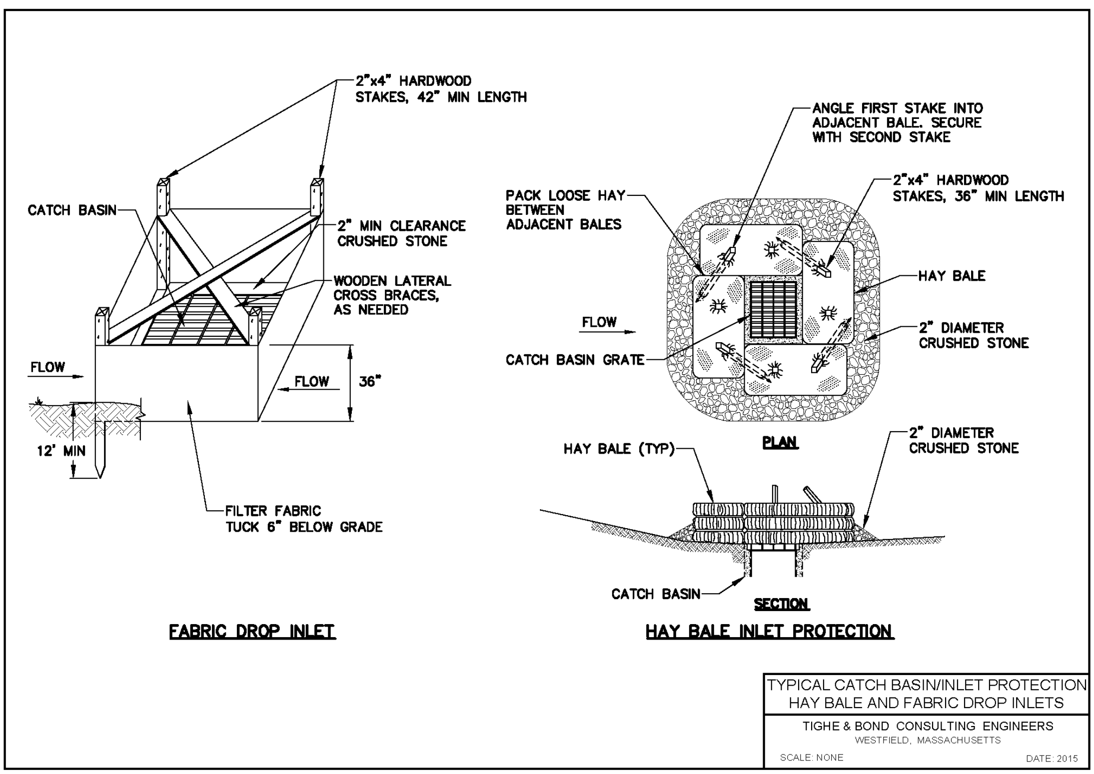
Filter baskets/silt bags are installed within catch basins in combination with hay bales, fabric, stone or sod drop inlets. They can potentially be used alone where drainage area is small with shallow flows. They may cause ponding or may rip under heavier flows without the additional external filtering method.

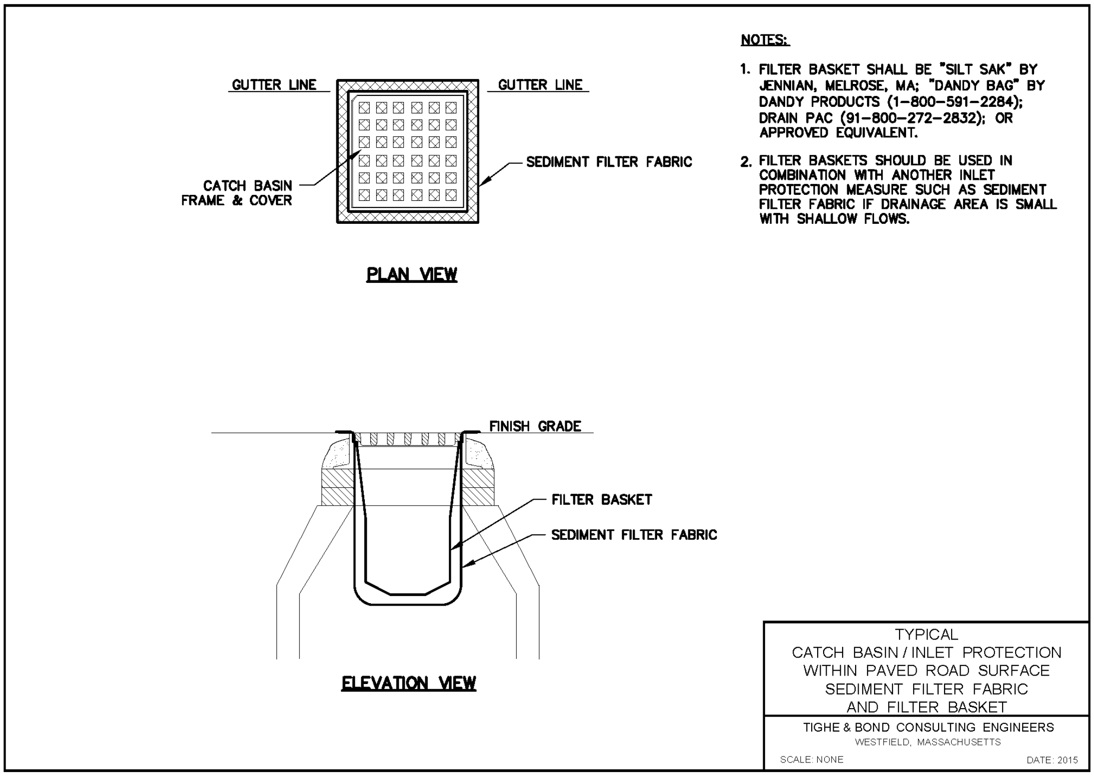
Installation:

- Several trademarked/name brand filter/silt bags exist and should be installed per the manufacturer's instructions. Almost all consist of a porous fabric bag which is fitted under the catch basin grate. Sediments are filtered out of the stormwater and accumulate in the bag.

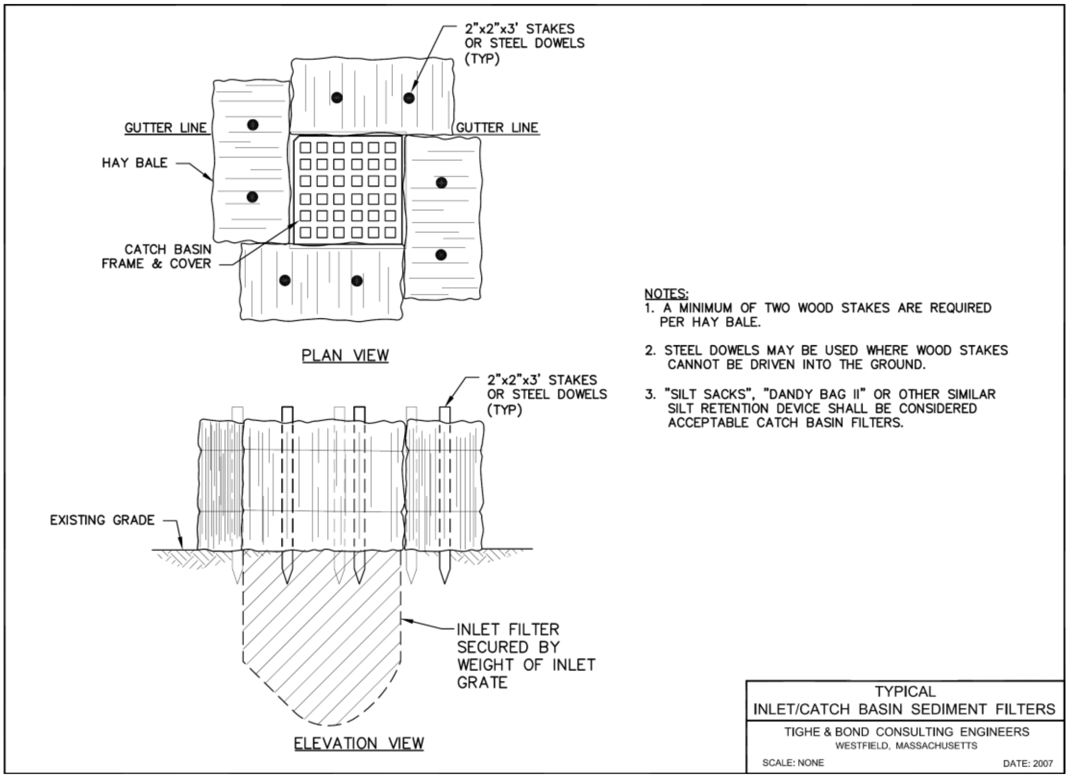
Maintenance:

- Inspect inlet and fabric weekly and after each major rain event.
- Remove sediment when the bag is halfway full.
- Replace bags as necessary due to wear or ripping.





Catchbasin protected from sedimentation by filter fabric.


2"x2"x3' STAKES
OR STEEL DOWELS
(TYP)
GUTTER LINE
GUTTER LINE
HAY BALE
CATCH BASIN
FRAME & COVER
PLAN VIEW
2"x2"x3' STAKES
OR STEEL DOWELS
(TYP)
EXISTING GRADE
INLET FILTER
SECURED BY
WEIGHT OF INLET
GRATE
ELEVATION VIEW
NOTES:
1. A MINIMUM OF TWO WOOD STAKES ARE REQUIRED PER HAY BALE.
2. STEEL DOWELS MAY BE USED WHERE WOOD STAKES CANNOT BE DRIVEN INTO THE GROUND.
3. "SILT SACKS", "DANDY BAG II" OR OTHER SIMILAR SILT RETENTION DEVICE SHALL BE CONSIDERED ACCEPTABLE CATCH BASIN FILTERS.
TYPICAL
INLET/CATCH BASIN SEDIMENT FILTERS
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: 2007

1.10 Loaming and Seeding

Applications: Erosion control, soil stabilization, site restoration

Limitations:

- May be site specific limitations (e.g. permit or State requirements).
- Applies to upland areas only.

Overview:

Permanent seeding is appropriate for vegetated swales, steep slopes, or filter strips. Temporary seeding is used if construction has ceased and if an area will be exposed.

Installation:

- Apply loam/ topsoil prior to spreading seed mix per manufacturer's recommendations. Apply water, fertilizer, and mulch to seedbed, as needed.
- Plant native species of grasses and legumes where practicable.

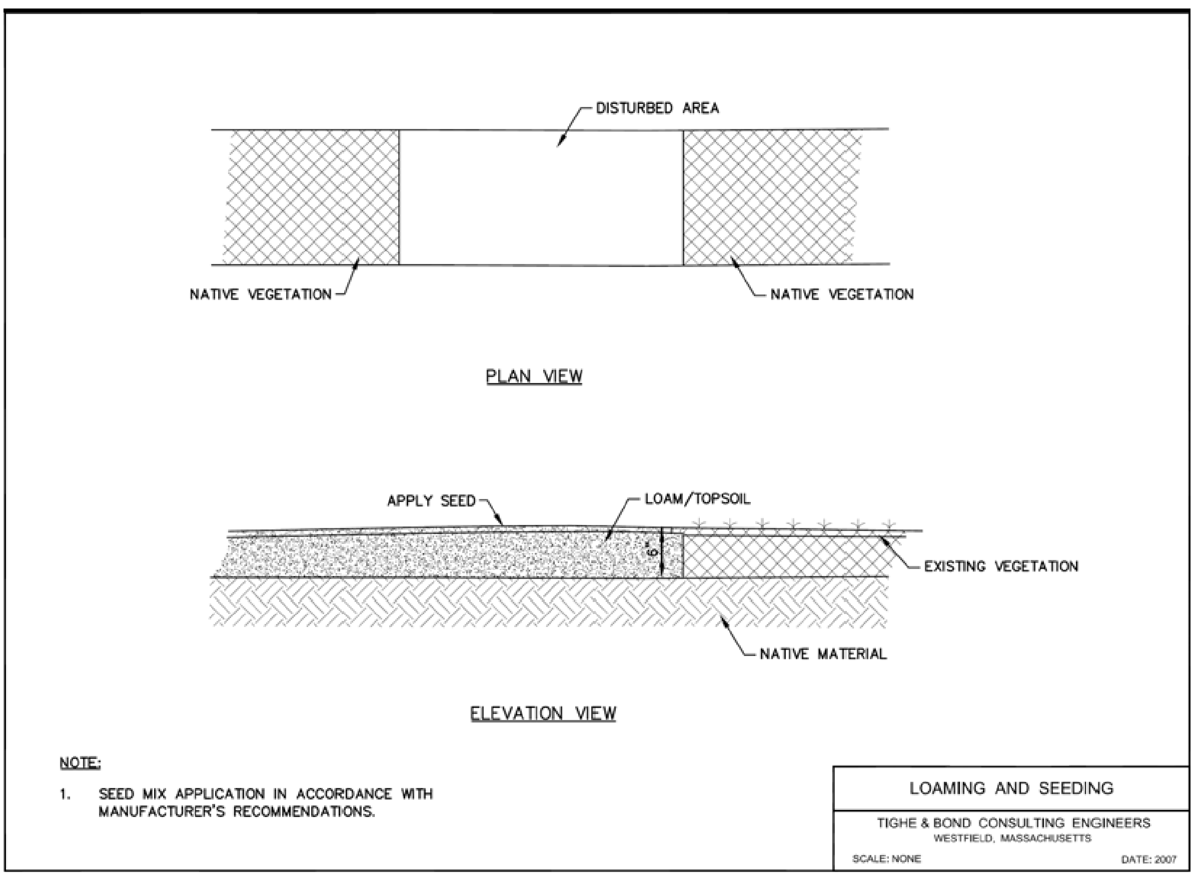
Maintenance:

- Inspect on regular basis until vegetation has established.
- If washout or erosion occurs, repair surface, re-seed, re-mulch and install new netting.
- Follow permit requirements regarding use of wetland seed mix in wetlands where required.

Additional Comments:

Cool Season Grasses	**Warm Season Grasses**
• Best growth in the cool weather of fall and spring, set seed in June and July. • Seed April 1-May 31 and Aug 1-Sept 10.	• Growth begins in the spring, accelerates in the summer, and plants set seed in the fall. • Seed April 1-May 15, dormant seeding Nov 1-Dec 15.

Loaming and seeding of recently disturbed right of way.



1.11 Mulching with Hay/Straw/Woodchips

Applications: Erosion control, soil stabilization, site restoration

Limitations:

- May be site specific limitations (e.g. permit or State requirements).
- Applies to upland areas only.
- Thick mulch may prevent seed germinations.
- Mulch on steep slopes must be secured with netting to prevent it from being washed away.

Overview:

Mulching consists of an application of a protective blanket of straw or other plant residue, gravel, or synthetic material to the soil surface to provide short term soil protection. It enhances plant establishment by conserving moisture and moderating soil temperatures, and anchors seed and topsoil in place. Mulch also reduces stormwater runoff velocity.

Application rates and technique depend on material used. Select mulch material based on soil type, site conditions and season. Straw/hay provides the densest cover if applied at the appropriate rate (at least ½ inch) and should be mechanically or chemically secured to the soil surface. Woodchip application can be less expensive if on-site materials are used.

Installation:

- Use in areas which have been temporarily or permanently seeded.
- Use mulch netting on slopes greater than 3% or in concentrated flows.
- Mulch prior to winter (ideally in mid-summer).

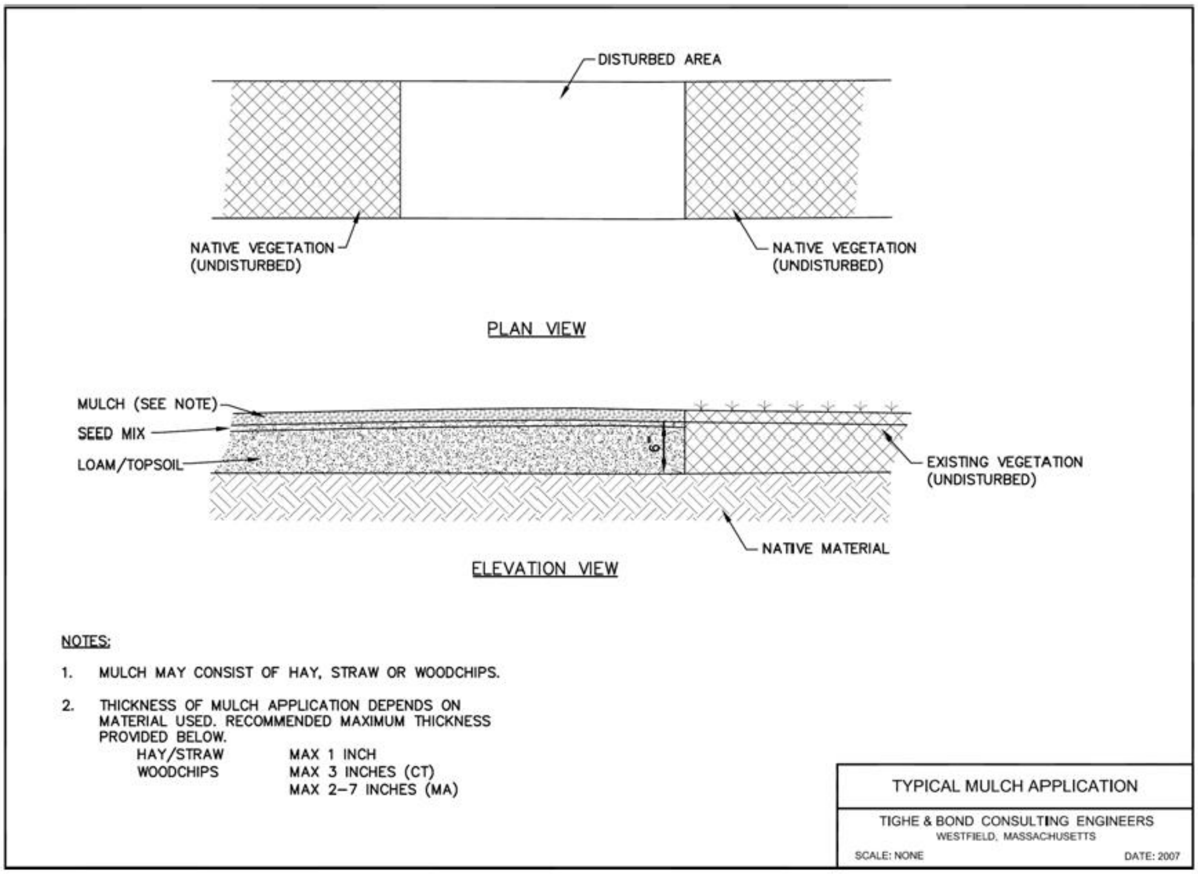
Maintenance:

- Inspect on regular basis until vegetation has established.
- If washout or erosion occurs, repair surface, re-seed, re-mulch, and install new netting.

Additional Comments:

Type	Description/Use
Straw/Hay	• Straw or hay applied to surface at 2-4 tons per acre • Mechanically or chemically secured to soil surface • Provides the densest cover to protect soil and seeds
Wood Fiber/Hydraulic Mulch	• Chopped up fibers applied to the soil surface with a hydroseeder • Tackifier when necessary can be applied with fiber, seeds and fertilizer in one step. This is best when done with fast growing seeds
Compost	• Compost acts as a soil amendment but is more expensive than most mulches • Its efficiency is comparable to wood fiber
Wood Chips	• Use of wood chips as a mulch saves money if on-site materials are used • Effective when applied at high levels (6 tons per acre) and on up to 35% slopes

Typical view of light mulching atop unstable, seeded soils.



1.12 Coir Log Use for Bank Stabilization

Applications: Bank stabilization, wetlands and watercourse restoration

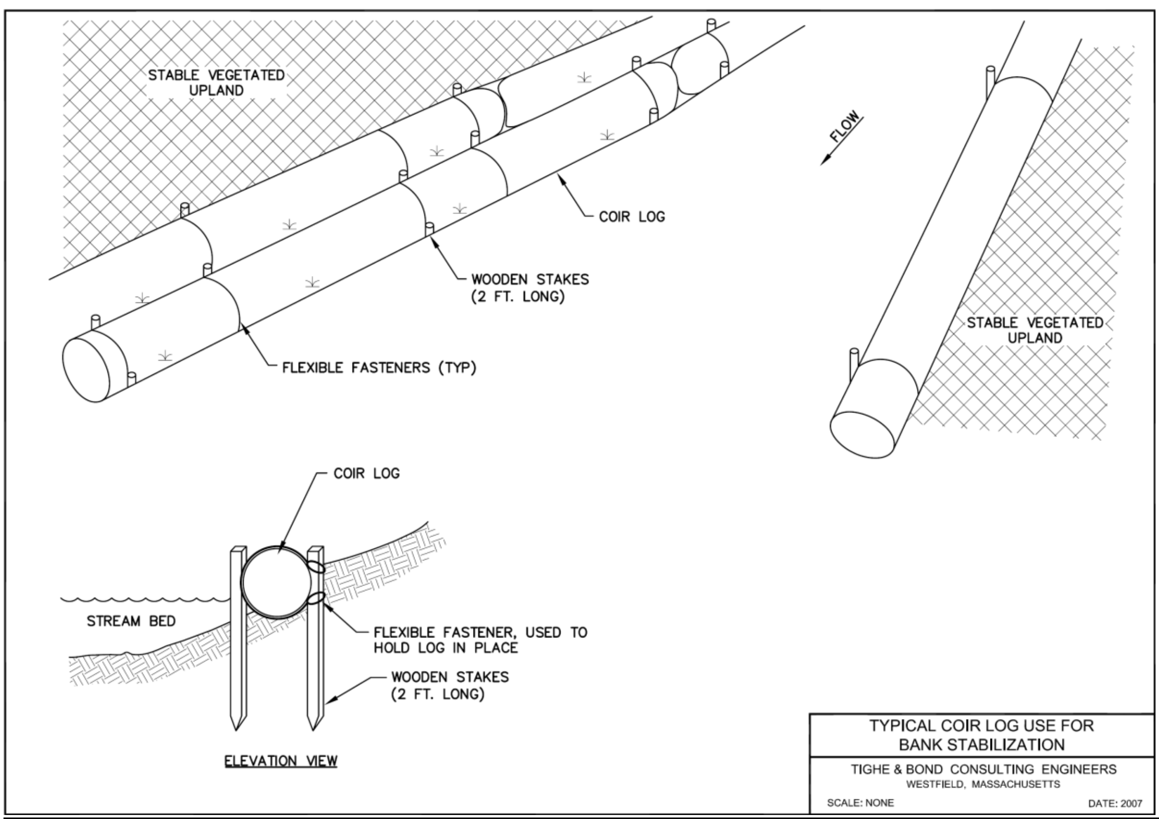
Limitations:

- Moderately expensive.

Overview:

- Refer to permit requirements (if applicable) and manufacturer’s specifications.
- Install along banks between upland and watercourse using wooden stakes (2 foot long) and flexible fasteners (to hold log in place).

Coir logs used to restore a stream bed and banks.



1.13 Level Spreader

Applications: Erosion and sedimentation control

Limitations:

- Downgradient area must be adequately vegetated and have minimum width of 100 feet before surface water
- No vehicle traffic over level spreader

Overview:

Level spreaders, also called grade stabilization structures, are excavated depressions constructed at zero percent grade across a slope. They convert concentrated flow into sheet flow and discharges to stable areas without causing erosion.

Level spreaders are not applicable at all locations. Some general site requirements include:

- Drainage area of 5 acres or less
- Undisturbed soil (not fill)
- A level lip that can be installed without filling
- Area directly below is stabilized by existing vegetation
- At least 100 feet of vegetated area between the spreader and surface waters
- Slope of the area below the spreader lip is uniform and a 10% grade or less
- Water won't become concentrated below the spreader and can be released in sheet flow down a stabilized slope without causing erosion
- There will be no construction traffic over the spreader

Installation:

- Set the channel grade to be no steeper than 1% for the last 20 feet entering the level spreader.
- Install level spreader using the suggested dimensions: length—5 to 50 feet, width—at least 6 feet, and depth—approximately 6 inches (measured from the lip) and uniform.
- Stabilize the level spreader with an appropriate grass seed mixture and mulch, if necessary. Protect the level lip with an erosion stop and jute netting/excelsior matting. The downgradient area should have stable, complete, erosion resistant vegetative cover.

Maintenance:

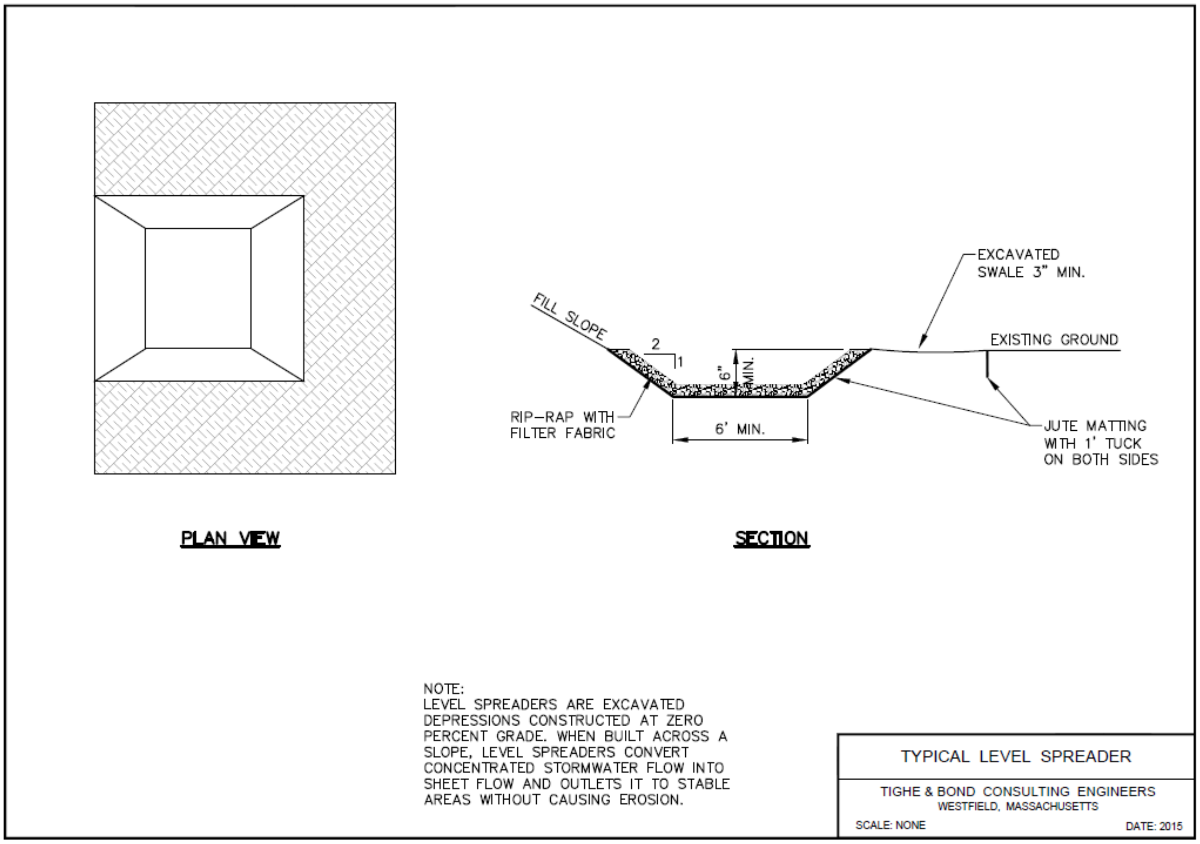
- Inspect after every rain event and remove accumulated sediment. Repair erosion damage and re-seed as necessary.

- Mow vegetation occasionally to control weeds and the encroachment of woody vegetation.

Additional Comments:

If channels form and erosion is evident in level spreader, the level spreader is not uniformly flat. Repair the low spots in the level spreader.

If erosion is occurring downgradient of the level spreader, the level spreader is not long enough or not wide enough. Alternatively, the vegetation is not stable. Re-seed the area.



1.14 Check Dams

Applications: Stormwater management, erosion control

Limitations:

- Need to be adequately sized based on expected rain events.

Overview:

Check dams are porous physical barriers placed across a drainageway to reduce the velocity of concentrated stormwater flows and erosion. Check dams also temporarily pond stormwater runoff to allow sediment in the water column to settle out. Permanent or long-term check dams are typically constructed of rip rap or other stone material. Short-term check dams can be constructed of rip rap. Rip rap check dams are preferred over hay bales.

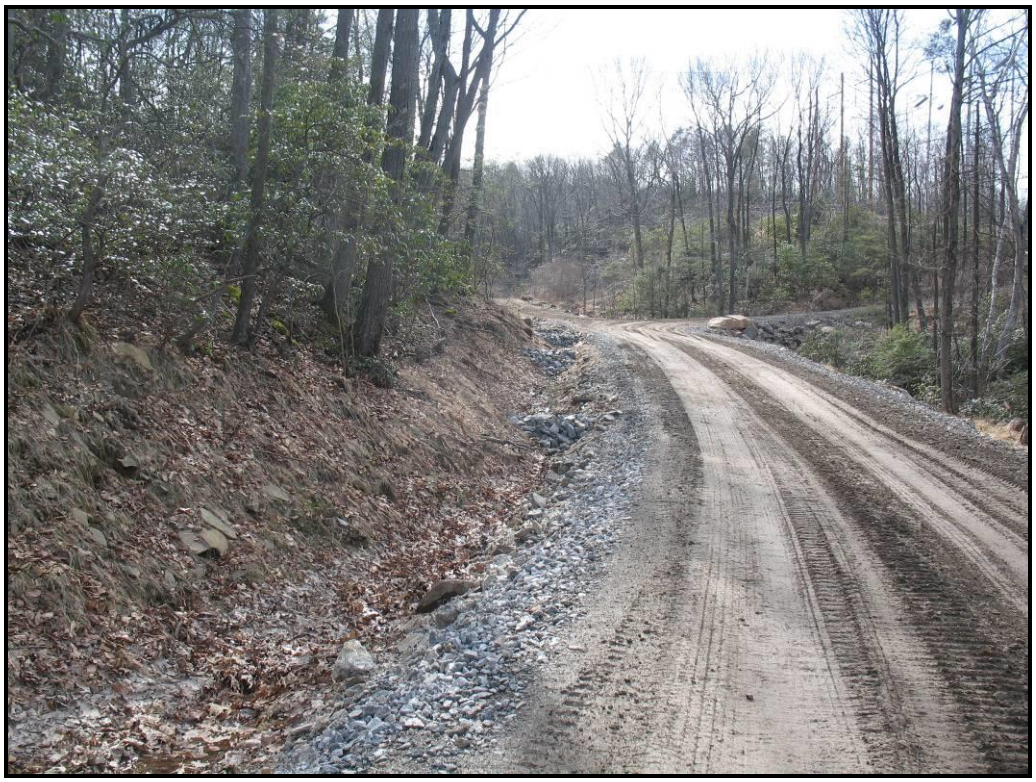
Installation:

- Place stone by hand or machine, making side slopes no steeper than 1:1 and with a maximum height of 3 feet at the center of the check dam. A geotextile may be used under the stone to provide a stable foundation and/or to facilitate removal of the stone.
- The minimum height of the check dam shall be the flow depth of the drainageway, but shall not exceed 3 feet at the center.
- Install the check dam so that it spans the full width of the drainageway, plus 18 inches on each side. Leave the center of the check dam approximately 6 inches lower than the height of the outer edges.
- The maximum spacing between check dams should be such that the toe of the upstream check dam is at the same elevation as the top of the center of the downstream check dam.

Maintenance:

- For permanent stone check dams, inspect and maintain the check dam in accordance with the standards and specifications provided in the design for the site.
- For temporary check dams, inspect at least once per week and within 24 hours of the end of a precipitation event of 0.5 inches or more to determine maintenance needs.
- Maintenance may include, but are not limited to, the replacement of stone, repair of erosion around or under the structure, and/or the removal and proper disposal of accumulated sediment.

Problem	Solution/Explanation
Stone displaced from face of dam	Stone size too small and/or face too steep
Erosion downstream from dam	Install stone lined apron
Erosion of abutments during high flow	Rock abutment height too low
Sediment loss through dam	Inadequate layer of stone on inside face or stone too coarse to restrict flow through dam


Stone check dams at construction site.

Stone check dam at construction site.

1.15 Temporary and Permanent Diversions

Applications: Stormwater management, erosion control

Limitations:

- Need to be adequately sized based on expected rain events and the contributing drainage area.

Overview:

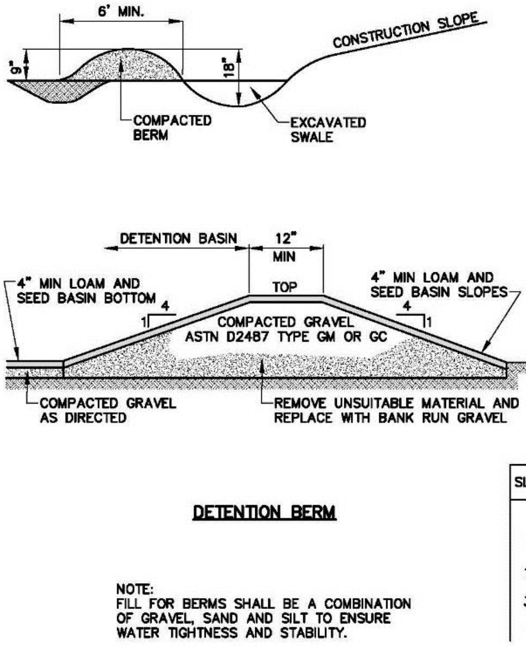
Temporary and permanent diversions are ridges or channels constructed across steep slopes that convey the runoff to a stable outlet at a non-erosive velocity. Use permanent diversions on slopes with high runoff velocities to break up concentrated flow. They can be installed as temporary diversion and completed as permanent when the site is stabilized or can be installed in the final form initially.

Installation:

- Remove woody vegetation and fill and compact the ditches and gullies that must be crossed before construction.
- Remove vegetation around the proposed location of the base of the diversion ridge to form a strong bond between the ground and fill material.
- Stabilize the outlet of the diversion channel using sediment traps, natural or constructed vegetated outlets, or level spreaders.
- Stabilize the diversion channel with riprap, vegetation, paving, or stone.
- Install a filter strip of close growing grass above the channel to prevent sediment accumulation.
- Seed and mulch diversions that are intended for use for more than 30 days.
- After the area has been permanently stabilized, remove the ridge and channel to blend with the natural ground level.

Maintenance:

- Inspect bi-weekly and repair any erosion problems.
- Remove accumulated sediment and debris.



SLOPE %	DISTANCE APART
< 5	125
5–10	100
10–20	75
30–35	50
> 35	25

1.16 Temporary and Permanent Trench Breakers (Trench Plugs)

Applications: Keeping work areas dry, long-term stabilization of soil (prevents sinkholes)

Limitations:

- Water that accumulates behind the trench breaker requires pumping to a filtering device, preferable in a well-vegetated, upland area.

Overview:

Trench breakers (trench plugs) are temporary or permanent measures used to slow the movement of groundwater and surface runoff within a trench. They are often used when runoff draining to downgradient work areas causes problems within the trench. Trench breakers may be placed adjacent to waterways and wetlands to prevent water from seeping into work areas or disrupting the hydrology of the resource areas. They can be used on slopes throughout all types of land uses (including agricultural and residential). Trench breakers should be installed upslope of each permanent slope breaker or waterbar.

Temporary Trench Breakers (Trench Plugs)

Temporary trench plugs may consist of hard or soft plugs. Hard plugs leave small portions of the ditch unexcavated at certain intervals. Soft plugs involve placing compacted subsoil or sandbags into the ditch following excavation.

Installation:

- Install temporary trench plugs at the same intervals as temporary slope breakers or water bars (see table).

Maintenance:

- Inspect trench breakers regularly for signs of any instability, and repair any erosion problems.
- If water accumulates behind the trench breaker, pump to a filtering device, preferably in a well-vegetated, upland area.

Permanent Trench Breakers

Permanent trench breakers are left in the trench and backfilled to slow the movement of subsurface water along the trench. This helps prevent undermining the stability of the right of way that may lead to sinkholes or erosion.

Installation:

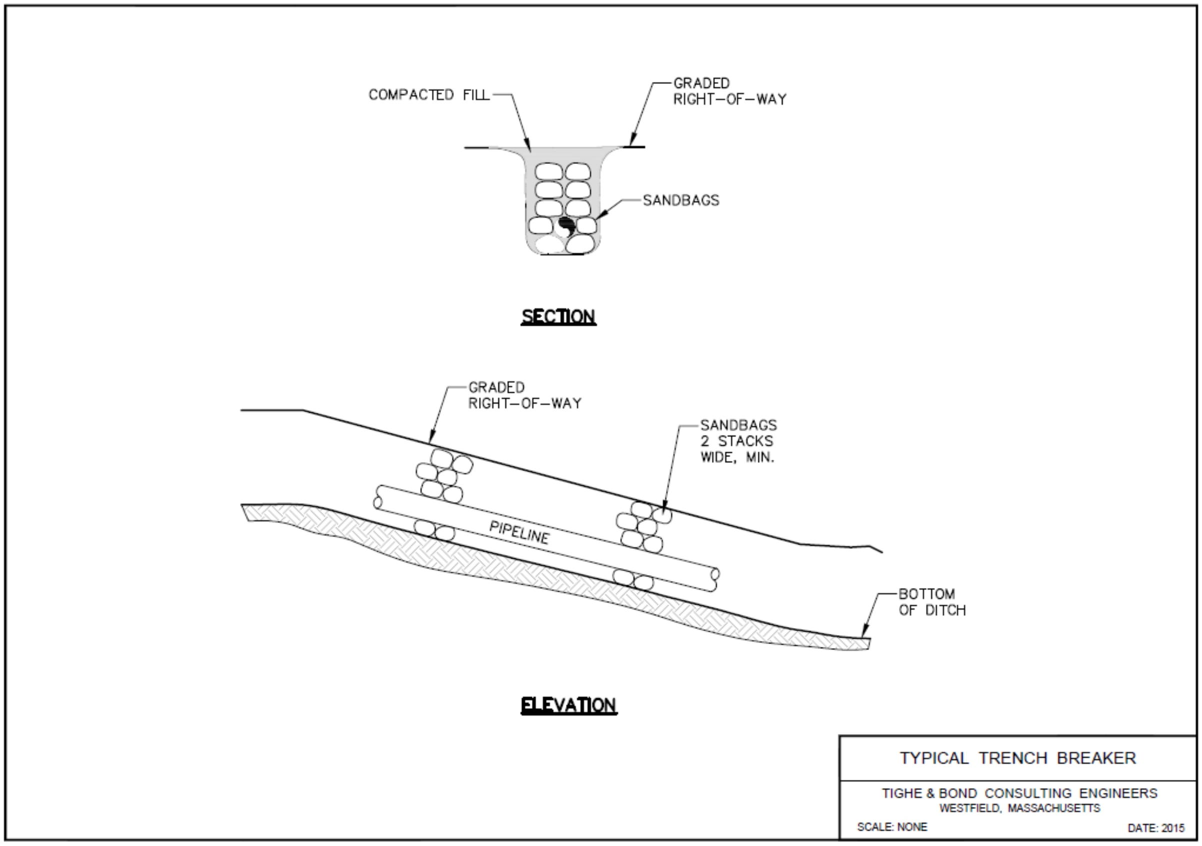
- Trench breakers can be composed of sandbags or polyurethane foam. Do not use topsoil to construct trench breakers.
- Build the trench breaker under and around the pipeline at intervals specified by the local soil conservation service or as shown in the table below.
- Install temporary trench plugs at the same intervals as temporary slope breakers or water bars (see table).
- When using sandbags, construct the trench breakers to be a minimum of two bags wide.
- Backfill the top of the trench breakers along with the rest of the trench. Grade the entire area to the original contours and stabilize.

Maintenance:

- Inspect trench breakers for stability and effectiveness before the trench is backfilled.
- During future inspections of the completed right of way, observe the ditch line for any unusual settling or erosion.
- Inspect wetlands and waterways for any change to their original hydrology.

Additional Comments:

Recommended Spacing	
Land Slope	**Spacing (ft)**
5-15%	300
>15-30%	200
>30%	100


COMPACTED FILL
GRADED RIGHT-OF-WAY
SANDBAGS
SECTION
GRADED RIGHT-OF-WAY
SANDBAGS 2 STACKS WIDE, MIN.
PIPELINE
BOTTOM OF DITCH
ELEVATION
TYPICAL TRENCH BREAKER
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: 2015

Appendix A

Section II

Section 2
Water Control

Several methods exist for temporarily diverting and dewatering surface water from work areas. No untreated groundwater shall be discharged to wetlands or water bodies. A variety of methods may be employed to prevent sedimentation due to dewatering. These methods, which are primarily appropriate during construction of capital projects, are described below.

2.1 Dewatering Activities

Applications: Dewatering

Limitations:

- Overland flow limited to sites with appropriate upland area.
- Frac tanks have limited capacity and are expensive.
- Pumps require oversight at all times.
- Filter bags clog and require replacement.

Overview:

Dewatering activities may be necessary to expose the ditch line and provide drier workspace when high groundwater or saturated soil is present. This condition often occurs in wetlands or near streambanks during excavation activities for installing or replacing utility poles or natural gas pipelines. *Under no circumstances should trench water or other forms of turbid water be directly discharged onto exposed soil or into any wetland or waterbody.*

2.1.1 Overland Flow

Applications: Dewatering

Limitations:

- Space constraints and adjacent wetlands or watercourses may prevent use of this dewatering method.

Overview:

Overland Flow may be used if a discharge location is available where there is no potential for discharged water to flow overland into wetlands or waterbodies. Discharge water overland without any filtering to well-drained, vegetated upland areas and allow to naturally infiltrate into soils.

2.1.2 Frac Tank

Applications: Dewatering, managing contaminated groundwater

Limitations:

- Expensive
- May be site specific limitations (e.g. extremely unlevel ground)
- May require proper disposal at a regulated facility (in cases of contaminated groundwater)

Overview:

Frac Tanks are pre-fabricated and self-contained units that contain a series of baffles that allow fine materials to settle out of the water column. Use frac tanks when the work requires dewatering in an area with very silt laden water and/or contaminated groundwater.

Frac tank on-site for dewatering activities.

2.1.3 Filter Bags and Hay Bale Containment Area

Applications: Dewatering

Limitations:

- Pumps require oversight at all times.
- Filter bags clog and require replacement.

Overview:

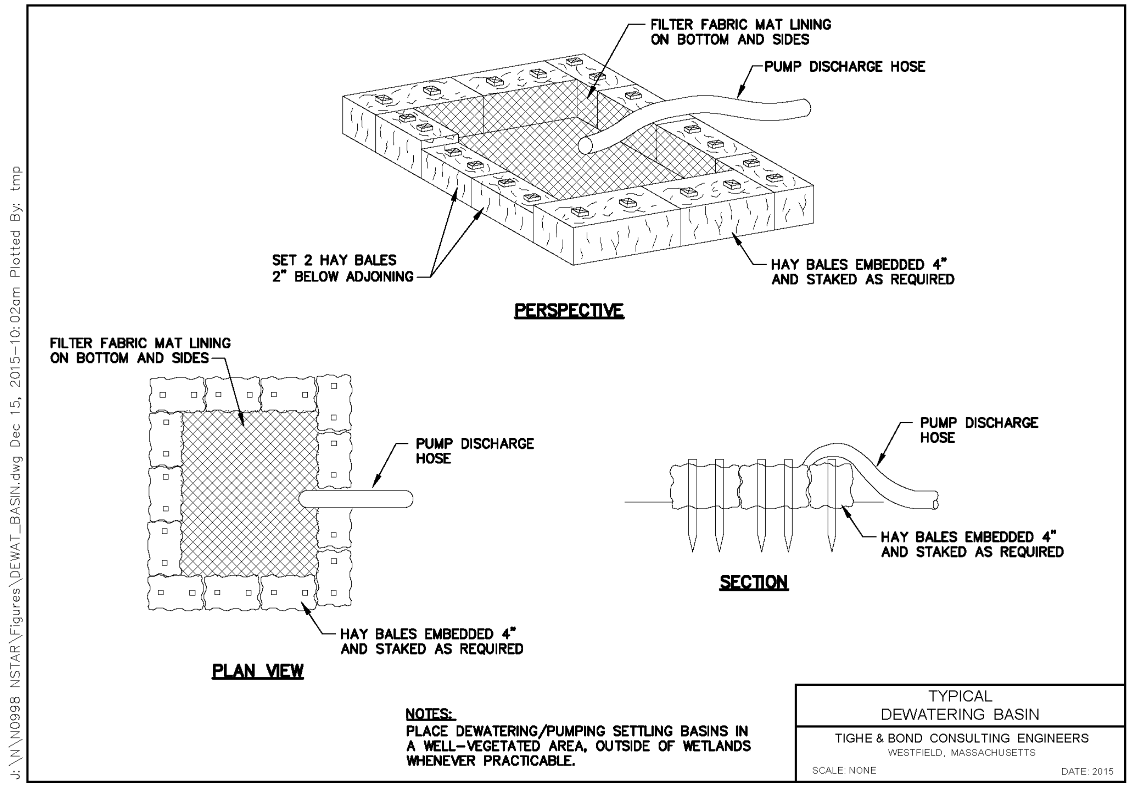
Use filter bags with hay bale containment area for dewatering when there is the potential for discharged water to flow overland into wetlands or waterbodies. Locate dewatering sites in well-vegetated areas within the right of way or approved work areas. Locate discharges outside of wetlands and over 100 feet from a streambank or waterbody, if practicable.

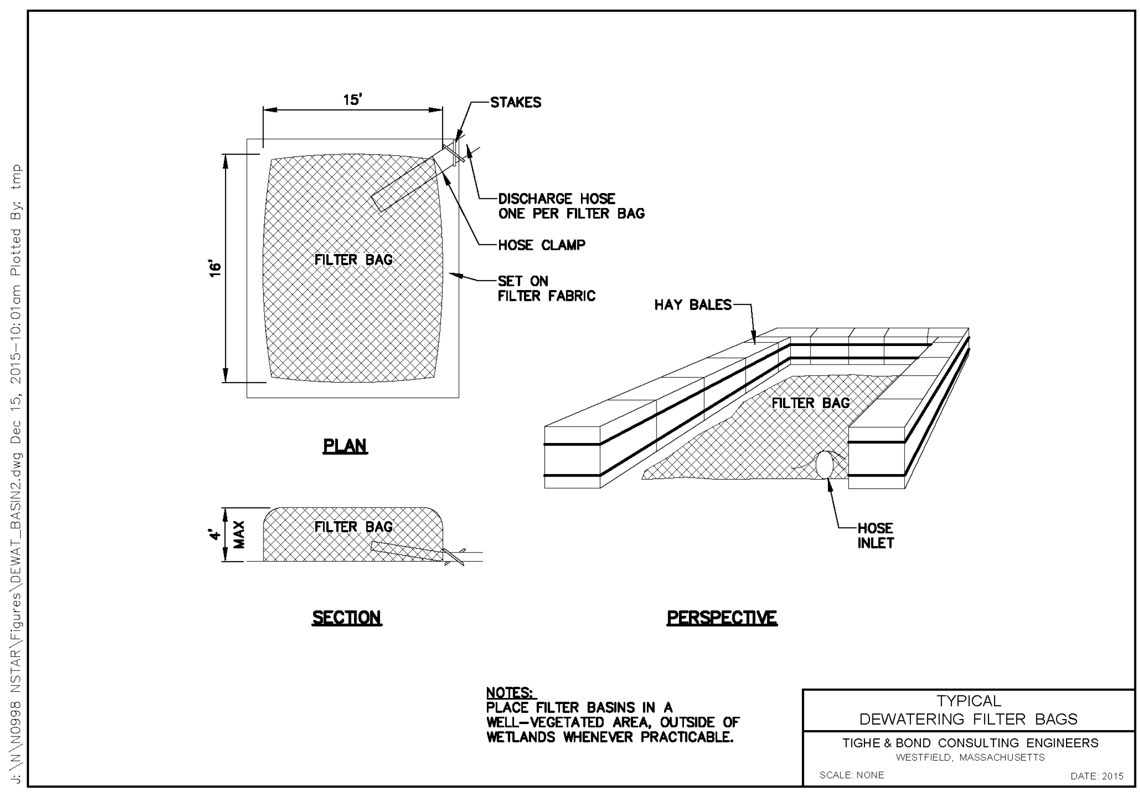
Installation:

- Place pump in a containment structure (i.e., child-sized plastic pool) to avoid fuel leakage to the wetlands or waterways.
- Properly place the discharge hose into a pre-manufactured, geotextile filter bag per the manufacturer's instructions.
- Place the filter bag in a well-vegetated area outside of a wetland area and over 100 feet from a waterbody, if practicable.
- Elevate the intake hose off the trench bottom and create a sump with clean rock in order to avoid pumping additional sediment.
- Build a hay bale corral for the filter bag if the water must be discharged within 100 feet of a wetland, waterbody, or other sensitive area.
- Stake a double vertical line of hay bales in an "L" or "U" shape on the downgradient sides of the bag to further filter the discharge water.

Maintenance:

- Man the pump at all times.
- Refuel pump within a plastic containment structure and/or over 100 feet from the wetland or waterbody.
- Routinely check the filter bag during pumping activities to ensure that it is not reaching its holding capacity.
- If the bag appears to be nearing its limits, stop dewatering until more water has filtered out and the bag can be replaced.
- Properly dispose of used filter bags and trapped sediment.


FILTER FABRIC MAT LINING
ON BOTTOM AND SIDES
PUMP DISCHARGE HOSE
SET 2 HAY BALES
2" BELOW ADJOINING
HAY BALES EMBEDDED 4"
AND STAKED AS REQUIRED
PERSPECTIVE
FILTER FABRIC MAT LINING
ON BOTTOM AND SIDES
PUMP DISCHARGE
HOSE
HAY BALES EMBEDDED 4"
AND STAKED AS REQUIRED
PLAN VIEW
PUMP DISCHARGE
HOSE
HAY BALES EMBEDDED 4"
AND STAKED AS REQUIRED
SECTION
NOTES:
PLACE DEWATERING/PUMPING SETTLING BASINS IN
A WELL-VEGETATED AREA, OUTSIDE OF WETLANDS
WHENEVER PRACTICABLE.
TYPICAL
DEWATERING BASIN
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: 2015
J:\N\N0998 NSTAR\Figures\DEWAT_BASIN.dwg Dec 15, 2015-10:02am Plotted By: tmp


15'
STAKES
DISCHARGE HOSE
ONE PER FILTER BAG
HOSE CLAMP
16'
FILTER BAG
SET ON
FILTER FABRIC
PLAN
HAY BALES
FILTER BAG
HOSE
INLET
4' MAX
FILTER BAG
SECTION
PERSPECTIVE
NOTES:
PLACE FILTER BASINS IN A
WELL-VEGETATED AREA, OUTSIDE OF
WETLANDS WHENEVER PRACTICABLE.
TYPICAL
DEWATERING FILTER BAGS
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: 2015
J:\N\N0998 NSTAR\Figures\DEWAT_BASIN2.dwg Dec 15, 2015-10:01am Plotted By: tmp

2.1.4 Discharge Hose Filter Socks

Applications: Dewatering

Limitations:

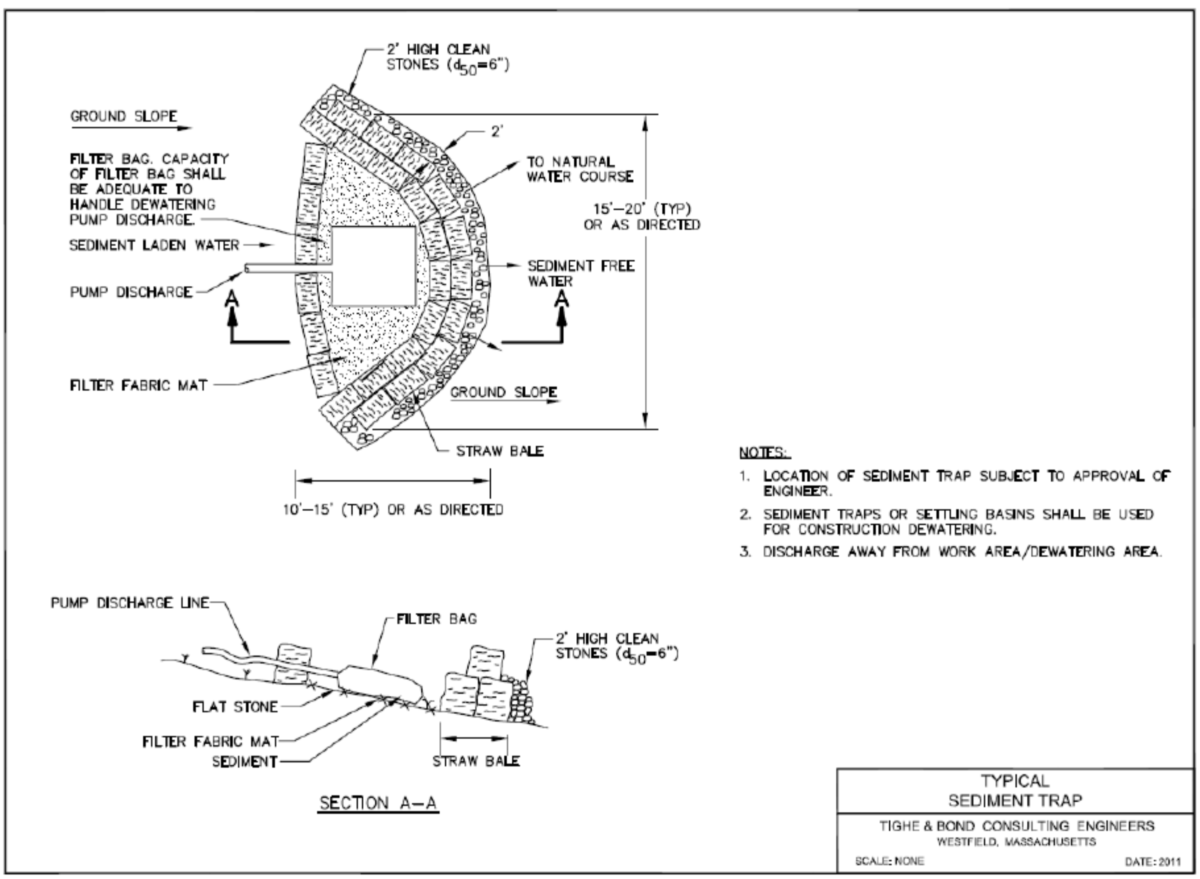
- Ineffective for very silty water

Overview:

Use discharge hose filter socks at sites where there is insufficient space to construct sediment basins or enough suitable uplands for overland flow and infiltration. Filter "socks" or bags may be affixed to the end for the discharge hose of the pump and used for dewatering. It is important that enough socks be on hand at the site to accommodate the anticipated need, as they fill fast with more turbid water. Additional measures such as hay or straw bales can be installed around the filter device for added protection.

Dewatering to filter "sock" surrounded by hay bales.

Riprap underlain by geotextile fabric



2.2 Coffer Dam and Stream Bypass Pumping

Applications: Dewatering/water diversion, turbidity control

Limitations:

- Pipes need to be adequately sized to accommodate heavy rain events.
- Coffer dams require careful maintenance at all times.

Overview:

A coffer dam is a temporary structure used during instream work to enclose a work area by diverting stream flow using pumps (or gravity) while containing sediment and turbidity. Coffer dams make an impoundment upstream of a work area and then use pumps to remove the water from inside the dammed (isolated) area to beyond the work area. They are used in areas with high flows where siltation barriers are not effective. Coffer dams can consist of sandbags, concrete structures, or pre-manufactured products and should be used on a site-by-site basis according to engineering specifications and/or manufacturer's instructions.

Dewatering measures may be necessary if groundwater is encountered within an excavation (e.g., during installation or repair of a buried cable, footings, foundations or structure replacement) or other area if the presence of water is incompatible with construction. In rare cases, surface water diversions will be necessary in order to create dry working conditions for subsurface work in water bodies.

Installation:

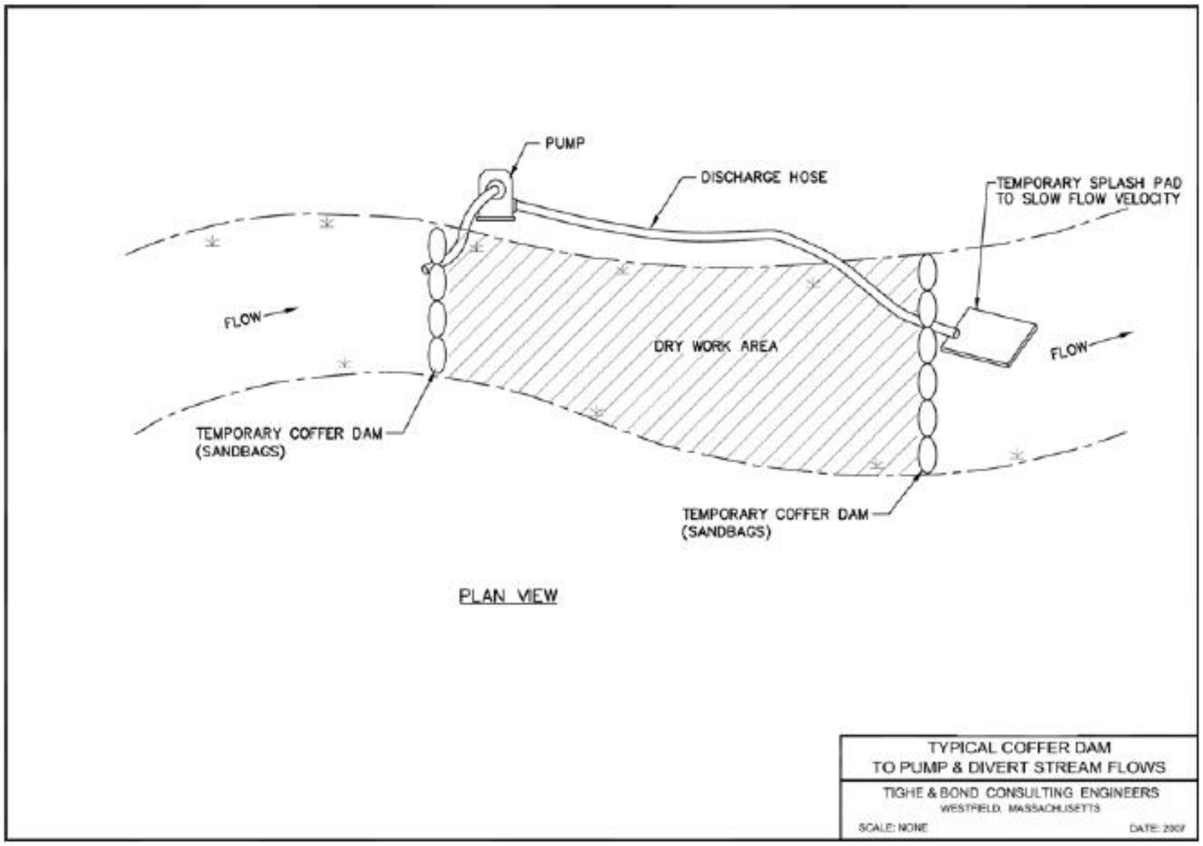
- All cofferdam installations should be designed and approved by engineering staff following geotechnical and hydrological studies. If using a pre-fabricated product, follow manufacturer's instructions and engineer's guidance.
- Place hay bales or silt fence along the streambanks approaching the edges of the workspace.
- Coffer dams should be a semicircle or U-shaped and lined with a geotextile. Use clean durable rockfill or large pre-cast concrete blocks for construction.
- Locate the geotextile outside of the dam for the upstream half and inside for the downstream half to prevent displacement of the geotextile. Place the geotextile with a short flap (1 foot) at the base of the dam, weighted down with clean rockfill.
- Dewatering of the isolated work area may or may not be necessary or even possible. If dewatering is necessary, install an impermeable liner or clay plug.
- After the sediment in suspension has settled out, remove the cofferdam carefully so that sediment disturbance is minimized.
- Do not install in channels where dams would hinder the passage of boats or fish.

Maintenance:

- Cofferdams require careful maintenance at all times.
- Observe the stream flow for any turbidity as a result of the construction activities.

<u>Additional Comments</u>:

Where use of pumps is impractical, coffer dams and temporary pipes can be used to divert flows via gravity and dry out a work area. The instream constriction caused by the cofferdam should be small in order to avoid generating unacceptable scour velocities in the remaining channel section.



2.3 Coffer Dam and Stream Bypass via Gravity

Applications: Dewatering/water diversion, turbidity control

Limitations:

- Pipes need to be adequately sized to accommodate heavy rain events.
- Coffer dams require careful maintenance at all times.

Overview:

A coffer dam is a temporary structure used during instream work to enclose a work area by diverting stream flow via gravity (or using pumps) while containing sediment and turbidity. Coffer dams make an impoundment upstream of a work area and then use a piping and gravity to remove the water from inside the dammed (isolated) area to beyond the work area. They are used in areas with high flows where siltation barriers are not effective. Coffer dams can consist of sandbags, concrete structures, or pre-manufactured products and should be used on a site-by-site basis according to engineering specifications and/or manufacturer's instructions.

Dewatering measures may be necessary if groundwater is encountered within an excavation (e.g., during installation or repair of a buried cable, footings, foundations or structure replacement) or other area if the presence of water is incompatible with construction. In rare cases, surface water diversions will be necessary in order to create dry working conditions for subsurface work in water bodies.

Installation:

- All cofferdam installations should be designed and approved by engineering staff following geotechnical and hydrological studies. If using a pre-fabricated product, follow manufacturer's instructions and engineer's guidance.
- Place hay bales or silt fence along the streambanks approaching the edges of the workspace.
- Coffer dams should be a semicircle or U-shaped and lined with a geotextile. Use clean durable rockfill or large pre-cast concrete blocks for construction.
- Locate the geotextile outside of the dam for the upstream half and inside for the downstream half to prevent displacement of the geotextile. Place the geotextile with a short flap (1 foot) at the base of the dam, weighted down with clean rockfill.
- Dewatering of the isolated work area may or may not be necessary or even possible. If dewatering is necessary, install an impermeable liner or clay plug.
- After the sediment in suspension has settled out, remove the cofferdam carefully so that sediment disturbance is minimized.
- Do not install in channels where dams would hinder the passage of boats or fish.

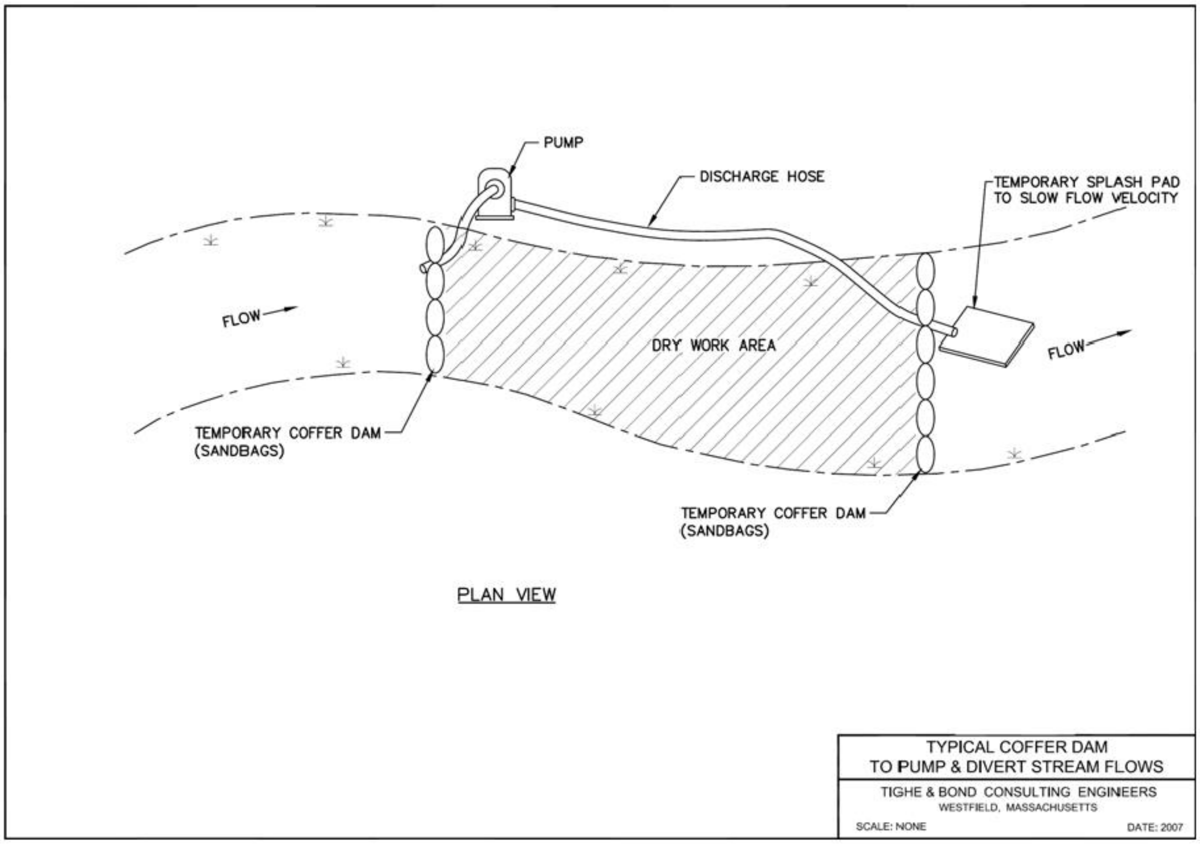
Maintenance:

- Cofferdams require careful maintenance at all times.
- Observe the stream flow for any turbidity as a result of the construction activities.

Additional Comments:

Where gravity flows cannot be circumvented through a coffer dam and temporary flexible pipe via gravity, use a pump, discharge hose and downstream temporary splash pad to slow flow velocity can be used. The instream constriction caused by the cofferdam should be small in order to avoid generating unacceptable scour velocities in the remaining channel section.

Sand bag coffer dam and streamflow gravity bypass.


PUMP
DISCHARGE HOSE
TEMPORARY SPLASH PAD
TO SLOW FLOW VELOCITY
FLOW
DRY WORK AREA
FLOW
TEMPORARY COFFER DAM
(SANDBAGS)
TEMPORARY COFFER DAM
(SANDBAGS)
PLAN VIEW
TYPICAL COFFER DAM
TO PUMP & DIVERT STREAM FLOWS
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: 2007

2.4 Silt Barriers

Applications: Turbidity control

Limitations:

- Must be rated to withstand anticipated flow velocity and quantity.

Overview:

Staked and floating silt barriers are temporary flexible barriers used within a waterbody to separate or deflect natural flow around a work area. Barriers are placed around the sediment source to contain the sediment-laden water, allowing suspended soil particle to settle out of suspension and stay in the immediate area. The staked barrier consists of geotextile fabric attached to support posts and a wire support fence and a chain sewn into a sleeve along the bottom edge to allow the barrier to conform to the channel.

The floating silt barriers are often called silt or turbidity curtains, and can be purchased from manufacturers or can be made on site. Construction generally includes a skirt (geotextile fabric) that forms the barrier, flotation segments such as styrofoam sealed in a seam along the top of the fabric, a ballast chain sealed into a sleeve along the bottom edge of the fabric, a loadline built into the barrier above or below the floatation segments, and piles or posts tied back to underwater or on shore anchor points.

Staked Silt Barriers

- For installations which only isolate a part of the stream, barriers can be used in higher flows (shallow streams with currents less than 0.5 ft/s).
- Do not use in streams/river with strong currents, strong waves, ice, floating debris, or boats and do not place barriers completely across stream channels unless they are minor or intermittent streams with negligible flow.

Installation:

- Place the staked barrier and wire support fence at least 1 foot above the waterline. Do not install in a waterbody deeper than 4 feet.
- Place support stakes 10 feet apart and drive them 2 feet into the channel bottom.
- Fasten the wire mesh securely against the fabric with heavy duty wire staples at least 1” long. If possible, use a continuous roll of fabric and fasten securely to the posts with heavy duty staples with a maximum spacing of 2”.
- Where possible, prefabricate a staked barrier on shore. Carefully roll it up lengthwise and move it into place.
- Secure the bottom edge of fabric to the channel bottom by placing a heavy chain into a sewn sleeve along the fabric edge, or by placing clean rockfill over the edge.

Floating Silt Barriers

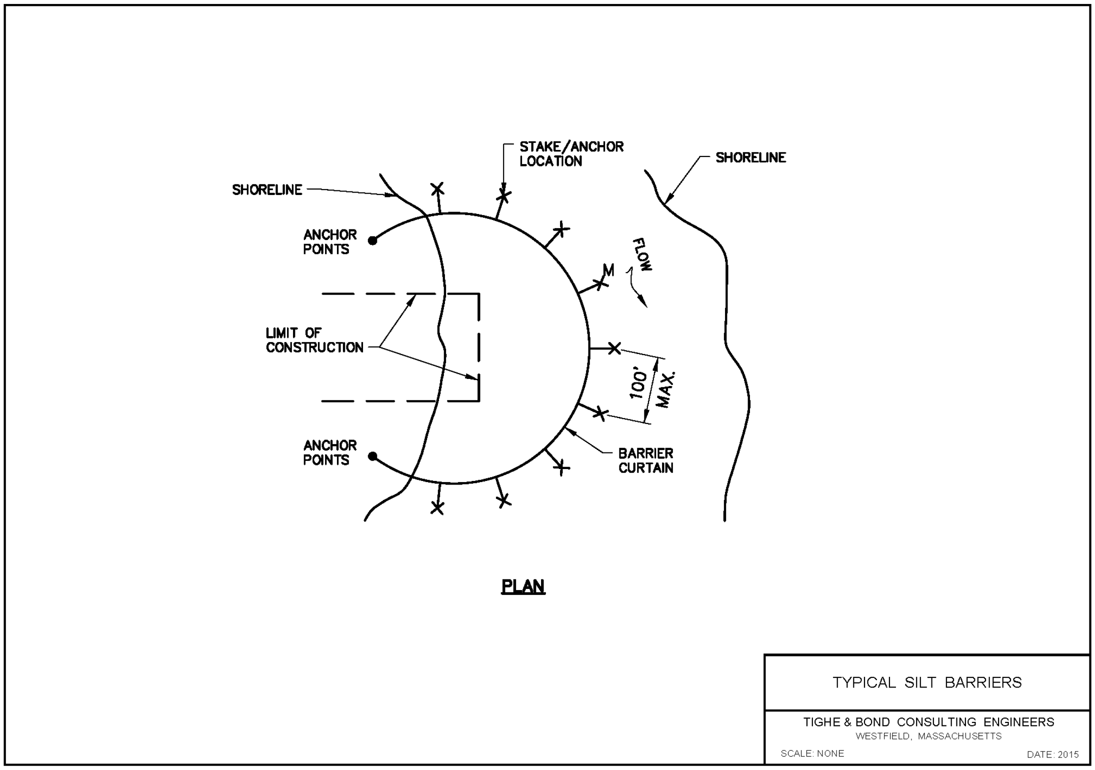
- Use only in negligible or low flow conditions. Can be used for instream areas between 2.6 feet and 6 feet deep and with waves potentially up to 10 feet.
- Do not use to stop, divert, or filter a significant volume of water.

Installation:

- Purchasing a pre-manufactured silt curtain such as Siltmaster® will save time constructing the barrier. Follow manufacturer's advice for the area.
- Enclose the smallest area as practicable. Locate the barrier far enough away from construction equipment to avoid damage.
- Launch the furled barrier from a ramp, pier or shore. Set the shore anchor points and tie off one end of the barrier to the stream anchor point and the downstream end to a boat. Bring to the downstream point to be anchored.
- Anchor the barrier in the desired formation and make sure the skirt is not twisted around the flotation.
- Cut the furling ties and let the ballast sink to its maximum depth.
- Slant the barrier at an angle, not perpendicular to the flow. If the barrier will be exposed to reversing currents, anchor it on both sides.

Maintenance for both:

- Inspect daily for any rips or tears or turbidity in the stream flow. Repair immediately with overlapping pieces of geotextile fabric.
- Remove accumulated sediment from the base of the barrier. If necessary, dewater turbid water to an onshore filter bag before removing the barrier.
- Remove the barrier carefully when the work is completed and after suspended sediments have time to settle out.


STAKE/ANCHOR LOCATION
SHORELINE
SHORELINE
ANCHOR POINTS
FLOW
LIMIT OF CONSTRUCTION
100' MAX.
ANCHOR POINTS
BARRIER CURTAIN
PLAN
TYPICAL SILT BARRIERS
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: 2015

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Tighe&Bond

APPENDIX B

Appendix B

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Appendix B

B.1 Applicable Laws/Regulations

In Connecticut, there are no fewer than eight potentially pertinent regulatory programs associated with activities proposed in environmentally sensitive areas. The following list of laws and regulations are most likely to apply to electrical utility projects in the State.

- Connecticut Inland Wetlands and Watercourses Act (C.G.S. §§ 22a-36 through 22a-45a)
- Municipal inland wetland and zoning regulations
- Connecticut General Permit for Water Resource Construction Activities (C.G.S. §§ 22a-6, 22a-45a and 22a-378a)
- Connecticut Environmental Policy Act (C.G.S. §§ 22a-1a through 22a-1h)
- Connecticut Coastal Management Act (C.G.S. §§ 22a-359 through 22a-363; 22a-28 through 22a-35; 22a-90 through 22a-112; 33 U.S.C. § 1314)
- Connecticut Water Diversion Policy Act (C.G.S. §§ 22a-365 through 22a-379)
- Connecticut Endangered Species Act (C.G.S. §§ 26-303 through 26-315)
- Section 10 of the Rivers and Harbors Act of 1899 (C.G.S. §§ 22a-426; 33 U.S.C. § 403)
- Section 401 of the Clean Water Act (33 U.S.C. § 1251)
- Section 404 of the Clean Water Act (33 U.S.C. § 1344)

B.2 Geographic Areas Subject to Jurisdiction

The following areas are subject to regulatory jurisdiction by at least one of the regulatory programs discussed in this section: It is important to note that more than one jurisdictional resource type may be present at any given location.

- Inland wetlands, watercourses (rivers, streams, lakes, ponds), and floodplains
- Areas subject to municipal wetlands bylaws or ordinances. (These vary by town.)
- Coastal Resource Areas (beaches, dunes, bluffs, escarpments, coastal hazard areas, coastal waters, nearshore waters, offshore waters, estuarine embayments, developed shorefront, intertidal flats, islands, rocky shorefronts, shellfish concentration areas, shorelands, and tidal wetlands)
- Navigable waters
- Essential Fish Habitat (EFH)
- Rare species habitat as mapped by the Connecticut Natural Diversity Database

B.3 Applicable Regulatory Agencies

Activities subject to jurisdiction under the above-referenced programs will generally be subject to review by one or more regulatory agencies (refer to list below). Most stream and wetland crossings will require notification or consultation with municipal Inland Wetland and Watercourses Agencies, and may require permitting with the U.S. Army Corps of Engineers (Corps) and Connecticut Department of Energy & Environmental Protection (CT DEEP) under Sections 404 and 401 of the Clean Water Act. Coordination with CT DEEP may also be required for projects located within areas mapped by the Connecticut Natural Diversity Database. For work within tidal, coastal or navigable waters or in tidal wetlands, permitting will be required with the Connecticut Department of Energy & Environmental Protection (CT DEEP) Office of Long Island Sound Program (OLISP).

- Municipal Conservation Commissions
- Connecticut Department of Energy & Environmental Protection (CT DEEP) Bureau of Water Management, Inland Water Resources Division
- CT DEEP Wildlife Division
- CT DEEP Office of Environmental Review
- CT DEEP Office of Long Island Sound Programs (OLISP)
- United States Army Corps of Engineers (Corps) New England District

The State of Connecticut and the Federal Government define wetlands differently. According to the Inland Wetlands and Watercourses Act, inland wetlands are defined as "land, including submerged land, not regulated pursuant to Sections 22a-28 through 22a-35 of the Connecticut General Statutes, as amended, which consists of any of the soil types designated as poorly drained, very poorly drained, alluvial, and floodplain by the National Cooperative Soil Survey, as it may be amended from time to time by the United States Department of Agriculture Natural Resource Conservation Service. Such areas may include filled, graded, or excavated sites which possess an aquic (saturated) soil moisture regime as defined by the National Cooperative Soil Survey." State wetland identification is based solely on the presence of these soil types.

"Watercourses" means rivers, streams, brooks, waterways, lakes, ponds, marshes, swamps, bogs and all other bodies of water, natural or artificial, vernal or intermittent, public or private, which are contained within, flow through or border upon this state or any portion thereof. Intermittent watercourses shall be delineated by a defined permanent channel and bank and the occurrence of two or more of the following characteristics: (A) Evidence of scour or deposits of recent alluvium or detritus, (B) the presence of standing or flowing water for a duration longer than a particular storm incident, and (C) the presence of hydrophytic vegetation.

The Federal Government defines wetlands as "Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Federal wetland identification is based on a three parameter approach, where a prevalence of hydrophytic vegetation, hydric soils, and wetland hydrology is used to make a wetland determination.

B.4 Maintenance, Repair, or Emergency Projects

Most regulatory programs contain provisions that allow normal maintenance of existing structures and/or response to emergency situations that require immediate attention.

Prior to commencement of new construction, all jurisdictional wetland areas within the work corridor should be delineated by a qualified wetland and soil scientist. The specialist shall delineate areas in accordance with the General Statutes of Connecticut (revised January 1, 2007) as set forth at Title 22a Chapter 440 "Inland Wetlands and Watercourses Act", the U.S. Army Corps of Engineers 1987 Wetland Delineation Manual, and any local inland wetland regulations, ordinances or bylaws that may exist. Refer to each set of regulations regarding applicable wetland definitions. Wetland areas shall be clearly demarcated using appropriate flagging tape or similar means. It is important to note that certain jurisdictional wetland areas in Connecticut can actually occur in uplands, such as floodplains. In addition, Upland Review Areas generally apply to work activities and vary in each community. This makes consultation with a wetland specialist particularly important.

B.4.1 Maintain, Repair and/or Replace

Exemptions or considerations for maintenance, repair, and/or replacement of existing electrical utility structures exist in some environmental regulations, but not all. The exemptions are limited to work related to existing and lawfully located structures where no change in the original structure or footprint is proposed. It is not for the selected contractor of a particular project to make a determination as to whether an activity is exempt. This determination will be made prior to work by the Eversource project manager, in consultation with Eversource environmental staff.

These exemptions/considerations are afforded at:

- CT Inland Wetlands & Watercourses Act (RCSA § 22a-39-4)
- CT General Permit (Section 3)
- CT Coastal Management Act (RCSA § 22a-363b)
- CT GP [33 CFR 323.4(a)(2)]
- CT Water Diversion Policy Act (RCSA § 22a-377(b)1)

B.4.2 Emergency Projects

Emergency provisions are generally afforded to activities that need to abate conditions that pose a threat to public health or safety. These provisions generally do not allow work beyond what is necessary to abate the emergency condition, and will generally require an after-the-fact permit. It is not for the selected contractor of a particular project to make a determination as to whether an activity is an emergency. This determination will be made prior to work by the Eversource project manager, in consultation with Eversource environmental staff.

It is important to note that invocation of an emergency provision does not release the project proponent from reporting requirements.

Emergency provisions are afforded at:

- CEPA (RCSA § 22a-1a-3)
- CT Coastal Management Act (RCSA § 22a-29)
- CT GP [33 CFR Part 323.4(a)(2)]

B.5 Municipal Permitting

Work within wetlands, watercourses and designated Upland Review Areas typically requires notification to municipal staff, (Department of Public Works and/or the Inland Wetland and Watercourse Agency staff). In October 1996 the Connecticut Department of Public Utility Control opened a docket (Docket Number 95-08-34) to conduct a generic investigation on the allocation of siting jurisdiction over utility plant facilities. This included an investigation as to whether local authorities (including local Inland Wetlands and Watercourses Agencies) have jurisdiction over public utility projects.

The investigation resulted in several orders which provide guidance on how public utility companies should coordinate with municipalities on the construction of new facilities, upgrades, significant maintenance activities, and routine maintenance activities.

- For the construction of new facilities, alterations to existing facilities (including upgrades) or significant maintenance involving substantial disturbance of soil, water or vegetation which would regularly fall under the review requirements of certain local authorities (ie. Planning and Zoning Authority; Inland Wetlands Commission; Public Works Department; Historic District Commission), the utility shall at least notify and consult with such local authority, or its designated agent or staff, toward the development of mutually agreeable schedules and procedures for the proposed activity.
- For routine maintenance activities or alterations to existing facilities (including upgrades) involving minor disturbance of soil, water or vegetation which would regularly fall under the review and approval requirements of certain local authorities, the utility shall make local authorities or their designated agent or staff aware of such ongoing activities.

B.6 CT Department of Energy & Environmental Protection

If the project requires formal permitting with the Corps (Category 2 or Individual Permit), copies of the application should be forwarded to CT DEEP for review under Section 401 of the Clean Water Act. The CT DEEP requires that a GP Addendum form be completed and submitted along with the Corps application. If the project qualifies as Category 1 under the Corps GP, the project also is granted authorization (Water Quality Certification, WQC) with no formal application under Section 401 of the Clean Water Act, provided the project meets the additional WQC general conditions. The general conditions commonly applicable to utility projects include:

- Prohibiting dumping of any quantity of oil, chemicals, or other deleterious material on the ground;

- Immediately informing the CT DEEP Oil and Chemical Spill Response Division at (860) 424-3338 (24 hours) of any adverse impact or hazard to the environment including any discharge or spillage of oil or chemical liquids or solids;

- Separating staging areas at the site from the regulated areas by silt fences or stray/hay bales at all times;

- Prohibiting storage of any fuel and refueling of equipment within 25 feet from any wetland or watercourse;

- Following the document "Connecticut Guidelines for Soil and Erosion Control," inspecting employed controls at least once per week, after each rainfall, and at least daily during prolonged rainfall, and correcting any deficiencies within 48 hours of being found.

- Prohibiting the storage of any materials at the site which are buoyant, hazardous, flammable, explosive, soluble, expansive, radioactive, or which could in the event of a flood be injurious to human, animal or plant life, below the elevation of the 500 year flood. Any other material or equipment stored at the site below this elevation must be firmly anchored, restrained or enclosed to prevent flotation. The quantity of fuel for equipment at the site stored below such elevation shall not exceed the quantity of fuel that is expected to be used by such equipment in one day.

- Immediately informing DEEP at (860) 424-3019 and the Corps at (617) 647-8674 of the occurrence of pollution or other environmental damage in violation of the WQC, and within 48 hours support a written report including information specified in the general conditions.

If the project falls within areas mapped by the Connecticut Natural Diversity Database, or is less than 0.50 miles upstream or downstream of a mapped area, a data request and possible coordination will be required with the Natural Diversity Database.

If a project is located within tidal, coastal or navigable waters of the state or in tidal wetlands, permitting may be required with the CT DEEP OLISP. For the routine maintenance of previously permitted structures or structures that were in place prior to June 24, 1939, no permitting is required. For significant maintenance of previously permitted structures or structures that were in place prior to June 24, 1939, a Certificate of Permission is required. For new projects a Structures, Dredging and Fill Permit and/or a Tidal Wetlands Permit may be required. The CT DEEP OLISP should be consulted prior to preparing permits to conduct a pre-application meeting and determine the appropriate permitting route.

B.7 U.S. Army Corps of Engineers

Work within wetlands and waters of the United States is subject to jurisdiction under Section 404 of the Clean Water Act, which is administered by the Corps. Work within navigable waters is also administered by the Corps under Section 10 of the Rivers and Harbors Act of 1899. The Corps has issued a General Permit (GP) which establishes categories for projects based on their nature of impacts. The current permit was issued on July 15, 2011, and expires on July 15, 2016. The permit will be reissued by July 15, 2016 for another five years. Applications are not required for Category 1 projects, but submittal of a Category 1 Form before the work occurs and submittal of a Compliance Certification Form within one month after the work is completed is required. The Category 1 Form and Compliance Certification Form entails self-certification by applicants that their project complies with the terms and conditions of Category 1 of the GP. Category 2 projects require the submittal of an application to the Corps, followed by a screening of the application by the Corps, the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, National Marine Fisheries Service and CT DEEP, and consultation with the Connecticut Commission on Culture and Tourism and Tribal Historic Preservation Officers. Category 2 projects may not proceed until written approval from the Corps is received. Written approval is generally provided within 45 days of the multi-agency screening. After written approval is received, a Work-Start Notification Form must be submitted before the work occurs, and a Compliance Certification Form must be submitted within one month after the work is completed.

For work proposed within a FEMA floodway or floodplain, the Corps recommends that the applicant apply for and receive a Flood Management Certification (if required), prior to applying to the Corps. Additionally, applications for Category 2 inland projects that propose fill in Corps jurisdiction must include an Invasive Species Control Plan (ISCP), unless otherwise directed by the Corps.

An Individual Permit requires a formal permit application to be submitted to the Corps. The application is reviewed in detail by both state and federal agencies, and a Public Notice is released for public comment. Projects which trigger an Individual Permit generally result in significant impacts to wetlands and/or watercourses.

Stream and wetland crossings are only subject to jurisdiction under the Corps if there is **a discharge of dredge or fill material into wetlands or waters of the United States**. Equipment access through a stream or wetland with no structural BMP is not regulated by the Corps if there is no discharge of dredge or fill material (note that equipment rutting as a result of not using an appropriate BMP can be considered a "discharge of dredge material"). Similarly, the use of a timber or rail car bridge that extends from bank to bank with no stream impacts is not regulated by the Corps. Additionally, the use of timber mats and stone is considered "fill material" by the Corps, and must be calculated to determine overall impacts. Temporary mats are not counted towards the 1 acre threshold under Category 2 if they are adequately cleaned after previous use, removed immediately after completion of construction and disposed of at an upland site.

Maintenance, including emergency reconstruction of currently serviceable structures, is exempt from Corps jurisdiction and does not require formal permitting. Maintenance does not include any modification that changes the character, scope, or size of the original fill design. Emergency reconstruction must occur within a reasonable period of time after damage occurs to qualify for this exemption.

Stream and wetland crossings that involve the discharge of dredge and fill material may be conducted under Category 1 if the work complies with the general conditions and Category 1 criteria of the GP. The following are Category 1 criteria that are commonly applicable to stream and wetland crossings in utility rights of way. See Section 1.8 for additional criteria for culvert crossings:

- The work results in less than 5,000 square feet of impacts to wetlands or waters of the United States. Replacement of utility line projects with impacts solely within wetlands greater than 5,000 square feet may be eligible for Category 1 Authorization after consultation with the Corps about the specific project;

- Temporary fill, with the exceptions of swamp and timber mats, discharged to wetlands shall be placed on geotextile fabric laid on the pre-construction wetland grade. Unconfined temporary fill discharged into flowing water (rivers and streams) shall consist only of clean stone. All temporary fill shall be removed as soon as it is no longer needed, and disposed of at an appropriate upland site.
- Any unconfined in-stream work, including construction, installation or removal of sheet pile cofferdam structures, is conducted during the low-flow period between July 1 and September 30. However, installation of cofferdams, other than sheet pile cofferdams, is not restricted to the low-flow period;
- No work will occur in the main stem or tributary streams of the Connecticut River watershed that are being managed for Atlantic salmon (*Salmo salar*). (Work of this nature requires screening for potential impacts to designated Essential Fish Habitat.);
- The work does not result in direct or secondary impacts to Special Wetlands, Threatened, Endangered or Special Concern Species, or Significant Natural Communities identified by the Connecticut Natural Diversity Database. Work within 750 feet of vernal pools shall be minimized;
- The project does not require a Corps permit with associated construction activities within 100 feet of Special Wetlands;
- The project does not result in fill placed within a FEMA established floodway, unless the applicant has a State of Connecticut Flood Management Certification pursuant to Section 25-68d of the Connecticut General Statutes;
- The project does not result in fill placed within a FEMA established floodplain that would adversely affect the hydraulic characteristics of the floodplain;
- The project does not entail stormwater detention or retention in inland waters or wetlands;
- The project is not located in a segment of a National Wild and Scenic River System (includes rivers officially designated by Congress as active study status rivers for possible inclusion) or within 0.25 miles upstream or downstream of the main stem or tributaries to such a system;
- The project has no potential for an effect on a historic property which is listed or eligible for listing in the National Register of Historic Places;
- The project does not impinge upon the value of any National Wildlife Refuge, National Forest, or any other area administered by the U.S. Fish and Wildlife Service, U.S. Forest Service or National Park Service;
- Section 106 needs to be taken into account for all work that requires federal permitting – including Category 1;
- The project does not use slip lining, plastic pipes, or High Density Polyethylene Pipes (HDPP).
- Appropriate BMPs are employed in regards to heavy equipment in wetlands (General Condition 16) and sedimentation and erosion controls (General Condition 20).

- Disturbed inland wetland areas are restored in accordance with General Condition 18.

Stream and wetland crossings that involve the discharge of dredge and fill material may be conducted under Category 2 if the work complies with the general conditions and Category 2 criteria of the GP. The following are Category 2 criteria that are commonly applicable to stream and wetland crossings in utility right of ways. See Section 1.8 for additional criteria for culvert crossings:

- The work results in less than one acre of impacts to wetlands or waters of the United States;
- The project does not result in fill placed within a FEMA established floodplain that would adversely affect the hydraulic characteristics of the floodplain;
- The project does not entail stormwater detention or retention in inland waters or wetlands.
- Temporary fill, with the exceptions of swamp and timber mats, discharged to wetlands shall be placed on geotextile fabric laid on the pre-construction wetland grade. Unconfined temporary fill discharged into flowing water (rivers and streams) shall consist only of clean stone. All temporary fill shall be removed as soon as it is no longer needed, and disposed of at an appropriate upland site.
- Appropriate BMPs are employed in regards to heavy equipment in wetlands (General Condition 16) and sedimentation and erosion controls (General Condition 20).
- Disturbed inland wetland areas are restored in accordance with General Condition 18.

Stream and wetland crossings that cannot meet Category 1 or Category 2 criteria may require review under an Individual Permit. The Corps should be consulted before assuming an Individual Permit will be required, as exceptions can be made under certain circumstances.

B.8 Culvert Installation

New culvert installation or existing culvert replacements will require notification or consultation with municipal staffers which might include the Department of Public Works and/or the inland wetlands officer, and may require permitting with the Corps under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act of 1899, and the CT DEEP under Section 401 of the Clean Water Act. Coordination with CT DEEP may also be required for projects located within areas mapped by the Connecticut Natural Diversity Database. For work within tidal, coastal or navigable waters or in tidal wetlands, permitting will be required with the CT DEEP Office of Long Island Sound Program (OLISP).

B.8.1 Municipal Permitting

See Section 1.5 for general local permitting guidance.

- For the installation of new culverts and the replacement of culverts that involve substantial disturbance of soil, water or vegetation which would regularly fall under the review and approval requirements of certain local authorities (ie.

Planning and Zoning Authority; Inland Wetlands Commission; Public Works Department; Historic District Commission), the utility shall at least notify and consult with such local authority, or its designated agent or staff, toward the development of mutually agreeable schedules and procedures for the proposed activity.

- For the replacement of culverts involving only minor disturbance of soil, water or vegetation which would regularly fall under the review and approval requirements of certain local authorities, the utility shall make local authorities or their designated agent or staff aware of such ongoing activities.

B.8.2 CT Department of Energy & Environmental Protection

If the project requires formal permitting with the Corps, copies of the application should be forwarded to CT DEEP for review under Section 401 of the Clean Water Act. The CT DEEP requires that a PGP Addendum form be completed and submitted along with the Corps application.

If a culvert project falls within areas mapped by the Connecticut Natural Diversity Database, or falls within 0.50 miles upstream or downstream of a mapped area, a data request and possible coordination will be required with the Natural Diversity Database.

If a culvert project is located within tidal, coastal or navigable waters of the state or in tidal wetlands, permitting will be required with the CT DEEP OLISP. For new projects a Structures, Dredging and Fill Permit and/or a Tidal Wetlands Permit will be required. For replacement structures which were previously permitted, or which were in place prior to June 24, 1939, a Certificate of Permission may only be required, which entails a shorter permitting process.

B.8.3 U.S. Army Corps of Engineers

See Section 1.7 for general Corps permitting requirements. Open bottom arches, bridge spans or embedded culverts are preferred over traditional culverts and are required for Category 1 projects. However, where site constraints make these approaches impractical, the Corps should be consulted.

New bridge or open-bottom structure crossings may be conducted under Category 1 or Category 2 if the following criteria are met in addition to meeting any applicable general criteria listed in section 1.7 of this manual:

- The work spans at least 1.2 times the watercourse bank full width;
- The structure has an openness ratio equal to or greater than 0.25 meters;
- The structure allows for continuous flow of the 50-year frequency storm flows.

New culvert installations may be conducted under Category 1 if the work complies with the general conditions and Category 1 criteria of the GP. The following are Category 1 criteria that are commonly applicable to new culvert installations in utility right of ways:

- Work is conducted in accordance with the design requirements listed in Section 3.1.3 of the Best Management Practices Manual;
- Plastic and High Density Polyethylene Pipes (HDPE) are not used;

- The work results in less than 5,000 square feet of impacts to wetlands or waters of the United States;
- Any unconfined in-stream work, including construction, installation or removal of sheet pile cofferdam structures, is conducted during the low-flow period between July 1 and September 30, except in instances where a specific written exception has been issued by the Connecticut Department of Energy & Environmental Protection. However, installation of cofferdams, other than sheet pile cofferdams, is not restricted to the low-flow period;
- No open trench excavation is conducted within flowing waters. Work within flowing waters can be avoided by using temporary flume pipes, culverts, cofferdams, etc. to isolate work areas and maintain normal flows;
- The tributary watershed to the culvert does not exceed 1.0 square mile (640 acres);
- The culvert gradient (slope) is not steeper than the streambed gradient immediately upstream or downstream of the culvert;
- For a single box or pipe arch culvert crossing, the inverts are set not less than 12 inches below the streambed elevation;
- For a multiple box or pipe arch culvert crossing, the inverts of one of the boxes or pipe arch culverts are set not less than 12 inches below the elevation of the streambed;
- For a pipe culvert crossing, the inverts are set such that not less than 25% of the pipe diameter or 12 inches, whichever is less, is set below the streambed elevation;
- The culvert is backfilled with natural substrate material matching upstream and downstream streambed substrate;
- The structure does not otherwise impede the passage of fish and other aquatic organisms;
- The structure allows for continuous flow of the 50-year frequency storm flows;
- The work does not result in direct or secondary impacts to Special Wetlands, Threatened, Endangered or Special Concern Species, or Significant Natural Communities identified by the Connecticut Natural Diversity Database. Work within 750 feet of vernal pools shall be minimized;
- The project does not require a Corps permit with associated construction activities within 100 feet of Special Wetlands;
- The project does not result in fill placed within a FEMA established floodway, unless the applicant has a State of Connecticut Flood Management Certification pursuant to section 25-68d of the Connecticut General Statutes;
- The project does not result in fill placed within a FEMA established floodplain that would adversely affect the hydraulic characteristics of the floodplain;
- The project does not entail stormwater detention or retention in inland waters or wetlands;
- The project is not located in a segment of a National Wild and Scenic River System (includes rivers officially designated by Congress as active study status

rivers for possible inclusion) or within 0.25 miles upstream or downstream of the main stem or tributaries to such a system;

- The project has no potential for an effect on a historic property which is listed or eligible for listing in the National Register of Historic Places;
- The project does not impinge upon the value of any National Wildlife Refuge, National Forest, or any other area administered by the U.S. Fish and Wildlife Service, U.S. Forest Service or National Park Service.
- Appropriate BMPs are employed in regards to sedimentation and erosion controls (General Condition 20).

New culvert installations may be conducted under Category 2 if the work complies with the general conditions and Category 2 criteria of the GP. The following are Category 2 criteria that are commonly applicable to new culvert installations in utility right of ways:

- Work is conducted in accordance with the design requirements listed in Section 3.1.3 of the Best Management Practices Manual;
- The work results in less than one acre of impacts to wetlands or waters of the United States;
- The project does not result in fill placed within a FEMA established floodplain that would adversely affect the hydraulic characteristics of the floodplain;
- There is no practicable alternative location for the crossing that would have less environmental impacts;
- The use of a bridge or open-bottom structure is determined to be not practicable;
- For a single box or pipe arch culvert crossing, the inverts are set not less than 12 inches below the streambed elevation;
- For a multiple box or pipe arch culvert crossing, the inverts of one of the boxes or pipe arch culverts are set not less than 12 inches below the elevation of the streambed;
- For a pipe culvert crossing, the inverts are set such that not less than the pipe diameter or 12 inches, whichever is less, is set below the streambed elevation;
- The culvert is backfilled with natural substrate material matching upstream and downstream streambed substrate;
- The culvert has an openness ratio equal to or greater than 0.25 meters;
- The structure does not result in a change in the normal water surface elevation of the upstream waters or wetlands;
- The structure allows for continuous flow of the 50-year frequency storm flows;
- Appropriate BMPs are employed in regards to sedimentation and erosion controls (General Condition 20).

New culvert installations that cannot meet Category 1 or Category 2 criteria may require review under an Individual Permit. The Corps should be consulted before assuming an Individual Permit will be required, as exceptions can be made under certain circumstances.

In-kind replacement of culverts using the same materials is exempt from Section 404 of the Clean Water Act, and does not require permitting with the Corps. The Corps, however, should be consulted before assuming an activity is exempt from their jurisdiction. Consult with Siting and Permitting.

Bridge or open-bottom structure replacements may be conducted under Category 1 if the conditions for a new bridge or open-bottom structure replacement have been met. In addition, bridge or open-bottom structure replacements should not result in a change in the normal surface elevation of the upstream waters or wetland, and the replacement structure should have a riparian bank on one or both sides for wildlife passage. Culvert replacements may be conducted under Category 1 if the conditions for new culvert installation are met.

Bridge or open-bottom structure replacements may be conducted under Category 2 if the conditions for a new bridge or open-bottom structure replacement have been met. Culvert replacements may be conducted under Category 2 if the following conditions are met:

- The work results in 5,000 square feet to less than one acre of impacts to wetlands or waters of the United States;
- The use of a bridge or open-bottom structure is determined to be not practicable;
- For a single box or pipe arch culvert crossing, the inverts are set not less than 12 inches below the streambed elevation;
- For a multiple box or pipe arch culvert crossing, the inverts of one of the boxes or pipe arch culverts are set not less than 12 inches below the elevation of the streambed;
- For a pipe culvert crossing, the inverts are set such that not less than the pipe diameter or 12 inches, whichever is less, is set below the streambed elevation;
- The culvert is backfilled with natural substrate material matching upstream and downstream streambed substrate;
- The culvert has an openness ratio equal to or greater than 0.25 meters;
- The structure does not result in a change in the normal water surface elevation of the upstream waters or wetlands;
- The structure allows for continuous flow of the 50-year frequency storm flows.
- Appropriate BMPs are employed in regards to sedimentation and erosion controls (General Condition 20).

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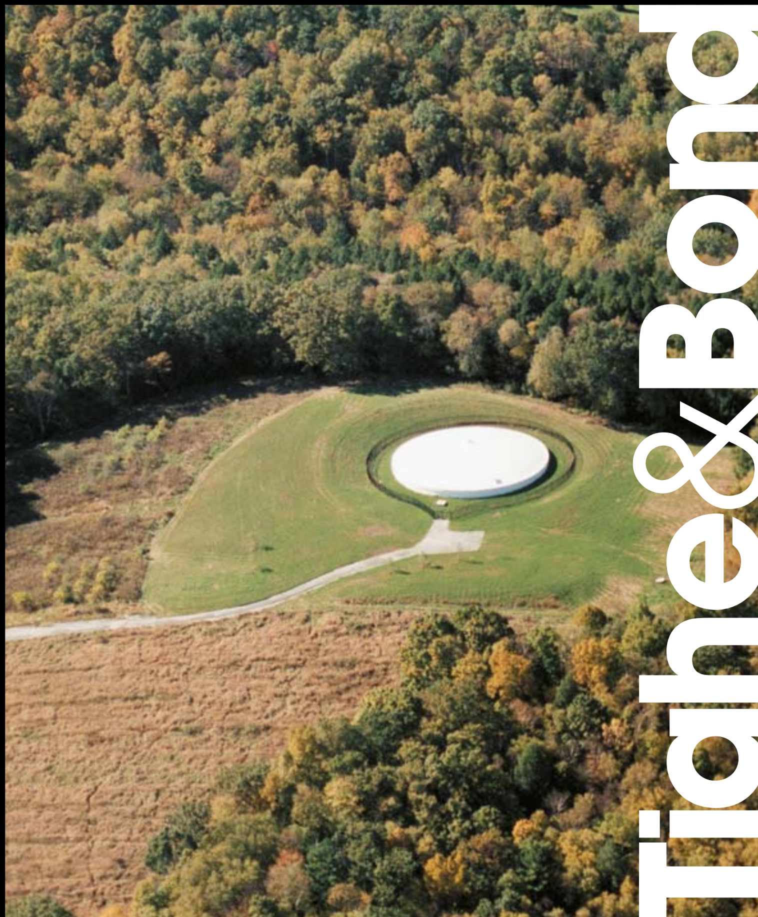

APPENDIX C

Appendix C

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Appendix C

C.1 Applicable Laws/Regulations

In Massachusetts, there are no fewer than seven potentially pertinent regulatory programs associated with activities proposed in environmentally sensitive areas. The following list of laws and regulations are most likely to apply to electrical utility projects in the Commonwealth.

- Massachusetts Wetlands Protection Act (M.G.L. 131 § 40) (MA WPA)
- Municipal wetland bylaws (varies by town)
- Massachusetts Endangered Species Act (M.G.L. 131A) (MESA)
- "Chapter 91" Public Waterfront Act (M.G.L. c. 91 §§ 1 through 63)
- Massachusetts Environmental Policy Act (M.G.L. c. 30 §§ 61 through 62H) (MEPA)
- Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 403)
- Section 401 of the Clean Water Act (33 U.S.C. § 1251)
- Section 404 of the Clean Water Act (33 U.S.C. § 1344)
- Massachusetts Watershed Protection Act (M.G.L. 92A §1/2) (MA WsPA)

C.2 Geographic Areas Subject to Jurisdiction

The following areas are subject to regulatory jurisdiction by at least one of the regulatory programs discussed in this section: It is important to note that more than one jurisdictional resource type may be present at any given location. Further, while coastal wetland resource areas are jurisdictional under the Massachusetts Wetlands Protection Act (MAWPA), Eversource's territory does not extend into these areas at the present time. Therefore, these areas are not discussed in detail below.

- Massachusetts Wetlands Protection Act Resource Areas:
  - <u>(Inland)</u>. Bordering Vegetated Wetland; Bank; Land Under Water Bodies and Waterways; Land Subject to Flooding; 200-foot Riverfront Area and associated 100-foot Buffer Zones.
- Areas subject to municipal wetlands bylaws or ordinances. (These vary by town.)
- Estimated and/or Priority Habitat of State-listed Rare Species
- Outstanding Resource Waters (ORWs = certified vernal pools and public surface drinking waters)
- Essential Fish Habitat (EFH)
- Cold Water Fisheries Resources (CFRs)
- Areas of Critical Environmental Concern (ACECs)
- Great Ponds
- Navigable waterways

- Quabbin Reservoir, Ware River and Wachusett Reservoir watersheds

C.2.1 Endangered Species

The Massachusetts Natural Heritage and Endangered Species Program (NHESP) maintains the current list of rare and endangered species and species of special concern in Massachusetts. Publically available data only allows for identification of Priority Habitats for the listed species, not specific species information. Priority Habitat location information is available on the NHESP website.

Species specific information is provided for planned linear maintenance activities which are submitted to NHESP in WMECO's annual O&M Plan. Projects/ activities which are not covered in the O&M Plan must file an independent request for information.

Applicable regulations and agency are listed below:

- Massachusetts Endangered Species Act: 321 CMR 10.00 – Division of Fish and Wildlife – NHESP

C.2.2 Vernal Pools

NHESP maintains a database of certified and potential vernal pools in Massachusetts. These data are available on the NHESP website and MassGIS. Certified vernal pools are considered Outstanding Resource Waters. The Corps' GP modified July 28, 2011 includes provisions for protection of certified vernal pools and potential vernal pools, including the vernal pool depression, the vernal pool envelope (area within 100 feet of the vernal pool depression's edge), and the critical terrestrial habitat (area within 100-750 feet of the vernal pool depression's edge). Temporary impacts associated with timber (construction) mats in previously disturbed areas of existing utility projects rights-of-way are exempt from GP requirements regarding work in the vernal pool envelope or critical terrestrial habitat, provided that a Vegetation Management Plan exists that avoids, minimizes and mitigates impacts to aquatic resources. Applicable regulations and agencies for certified vernal pools are listed below:

- Wetlands Protection Act: 310 CMR 10.00 – MassDEP and local Conservation Commissions

- 401 Water Quality Certification for Discharge of Dredged or Fill Material, Dredging, and Dredged Material Disposal in Waters of the U.S. within the Commonwealth: 314 CMR 9.00 – MassDEP

- Department of the Army General Permit Commonwealth of Massachusetts - Corps

C.2.3 Essential Fish Habitat and Wild & Scenic River Designation

Essential Fish Habitat is a habitat essential for spawning, breeding, feeding, or growth to maturity of federally managed species. This website provides more information: www.greateratlantic.fisheries.noaa.gov/habitat. Consultation with the Corps is recommended to confirm the location of Essential Fish Habitat with respect to a proposed project.

Currently portions of the Westfield River and its tributaries, the Farmington River, West Branch, portions of the Sudbury, Assabet, and Concord Rivers, and the Taunton River are designated as National Wild and Scenic Rivers (www.rivers.gov/wildriverslist.html) in

Massachusetts. The Lower Farmington and Salmon Brook and Nashua Rivers are under study to determine consideration for National Wild and Scenic designation (www.rivers.gov/study.html). The Corps reviews projects for impacts to both Essential Fish Habitat and National Wild & Scenic Rivers.

- Department of the Army General Permit Commonwealth of Massachusetts – Corps

C.2.4 Cold Water Fisheries Resources

The Massachusetts Division of Fisheries and Wildlife maintains a list of waters that are known to have cold water fisheries resources (CFRs). This list is useful in highlighting environmental sensitive areas which could be avoided during project planning. The MassDEP reviews projects for potential impacts to CFRs.

- 401 Water Quality Certification for Discharge of Dredged or Fill Material, Dredging, and Dredged Material Disposal in Waters of the U.S. within the Commonwealth: 314 CMR 9.00 – MassDEP

C.2.5 Outstanding Resource Waters

Outstanding Resource Waters include Certified Vernal Pools (CVPs), surface drinking water supplies and tributaries to surface drinking water supplies. CVPs are determined by NHESP and locations are available through MassGIS. Locations of surface water supplies and other Outstanding Resource Waters are also available through MassGIS. The applicable regulations and agency are listed below:

- 401 Water Quality Certification for Discharge of Dredged or Fill Material, Dredging, and Dredged Material Disposal in Waters of the U.S. within the Commonwealth: 314 CMR 9.00 – MassDEP

C.2.6 Historic and Cultural Resources

The Massachusetts Historic Commission (MHC) is the State Historic Preservation Office (SHPO) and is responsible for protecting the state's historic and cultural resources. In addition, four Native American tribes have interests in Massachusetts, and the Board of Underwater Archaeological Resources (BUAR) protects underwater resources in Massachusetts' lakes, ponds, rivers and coastal waters. Historic and cultural concerns are typically associated with maintenance activities that may require excavation (i.e. new poles, new roads, guy wire installations, etc.).

C.3 Applicable Regulatory Agencies

Activities subject to jurisdiction under the above-referenced programs will generally be subject to review by one or more regulatory agencies (refer to list below). New stream and wetland crossings not related to maintenance will require permitting with municipal Conservation Commissions, and may require permitting with the U.S. Army Corps of Engineers (Corps) and Massachusetts Department of Environmental Protection (MassDEP) under Sections 404 and 401 of the Clean Water Act. Any non-maintenance work within Land Under Water will require permitting with the MassDEP Wetland and Waterways Division. Coordination with the NHESP may also be required for projects located within areas mapped as priority and/or estimated habitat for state-listed rare species. For work within navigable waters, consultation may be required with the Massachusetts Office of Coastal Zone Management (MA CZM).

- Municipal Conservation Commissions
- Massachusetts Department of Environmental Protection (MassDEP) Wetlands and Waterways Program
- Massachusetts Division of Fish and Wildlife: Natural Heritage and Endangered Species Program (NHESP)
- Massachusetts Executive Office of Environmental Affairs (EOEA)
- United States Army Corps of Engineers (Corps) New England District
- Massachusetts Office of Coastal Zone Management (MA CZM)
- Massachusetts Division of Conservation and Recreation (MA DCR)

C.4 Maintenance, Repair, or Emergency Projects

Most regulatory programs contain provisions that allow normal maintenance of existing structures and/or response to emergency situations that require immediate attention.

C.4.1 Maintain, Repair and/or Replace

Exemptions or considerations for maintenance, repair, and/or replacement of existing electrical utility structures exist in some environmental regulations, but not all. The exemptions are limited to work related to existing and lawfully located structures where no change in the original structure or footprint is proposed. It is not for the selected contractor of a particular project to make a determination as to whether an activity is exempt. This determination will be made prior to work by the Eversource project manager, in consultation with Eversource environmental staff.

These exemptions/considerations are afforded at:

- MAWPA (M.G.L Chapter 131, § 40, paragraph 1)
- MAWPA regulations for Riverfront Area (310 CMR 10.58(6))
- MEPA regulations (301 CMR 11.01(2)(b)(3))
- 33 CFR Part 323.4(a)(2)
- MA 401 WQC (314 CMR 9.03(1))
- MESA (M.G.L. Chapter 131A, § 3; 321 CMR 10.14(5-7) and (12)
- MAWPA (350 CMR 11.05(11) and (12))
- National Pollutant Discharge Elimination System (NPDES), Construction General Permit (as modified effective February 16, 2012)

However, certain operations and maintenance activities which impact Waters of the United States are subject to Sections 401 and 404 of the Clean Water Act, per Sections 1.6 and 1.7 below.

C.4.2 Emergency Projects

Emergency provisions are generally afforded to activities that need to abate conditions that pose a threat to public health or safety. These provisions generally do not allow work beyond what is necessary to abate the emergency condition, and will generally require an after-the-fact permit. It is not for the selected contractor of a particular project to make a determination as to whether an activity is an emergency. This determination will be made prior to work by the Eversource project manager, in consultation with Eversource environmental staff.

It is important to note that invocation of an emergency provision does not release the project proponent from reporting requirements.

Emergency provisions are afforded at:

- MAWPA regulations (310 CMR 10.06)
- MEPA (301 CMR 11.00)
- MA 401 WQC (314 CMR 9.12)
- Chapter 91 (310 CMR 9.20)
- MESA (321 CMR 10.15)

C.5 Municipal Permitting

Work within wetlands, watercourses and Buffer Zones typically requires permitting with municipal Conservation Commissions. Work that entails "maintaining, repairing or replacing, but not substantially changing or enlarging, an existing and lawfully located structure or facility used in the service of the public and used to provide electric service" is exempt under the Massachusetts Wetlands Protection Act (MA WPA) per MGL Chapter 131 Section 40. However, individual municipalities may establish their own wetlands bylaws under Home Rule authority which could require permitting for operation and maintenance activities. The table below lists communities which have a wetland bylaw in which Eversource Energy operates and maintains infrastructure. Appropriate municipal permitting or notification should be completed in these towns as required prior to conducting operation and maintenance activities.

TABLE C-1
Eversource Energy Communities with Municipal Wetland Bylaws[1]

Community	Date of Bylaw	Utility Maintenance Exemption	Notification Required
Acton	7/8/2003	Yes	No
Amherst	9/27/2006	Yes	Yes
Ashland	5/6/2009	Yes	Yes
Auburn	5/1/2012	Yes	Yes
Bedford	1987/rev. 1995	Yes	Yes
Belchertown	5/3/2006	Yes	No
Bellingham	As of 12/2015	No	Yes
Bolton	5/7/2012	Yes	No
Brookline	12/2009 (regs)	Yes	Yes
Burlington	5/20/2013	Yes	Yes
Canton	4/29/1989	Yes	Yes
Carlisle	2009	Yes	No
Carver	As of 12/2015	Yes	Yes
Chicopee	4/3/2002	Yes	No
Chilmark	10/12/1993	No	Yes
Dedham	11/182013	Yes	Yes
Deerfield	11/6/1989	Yes	Yes
Dover	5/2/1994	Yes	Yes
East Longmeadow	10/1992	Yes	Yes
Framingham	4/26/2005	Yes	Yes
Grafton	5/11/1987	Yes	Yes
Greenfield	11/23/2001	Yes	No
Hadley	5/1/2008	No	Yes
Holden	2011	Yes	Yes
Hopkinton	5/2/1995	Yes	Yes
Hampden	8/5/1992	Yes	Yes
Holyoke	11/2005	Yes	Yes
Kingston	2004	No	Yes
Leicester	11/2015	Yes	Yes
Lexington	5/3/1982	No	Yes
Lincoln	3/24/2007	No	Yes
Longmeadow	10/2000	Yes	No
Ludlow	5/1/2002	Yes	No
Maynard	12/3/2005	Yes	Yes
Medway	7/2014	Yes	Yes
Milford	5/2010	Yes	No
Millis	5/13/1191	Yes	No
Millville	5/13/2013	Yes	Yes

Community	Date of Bylaw	Utility Maintenance Exemption	Notification Required
Natick	4/27/2000	Yes	No
Needham	9/1/1988	Yes	Yes
Norfolk	11/9/2010	Yes	Yes
Northampton	8/17/1989	Yes	Yes
Northborough	5/21/1990	Yes	Yes
Northbridge	5/6/2008	Yes	Yes
Pelham	5/2/1987	Yes	Yes
Pembroke	4/22/2008	Yes	No
Plympton	5/16/2012	Yes	Yes
Richmond	5/2015	Yes	Yes
Rochester	As of 12/2015	Yes	Yes
Sharon	As of 12/2015	Yes	No
Sherborn	2013	Yes	No
Shutesbury	5/2/1987	Yes	Yes
Southborough	4/10/1995	Yes	Yes
South Hadley	12/27/2005	No	Yes
Southwick	6/6/1989	Yes	Yes
Springfield	5/5/1993	Yes	Yes
Stoneham	4/2013	Yes	Yes
Stow	5/21/2003	No	Yes
Sunderland	4/27/1990	Yes	Yes
Sutton	5/11/2015	Yes	Yes
Truro	9/30/2010	No	Yes
Upton	2009	Yes	Yes
Walpole	2002	Yes	Yes
Wayland	5/1/2002	Yes	No
Wendell	3/10/1988	Yes	Yes
West Tisbury	6/3/2004	Yes	Yes
Westborough	10/20/2008	Yes	Yes
Westfield	5/20/2003	Yes	Yes
Westwood	1989	Yes	Yes
Wilbraham	5/27/1997	Yes	Yes
Worcester	7/1/2007	Partial	Yes

[1]According to Massachusetts Association of Conservation Commissions website as of December, 2015 and Town/City websites.
[2]Refer to municipal bylaws prior to conducting work in the community.

C.6 MA Department of Environmental Protection

Review and approval under the Commonwealth's Water Quality Certification Regulations is required for "*discharge of dredged or fill materials, dredging, and dredged material disposal activities in waters of the United States within the Commonwealth which require federal licenses or permits and which are subject to state water quality certification* *under 33 U.S.C. 1251, et seq. The federal agency issuing a permit initially determines the scope of geographic and activity jurisdiction*" (314 CMR 9.01(2)). An individual Water Quality Certification is required from the Massachusetts Department of Environmental Protection (MassDEP) for any activity identified at 314 CMR 9.04. In accordance with 314 9.04 (4) activities which are exempt from MGL Chapter 131 Section 40 but are subject to 33 U.S.C. 1251, *et seq*., and will result in any discharge of dredge or fill material to bordering vegetated wetlands or land under water require an individual 401 Water Quality Certification. Temporary fill placed within an Outstanding Resource Water shall require the filing of an Individual WQC and a Variance Request when required pursuant to 314 CMR 9.06(3). Activities which are exempt from Section 404 of the Clean Water Act and any other federal permit or license do not require 401 authorization.

Work within certain Outstanding Resource Waters, such as certified vernal pools, are prohibited unless a variance is obtained under 314 CMR 9.08. However, under 314 CMR 9.06(3)(c), maintenance, repair, replacement and reconstruction but not substantial enlargement of existing and lawfully located structures or facilities including roads and utilities are allowed to occur within ORWs when authorized by a Water Quality Certification.

C.7 U.S. Army Corps of Engineers

Work within wetlands and waters of the United States is subject to jurisdiction under Section 404 of the Clean Water Act, which is administered by the Corps. Work within navigable waters is also administered by the Corps under Section 10 of the Rivers and Harbors Act of 1899. The Corps has issued a General Permits (GPs) for Massachusetts which establishes categories for projects based on their nature of impacts. The General Permits were issued on February 4, 2015, and expire on February 4, 2020. Certain minor activities are eligible for Self-Verification, which requires submittal of a Self-Verification Notification Form (SVNF) before the work occurs. Activities eligible for Self-Verification are authorized under the general permit and may proceed without written verification from the Corps as long as the SVNF has been submitted and the activity meets the terms and conditions of the applicable GPs. Activities requiring Pre-Construction Notification (PCN) require the submittal of an application to the Corps, followed by a screening of the application by the Corps, the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, National Marine Fisheries Service, MassDEP, and consultation with the Massachusetts Historical Commission, Tribal Historic Preservation Officers and the Massachusetts Board of Underwater Archaeological Resources (BUAR). PCN projects may not proceed until written verification from the Corps is received. An Individual Permit requires a formal permit application to be submitted to the Corps. The application is reviewed in detail by both state and federal agencies, and a Public Notice is released for public comment. Projects which trigger an Individual Permit generally result in significant impacts to wetlands and/or watercourses.

Corps permitting does not apply to activities that fall under the maintenance exemption set forth at 33 CFR 323.4(a)(2) – Discharges Not Requiring Permits:

"Maintenance, including emergency reconstruction of recently damaged parts, of currently serviceable structures such as dikes, dams, levees, groins, riprap, breakwaters, causeways, bridge abutments or approaches, and transportation structures. Maintenance does not include any modification that changes the character,

scope, or size of the original fill design. Emergency reconstruction must occur within a reasonable period of time after damage occurs in order to qualify for this exemption."

Maintenance projects that occurred prior to the Corps jurisdiction over fill activities, or that were properly permitted, can proceed under the maintenance exemption noted above, provided that the same temporary fill areas are used. However, it is recommended that a formal determination be requested from the Corps to confirm these activities are exempt. The repair, rehabilitation or replacement of a previously authorized, currently serviceable structure or fill (with some minor deviations in the structure's configuration or filled area) are regulated under GP1 and subject to Self-Verification or Pre-Construction Notification.

Also, operation and maintenance related activities that do not meet the above exemption may qualify for Self-Verification. In that case, it is recommended that a copy of the SVNF be submitted to MassDEP.

The Massachusetts General Permits are listed below. GPs specifically applicable to utility projects are bolded and italicized:

GP1. Repair, Replacement and Maintenance of Authorized Structures and Fills
GP2. Moorings
GP3. Pile-Supported Structures, Floats and Lifts
GP4. Aids to Navigation, and Temporary Recreational Structures
GP5. Dredging, Disposal of Dredged Material, Beach Nourishment, and Rock Removal and Relocation
GP6. Discharges of Dredged or Fill Material Incidental to the Construction of Bridges
GP7. Bank and Shoreline Stabilization
GP8. Residential, Commercial and Institutional Developments, and Recreational Facilities
GP9. Utility Line Activities
GP10. Linear Transportation Projects Including Stream Crossings
GP11. Mining Activities
GP12. Boat Ramps and Marine Railways
GP13. Land and Water-Based Renewable Energy Generation Facilities and Hydropower Projects
GP14. Temporary Construction, Access, and Dewatering
GP15. Reshaping Existing Drainage Ditches, New Ditches, and Mosquito Management
GP16. Response Operations for Oil and Hazardous Substances
GP17. Cleanup of Hazardous and Toxic Waste
GP18. Scientific Measurement Devices
GP19. Survey Activities
GP20. Agricultural Activities
GP21. Fish and Wildlife Harvesting and Attraction Devices and Activities
GP22. Habitat Restoration, Establishment and Enhancement Activities
GP23. Previously Authorized Activities

In general the following cumulative thresholds apply for determining the level of Corps permitting required:

Table C-2
Corps Permits Limits

Resources	SV Limits (SV Eligible)	PCN Limits (PCN Eligible)	IP Limits (IP Required)
Non-tidal waters of the US	0 to 5,000 sf	5,000 sf to 1 acre	>1 acre
Tidal waters of the US	Not eligible	All discharges ≤1/2 acre	>1/2 acre
SAS in tidal waters of the US excluding vegetated shallows	Not eligible	All discharges ≤1,000 sf	>1,000 sf
SAS in tidal waters of the US consisting of vegetated shallows only	Not eligible	All discharges ≤100 sf (compensatory mitigation is required	>100 sf

*Special Aquatic Sites (SAS) consist of wetlands, mud flats, vegetated shallows, sanctuaries and refuges, coral reefs, and riffle and pool complexes. These are defined at 40 CFR 230 Subpart E.

Stream and wetland crossings are only subject to jurisdiction under the Corps if there is **a discharge of dredge or fill material into wetlands or waters of the United States**. Equipment access through a stream or wetland with no structural BMP is not regulated by the Corps if there is no discharge of dredge or fill material (note that equipment rutting as a result of not using an appropriate BMP can be considered a "discharge of dredge material"). Similarly, the use of a timber or rail car bridge that extends from bank to bank with no stream impacts is not regulated by the Corps. The use of timber mats, stone, and log corduroy is considered "fill material" by the Corps MA GPs, and must be calculated to determine overall impacts.

Maintenance, including emergency reconstruction of currently serviceable structures, is exempt from Corps jurisdiction and does not require formal permitting. Maintenance does not include any modification that changes the character, scope, or size of the original fill design. Emergency reconstruction must occur within a reasonable period of time after damage occurs to qualify for this exemption.

New culvert installation or existing culvert replacements may require permitting with local Conservation Commissions under the MA WPA, and may also require permitting with the Corps under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act of 1899, and the MassDEP under Section 401 of the Clean Water Act.

Stream and wetland crossings (including culvert installations) that involve the discharge of dredge and fill material may be conducted under Self-Verification if the following criteria are met.

- The use of construction mats of any area can be used to conduct activities that were previously authorized, authorized under Self-Verification, or not subject to regulation. Other temporary or permanent fill and associated secondary impacts must meet the SV limits.
- Authorized construction mats must be removed immediately upon work completion, and the wetlands must be restored per the General Conditions.
- The project has no potential for an effect on a historic property within the permit area or any known historic property that may occur outside the permit area.

- Any in-water work is limited to Time of Year windows appropriate for the spawning, breeding and migration of present species specified by the Massachusetts Division of Marine Fisheries. The TOY restriction for any inland stream not specified by MA DMF is October 1 to June 30. Activities within water proposed during these TOY restrictions are ineligible for Self-Verification authorization.
- The work does not result in direct or secondary impacts to Special Aquatic Sites.
- No work occurs in navigable waters of the U.S.
- Span streams or size culverts or pipe arches such that they are wider than bankfull width (BFW). Spans are strongly preferred as they avoid or minimize disruption to the streambed, and avoid entire streambed reconstruction and maintenance inside the culvert or pipe arch, which may be difficult in smaller structures. Footings and abutments for spans and scour protection should be landward of 1.2 times BFW. The width of culverts and arches at bankfull elevation should be ≥1.2 times BFW.
- Embed culverts or pipe arches below the grade of the streambed. This is not required when ledge/bedrock prevents embedment, in which case spans are required. The following depths are recommended to prevent streambed washout, and ensure compliance and long-term success:
  - ≥ 2 feet for box culverts and pipe arches, or
  - ≥ 2 feet and at least 25% for round pipe culverts.
- Match the culvert gradient (slope) with the stream channel profile.
- Construct crossings with a natural bottom substrate within the structure matching the characteristics of the substrate in the natural stream channel and the banks (mobility, slope, stability, confinement, grain and rock size) at the time of construction and over time as the structure has had the opportunity to pass substantial high flow events.
- Construct crossings with appropriate bed forms and streambed characteristics so that water depths and velocities are comparable to those found in the natural channel at a variety of flows at the time of construction and over time. In order to provide appropriate water depths and velocities at a variety of flows and especially low flows, it is usually necessary to reconstruct the streambed (sometimes including a low flow channel), or replicate or preserve the natural channel within the structure. Otherwise, the width of the structure needed to accommodate higher flows will create conditions that are too shallow at low flows. Flows could go subsurface within the structure if only large material is used without smaller material filling the voids.
- Openness, which is the is the cross-sectional area of a structure opening divided by its crossing length when measured in consistent units, is > 0.82 feet (0.25 meters).
- Banks on each side of the stream inside the crossing matching the horizontal profile of the existing stream and banks outside the crossing are recommended. To prevent failure, all constructed banks should have a height to width ratio of no greater than 1:1.5 (vertical:horizontal) unless the stream is naturally incised. Tie these banks into the up and downstream banks and configure them to be stable during expected high flows.

- The project is not located within a vernal pool depression, or vernal pool envelope, and does not individually or cumulatively impact greater than 25% of the vernal pool critical terrestrial habitat. It is feasible for some temporary impacts associated with the use of construction mats in previously disturbed right-of-ways to occur within the vernal pool envelope or critical terrestrial habitat if a Vegetation Management Plan demonstrates avoidance, minimization and mitigation impacts to aquatic resources.
- Culvert extensions do not qualify for Self-Verification.
- Culvert projects using slip lining do not qualify for Self-Verification, either as new work or maintenance activities.
- No open trench excavation in flowing waters. No work in riffles and pools.
- The project does not entail stream relocation.
- Work is not conducted within riffles or pools.
- Normal flows within the stream boundary's confines must be maintained, i.e., temporary flume pipes, culverts, cofferdams, etc.
- Water diversions (i.e., bypass pumping or water withdrawals) may be used immediately up and downstream of the work footprint.
- The project is (a) not located in the designated main stem of, or within 0.25 miles up or downstream of the designated main stem of, or in tributaries within 0.25 miles of the designated main stem of a National Wild and Scenic River System; (b) not in "bordering or contiguous wetlands" that are adjacent to the designated main stem of a National Wild and Scenic River; or (c) does not have the potential to alter flows within a river within the National Wild and Scenic River System.
- The project is not located within areas containing USFWS or National Marine Fisheries Service (NMFS)-listed species or critical habitat. The project is not "likely to adversely affect" listed species or habitat per the federal Endangered Species Act (ESA) or result in a "take" of any federally-listed threatened or endangered species of fish or wildlife.
- The project does not impinge upon the value of any National Wildlife Refuge, National Forest, National Marine Sanctuary, or any other area administered by the U.S. Fish and Wildlife Service, U.S. Forest Service or National Park Service.
- The project is not located on Corps properties and Corps-controlled easements.
- The project does not propose temporary or permanent modification or use of a federal project beyond minor modifications required for normal operation and maintenance.
- The project minimizes use of heavy construction equipment, and, where required, either has low ground pressure (typically less than 3 psi) or it must be placed on construction mats.
- Construction mats must be placed in the wetland from the upland or from equipment positioned on swamp mats if working within a wetland.
- Temporary fill must be stabilized. Unconfined, authorized temporary fill must consist of clean material that minimizes impacts to water quality. Temporary fill

placed during the growing season must be removed before the beginning of the next growing season. If temporary fill is placed during the non-growing season, it may remain throughout the following growing season but must be removed before the beginning of the next growing season.

- Appropriate erosion, sedimentation and turbidity controls are used and maintained during construction.
- Appropriate measures must be taken to minimize flooding to the maximum extent practicable.

Wetland and stream crossings may be authorized under Pre-Construction Notification if the following criteria are met:

- The work results in less than one acre of impacts to inland, non-tidal, wetlands or waters of the United States.

Stream and wetland crossings that cannot meet Self-Verification or Pre-Construction Notification criteria may require review under an Individual Permit. The Corps should be consulted before assuming an Individual Permit will be required, as exceptions can be made under certain circumstances.

C.8 Temporary Stream Crossings

C.8.1 U.S. Army Corps of Engineers

See Section C.7 for general Corps permitting requirements for stream crossings. To qualify for Self-Verification, temporary stream crossings (typically culverts) that are not spans must be designed in accordance with below.

1) Installed outside of the TOY restrictions and must be removed before the beginning of the TOY restriction of that same season. Temporary crossings that must remain into the TOY restriction will require Pre-Construction Notification review.
2) Impacts to the streambed or banks require restoration to their original condition (see "Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings," for stream simulation restoration methods). Use geotextile fabric or other appropriate bedding for stream beds and approaches where practicable to ensure restoration to the original grade. The requirements in GCs 17, 18 and 19 are particularly relevant.
3) Avoid excavating the stream or embedding crossings.
4) For Culverts:
    a. The water height should be no higher than the top of the culvert's inlet and the culvert is large enough to pass debris.
    b. Install energy dissipating devices downstream if necessary to prevent scour.

c. The TOY restrictions in GC 18 and the restrictions in GC 17(f) are particularly relevant.

5) Removed upon the completion of work. Impacts to the streambed or banks requires restoration to their original condition using stream simulation methods.

In-kind repair, replacement and maintenance of currently serviceable, authorized fills are eligible for Self-Verification. However, the conditions of the original authorization apply, and minor deviations in fill design are allowed. In-kind repair and maintenance of culverts that includes an expansion or change in use requires Pre-Construction Notification. Replacement of non-serviceable fills, including an expansion or change in use, also requires Pre-Construction Notification. In-kind replacement using the same materials is exempt from Section 404 of the Clean Water Act, and does not require permitting with the Corps. The Corps, however, should be consulted before assuming an activity is exempt from their jurisdiction.

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APPENDIX D

Horizontal directional drilling (HDD) for subsurface utility installations is considered to be the most effective and least environmentally damaging technique when compared to traditional mechanical dredging and trenching. This method ensures the placement of the pipeline at the target burial depth with no wetland or water body disturbance. HDD installation is the preferred method for crossing sensitive resources–the alternative is open cut trenching.

The HDD procedure uses bentonite slurry, a fine clay material as a drilling lubricant. Directional drilling has the small potential to release bentonite slurry into the surface environment through frac-outs. This term describes the situation caused when the drilling head and its accompanying inert clay lubricant slurry, hits a subterranean fractured substrate. When the pressurized lubricant slurry reaches the fracture it can follow the fracture up or otherwise force itself to the surface or into the water if drilling is occurring under a waterbody. If a "frac-out" occurs under these water features, the potential exists for the inert clay (a non-toxic bentonite-based substance) to be released into the water column. In large quantities, the release of drilling mud into a waterbody could affect fisheries or other aquatic organisms by settling and temporarily inundating the habitats used by these species. Properly monitoring the slurry pressures and amounts significantly decreases risk of significant quantities of drilling fluid being released into the environment.

Frac-out is most likely to occur near the bore entry and exit points where the drill head is shallow. Should a frac-out occur during HDD operations, the following measures will be taken.

- Temporarily suspend forward drilling progress.
- Monitor frac-out for 4 hours to determine if the drilling mud congeals. (Bentonite will usually harden, effectively sealing the frac-out location.)
- If drilling mud congeals, take no other action that would potentially suspend sediments in the water column.
- If drilling mud does not congeal, erect appropriate isolation/containment measures (i.e. turbidity curtains and/or underwater boom and curtain).
- If the fracture becomes excessively large, a spill response team would be called in to contain and clean up excess drilling mud in the water. Phone numbers of spill response teams in the area will be on site.
- Following containment, evaluate the current drilling profile (i.e. drill pressures, pump volume rates, drilling mud consistency) to identify means to prevent further frac-out events.
- If the fracture is mitigated and controlled, forward progress of the drilling may resume.

Appendix 5-4

Andrew Square to Dewar Street Transmission Reliability Project: Magnetic Field Assessment

Electrical Engineering and
Computer Science Practice

Exponent®

Andrew Square to Dewar Street Transmission Reliability Project

Magnetic Field Assessment

Andrew Square to Dewar Street Transmission Reliability Project

Magnetic Field Assessment

Prepared for

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One South Station, Fifth Floor
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On behalf of

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247 Station Drive
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Prepared by

Exponent
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February 4, 2019

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Executive Summary

The Andrew Square to Dewar Street Transmission Reliability Project (Project) is a new, approximately 2.0 mile underground 115-kilovolt electric transmission line between Eversource Energy's existing Andrew Square and Dewar Street Substations. The Project is proposed to support electrical load requirements and ensure the reliability of electrical service in the South Boston, Roxbury and Dorchester neighborhoods of the City of Boston.

The Project is proposed to be constructed primarily in existing streets and will be a source of 60-Hertz magnetic fields above ground. To characterize the levels of magnetic fields associated with the proposed Project, Exponent modeled the different configurations of the line corresponding to underground installations in inverted-delta (∇), horizontal, and vertical duct bank configurations. Each of these configurations was modeled for two loading scenarios appropriate for calculating expected average and peak loading levels of the proposed transmission line.

Magnetic field levels were compared to health-based international standards and guidelines developed by the International Commission on Non-Ionizing Radiation Protection and the International Committee for Electromagnetic Safety and were found to be far below these standards, even directly above the underground transmission line. In addition, the magnetic-field level from the proposed transmission line at average loading would generally fall within the range of measured existing magnetic field levels produced by the various existing sources in the area surrounding the Project.

Introduction

NSTAR Electric Company d/b/a Eversource Energy ("Eversource" or the "Company") has proposed construction of a new, approximately 2.0 mile underground 115-kilovolt electric transmission line between Eversource's existing Andrew Square and Dewar Street Substations. The Andrew Square to Dewar Street Transmission Reliability Project (Project) is proposed to support electrical load requirements and ensure the reliability of electrical service in the South Boston, Roxbury and Dorchester neighborhoods of the City of Boston. Unless the Project is constructed, the loss of two transmission lines would result in the loss of supply to approximately 58,000 customers in the Project area.

The proposed transmission line will be a source of 60-Hertz (Hz) magnetic fields.[1] To characterize the Project-related magnetic-field levels, Exponent modeled the transmission line in different configurations corresponding to installation in inverted-delta (∇), horizontal, and vertical duct bank configurations. Each of these configurations was modeled for two loading scenarios appropriate for calculating expected average and peak loading levels of the proposed transmission line.

Eversource considered several different routes for the Project, and after incorporating input from community outreach, working meetings with State and City of Boston representatives, government officials, residents, and other stakeholders Eversource proposed a route along Morrisey Boulevard and the Mary Ellen McCormick Development as well as a route generally following Sydney Street (Figure 1). The selection of route will not affect the magnetic field calculations and the calculations presented below are representative of the magnetic field levels expected from the operation of the Project along either route.

[1] Electric fields from the transmission line will be shielded by the insulation and armoring of the cable itself as well as the earth and so the underground transmission line will not be a source of electric fields above ground.

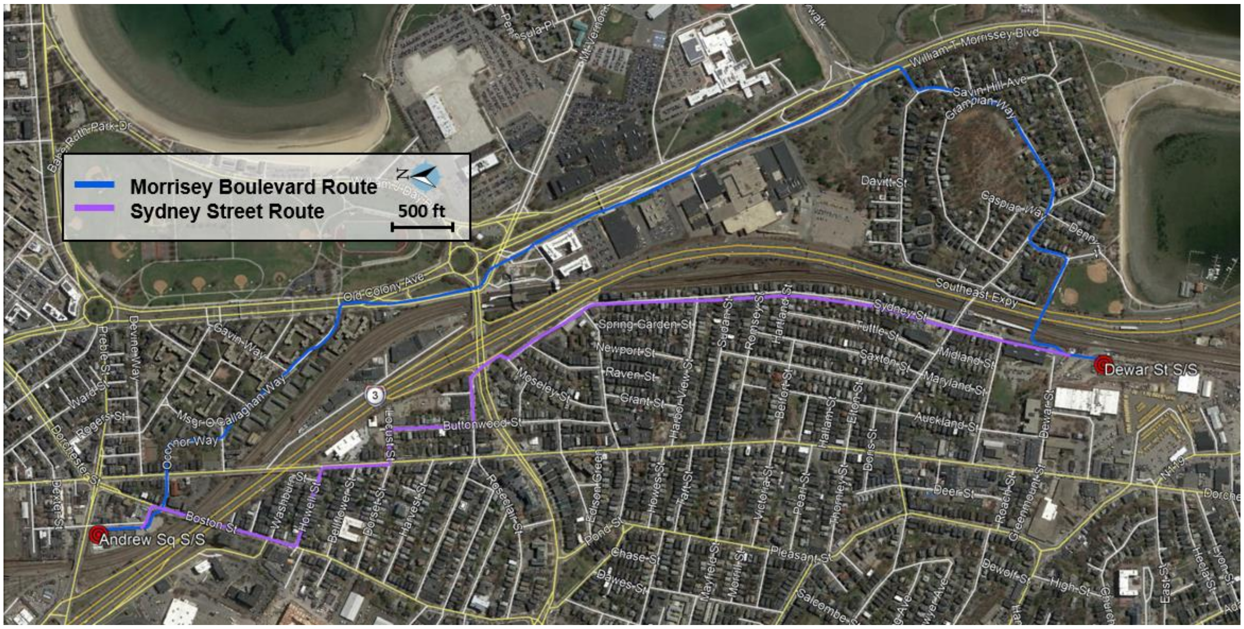

Figure 1. Route alternatives for the Andrew Square to Dewar Street transmission line.

Proposed Configuration

Magnetic-field levels were calculated assuming the proposed line is operating in isolation from all other magnetic-field sources.[2] As a result, the calculated magnetic-field levels depend only on the physical configuration of the line and the loading of the line. Three underground line configurations were evaluated with cables in: a) an inverted delta configuration, b) a horizontal configuration and c) a vertical configuration. The proposed configurations are shown below in Figure 2.

2 There is an existing pipe-type transmission line along a portion of both routes outside the Dewar Street substation. This line was not included for the calculations because the steel pipe surrounding the conductors of pipe-type transmission lines reduces the magnetic field to such a very low level (e.g., Stoffel et al., 1994; Commonwealth Associates, 1997).

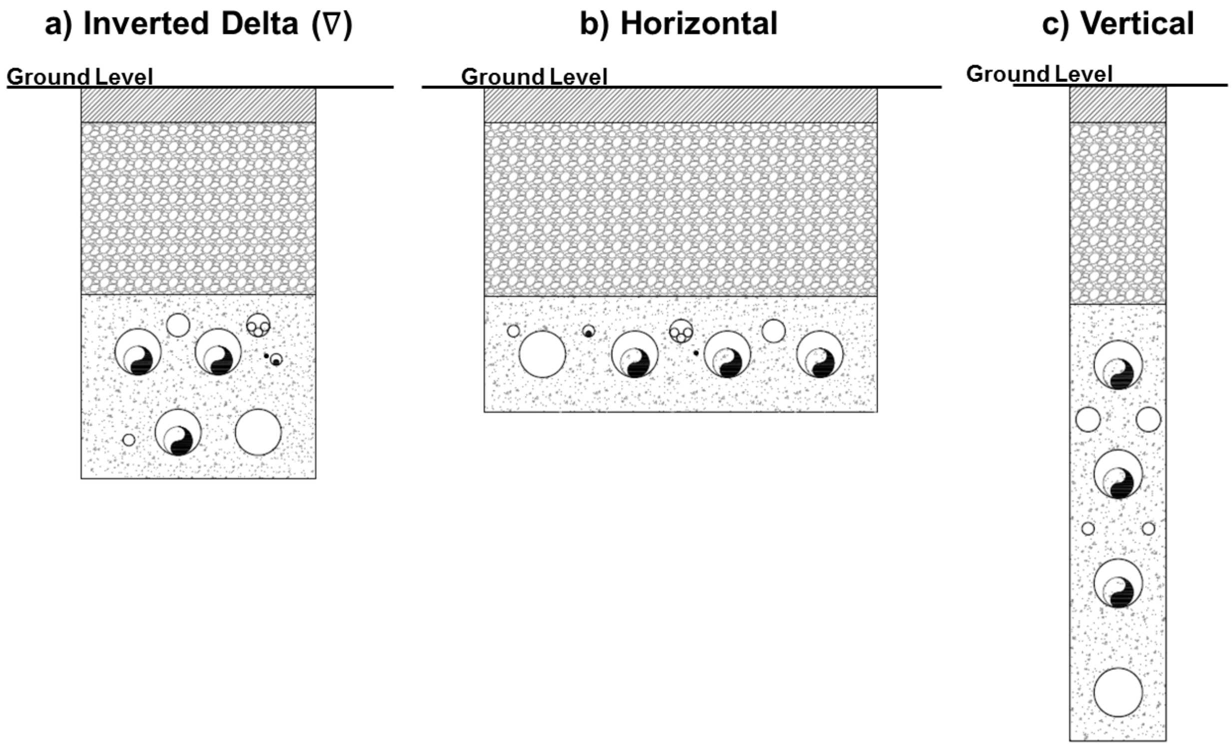

Figure 2. Configurations of the proposed transmission line used for magnetic-field modeling.

Methods

Eversource provided data to Exponent regarding the configuration and loading of the transmission line, as described above. In accordance with IEEE Std. C95.3.1-2010 and Std. 0644-1994 (R2008), magnetic-field levels were calculated in units of milligauss (mG) as the resultant root-mean-square (RMS) value along a transect perpendicular to the distribution line at a height of 1 meter (3.28 feet) above ground.

Magnetic-levels were calculated using computer algorithms developed by the Bonneville Power Administration (BPA), an agency of the U.S. Department of Energy (BPA, 1991). These algorithms have been shown to accurately predict magnetic field levels measured near power lines (Chartier and Dickson, 1990; Perrin et al., 1991). The inputs to the program are data regarding voltage, current flow, phasing, and conductor configurations. The current is assumed to be equally balanced on all three transmission line conductors and the ground continuity conductor is assumed to carry no current.

Measurements of magnetic field levels from existing sources in the neighborhoods on and adjacent the two route alternatives were performed on July 12, 2018, between the hours of 9 AM and 1 PM. A summary of these measurements is provided in Appendix B.

Conductor Specification and Modeling Configurations

The power cables are proposed to be installed underground in three different configurations as shown in Figure 2, above. The insulation on the power cables is proposed to be cross-linked polyethylene (XLPE), and each cable will have an outer diameter conservatively modeled as 6 inches and a conductor area of 3,500 kcmil. In all three configurations, the center of the top-most phase conductor is modeled to be approximately 47 inches below grade. The vertical and horizontal spacing of the conductors in each configuration is summarized below in Table 1.

Table 1. Spacing of conductors in underground duct bank configurations

Modeling Configuration	Horizontal Conductor Spacing (inches)	Vertical Conductor Spacing (inches)
Inverted Delta	14	14
Horizontal	16	n/a
Vertical	n/a	18

Loading

Power demand on a given day, throughout a week, or over the course of months and years can vary, so the magnetic field produced by the transmission line can also vary. Therefore, current flow is often expressed as an average load, which provides a good prediction of the magnetic field on any randomly selected day of the year. Magnetic field levels may be higher during other times and peak load, which might occur for a few hours or days during the year, is therefore also used to calculate magnetic field levels representative of those time periods. The average and peak loading levels (in units of megawatts [MW] and megavolt-ampere-reactive [MVAR]) used in calculations are summarized in Table 1, below.

Table 2. Average and Peak Loading Levels

Average Loading		Peak Loading	
MW	MVAR	MW	MVAR
8.2	12.5	13.0	13.6

Assessment Criteria

While the federal government has no regulations regarding magnetic-fields, including from transmission lines, the Massachusetts Energy Facilities Siting Board (EFSB) assesses magnetic field levels from transmission lines on a case-by-case basis with a focus on practical options to reduce magnetic fields along transmission ROWs. This practice is also consistent with the recommendations of the WHO (WHO, 2007).

Magnetic-field levels can also be assessed in reference to standards and guidelines developed by scientific and health agencies. Two international agencies that have published limits of exposure to magnetic fields include the International Committee on Electromagnetic Safety (ICES) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The assessment levels (reference levels) set by these organizations are summarized in Table 3 below.

The reference levels listed in Table 3 were used as criteria for the evaluation of potential line designs and their potential effects on the electrical environment around transmission lines.

Table 3. Reference levels for whole body exposure to 60-Hz fields: general public.

Organization	Magnetic Fields
ICNIRP	2,000 mG
ICES	9,040 mG

Results and Discussion

Results

The calculated magnetic-field levels are highest directly above the transmission line duct bank and decrease rapidly with distance. A graphical profile of the calculated magnetic field levels at a height of one meter above ground under the typical loading scenario is shown in in Figure 3. This figure shows that magnetic field levels are slightly higher over the horizontal configuration than they are over the vertical configuration and the field levels over the inverted delta configuration are the lowest. Table 3 summarizes the predicted magnetic field levels for each of the configurations and compares those calculated levels to the ICNIRP and ICES reference levels. A detailed tabular summary of the magnetic field levels at distances of 10, 25 and 50 feet from the centerline is provided in Appendix A, Tables A-1 and A-2 for typical loading and emergency peak loading scenarios, respectively.

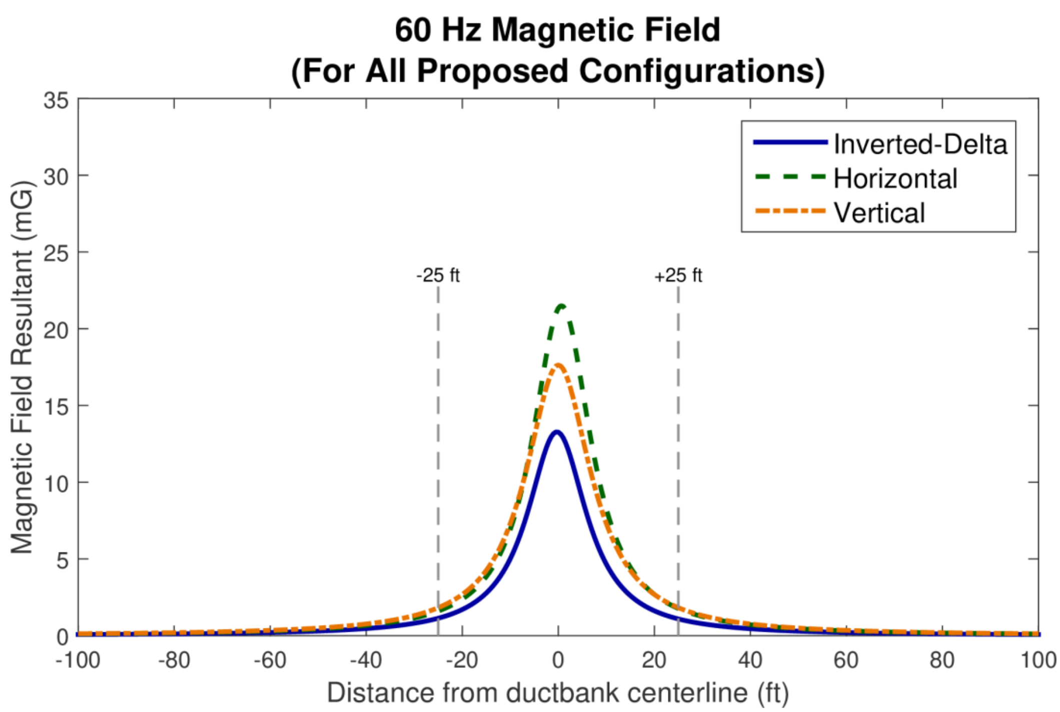

Figure 3. Calculated magnetic-field level for the three configurations of the transmission line under average loading conditions.

Table 3. Comparison of calculated magnetic field levels from the line to ICNIRP (2,000 mG) and ICES (9,040 mG) reference levels.

Configuration	Average Loading		Peak Loading	
	Max at ±25 ft	Maximum above duct bank	Max at ±25 ft	Maximum above duct bank
Inverted Delta	1.1	13	1.4	17
Horizontal	1.8	21	2.2	27
Vertical	1.8	18	2.3	22

Note all distances shown are referenced to the duct bank centerlines

Discussion

The Project design incorporates methods recognized by the EFSB and WHO for reducing magnetic field exposure such as constructing the line underground with the conductors installed close together to maximize mutual cancellation of the magnetic field vectors from each conductor. The magnetic field from the underground transmission line is highest directly over the duct bank and decreases rapidly with increasing distance.

The calculated magnetic-field levels for all configurations are far below both ICNIRP (2,000 mG) and ICES (9,040 mG) guideline values for the general public. In addition, measurements of existing magnetic-field levels in neighborhoods on and around routes indicate that the magnetic field level from the proposed transmission line would generally fall below the measured existing average background levels within 25 feet of the duct bank centerline.

Summary

This report summarizes calculations of magnetic field levels associated with the proposed transmission line between the Andrew Square and Dewar Street Substations in the South Boston, Roxbury and Dorchester neighborhoods of the City of Boston. These calculations have been performed using methods that are accepted within the scientific, engineering, and regulatory communities and which previously have been found to match well with measurements. These calculations have been compared to applicable guidelines and found to be below levels used to assess potential adverse impacts to public health.

The predicted magnetic field levels at both average and peak line loadings are far below recommended guidelines for public exposure of ICNIRP (2,000 mG) and ICES (9,040 mG), even directly above the underground line in city streets. Measurements of existing magnetic-field levels in neighborhoods on and around the route indicate that the magnetic field level from the proposed transmission line would generally fall below existing average measured background levels within 25 feet of the duct bank centerline.

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World Health Organization (WHO). Fact Sheet No. 322: Electromagnetic Fields and Public Health – Exposure to Extremely Low Frequency Fields. Geneva, Switzerland: World Health Organization, 2007.

Notice

At the request of Eversource Energy, Exponent modeled the levels of magnetic field associated with the proposed 115-kV transmission line between the Andrew Square and Dewar Street Substations. This report summarizes work performed to date and presents the findings resulting from that work. In the analysis, we have relied on geometry, material data, usage conditions, specifications, and various other types of information provided by Eversource Energy. Eversource Energy has confirmed to Exponent that the data provided to Exponent, and summary contained herein, are not subject to Critical Energy Infrastructure Information restrictions. We cannot verify the correctness of this data and rely on the clients for the data's accuracy. Although Exponent has exercised usual and customary care in the conduct of this analysis, the responsibility for the design and operation of the Project remains fully with the clients.

The findings presented herein are made to a reasonable degree of engineering and scientific certainty. Exponent reserves the right to supplement this report and to expand or modify opinions based on review of additional material as it becomes available, through any additional work, or review of additional work performed by others.

The scope of services performed during this investigation may not adequately address the needs of other users of this report outside of the EFSB permitting process, and any re-use of this report or its findings, conclusions, or recommendations presented herein are at the sole risk of the user. The opinions and comments formulated during this assessment are based on observations and information available at the time of the investigation. No guarantee or warranty as to future life or performance of any reviewed condition is expressed or implied.

Appendix A

Summary Tables of Calculated Magnetic Field Levels

Table A-1. Magnetic field levels (mG) for the three proposed underground duct bank configurations at average loading.

	Location						
Field	**–50 ft**	**–25 ft**	**–10 ft**	**Max**	**+10 ft**	**+25 ft**	**+50 ft**
Inverted Delta	0.3	1.1	5.0	13	4.7	1.1	0.3
Horizontal	0.4	1.6	6.9	21	8.3	1.8	0.5
Vertical	0.5	1.8	7.3	18	7.3	1.8	0.5

Table A-2. Magnetic field levels (mG) for the three proposed underground duct bank configurations at peak loading.

	Location						
Field	**–50 ft**	**–25 ft**	**–10 ft**	**Max**	**+10 ft**	**+25 ft**	**+50 ft**
Inverted Delta	0.4	1.4	6.3	17	5.9	1.4	0.4
Horizontal	0.5	2.0	8.7	27	10	2.2	0.6
Vertical	0.6	2.3	9.2	22	9.2	2.3	0.6

Appendix B

Measurements

To provide context for the calculated levels of magnetic fields discussed in the body of the report, Exponent performed measurements of the magnetic fields along two routes in neighborhoods on and nearby both the Morrisey Boulevard and Sydney Street routes between the Dewar Street Substation and the Andrew Square Substation (as shown in Figure B-1). These measurements of existing sources were performed on July 12, 2018, between the hours of 9 AM and 1 PM.

The dominant sources of magnetic field levels along the route vary by location, but generally include overhead and underground distribution lines as well as the service lines bringing electricity to individual homes or businesses.

Measurement Methods

Magnetic field measurements were taken along the sidewalk at a height of 1 meter (3.28 feet) above ground in accordance with standard methods for measuring magnetic-field levels (IEEE Std. C95.3.1-2010). Magnetic field levels were measured in units of mG by three orthogonally mounted sensing coils whose output was logged by a digital recording meter (EMDEX II) manufactured by Enertech Consultants. These instruments meet the IEEE instrumentation standard for obtaining accurate field measurements at power line frequencies (IEEE Std. 1308-1994) and the meters were calibrated by the manufacturer by methods like those described in IEEE Std. 644-1994 R2008. The calibration certificate is shown in Appendix C.

Measurement Results

Measured magnetic-field levels were generally low and varied with distance from existing source such as overhead or underground distribution lines. The average measured magnetic field levels along the two measurement routes were approximately 2.7 mG and 1.2 mG, respectively. Comparison of these measurements with calculations at average loading (see Table A-1) indicates that magnetic field levels from the proposed transmission line at average loading would generally fall below existing average measured background levels within 25 feet of the duct bank centerline.

Higher magnetic field levels were measured in localized portions of both routes with maximum measured magnetic field level of approximately 39 mG and 14 mG over limited portions of the respective routes.

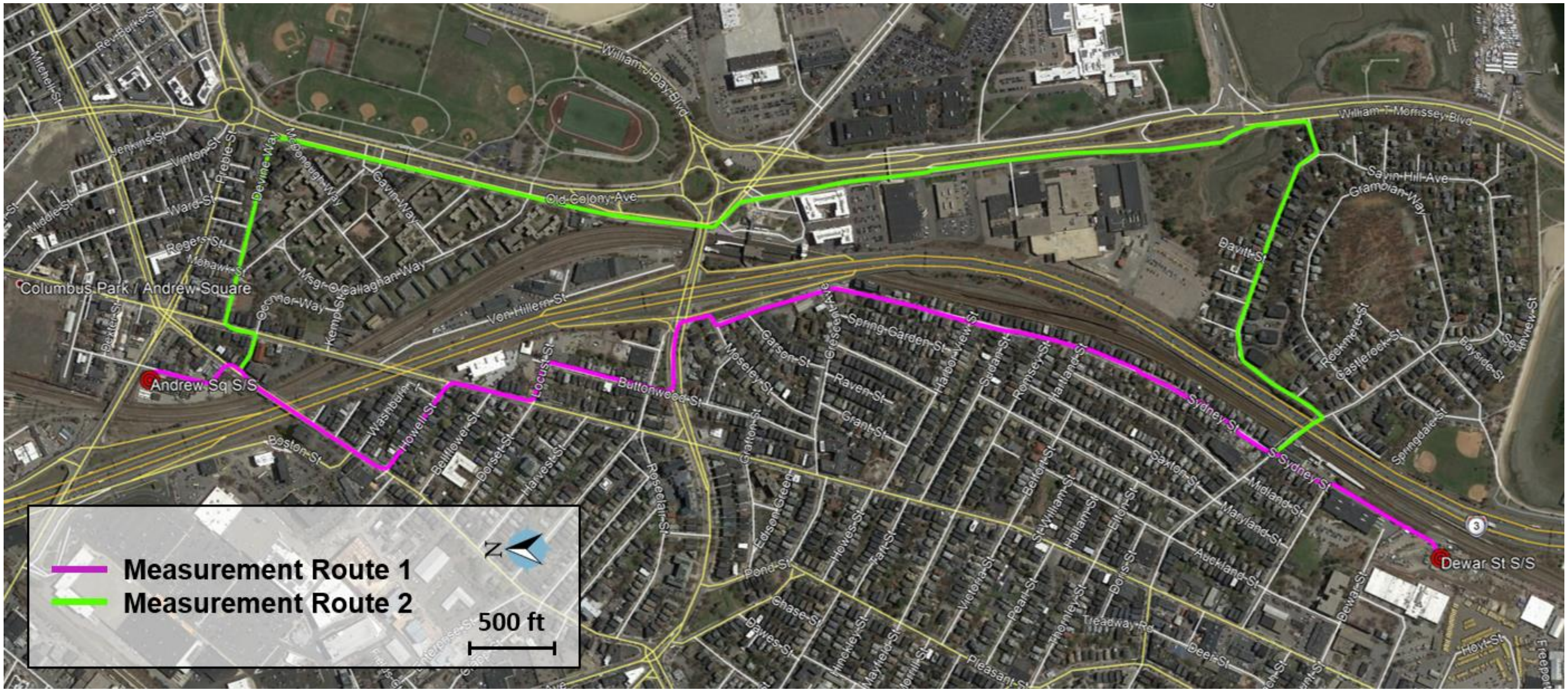

Figure B-1. Path of measurements performed along the Sydney Street Route (purple) and the Morrisey Boulevard Route (green). .

Appendix C

Calibration Certificate

Certificate of Calibration

The calibration of this instrument was controlled by documented procedures as outlined on the attached Certificate of Testing Operations and Accuracy Report using equipment traceable to N.I.S.T., ISO 17025, and ANIZ540-1 COMPLIANT.

Instrument Model: EMDEX II

Frequency: 60 Hertz

Serial Number: 3074

Date of Calibration: 7/5/2018

Re-Calibration suggested at one year from above date.

EMDEX LLC

EMDEX-LLC
1356 Beaver Creek Drive
Patterson, California 95363
(408) 866-7266

H. Christopher Hooper
Calibration Inspector