MUNICIPAL CONSULTATION FILING

Connecticut General Statutes Section 16-50*l*(e)

For a Certificate of Environmental Compatibility and Public Need

Greenwich Substation and Line Project

Greenwich, Connecticut

February 2015

Submitted to:
The Honorable Peter Tesei
Chief Elected Official

Greenwich, Connecticut

Submitted by:
The Connecticut Light and Power Company doing business as Eversource Energy
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Table of Contents

List of Figures

List of Tables

List of Appendices

EXECUTIVE SUMMARY

What is the Greenwich Substation and Line Project and why is it needed?

The Greenwich Substation and Line Project (the "Project") consists of a new 115-kilovolt ("kV") bulk substation and associated underground transmission supply lines (or "circuits") that would extend approximately 2.3 miles from the Cos Cob Substation on Sound Shore Drive to 290 Railroad Avenue in Greenwich, Connecticut ("Greenwich" or the "Town"). The Connecticut Light and Power Company doing business as Eversource Energy ("Eversource" or the "Company") is proposing the Project to provide immediate load relief to the electric distribution supply system in the Town of Greenwich by establishing the new bulk substation near the center of the customer electrical demand (or "load") to avoid overloads on system equipment.

What deficiencies currently exist on the electric distribution system?

Increased electrical demand in Greenwich currently exposes the distribution system to risk of overloads on system equipment during certain contingency events. Presently, the western part of Town is served primarily by one bulk substation which has multiple transmission supply lines and step-down transformers (Cos Cob Substation). Cos Cob Substation was constructed in 1964 to serve an electrical load much lower than what exists today. Without improvements, certain contingency events could result in the overload of Cos Cob Substation transformers by 2017. Currently, certain contingency events could cause the overload of lines that serve distribution substations from Cos Cob Substation. A distribution substation in the area of highest load concentration (Prospect Substation) would be exposed to overloads beginning in 2021. If such overloads were allowed to occur, widespread service interruptions and damage to Eversource's equipment may result. To avoid the overloads, controlled load shedding (targeted blackouts) would likely be required.

The Project also requires expansion of Cos Cob Substation for the installation of new equipment to support the underground transmission lines and provide for safe and proper operation. The Cos Cob Substation fence will be extended approximately 90 feet to the south to accommodate the yard expansion and new equipment installation.

How would the Project address these deficiencies?

The construction of a new bulk substation in the western part of Greenwich (the proposed “Greenwich Substation” or “Substation”) would share the load with Cos Cob Substation in normal conditions, and provide for continuity of service during many contingency events upon installation of equipment to implement transfers of load. The ability to transfer load in many contingency events is the typical design in most areas of the Eversource system with the size of load comparable to the Greenwich load. The proposed Greenwich Substation together with Cos Cob Substation would adequately meet projected demand in 2017 and for 30 years thereafter.

Are there any other benefits that the Project would provide?

With the new capacity and an additional bulk substation source, the risk of projected overloads will be mitigated, thereby improving system reliability. The new Greenwich Substation will allow for the transfer of approximately one-half of the load currently served by Cos Cob Substation to the new facility. In so doing, the reliance on a substation that is nearing its capacity to serve a high level of system load through heavily loaded distribution feeders would be eliminated. Loads could also be transferred between the two substations under contingency operating conditions, thus further improving reliability. Additionally, bringing a transmission level power source to central Greenwich will provide a more reliable power supply than the existing multiple lengthy distribution feeders originating from Cos Cob Substation. By building two new transmission circuits, Eversource is providing a backup power source should one circuit be out of service.

Where would the proposed substation be located?

The proposed Greenwich Substation would be constructed on commercially-zoned property at 290 Railroad Avenue in Greenwich (the “Property” or “Site”).

How was the location for the Greenwich Substation selected?

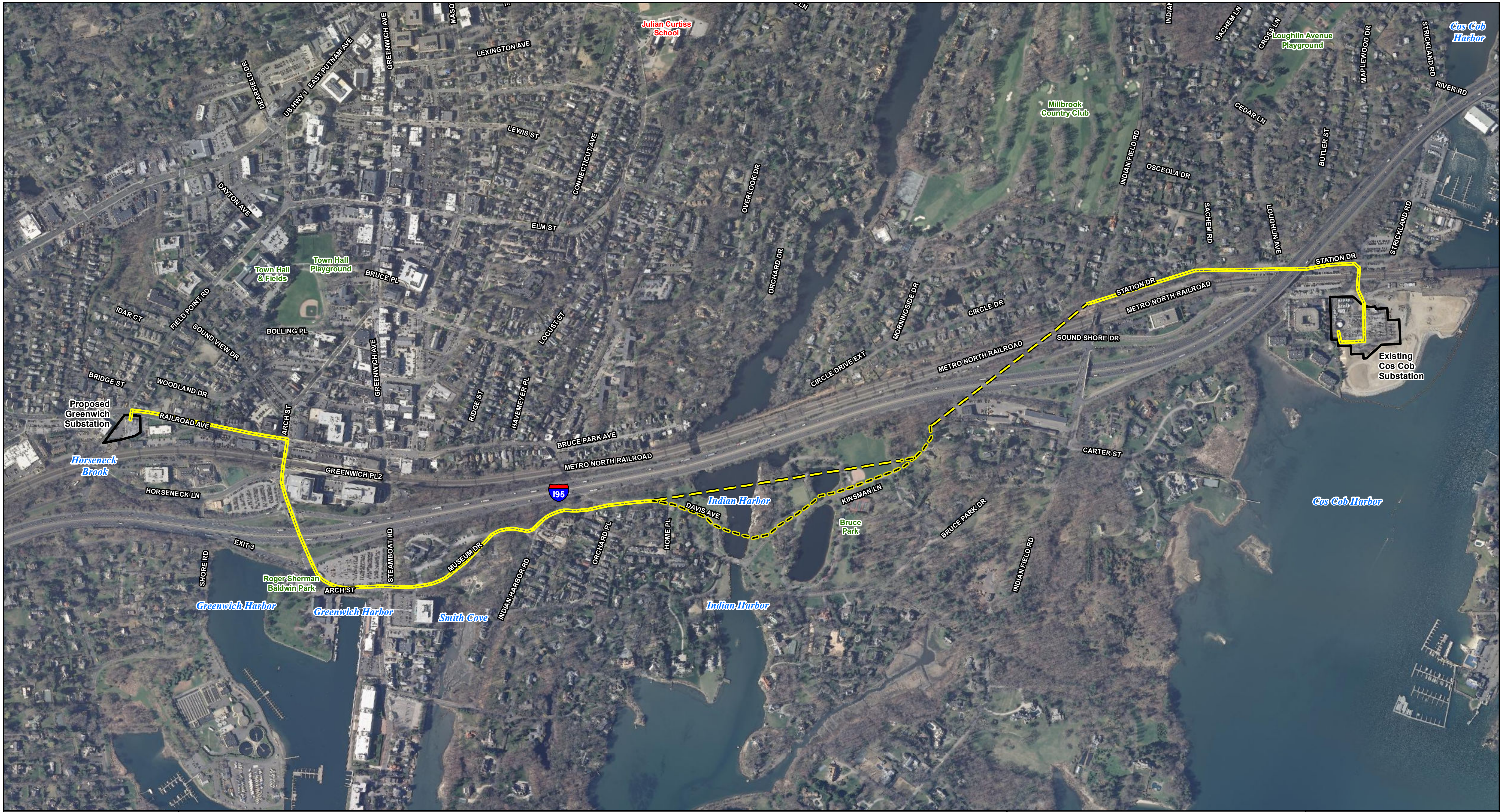
The Company evaluated and compared several properties using its location selection criteria and determined that the Property is the most appropriate location for development of the new Substation. The Property best fulfills Eversource's electrical system objectives for proximity to the customer load pocket and to existing distribution feeders. Moreover, it also meets Eversource's additional site selection criteria by supporting the installation of the Substation while minimizing potential adverse effects on the community and the environment.

How will the Greenwich Substation be constructed?

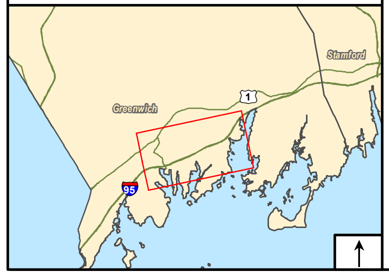
The new Substation would be developed within the confines of the 0.81-acre, Eversource-controlled Property. Gas insulated switchgear equipment would be housed in a 50-foot by 120-foot building fronting Railroad Avenue. The 35-foot tall Gas Insulated Substation ("GIS") building would be outfitted with circuit breakers, disconnect switches, protective relaying and control equipment as well as the battery and charger associated with transmission equipment. In addition, the exterior Substation yard would also be outfitted with three 115-kV circuit switchers with integral disconnect switches and three 60-Megavolt-Ampere ("MVA") power transformers, which would step down the voltage from 115 kV to 13.2 kV. One metal switchgear enclosure would also be installed to house the switching equipment, relaying and control equipment for the 13.2-kV distribution feeders. A free-standing pump house that supports the high pressure fluid filled transmission ("HPFF") cables would be located in the southwest corner of the Site, adjacent to Field Point Road.

Where would the underground transmission lines be located?

To the extent feasible, the underground transmission lines would be located within existing public roadways and associated rights-of-way ("ROW") and on public and private properties. Upon evaluating various route options and following consultation with Town officials, the Company identified a preferred route ("Preferred Route") that is shown in Figure ES-1. The Company also identified a variation to a short segment of the Preferred Route (through Bruce Park) and two alternate route options ("Southern Alternative" and "Northern Alternative").



INDEX MAP



Legend

- Preferred Route
- Preferred Route HDD Crossing
- Preferred Route Open Trench Crossing

1 inch = 700 feet

750 375 0 750 Feet

Base Map: 2012 Aerial Photograph (CTECO)

Figure ES-1
Preferred Route Map

Greenwich Substation and Line Project

EVERSOURCE ENERGY

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February 2015

The Preferred Route is described as follows: Beginning at Cos Cob Substation, the Preferred Route would exit the Substation under the Metro-North Railroad ("MNRR"), extend west along Station Drive (crossing beneath Interstate 95 ("I-95")) before reaching Town-owned properties west of Indian Field Road. The route would turn southwest and extend beneath the MNRR and I-95 again, to an area west of Kinsman Lane. The route would then travel under Kinsman Lane and through Bruce Park. West of Bruce Park, the route would generally follow Davis Avenue, Indian Harbor Drive and Museum Drive west before turning north on Arch Street and extending beneath I-95 and the MNRR to Railroad Avenue. The route would turn west and follow Railroad Avenue to the Site.

How was the Preferred Route for the lines selected?

The Company analyzed a number of possible route options originating at Cos Cob Substation. The Company selected the Preferred Route based on engineering, environmental, cultural, economic, and community considerations and utility routing objectives. These objectives include: ease of constructability; minimizing conflicts with existing utilities; meeting operations and maintenance requirements; limiting the need for right-of-way/easements as much as possible; and, limiting surface disruption impacts, scheduling delays, length of the route, and increased costs.

What were the key factors for selecting the Preferred Route over the Alternate Routes?

The key factors for selecting the Preferred Route over the alternate routes were the route's length (which affects construction time and cost), construction complexities and desire to minimize environmental and community impacts.

How would the transmission line system be constructed?

The transmission line system installed on the Preferred Route, or either of the alternate routes, if selected as the route for the Project, would be constructed underground and would use HPFF pipe type cables. Two HPFF lines (or circuits) would provide for redundancy of supply and increased reliability to the Greenwich Substation. The Project's HPFF underground 115-kV line system would consist of two 8-inch steel pipes in a common trench, in which the two HPFF lines would be installed, along with a 6-inch fluid return pipe for fluid circulation, and four fiber optic cables (two for communications and two for dynamic temperature sensing).

Concrete splice vaults would be installed below ground for cable installation and splicing. Vaults are typically spaced in the range of 2,000 feet to 2,800 feet depending upon cable construction and route characteristics. To install each concrete splice vault, an excavation area approximately 12 feet wide by 12 feet high and up to 24 feet long would be required. The exact number of splice vaults would depend on design considerations and the maximum length of cable that can be transported on a single reel.

What is the purpose of this Municipal Consultation Filing ("MCF")?

In the second quarter of 2015, the Company plans to apply to the Connecticut Siting Council ("Council") for a Certificate of Environmental Compatibility and Public Need ("Certificate") for the Project. This MCF is a key initial step in the Council's comprehensive regulatory process that governs substation and transmission facility planning and siting. Specifically, the MCF is intended to:

- Provide information about the Project to representatives of the potentially affected municipalities and the public; and
- Solicit public participation at an early stage in the development of the Project so that issues of concern to the public can be identified and addressed in the Project planning process.

The MCF presents technical information concerning Project need, the proposed Substation and Substation site, the transmission line route selection process, and potential environmental effects and mitigation measures, including the results of studies that the Company or its consultants have performed to date.

A. Purpose of the Filing

The Connecticut Light and Power Company doing business as Eversource Energy ("Eversource" or the "Company") intends to apply to the Connecticut Siting Council (the "Council") for a Certificate of Environmental Compatibility and Public Need ("Certificate") for the Greenwich Substation and Line Project (the "Project"). The Project includes: construction of a new 115-kilovolt ("kV") bulk substation; installation of two underground transmission supply lines (consisting of two separate 115-kV circuits) extending approximately 2.3 miles from Cos Cob Substation on Sound Shore Drive to 290 Railroad Avenue; and equipment upgrades at Cos Cob Substation.

The purpose of the Project is to provide immediate load relief to the electric distribution supply system in the Town of Greenwich ("Town" or "Greenwich") by establishing a new bulk substation near the center of the customer electrical demand (or "load") to avoid overloads on system equipment. Currently, the main supply source of the electric distribution system in the Town is Cos Cob Substation, which cannot reliably meet the Town's growing electricity needs.

A.1 Preliminary Municipal Consultations

At numerous meetings over the past three-plus years, the Company has consulted with Town officials, including the First Selectman, regarding the pressing need for improvements to the electrical system serving Greenwich. The focus of the meetings was primarily to communicate the Company's desire to improve the electric power distribution system in Greenwich and to establish a line of communication with Town officials. The following Table A-1 denotes meeting dates and briefly summarizes the subject matter.

Table A-1 Preliminary Municipal Consultations

Meeting Date	Purpose of Meeting	Attendees
June 11, 2011	The Company's Executives met with First Selectman and other elected officials to announce plans for a new substation to address distribution system reliability issues. A press conference was held at the same time.	First Selectman, Greenwich's General Assembly delegation
January 17, 2012	Project team members provided a Project update.	First Selectman, Department Heads
March 21, 2012	Project team members provided a Project update.	First Selectman, Department Heads
September 18, 2012	Project team members provided a Project update.	First Selectman, Department Heads
October 30, 2013	Project team members provided a Project update.	Department Heads
January 28, 2014	Project team members provided a Project update.	Department Heads
February 26, 2014	Project team members provided a Project update.	First Selectman
May 13, 2014	Project team members provided a Project update.	First Selectman
December 1, 2014	Project team members provided a Project update.	Department Heads
December 17, 2014	Project team members provided a Project update.	First Selectman
January 7, 2015	Project team members discussed the Location Review process.	Director of Planning

A.2 Municipal Participation during Municipal Consultation Process

Eversource plans to file its application with the Council for approval of the Project during the second quarter of 2015. The Project consists of the construction of a new 115-kV substation and associated transmission supply lines. The formal designation of the Council's approval is a Certificate. Pursuant to the Public Utility Environmental Standards Act, Conn. Gen. Stat. §16-50g et seq., Eversource has a statutory obligation to consult with any municipalities in which the primary or alternate routes of a facility for which it seeks a Certificate are located (and any municipalities within 2,500 feet of such routes). Specifically, Conn. Gen. Stat. §16-50*l*(e) requires that:

> at least sixty days prior to the filing of an application with the council, the applicant shall consult with the municipality in which the facility may be located, and with any other municipality required to be served with a copy of the application under subdivision (1) of subsection (b) of this section concerning the proposed and alternative sites of the facility . . . Such consultation with the municipality shall include, but not be limited to good faith efforts to meet with the chief elected official of the municipality. At the time of the consultation, the applicant shall provide the chief elected official with any technical reports concerning the public need, the site selection process and the environmental effects of the proposed facility.

The Company has held preliminary meetings with the Chief Elected Official of Greenwich and Town representatives concerning the proposed Substation and the various routes considered for installation of the transmission supply lines. These meetings have been beneficial for the Company to gather useful information and preliminary feedback from the Town. The delivery of this municipal consultation package initiates the formal municipal consultation process required before Eversource may file its application to the Council. This package presents information regarding the proposed Substation location and route for the underground transmission supply lines that Eversource expects to recommend to the Council, as well as information about the Project alternatives evaluated, including the alternate sites and routes considered.

Connecticut General Statutes ("CGS") §16-50*l*(e) also outlines the role of a municipality during the consultation process preceding an applicant's filing with the Council for a Certificate. Once the applicant provides the Municipal Consultation Filing with relevant information and any technical reports concerning public need, the site selection process, and environmental effects of the Project:

> [t]he municipality may conduct public hearings and meetings as it deems necessary for it to advise the applicant of its recommendations concerning the proposed facility. Within sixty days of the initial consultation, the municipality shall issue its recommendations to the applicant. No later than fifteen days after submitting an application to the council, the applicant shall provide to the council all materials provided to the municipality and a summary of the consultations with the municipality including all recommendations issued by the municipality.

This municipal consultation package provides the Town of Greenwich, the only affected municipality, with technical reports and other information concerning need, site selection, and potential environmental effects as required by CGS §16-50*l*(e). There is no other municipality located within 2,500 feet of the Project area.

During this municipal consultation process, Eversource seeks to receive additional input from representatives of the Town and from the interested public to assist in designing and constructing the Project that would provide needed system load relief at the lowest reasonable cost to customers, while minimizing and appropriately mitigating effects on the community and environment. Eversource expects to consider such information in finalizing its application to the Council for the Greenwich Substation design and the specific underground route for the related transmission supply lines. This approach enables the Company to take full advantage of the Town's views and local knowledge, as well as to have a greater understanding of the municipal concerns prior to submitting a formal application for the Project to the Council.

To facilitate community outreach in the Town, Eversource will hold an Open House at which information regarding the Project will be provided by the Company. Representatives of the Town have proposed that the Open House be held in the Greenwich Town Hall Meeting Room. Eversource will use this Open House to provide information to the public regarding the Project and also to receive direct feedback from interested persons concerning the Substation, transmission route and other matters relating to the Project. Comments received from Town representatives and from the community will be reviewed for inclusion in the application and will be provided to the Council.

B. Project Contacts

Correspondence and other communications regarding this submittal should be addressed to:

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C. Description of Filing Contents

This filing includes the following information concerning the Project:

- Project need and purpose;
- Location and design;
- Various alternatives considered and the process by which the location of the proposed Greenwich Substation and the proposed routing options were identified and selected;
- Potential effects on the environment and proposed mitigation measures;
- Design of the Substation and underground transmission supply lines;
- Construction procedures and methods required for development of the Project;
- Electric and magnetic fields; and,
- Project schedule.

D. Project Need

D.1 Need for Capacity

Greenwich needs an additional bulk substation, one that is located near its current highest load concentration in the western part of Town and served by reliable transmission supply lines. Presently, the western part of Town is served primarily by one bulk substation which has multiple transmission supply lines and step-down transformers (Cos Cob Substation). Cos Cob Substation was constructed in 1964 to serve a load much lower than what exists today.

Without system improvements, contingency events could result in the overload of Cos Cob Substation transformers by 2017. Currently, certain contingency events could cause the overload of lines that serve distribution substations from Cos Cob Substation. The distribution substation in the area of highest load concentration (Prospect Substation) would be exposed to overloads beginning in 2021. If such overloads were allowed to occur, widespread service interruptions and damage to Eversource's equipment may result. To avoid the overloads, controlled load shedding (targeted blackouts) would likely be required. The construction of an additional bulk substation (the proposed Greenwich Substation) would not only enable the two bulk substations to share the load in normal conditions, but would also provide for continuity of service in many contingency events upon installation of equipment to implement transfers of load from one bulk substation to another. The ability to transfer load in many contingency events is the typical design in most areas of the Eversource system with the size of load comparable to the Greenwich load. The proposed Greenwich Substation would adequately meet current and projected demand and avoid reliance on a single bulk substation that is near its permissible load rating.[1]

The problem of serving the vast majority of the Greenwich load from a single bulk substation that is nearing its permissible load rating is exacerbated by the location of Cos Cob Substation, a substantial distance east of the downtown Greenwich area. Most of the projected load growth and the greatest concentration of existing load are in the

[1] Permissible load of a substation is the load the substation can be allowed to carry under normal conditions and loss of one transformer.

downtown area, well to the west of Cos Cob Substation. At present, this load is being served by relatively long and heavily loaded distribution feeders, and continuity of service is threatened by the loss of any 2 feeders. The proposed Greenwich Substation would be located approximately 2.3 miles to the southwest of Cos Cob Substation, near the center of this load concentration. Moreover, the new substation would be served by two new 115-kV transmission supply lines, so that it could remain in service even with the loss of one of its supply lines in a contingency event.

Since Cos Cob Substation first reached its capacity in 1994, the Company has postponed incurring the substantial cost of an additional bulk substation by implementing a series of incremental improvements to the electric supply system in and near Greenwich. However, the extent and location of the load growth that must be served by 2017 and beyond make further incremental measures inadvisable. A robust solution is required. The construction of the Greenwich Substation will provide the needed reliability of electricity to one of the state's most dynamic growth areas, and will provide a margin for future growth beyond 2017 as well.

D.2 Reliability Benefits

With the new capacity and an additional bulk substation source, the risk of projected overloads will be mitigated, thereby improving system reliability. The new Greenwich Substation will allow for the transfer of approximately one-half of the load currently served by the Cos Cob Substation to the new facility. In so doing, the reliance on a bulk substation that is nearing its permissible load rating to serve a high level of system load through heavily loaded distribution feeders would be eliminated. In addition, with the installation of equipment, loads could also be transferred between the two bulk substations under contingency operating conditions, thus improving reliability. Also, bringing a transmission level power source to central Greenwich will provide a more reliable power source than the existing multiple lengthy distribution feeders emanating from Cos Cob Substation. By building two new transmission circuits, Eversource is providing a backup power source should one circuit be out of service.

D.3 Substation

D.3.1 Introduction

The purpose of the Greenwich Substation is to provide immediate load relief to the distribution supply system in Greenwich to avoid overloads on system equipment, by establishing a new bulk substation in Greenwich in 2017. This new bulk substation would also accommodate anticipated future load growth and greatly improve the reliability of the entire electric distribution system in Greenwich.

Currently, the vast majority of load in Greenwich is served from a single bulk substation, Cos Cob Substation, serving approximately 130.5 MVA[2] of electric load at 27.6 kV.[3] It feeds three distribution substations at 27.6 kV in Greenwich (Prospect, Byram and North Greenwich Substations), supplies power directly to large commercial customers and the secondary network, and provides a backup power source at 27.6 kV to two other substations in Greenwich (Mianus and Tomac Substations). The proposed Greenwich Substation would provide for the transfer of approximately half of Cos Cob Substation's 27.6-kV load to the Greenwich Substation.[4]

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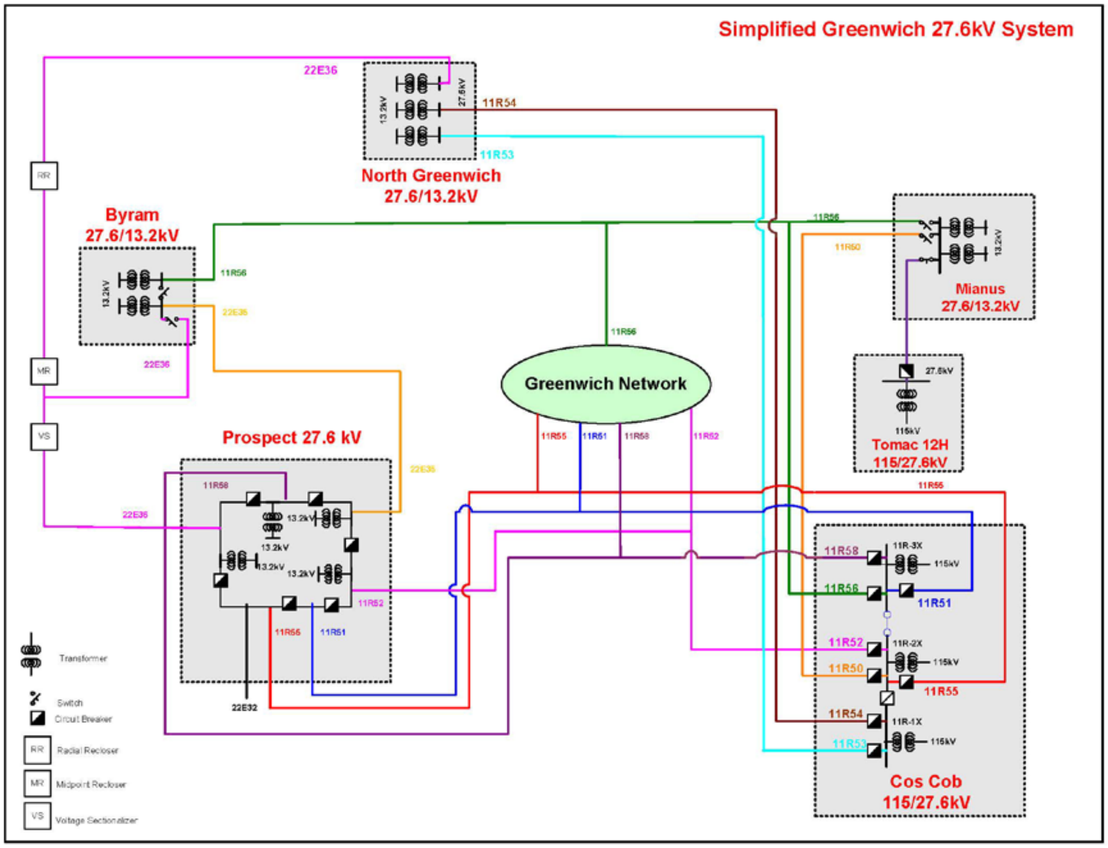
[2] Load is based on 2013 summer peak.

[3] Cos Cob Substation also serves approximately 16.4 MVA of peak load at 115-kV solely for the benefit of Metro-North Railroad and another 29.5 MVA of peak load at 13.2 kV.

[4] Cos Cob Substation provides a reliable level of service now and in the foreseeable future at 13.2 kV; therefore, no improvements at Cos Cob Substation at the 13.2-kV level are recommended or included in the Project.

Figure D-1 presents a one-line diagram of the existing electric distribution system in Greenwich. The diagram identifies substations and equipment connections.

Figure D-1 Greenwich Electric Distribution System



D.3.1.1 Cos Cob Substation The Need for Capacity to Avoid Transformer Overloads

The cornerstone of the electric distribution system in Greenwich is Cos Cob Substation. It is a bulk substation that has several distinct functions. First, it acts as an electrical "off-ramp," taking power at 115 kV from the transmission system (the highway system of lines that move high voltage power over long distances) and reducing the transmission voltage levels down to distribution voltage levels, in this case 27.6- and 13.2-kV, which are reduced further to serve homes and businesses. Second, Cos Cob Substation supplies power at 27.6 kV to other substations in Greenwich to enable those substations to serve homes and businesses. Third, Cos Cob Substation supplies power at 27.6 kV to large commercial customers and the secondary network in downtown Greenwich.

During its on-going planning process, the Company examined actual load levels for 2013 and projected load levels for 2017 for loads served by Cos Cob Substation. Based on this analysis, the Company concluded that Cos Cob Substation's 115- to 27.6-kV transformers could be overloaded starting in 2017 under certain contingency events. To avoid such overloading, 27.6-kV load relief at Cos Cob Substation should be in place in 2017. In addition, 27.6-kV load relief is needed at two distribution substations (Prospect and Byram Substations) that are supplied from Cos Cob Substation. The proposed Greenwich Substation would provide the necessary load relief to the 27.6-kV system by transferring load off the existing 27.6- to 13.2-kV transformers at Byram and Prospect Substations to new 115- to 13.2-kV transformers at Greenwich Substation.

Local load area deficiencies resulting from inadequate transformer and feeder capacities at Cos Cob Substation currently exist in Greenwich, which will be resolved with the new bulk substation. Based on 2013 actual loads, Cos Cob Substation serves 130.5 MVA of load at 27.6 kV. Eversource's projected 27.6-kV loads at Cos Cob Substation in 2017, without the proposed Greenwich Substation, would be 135.8 MVA. Because Cos Cob Substation's permissible load rating is 135 MVA, Cos Cob Substation is projected to be overloaded in 2017, based on projected load levels under peak load conditions if certain contingency events occur. Table D-1 summarizes the actual and projected load levels on the transformers at Cos Cob Substation.

Table D-1 Summer Peak Load Levels[5]

Cos Cob Substation 27.6 kV – Load in MVA											
Transformers ID Numbers	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
1X	26.8	27.1	27.3	27.6	27.9	28.2	28.4	28.7	29.0	29.3	29.6
2X+3X	103.7	104.7	105.8	106.8	107.9	109.0	110.1	111.2	112.3	113.4	114.5
Total MVA	130.5	131.8	133.1	134.5	135.8	137.2	138.5	139.9	141.3	142.7	144.2

Construction of a new bulk substation in Greenwich to provide load relief is consistent with the Company's current electric distribution system design. In most geographic

[5] 2013 are actual summer peak loads; 2014 and beyond are projected peak loads.

areas of Connecticut with large amounts of customer load, usually two or more bulk substations that have multiple transmission supply lines are used to supply power, so that if one power supply source is unavailable, the remaining bulk substation(s) would supply the needed power. For example, Stamford has four bulk substations that serve the load in that area: Glenbrook, Cedar Heights, South End and Waterside. In contingency conditions, significant load can be quickly transferred from any of these substations to one or more of the others, through the use of automatic distribution recloser transfer systems.

The load relief provided by the proposed Greenwich Substation would not only meet the current needs but also the projected future needs that would arise from continued load growth. The Southwest Connecticut region and Greenwich in particular, continues to experience economic growth and, as a result, load has increased at a faster pace than in other parts of Connecticut. Adding the proposed new bulk substation in Greenwich would enable Eversource to meet the projected load in 2017 and approximately 30 years thereafter, as well as provide capacity for additional load increases that will likely arise from continuing economic development in Greenwich.

D.3.1.2 The New Substation Eliminates Distribution Feeder Overloads

In Greenwich, dependence on one bulk substation (Cos Cob) to supply 130.5 MVA of load at 27.6 kV through distribution feeders provides insufficient reliability of service to the majority of customers because it renders the system vulnerable to feeder overloads and potential outages under certain contingency conditions. Such overloads and outages may result not only in an interruption of service to customers, but also in damage to Eversource’s equipment. Such damage could, in turn, lead to more widespread and/or longer duration customer outages.

Currently, multiple lengthy distribution feeders (approximately 2.3 miles) are used to supply power to Prospect Substation. The longer the length of the distribution feeders, the greater the risk of feeder failures, which could result in outages. These reliability vulnerabilities would be substantially reduced by locating a new substation near the load that it will serve and supplying the new substation with power delivered by transmission supply lines. This increased risk of consequential effects and expanding outages arises from the design of the system that currently serves Greenwich.

The electric distribution system in Greenwich was designed more than 50 years ago to serve substantially lower load levels than exist today. Based on the current and projected loads, the system equipment components are at or near their maximum load levels in peak or near peak conditions. Therefore, any event that causes a loss of one or more system components, such as a transformer or distribution feeder, will require the remaining system components to carry higher loads, thereby further stressing those components in contingency conditions. As those components are further stressed, there is increased risk that more components will fail, thus potentially causing the initial loss to "expand" onto additional components throughout the system. For example, past double contingencies have resulted in load loss because essentially all of the eggs are in one basket – Cos Cob Substation is supplying power via long distribution feeders. Moreover, four 27.6-kV circuits operate electrically in parallel from Cos Cob Substation to Prospect Substation, such that if one or more of these circuits is out, the remaining circuits must carry the entire load. Additionally, if a loss of two network feeders occurs during summer peak, then the entire secondary network in Greenwich must be shed by tripping (de-energizing) the transformers that supply power to all five circuits. [6] Finally, secondary network emergencies, such as a manhole fire, damage to a duct bank, or damage caused by lightning storms may require shedding the entire network load.

Further, Greenwich is located at the end of the Company's Southwest Connecticut transmission system. The transmission lines that supply Greenwich terminate a substantial distance (approximately 2.5 miles) from the existing distribution substations located west of Indian Harbor, with the result that power for the majority of the Greenwich customer load is supplied from the east only by relatively long distribution feeders of limited capacity. Bringing a transmission source into the center of customer demand will eliminate the need to rely solely on the long distribution feeders to deliver electricity.

[6] All 5 feeders carry a total load of 103.7 MVA (based on 2013 actual summer peak).

A new Greenwich bulk substation is a long-term solution. It will avoid the need to find additional short-term distribution measures to keep the system operational, beyond the numerous upgrades that the Company has implemented to date. These upgrades have allowed the electric power system in Greenwich to function until a long-term solution could be implemented. That time is now.

D.3.1.3 Prospect Substation - The Need for Capacity to Reduce the Risk of Transformer Overloads

Prospect Substation is a 27.6- to 13.2-kV substation that has four transformers supplying seven 13.2-kV circuits. This substation also serves as a common bus for the 27.6-kV system in Greenwich, with four incoming 27.6-kV lines from Cos Cob Substation and three outgoing 27.6-kV lines, which supply several large customers and the distribution network. Further, this substation supplies a significant amount of load from a very constrained footprint, with little room for additional capacity.

As a result of the current system facilities operating in Greenwich and the current high level of demand, the Prospect Substation is a non-bulk substation that carries more load than a typical distribution substation, and in fact, more load than many existing bulk substations. It is served by only one source (the 27.6-kV supply from Cos Cob Substation) with very limited back up (about 1% of the load) for a failure of that one source. Based on current projections, four 27.6- to 13.2-kV transformers at Prospect Substation would be overloaded beginning in 2021 based on a load level of 55 MVA.[7]

[7] The capacity of Prospect Substation is 55 MVA, which represents the sum of the nameplate capacities of all the transformers.

Table D-2 summarizes the actual and projected load on the transformers at Prospect Substation.

Table D-2 Actual and Projected Loads[8]

Prospect Substation 13.2 kV – Summer Peak Load in MVA												
Transformer ID Number	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
1X	13.3	13.4	13.6	13.7	13.8	14.0	14.1	14.3	14.4	14.5	14.7	14.8
2X	11.9	12.0	12.1	12.3	12.4	12.5	12.6	12.8	12.9	13.0	13.1	13.3
3X	9.8	11.9*	12.0	12.2	12.3	12.4	12.5	12.7	12.8	12.9	13.0	13.2
4X	16.2	14.4*	14.5	14.7	14.8	14.9	15.1	15.2	15.4	15.6	15.7	15.9
Total 13.2kV	51.2	51.7	52.2	52.8	53.3	53.8	54.4	54.9	55.5	56.0	56.6	57.1
% Loading**	93%	94%	95%	96%	97%	98%	99%	99%	OVERLOADED			

* Load was transferred from the 4X to the 3X in 2014.

**For each year, total 13.2-kV MVA divided by the 55 MVA capacity of the substation times 100.

D.3.1.4 Locating a Source of Electric Supply Near the Load Center

The Greenwich Substation is planned to be located in the heart of the area of greatest customer demand in Greenwich. By building a new bulk substation near the load center, the two bulk substations (Cos Cob Substation and the proposed Greenwich Substation) can be used to diversify the load by dividing the load approximately equally between the two substations, which improves system reliability. In addition, field ties between the distribution circuits served by the two substations would allow for transfer of a portion of the load to the other substation if system components were lost at either of these substations.

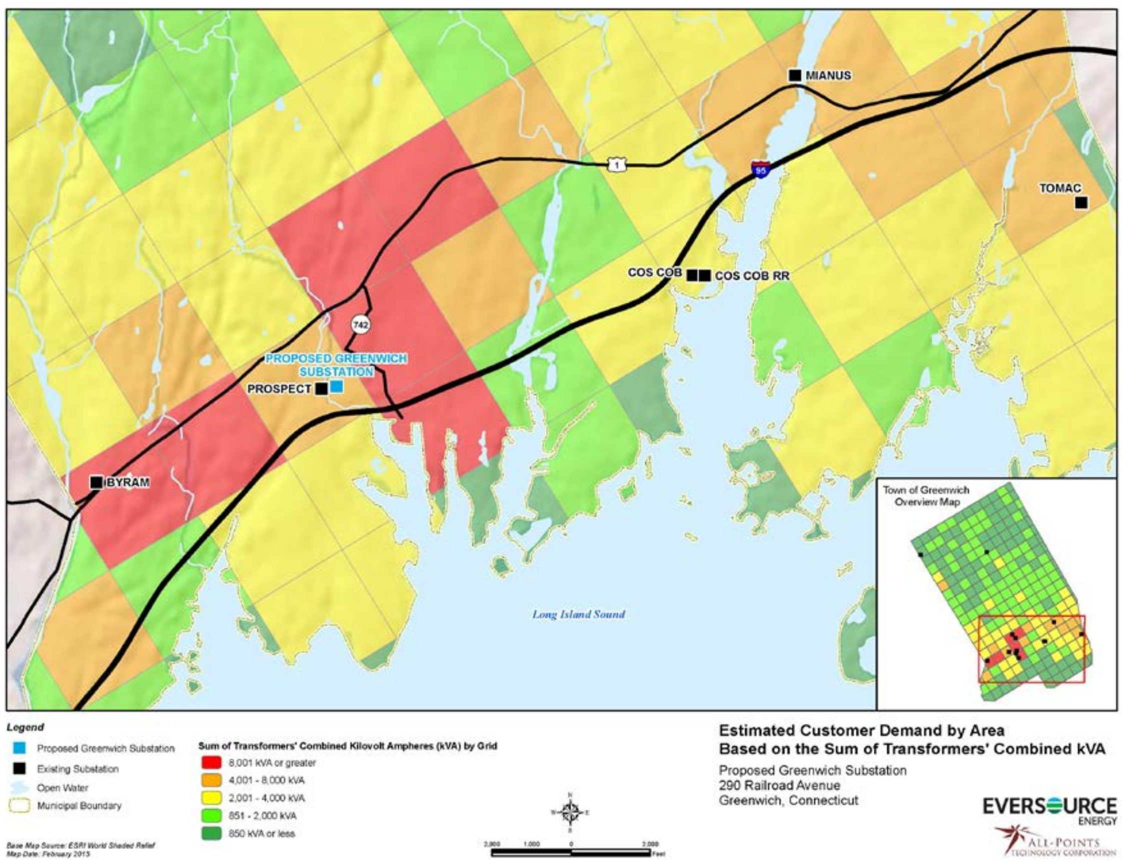
Cos Cob Substation, the most heavily loaded bulk substation in Connecticut, serves approximately 176 MVA of load. The current load in Greenwich is concentrated in its downtown area, which is well to the west of Cos Cob Substation. The proposed

[8] 2013 are actual summer peak loads; 2014 and beyond are projected peak loads.

Greenwich Substation would be much closer to this load concentration. With a bulk substation positioned closer to the customer load, reliability risks arising from reliance on power supplied by relatively lengthy distribution feeders would be substantially reduced.

Figure D-2 depicts the locations of Eversource's existing substations and the current load in Greenwich, which is concentrated around the proposed Greenwich Substation Site. The highest load concentrations are represented in red and the lowest in dark green. Because the proposed site of the new Greenwich Substation is near the center of the highest load areas in the Town, this location is ideal.

Figure D-2 Estimated Customer Demand by Area



D.3.2 Initial Determination of Need

As part of an ongoing analysis of its distribution system, in 1989 the Company identified the need for a new substation in Greenwich because Cos Cob Substation was projected to reach capacity in 1994, and the Company considered building a new substation west of Indian Harbor, as the analysis then suggested. However, in 1994, the Company was able to provide the needed additional capacity at a much lower cost by upgrading Tomac Substation to the east of Indian Harbor, where it could tap into an existing 115-kV transmission line.

To address additional incremental load growth, the Company added a 25-MVA transformer at Cos Cob Substation in 2000. From 2010-2012, the Company was able to further postpone construction of a new substation west of Indian Harbor by upgrading equipment at the existing substations in Greenwich, as explained more fully in Section D.3.5, Table D-4 Greenwich Interim Measures. During 2011-2013, the Company was also able to move load to Waterside Substation in Stamford to relieve Tomac Substation. However, none of these improvements were a long-term solution to the need for a new substation closer to the load center (west of Indian Harbor).

The Company's planned long-term solution of a new substation west of Indian Harbor was publicly identified by the company in June of 2011 as part of a series of steps needed to improve reliability in Greenwich and to address vulnerabilities that appeared after loss of three circuits at Cos Cob Substation due to lightning strikes occurring over two consecutive days during a heat wave. Service to 5,643 customers was lost during the first two days. Subsequently, high system loads on the remaining circuits caused three underground circuits to fail. In response, the company had to quickly implement multiple steps to protect the electric power system in Greenwich. One of those steps included de-energizing approximately 2,300 customers in North Greenwich to help prevent further damage to the electrical distribution system. Additionally, the Company undertook public appeals to Greenwich customers for conservation and requested commercial customers to operate their on-site generation. The Company also continuously shifted loads between available supplies in the Greenwich area to avoid exceeding equipment capabilities and to minimize customer outages. As a final step, the Company mobilized an emergency bulk substation transformer and other equipment into the area, on standby status, to protect against the occurrence of additional contingencies. All of these activities were conducted at a time when the Company was also restoring power to over 210,000 Connecticut customers, whose power was lost due to severe storms.

Once electric service was properly restored and system stability was achieved, the Company began the process of proactively accelerating planned intermediate-term reliability improvements in Greenwich. At that time, the Company also announced that it was accelerating the long-term plan for a new bulk substation in Greenwich.[9]

D.3.3 Existing System and its Current Limitations

D.3.3.1 Background

The Southwest Connecticut area is the most concentrated load area within Connecticut. It comprises 54 towns, including all of United Illuminating's service territory, and accounts for approximately 50% of Connecticut's peak electric load demand.[10] Addressing the issues associated with the electric power system in Southwest Connecticut has been the focus of transmission studies that have identified the need for additional transmission capacity in the region; in response, the Company has placed new facilities in service. Initially, the backbone of the transmission grid was the subject of major system improvements to enhance reliability and efficiency. Specifically, the Company constructed and placed in service the Bethel-Norwalk 345-kV Project (2006), Long Island Cables Replacement Project (2008), Middletown-Norwalk 345-kV Project with United Illuminating (2008) and the Norwalk-Glenbrook 115-kV Project (2008). Recently, the Company placed in service the Stamford Reliability Cable Project, which is a new 115-kV underground transmission circuit that extends between the Glenbrook and South End Substations located in Stamford. All of these projects have strengthened the reliability and efficiency of the transmission system in the Southwest Connecticut area.

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[9] See Docket No. 86-11-18 – DPUC Review of Performance of UI, CL&P and SNETCO in Restoring Service After Storm Carl – Order No. 6 Compliance. Note that pursuant to the final decision in this docket, Eversource has a continuing obligation to report the details of events when implementation of its emergency plan for service restoration occurs, including the events in 2011.

[10] CL&P 2014 Forecast of Loads and Resources For the Period 2014-2023, February 28, 2014, p. 17.

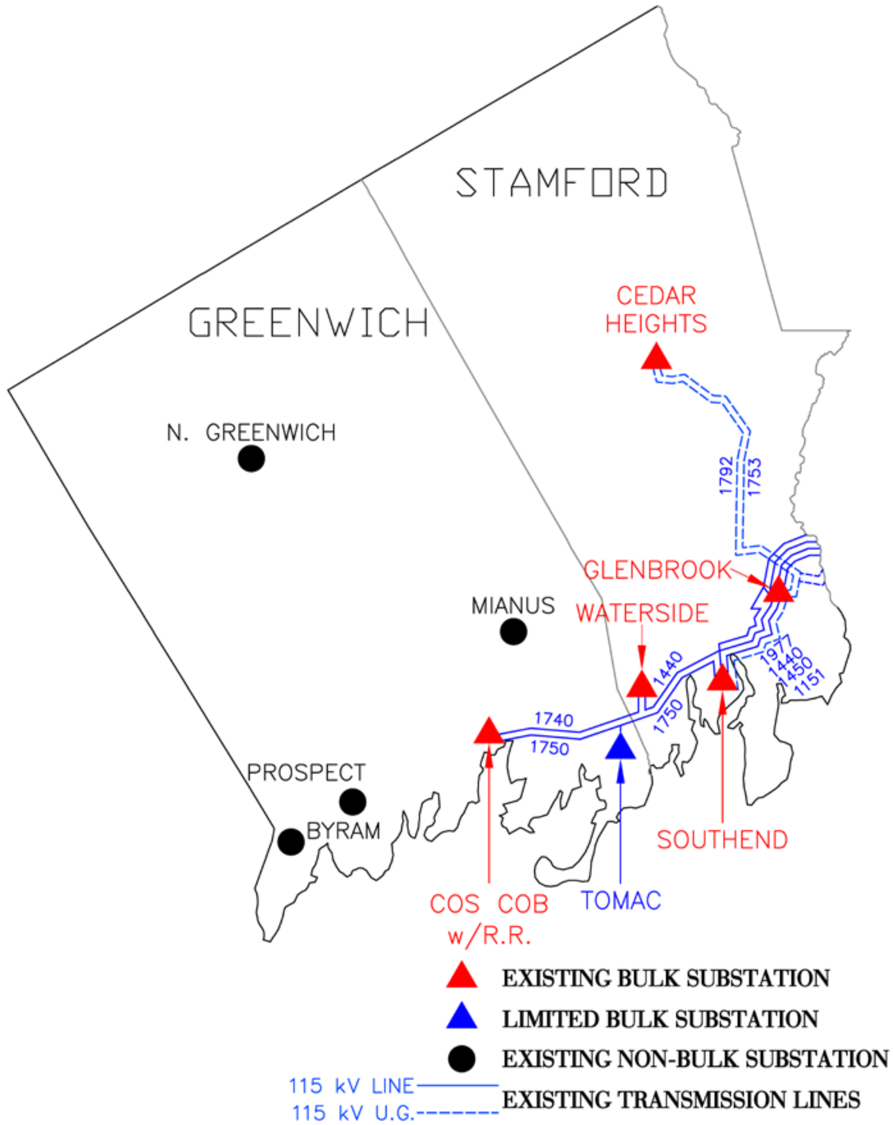
D.3.3.2 Area Substations

As noted above, Greenwich is served by Cos Cob Substation (a bulk substation), which supplies power to Prospect, Byram and North Greenwich distribution substations via distribution feeders. Cos Cob Substation is located on Sound Shore Drive; Prospect Substation is located at 330 Railroad Avenue; Byram Substation is located on Pemberwick Road; and, North Greenwich Substation is located on Old Mill Road.

In addition to serving as the Town's primary electric supply source, Cos Cob Substation also provides a back-up source for power to Tomac Substation[11] and Mianus Substation at 27.6 kV. Figure D-3 illustrates the substations and 115-kV transmission lines located in Greenwich and in Stamford.

[11] Tomac Substation is technically considered a bulk substation; however, it is a very limited one because there is space for only one 115-kV to 27.6-kV transformer.

Figure D-3 Greenwich and Stamford Substations and Transmission Lines



D.3.3.3 Load Served by Area Substations in Greenwich and 2017 Projected Load

The Company examined the 2013 actual loads and projected the 2017 loads for the distribution (non-bulk) substations, secondary network and commercial customers in Greenwich fed by Cos Cob Substation at 27.6 kV.

Table D-3 summarizes the Company's findings of existing and future loadings at substations, secondary network and commercial customers in Greenwich fed by Cos Cob Substation at 27.6 kV.

Table D-3 Existing and Future Loads Fed by Cos Cob Substation via 27.6-kV Feeders

Substation/ Customers	Peak Load		27.6- to 13.2- kV Transformer Nameplate MVA
	Actual MVA 2013	Projection MVA 2017	
North Greenwich – 1X, 2X & 3X	31.0	32.3	75
Byram – 1X & 2X	15.9	16.5	25
Prospect – 1X, 2X, 3X and 4X	51.2	53.3	55.0*
Network & Prospect Commercial Customers Loads	32.4	33.7	Supplied directly from Cos Cob
Total MVA	130.5	135.8**	-

*The Prospect 13.2-kV switchgear is nearing its end of life, with components 45 to 60 years old. In addition, loads are approaching maximum capacity with limited distribution field ties to allow for temporary transfer of portions of the load to help address substation overloads. In other towns, portions of load can be transferred between bulk substations by automatic distribution recloser transfer systems to address overloads.

** Permissible load for Cos Cob Substation @ 27.6 kV is 135 MVA.

Projected loads at 27.6 kV on Cos Cob Substation in 2017 will exceed its permissible load of 135 MVA for its 27.6 kV transformers. Based on loads projected for years after 2017, the Company concluded that four 27.6- to 13.2-kV transformers at Prospect Substation would also be overloaded in 2021.[12]

[12] For Byram Substation, one (1) 27.6- to 13.2-kV transformer would be overloaded in 2028 based on current projections.

D.3.3.4 Area Substation Constraints and Considerations

After closely examining current conditions at each of the area substations (Cos Cob, Prospect, Byram, North Greenwich, Mianus, and Tomac), the Company concluded that the existing distribution system is beyond the capabilities of the current design and cannot be strengthened without a new bulk substation located west of Indian Harbor.

Constraints on the current system are summarized as follows:

(i) Cos Cob (Bulk Substation)

- was built in 1964 on two properties consisting of 2 acres - 1.506 acres owned by Eversource (0.6 acre is utilized by the Company and 0.9 acre is subject to an exclusive third party easement) and 2.5 acres owned by the Connecticut Department of Transportation ("ConnDOT") (1.4 acres subject to easement to the Company) - and is a fully utilized property, so there is no available space to add transformers and feeders
- is constrained by a public road, ConnDOT property, an office building and a town park (under development)

(ii) Prospect (Distribution Substation)

- was built in 1934 on a 0.35 acre portion of a 1.3 acre property
- carries more load than a typical distribution substation and more than many bulk substations
- is bounded by public roads and bisected by an underground brook within a concrete culvert and a municipal sewer main
- is partially located in a 500 year flood zone
- is an operating substation serving load in Greenwich that must remain energized both during and after the construction of the new substation

(iii) Byram (Distribution Substation)

- was built in 1955 on a 0.2 acre portion of a 1.17 acre property
- has severe slopes and is bounded by residential properties on the north, Pemberwick Road on the west, a commercial property on the east and Route 1 on the south

(iv) North Greenwich (Distribution Substation)

- was built in 1972 on 0.467 acre property
- is too far from center of customer load

(v) Mianus (Distribution Substation)

- was built in 1956 on 0.313 acre property
- is bounded by Mianus River and senior care facility, public road and a business
- is too far from center of customer load

(vi) Tomac (Very Limited Bulk Substation)

- was built in 1971 on a 0.45 acre portion (includes 0.1 acre for access easement to the railroad) of an 0.862 acre property (0.189 acre subject to railroad easement)
- is bounded by wetlands, a golf course, a railroad and a public road
- is too far east from center of customer load

D.3.3.5 Interim Measures to Supply the Greenwich Service Area

Beginning in 2010 until the present, the Company implemented several interim measures to bolster the functioning and capacity of substations and the distribution system in the Greenwich area. The projects listed in Table G-4 comprise these interim measures, which were designed not only to improve reliability, but also to increase the capacity of the distribution system in the area, until a new bulk substation could be constructed in Greenwich. After the proposed Greenwich Substation is built, the interim measures will complement the new circuits from the Greenwich Substation and improve the distribution tie capabilities between the substations going forward.

Table D-4 summarizes these projects.

Table D-4 Greenwich Interim Measures

	Substation	In-service Date	Initiative	Company Investment ($ millions)
1	Cos Cob	2010	Upgrade switchgear – 27.6-kV	$3.8
2	Cos Cob	2012	Tie connection between two transformers	$1.2
3	Cos Cob	2012	Add a new 30-MVA transformer	$4.8
4	Byram	2011	Upgrade equipment – install two reclosers	$0.2
5	Mianus	2012	Upgrade equipment – Install underground cable and switching to serve load from Cos Cob	$0.8
6	Distribution Feeder Improvements	2012	Replace distribution cables from Cos Cob Substation to Prospect Substation and Bruce Park	$2.0
7	North Greenwich	2012	Add an aerial feed to North Greenwich Substation and upgrade Right-of-way	$8.4
8	North Greenwich	2010-2012	Replace three distribution transformers	$14.0
9	Distribution Underground Cable Improvements	2012	Replace underground distribution cable from Cos Cob Substation to Sound Shore Drive	$1.1
			Total	$36.3

Currently, there are no additional feasible interim measures at the distribution level that could be undertaken to continue to provide reliable service, other than to build a new substation in Greenwich. Unlike other communities, Greenwich is electrically isolated because the area transmission lines end at Cos Cob Substation and distribution substations that serve a substantial level of Greenwich's customer load are fed by distribution feeders that originate at Cos Cob Substation; the proposed Greenwich Substation would be supplied by either of two new reliable 115-kV transmission circuits.

Further, Cos Cob Substation is currently the only source of supply for three distribution substations in Greenwich. There are no 27.6-kV ties to other bulk substations and very limited 13.2-kV ties between distribution substations not supplied by Cos Cob Substation.

Finally, by 2017 and 2021, the Cos Cob and Prospect Substations, respectively, are projected to exceed their load ratings, thereby placing Greenwich customers at greater risk for load shedding (targeted blackouts). With a projected peak load in excess of permissible load rating of 135 MVA, if a substation equipment failure were to occur at Cos Cob Substation during peak load conditions, the failure could extend to other system equipment, which would be at risk of also becoming overloaded. To avoid consequential equipment failures, the Company is required to have a procedure in place to prevent damage to the remaining equipment. This procedure would initiate targeted blackouts to quickly reduce the risk of overloading additional parts of the distribution system supplying electric service to Greenwich customers.

The Greenwich Substation would allow Cos Cob Substation to continue to operate within the limits of its permissible load rating. The additional distribution capacity from the Greenwich Substation would allow for distribution ties between the two bulk substations, thereby improving reliability and eliminating a risk of equipment damage and the resultant forced service interruptions from equipment overloads.

D.3.3.6 Projected Load Growth

Load growth in Greenwich would exacerbate the anticipated strains on the electric distribution system in Greenwich. the Company projected the load growth as set forth in Table D-5 [transformers at Cos Cob Substation] based on a conservative load growth factor. In addition, based on records on file in the Greenwich Town Hall, a number of developments are planned that would create additional load growth, such as:

- Over 110 new residential units, including a 100-unit project on Havemeyer Lane;
- Over 82,000 square feet of additions and new buildings, including properties of Convent of Sacred Heart, Jehovah's Witness and Greenwich Skating Club;
- A new 72,827 square foot mixed used building with office space and 63 residential units at 16 Old Track Road;
- Additions at Greenwich High School and Brunswick School, and an upgrade at Easter Middle School; and,
- Upgrades at the State of Connecticut Rest Stop, Greenwich Office Park and Greenwich Plaza.

D.3.4 Proposed Greenwich Substation

The Greenwich Substation is proposed as a 115- to 13.2-kV bulk substation with capacity to serve approximately 134 MVA of permissible load. This capacity allows for an equal division of load between the two bulk substations, Cos Cob and the proposed Greenwich Substation.

Table D-5 shows how the customer load will be split when the proposed Greenwich Substation is placed in-service.

Table D-5 Customer Load

	Loads in MVA (27.6 kV)		Permissible Load Ratings in MVA
	2013	2017	
Cos Cob Substation	130.5	66	135*
Greenwich Substation	N/A	69.8	134**
Total	130.5	135.8	

*Cos Cob at 27.6 kV. For the loss of largest transformer and two hour rating on remaining 67.5 MVA + 67.5 MVA = 135 MVA.

**Greenwich at 13.2 kV. Based on expected ratings of ratings for new transformers and normal rating for 2 transformers with third out of service 67.0 MVA + 67.0 MVA =134 MVA.

The Company calculated the future loads for the area substations based on 2013 actual loads and 2017 projected loads with the proposed Greenwich Substation in service (2017). The permissible load for the proposed Greenwich Substation in 2017 would be approximately 134 MVA and the Substation would serve 69.8 MVA, and the future load served by Cos Cob Substation at 27.6-kV would be 66 MVA (reduced from its projected 2017 load of 135.8 MVA). Next, the Company estimated the projected load for the substations that Cos Cob Substation would continue to serve with proposed Greenwich Substation in service.

Table D-6 sets forth the before and after (once the proposed Greenwich Substation is in service) calculations of the loads fed by Cos Cob Substation. Note that the entire loads formerly supplied by Byram and Prospect Substations (at 13.2 kV) would be transferred to the proposed Greenwich Substation after it is placed in-service. Prospect Substation would continue to be a critical distribution tie station for the remaining 27.6-kV circuits and Byram Substation would continue to be utilized for voltage regulation.

Table D-6 Load Calculations

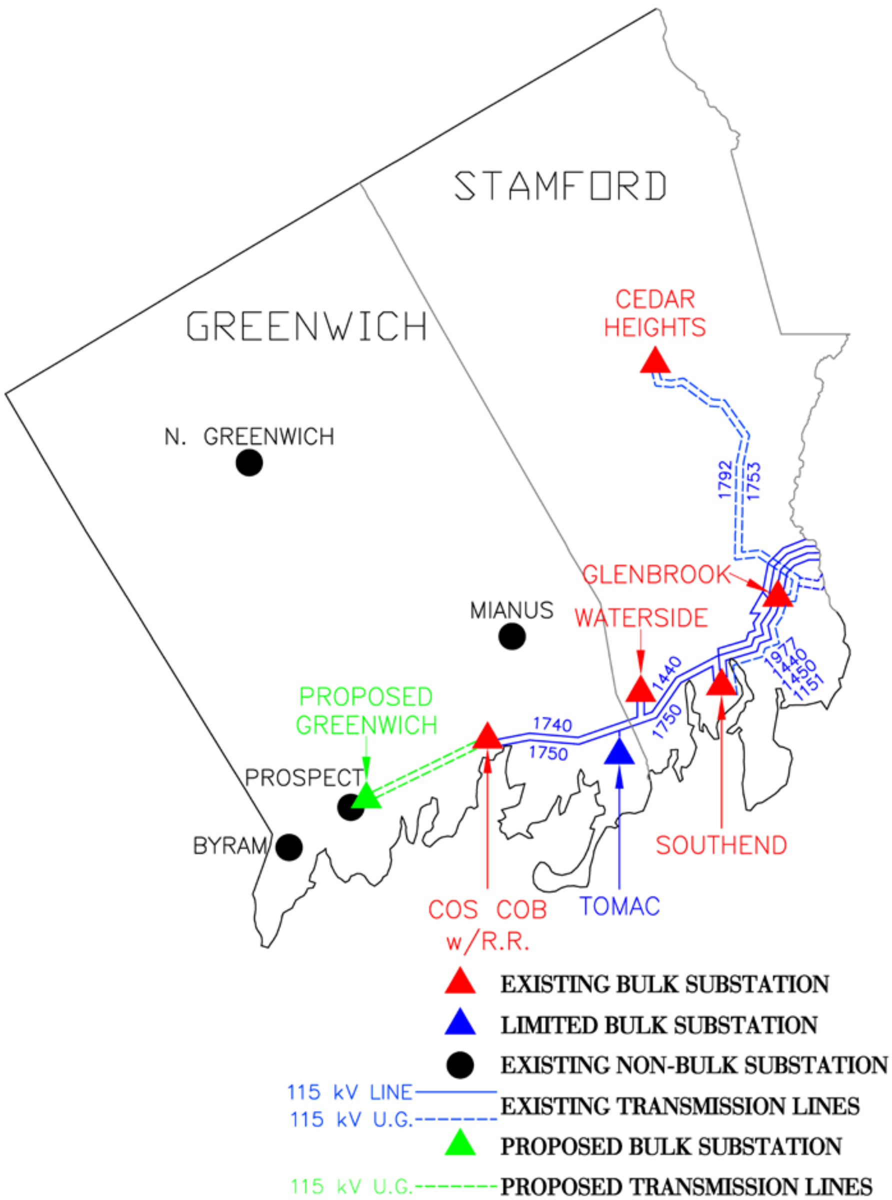
Loads fed by Cos Cob Substation at 27.6 kV with the Addition of the Proposed Greenwich Substation in 2017			
Substation	**Peak Load**		**Transformation Capacity 27.6 kV to 13.2 kV**
	Actual 2013	**Projection 2017**	
North Greenwich – 1X, 2X & 3X	31.0	32.3	75.0
Byram – 1X & 2X	15.9	-	Transformers removed and load transferred to the proposed Greenwich Substation
Prospect – 1X, 2X, 3X and 4X	51.2	-	Transformers removed and load transferred to the proposed Greenwich Substation
Network & Prospect Commercial Customers Loads	32.4	33.7	Supplied directly from Cos Cob
Total MVA	130.5	66.0	135 MVA (permissible load for Cos Cob Substation at 27.6 kV)

After shifting load from Cos Cob Substation to the proposed Greenwich Substation, risk of future overloads of 27.6- to 13.2-kV transformers in substations served by Cos Cob Substation would be eliminated.

In summary, with the proposed Substation in service, both Greenwich Substation and Cos Cob Substation would serve the western part of Greenwich with greater reliability. The projected transformer and feeder overloads at Cos Cob Substation and projected transformer overloads at Prospect Substation would be eliminated.

Figure D-4 depicts the location of the proposed Greenwich Substation and transmission lines with the existing transmission system and substations as shown in Figure D-3, Greenwich and Stamford Substations and Transmission Lines (presented previously in Section D.3.3.3, Load Served by Area Substations in Greenwich and 2017 Projected Load).

Figure D-4 Greenwich and Stamford Substations and Transmission Lines with Addition of the Project



The proposed Greenwich Substation would provide additional capacity that Eversource anticipates should be sufficient to meet the current projected demand for approximately 30 years. In addition, the proposed Greenwich Substation would allow Eversource to remove aging equipment at Prospect Substation (4 transformers and switchgear) and at Byram Substation (two transformers and switchgear). Prospect Substation will remain in service as a distribution tie station for the remaining 27.6 kV circuits; Byram Substation will serve as a voltage regulation site.

D.4 Transmission Supply Lines

The Project also includes two new 115-kV transmission supply lines whose purpose would be to transmit bulk power west from Cos Cob Substation to the location of the new bulk substation in central Greenwich (i.e., the area with the largest customer load).

Although these supply lines would provide a connection between two substations, the definitions of "line" and "transmission line", applied by the Connecticut Siting Council in Docket No. 370 in its Findings of Fact Glossary, dictate that the Company treat these lines as a "facility" pursuant to Connecticut General Statutes Section 16-50i(a)(1):

> Line: A series of overhead transmission structures which support one or more circuits; or in the case of underground construction, a duct bank housing one or more cable circuits.
>
> Transmission Line: Any line operating at 69,000 or more volts. Glossary 6.

These lines would be needed to supply the Greenwich Substation. Ideally, new bulk substations are purposely located to require only short line sections to connect to existing nearby transmission lines. For example, for Sherwood Substation in Westport (see Council Docket No. 398), only short line segments were required to connect the nearest 115-kV transmission line, which was located along the adjacent railroad right-of-way, to Sherwood Substation. Similarly, for Waterford Substation (see Council Docket No. 364), the existing 115-kV transmission line was located nearby; therefore, only two new steel poles were needed to connect that line to Waterford Substation.

However, for the proposed Greenwich Substation, the nearest transmission lines available for connection to the proposed Greenwich Substation are at Cos Cob Substation, so new supply lines would be required. For a substation to perform as a bulk substation, it must be connected directly to a transmission supply line. Because the existing transmission lines end to the east, at the Cos Cob Substation, transmission lines must be extended to the proposed Greenwich Substation site.

D.5 Proposed In-Service Date Justification

The proposed in-service date for the Project is 2017. That date is based on projections that Cos Cob Substation would reach its permissible load in 2017.

To the extent that customer demand increases beyond current projections in Greenwich, or the proposed Greenwich Substation is not in service by 2017 and a contingency event occurs during a peak load period, then Eversource can implement a limited number of distribution operating actions to maintain service.

Given the importance of Cos Cob Substation to the reliability of electric service in Greenwich, the new Substation and supply lines should be placed in service as soon as possible to reduce the risk of customer outages, equipment failures and damage. With the proposed new Substation and supply lines in service, reliable electric service can be maintained to meet existing and projected customer demand.

D.6 Identification of the Facility in the Forecast of Loads and Resource

A new substation for Greenwich was included in the Company's filings to the Council, specifically in tables listing proposed substation projects in the Company's 2012, 2013 and 2014 Forecasts of Loads and Resources. Moreover, in its 2012/2013 Forecast Final Report dated December 12, 2013 (see Council Docket No. F-2012/2013), the Council identified the new Greenwich Substation in Appendix C: Planned Substations. Lastly, the Greenwich Substation was included in the Connecticut Department of Energy and Environmental Protection's ("CT DEEP") 2012 Integrated Resource Plan for Connecticut, Appendix G, Figure 6, pp. 6-10, as a "concept" new substation.

D.7 Conformance to Long-Range Plan for Expansion of Electric Power Serving the State and Interconnected Utility Systems

As the Company previously reported in Docket No. 435, the Stamford Reliability Cable Project ("SRCP") was the initial step in a long-range plan for the Stamford-Greenwich Sub-area[13] of Southwest Connecticut. The Company proposed SRCP to bring the benefits of the major transmission improvements of Southwest Connecticut to the Stamford-Greenwich Sub-area.[14] The next step in the long-range plan for the Stamford-Greenwich Sub-area is to address a local load area deficiency by adding a new bulk substation in Greenwich and adding transmission connections to the new Greenwich Substation.

D.8 Need Summary

The proposed Greenwich Substation would provide immediate load relief to the distribution supply system in Greenwich, thereby avoiding the risk of overloads on system equipment during contingency events. It would also greatly improve the reliability of the electric power system in Greenwich and accommodate anticipated future load growth for approximately the next 30 years.

The proposed Greenwich Substation would adequately meet current and projected demand and avoid reliance on a bulk substation that is near or above its permissible load rating (Cos Cob Substation) to serve a large level of system load in Greenwich. This new substation will accomplish such purposes by providing for the transfer of significant portions of customer load from Cos Cob Substation to a new 115- to 13.2-kV bulk substation.

The Project will also extend transmission supply lines to a point near the highest load concentration, in an area currently served only by distribution feeders from the east. The new substation would reduce the potential for consequential equipment failures due to loss of equipment from weather and other contingency events as well as overloads that

[13] The Stamford-Greenwich Sub-area, which comprises the City of Stamford and the Town of Greenwich, is a component of the Norwalk-Stamford Sub-area, which includes all or a portion of the following municipalities: Bridgeport, Darien, Easton, Fairfield, Greenwich, New Canaan, Norwalk, Redding, Ridgefield, Stamford, Trumbull, Weston, Westport and Wilton.

[14] SRCP was placed in service on November 21, 2014.

could occur as early as 2017. It would improve the reliability of the 27.6 kV electric system serving Greenwich by reducing the large level of load served by Cos Cob Substation via lengthy parallel distribution feeders extending to central Greenwich. Lastly, the new substation would further the Company's initiative of infrastructure improvements in Greenwich by addressing existing constraints at area substations by avoiding equipment overloads.

D.9 Non-Transmission Alternatives

After the Company identified the need to provide immediate and long-term load relief to the distribution system in Greenwich and to increase system reliability, it analyzed a range of long-term alternatives including distribution alternatives, energy alternatives and demand side management alternatives. While some of the alternatives might reduce demand served in Greenwich by small increments, none of the alternatives would achieve the significant increases in reliability and source diversity of the electric distribution system in Greenwich that the Project would achieve. The Project would achieve the following important benefits:

- reducing dependence on a heavily-loaded bulk substation that is approaching its permissible load rating (Cost Cob Substation) by transferring customer demand to the proposed new bulk substation;
- reducing dependence on a heavily-loaded non-bulk substation (Prospect Substation) by transferring customer demand to the proposed new bulk substation;
- providing an independent and separate source for the 27.6-kV distribution feeders so that if a problem occurs on a circuit that serves the secondary network, the customers supplied by the 27.6-kV distribution feeders will not be interrupted or otherwise adversely affected; and
- extending the transmission system near the center of the customer demand.

The alternatives that are set out in the following sections were evaluated to determine whether they could be developed and sized to provide sufficient additional capacity to meet the projected demand, a key benefit of the proposed Greenwich Substation. Because none of these alternatives could be developed to an extent sufficient to eliminate the pressing need for additional capacity at a cost that is comparable to the Project's cost or less, the distribution alternative, energy alternatives and demand side management alternatives do not present practical alternatives to the Project. Additionally, implementation of such alternatives by 2017 to address the Company's need to increase capacity would be challenged.

Even if any of the alternatives were readily available and could be implemented in a timely fashion to avoid the projected overloads, they would provide only limited demand relief on a short-term basis and would be insufficient to address the pressing issues concerning the operation of existing distribution system. New generation, energy efficiency and contracted load curtailment could provide only incremental load relief benefits; they could not provide enhanced reliability of the distribution system or extend the transmission system near the center of customer demand in Greenwich. In contrast, the proposed Greenwich Substation would timely provide the needed capacity and greatly enhance the reliability of the system as a whole.

D.9.1 No Action Alternative

Under the no action alternative, demand relief would not be achieved in Greenwich and customers throughout the Town would be at risk because the transformers at Cos Cob will reach their capacity limits, under certain contingencies, in 2017. Without additional capacity, anticipated future demand growth could not be reliably served. This alternative was rejected because it would undermine the Company's comprehensive efforts to improve the adequacy of the electric power system in Greenwich.

D.9.2 Distribution Alternative

To achieve load relief alone, the Company considered a group of component steps involving only improvements to its distribution system. Those steps comprised (1) establishing a substation expansion module adjacent to Cos Cob Substation, (2) increased transformer capacity at Prospect Substation and (3) associated enhancements to the existing duct bank systems and loop schemes. Because the Cos Cob Substation property is fully utilized, the existing facility cannot accommodate additional transformers. Consequently, Eversource would need to acquire nearby property for the substation expansion area.

The specific components of the distribution alternative are as follows:

- Establishing a new substation expansion area located in close proximity to Cos Cob Substation: installation of two-60 MVA 115- to 13.2-kV transformers and switchgear, as well as two new 115-kV underground cable connections between Cos Cob Substation and the adjacent substation expansion area;
- Modifications to Prospect Substation, within the existing fence line, including the removal of four transformers (55 MVA in total), the addition of two 47-MVA, 27.6- to 13.2-kV transformers, and the replacement of switchgear and installation of flood protection measures;
- Additions to the distribution duct bank system involving the construction of two-duct bank systems with four 1000-kcmil copper feeders each from the new substation expansion area to a location near the center of demand in Greenwich (approximately 15,000 feet for each duct bank);
- Modification to the current distribution loop schemes involving a re-design and construction of the loop schemes between the new expansion area, Cos Cob Substation, and Prospect Substation.

The Company rejected the distribution alternative because (i) the estimated cost would exceed the cost of the proposed Project while providing less capacity than the Project and (ii) the same reliability benefits achieved by the Project cannot be achieved by the distribution alternative. The cost of the distribution alternative would be approximately $54 million higher than the Project cost and achieve a capacity increase that is actually 60 MVA lower than the Project capacity increase (more money for less capacity). Moreover, the distribution alternative would not address the long term reliability needs that are fulfilled by the proposed Project by adding capacity and bringing a reliable transmission line power source near the center of the customer demand.

D.9.3 Energy Alternatives

D.9.3.1 Generation

Generation can theoretically provide capacity similar to that provided by a new bulk substation and new transmission supply lines. However, in order to provide a practical substitute for additional capacity available from a new bulk substation and transmission supply lines, the new generation must be available at the right times, in the right amounts, and at the right location. Local generation sources would help reduce the demand if they are appropriately sized, located in a place where they could offset the demand on the distribution feeder system, and operating at the times of need. Currently, there are no substations connected to existing generation facilities near the center of the customer demand in Greenwich.

The closest Eversource substations connected to existing generation facilities are Cos Cob and Waterside Substations, which are both connected to independently-owned generation facilities. Adding generating facilities at either of these substations and interconnecting them to the 115-kV transmission system would not eliminate the capacity need that the new Greenwich Substation would eliminate because the power supplied by the new units would not reduce demand on the Company's 115- to 27.6-kV transformers at Cos Cob Substation or on the distribution feeders that supply the Greenwich demand.

The independently-owned new generation would have to consist of multiple units at a strategic location that is near the center of the customer demand in Greenwich. The generation would have to meet the following requirements:

- Have a reliable source of clean burning fuel in order to comply with CT DEEP emissions requirements.
- Produce enough power to eliminate thermal overloads on the existing distribution feeders and transformers.
- Include redundant units to address the potential unavailability of a portion of the generation resulting from unit failure. The need for multiple units to provide a capacity margin is based on a recognition that all generation units

cannot be counted on to be available at all times. This requirement takes into account the ISO-NE target of 80% successful startup of fast start generation when called to be dispatched.

For sufficient generation to adequately mitigate the risk of overloads on the 115- to 27.6-kV transformers at Cos Cob Substation and to accommodate an interruption of two of the 27.6-kV distribution feeders (referred to as an N-2 design), the generation must be available (1) during peak periods, (2) any time there is a loss of one of three 115- to 27.6-kV transformers that supply the Cos Cob 27.6-kV distribution system, and (3) any time the 27.6-kV feeders experience power flows above their normal rating.

Table D-7 sets forth the minimum amount of new generation that would be required to eliminate the projected Cos Cob Substation transformer overloads and the Cos Cob Substation to Prospect Substation feeder overloads.

Table D-7 Generation Required to Mitigate Transformer and Feeder Overloads

Year	Cos Cob Transformer Overloads		Cos Cob to Prospect Feeder Overloads	
	MW Overloads *	MW Plus 20% Reserves	MW Overloads	MW Plus 20% Reserves
2017	9	11	40	48
2018	10	12	40	48
2027	23	28	49	59
2037	39	47	61	74
2047	56	68	74	89

* Overloads are based on the transformers “Remaining 22-hours” rating of 124 MVA, which is the maximum load that can be carried for 22 hours after an initial 2 hour emergency rating of 135 MVA.

At the present time, there are no large scale generation units that are located in the downtown Greenwich area and currently available (installed) or any projects in the interconnection process awaiting approval. Nor has the Company been approached for any interconnection studies on behalf of independent generators seeking to install generation in this area. The Project addresses an immediate capacity need while the development of any new generating units would most likely not meet the proposed Project's in-service date of 2017. Adding any amount of generation to any of the five 27.6-kV network feeders is not recommended due to the Company's design criteria, further limiting the available sites for new generation. In addition, generation cannot be connected to the integrated secondary network system that serves downtown Greenwich.[15]

D.9.3.1.1 Generation Interconnection Limitations

For generation to relieve Cos Cob Substation transformer overloads and distribution feeder overloads it must be interconnected to substations in the Greenwich area to reduce demand. Review of the substations in the Greenwich area reveals that the options to interconnect generation are limited.

- **Cos Cob Substation at 115-kV** - Interconnection of generation at the 115-kV bus at Cos Cob Substation would not reduce overloads on the 115- to 27.6-kV transformers because the demand is connected to the 27.6-kV distribution system. Consequently, the demand on the Cos Cob Substation transformers would remain exactly the same if generation were interconnected at the Substation's 115-KV bus.

- **Cos Cob Substation at 27.6-kV** - If sufficient space were available at Cos Cob Substation, interconnection of generation at the 27.6-kV level would avoid overloads of the 115- to 27.6-kV transformers. However, such interconnection at the 27.6-kV bus would not reduce overloads on the 27.6–kV distribution feeders because the demand is connected to the 27.6-kV distribution system near Prospect Substation. The demand on the distribution feeder system would not be reduced at all by any amount of generation connected to the 27.6-kV transmission system via the 27.6-kV bus at Cos Cob Substation.

[15] See CL&P/UI's Interconnection Standards for Distributed Generation approved by Department of Public Utility Control in Docket No. 03-01-15RE02, Decision dated April 28, 2010, and IEEE standard: IEEE 1547.6, Recommended Practices for Interconnecting Distributed Resources with Electric Power Systems Distribution Secondary Networks.

There are two existing distribution substations close to the Greenwich demand center that were reviewed for interconnecting generation: Prospect and Byram 13.2-kV Substations.[16]

- **Prospect Substation at 27.6-kV** - The Prospect Substation site is designed as a connection point for the integrated distribution network system; addition of generation at this Substation has the potential to create technical problems on the integrated distribution system, which may limit the amount of generation that could be connected to the site. In addition, physical space constraints at the Prospect Substation site would limit the actual amount of generation that could be installed at the Substation. Also, Prospect Substation is located in a flood zone and Eversource's future plan includes transferring the demand at Prospect Substation to the proposed Greenwich Substation, which would minimize any risk of flooding. Hence, adding generation at Prospect Substation is not a feasible solution to supply Greenwich demand.

- **Prospect Substation at 27.6-kV Network Feeder Level** - Adding any large amounts of generation to any of the five 27.6-kV network feeders is not recommended due to the limited available cable capacity of the 27.6-kV feeder cables. Therefore, there would be very limited available locations to site the new generation.

- **Prospect Substation Network Feeder 208 Volt Level** - Generation connected to a secondary network system, under The Connecticut Light and Power Company and The United Illuminating Company Generator Interconnection Technical Requirements, May 10, 2010, approved by the then Department of Public Utility Control (now PURA), is limited to 50 kW of inverter based equipment at any customer location.

[16] Due to the 27.6-kV system design, generation would be needed to relieve demand supplied from 115- to 27.6-kV transformers at Cos Cob Substation. The possible locations for generation to relieve this demand would be at Byram and Prospect Substations. Locating generation at North Greenwich Substation would not relieve the demand on the distribution circuits in the areas served by Prospect and Byram Substations.

- **Byram Substation at 27.6-kV level** - The maximum generation that can be connected to Byram Substation is 17 MW (this would serve the entire demand of Byram Substation). Physical space constraints at Byram Substation would limit the actual amount of generation that could be installed there.

At the present time, there are no generation units currently available (installed) or in the interconnection process. Additionally, the proposed Greenwich Substation and Line Project addresses an immediate need; development of any additional generating units would take time and thus would not timely address the existing conditions.

Even if the generation could be interconnected to either Prospect Substation or Byram Substation, the proposed Greenwich Substation and transmission lines have a lower cost and provide more capacity than any of the generation alternatives. To obtain the minimum capacity to eliminate the overloads on the Cos Cob Substation transformers and the distribution feeders by installing clean-burning generation (i.e. natural gas-fueled generation, simple cycle combustion turbine, reciprocating engine, fuel cell or combined cycle) must be located in proximity to Prospect or Byram Substations. With the size of land required to site a generation facility, the high cost of the property in the downtown Greenwich area, the cost of the generating equipment and plant construction, the costs to construct the interconnections to one of the substations, and required distribution upgrades, any generation project would be more costly than the Project. Further, renewable generation, such as large scale solar, wind or geothermal facilities, would require even larger footprints than natural gas-fueled generation and substantially higher capital costs.

Further, such generation, if available, could not achieve all the benefits that the Project would achieve. The Project would provide the following four important benefits: (1) relieve overloads on transformers at Cos Cob Substation, (2) relieve a heavily loaded non-bulk distribution substation (Prospect Substation), (3) enhance the reliability of the distribution system by providing an independent and separate source for the distribution feeders, and (4) extend the transmission system near the center of the customer demand. New generation could only provide incremental load relief benefits, but it could not provide enhanced reliability of the distribution system or extend the transmission system near the center of customer demand in Greenwich.

D.9.4 Microgrids

Eversource does not consider a microgrid as a technically-feasible alternative to the proposed Greenwich Substation. This Project is necessary to provide demand relief in 2017 and to accommodate future demand growth. A microgrid would need to have a generation source of significant size and control technologies to be able to serve the area demand and maintain reliability. Connecticut General Statutes §16-243y defines a microgrid as “a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid and that connects and disconnects from such grid to enable it to operate in both grid-connected or island mode." Connecticut’s microgrid program is designed to support critical facilities only, as identified by the CT DEEP and municipalities, in geographically dispersed communities throughout out the state.

Microgrids are an emerging approach of using small scale Distributed Generation (“DG”) to supply electric demand in a discrete local geographic area that can “island” itself from the remaining distribution system when major disruptions occur. In 2013, the CT DEEP awarded grants to assist in the funding of nine (9) microgrid projects that were dispersed throughout 8 communities in Connecticut.[17] The generation assets included in these microgrids were significantly less than the needed capacity, with projects ranging from 400 kW to 5 MWs.

The Company also participated with the CT DEEP in 2014 on a second round of microgrids throughout the State. The goal of the second round of Connecticut’s microgrid program was to deploy an additional set of microgrids, with preference given to projects that include clean, 24/7 operational DG, provide power to critical facilities, and are distributed among Connecticut’s five (5) Department of Emergency Management and Homeland Security Regions. The goal of the program is to provide an increased level of safety and quality of life in the event of a large-scale electrical outage. In 2014,

[17] There are no proposed microgrid projects slated for Greenwich in the CT DEEP’s funding cycles.

the CT DEEP awarded grants to assist in the funding in the City of Milford (0.6 MW) and the City of Bridgeport (1.4 MW). Eversource will also participate with CT DEEP on a third round of microgrid program funding in 2015.

Given the state of available technology the distributed generation capacity needed is insufficient and not practical to eliminate the risk of overloads on the transformers, therefore this option was removed from further consideration.

D.9.5 Demand Side Management Alternatives

Energy efficiency resources are passive and active demand resources that result in demand reductions through conservation of energy use and the addition of distributed generation at the source of the demand. Passive demand resource programs typically target increasing efficiency for equipment and often include incentives to replace older less efficient equipment with newer more efficient equipment. The improvement in efficiency means the new equipment will provide the same function with less energy consumption, all else equal. Likewise, an energy efficiency program may provide for more efficient operation of existing equipment through better management or maintenance of that equipment. Active demand resources are controllable resources that respond to particular indicators such as demand levels, dispatch signals, or prices, to activate. These demand resources are described in more detail below. However, because such resources provide only limited, incremental effects, they could not be a comprehensive alternative to the demand relief that the new substation would achieve.

D.9.5.1 Passive Demand Resources

Passive demand resources are technologies that may range from relatively simple residential programs (e.g., Energy Star appliances, high efficiency LED bulbs, improved heating and cooling systems) to complex manufacturing processes at industrial facilities (e.g., high efficiency cooling/refrigeration or variable speed motors). These passive demand resources are assumed to provide system benefits 100% of the time.

Eversource offers a number of energy efficiency programs to both its residential and commercial customers. Eversource's efforts at conservation and demand management also include incentive programs through the CEEF. Table D-8 provides net annual kWh, lifetime kWh, peak summer kW reductions representing the savings installed measures would provide, and includes the number of projects implemented.

Table D-8 Energy Efficiency Data for Town of Greenwich

Energy Efficiency	2009	2010	2011[18]	2012	2013
Annual MWh	1,523	1,801	5,448	3,239	2,176
Lifetime MWh	20,730	24,318	66,373	38,229	26,220
Summer Peak MW*	0.331	0.323	0.689	0.563	0.293
Number of Projects	3,056	1,517	1,930	567	445

*Summer Peak represents incremental savings achieved in the respective years.

Because projections for peak load in Greenwich reflect all prior energy efficiency measures, as well as anticipated future energy efficiency measure, of the limited incremental effects of energy efficiency measures, such measures could not provide the demand relief and reliability improvements that the proposed Greenwich Substation would provide.

Projections of peak demand in Greenwich account for the savings achieved by energy efficiency measures installed in prior years. Consequently, to provide energy savings to reduce its peak demand in future years, the electric service customers in Greenwich would need to implement new energy efficiency measures beyond those already reflected in the projected peak demand. Because of the limited, incremental effects of energy efficiency measures, there is no basis to reasonably conclude that such new installations of energy efficiency measures in Greenwich could provide the demand relief and reliability improvements that the proposed Greenwich Substation would provide.

[18] In 2011, there was an extensive lighting project for one very large commercial customer in Greenwich that contributed to significantly higher savings.

D.9.5.2 Active Demand Resources

Active demand resources consist of generation that is located on the customer's side of the meter (and thus the generation reduces the demand on the electric system when it is turned on) or demand that a customer agrees can be interrupted when necessary. In either case, the resource must be "dispatchable," that is, activated when called upon. Active demand resources could reflect resources that would be located at an end-use location and could serve as either a primary or supplementary source of power for that location. Generation produced from these facilities would reduce the overall demand for generation and hence reduce the demand for electric services.

Under active demand resource initiatives, certain industrial and commercial facilities implement measures, on a voluntary basis, to reduce the demand on the electric grid during peak periods. Active demand resources are not limited to a particular type of technology or fuel and may include combustion turbines, small biomass based generators, fuel cells, wind turbines, solar power and photovoltaic systems, etc. Further, active demand resources systems may operate independently or be connected to the electrical distribution grid.

Active demand resources can also function as a microgrid, which is a localized grouping of electricity generation, energy storage, and demand that could normally operate autonomously from the traditional centralized regional grid. Microgrid generation resources can also include fuel cells, wind, solar, or other energy sources. The multiple dispersed generation sources and ability to isolate the microgrid from a larger regional power grid could provide electric power to small demand pockets.

D.9.5.2.1 Distributed Generation

In contrast to microgrids, which work together as a group, DG would include smaller units, located closer to areas of higher demand to provide local redundancy. The addition of properly sized, properly located, available, and dispatchable DG (interconnected to distribution feeders or customer-side), can help mitigate the increasing pressure on local electric distribution facilities from demand growth. Generally speaking, DG might assist in reducing some demand on the substation and feeders presently serving Greenwich, however, not to the levels needed to eliminate the need for the proposed Greenwich Substation.

For DG proposals to reduce demand:

- an adequate number of generators are needed;
- reliable interconnections to the distribution network must be established; and
- integration with multiple power supply sources must be carefully planned.

In addition, protective devices on distributed generators and Eversource's distribution feeders would be required. Currently, there are six (6) DG units (0.41 MW in total) fueled by natural gas and 102 photovoltaic units (1.05 MW in total) installed in Greenwich. Eversource is aware of an additional 0.4 MW of intermittent photovoltaic units that are planned in Greenwich.

D.9.5.2.2 Real-Time Emergency Generation

Real-time emergency generation resources are similar to active demand resources, which are responsive to a particular event. Often, real-time emergency generators are specific resources that are activated in instances of system outages affecting the location and are used for back-up generation. Currently, these types of resources are only activated during ISO-NE Operating Procedure #4 – Action 6 during a Capacity Deficiency. Thus, they are only operated when needed and are not otherwise available. At this time, there is one Demand Response generator at Fairview Country Club in Greenwich capable of providing, in the aggregate, 200 kW of demand response. Therefore, these types of units are not considered a viable alternative to the Project.

Reliance on demand resources must be self-sustaining through time and account for demand growth. In such a scenario over time, the activation of active demand resources would become more frequent and at higher kW levels. As demand grows over time, there may be a risk that Greenwich would be exposed to significant attrition of active demand resources by the "fatigue" of being called on extensively and repeatedly in hot weather to decrease demand.

Under the Company's ISO-NE Forward Capacity Market Participation, interruptible demand contracting is based on multi-year agreements; however, the parties who agree to service interruptions may leave the Demand Resource programs with 90-day notice and no financial penalties or exit fees. The market changes being undertaken at ISO-NE are also of concern. Active demand response will be eliminated as of June 2017 and will be integrated as actual generation based customers who are required to bid into the energy market daily. The assumption is that some Real-Time Emergency Generation and Real-Time Demand Response customers for Eversource and other third party customers may not be willing to participate in the daily energy market.

D.9.5.2.3 Summary of Active Demand Resource Program Results

Measures implemented under active demand resource programs reduced demand in 2013 in Greenwich are presented in Table D-9.

Table D-9 2013 Reduced Demand by Programs - Greenwich

Programs	Reduced Demand (MW)
Energy Efficiency	0.3
Distributed Generation	0.4
Photovoltaic	1.1
Emergency Generators	0.2
Total	**2.0**

These results demonstrate that active demand resource programs in Greenwich only provide marginal reductions in demand; such reductions cannot eliminate the need for the proposed Greenwich Substation. In addition, all of these programs are already accounted for in the actual load for Greenwich and the Company's projections for future load in the Town.

D.9.6 Contracted Load Curtailment

After 2017 if contingency events occur under peak demand conditions, in the absence of the proposed Greenwich Substation, Eversource would require demand to be curtailed during the peak demand to forestall overloads of the transformers at Cos Cob and sustain the operability of the electric system in Greenwich. This would mean that contracted load curtailment could include measures where it would be necessary for the Company to interrupt electric service to customers and to do so without notice or preparation.

Factors to consider in developing contracted load curtailment alternatives include:

- The frequency and timing of the program requests to curtail would be affected by contingencies (e.g. faults on the 27.6 kV system) and such curtailment requests must be implemented instantaneously;
- The duration of load interruption that would be needed given demand-cycle characteristics and the difficulty of restoring service in a relatively short time period;
- The duration of time that the affected system components could be out of service;
- The number of days or hours in the summer season that the potential for demand interruptions would exist, and
- The demand characteristics of affected customers and the potential impact to the health and safety of customers.

Currently, there are no Eversource customers in Greenwich participating in the Company’s load curtailment program with the ability to curtail demand during peak demand periods when called upon. Accordingly, contracted load curtailment is not a viable system alternative to the proposed Greenwich Substation.

D.9.7 Transmission Alternatives

The identified need for an additional bulk substation in Greenwich, one that is located near its current highest load concentration, to reduce overloads on Cos Cob Substation transformers and 27.6-kV distribution feeders could not be resolved with new or upgraded transmission facilities alone. Adding a new or upgrading an existing transmission line would not add the additional source of capacity necessary to meet the existing and growing demand that the new Greenwich Substation will provide.

D.9.8 Alternatives Summary

Any of the above alternatives individually, or in combination, have the potential to provide some limited demand relief. However, they are not currently available to meet the immediate demand relief needs that the Project would address. Alternatives, including distribution alternatives, energy alternatives and demand side management alternatives, even if available, in the right amounts and at the right locations, do not present practical alternatives that provide the immediate demand relief needed and the ability to reliably accommodate future demand growth. And, such alternatives would not increase the reliability of the system with a new reliable capacity source sufficient to supply anticipated customer demand for the long-term future or extend the transmission infrastructure closer to the demand center. The proposed Greenwich Substation would provide immediate demand relief, the means to accommodate future demand growth in a timely manner, and a more reliable system by extending the transmission system near the center of the customer demand in Greenwich.

E. Description of the Project

The Project consists of a new 115-kV substation and underground transmission supply lines (comprising two separate circuits) that would extend approximately 2.3 miles from Cos Cob Substation on Sound Shore Drive to the Greenwich Substation. The Project is necessary to provide immediate load relief to the electric distribution supply system in Greenwich by establishing the new substation near the center of the customer electrical load and to avoid overloads on Eversource system equipment.

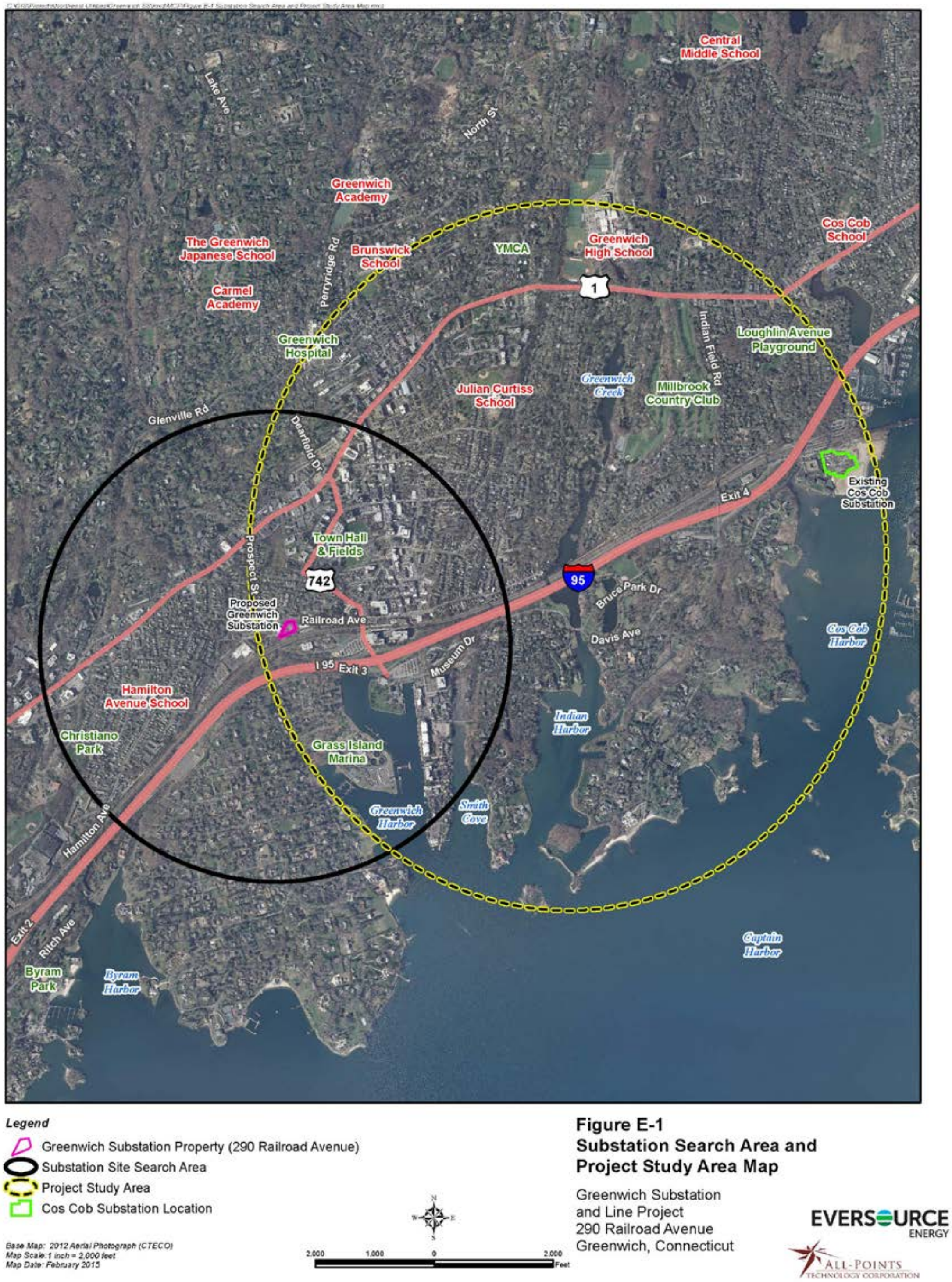
The Company's approach for identifying the location for the Greenwich Substation and best routes for the necessary transmission supply lines included a determination of conditions within a defined geographic "Project Study Area," evaluation of site selection and route identification criteria and objectives, and consideration of input from Town officials.

E.1 Geographic Boundaries of the Project Study Area

As noted in Section D, the Company identified a need for a new substation and transmission supply lines in Greenwich and found that such need would be met by a 115-kV substation and 115-kV underground lines between the new Substation and Cos Cob Substation. The Company initially defined a geographic Search Area for the Substation and another for the Project Study Area, and then identified and analyzed potential substation sites and transmission line routes within these areas. The Substation Search Area focused on the part of Town with the highest customer demand and where increased substation capacity is needed (i.e., the load pocket), which was north of I-95.

In formulating the Project Study Area, the Project team took into consideration that the shortest routes between the new and existing substations would typically minimize environmental and community impacts, as well as cost. As a result, the Company generated potential routes that were between two and three miles long. Figure E-1, *Substation Search Area and Project Study Area Map*, depicts the Company's areas of concentration for the Substation and the transmission supply lines.

Figure E-1 Substation Search Area and Project Study Area Map



Once the Substation Search Area and Project Study Area were determined, the Company began its analysis of potential substation sites and transmission line routes.

E.2 Substation Site Selection Objective and Criteria

The Company considered engineering, environmental, community and economic factors in conducting its search for a potential substation site in Greenwich. The objective was to select from among those viable candidates the site that would be technically, environmentally and economically practicable and best meet the Project goal to address the need.

The Company's primary selection criteria for locating a new substation are:

- Proximity to customer demand (or "load pocket");
- Proximity to existing distribution feeders;
- Proximity to existing transmission electrical circuits;
- Proximity to public water supply, watershed and aquifer areas;
- Ease of access;
- Zoning and adjacent land use constraints;
- Earthwork requirements;
- Suitability of a site to accommodate the substation; and,
- Minimizing effects on the environment.

E.2.1 Greenwich Substation

The Substation would be located at 290 Railroad Avenue (the "Property" or "Site") and would be compatible with existing commercial land uses in the vicinity, including warehouses, an electric substation (Eversource's Prospect Substation), utility storage yard, and active rail line. The Property is identified by the Greenwich Assessor's Office on Map 01 as Lot 2389/S, and is located within a General Business zone. The Property was leased in 1971 by the Company as a potential location for a future substation. This property lease (with future option to purchase) has provided the Company the flexibility to transition to Company use of the property based on the timing of the need for distribution system improvements in Greenwich.

Since 1971, the Company has subleased the 0.81-acre Property, which is currently improved with a commercial building and parking area. To accommodate the new Substation, the existing commercial building located on the Property would be removed as part of the Project.

The Greenwich Substation would be supplied from two 115-kV transmission lines originating from Cos Cob Substation on Sound Shore Drive. The two new transmission supply lines would enter the Greenwich Substation via underground pipes and terminate at gas insulated switchgear equipment, which would be housed in a building along Railroad Avenue measuring approximately 120 feet by 50 feet and standing 35 feet tall. The Gas Insulated Substation ("GIS") building would house six (6) 115-kV circuit breakers and associated disconnect switches, protective relay and control equipment as well as the battery and charger associated with the transmission equipment. For GIS substation yards similar to that proposed in Greenwich, the Company typically uses a corrugated metal building enclosure and chain-link fence topped with three strands of barbed wire. Based on the location of the substation and the proximity to the commercial center of the Town, an alternate design has been incorporated for this Project. The GIS building would include a concrete panel façade and the Substation yard would be surrounded by an eight-foot high, wrought iron-style fence for security.

In addition, the Substation yard would also be outfitted with three 115-kV circuit switchers with integral disconnect switches and three 60-Megavolt-Ampere ("MVA") power transformers that would step down the voltage from 115 kV to 13.2 kV. The three 60-MVA transformers would contain insulating (not containing PCBs) mineral oil. The transformers would be installed on foundations and each would have secondary containment sufficient to contain 110% of the volume of mineral oil in the transformer. Periodic inspections of the containment area would be performed by Eversource personnel to verify proper functioning of the containment systems. One metal switchgear enclosure (measuring approximately 108 feet long, 24 feet wide and 14 feet tall) would also be installed to house the switching equipment, relaying and control equipment for the 13.2-kV distribution feeders. A 12-foot high pump house (50 feet long by 12 feet wide) that supports the high pressure fluid filled ("HPFF") transmission cables would be placed in the southwest corner of the Site, adjacent to Field Point Road.

The Substation would be accessed by a new approximately 20-foot wide, gated entrance from Field Point Road. The Substation yard would be covered with a trap rock surface. Lighting would be installed within the Substation yard to facilitate work at night under emergency conditions and during inclement weather. The Substation would have low-level lighting for safety and security purposes consistent with the lighting in the area. Two 65-foot tall lightning masts would also be installed.

Details of the substation design are presented in Appendix A (Greenwich Substation Site Plan Drawings).

Figure E-2, *Proposed Greenwich Substation Map*, depicts the proposed lay out of the Substation on the Property. A depiction of the proposed Greenwich Substation is provided in Figure E-3, *Proposed Greenwich Substation Rendering*.

E.2.1.1 Substation Service Life

The Substation equipment and supporting infrastructure would have a service life of approximately 40 years.

E.2.1.2 Distribution Feeders

Cables for each distribution feeder would exit the Substation property via underground power duct bank systems. There would be three (3) duct banks exiting the Substation to accommodate the Project and allow for the addition of future feeders. Initially, nine (9) distribution feeders will be energized and connected to the existing distribution system located on Railroad Ave and Prospect Street. The feeder ducts would be constructed with six-inch polyvinyl chloride (“PVC”) Type Schedule 40 or direct burial (“DB”) conduit encased in concrete.

The new distribution power duct system and lines would have an estimated service life of approximately 40 years. The power duct system would be capable of supporting a total of eighteen feeders to accommodate future load.

Figure E-2 Proposed Greenwich Substation Map

Figure E-3 Proposed Greenwich Substation Rendering

Legend

Subject Property Boundary

Base Map: 2012 Aerial Photograph (CTECO)
Map Scale: 1 inch = 100 feet
Map Date: February 2015

100 50 0 100 Feet

Figure E-3
Proposed Greenwich Substation Rendering

Proposed Greenwich Substation
290 Railroad Avenue
Greenwich, Connecticut

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E.2.2 Substation Site Selection Process

In 2012 and 2013, the Company's Real Estate staff, aided by a local real estate broker, conducted site searches for a potential substation site in Greenwich. The search area boundaries were determined by the Company's Distribution Design group and encompassed the load pocket. The Company's owned and/or leased sites were also included in the search. New sites under 0.5 acres were rejected, as well as those parcels that did not have at least two sides with a minimum 150 feet property line depth (dimensions estimated to accommodate various substation design scenarios). One parcel mentioned by the Town of Greenwich during preliminary discussions was also considered. The Company's Real Estate staff conducted an additional site search in January 2014 to determine if any potential new candidate properties had become available.

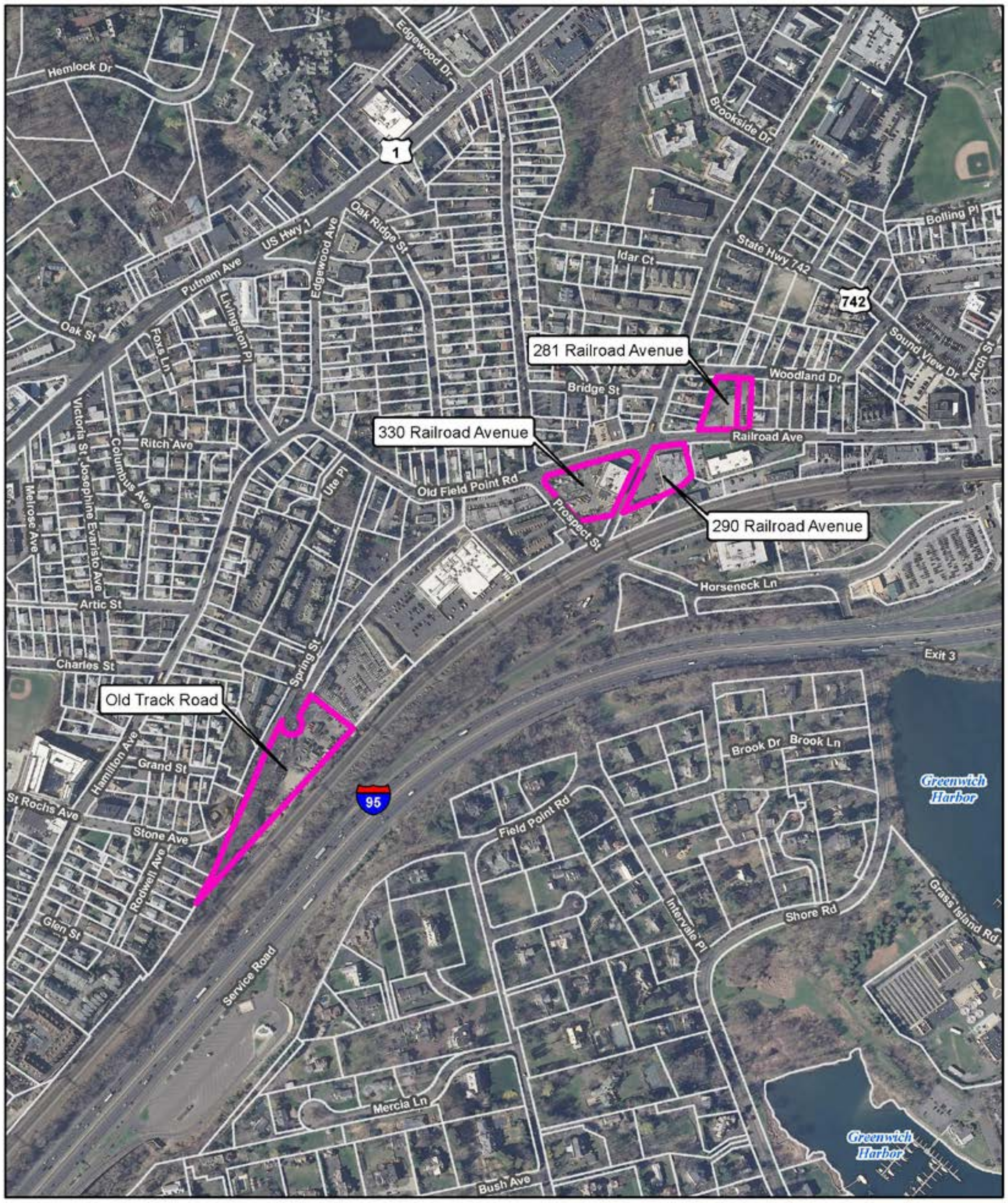
Based on the candidate site information provided by the Company's Real Estate staff and a cross functional Site Selection Evaluation Team's (Team) review of these and other potential candidate sites within the Project Study Area, four substation location sites were ultimately identified for further consideration and were evaluated by the Team prior to 2014. No new feasible candidate sites resulted from the January 2014 site search.

In addition to the criteria introduced in Section E-2, the Company also considered other relevant factors including community impacts, cost, construction complexities, timing and the ability to accommodate additional equipment in the future, if necessary.

E.2.3 Alternative Sites Evaluated

During its site screening process, the Company reviewed numerous properties and ultimately identified four potential site locations for further evaluation. For each of the four sites, the Company conducted a more detailed evaluation, assessing each site using the selection criteria. These sites are discussed in order of preference and depicted on the following Figure E-4, *Alternate Sites Evaluated Map*.

Figure E-4 Alternate Sites Evaluated Map



Legend

Alternate Sites Evaluated

Approximate Parcel Boundary (CTDEEP)

Base Map: 2012 Aerial Photograph (CTECO)
Map Scale: 1 inch = 500 feet
Map Date: February 2015

300 150 0 300 Feet

Figure E-4
Alternate Sites Evaluated Map

Greenwich Substation
and Line Project
Greenwich, Connecticut

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E.2.3.1 290 Railroad Avenue (the Site)

This is a commercial property, zoned as GB ("General Business") that the Company has held under a long standing lease (greater than 40 years). The Company has an option to buy the Property from the owner that may be exercised in the year 2021. The Company has determined that a substation could be built on this site using GIS technology.

Key features of this Site are:

- This parcel is located within the customer load pocket.
- This Site provides optimal connections to existing distribution feeders and affords two routes for distribution via Railroad Avenue and Field Point Road.
- There is direct access to the Site from Field Point Road and Railroad Avenue.
- The Property is zoned General Business, is currently developed with an existing commercial building and surrounded by other commercial properties and the railroad.
- The diamond-shaped parcel is 0.81 acres in size, has no physical encumbrances and is capable of accommodating the necessary substation components.
- No wetlands or watercourses are located on the Property and it is located outside both the 100-year and 500-year flood zones. A small portion of the Property (approximately 1,120 square feet) is located within the Coastal Boundary.

Site Summary: This Site satisfies the need for proximity to the load pocket and to existing feeders. It is a commercially-zoned property that is surrounded by other commercial properties and transportation infrastructure, so a substation on the Site would be compatible with the existing land uses in the immediate vicinity. The Site's size and shape are sufficient to properly configure the substation to fit within the Property boundaries and, after removal of the existing building, no physical encumbrances exist that would impede development. The Site is level and would require minimal earthwork. No wetlands or watercourses exist on or are proximate to the Property and its distance from nearby residences would provide adequate buffer for noise emanating from substation equipment.

E.2.3.2 281 Railroad Avenue (the Alternate Site)

This is a commercial property, zoned as General Business, that is owned by Eversource and is currently used as a ground storage area for materials (pole yard) and previously for additional parking for personnel working at the Greenwich Area Work Center, located across the street at 330 Railroad Avenue. The Company has determined that this site could be a candidate site using GIS technology, however, the property size combined with the location and orientation of the substation equipment would likely cause the substation to exceed State and local noise regulations/ordinance at the property line. At a minimum, Eversource would need to acquire abutting properties to comply with the applicable noise regulations.

Key features of this site are:

- This property is located within the customer load pocket.
- There are existing distribution feeders along Railroad Avenue. This property provides two routes for distribution feeder egress, via Railroad Avenue and Woodland Drive, respectively.
- There is direct access from Railroad Avenue and Woodland Drive.
- The property is owned by Eversource and is commercially developed. Commercial and residential properties are located on the east and west sides. Residential properties are located across Woodland Drive to the north.
- The property is level and there would be no major earthwork or clearing requirements for development on this property. The Company currently uses the property for surface storage and parking.
- This property is close to residences and an inadequate buffer currently exists for noise emanating from certain substation equipment.
- The property is 0.75 acre in size and encumbered by two utility easements;
- The combination of this property's current configuration and the existing utility encumbrances do not allow adequate space to accommodate a substation without the acquisition of additional properties.
- This property is located outside of the 100-year and 500-year flood zones, and no wetlands or watercourses are on the parcel.
- Locating a substation on this property could result in noise impacts to abutting and nearby residences.

Alternate Site Summary: This property is proximate to the load pocket and existing feeders, but is not the preferred location for a substation, as it would require purchasing additional property currently used for residential or commercial purposes to properly configure the facility and meet acceptable noise regulations. Being closer to residential neighbors than 290 Railroad Avenue, regardless of the acquisition of one or more abutting properties, development of this property with a substation would require substantial noise mitigation to adequately address sound levels. Depending on the final substation design, three to four additional properties would need to be acquired for sufficient noise attenuation from the substation transformers and to provide landscaping and additional screening from substation equipment. This site is being proposed as the alternate site because it meets most of the evaluation criteria and is an environmentally, technically and economically practicable alternative, as compared to the remaining sites evaluated.

E.2.3.3 330 Railroad Avenue

This commercial property, zoned as General Business is owned by the Company [19] and currently includes the Company's former Greenwich Area Work Center building and Prospect Substation. The Company determined that this site was not a viable option for the new substation because it contains too many impediments that would impact Project cost and schedule, even if these constraints could be effectively managed. The site also has some constructability uncertainties that could put the Project schedule at risk. A majority of the site is located within the 500-year flood plain and would require additional design features to raise the substation elevation.

Key features of this site are:

- This property is located within the customer load pocket.
- There are existing distribution feeders along Railroad Avenue. This property provides two routes for distribution feeder egress, from Railroad Avenue and Prospect Street, respectively.

[19] This property was evaluated as a site for the proposed Substation. However, the Company determined that other evaluated properties are more suitable for the Substation than this property. In 2014, the Company offered this property for sale as part of its facility consolidation plan.

- There is direct access to this property from Field Point Road, Railroad Avenue and Prospect Street.
- The property is commercially developed with the building for the Company's former Greenwich Area Work Center, which occupies the east side of the parcel and Prospect Substation, an existing distribution substation on the west side. The substation will not be transferred with the sale of the property and must remain in service during and after construction of the new Greenwich Substation. Two major obstacles exist on the parcel, including Horseneck Brook, which flows beneath the property within a 16-foot wide culvert, and a municipal sanitary sewer easement (containing a 15-inch sewer pipe) located adjacent to the Brook.
- The property is 1.27 acres in size and roughly triangular in shape. Although the former Greenwich Area Work Center building could be removed, nearly half of the property (approximately 0.6 acre) is currently unusable due to the presence of Prospect Substation, the Horseneck Brook culvert and the sewer pipe. In addition, several months of dismantling work would be required when compared to 290 Railroad Avenue because of the time necessary to relocate relaying equipment to Prospect Substation prior to demolition of the building.
- The property is bisected by Horseneck Brook. Built in 1934, the subgrade culvert that encloses the brook, which extends beneath a portion of the substation yard, is not designed to withstand the weights of heavy loads that would be required during construction. Access over the culvert would be essential during construction to move equipment into and out of the substation. Eversource could not install equipment foundations on top of the culvert, and no room would be available on the property for an alternate construction access. Permanent structural improvements (replacement or reinforcement) to the culvert would be required to allow for construction and for future access for maintenance and repairs. The culvert could be replaced, reinforced or left in place and bridged over. However, that activity would present significant challenges. Given the culvert's close proximity to the existing energized substation, work associated with the culvert would increase safety and reliability risks, limit access for emergency response and extend the construction period by the extra time needed to stage the work necessary to protect worker safety.

- In order to accommodate a new substation, the underground municipal sewer main would need to be relocated off the site before substation construction could commence.
- If the physical challenges could be designed around, the space constraints would necessitate long runs of overhead bus work (nearly three times the length required at 290 Railroad Avenue) and substantial support trusses. This arrangement would create additional clearance, safety and reliability concerns, especially during any work on the sewer or culvert, portions of which would be directly beneath the energized bus. In addition, it would increase cost.
- The parcel is located within the 500-year flood zone associated with Horseneck Brook.

Summary: Although this property is proximate to the load pocket and existing feeders, limited available space and other site constraints, including Horseneck Brook and the associated culvert, the municipal sewer main and the floodplain area would introduce development complexities that would create risks to the construction schedule and to the safe operation of a substation if left in place. Design elements could conceivably be incorporated to work around these physical impediments; however, development at this property would involve a significant amount of risk for constructing, operating and maintaining a new substation.

E.2.3.4 Old Track Road

This is a privately owned commercial property, zoned as General Business that was suggested by the Town as a potential substation location.

Key features of this site are:

- This parcel is located within the customer load pocket.
- The length of the distribution feeders would increase substantially because all of the feeders would have to be extended to this property.
- There is no direct access to public roads, so easements would be required for access/egress and for both distribution and transmission electrical conduits. Although Stone Avenue (northwest of the parcel) is a public road, Town

ownership ends before abutting the Old Track Road property. Access via Stone Avenue would require purchasing land from the owner and access may not be feasible due to a significant elevation change on that property. Similarly, Spring Street (to the northeast) is also a public road, but Town ownership ends before abutting the Old Track Road property.

- The property is generally level. There would be limited earthwork required.
- The parcel abuts a residential area with homes less than 100 feet away.
- The parcel is 2.49 acres in size, with adequate room for a substation on the easternmost portion of the property. The property is a narrow strip of land, triangular in shape, with the western half of the property being insufficient to properly configure a substation. There is an existing gas easement in favor of Connecticut Natural Gas extending across the property, further limiting the available space.
- The parcel is zoned commercial, but several residential homes are located immediately north of the property. The Metro-North railroad ("MNRR") is located along the southern boundary of this parcel.
- The property is located outside flood zones, and no wetlands or watercourses are on or adjacent to the parcel.

Summary: This property is proximate to the load pocket, but not to existing distribution feeders. Although this parcel is of sufficient size, there are limitations with the property because additional easements would be needed to use the privately-owned Old Track Road for access and installation of electrical conduits. In addition, this property is unfavorable due to its proximity to residential housing to the north, as compared to the proposed Site. Future expansion of additional feeders would require extending the existing distribution system across the Horseneck Brook culvert, which would be costly.

E.2.4 Site Evaluation Summary

A comparison of the evaluating criteria is provided in Table E-1.

Table E-1 Site Evaluation Summary

Site Selection Review Criteria	**SITES EVALUATED IN GREENWICH SUBSTATION SEARCH AREA**			
	290 Railroad Ave	281 Railroad Avenue	330 Railroad Avenue	Old Track Road
Proximity to Customer Load	**Within load pocket**	Within load pocket	Within load pocket	Within load pocket
Proximity to Existing Feeders	**Existing distribution feeders in street**	Existing distribution feeders in street	Existing distribution feeders in street	0.25 mile extension of distribution feeders needed via new easement
Proximity to Existing Transmission Circuits	**2.31 miles**	2.33 miles	2.3 miles	2.6 miles
Ease of Access	**Direct access from Field Point Road**	Direct access from Railroad Avenue and Woodland Drive	Direct access from Railroad Avenue, Field Point Road and Prospect Street	Limited vehicular access; additional/expanded access rights would be required from one or more landowners
Size (acres)	**0.81**	0.75	0.92*	2.49
Consistency with Existing Land Uses	**Commercial Neighbors**	Residential Neighbors	Commercial Neighbors	Residential Neighbors
Earthwork requirements	**Level terrain - limited grading needed**	Level terrain - limited grading needed	Significant earthwork and grading needed	Level terrain - limited grading needed
Site Constraints	**Existing building**	Multiple easements require relocation - would likely need to purchase adjacent property to meet noise regulations at the property line	Existing building, distribution substation, sanitary sewer line and culvert**	Gas easement
Environmental Effects	**None**	None	In 500-year Floodplain; Horseneck Brook flows under property in culvert	None

* Does not include 0.35 acre occupied by the existing distribution substation.

** The time required to locate an alternate route (working with the municipality) and then move the municipal sanitary sewer off of the property, in addition to undertaking the supplemental earthwork and design modifications required to construct the substation in the 500-year flood plain, would likely delay project schedule and jeopardize facility's target in-service date.

E.3 Cos Cob Substation Modifications

The Greenwich Substation would be supplied from two new 115-kV transmission lines originating from Cos Cob Substation on Sound Shore Drive. The Project also requires expansion of Cos Cob Substation for the installation of new equipment to support the underground transmission lines and provide for safe and proper operation. The Cos Cob Substation fence would be extended approximately 90 feet to the south to accommodate the expansion and new equipment installation, including:

- Three (3) 115-kV 3,000 Amp-rated circuit breakers with associated foundations;
- Seven (7) manually operated disconnect switches with associated foundations;
- Two (2) motor operated disconnect switches with grounding switch with associated foundations;
- Six (6) instrumentation potential transformers - 3 per underground line position with associated foundations;
- Four (4) sets of cable termination structures with associated foundations;
- Three (3) bus support structures;
- One (1) A-Frame line structure;
- Underground conduits and duct banks for communication and control cables, and underground lines and bus sections;
- Relays, and, control and communication equipment to be installed within the existing control enclosures; and,
- Bus expansion.

To accommodate the new equipment installation at Cos Cob Substation, the following equipment would be removed:

- Two (2) A-Frame line structures and 1 H-Frame structure;
- Strain overhead bus sections;
- One (1) line trap; and,
- One (1) manual disconnect switch.

Plan and Sections schematics depicting the proposed modifications (additions and removals) are provided in Appendix B (Cos Cob Substation Site Plan Drawings).

E.4 Transmission Line Route Identification and Route Selection Criteria

Overhead and underground routing alternatives were identified and evaluated taking into consideration system benefits (reliability and operability), potential property impacts, environmental impacts, engineering (technical) feasibility, and costs. For the Project, the Company applied the following set of route selection criteria for transmission lines:

- Comply with all statutory requirements, regulations and state and federal siting agency policies;
- Achieve a reliable, operable, constructible and cost-effective solution;
- Maximize the reasonable, practical and feasible use of existing linear corridors (e.g., transmission lines, highways, public roadways, railroads, pipelines);
- Minimize the need to acquire property;
- Minimize adverse effects to environmental resources;
- Minimize adverse effects to significant cultural resources (archaeological and historical);
- Minimize adverse effects on designated scenic resources;
- Minimize conflicts with local, state and federal land use plans and resource policies; and
- Maintain public health and safety.

The route identification criteria created the framework for the Company to identify an appropriate route for interconnecting the new substation on Railroad Avenue with Cos Cob Substation. Given the density of existing development and land uses within the Project Study Area, the Company focused its analysis of route options on the use of existing right-of-way (“ROW”), including public roads, existing utility corridors, the MNRR, and Interstate 95 (“I-95”), along with some parking lots and private/public lands in locations where off-ROW properties were needed to complete a potential route option.

E.4.1 Transmission Line Routing Selection Analysis

The Company began the route selection process by evaluating overhead, underground, and marine routes within the Project Study Area. The Company initially identified 12 potential route options with several variations. For these potential route alignments, the

Company conducted additional screening analyses involving further field reconnaissance, as well as consideration of baseline environmental data compilation and review. The Company requested and considered input from Town officials in the route selection process.

Overhead v. Underground

Overhead routes were eliminated from further consideration based on the results of the Company's analyses, in particular the physical constraints posed by the combination of existing dense residential and commercial development, the MNRR corridor and the I-95 corridor, and associated community impacts.

Selection Criteria

The following additional identification criteria are relevant when evaluating underground routes:

- **Constructability** - Measures the complexity of construction and impact on schedule. Such complexities include trenchless installation techniques (e.g. directional drilling or pipe jacking) requiring specialized equipment during construction, anticipated work hour restrictions and space constraints. Sharp changes in direction for the duct bank may require additional vaults and splices, as well as long radius bends that can require easements.

- **Existing Utilities Impacts** - Depending on the route, the presence of existing utilities will create conflicts with the alignment of the proposed duct bank installation. Some existing utilities may require relocation or represent challenging geometric requirements for locating portions of the duct bank. External heat sources such as existing electric circuits that may negatively impact the ampacity rating of the line must also be considered in the final design.

- **Operations and Maintenance** - Routes were evaluated based upon the operating performance of the underground transmission lines in terms of ampacity and the proximity to other underground transmission lines. For maintenance purposes, routes that site splice vaults[20] in readily accessible locations and minimize the total number of vaults are more favorable.

- **Permits, ROW, and Easements** - Route alternatives that avoid certain permitting requirements, such as those associated with the railroad, ConnDOT or Army Corps of Engineers, can provide project cost and schedule benefits. The actual permits required and ease of obtaining these permits vary for different route alignments. Route alternatives that require additional easements and/or property acquisitions increase the overall project cost, could increase the potential for delays in the project schedule, and potentially increase effects on abutting land uses.

- **Surface Disruption Impacts** - Surface disruptions would be limited to only areas of public ROW and on properties where temporary construction and permanent easements are required. The location, size, depth, and duration of such surface disruptions would vary depending on the final route alignment, the construction method, line and casing materials, and overall site constraints. Route alternatives presenting greater surface disruptions may also increase inconvenience to the public.

- **Scheduling Impacts** - Several routes within the Project Study Area involve limitations with regard to schedule. Work in residential areas might only be permitted during day-time hours, and further restricted on weekends and holidays. Some construction activities could be subject to restrictions imposed by the MNRR and/or ConnDOT.

- **Length of Route** - Generally, the shorter and straighter a route, the lower the route installation cost, due to less material and less time for construction. A shorter route would also equate to fewer surface disruptions and conflicts with existing utilities. When comparing routes that have major differences in length, the number of splice vaults required can increase complexity, add more materials and result in significant additional costs.

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[20] A splice vault is a buried enclosure where underground line ends are spliced together.

- **Environmental Resources** - Alignment of underground lines along roadway ROW may pose potential environmental issues, such as excavation through areas of contaminated soils or groundwater; traffic congestion; difficult crossings of watercourse and wetlands that the roads traverse via bridge; and disturbance to vegetation and land uses adjacent to roads (due to construction staging, heavy equipment operation, etc.). Selecting a route that avoids or minimizes adverse environmental effects is preferred.

- **Cost** - The route with the lowest construction cost would have greater weight and significance in selecting the recommended route. Cost must always be balanced with several factors, such as environmental impacts (including traffic and noise), effects on local business and other impacts.

- **Proximity to Public Services** - Route alternatives that avoid public services such as police stations, fire stations, and hospitals will be more favorable, from a construction point of view, as measures to maintain around the clock access to such places will not be needed.

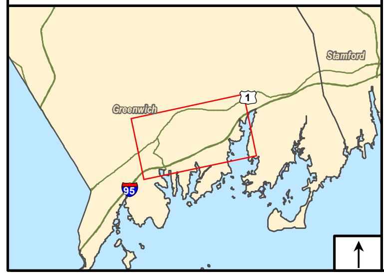
Some of the underground route options initially identified by the Company were quickly found to be impractical because of overriding environmental, community, or engineering constraints. A route along I-95 was eliminated as a viable alternative because ConnDOT policies limit the longitudinal occupation of interstate corridors unless no other practical option exists. In addition, the I-95 corridor is raised above grade in portions of the Project Study Area, or has both limited land available outside of the highway (where at grade) and difficult topography. Based on past project experience, direct access to work areas and work hours would be limited.

Similarly, the MNRR corridor does not present a viable overhead or underground route for the extension of the transmission lines due to the number of easements and acquisitions, potential conflicts with the various land use developments that abut the railroad, and construction obstacles associated with various above- and below-grade railroad crossings. Regardless of the route alternative, at least one crossing of the railroad corridor is required to install a transmission line from Cos Cob Substation to the Greenwich Substation. During its evaluation, the Company focused its efforts on minimizing the length of the MNRR ROW required for the Project due to limited space. Additionally, a Greenwich sewer main is located within a portion of the MNRR corridor.

The Company also evaluated a marine line route option through Cos Cob Harbor and Long Island Sound. Spanning over four miles in length, this option was not deemed feasible due to the significant environmental and construction challenges that could negatively affect the Project’s schedule and costs.

By analyzing and comparing key factors associated with each of the possible route options, three (3) potentially viable routes between the Greenwich Substation and Cos Cob Substation were identified that generally satisfied routing criteria and objectives. Based on the comparative analysis, the Company concentrated on three viable underground line routes and designated the routes as follows: Preferred Route, Southern Alternative, and Northern Alternative. These routes are depicted in Figure E-5, *Proposed Underground Route Options Map*. Sections E.4.1.1 through E.4.1.3 describe the Preferred Route, Southern Alternative, and Northern Alternative in detail.

INDEX MAP



Legend

- Preferred Route
- Preferred Route HDD Crossing
- Preferred Route Open Trench Crossing
- Southern Alternative
- Southern Alternative HDD Crossing
- Southern Alternative Open Trench Crossing
- Northern Alternative

Base Map: 2012 Aerial Photograph (CTECO)

1 inch = 750 feet

750 375 0 750 Feet

Figure E-5
Proposed Underground Route Options Map

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February 2015

E.4.1.1 Preferred Route

The Preferred Route would exit Cos Cob Substation north under the MNRR, turn west along Station Drive, crossing beneath I-95 and extending to Town-owned properties west of Indian Field Road. The route would then require approximately 1,500 feet of horizontal direct drilling ("HDD") beneath the MNRR and I-95 to an area west of Kinsman Lane, where open trenching would continue in the road and into Bruce Park. HDD technology would be employed again to span Bruce Park and Indian Harbor, a distance of nearly 0.5 mile. The route would then follow Davis Avenue, Indian Harbor Drive and Museum Drive westward before turning north on Arch Street and extending beneath I-95 and the MNRR to Railroad Avenue. The route would turn west and follow Railroad Avenue to the Greenwich Substation.

Bruce Park Underground Trenching Variation: The Company also evaluated a variation of this route through Bruce Park that would generally follow Kinsman Lane and Bruce Park Drive using open trench line installation construction.

The route segments are listed below and depicted in Figure E-6, *Preferred Route Map*. The Preferred Route Segment Maps are provided in Appendix C.

Preferred Route - Total Length = Approximately 12,190 feet (2.31 miles)
Approximately 12,630 feet (2.39 miles) with variation

P1 Originating in the Cos Cob Substation, the Preferred Route would extend north from the substation. A pipe jacking installation would be used to cross under the MNRR corridor to a parking lot next to Station Drive. This segment would span a distance of approximately 880 feet.

P2 This route would extend west on private properties along the north side of Station Drive to the intersection with Loughlin Avenue, a distance of approximately 705 feet.

P3 The route would continue west along Station Drive to the intersection with Sachem Road, a distance of approximately 505 feet.

P4 The route would continue west on Station Drive through private properties and crossing Indian Field Road onto Town-owned property to an HDD staging area, a distance of approximately 1,100 feet.

P5 An HDD would be used to cross the MNRR and I-95 southwestward to an HDD receiving area at the end of Kinsman Lane (a span of approximately 1,400 feet). From there open trenching would occur down Kinsman Lane to a new HDD staging area near the intersection of Bruce Park Drive for a total segment distance of approximately 1,900 feet.

P6 A second HDD would cross under the Bruce Park ball fields and waterways to a receiving site on Davis Avenue just west of Home Place, a distance of approximately 1,800 feet.

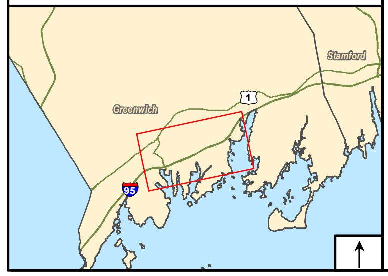
P6V The open trenching variation would continue southwestward (from P5), along the north side of Kinsman Lane and Bruce Park Drive for a distance of approximately 2,240 feet to Davis Lane. This variation would require coffer dams be installed within the tidal water bodies that comprise Indian Harbor in Bruce Park.

P7 The route would extend westward along Davis Avenue to its intersection with Indian Harbor Drive, a distance of approximately 1,100 feet.

P8 The route would continue west along Indian Harbor Drive and Museum Drive, which becomes Arch Street beyond the Steamboat Road intersection. The route would continue along Arch Street, turning northward and crossing beneath the I-95 and the MNRR corridor to the intersection with Railroad Avenue, a distance of approximately 2,940 feet.

P9 The route would turn west on Railroad Avenue to the Greenwich Substation, a distance of 1,260 feet.

INDEX MAP



Legend

- Preferred Route Segment Point
- Preferred Route
- Preferred Route HDD Crossing
- Preferred Route Open Trench Crossing

1 inch = 700 feet

750 375 0 750 Feet

Base Map: 2012 Aerial Photograph (CTECO)

Figure E-6
Preferred Route Map

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February 2015

E.4.1.2 Southern Alternative

The Southern Alternative would exit Cos Cob Substation south of the MNRR and extend west along Sound Shore Drive, passing under I-95. The route would extend southwesterly under I-95 a second time with an HDD crossing that would require staging locations for the duration of the Project along Sound Shore Drive near One Sound Shore Drive and a sending pit location near Kinsman Lane. Open trenching would continue in the road and into Bruce Park. HDD technology would be employed again to span Bruce Park and Indian Harbor, a distance of nearly 0.5 mile. This route would then generally follow Davis Avenue, Indian Harbor Drive and Museum Drive west before turning north on Arch Street and extending beneath I-95 and the MNRR to Railroad Avenue. The route would turn west and follow Railroad Avenue to the Greenwich Substation. The route segments are listed below and depicted in Figure E-7, *Southern Alternative Map*.

<u>Bruce Park Underground Trenching Variation:</u> Similar to the Preferred Route, an underground trenching variation of this route through Bruce Park would generally follow Kinsman Lane and Bruce Park Drive to Davis Avenue.

Southern Alternative - Total Length = Approximately 11,780 feet (2.23 miles)
Approximately 12,220 feet (2.31 miles) with variation

- S1 Originating in the Cos Cob Substation, the underground transmission lines would extend north from the substation and west through the main entrance from Sound Shore Drive, a distance of approximately 750 feet.
- S2 The route would continue west on private property along Sound Shore Drive under the I-95 underpass to the intersection with Sachem Road, a distance of approximately 1,040 feet.
- S3 The route would continue west under private property on Sound Shore Drive to an HDD staging area near One Sound Shore Drive, a distance of approximately 570 feet.
- S4 An HDD would be used to cross under I-95 to a staging location near the end of Kinsman Lane (an approximate HDD distance of 1,770 feet). The route would continue with open trenching down Kinsman Lane to the intersection of Bruce Park Drive, a total segment distance of approximately 2,320 feet.

S5 A second HDD would cross under the Bruce Park ball fields and waterways to a receiving site on Davis Avenue just west of Home Place, a distance of approximately 1,800 feet.

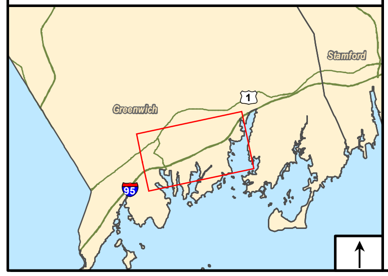
S5V The open trenching variation would continue southwestward (from S4), along the north side of Kinsman Lane and Bruce Park Drive for a distance of approximately 2,240 feet to Davis Lane. This variation would require coffer dams be installed within the tidal water bodies that comprise Indian Harbor in Bruce Park.

S6 The route would extend westward along Davis Avenue to its intersection with Indian Harbor Drive, a distance of approximately 1,100 feet.

S7 The route would continue west along Indian Harbor Drive and Museum Drive, which becomes Arch Street beyond the intersection with Steamboat Road. The route would continue along Arch Street, turning north and crossing beneath the I-95 and the MNRR to the intersection with Railroad Avenue, a distance of approximately 2,940 feet.

S8 The route would turn west on Railroad Avenue to the Greenwich Substation, a distance of approximately 1,260 feet.

This route is not as desirable as the Preferred Route because of the more difficult, longer HDD which would come very close to a Town highway garage and creates a lengthy diagonal crossing beneath I-95. In addition, the Southern Alternative lacks sufficient room for the new transmission lines under Sound Shore Drive. Either the existing utilities would have to be relocated or the Project would need to obtain private property easements within a limited and constrained area.



Legend

- Southern Alternative Segment Point
- Southern Alternative
- Southern Alternative HDD Crossing
- Southern Alternative Open Trench Crossing

Base Map: 2012 Aerial Photograph (CTECO)

1 inch = 700 feet

750 375 0 750 Feet

Figure E-7
Southern Alternative Map

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February 2015

E.4.1.3 Northern Alternative

The Northern Alternative uses a lengthy section of US Route 1 and for the most part stays within the public ROW. This route would exit north out of Cos Cob Substation under the MNRR before turning east and then north, following Strickland Avenue approximately 0.5 mile to Route 1. It would then head generally west along Route 1 for nearly two miles before turning southwest onto Field Point Road. The route would continue approximately 0.5 mile and terminate after crossing Railroad Avenue and entering the Greenwich Substation.

The route segments are listed below and depicted in Figure E-8, *Northern Alternative Map*.

Northern Alternative Total Length = Approximately 16,230 feet (3.07 miles)

N1 Originating in the Cos Cob Substation, this route would extend north from the substation using a pipe jacking installation to cross under the MNRR corridor to Station Drive, a distance of approximately 880 feet.

N2 The route would extend north on Strickland Road to its intersection with East Putnam Avenue (Route 1) crossing the I-95 underpass, a distance of approximately 3,150 feet.

N3 The route would turn west onto East Putnam Avenue and extend westward to the intersection with Indian Field Road, a distance of approximately 1,720 feet.

N4 The route would continue west on East Putnam Avenue to the intersection with Overlook Drive, a distance of approximately 2,000 feet.

N5 The route would continue southwest on East Putnam Avenue to the intersection with Milbank Avenue, a distance of approximately 2,830 feet.

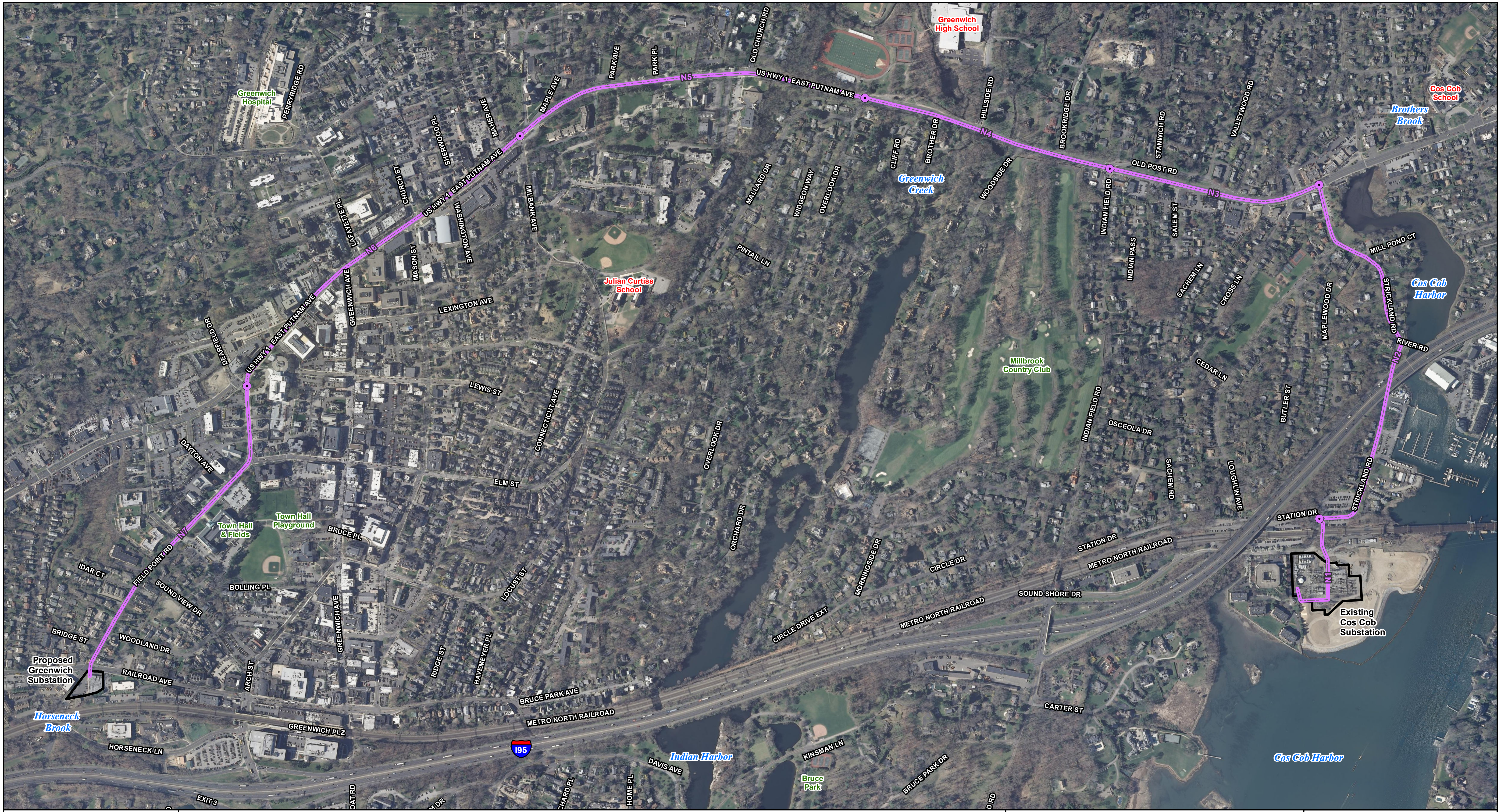
N6 The route would continue southwest on East Putnam Avenue, which becomes West Putnam Avenue, to Field Point Road, a distance of approximately 2,880 feet.

N7 The route would follow Field Point Road south and cross Railroad Avenue into the proposed Greenwich Substation, a distance of approximately 2,770 feet.

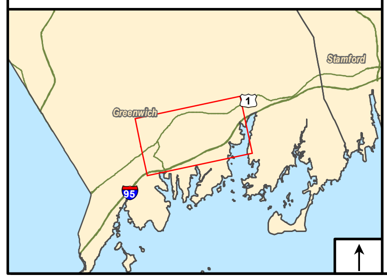
The Northern Alternative is not as desirable as the Preferred Route because of its greater length (nearly one mile longer), conflicts with existing utilities, and ConnDOT's requirements for off-road vault locations, all of which could increase the Project's cost and likely prolong the construction schedule. Additionally, this route would have more negative community and environmental impacts. It would extend through densely populated residential and commercial areas, as well as four (4) historic districts.

E.4.1.4 Selection of Preferred Route

Table E-2 shows that, after consideration of the key factors for the three potentially viable routes, the Preferred Route was selected by the Company as the most feasible and cost-effective route extending the transmission line to the Greenwich Substation. This determination was based on the Preferred Route's length and impacts to environmental, cultural, and community resources.



INDEX MAP



Legend

Northern Alternative Segment Point

Northern Alternative

Base Map: 2012 Aerial Photograph (CTECO)

1 inch = 700 feet

750 375 0 750 Feet

Figure E-8
Northern Alternative Map

Greenwich Substation and Line Project

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February 2015

Table E-2 Route Analysis Summary

Key Factors	Preferred Route	Southern Alternative	Northern Alternative
Route Length	2.31*	2.23 miles	3.08 miles
ConnDOT Encroachment Agreement Required	No	No	Yes
ConnDOT Encroachment Permit	Yes	Yes	Yes
ConnDOT Rails License Agreement	Yes	Yes	Yes
MNRR License Agreement	Yes	Yes	Yes
Impacts on Environmental and Cultural Resources	Minimal	Minimal	Moderate
Underground Utilities Congestion	Least	Moderate	Greatest
Constructability Challenges[21]	Minimal	Moderate	Greatest
Easements Required[22]	10	6	10
Schools/Day Cares within 500 feet	0	1	6
Estimated Number of Vault Locations	6	6	8

*If Bruce Park underground trench alternative is selected, the Preferred Route would be slightly longer.

[21] Includes length and angle of HDD, need for all off-road easements, limited work hours, and space constraints.
[22] Estimated, based and dependent on the vault locations selected; all with varying complexities.

E.4.2 Additional Routes Analyzed

The Company initially evaluated numerous overhead, underground, and marine routes, as well as hybrid combinations incorporating different segments of select options. A total of 12 routes, some with variations, were initially considered and analyzed, including four (4) overhead routes, five (5) underground options, one (1) marine route, and two (2) combination routes. The 12 routes (and their variations) are discussed below.

E.4.2.1 Overhead Routes

The configuration of overhead transmission lines allows flexibility provided that a continuous ROW width is available. Individual structures can often be located to avoid or span conductors over sensitive environmental areas (e.g., wetlands, streams, steep slopes). However, overhead lines require relatively wide ROW, within which certain land uses and tall growing vegetation are precluded. Overhead transmission line support structures that would be required for this Project would rise to heights of approximately 90 to 110 feet above ground level. A typical Eversource overhead ROW would require 70 to 100 feet in width.

Descriptions of the four overhead routes evaluated are summarized below.

Overhead Southern Route

This route would exit Cos Cob Substation, south of I-95, extending generally westward over private properties along Cob Island Road and Kinsman Lane before traversing through Bruce Park. On the park's west side, the overhead lines would continue westward along Davis Avenue and Arch Street before turning north and crossing the highway and railroad corridor to reach the Greenwich Substation. No existing ROW is available along this route, so new easements/acquisitions affecting approximately 46 public and private properties would be required. Due to the high level of impacts, easements/acquisitions and substantial clearing requirements associated with this overhead route, it was removed from further consideration.

Overhead Central Route

This option would initially exit north out of Cos Cob Substation over the MNRR before turning west, requiring the use of private properties north of Station Road to Indian Field Road. The Company's existing distribution ROW could be expanded to the north using private properties off Circle Drive and Circle Drive Extension. This route would then cross Indian Harbor, north of the MNRR and I-95, and follow Bruce Park Avenue and Railroad Avenue west directly to the Greenwich Substation Property. Although this option attempts to use existing transportation and utility ROWs, the corridor does not currently have sufficient width to accommodate the line. Thus, a substantial amount of private properties would be directly affected (approximately 97 parcels would require easements/acquisitions). This option would also require the removal of numerous trees that are currently providing screening for residences from the MNRR and I-95. Due to the high level of impacts, easements/acquisitions and substantial clearing requirements associated with this overhead route, it was removed from further consideration.

Overhead Northern Route

This route would require traversing densely populated residential and commercial areas and pass through the heart of the Greenwich Avenue Historic District and Greenwich Municipal Center Historic District, crossing a wide portion of Indian Harbor in the Millbrook Club area. Similar to the Overhead Southern Option, numerous easements/acquisitions would be required because no existing ROW is available. Based on the high level of impacts to historic districts and very densely populated areas associated with this route, it was removed from further consideration.

Overhead Metro-North Railroad Corridor

North Easement: This route would occupy a portion of the existing MNRR ROW as well as adjacent private properties. It would initially exit Cos Cob Substation north over parking lots and turn west along the north side of the rail line. This route would then follow the railroad for almost two miles to a point directly south of Railroad Avenue, where a 90-degree turn northward would allow for a short segment into the Greenwich Substation. This route would require a width of at least 40 feet provided shorter spans are used (which would require substantially more structures compared to a typical design). West of Indian Field Road, this route requires new ROW beyond the existing MNRR ROW, impacting up to 64 properties. The Company anticipates that several properties would have to be acquired due to the extent of the ROW needed on those properties. Further, construction would require removing the existing vegetation buffer for those homes to the north of the ROW. Based on preliminary communications with the MNRR, limited work hours would be imposed by the railroad to avoid conflicts with the rail line's active use, adding substantial time to the construction schedule that could jeopardize the in-service date of the Project.

Variation 1 - South Easement: The Company evaluated a variation to the MNRR Corridor route in an attempt to minimize property impacts. Following the initial path out of Cos Cob Substation westward over Indian Harbor, the variation route would turn south at the end of Bruce Park Avenue, crossing the railroad and I-95 to the west end of Bruce Park. This variation would then turn west along the south side of I-95, generally following Museum Drive to an area near the intersection of Arch Street and exit 3 off I-95. This variation of the Overhead MNRR corridor route would then head northwest back over the transportation corridors into the Greenwich Substation. Although this variation could reduce the number of properties directly affected by nearly 50 percent, it would also require installation of overhead support structures in Bruce Park and substantial clearing of trees that currently provide screening of the transportation corridor for neighborhoods to the south. Further, ConnDOT policies limit the longitudinal occupation of interstate corridors unless no other practical option exists.

Variation 2 - Middle Easement: The Company also assessed an overhead route generally following the MNRR ROW adjacent to the south side of the rail line. In addition to similar technical requirements and work hour limitations imposed by working within or near the MNRR ROW, this route variation would also require removal of large stands of mature trees and installation of new structures adjacent to Bruce Park. This would require construction in a very narrow area between the MNRR and I-95 (the existing ROW measures 36 feet wide at its narrowest point). In addition, the Town's sewer line and the MNRR facilities are located in this area, creating a higher level of construction complexities. Further, ConnDOT policies limit the longitudinal occupation of interstate corridors unless no other practical option exists.

ConnDOT has determined that all three of these proposed route variations are not desirable.

Due to the high level of impacts, easements/acquisitions and substantial clearing requirements, as well as construction complexities, the overhead options were removed from further consideration.

E.4.2.2 Underground Routes

Descriptions of the five underground routes considered are provided below.

Underground Southern Route

This route was ultimately selected as the Southern Alternative.

Underground Central Route

This route would exit Cos Cob Substation north beneath the MNRR and turn west, extending beneath private and Town-owned properties along Station Drive and Circle Drive for nearly 0.75 mile to an HDD staging area off Circle Drive Extension. The route would extend southwest beneath private properties, the MNRR, I-95 and Indian Harbor to Davis Avenue. It would then follow Davis Avenue, Indian Harbor Drive and Museum Drive westward before turning north on Arch Street to Railroad Avenue. The route would turn 90 degrees and follow Railroad Avenue before interconnecting with the Greenwich Substation. This option would require the use of several private and Town-owned parcels along Station Drive, Intrieri Lane, Circle Drive, Circle Drive Extension, Woodside Drive, Davis Avenue, and Railroad Avenue, resulting in significant disruption to several residential neighborhoods and, depending on the vault locations, requires 10 or more easements with a high probability for some acquisitions.

Due to the high level of impacts and probable acquisition requirements, this underground option was removed from further consideration.

Underground Central Route Using Existing Distribution ROW

This underground option would expand Eversource's existing distribution ROW east of Indian Harbor. After exiting Cos Cob Substation northward under the MNRR, the route would turn west on private properties and parallel the north side of Station Drive for nearly 0.5 mile. After crossing Indian Field Road, this route would follow the north side of the existing ROW for approximately another 0.5 mile to an HDD staging area south of Woodside Drive. This option would require the use of several private and Town-owned parcels along Station Drive, Intrieri Lane, Circle Drive, Circle Drive Extension, and Woodside Drive. The route would extend southwest via HDD beneath private properties, the MNRR, I-95 and Indian Harbor to Davis Avenue. Transitioning to open trenching, it would then follow Davis Avenue, Indian Harbor Drive and Museum Drive westward before turning north on Arch Street to Railroad Avenue. The route would turn 90 degrees and follow Railroad Avenue before entering the Greenwich Substation. Approximately 21 residential properties would be affected by the expansion of the ROW, which would require the removal of existing trees that currently screen these backyards from the MNRR and I-95. Another 8 residential properties would be impacted to reach the ROW from Cos Cob Substation. Similar to the Central Route (All Underground) above, construction along this route would disrupt several residential neighborhoods and, depending on the vault locations, requires 18 or more easements and 6 or more acquisitions.

Due to the high level of impacts and acquisition requirements, this underground option was removed from further consideration.

Underground Central-Southern Route
This route was ultimately chosen as the Preferred Route.

Underground Northern Route This route was ultimately selected as the Northern Alternative.

E.4.2.3 Marine Route

This route option would consist of an underground line exiting Cos Cob Substation into Cos Cob Harbor and extending south and west around Indian Field Point and Tweed Island before turning north and coming ashore in the vicinity of the Town's Water Treatment Plant. Underground lines would continue north along Shore Road, under I-95, then turn east onto Horseneck Lane and then north on Arch Street, crossing beneath the MNRR to Railroad Avenue. This route would then turn west and follow Railroad Avenue to the Greenwich Substation. The marine route is significantly longer than the land routes considered and poses additional challenges. Installation of a line within the harbor would be challenging as the channel is very narrow and shallow in several areas.

Future dredging activities could pose a risk to the submerged lines. The marine line equipment may also have to be customized. The route passes through several boat moorings and near marinas, which could significantly hamper construction efforts. Environmental permitting challenges might jeopardize the Project schedule. State and federal regulations and policies provide much higher levels of protection to water dependent uses. Generally, if there is a reasonable opportunity to avoid impacts on water dependent uses, then alternative overland routes are preferred. Eversource would have to provide overwhelming evidence that no overland routes are feasible for regulatory agencies to consider a marine route through Long Island Sound.

Given the challenges associated with a marine route option, and the availability of feasible alternatives, a marine option for the transmission line route was removed from further consideration.

E.4.2.4 Combination Routes

Two combination routes were also assessed, incorporating underground, overhead and marine route segments. These combination routes are discussed below.

Southern Route Marine and Underground Line Combination Route

This route would exit Cos Cob Substation underground and, using HDD techniques, extend southwestward under Cos Cob Harbor and come ashore at private property on Mead Point. An underground line segment would then extend west through private property, across Indian Field Road, and beneath Town-owned property to Bruce Park Drive. A second HDD crossing would be required through Bruce Park and Indian Harbor to Davis Avenue. This route would then follow Davis Avenue, Indian Harbor Drive and Museum Drive westward before turning north on Arch Street to Railroad Avenue. It would turn 90 degrees and follow Railroad Avenue before interconnecting with the Greenwich Substation. The marine line segment poses similar challenges to those discussed above regarding the Marine Route, plus the need to cross private property. In addition, the getaway from Cos Cob Substation would require major disruptions to the Town's new Cos Cob Park.

Central Route East Side Overhead and West Side Underground Combination Route

This combination route would extend overhead lines from Cos Cob Substation to Bruce Park Avenue west of Indian Harbor where it would transition to an underground line along private properties and Railroad Avenue directly to the Greenwich Substation. The overhead line portion would follow Station Drive and Eversource's existing distribution ROW.

Variation: A variation of this combination route would extend overhead lines to a staging area off Circle Drive Extension, where it would transition to underground lines and cross beneath the MNRR, I-95 and Indian Harbor to Davis Avenue via HDD. From there, the route would follow Davis Avenue, Indian Harbor Drive and Museum Drive west and the Arch Street north to Railroad Avenue. It would turn west again and follow Railroad Avenue to the Greenwich Substation.

The primary combination route and its variation would encounter similar constraints. Over 50 properties would be directly impacted to accommodate expansion of the existing Eversource distribution ROW. This would also require the removal of trees that currently serve as screening for residences from the MNRR and I-95.

Given the high level of impacts and acquisition requirements and the availability of feasible alternatives, these combination route options were removed from further consideration.

F. Existing Environmental Conditions

This section describes the existing environmental conditions at the Site and along the Preferred Route and alternate routes and the Cos Cob Substation property. The information presented herein provides a context for the discussion in Section G, which considers the extent to which the Project could potentially affect resources and how such effects may be mitigated.

F.1 Greenwich Substation Property

The Site selected for the Greenwich Substation is 290 Railroad Avenue, a property that is compatible with existing commercial land uses. Nearly the entire 0.81-acre Site is currently developed and covered by impervious surfaces. Railroad Avenue and commercial properties are located north of the Site, including an Eversource-owned property used for parking and storage. The Company's former Greenwich Area Work Center and Prospect Substation are located across Field Point Road to the west. Commercial buildings are located east of the Site. Commercial buildings and the MNRR corridor are located to the south.

Environmental resources associated with the Site are depicted on Figure F-1, *Greenwich Substation Environmental Resources Map*.

F.1.1 Topography, Geology and Soils

The Site for the proposed Greenwich Substation is located at an elevation of approximately 40 feet above mean sea level ("AMSL"). The Site is generally flat. The character of the surficial geology at the Site is predominantly glacial till of varying thickness over irregular bedrock that is almost entirely paved or developed with buildings.

F.1.2 Water Resources

The Site is located within the Southwest Coast Major Drainage Basin. No tidal or fresh water wetlands/watercourses or coastal resources are located on the Site. In addition, the Site is not located within either the 100-year or 500-year flood zones established by the Federal Emergency Management Agency ("FEMA") or within flood surge limits. The edge of the 500-year flood zone is

Figure F-1 Greenwich Substation Environmental Resources Map

located approximately 10 feet from the southwest corner of the Site.[23] Portions of the northeast and southeast corners of the Site lie within the Coastal Boundary pursuant to the Connecticut Coastal Management Act ("CCMA"). In total, an area of approximately 1,120 square feet of the Site is physically located within the Coastal Boundary. Based on available information on Worst Case Hurricane Surge Inundation data developed by the National Hurricane Center using the SLOSH (Sea Lake and Overland Surge from Hurricanes) Model, no portions of the Site are within Category 1, 2, 3, or 4 areas.[24]

Horseneck Brook is located west of the Site across Field Point Road and flows southward via a culvert beneath the 330 Railroad Avenue property (the Company's former Greenwich Area Work Center). Horseneck Brook is not tidally influenced in areas north of I-95 (including the vicinity of the Site). The CT DEEP surface water quality classification for Horseneck Brook is A for locations north of I-95. Designated uses include potential drinking water supply, fish and wildlife habitat, recreational use, agricultural and industrial supply and other qualifying uses. Permitted receiving discharges are restricted to those from public or private drinking water treatment systems, dredging and dewatering, emergency and clean water discharges.

Groundwater beneath the Site is classified by the CT DEEP as GB, indicating it is not fit for human consumption without treatment. No water supply wells are located at or in the vicinity of the Site. Based on available mapping, no portions of the Site are located within any Aquifer Protection Area.

F.1.3 Biological Resources

The Site is entirely developed and maintains little to no value for any flora or fauna due to its previously disturbed nature and impervious surface coverings.

CT DEEP's Natural Diversity Data Base ("NDDB") program performs hundreds of environmental reviews each year to determine the impact of proposed development projects on state listed species and to help landowners conserve the state's biodiversity. State agencies are required to ensure that

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[23] National Geodetic Vertical Datum of 1929; *FEMA Map*, Panel Number 09001C 0494G, revised July 8, 2013.

[24] CT DEEP Geographic Information System data, based on *Worst Case Hurricane Surge Inundation* areas for category 1 through 4 hurricanes striking the coast of Connecticut. Hurricane surge values were developed by the National Hurricane Center using the SLOSH (Sea Lake and Overland Surge from Hurricanes) Model to assist emergency management officials in hurricane preparedness and operations.

any activity authorized, funded or performed by a state agency does not threaten the continued existence of endangered or threatened species. Maps have been developed to serve as a pre-screening tool to help applicants determine if there is a potential impact to state listed species.

The NDDB maps represent approximate locations of endangered or threatened species, special concern species and significant natural communities in Connecticut. The locations of species and natural communities depicted on the maps are based on data collected over the years by CT DEEP staff, scientists, conservation groups, and landowners. In some cases an occurrence represents a location derived from literature, museum records and/or specimens. These data are compiled and maintained in the NDDB. The general locations of species and communities are symbolized as shaded areas on the maps. Exact locations have been masked to protect sensitive species from collection and disturbance and to protect landowner's rights whenever species occur on private property.

CT DEEP NDDB mapping indicates that the Site is not located within any polygons depicted as areas of known habitat for state-listed endangered or threatened species, or species of special concern. The Company consulted with CT DEEP NDDB regarding the Site and determined that no such resources would be impacted by development and operation of the Substation (see Section G.1.3). Further, the Site is not within or proximate to any mapped areas of Critical Habitat.

F.1.4 Land Use

The Site is situated within an area that is a mix of industrial, commercial, and residential land uses with a major transportation corridor to the south.

F.1.5 Historical and Archaeological Resources

The Company retained the services of Heritage Consultants, LLC of Newington, Connecticut ("Heritage"), to review and evaluate historic and archaeological resources (collectively, "cultural" resources) within the entire Project area. No cultural resources (buried archaeological sites or standing historic structures) occur at or adjacent to the Site. The Site is not located within or proximate to a local or national historic district. The Heritage assessment report, entitled *Preliminary*

Archaeological Assessment of the Project Region Associated with the Proposed Substation and Transmission Line Project in Greenwich, Connecticut is provided as Appendix E.

F.1.6 Noise

Existing noise levels emanating from the Site meet criteria established for commercial areas by both the Greenwich Noise Ordinances and the CT DEEP's noise control regulations (Regulations of Connecticut State Agencies Title 22a, §22a-69-1 to 22a-69-7.4). The environment immediately surrounding the Site consists of primary local roadways and commercial establishments, where the existing noise environment is influenced by traffic noise, including from I-95, as well as from the MNRR corridor.

F.1.7 Statutory Facilities, Scenic and Recreational Areas

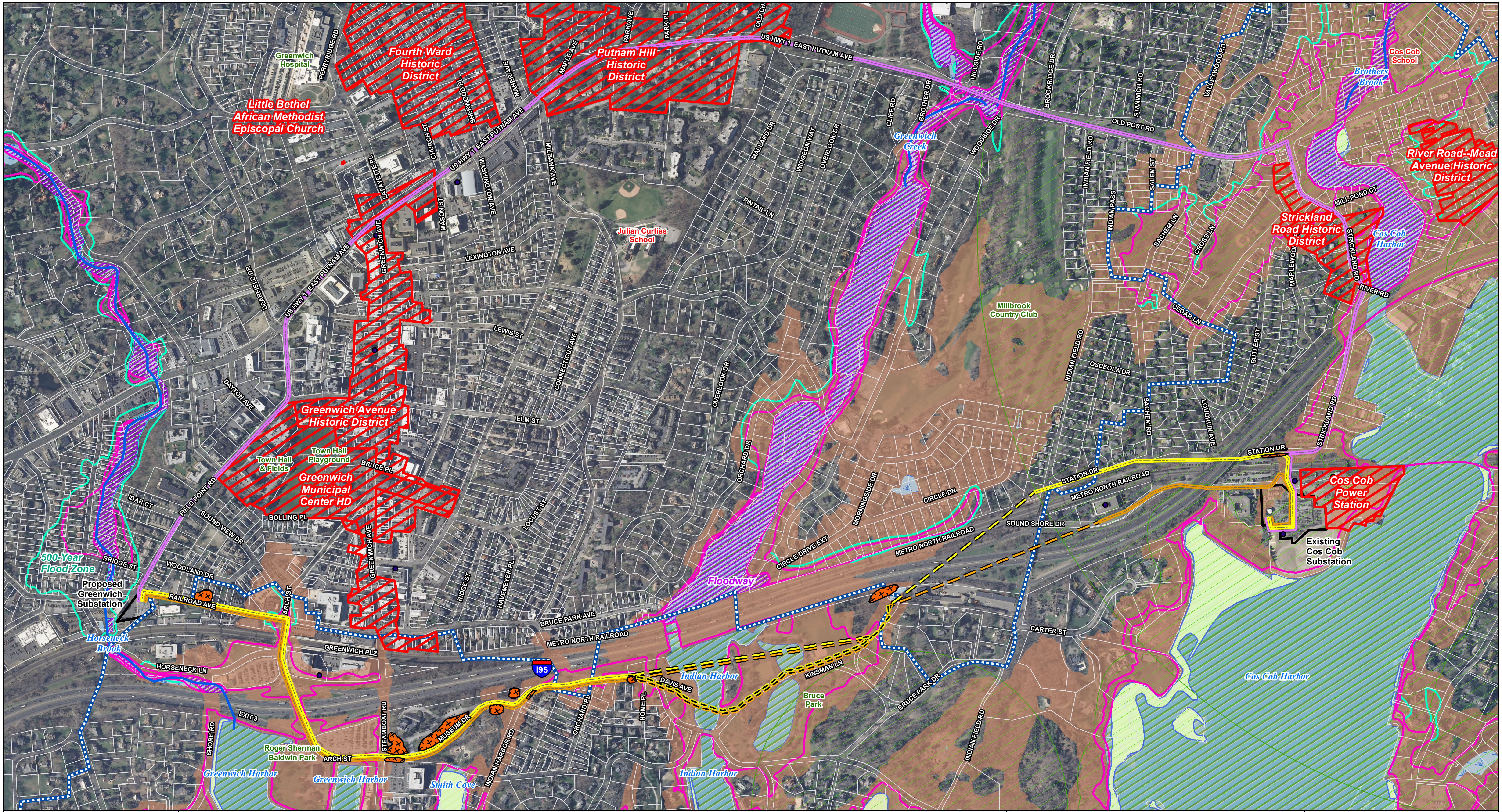
No Statutory Facilities, or scenic or recreational areas occur on or adjacent to the Site.

F.2 Project Area

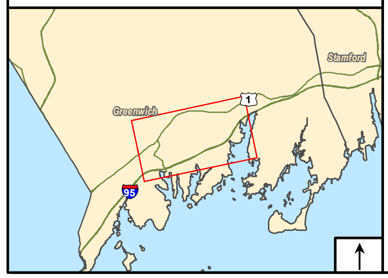
This section discusses existing land uses and natural resources located within the "Project Area", which is generally defined as being bound to the west by the Greenwich Substation Site; to the east by Cos Cob Substation; and to the north and south by the Preferred and alternate routes. The principal land use features and natural resources within the Project Area and along the Preferred Route and the alternate routes are depicted on Figure F-2, *Project Area Environmental Resources Map*.

F.2.1 Geology and Soils throughout the Project Area

Bedrock geology in the Project Area consists of two different forms of gneiss and one form of schist, Pumpkin Ground Member of Harrison Gneiss, Ordovician Granitic Gneiss and The Trap Falls Formation (schist). The Pumpkin Ground Member of Harrison Gneiss is gray to spotted, medium to coarse grained, foliated gneiss. The Ordovician Granitic Gneiss is light-colored, foliate granitic gneiss. The Trap Falls Formation consists of gray to silvery, partly rusty weathering, medium grained schist.



INDEX MAP



Legend

- Preferred Route
- Preferred Route HDD Crossing
- Preferred Route Open Trench Crossing
- Southern Alternative
- Southern Alternative HDD Crossing
- Southern Alternative Open Trench Crossing
- Northern Alternative
- Bedrock Outcrops
- National Register of Historic Places Historic District
- Natural Diversity Database Area
- Inland Wetland
- Tidal/Coastal Resource
- CTDEEP Tidal Wetland (1990)
- CTDEEP Watercourse
- CTDEEP Coastal Boundary
- CTDEEP Hurricane Surge Inundation
- Greenwich Parcels (Greenwich GIS)

FEMA Flood Zones

- 100-Year Flood Zone
- 500-Year Flood Zone
- Floodway

1 inch = 750 feet

750 375 0 750 Feet

Base Map: 2012 Aerial Photograph (CTECO) Data Sources: CTDEEP GIS, FEMA, CL&P, and APT Field Inventory 2014

Figure F-2
Project Area Environmental Resources Map

Greenwich Substation and Line Project

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Surficial geology in the Project Area varies and consists of different thicknesses of sand, gravel and glacial till (till), as well as significant areas of artificial fill deposition. Information concerning the physical properties and classification of soils in the vicinity of the Project is presented in Table F-1.

Table F-1 Principal Soil Associations within the Project Area

Soil Map Unit Name and Symbol	General Description	Hydric Soil	Depth to Bedrock
Urban land Charlton – Chatfield complex	Highly developed areas interspersed with well drained till based soils	No	0-25 feet
Udorthents - Urban land complex	Areas of substantial cutting or filling interspersed with highly developed areas	No	0-25 feet
Urban land	Highly developed areas	No	0-25 feet

Sources: USDA Soil Conservation Service, Soil Surveys of Fairfield County Soil Survey Staff Natural Resources Conservation Service, United States Department of Agriculture. Soil Survey Geographic (SSURGO) http://soildatamart.nrcs.usda.gov. Accessed 5/5/2014.

This information provides a useful baseline for identifying areas of hydric soils (which signal the presence of a wetland); for assessing the potential for erosion and sedimentation (“E&S”) during construction; and for planning appropriate mitigation measures (including E&S controls) to be implemented during Project construction.

Descriptions of soil types identified along the Preferred Route were obtained from the U.S. Department of Agriculture (“USDA”), Natural Resource Conservation Service (“NRCS”) Web Soil Survey (accessed May, 2012), and the USDA NRCS Soil Survey Geographic (“SSURGO”) database.

The Charlton series consists of very deep, well drained loamy soils formed in till derived from parent materials that are very low in iron sulfides. They range from nearly level to very steep soils on till plains and hills. Slope ranges from 0 to 50 percent. Saturated hydraulic conductivity is moderately high or high.

The Chatfield series consists of well drained and somewhat excessively drained soils formed in till derived from parent materials that are very low in iron sulfides. They are moderately deep to bedrock. These are nearly level through very steep soils on glaciated plains, hills, and ridges. Slope ranges from 0 through 70 percent. Saturated hydraulic conductivity is moderately high or high in the mineral soil.

Udorthents-Urban land complex soils typically consist of variably drained soils that have been disturbed by cutting or filling, and areas that are covered by buildings and pavement. Most areas of these components are so intermingled that it is not practical to map them separately. These soils are in areas that have been cut to a depth of 2 feet or more or are on areas with more than 2 feet of fill.

Urban land consists entirely of man-made surfaces such as pavement, concrete and buildings. Urban land is typically impervious and will not infiltrate water.

F.2.2 Air Quality in the Project Area

Ambient air quality is affected by pollutants emitted from both mobile sources (e.g., automobiles, trucks) and stationary sources (e.g., manufacturing facilities, power plants, and gasoline stations). Also, naturally occurring pollutants, such as radon gas or emissions from forest fires, affect air quality. In addition to emissions from sources within the state, Connecticut's air quality is significantly affected by pollutants emitted in states located to the south and west, and then transported into Connecticut by prevailing winds. Ambient air quality in the state is monitored and evaluated by the CT DEEP. Air quality is assessed in terms of compliance with the National Ambient Air Quality Standards ("NAAQS") for selected "criteria" pollutants, as well as conformance with regulations governing the release of toxic or hazardous air pollutants.

The state is currently designated as in attainment or is unclassified with respect to the NAAQS standards for five criteria air pollutants: particulate matter no greater than 10 micrometers in diameter (PM10), sulfur dioxide, nitrogen dioxide, carbon monoxide, and lead. The state is currently designated as being in non-attainment with the 8-hour NAAQS standard for ozone, and the 2006 24-hour PM2.5 standard. Fairfield County is non-attainment for both the 8-hour ozone and 24-hour PM2.5 standard.

The U.S. Environmental Protection Agency ("EPA") has determined that carbon dioxide ("CO2") is a pollutant and has included CO2 in its list of criteria pollutants. Areas of non-attainment have not yet been established for CO2 or other greenhouse gases.

F.2.3 Natural Resources in the Project Area

The Company initially focused its efforts on inventorying natural resources within the Project Area proximate to the transmission line routes considered for the Project. The following procedures were used to identify natural resources in the Project Area.

- An initial desk-top review using existing aerial photography and publicly available electronic natural resource wetland information.

- A 'windshield' survey to identify, visually assess, and record the locations of resources occurring in close proximity to the Project.

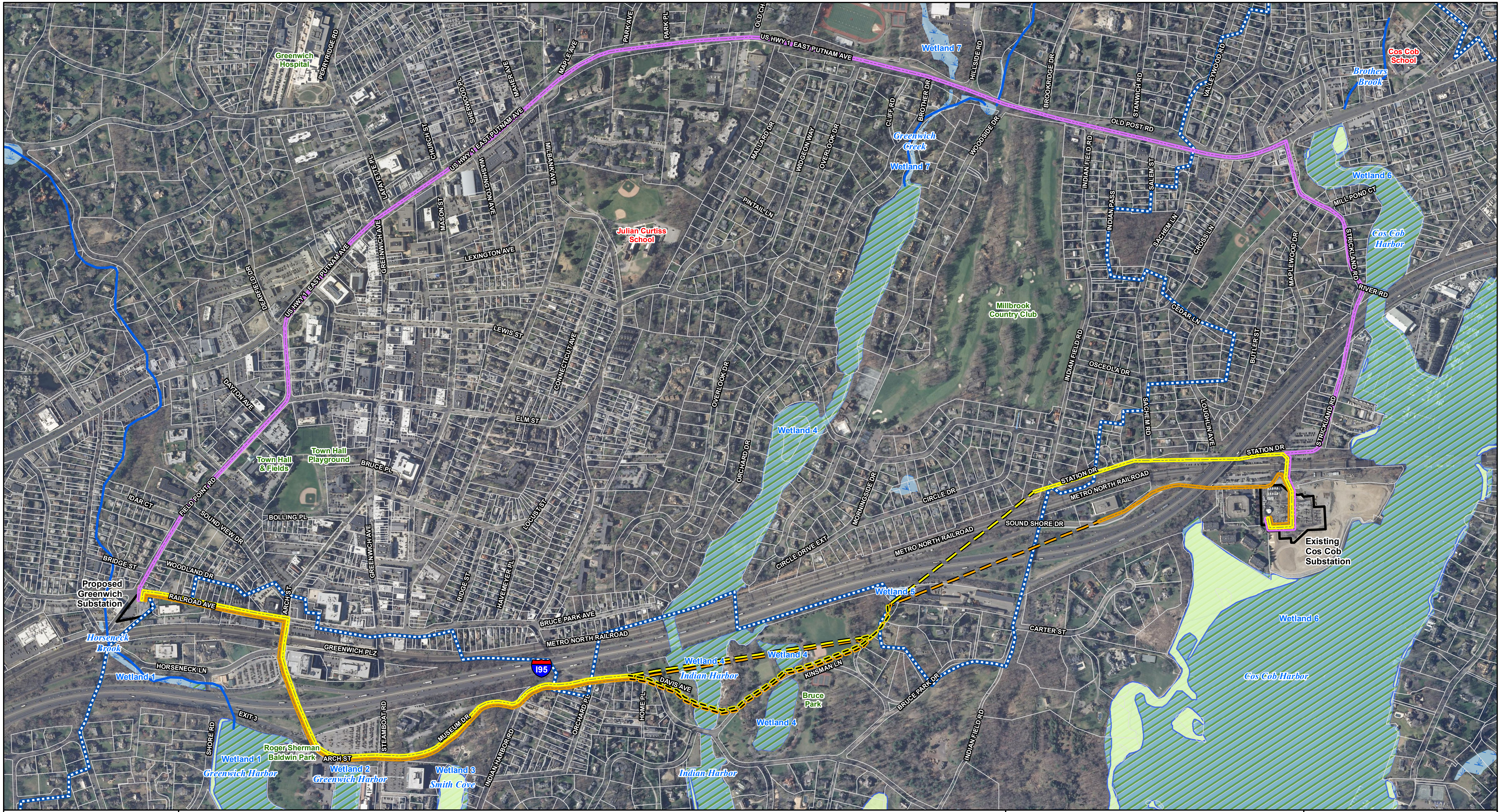
- Resource information was collected and recorded for:
    - Watercourses;
    - Wetland areas including but not limited to location and extent, resource type, tidal influence, and bordering vegetated wetlands;
    - Trees and road-side landscaping[25];
    - Bedrock outcrops.

The following subsections discuss the natural resources identified within the Project Area proximate to the Preferred and alternate routes.

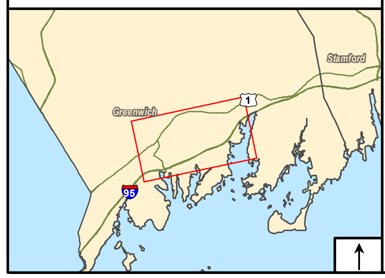
F.2.3.1 Wetland Resources in the Project Area

Several wetland resources were identified within the Project Area, as depicted on Figure F-3, *Wetlands Map* and discussed further in this section.

[25] Town of Greenwich Tree Point data was refined using the collected and recorded resource information. Singular trees were removed from and added to this data set based on field observations. In locations where groupings of trees exist, an area feature was used in addition to the modified Town of Greenwich Tree Point data.



INDEX MAP



Legend

- Preferred Route
- Preferred Route HDD Crossing
- Preferred Route Open Trench Crossing
- Southern Alternative
- Southern Alternative HDD Crossing
- Southern Alternative Open Trench Crossing
- Northern Alternative

Project Area Wetlands

- Inland Wetland
- Tidal/Coastal Resource
- CTDEEP Tidal Wetland (1990)
- CTDEEP Watercourse
- CTDEEP Coastal Boundary
- Greenwich Parcels (Greenwich GIS)

1 inch = 750 feet

750 375 0 750 Feet

Base Map: 2012 Aerial Photograph (CTECO) Data Sources: CTDEEP GIS, FEMA, CL&P, and APT Field Inventory 2014

Figure F-3
Wetlands Map

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February 2015

Wetland 1

Wetland 1 is a forested riverine wetland system, associated with Horseneck Brook, located west and south of the Site for the proposed Greenwich Substation. The system consists of a well incised forested perennial stream that outfalls from a culvert to the rear (south) of the existing Prospect Substation property parking area. It flows south, passing under the intersection of Horseneck Lane and Field Point Road and the MNRR ROW before continuing east paralleling Horseneck Lane. It then passes under Shore Road, at which point indicators of tidal influence were observed. The banks at the crossing point under Shore Road are armored up to the concrete headwalls. Several storm water outlet pipes were observed draining into this stream system. This system continues as an estuarine embayment south of I-95 and west of Shore Road, part of Greenwich Harbor. This area is characterized as having a narrow tidal fringe primarily consisting of common reed, high-tide bush, and various species of grasses. The shore is well developed with rock armoring.

Wetland 2

Wetland 2 is an estuarine bay located south of Arch Street and west of Steamboat Road within Greenwich Harbor. It is primarily developed with a marina.

Wetland 3

Wetland 3 is an estuarine tidal marsh located south of Arch Street and east of Steamboat Road, directly south of Bruce Park Museum. This marsh contains an interior channel within Smith Cove that has broad areas of tidal marsh grasses and common reed.

Wetland 4

Wetland 4 is a complex of forested Palustrine perennial streams north of I-95 and estuarine tidal open water features located interior to Bruce Park. This large wetland system generally drains southward from its connection to Greenwich Creek via a number of channels and crossing structures before it outfalls from a crossing under the MNRR and I-95 corridor into Bruce Park, and ultimately Indian Harbor. The banks of this wetland system are generally well developed with stone armoring and maintained lawn. Some slow moving backwater areas exist where intertidal flats occur.

Wetland 5

Wetland 5 is an isolated Palustrine forested wetland depression surrounded by dense development including I-95 to the north, commercial operations to the east, residences to the south, and Bruce Park to the west. The area is characterized by large amounts of refuse and debris. A sand delta was also noted originating from a storm water outfall to the north.

Wetland 6

Wetland 6 is a combination estuarine tidal marsh and estuarine embayment that surrounds 3 sides of Cos Cob Substation. The tidal marsh, to the south/southwest, consists of a large open water tidal area and various degrees of tidal fringe dominated by common reed. The estuarine embayment, south/southeast side of Cos Cob Substation, extends north to Boston Post Road, east of Strickland Road, and south into Cos Cob Harbor. This portion of Wetland 6 differs from its tidal marsh component in that the banks are entirely developed with no tidal fringe.

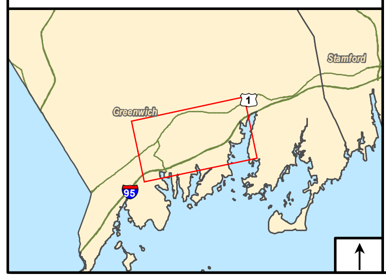
Wetland 7

Wetland 7 is associated with Greenwich Creek, which consists of a series of forested Palustrine perennial streams located both north and south of Boston Post Road in the vicinity of Hillside Road. Several well-incised stream channels form this system, generally draining south towards Wetland 4.

F.2.3.2 Trees and Landscaping in the Project Area

Figure F-4, *Trees and Landscaping Map* depicts the existing trees and landscaping proximate to the Preferred Route and alternate routes. In general, larger stands of trees are found in the southern portion of the Project Area, particularly in and around Bruce Park and the MNRR and I-95 transportation corridors. Landscaping and individual tree specimens measuring 6 inches or greater characterize the northern Project Area along Route 1.

INDEX MAP



Legend

- Preferred Route
- Preferred Route HDD Crossing
- Preferred Route Open Trench Crossing
- Southern Alternative
- Southern Alternative HDD Crossing
- Southern Alternative Open Trench Crossing
- Northern Alternative
- Singular Trees
- Grouping of Trees
- Landscaped Areas
- Open Water
- Greenwich Parcels (Greenwich GIS)

1 inch = 750 feet

750 375 0 750 Feet

Base Map: 2012 Aerial Photograph (CTECO) Source: APT Field Inventory 2014

Figure F-4
Trees and Landscaping within Project Area

Greenwich Substation and Line Project

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February 2015

F.2.4 Statutory Facilities and Other Surrounding Features in the Project Area

Table F-2 lists the Statutory Facilities and other surrounding features[26] within or proximate to the Project area. Figure F-5, *Statutory Facilities and Other Surrounding Features* depicts the locations of these resources.

Table F-2 Statutory Facilities and Other Surrounding Features in the Project Area

Type	Name	Address
Child Day Care	Chabad Lubavitch of Greenwich	75 Mason Street
Child Day Care	Children's Day School	8 Riverside Avenue
Child Day Care	Christ Church Nursery School	254 East Putnam Avenue
Child Day Care	Cos Cob Play Group	54 Bible Street
Child Day Care	Family Centers First Steps	Armstrong Court - Building #8
Child Day Care	Family Centers Preschool	40 Arch Street
Child Day Care	First Presbyterian Church Nursery School	37 Lafayette Place
Child Day Care	Greenwich Family YMCA	184 Hamilton Avenue
Child Day Care	Greenwich Family YMCA Child Care	2 St Roch Avenue
Child Day Care	Greenwich Spanish School	6 Riverside Avenue -#109
Child Day Care	Joan Melber Warburg Early Childhood	22 Bridge Street
Child Day Care	Kids Corner Preschool	Armstrong Court - Building #2
Child Day Care	Little Friends	25 Valley Drive
Child Day Care	Mencius Mandarin Preschool	59 East Putnam Avenue
Child Day Care	Putnam Indian Field School	101 Indian Field Road
Child Day Care	Selma Maisel Nursery School	300 East Putnam Avenue
Child Day Care	St Paul's Day School	200 Riverside Avenue
Child Day Care	The Preschool at Second Congregational Church	139 East Putnam Avenue
Child Day Care	Two Year Old Prog First Presbyterian Ch Nrsry Sch	1 West Putnam Avenue
Child Day Care	Wideworld Children's Corner	521 East Putnam Avenue
Child Day Care	YMCA Child Care	259 East Putnam Avenue
Recreation	Millbrook Country Club	61 Woodside Drive
Recreation	YMCA	259 East Putnam Avenue
Hospital	Greenwich Hospital	5 Perryridge Road
Park	Bruce Park	Bruce Park Drive
Park	Christiano Park	Lyon Avenue
Park	Grass Island Marina	Grass Island
Park	Mianus Park	Cary Road
Park	Roger Sherman Baldwin Park	Arch Street
Park	Town Hall & Fields	101 Field Point Rd

[26] Statutory Facilities are defined in CGS 16-50*l*(a)(1)(A). The Council's *Application Guide for Electric Substation Facilities* and *Application Guide for Electric and Fuel Transmission Line Facilities* requires applicants to identify a project's proximity to these resources.

Type	Name	Address
Playground	Christiano Park	99 Holly Hill Avenue
Playground	Cos Cob School	350 East Putnam Avenue
Playground	Julian Curtiss School	180 E Elm Street
Playground	Loughlin Avenue Playground	59 Loughlin Avenue
Playground	Town Hall & Fields	Greenwich Avenue
Private School	Brunswick School	100 Maher Avenue
Private School	Carmel Academy	44 Rock Ridge Avenue
Private School	Greenwich Academy	200 North Maple Avenue
Private School	Greenwich Country Day School	401 Old Church Road
Private School	The Greenwich Japanese School	276 Lake Avenue
Public School	Central Middle School	9 Indian Rock Lane
Public School	Cos Cob School	350 East Putnam Avenue
Public School	Eastern Middle School	51 Hendrie Avenue
Public School	Greenwich High School	10 Hillside Road
Public School	Hamilton Avenue School	184 Hamilton Avenue
Public School	Julian Curtiss School	180 E Elm Street
Youth Camp	Boys & Girls Club of Greenwich	4 Horseneck Lane
Youth Camp	Camp Gan Israel	270 Lake Avenue
Youth Camp	Camp Shine	254 Putnam Avenue
Youth Camp	Camp Ta-Yi-To	259 East Putnam Avenue
Youth Camp	ESF Summer Camps	200 North Maple Ave
Youth Camp	Greenwich Country Day School Day Camp	401 Old Church Road
Youth Camp	Greenwich Family YMCA Sports Camp	50 East Putnam Avenue
Youth Camp	Greenwich Historical Society History & Arts Camp	39 Strickland Road
Youth Camp	Millbrook Lion Cubs Camp	61 Woodside Drive
Youth Camp	The Field Club Camp	276 Lake Avenue

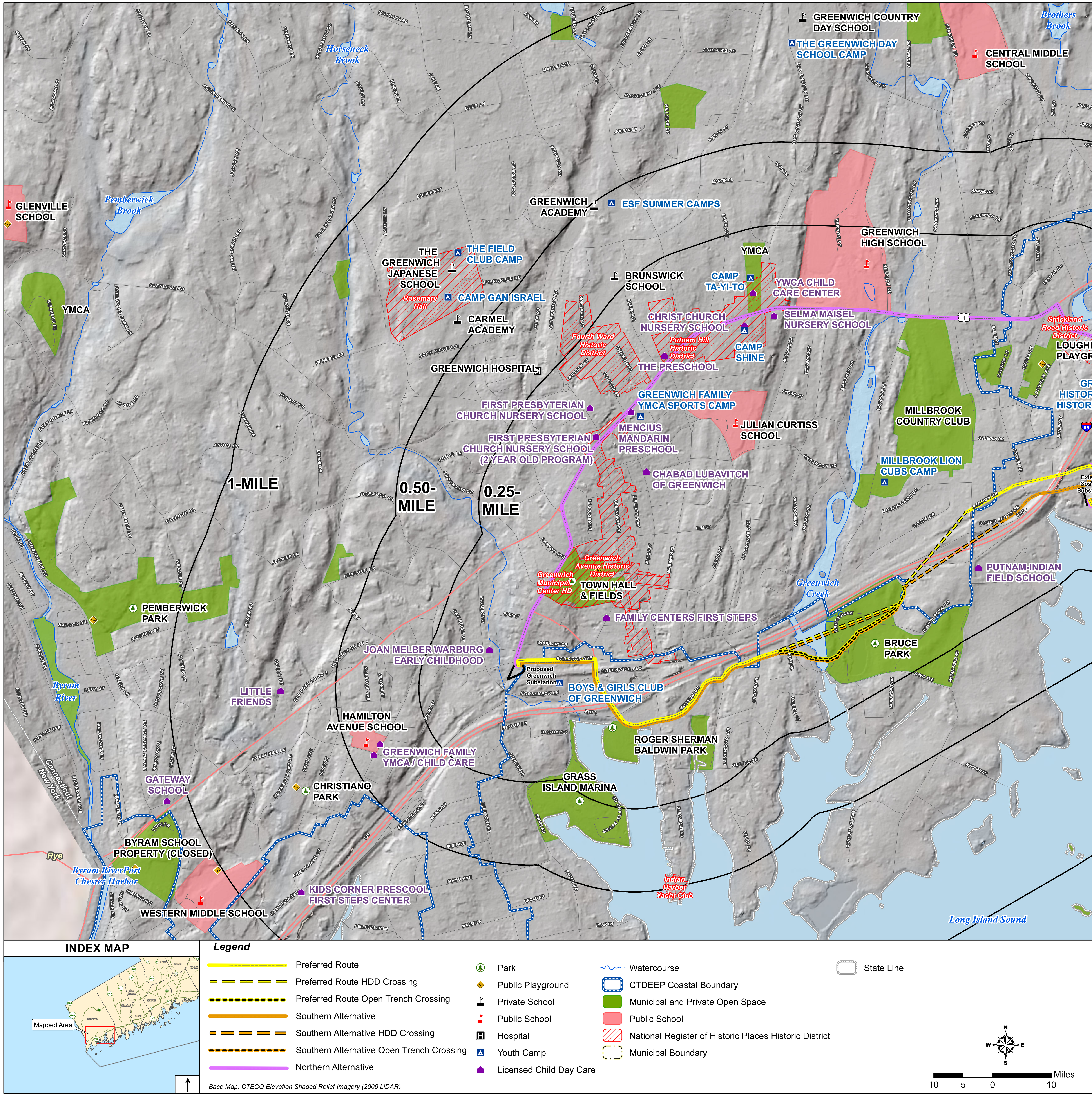

Figure F-5
Statutory Facilities and Other Surrounding Features

Greenwich Substation and Line Project

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February 2015

F.3 Preferred Route

F.3.1 Topography

Topography along the Preferred Route ranges from approximately sea level feet to 50 feet AMSL and is characterized by gentle to moderate elevation changes. Low-lying areas are found in conjunction with the MNRR and I-95 corridors and nearby coastal locations.

Minor elevation changes occur from Cos Cob Substation along existing maintained roadway ROWs north of the MNRR and I-95, ultimately achieving a maximum elevation of approximately 50 feet AMSL. Elevations transition from moderate slopes to level terrain south of I-95 and through Bruce Park.

The character of the surficial geology along the Preferred Route is predominantly glacial till of varying thickness over irregular bedrock. As this line route crosses Bruce Park and Indian Harbor, the surficial geology changes to a mix of sand and gravel areas and depressions/watercourse crossings of outwash and alluvium.

F.3.2 Water Resources

The Preferred Route is contained within the Southwest Coast Major Drainage Basin. Portions of this route occur within the Connecticut Coastal Boundary. In addition, portions of the Preferred Route are located within 100-year and 500-year flood boundaries. Portions of this route are located within Category 1, 2, 3, and 4 Hurricane Surge Inundation areas established by the National Hurricane Center, primarily in low-lying areas adjacent to Indian Harbor and in Bruce Park.

The Preferred Route would require crossing water bodies associated with Indian Harbor within Bruce Park. These surface waters are designated as Class A waters by the CT DEEP. Uses include potential drinking water supply, fish and wildlife habitat, recreational use, agricultural and industrial supply and other legitimate uses. Discharges are restricted to those from public or private drinking water treatment systems, dredging and dewatering, emergency and clean water discharges.

Wetland resources are associated with these surface waters, consisting primarily of tidal influenced open water, wetland forest, scrub-shrub, and emergent habitats.

Groundwater beneath the Preferred Route has been classified as GA[27] or GB[28]. No portion of the Preferred Route is located within an Aquifer Protection Area.

F.3.3 Biological Resources

The Preferred Route traverses areas consisting primarily of disturbed roadside edges and small areas of upland forest, open field/scrub-shrub, and wetlands/watercourses. Coastal and marine resources associated with Long Island Sound, Cos Cob Harbor, Bruce Park, Indian Harbor, Smith Cove, and Greenwich Harbor are located in close proximity to this route. Data provided by CT DEEP NDDB mapping indicates that the Preferred Route extends through polygons depicted as areas of known habitat for state-listed endangered or threatened species, or species of special concern. The Company consulted with CT DEEP NDDB regarding the potential routing of the underground transmission lines and determined that no such resources would be impacted by development and operation of the Project (see Section G.1.3).

F.3.4 Land Use

The Preferred Route passes through a combination of transportation corridors, with large areas of impervious surface associated with roads and parking lots, residential areas, the municipal park, small areas of riparian habitat, and very narrow blocks of upland forest and old field/scrub-shrub habitat. After exiting Cos Cob Substation beneath the MNRR and I-95, the Preferred Route would initially pass through areas of residential development as it extends west along Station Drive. As the line route continues southwest beneath I-95 and the MNRR, land use transitions to commercial and residential before entering Bruce Park. West of Bruce Park, a mix of residential and commercial development characterizes the remainder of this route.

F.3.5 Historical and Archaeological Resources

Based on the Heritage report, no known archaeological or historical resources are located in or along the Preferred Route. The nearest resource is the southernmost extent of the Greenwich Avenue Historic District, over 700 feet to the east of the Arch Street and Railroad Avenue intersection.

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[27] GA designation assumes ground water quality is fit for human consumption without treatment.

[28] GB designation indicates ground water quality is not fit for human consumption without treatment

F.3.6 Noise

The environment along the Preferred Route is a mix of transportation, commercial, recreational and residential land uses. With the exception of Bruce Park, the existing noise environment along the route is heavily influenced by traffic noise along roads, most prominently I-95, and the MNRR corridor.

F.3.7 Statutory Facilities and Other Surrounding Features

The Preferred Route would traverse Bruce Park and settled residential areas, including Station Drive, Intrieri Lane, Kinsman Lane, Davis Avenue, and Railroad Avenue. No scenic or recreational areas exist north of the MNRR and I-95 along the Preferred Route. Bruce Park represents the most significant scenic and recreational resources along this route. Due to its close proximity to Long Island Sound, additional scenic and recreational opportunities exist in the general vicinity of the Preferred Route.

F.4 Southern Alternative

F.4.1 Topography

Topography along the Southern Alternative ranges from approximately sea level to nearly 50 feet AMSL. Gentle to moderate elevation changes occur from Cos Cob Substation along existing maintained roadway ROWs north of I-95, ultimately achieving a maximum elevation of approximately 50 feet AMSL.

The character of the surficial geology along the Southern Alternative is predominantly glacial till of varying thickness over irregular bedrock. As this line route crosses Bruce Park and Indian Harbor, the surficial geology changes to a mix of sand and gravel areas and depressions/watercourse crossings of outwash and alluvium.

F.4.2 Water Resources

The Southern Alternative is located within the Southwest Coast Major Drainage Basin. Portions of this route occur within the Coastal Boundary. In addition, portions of this route are located within 100-year and 500-year flood boundaries. Worst Case Hurricane Surge Inundation data developed by the

National Hurricane Center indicate that portions of this route are located within Category 1, 2, 3, and 4 areas. These Hurricane Surge Inundation areas are focused along low-lying areas adjacent to Indian Harbor and in Bruce Park.

The Southern Alternative would require crossing water bodies associated with Indian Harbor in Bruce Park. The surface waters identified along this Route are classified as A waters, with designated uses including potential drinking water supply, fish and wildlife habitat, recreational use, agricultural and industrial supply and other qualifying uses. Permitted receiving discharges are restricted to those from public or private drinking water treatment systems, dredging and dewatering, emergency and clean water discharges.

Wetland resources are associated with these surface waters, consisting primarily of tidal influenced open water, wetland forest, scrub-shrub, and emergent habitats.

Groundwater beneath the Southern Alternative has been classified as either GA or GB. No portion of the Southern Alternative is located within an Aquifer Protection Area.

F.4.3 Biological Resources

The Southern Alternative traverses habitat consisting primarily of disturbed roadside edges, with areas of upland forest, parklands, open fields, scrub-shrub, wetlands and watercourses. Coastal and marine resources associated with Long Island Sound, Cos Cob Harbor, Bruce Park, Indian Harbor, Smith Cove, and Greenwich Harbor are located in close proximity to this route. Data provided by CT DEEP NDDB indicates that the Southern Alternative occurs within a number of polygons depicted as areas of known habitat for state-listed endangered or threatened species, or species of special concern. The Company consulted with CT DEEP NDDB regarding the Site and determined that no such resources would be impacted by development and operation of the Substation (see Section G.1.3). This route does not occur within any mapped areas of Critical Habitat.

F.4.4 Land Use

The Southern Alternative would extend through areas of residential and commercial development, including large areas of impervious surfaces associated with roads and parking areas, Bruce Park, small areas of riparian habitat, and very narrow blocks of upland forest and old field/scrub-shrub habitat.

F.4.5 Historical and Archaeological Resources

Based on the results of the Heritage report, no known cultural resources are located within or in proximity to the Southern Alternative. Similar to the Preferred Route, the nearest resource is the southernmost extent of the Greenwich Avenue Historic District, located over 700 feet to the east of the Arch Street and Railroad Avenue intersection.

F.4.6 Noise

The environment along the Southern Alternative consists primarily of heavily travelled roadways, with the exception of Bruce Park. Residential and commercial developments exist along the west portions of this route. The existing noise environment is influenced by associated traffic noise, including from I-95, as well as from the MNRR corridor, which parallel the entire route.

F.4.7 Statutory Facilities and Other Surrounding Features

Most of the Southern Alternative follows existing state and local roadways. However, the route does cross Bruce Park and extends through or proximate to settled residential areas, including Kinsman Lane, Davis Avenue, and Railroad Avenue. Being in close proximity to Long Island Sound, scenic and recreational opportunities exist in the general vicinity of this alternative.

F.5 Northern Alternative

F.5.1 Topography

Topography along the Northern Alternative is characterized by flat and gently sloping areas with elevations ranging from approximately 10 to 20 feet above sea level.

F.5.2 Water Resources

The Northern Alternative is located within the Southwest Coast Major Drainage Basin. The eastern portion of this route, from Cos Cob Substation north to Route 1 (and west to its intersection with Valleywood Road), lies within the Coastal Boundary. Portions of the Northern Alternative are located within the 100-year and 500-year flood boundaries associated with Greenwich Creek and Cos Cob Harbor. According to data developed by the National Hurricane Center, portions of this alternative are located within Category 1, 2, 3, and 4 Hurricane Surge Inundation areas, along the northern portion of Strickland Road and eastern portion of Route 1, associated with Cos Cob Harbor.

The Northern Alternative would require crossing upper portions of Greenwich Creek north and south of Route 1 at existing bridge/culvert locations. Greenwich Creek is classified by CT DEEP as Class A waters. with designated uses including potential drinking water supply, fish and wildlife habitat, recreational use, agricultural and industrial supply and other qualifying uses. Permitted receiving discharges are restricted to those from public or private drinking water treatment systems, dredging and dewatering, emergency and clean water discharges.

Groundwater beneath the Northern Alternative has been classified as either GA or GB. Based on available mapping, no portions of the Northern Alternative are located within an Aquifer Protection Area.

F.5.3 Biological Resources

The Northern Alternative traverses habitat consisting primarily of disturbed roadside edges, though select locations include small areas of upland forest, open field/scrub-shrub, wetlands, and coastal habitats. Coastal and marine resources associated with Cos Cob Harbor, the Mianus River, and Greenwich Creek occur in close proximity to this route. Data provided by CT DEEP NDDB indicates that this route extends through polygons depicted as areas of known habitat for state-listed endangered or threatened species, or species of special concern; the polygons appear to be associated with Cos Cob Harbor and lower portions of the Mianus River. The Company consulted with CT DEEP NDDB regarding the Site and determined that no such resources would be impacted by development and operation of the Substation (see Section G.1.3). The Northern Alternative does not occur within any mapped areas of Critical Habitat.

F.5.4 Land Use

The Northern Alternative would extend through a mix of commercial and residential development, primarily within or adjacent to areas of impervious surfaces. Isolated narrow blocks of upland forest and old field/scrub-shrub habitat occur in select locations along this route. In the eastern-most portion of this route, along Strickland Road northward from Cos Cob Substation, land uses also include both residential development and marinas. As the route would turn west along CT State Route 1, land use is primarily commercial with small isolated areas of upland forest and open field/scrub-shrub habitat primarily associated with the Millbrook Country Club and Greenwich Creek. Land-use transitions from a mix of residential, municipal and commercial uses to primarily residential as the route turns south along Field Point Road to its intersection with Railroad Avenue.

F.5.5 Historical and Archaeological Resources

The Northern Alternative would pass directly by the Bush Holly House, an historic resource listed on the National Register of Historic Places ("NRHP"). The route would also pass through four areas listed on the NRHP, including: the Strickland Road Historic District; the Putnam Hill Historic District; the Greenwich Municipal Center Historic District; and, the Greenwich Avenue Historic District. A fifth area, the Fourth Ward Historic District, is located immediately north of Route 1 between the Putnam Hill and Greenwich Avenue districts.

F.5.6 Noise

The environment along the Northern Alternative is a mix of mostly commercial and residential land uses. The existing noise environment is influenced greatly by traffic noise along local and state roads, including Route 1 and Field Point Road. Locations along the southern portions of this route are also impacted by noise attributable to activity with I-95 and the MNRR corridor.

F.5.7 Statutory Facilities and Other Surrounding Features

Most of the Northern Alternative follows existing state and local routes. This alternative would pass both the Greenwich High School and YMCA, as well as through settled residential areas including Strickland Road, Route 1, Field Point Road, and Railroad Avenue. Scenic and recreational opportunities in proximity to the route include the CT DEEP's Mianus River Water Access, the Millbrook Country Club, Cos Cob Harbor, and Greenwich Creek.

F.6 Cos Cob Substation

The Cos Cob Substation property on Sound Shore Drive consists primarily of previously disturbed and developed land, where both Eversource and the MNRR maintain extensive substation and other electrical infrastructure. The MNRR, associated parking lots and the train station are all located north of the Substation. The Town has recently created a park east of the substations.

Environmental resources associated with Cos Cob Substation are depicted on Figure F-6, Cos Cob *Substation Environmental Resources Map*.

F.6.1 Topography

Topography at Cos Cob Substation is generally level with man-made earthen berms located south of the existing fence line (and within the planned construction expansion area).

F.6.2 Water Resources

Cos Cob Substation is located within the Southwest Coast Major Drainage Basin and the Coastal Boundary. Cos Cob Substation is located outside of the 100-year and 500-year flood boundaries associated with Cos Cob Harbor. Based on available information, the northwest corner of the substation is located within Category 1, 2, 3, and 4 Hurricane Surge Inundation areas.

No wetlands or watercourses are located at the Cos Cob Substation. CT DEEP mapping identifies wetlands immediately south of the substation within developed areas of the property, which is located within approximately 300 feet of Cos Cob Harbor.

Cos Cob Harbor is classified by CT DEEP as Class A waters with designated uses including potential drinking water supply, fish and wildlife habitat, recreational use, agricultural and industrial supply and other qualifying uses. Permitted receiving discharges are restricted to those from public or private drinking water treatment systems, dredging and dewatering, emergency and clean water discharges.

Groundwater beneath Cos Cob Substation has been classified as GB, indicating it is not fit for human consumption without treatment. No water supply wells are located at or in the vicinity of the Site. Based on available mapping, no portions of this site are located within any Aquifer Protection Area.

Figure F-6 Cos Cob Substation Environmental Resources Map

F.6.3 Biological Resources

Eversource's portion of the Cos Cob Substation property is nearly entirely developed and maintains little to no value for any flora or fauna due to current uses. CT DEEP NDDB mapping depicts polygons (buffered areas that include known habitat for state-listed endangered or threatened species, or species of special concern) covering the majority of the site. The Company consulted with CT DEEP NDDB regarding the proposed modifications to Cos Cob Substation and determined that no such resources would be impacted by the proposed modifications (see Section G.1.3).

Marine and other natural resources associated with Cos Cob Harbor are located in proximity to the property. Cos Cob Substation is not located within or proximate to any mapped areas of Critical Habitat.

F.6.4 Land Use

Cos Cob Substation lies within a mix of utility, recreational, commercial, and residential land uses with the I-95 and the MNRR transportation corridors to the north.

F.6.5 Historical and Archaeological Resources

Based on the results of the Heritage report, there are no known cultural resources (buried archaeological sites or standing historic structures) at Cos Cob Substation.

The property immediately to the east of the existing substation, now developed as a Town park, is listed on the NRHP. This listing is associated with the former Cos Cob Power Plant. Built in 1905 to 1907 and expanded in 1912, the Cos Cob Power Plant powered the Shoreline Division of the New York, New Haven and Hartford Railway, which was the first long-distance electrified main line railway in the U.S. A complex of six buildings, it included a 3-story power house, a coal crusher house, a dock, two concrete water tanks, and a coal conveyor (as well as structures deemed non-contributing in the NRHP nomination, including a concrete shed, a steel warehouse, and an oil tank). The main building and its early additions had Spanish Mission style decorative elements. The power station was closed in 1986 and later demolished. As a successful experiment in railroad electrification, the power station was significant enough to be listed on the NRHP. Its power format and layout set the standard for similar plants for decades.[29]

F.6.6 Noise

Land uses adjacent to Cos Cob Substation consist primarily of busy roads (including I-95) and the MNRR ROW, where the existing noise environment is influenced greatly by traffic noise.

F.6.7 Statutory Facilities and Other Surrounding Features

Scenic and recreational opportunities exist in proximity to Cos Cob Substation, including the Town's recently completed Cos Cob Park and Cos Cob Harbor.

[29] Roth, Matthew and Clouette, Bruce. 1989. National Register of Historic Places Registration Form for Cos Cob Power Station, Sound Shore Drive, Greenwich, Connecticut. State Historic Preservation Office records, Hartford, CT.

G. Environmental Effects and Mitigation

This section identifies the potential environmental effects of the Project, based on the development of the Greenwich Substation and installation of the transmission supply lines along the Preferred and alternate routes, using the proposed facility design and construction methods as described in the following Sections H and I.

Based on the existing conditions at the Site and along the routes under consideration and the proposed design, construction and operation of the Project would not have significant permanent adverse effects on the existing environment or on the scenic, historic or recreational values of the surrounding area. Eversource has incorporated, and will continue to incorporate, measures into all phases of Project development and implementation to promote environmental protection in accordance with federal, state and local requirements. The sections below identify the potential short- and long-term effects that the Project would have on the environment, and on scenic, historic, and recreational resources, and then describes the measures that Eversource proposes to avoid, minimize, or mitigate any potential adverse effects.

Prior to the commencement of any construction activities, Eversource must prepare a Development and Management Plan ("D&M Plan"). The D&M Plan would include *Northeast Utilities Transmission Group Best Management Practices Manual for the State of Connecticut, Construction & Maintenance Environmental Requirements* (December 2011), which contains guidance and other information designed to minimize or eliminate potential adverse environmental effects that may result from construction activities. The D&M Plan will include specific detail as to procedures and information on erosion control, construction site dewatering, spill prevention and control, construction staffing and hours of work, traffic control and restoration.

Prior to the commencement of construction activities at the Substation Site, Eversource would install E&S controls at the limits of work and around adjacent catch basins, in accordance with the approved Project Plans, the D&M Plan and the *2002 Connecticut Guidelines for Soil Erosion and Sediment Control*. The E&S controls would be inspected and maintained throughout the course of the Project until all disturbed sites are stabilized. Similar controls would be established in work zones of other Project areas warranting these measures (Bruce Park, for example).

G.1 Project Effects

G.1.1 Topography, Geology, and Soils

Greenwich Substation

The development of the Greenwich Substation would have negligible, if any, adverse effects on topography and geology. Some earthwork will be required to prepare the Site and accommodate foundations but no substantive changes in site topography or grades are anticipated.

Transmission Supply Line Routes

Installation of the underground supply lines (including duct banks and splice vaults) will require substantial earthwork. However, all disruption to existing soils would be temporary in nature as excavations would be backfilled upon completion of equipment installations. No changes to existing grades are anticipated as a result of Project[30].

Duct bank and line installations would involve the excavation of a continuous trench, as well as the installations of concrete splice vaults which are typically spaced at intervals of approximately 2,000 to 2,800 feet, depending upon cable construction and route characteristics[31]. During such excavation activities, measures would be implemented, as required, to contain temporary soil storage piles and to avoid sedimentation into water resource areas and/or catch basins. As appropriate for work in urban areas, suitable temporary E&S control measures would be installed and maintained, where soils are disturbed at work sites. Typical E&S controls may not be required for trenching and other construction activities within road ROWs, where the potential for off-site erosion or sedimentation is limited, but would be employed as needed at any off-road ROW work

[30] If the cables are installed adjacent to, but not within, existing road ROWs, grading may be required to create a level work area.

[31] Cable construction in this instance means the dimension of the conductor and insulation layers. Route characteristics include (but are not necessarily limited to): the number of bends (and also the radius of the bend); elevation changes; available real estate to support the addition of a vault as well as cable pulling, splicing, testing, and maintenance activities; and, existing utility density.

sites. Any temporary controls would be maintained until the disturbed work sites are properly restored, as determined by standard criteria for storm water pollution prevention and erosion control. After the completion of conduit and splice vault installation, disturbed ROWs would be restored to the appropriate grade. Excess excavated materials and materials not suitable for backfilling the trench would be trucked off-site and disposed of in accordance with applicable regulations.

In the event that bedrock is encountered, excavation, drilling, or pneumatic hammer would be the preferred methods to remove rock. Although not anticipated, if extensive bedrock is encountered during construction, provisions for blasting would be considered and developed by Eversource, in accordance with controlled blasting techniques.

Cos Cob Substation

Modifications to the southern portion of Cos Cob Substation will require grading and other earthwork activities, including leveling of existing earthen berms and installation of foundations. Similar to those procedures discussed above, temporary E&S control measures would be installed, maintained and inspected routinely during construction. After the completion of the substation modifications, disturbed areas would be restored appropriately. Any excess excavated soils and materials not suitable for re-use on the site would be trucked off-site and disposed of in accordance with applicable regulations.

G.1.2 Water Resources

Neither the construction nor the operation of the Project would have any long-term adverse effects on surface or groundwater resources or water quality.

Greenwich Substation

The three (3) 60-MVA transformers associated with the Greenwich Substation would contain insulating (not containing PCBs) mineral oil. The transformers would be installed on foundations and each would have secondary containment sufficient to contain 110% of the insulating fluid capacity of the transformer. Periodic inspections of the containment area would be performed by Eversource personnel to verify proper functioning of the containment systems.

Project activities would include the demolition of an existing commercial structure and the construction of the Substation on the Site. A comprehensive stormwater management system would be designed in accordance with the 2004 *CT Stormwater Quality Manual* to adequately treat the quantity and quality of stormwater generated during construction and when the Substation is in operation.

Based on these design considerations, the Greenwich Substation would have no adverse environmental impacts.

The Site is not located within the 100-year or 500-year flood zones associated with Horseneck Brook. The edge of the 500-year flood zone is located approximately 10 feet from the southwest corner of the Site. The activities associated with the construction and operation of the Substation would be located entirely outside of the 100-year and 500-year flood zone and also the hurricane storm surge.

No portion of the Substation would be located within wetlands or watercourses and no components or structures would be situated within:

- 100 feet measured horizontally from the boundary of any wetland or watercourse not located within any public water supply watershed;
- 150 feet measured horizontally from the boundary of any wetland or watercourse, located within any public water supply watershed; or,
- 200 feet measured horizontally from the mean high water mark of any public water supply reservoir.

Based on these design considerations and Site features, the Greenwich Substation would have no adverse environmental impacts on water resources.

<u>Transmission Line Routes</u>

There are wetlands and watercourses proximate to each of the routes. Eversource would implement its transmission best management practices manual to minimize or eliminate potential adverse environmental effects during the construction phase of the

Project including measures to reduce the likelihood of sediment migration away from distinct construction sites.

It is possible that groundwater may be encountered in either the trench, which would be excavated to a depth of approximately 8 to 10 feet, or during installation of the splice vaults, which would require excavations to depths of approximately 12 feet. However, the Project area traverses densely developed urban areas, where groundwater is not used for direct potable water supply. If groundwater is encountered, dewatering would be performed in accordance with authorizations from applicable regulatory agencies and may involve discharge to catch basins, temporary holding tanks (frac tanks) or vacuum trucks for disposal outside of the Project area. During construction, care would be taken to avoid impacts to municipal water lines and other utilities that may be located within road ROWs.

Portions of the Preferred Route are located within mapped flood hazard areas. However, no permanent above ground structures are proposed in the areas. Therefore, no adverse effects on these areas are anticipated.

<u>Cos Cob Substation</u>

Proposed modifications to Cos Cob Substation include the addition of 6 potential transformers, each containing approximately 30 gallons of mineral oil (not containing PCBs). Similar to activities at the Greenwich Substation Site, the existing stormwater management system would be modified in accordance with the 2004 *CT Stormwater Quality Manual* to continue to adequately treat the quantity and quality of stormwater generated during construction and operation of the Substation.

G.1.2.1 Coastal Resources

<u>Greenwich Substation</u>

Construction and operation of the Substation would not result in adverse impacts to coastal resources, as defined in the CCMA (Connecticut Coastal Management Act). The CCMA identifies eight potential adverse impacts to coastal resources. This section provides a definition of each adverse impact and explains why construction and operation of the Substation would not result in or contribute to these impacts.

1) *Degrading* ***water quality*** *of coastal waters by introducing significant amounts of suspended solids, nutrients, toxics, heavy metals or pathogens, or through the significant alteration of temperature, pH, dissolved oxygen or salinity.*

During construction, E&S controls would be established and maintained in accordance with the CT DEEP Bulletin 34 *Connecticut Guidelines for Soil and Erosion and Sediment Control*, dated 2002. Construction activities associated with the proposed Substation are temporary and, with the appropriate E&S measures in place and maintained, are not expected to impact water quality. Throughout construction and operation of the Substation all stormwater generated at the Site would be adequately treated, both in quantity and quality, in accordance with the *2004 Connecticut Stormwater Quality Manual*. The existing development consists of a pre-1980s style stormwater management system that currently provides minimal stormwater quantity and quality treatment. The proposed Substation stormwater management system design would include appropriate levels of stormwater quantity and quality treatment through proper site planning and design with the selection of a variety of stormwater treatment practices to preserve pre-development hydrologic conditions and substantially reduce the average annual total suspended solids loadings. Therefore, with incorporation of these stormwater management principals, the Substation's construction and operation would not result in degradation of coastal water quality.

2) *Degrading* ***existing circulation patterns of coastal waters*** *by impacting tidal exchange or flushing rates, freshwater input, or existing basin characteristics and channel contours.*

The Substation would be located on a parcel that is currently developed and outside of tidally influenced areas and, as such, would not impact current drainage or circulation patterns of coastal waters.

3) *Degrading **natural erosion patterns** by significantly altering littoral transport of sediments in terms of deposition or source reduction.*

Because the Site does not border on Horseneck Brook or any other shoreline, the construction and operation of the Substation would not alter natural erosion patterns or affect littoral transport of sediments.

4) *Degrading natural or existing drainage patterns by significantly altering groundwater flow and recharge and volume of runoff.*

Drainage patterns would not be significantly altered by the construction and operation of the Substation. Considering that the Site currently consists of a majority of impervious surface, construction of the proposed Substation would decrease the area of impervious surface with the application of a trap rock in the substation yard, which would improve existing drainage. As a result, there would be an increase in groundwater recharge and a reduction in the volume of stormwater to be managed.

5) *Increasing the hazard of **coastal flooding** by significantly altering shoreline configurations or bathymetry, particularly within high velocity flood zones.*

As the Site is outside of the 100-year and 500-year flood zones, development and operation of the Substation would not affect the shoreline configurations or bathymetry.

6) *Degrading **visual quality** by significantly altering the natural features of vistas and viewpoints.*

The Site is located approximately 1,000 feet from the nearest shoreline and is located within a heavily developed commercial area. The MNRR and I-95 transportation corridors are located between Greenwich Harbor and the Site and the general area currently includes substantial utility infrastructure. Therefore, development and operation of the Substation would not degrade the visual quality of the natural features and viewpoints within the coastal zone.

7) *Degrading or destroying* ***essential wildlife, finfish or shellfish habitat*** *by significantly altering the composition, migration patterns, distribution, breeding or other population characteristics of the natural species or significantly altering the natural components of the habitat.*

The Site is currently entirely developed with impervious surfaces and does not contain any vegetated or open water habitat. Therefore, the proposed Substation would not degrade or destroy essential wildlife, finfish or shellfish habitat.

8) *Degrading* ***tidal wetlands, beaches and dunes, rocky shorefronts, and bluffs and escarpments*** *by significantly altering their natural characteristics or function.*

Development and operation of the Substation would not alter the natural characteristics of any coastal resource area as none exist on or adjacent to the Site.

Transmission Supply Line Routes

There would be no effect on coastal resources as a result of the construction and operation of the transmission supply lines. Construction activities would take place in previously developed areas and would have no effect on access to the shoreline. Along the portion of the route that traverses within the Coastal Boundary, any effects would be short-term, limited to the construction phase, and highly localized.

Cos Cob Substation

In addition to Eversource's Cos Cob Substation, the MNRR also maintains a separate substation facility at this property. The proposed Project modifications will require expansion of the existing southern fence line of Cos Cob Substation and new equipment installations, all within areas that have been previously disturbed. The Project would not result in a substantial change to the current natural and physical characteristics of the property. Therefore, no adverse effects on coastal resources are anticipated as a result of the planned modifications and ongoing operation of the substation.

G.1.3 Biological Resources

Based on agency correspondence (dated August 1, 2014), the Project would not impact any extant populations of federal or state Endangered or Threatened Species, or Special Concern Species. A copy of the CT DEEP letter is provided as Appendix F.

No significant areas of vegetation exist at the Greenwich Substation Site and no negative effects to vegetation or wildlife are anticipated. Similarly, the areas planned for expansion at the Cos Cob Substation have been previously disturbed and do not possess significant vegetation or wildlife habitat potential.

To accommodate the construction of the transmission supply lines, street (public) trees or other vegetation on private property may have to be trimmed or removed. Wherever possible, Project construction would occur within the street. However equipment such as excavators and cranes would still need the necessary overhead clearances to work safely. Therefore, trees with limbs overhanging the roadway may have to be pruned.

If it is necessary to install splice vaults along the side of the roadway, off the paved surface, it is more likely that trees or vegetation on private property could be affected. In these locations any vegetation within the construction workspace would have to be removed and it is possible that trees outside the workspace would have to be pruned to provide the necessary overhead clearances.

Where removal or pruning of woody vegetation is required along the roadway, it would be done by a professional crew with all appropriate training. When pruning is necessary, all cuts would be smooth and would be made in front of the branch collar and large, heavy branches would be precut on the underside to prevent splitting or peeling. The use of climbing spurs would be avoided unless safety issues preclude this.

Where a pipe jacking crossing method is needed (such as under the MNRR), some trees may have to be removed in order to provide the necessary work space for the jacking equipment. Vegetation removal and pruning in these areas would be done by hand, or with appropriately sized equipment.

Eversource recognizes that the excavation work could have potential impacts to the root systems of nearby vegetation. The impacts would be highly variable and depend on factors such as species type, size and location of the vegetation impacted, and would therefore need to be evaluated on an individual basis.

Eversource understands the importance of existing vegetation to the Town. As a result, wherever possible, the impacts to existing vegetation would be minimized by proposing routes that avoid such impacts. However, it is still possible that some existing vegetation would have to be removed or pruned. Eversource would work closely with Town officials, and the affected private landowners, to develop an appropriate vegetation restoration plan that would be implemented at the completion of construction.

Upon completion of construction, Eversource would reestablish previously vegetated, disturbed areas with seed mixtures or plantings, where necessary. In the absence of other specific requirements, disturbed areas would be re-vegetated in compliance with the *2002 Connecticut Guidelines for Soil Erosion and Sediment Control* and NRCS recommendations.

G.1.4 Local, State and Federal Land Use

The Project is consistent with local, state, and federal land use plans. According to the Town of Greenwich Zoning Regulations, the Site at 290 Railroad Avenue is located within a General Business Zone. The Preferred Route and alternate routes lie within areas zoned for Business, Industrial and Residential use.

The Company has also reviewed the *Conservation and Development Policies Plan for Connecticut 2005 - 2010* (“C&D Plan”) for information relating to the State’s growth in general, and which also provided information specifically on Greenwich and neighboring communities. The objective of the C&D Plan is to guide and balance regional and state development plans in response to human, environmental, and economic needs in a manner that best suits Connecticut’s future.

Based upon the general planning information provided in C&D Plan, the Project is consistent with the overall goals and objectives of the Plan and serves a public need for a reliable source of electricity for the Town of Greenwich. As stated in the C&D Plan:

The ability to redevelop Connecticut's Regional Centers requires that existing infrastructure be maintained and updated to support compact urban development. This holds true and is particularly relevant regarding electric capacity and delivery systems. While concentrated development in Connecticut's Regional Centers will require appropriate energy capacity and distribution infrastructure, this type of compact growth can help reduce the need for multiple delivery systems across dispersed areas. (p. 22).

In addition, the future land-use and planning objectives of the South Western Regional Planning Agency ("SWRPA"), the regional planning agency encompassing the Project area, are also consistent with the Project. The SWRPA *Regional Plan of Conservation and Development 2006-2015* notes the inadequacy of southwestern Connecticut's electrical transmission grid, and encourages coordination between state and federal siting agencies to achieve a balance between the need for expanded services and preservation of the natural environment and community character.

There are no federal properties or federally-designated areas located on or proximate to the Project and therefore, it would not be affected by any applicable federal land use plan.

G.1.5 Statutory Facilities and Other Surrounding Features

<u>Greenwich Substation</u>

Construction and operation of the Greenwich Substation would not result in any adverse effects to Statutory Facilities or on recreational and/or scenic resources. No municipal land, open space, recreation areas or parks are located proximate to the Site.

<u>Transmission Supply Line Routes</u>

No long-term or permanent adverse effects to recreational and/or scenic resources are expected as a result of the Project. This is primarily the result of the transmission lines being routed underground for its entire length. Temporary effects may occur in some locations during construction as the routes under consideration pass by municipal land, open space, and recreation areas. The Preferred Route and Southern Alternative pass through Bruce Park.

G.1.6 Historic and Archeological Resources

The Company's consultant completed a preliminary archeological assessment of the Site which included review of both historic and archeological resources. See Appendix D for details.

Greenwich Substation

No inventoried historic structures or properties listed on the NRHP were identified at or proximate to the Site. Similarly, no archaeological resources were identified on the Site. Therefore, construction of the Substation would not result in impacts to historic or archaeological resources.

Transmission Supply Line Routes

No historic resources are located proximate to either the Preferred Route or the Southern Alternative. Multiple historic resources abut Strickland Road and Route 1, along the Northern Alternative. However, any potential effects on these resources would be temporary in nature, as the entire line would be underground with no permanent visual impacts.

Cos Cob Substation

No inventoried historic structures or archaeological resources were identified on the Site. The property is developed with existing substation equipment and electrical systems infrastructure. The entire site has been previously disturbed, including the area proposed for expansion. Therefore, the proposed modifications to Cos Cob Substation would not result in impacts to historic or archaeological resources.

G.1.7 Noise

Construction noise is exempted under the Connecticut regulations for the control of noise, RCSA 22a-69-1.8(h). However, the temporary increase in construction related noise could potentially raise localized ambient sound levels near work sites. The extent of a noise effect to humans is dependent upon a number of factors, including the change in noise level from ambient, the duration and nature of the noise, the presence of other non-Project noise sources, people's attitudes concerning a specific noise or noise quality, such as tone, the number of people exposed to the noise and the type of activity affected by the noise (e.g. sleep, recreation, conversation). The effect of construction-generated noise on some receptors would also depend on the distance of the receptor from the source location, as sound attenuates with distance and with the presence of vegetative buffers or other barriers.

Standard types of construction equipment would be used for the Project. In general, the highest noise level from this type of equipment is approximately 92 dBA at the source. Taking into consideration the factors that would cause an increase in sound levels to cause public annoyance at noise sensitive receptors, the following procedures may be employed during construction to minimize noise effects at these sites.

- Engine-powered construction equipment would be properly muffled and maintained to minimize excessive noise to the extent possible.
- In areas where rock removal is required, efforts would be made to schedule work to minimize noise and vibration disturbances.
- To the extent feasible, construction work would be scheduled to minimize disruptions to traffic and to residential and business uses.

<u>Greenwich Substation</u>

The construction and testing of the Substation facilities is expected to occur over a 12- to 18-month period. In general, construction hours would be from 7 a.m. to 7 p.m., 6 days per week (Monday through Saturday). Site preparation, including grading and installation of foundations, would take place during the initial 6 months of construction and involve the use of earth-moving equipment and construction vehicles. Noise from these activities is expected to fall within the normal range for construction activities and would be temporary in nature.

After the Substation is placed in service, infrequent impulse noise would be generated from switching and circuit breaker opening and closing. The impulse noise levels and steady-state transformer noise levels are not expected to exceed the levels permitted at the Property line by both the Town of Greenwich Noise Ordinance and CT DEEP's noise regulations (RCSA Title 22a, §22a-69-1 to 22a-69-7.4). Using manufacturer's data for the proposed transformers, the Company calculated projected noise levels at the property lines and determined the projected levels would all fall below the applicable Town criteria of 62 dBA and the CT DEEP's criteria of 66 dBA.

Transmission Supply Line Routes

Construction-related noise for the transmission supply lines would be short-term and highly localized in the vicinity of work sites, would result from the operation of construction equipment; truck traffic; earth moving vehicles and equipment; and jackhammers.

A majority of the transmission supply line construction would be aligned within busy urban road ROWs, where the existing noise environment is influenced by traffic noise, including from I-95 and noise associated with the trains on the nearby railroad.

In general, construction activities are expected to occur over a 12- to18-month period and would typically be performed during the daytime (7:00 AM to 7:00 PM), 6 days per week (Monday through Saturday) when human sensitivity to noise is lower. During the Council's review process, Eversource expects to further define appropriate work hours for construction activities and include this detail in the D&M Plan.

Cos Cob Substation

The construction and testing of the new Cos Cob Substation facilities is expected to occur within the 12- to 18-month Project construction period. In general, construction hours would be from 7 a.m. to 7 p.m., 6 days per week (Monday through Saturday). Site preparation, including grading and installation of foundations, would involve the use of earth-moving equipment and construction vehicles. Noise from these activities is expected to fall within the normal range for construction activities and would be temporary in nature.

After the Cos Cob Substation modifications are in service, infrequent impulse noise would be generated from switching and circuit breaker opening and closing. The planned new equipment is not expected to significantly increase existing noise levels at the facility.

The installation of the Cos Cob Substation terminal structures, interconnection of the transmission supply lines to the Greenwich Substation and connections to the distribution system could occur outside of normal work hours because these activities necessitate taking critical transmission and/or distribution equipment out of service. As a result, this work would be scheduled for off-peak electrical demand hours.

G.1.8 Air Quality

Greenwich Substation

The construction and operation of the Greenwich Substation would result in short-term, highly localized effects on air quality during construction, primarily from fugitive dust and equipment emissions. To minimize the amount of dust generated by construction activities, the extent of exposed/disturbed areas on the Site at any one time would be minimized. Temporary gravel tracking pads would be installed at points of construction vehicle ingress/egress to minimize the potential for equipment to track dirt onto roads. To minimize dust, water may be used to wet down disturbed soils or work areas with heavy tracking, as needed.

Equipment in the GIS building contains the insulating gas sulfur hexafluoride[32] (“SF6”). The Company has had long experience with managing its potential for SF6 releases from its GIS equipment and does not anticipate any impacts to air quality as a result of its application at the Greenwich Substation.

[32] The most common use for SF6, both domestically and internationally, is as an electrical insulator in high voltage equipment that transmits and distributes electricity. Since the 1950s the U.S. electric power industry has used SF6 widely in circuit breakers, gas-insulated substations, and other switchgear used in the transmission system to manage the high voltages carried between generating stations and customer load centers. Like helium, sulfur hexafluoride is a non-toxic gas, but it has been identified as a "greenhouse gas" and utilities are required to monitor and regularly report on any releases of gas from its equipment and to reduce the potential for releases through improvements in the leak rate of new equipment, refurbishing of older equipment, and the use of more efficient operation and maintenance techniques.

Transmission Supply Line Routes

Construction activities along the selected transmission route would also have temporary effects on air quality. Similar techniques as used for the Substation would be employed to minimize dust.

Cos Cob Substation

Similar to the construction activities at Greenwich Substation, short-term and localized effects on air quality are anticipated. To minimize the amount of dust generated by construction activities, the extent of exposed/disturbed areas on the Site at any one time would be minimized. Temporary gravel tracking pads would be installed at points of construction vehicle ingress/egress to minimize the potential for equipment to track dirt onto roads. To minimize dust, water may be used to wet down disturbed soils or work areas with heavy tracking, as needed.

Three (3) new breakers planned for the Cos Cob Substation will each contain SF6.

G.1.9 Public Health, Safety and Security

The Project would be designed, constructed, and maintained in compliance with the standards of the National Electrical Safety Code ("NESC") and other applicable electrical safety codes. The facilities would be designed in accordance with sound engineering practices using established design codes, criteria and guides published by, among others, the Institute of Electrical and Electronic Engineers ("IEEE"), the American Society of Civil Engineers ("ASCE"), the American Concrete Institute ("ACI"), and the American National Standards Institute ("ANSI").

Greenwich Substation

The Substation would be constructed in full compliance with the standards of the NESC, PURA, and good utility practice. In the event that an energized line or substation equipment fails, protective relaying equipment would immediately remove the failed line or equipment from service, thereby protecting the public and the remaining equipment within the Substation.

As a general rule, in its planning process for new substations, the Company carefully designs its facilities to protect the security of the Site and the on-going transmission of electricity. In response to the Council's concerns expressed in its White Paper on the security of siting energy facilities, in addition to the design features and the measures discussed above to monitor the operation of the Greenwich Substation and to discourage unauthorized entry onto the Site.

The perimeter of the Substation would be enclosed by an 8 foot high wrought iron-style fence to discourage unauthorized entry and/or vandalism. The Substation entrance would be gated and locked. All gates would be padlocked at the end of the work day during construction activities and at all times once the Substation is in service. Appropriate signage would be posted at the Substation alerting the general public of high voltage facilities located within the Substation. The Substation would have low-level lighting for safety and security purposes consistent with the lighting in the area. Additional lighting would be available within the Substation yard to facilitate work at night or during inclement weather.

The Greenwich Substation would be equipped with measures to ensure continued service in the event of outages or faults on transmission or substation equipment. Continued reliability would be achieved by providing two 115-kV underground lines, transformer protection, and redundant automatic protective relaying equipment.

Protective relaying equipment would be provided to automatically detect abnormal system conditions (e.g., a faulted overhead transmission line) and would send a protective trip signal to circuit breakers to isolate the faulted section of the transmission system. The protective relaying schemes would include fully redundant primary and backup equipment so that a failure of one scheme would not require the portion of the system being monitored by the protective relaying equipment to be removed from service.

The protective relaying and associated equipment, along with a Supervisory Control and Data Acquisition (“SCADA”) system for remote control and equipment monitoring by the Connecticut Valley Electric Exchange (“CONVEX”) System Operator, would be housed in a weatherproof, environmentally-controlled electrical equipment enclosure.

The Company incorporates IEEE/ANSI and NFPA standards for fire protection in its Substation design and operates these facilities to minimize the impact of fire, in the unlikely event it occurs. Eversource also trains its employees and the local fire department on the safe methods to deal with a substation fire. The control enclosure would be locked and equipped with fire extinguishers, as well as smoke detectors that would be monitored from a remote location. Smoke detection would automatically activate an alarm at CONVEX and the system operators would then take appropriate action. Additional devices would constantly monitor the Substation to alert Eversource of any abnormal or emergency situations.

Transmission Supply Line Routes

Trenching, conduit installation, and backfilling would proceed progressively along the route such that relatively short sections of trench (typically 200 feet per crew) would be open at any given time and location. During non-work hours, temporary cover (steel plates) would be installed over the open trench within paved roads to maintain traffic flow over the work area. After backfilling, the trench area would be repaved using a temporary asphalt patch or equivalent. Disturbed areas would be permanently repaved as part of final restoration.

Eversource recognizes that the installation of buried lines within or adjacent to public roads would cause temporary inconvenience to the public and minor environmental effects. Construction work would be accomplished in several stages, and each stage may require in-road activities that temporarily affect vehicle and pedestrian traffic patterns and land uses in the immediate vicinity. In summary, the construction activities that may affect vehicle and pedestrian traffic patterns are:

- Reconfiguring traffic patterns and setup of traffic control devices;
- Marking the transmission supply lines within the roadway and locating existing utilities;
- Establishing temporary E&S control measures;
- Probing to locate rock and groundwater;
- Relocating existing overhead and underground utilities;

- Trimming or removing trees, fencing, landscaping;
- Installing the splice vaults;
- Trenching and installing the typical duct bank configuration for the transmission lines;
- Temporarily restoring pavement;
- Testing/proofing the transmission conduits (mandrelling and video inspection);
- Pulling the transmission lines into the conduits;
- Pulling the ground continuity conductors into the conduits;
- Splicing the transmission lines;
- Testing lines inside splice vaults;
- Pulling the temperature sensing fiber optic cables;
- Installing pull boxes for remote operation and control of the fiber optic cables;
- Pulling the fiber optic cables for remote operation and control;
- Installing the final roadway pavement;
- Installing off-road pavement and sidewalks; and,
- Reestablishing lawns, fencing, etc.

Cos Cob Substation

The perimeter of the substation expansion area would be enclosed by a 7 foot high chain-link fence (1¼" mesh) topped with 3 strands of barbed wire similar to existing conditions, to discourage unauthorized entry and/or vandalism. The substation entrance would continue to be gated and locked. All gates would be padlocked at the end of the work day during construction activities and at all times once the modifications are complete and in service. Appropriate signage is posted at the Substation alerting the general public of high voltage facilities located within the substation. No new lighting would be installed. Lighting protection is currently available within the substation yard to facilitate work at night or during inclement weather.

G.1.10 Seismic Areas

As with all substations constructed by the Company, the Greenwich Substation and the proposed modifications to Cos Cob Substation would meet or exceed the State Building Code, which includes seismic loading, wind loading, and snow and ice loadings, among others.

G.1.11 Statutory Facilities and Other Surrounding Features in the Project Area

No permanent adverse effects are anticipated to the facilities listed in Table F-2 from construction and operation of the Project, primarily because of their distances from the Site and proposed transmission supply lines.

Temporary effects to portions of Bruce Park would occur during construction of the transmission supply lines. These areas would be restored to their pre-construction state after completion of the construction.

H. Underground Transmission System Design

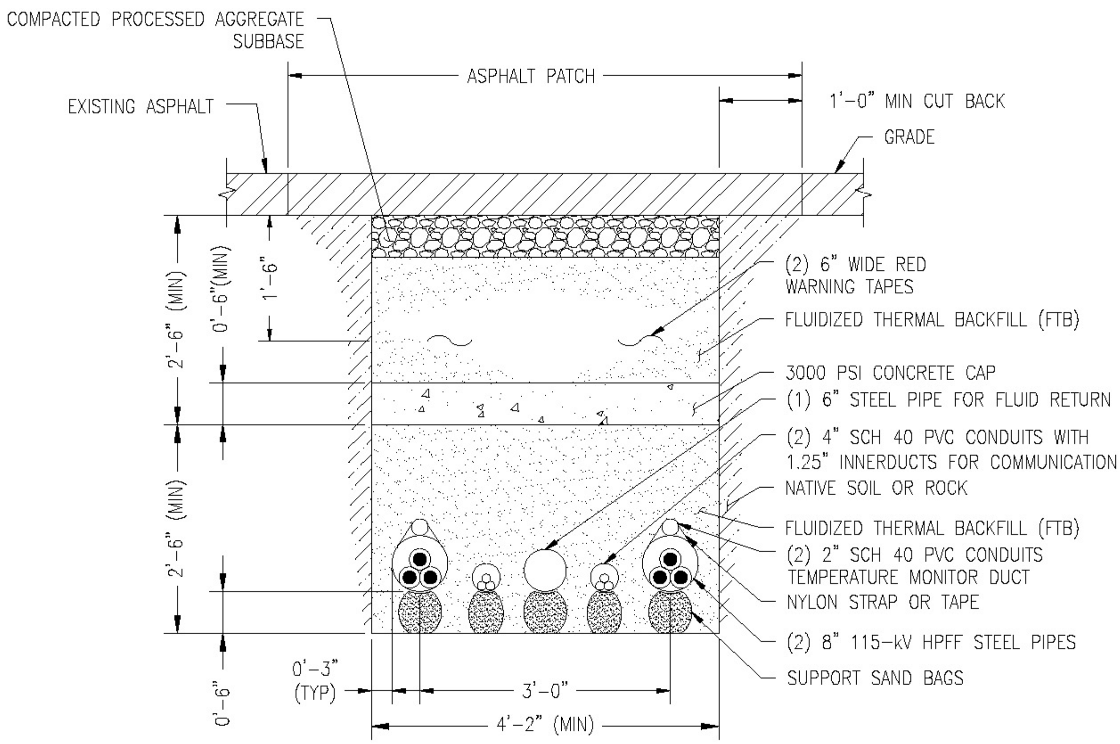
In addition to analyzing potential routes, the Company considered several different design technologies for the proposed underground transmission supply lines, settling on two underground cable technologies: HPFF pipe type cable and cross-linked polyethylene ("XLPE") cable. The load at the Greenwich Substation does not require the larger conductors that are available with XLPE cable technology. The Company concluded that two supply lines would be required to ensure a reliable power source.

Based on the Company's analysis, use of two HPFF cable circuits were determined to be the most appropriate for the Project for the following reasons:

- The HPFF cable can be provided in longer lengths, so fewer vaults and cable splices will be required along the route, resulting in a more cost-effective Project. Also, fewer vaults result in less accessories such as cable splices, which improves reliability since accessories have a higher rate of failure;
- A HPFF cable splice vault is smaller than an XLPE cable splice vault, and unlike XLPE cables, the splices for both HPFF circuits can be housed within the same splice vault. This results in less excavation than a comparable XLPE cable system, and therefore quicker construction and less impact to the community along the route;
- HPFF cable systems have the ability to circulate the dielectric fluid to smooth out hot spots along the cable route. This provides a great advantage over XLPE cable systems when running parallel to existing heat sources, such as the existing distribution circuits along Railroad Avenue or segments of the route requiring deeper installation, such as the HDD crossings;
- The three (3) power cables for each circuit are installed in a single 8-inch pipe versus three (3) individual 8-inch PVC conduits in a concrete duct bank, therefore the HPFF cable system is easier to route and install and should result in a shorter construction duration; and,
- HPFF cable systems can be upgraded with forced-cooling equipment to expand the load carrying capacity in the future.

A 115-kV HPFF underground transmission line system is comprised of the following general components: cable, steel cable pipe, splice vaults, trench, cable splices, terminations, grounding, communications, insulating fluid reservoir, pump house, termination structures and foundations, and a cathodic protection system. The Project's HPFF underground 115-kV line system would consist of two (2) 8-inch steel pipes in a common trench, in which the two HPFF lines would be installed, along with a 6-inch fluid return pipe for fluid circulation, and four (4) fiber optic cables (2 for communications and 2 for dynamic temperature sensing).

The electrical cable carbon steel pipes would be installed in a trench encased in low-strength concrete slurry, also known as fluidize thermal backfill ("FTB") and capped by a protective layer of high-strength concrete. Figure H-1 illustrates a typical trench cross section.



DOUBLE CIRCUIT 3500 kcmil
COPPER CONDUCTOR HPFF CABLE WITH FLUID RETURN
UNDERGROUND T-LINE NORMAL CAPACITY

Figure H-1 Typical High Pressure Fluid Filled (HPFF) Trench Cross Section with Two Line Pipes, Fluid Return Pipe and Communications and Duct Temperature Sensors Ducts

H.1 Lines

The 115-kV HPFF transmission system would consist of three (3) cables per line. Each cable would consist of a 3500-kcmil segmental copper conductor insulated to 115 kV with paper insulation and would be approximately three (3) inches in diameter. Figure H-2 illustrates the cross section of a typical 3500-kcmil segmental copper conductor HPFF 115-kV cable.

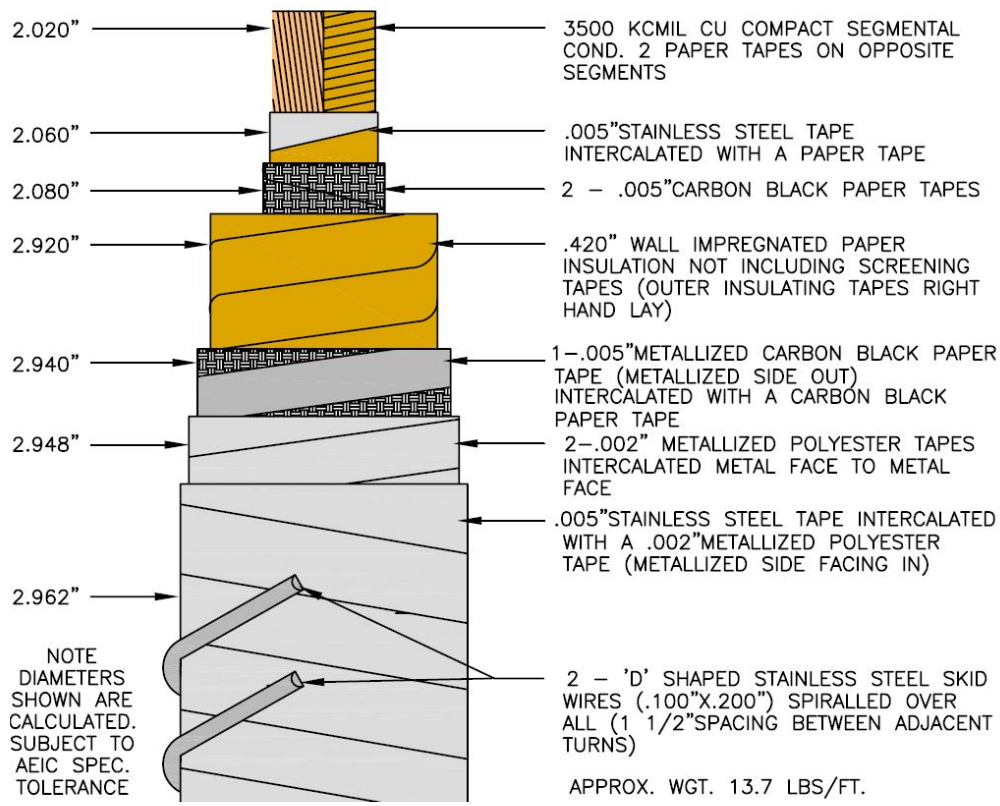


Figure H-2 3500-kcmil Copper Conductor 115-kV HPFF Cable Cross Section

A typical HPFF cable is composed of a conductor, conductor shield (carbon black or metalized paper tapes), insulation (Kraft paper or paper/polypropylene laminate impregnated 'LPP' with polybutene fluid, an insulation fluid that does not contain PCBs), insulation shield (carbon black or metalized paper tapes), a moisture barrier (non-magnetic tapes and metalized mylar tapes), and skid wires placed in a steel pipe filled with dielectric fluid. The purpose of the dielectric fluid is to keep moisture and contaminants out of the pipe and away from the cable. The moisture barrier prevents moisture and other contamination and loss of impregnating fluid prior to installation. The skid wires prevent damage to the cable during pulling.

Three (3) HPFF cables are pulled into a carbon steel pipe to constitute a single line (one circuit). The pipe is coated on the inside with an epoxy coating to prevent oxidation prior to pipe filling and to reduce pulling friction and tension. The pipe exterior is typically coated with polyethylene or epoxy to protect the pipe from environmental corrosion and to isolate the pipe from "ground" to allow use of a cathodic protection system. Figure H-3 shows a typical cable and transmission line pipe cross-section.

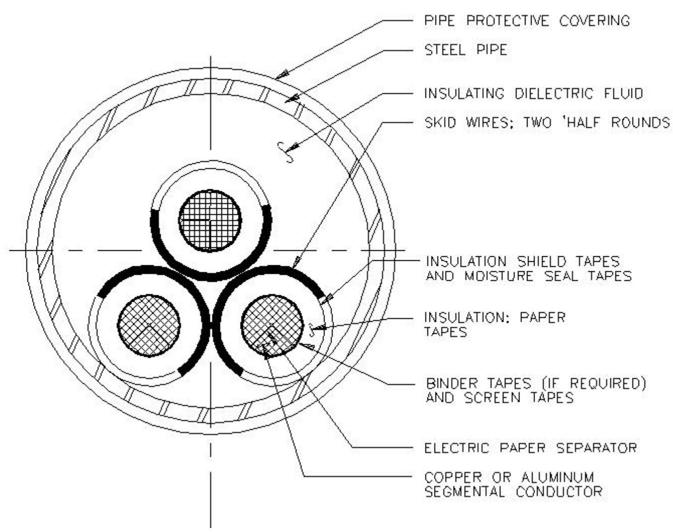


Figure H-3 Typical HPFF Cable and Transmission Line Pipe Cross-Section

The manufacturing process for each individual cable is as follows: a conductor core is covered by wound layers of metalized or carbon black paper tape for the conductor; high quality Kraft paper or paper/polypropylene laminate is then helically wound around the conductor in multiple layers for the insulation; additional layers of metalized or carbon black paper tape are helically wound around the insulation to form the insulation shield; the insulated cable is dried and then impregnated with fluid in large pressurized tanks.

H.2 Splice Vaults

Pre-fabricated splice vaults are installed whenever the maximum installable line length is reached. Limiting factors include maximum allowed pulling tension, and maximum length of line that can be transported on a reel. Reinforced concrete splice vaults are expected to be spaced approximately every 2,000 to 2,800 feet along the Preferred Route. Where possible, splice vaults are placed off of the primary roadway to avoid existing underground utilities and also to minimize the impact on traffic flow during splicing of the cable sections or should restoration work be required. Figure H-4 depicts a typical splice vault installation.

Figure H-4 Typical Splice Vault Installation

The outside dimensions of the splice vault excavation are approximately 24 feet long by 12 feet wide and 12 feet high. The top of the splice vault is installed a minimum of 3 feet below grade with two access holes or “chimneys” requiring manhole covers, each approximately 38 inches in diameter.

H.3 Trench Installation Technique

The most common method for installing an underground HPFF circuit is by open cut trenching. Typically, mechanical excavation is required to remove the concrete or asphalt road surface (for roadways), topsoil, and sub-grade material to the desired depth. Removed material is relocated to an appropriate off-site location for disposal, or occasionally reused as backfill. Once a length of trench is opened and shoring installed, where required, the steel pipes are placed, welded, x-rayed, and assorted conduits are assembled and lowered into the trench. The area around the pipe and conduits is filled with a low strength thermal concrete and capped with a layer of high strength thermal concrete. After the concrete is allowed to set up, the trench is then backfilled and the site restored. Backfill materials would be clean excavated material, thermal sand and/or FTB.

Figure H-5 illustrates a typical trench trenching operation performed during nighttime hours.

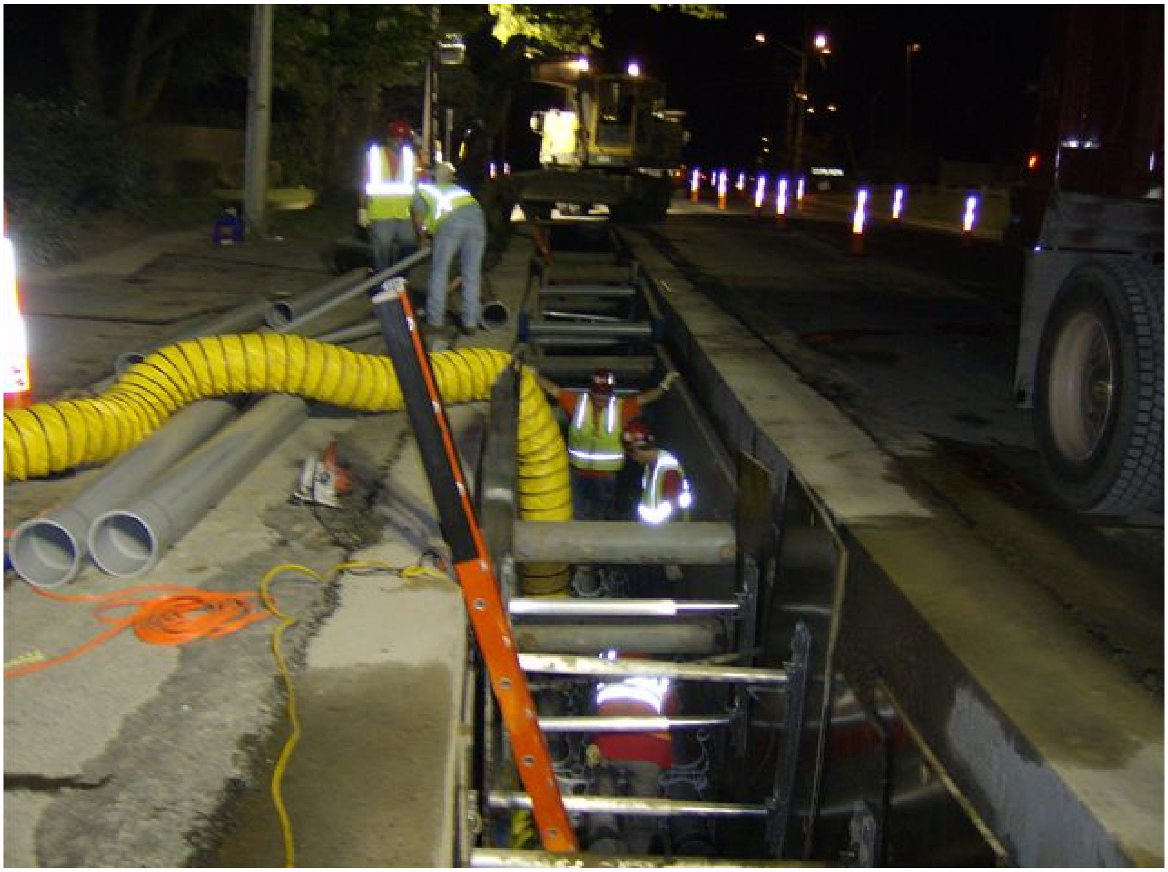


Figure H-5 Typical Trench

H.4 Trenchless Installation Techniques

Horizontal Directional Drill (HDD)

Both the Preferred Route and Southern Alternative would require the use of a horizontal directional drill (“HDD”). HDD is a steerable trenchless method of excavation for underground pipes, conduits and lines in a shallow arc along a prescribed bore path by using a surface-launched drilling rig, with minimal impact on the surrounding area. HDD is used when open trench excavation is not practical.

The HDD installation would consist of three individual bore holes, approximately 14 to 20 inches in diameter, spaced a minimum of 10 feet apart. The HDD installation would have an entry and exit angle of approximately 11 degrees (i.e. very flat) and a minimum bending radius of 800 feet. Depending upon the characteristics of the soil, a casing may be needed at both the entrance and exit of the HDD to prevent the bore from collapsing. After the bore holes have been drilled and reamed to the required diameter, an 8-inch steel pipe, with a 2-inch conduit attached to it, would be pulled through the two outer holes while the 6-inch pipe and the two 4-inch PVC conduits would be pulled through the center hole. HDD work areas are also required for transmission line entrance and exit locations. Figure H-6 shows an HDD equipment setup at the entry location.

Figure H-6 Typical HDD Setup – Entry Location

Pipe jacking

All three (3) routes may require the use of a trenchless installation known as pipe jacking to cross under the MNRR corridor. Pipe jacking is a trenchless installation involving auguring or hand-mining operations that simultaneously jacks or pushes a casing into the excavated cavity. Figure H-7 illustrates a typical pipe jacking installation.

As the equipment progresses forward, subsequent casing segments are added while the soils are removed through the center of the casing. Upon completing the casing installation, the three steel pipes and the PVC conduits are installed inside the casing pipe using specially designed spacers, and the entire casing is then backfilled with thermally designed grout. The grout not only solidifies the installation from any movement, but also helps dissipate heat away from the line system.

The pipe jacking would consist of an approximate 42-inch diameter casing pipe, which will allow personnel to enter the casing should the manual removal of obstacles be necessary.

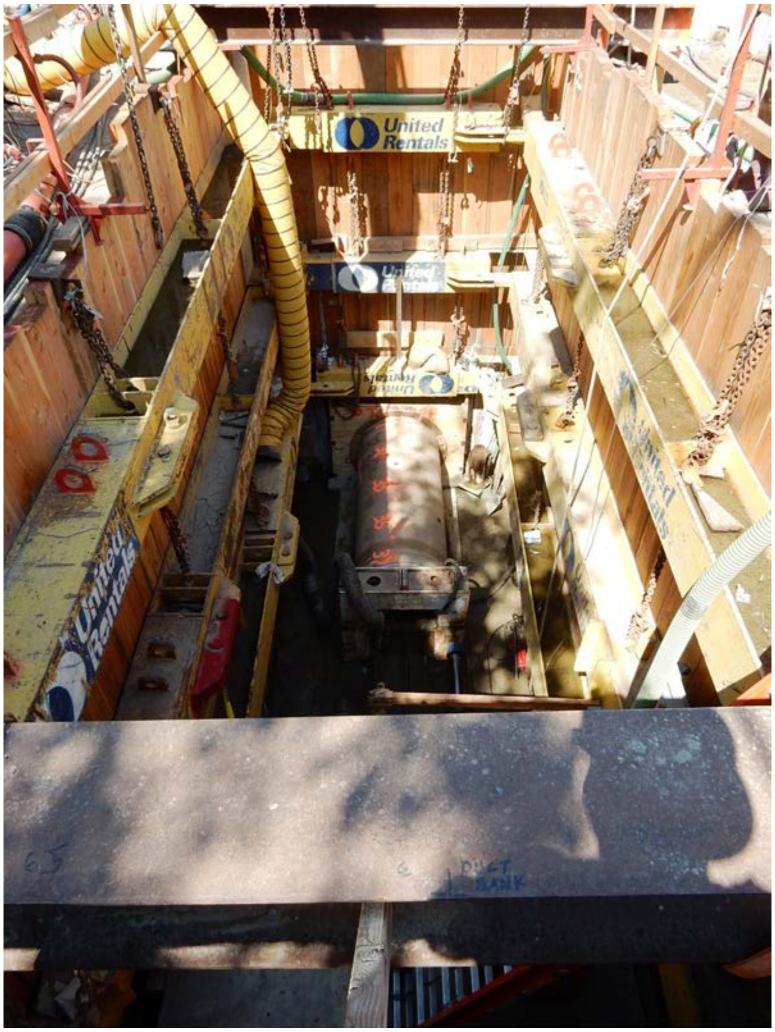


Figure H-7 Pipe Jacking

H.5 Cable Splices

The splicing of the HPFF transmission line cables is performed inside the splice vault, under a controlled atmosphere. A “clean room” atmosphere would be provided by an enclosure or vehicle located over the manhole access points during the splicing process. The splicing activity is a 24 hour a day/7 day a week activity and will take approximately 14 to 16 days to complete both circuits at each splice location. Splicing of HPFF cables begins with removal of the insulation and shields from the conductor; the insulation is tapered down to the conductor and the conductor ends are then joined. Insulation paper tape is wound around the spliced conductor, filling the tapered area of the insulation. Metalized tapes or carbon black tapes are used to re-establish the conductor and insulation shields. Small rolls of paper tape are used, as the three cables are very close together. Figure H-8 shows a typical nearly-finished HPFF splice installation in a vault along with associated equipment.

Figure H-8 Typical 115-kV HPFF Splice Assembly

H.6 Terminations

Terminations are devices that seal the end of the cable to allow it to “transition” to an overhead line, substation buswork or above ground equipment. These terminations are typically mounted on a substation termination structure or an overhead-to-underground transition structure, often called a riser. Terminations are made by first separating the three cables using a trifurcator, which allows the cables to be routed from the 8” pipe to smaller stainless steel pipes connecting to the individual phase terminations. Each phase termination is then made in fluid-filled terminators.

The preparation process closely resembles that of a splice and also requires a controlled atmosphere. Following the installation of the taped stress cone, the ceramic insulator is placed over the cable insulation to control electrical and mechanical stresses.

Termination structures would be installed in the Cos Cob Substation with the underground lines connecting into GIS equipment at the Greenwich Substation for transitioning the two 115-kV circuits from underground lines to the substation bus. Termination structures can have a variety of features and are commonly designed for each unique scenario. Figure H-9 shows an example of a substation termination structure utilizing an above ground spreaderhead as a trifurcator.

Figure H-9 Typical 115-kV HPFF Termination Structure

H.7 Pump House

A pump house must be provided to maintain the required liquid pressure for HPFF cables under all loading conditions and will also provide for slow or rapid fluid circulation to even out hot spots along the line route. The pump house would measure approximately 12 feet high and 50 feet long by 12 feet wide. It would be placed in the southwest corner of the Greenwich Substation Site, adjacent to Field Point Road.

The structure will contain pumps, relief valves and other controls to maintain fluid pressure, recorders, alarms, and a reservoir tank sized to accommodate fluid expansion and contraction as the load on the circuit cycles. The pump house will be serviced by two separate distribution circuits with automatic transfer for backup in case of power loss. Figure H-10 depicts a typical HPFF pump house similar to the proposed pump house for this Project.

Figure H-10 Typical HPFF Pump House

H.8 Transmission Supply Line Service Life

The transmission supply lines and supporting infrastructure have a service life of approximately 40 years.

I. Construction Procedures and Methods

The Project facilities would be constructed in accordance with established electric utility practices, best management practices, final engineering plans, Eversource's specifications and the conditions specified in certificates and permits obtained for the Project. The following subsections describe the land requirements for the development of the Project and the procedures that would be used to construct the Project facilities. During actual construction, certain work activities and sequences may vary, based on factors such as site-specific conditions, final Project designs, and the requirements of regulatory approvals.

I.1 Substation Construction Procedures

Construction of these facilities would involve a similar sequence of activities, as summarized later in this Section. The order of specific activities and methods of construction may vary based on the specific characteristics of each site and the final detail engineering design for each station.

I.1.1 Land Requirements

The new Substation would be developed within the confines of the 0.81-acre, Eversource-controlled Site at 290 Railroad Avenue. Modifications to the existing Cos Cob Substation would be performed on Eversource-owned property and adjoining property.

The Site is of sufficient size and shape to accommodate the new Substation using GIS technology and is free of encumbrances that might otherwise hinder its development. The Site also has direct access from two local roads, which facilitates construction. Upon completion, access would be limited to one point of entry from Field Point Road.

The proposed modifications to Cos Cob Substation require the expansion of the existing fenced area of the facility.

I.1.2 Substation Construction Sequence

I.1.2.1 Site Preparation

Pre-construction work at the new Greenwich Substation and Cos Cob Substation may include, as necessary:

- Installing temporary E&S controls (e.g., silt fence, straw bales). Such controls would be maintained, inspected and replaced as necessary throughout the construction process.
- Removal of the existing building at 290 Railroad Avenue.
- Grading and drainage improvements.

I.1.2.2 Foundation Construction

Foundation construction would commence after the completion of rough grading. The foundation installation would involve excavation, form work, steel reinforcement, and concrete placement. Excavated material would either be reused on-site or disposed of off-site in accordance with applicable requirements.

I.1.2.3 Installation of Equipment

After the foundations are installed, construction activities would shift to the erection of steel-support structures for electrical equipment, such as insulators, bus work, and disconnect switches. In addition, control and power conduits and ground-grid conductors would be installed.

At the new Greenwich Substation, the 115-kV equipment would be housed in a new building. The equipment would be of GIS type which is more compact than a typical air insulated substation. Transmission relay and control equipment will also be contained within the GIS building. Three (3) 115- to 13.2-kV transformers would be installed immediately behind the building with partitioning walls separating each unit. Bus work and switching equipment would be erected on the 115-kV side of each transformer and a distribution switchgear building that houses the 13.2-kV breakers, feeder breakers and protection and control equipment. There would also be auxiliary equipment installed adjacent to the switchgear.

Relay and control equipment would be installed within Cos Cob Substation's existing protective relay and control enclosures.

I.1.2.4 Testing and Interconnections

All of the substation equipment would be tested prior to final connection to the transmission grid. New termination structures and associated conductors and wires would be installed to connect the new transmission line terminals at the existing Cos Cob Substation to the new 115-kV underground transmission facilities.

I.1.2.5 Final Cleanup, Site Security and Restoration

After the facilities at each substation are installed, any remaining construction debris would be collected and properly disposed. Temporary E&S controls would be maintained until soils disturbed by construction activities are stabilized.

Temporary construction security fencing would be replaced with permanent, wrought iron-style fencing at Greenwich Substation. At Cos Cob Substation, Eversource would restore newly disturbed areas substantially to their prior condition. New fencing would be added on the south side of Cos Cob Substation to enclose the expanded area.

I.2 Underground Transmission Line Construction Procedures

The Project's underground 115-kV transmission line cables would be enclosed in pipes and buried in a common trench, along with a fluid return pipe for circulation and conduits for communication and temperature monitoring. Concrete splice vaults will be required for splicing together the cable sections and for pulling in the transmission supply line cables through the pipes. Splice vaults are typically buried at intervals of approximately 2,000 to 2,800 feet depending upon cable construction and route characteristics. Illustrations of typical trench cross-section and splice vault are included in Section H.

I.2.1 Land Requirements

Eversource proposes installing the underground transmission supply lines principally within or adjacent to public roads within the Town. The exact location of the lines and the splice vaults within and adjacent to such roads would be determined based on final engineering designs, taking into consideration the constraints posed by existing buried utilities and the location of other physical features.

Eversource is negotiating with representatives from the MNRR and ConnDOT to obtain rights to install segments of the Project beneath the railroad infrastructure and I-95, respectively. Depending on the final route, Eversource may also need to acquire rights from public and private parties to accommodate portions of the Project.

I.2.1.1 Trench Requirements for Off-Road Construction

For construction other than within public roads, the transmission supply lines would require a dedicated area and permanent easement for the location of the lines and/or splice vaults, and for future access. An additional temporary construction easement will be required for maneuverability of equipment and temporary storage of materials. The size of the temporary construction easement required to accommodate the construction will depend on the design depth of the trench, site-specific topographic conditions and environmental and land-use characteristics.

I.2.1.2 Trench Requirements for In-Road Construction

The installation of the transmission supply lines within a public road usually requires a minimum width of 24 feet to accommodate the excavation of the line trench, equipment, and staging of materials.

Installation of the transmission supply lines within public roads would require coordination with other underground, and potentially overhead, utilities. Prior to the installation of the transmission supply lines, the Project construction methods, including schedule, will be reviewed with the Town, the MNRR and/or ConnDOT for work that will occur within close proximity of Town, the MNRR and/or ConnDOT facilities to address any concerns.

I.2.1.3 Splice Vaults

The outside dimensions of pre-fabricated splice vaults for 115-kV HPFF lines are approximately 9 feet wide by 9 feet high and up to 20 feet long. The installation of each splice vault requires an excavation area approximately 12 feet wide, 12 feet deep, and

24 feet long. The top of the splice vault is installed a minimum of 3 feet below grade with two access holes or “chimneys” requiring manhole covers, each approximately 38 inches in diameter. The actual burial depth of each vault will vary, based on site-specific topographic conditions and on the depth of the pipe sections that must interconnect within the vault (the depth of the lines at any location would be based on factors such as the avoidance of other buried utilities).

Vaults may be installed within public ROWs or, in order to avoid conflicts with other buried utilities, may be installed in suitable locations adjacent to such roads (e.g., beneath parking lots, sidewalks, road shoulders, or road medians). However, the location of vaults off-road complicates construction due to the need to cross other buried utilities twice (going into and out of the splice vault).

Splice vaults located outside of the public ROWs would require a permanent easement, and an additional temporary easement for construction activities. Within the easements for the off-road splice vaults, most uses such as the development of structures and growth of trees would be prohibited to avoid damage and impacts to the operation of the lines.

I.2.1.4 Construction Support Areas

During construction, areas for temporarily storing and staging construction materials and equipment would be required in the vicinity of the transmission line route. To the extent possible, these construction support areas would be located on previously disturbed property (e.g., Eversource property, existing parking lots and other commercial properties, or properties formerly used for other types of construction staging, such as highway work). Landowner permission and regulatory approvals (as appropriate) would be obtained for the temporary use of such sites.

Eversource would establish one or more primary construction support areas near the Project area. These areas are used to store construction equipment, materials (including the conduits and splice vaults), and supplies, as well as to park contractor vehicles and parking for personal vehicles. Materials may also be assembled in the yards before they are delivered to work sites. After the completion of construction, the yard sites would be vacated with restoration according to the individual agreement with the landowner and the extent to which the support activities altered the site.

Smaller staging areas would be established next to active construction work sites, such as within or adjacent to roads (e.g., within paved travel lanes, on road shoulders, on road medians, or in parking lots), and would be used temporarily to park equipment, sanitary facilities, and store limited amounts of materials needed for line system installation (e.g., trench boxes, backfill material). Material deliveries would be more frequent in areas where less storage space is available.

As construction progresses along the line route, temporary support sites would be moved to keep equipment and materials near active work locations. Once a temporary construction support area is no longer needed, it would be restored substantially to its previous condition.

I.2.2 Underground Transmission Line Construction Sequence and Methods

The Project construction is expected to be completed over a 12 to 18 month period. However, the transmission supply line construction would be divided into multiple components so that the actual work at any one location would be periodic and would involve various discrete tasks performed in the area at different times. Such multiple mobilizations to an area cannot be avoided due to the sequential nature of the underground line installation work. However, the transmission supply line installation would involve parallel activities and multiple construction crews which would be deployed at the same time to perform construction activities at various locations along the line route.

For example, trenching and trench installation may be performed at various locations along the line route concurrently, using separate crews. At the same time, other crews may be dedicated to the installation of splice vaults. The time required for both trenching and splice vault installation is based on factors such as subsurface conditions (e.g., the presence of rock or groundwater) that dictate the use of special construction procedures, the depth at which the vaults or trenches must be installed, and conflicts with existing utilities that may need to be relocated. The activities involved in the line system construction are further described below.

I.2.2.1 Final Design and Pre-Construction Planning

Prior to the start of construction, Eversource would undertake location-specific studies and surveys and other activities which would include, but not be limited to:

- Conducting surveys to identify existing underground and overhead infrastructure and developing plans for the temporary or permanent relocation, if required, of facilities such as electric, gas, water, sewer, telecommunication facilities, utility poles, traffic signals, hydrants, and bus stops;
- Conducting analyses of soil and groundwater conditions along the line route and preparing plans for soil and groundwater handling during construction; and
- Identifying locations of construction storage yards and construction support areas and obtaining approvals for using such areas. Eversource would continue to consult or coordinate with the Town, as needed.

I.2.2.2 Construction Process

The first step in the construction process would be to deploy appropriate E&S controls (e.g., catch basin protection, silt fence or straw bales, as necessary) at locations where pavement or soils would be disturbed. Within roads and other paved areas, the pavement then would be saw cut and removed.

To install the pipe, a trench would be excavated approximately 6 to 10 feet deep and approximately 5 feet wide (for trench depths requiring shoring to stabilize the sidewalls). Excavated material (e.g., pavement, subsoil) would be placed directly into dump trucks and hauled away to a suitable disposal site or a temporary storage site for screening/testing prior to final disposal, or re-used in the excavations for backfill. If groundwater is encountered, dewatering would be performed in accordance with authorizations from applicable regulatory agencies and may involve discharge to catch basins, temporary settling basins, temporary holding tanks (frac tanks), or vacuum trucks.

For the transmission supply lines, the pipes and conduits would be installed in sections. The steel pipes will be delivered in approximately 40-foot lengths and welded together in the field, while the PVC conduits would be delivered in sections between 10 to 20 feet long and joined by swabbing the bell and spigot with glue and then pushing the sections together. After installation in the trench, the pipes and conduits would be encased in a low strength thermal concrete. The trench would then be backfilled with material with sufficient thermal characteristics to help dissipate the heat generated by the lines (thermally approved clean excavated material, thermal sand and/or a FTB).

Trenching, pipe installation, and backfilling would proceed progressively along the route such that relatively short sections of trench (typically 200 feet per crew) would be open at any given time and location. Work zones around the trench area usually range from approximately 600 to 800 feet. During non-work hours, temporary cover (steel plates) would be installed over the open trench within paved roads to maintain traffic flow over the work area. After backfilling, the trench area would be repaved using a temporary asphalt patch or equivalent. Disturbed areas would be permanently repaved as part of final restoration.

At intervals of approximately 2,000 to 2,800 feet along the line route, pre-cast concrete splice vaults would be installed below ground. The length of an underground line section between splice vaults (and therefore the location of the splice vaults) is determined based on engineering requirements (such as the maximum allowable cable pulling tensions; maximum allowable cable sidewall pressure; and, cable weight/length that can fit on a reel and be safely shipped) as well as land constraints. The specific locations of splice vaults would be determined during final engineering design.

For safety purposes, the splice vault excavation would be shored and fenced. Vault sites also may be demarcated by concrete (Jersey) barriers. Vault installation within roadways may require the closure of travel lanes in the immediate vicinity of the vault construction.

Each vault would have two entry points to the surface (manholes). After backfilling, these entry points would be identifiable as manhole covers, which would be set flush with the ground or road surface.

After the vaults and pipes and conduits are in place, the pipes and conduits would be swabbed and tested (proofed), using an internal inspection device (mandrel), to check for defects that could damage the lines upon pulling or during normal operation. Mandrelling is a testing procedure in which a “pig” (a painted aluminum or wood cylindrical object that is slightly smaller in diameter than the pipe or conduit) is pulled through the pipes and conduits. This is done to ensure that the “pig” can pass easily, verifying that the pipes and conduits have not been crushed, damaged, or installed improperly. After successful proofing, the transmission lines and fiber optic cables would be installed and spliced. Cable reels would be delivered by tractor trailers to the vault sites, where the cable would be pulled into the conduit using a truck-mounted winch and cable handling equipment.

To install each transmission line within the pipes, 3 large cable reels would be set up over the splice vault and a winch would be set up at one of the adjacent splice vault locations. The lines would then be pulled into the pipes by winching a pull rope attached to the end of a pulling eye attached to all 3 individual cables. The splice vaults would also be used as pull points for installing the temperature monitoring fiber optic cables under a separate pulling operation. In addition, pull boxes hand holes would be installed near the splice vaults for the pulling and splicing operations required for the communications fiber optic cables.

After the transmission lines are pulled into their respective pipes, the ends would be spliced together in the vaults or terminated inside the substations. Because of the time-consuming precise nature of splicing high-voltage transmission lines, their sensitivity moisture (moisture is detrimental to their useful life), and the need to maintain a clean working environment, splicing HPFF lines is a complex procedure and requires a controlled atmosphere. A “clean room” atmosphere would be provided by an enclosure or vehicle located over the manhole access points during the splicing process. It is expected to take approximately 14 to 16 days to complete the splicing operation in each splice vault (two 3-phase HPFF115-kV cable splices in each splice vault). During commissioning, access to splice vaults may also be required.

J. Electric and Magnetic Fields

Electric fields and magnetic fields (collectively “EMF”) are forms of energy that surround an electrical device.

EF are produced within the surrounding area of a conducting object (e.g., a wire) when a voltage is applied to it. Electric fields are measured in units of kilovolts per meter (“kV/m”). The level of an EF near to energized power line depends on the applied voltage, the distance between the conductors, and the distance to the measurement location.

Magnetic fields are produced within the surrounding area of a conductor or device which is carrying an electric current. Magnetic fields are measured in units of milliGauss (“mG”). The level of a magnetic field near to line conductors carrying current depends on the magnitude of the current, the distance between conductors, and the distance from the conductors to the measurement location.

Both electric and magnetic fields decrease rapidly as the distance from the source increases, and even more rapidly from electric equipment in comparison to line conductors. Electric fields levels are further weakened by obstructions such as trees and building walls, while magnetic fields pass through most obstructions. In the case of parallel lines of circuit conductors, the levels of electric fields and magnetic fields are also dependent on the phasings of the circuits.

The highest levels of EMF around the perimeter fence of a substation occur where transmission and distribution circuits cross over or under the substation boundary. The levels of fields from substation equipment decrease rapidly with distance, reaching very low levels at relatively short distances beyond the fenced-in equipment.

Substation-caused magnetic fields off the property of a substation will commonly be in the same range as the background MF levels in homes, which commonly range up to 4 mG.

Transmission lines are common sources of EMF, as are other components of electric power infrastructure, ranging from transformers and distribution lines, to the wiring and appliances in a home. To address concerns regarding potential health risks from exposure to EMF, the Council issued a policy document entitled, *Electric and Magnetic*

Fields Best Management Practices for the Construction of Electric Transmission Lines in Connecticut ("EMF BMP Document") and which was most recently revised by the Council on February 20, 2014. The EMF BMP document summarized the latest information regarding scientific knowledge and consensus on EMF and health concerns and adopted best practices concerning the design of new transmission lines, with respect to EMF. In the EMF BMP Document, the Council recognized "that a causal link between power-line magnetic fields exposure and demonstrated health effects has not been established, even after much scientific investigation in the U.S. and abroad," and "that timely additional research is unlikely to prove the safety of power-line magnetic fields to the satisfaction of all." Accordingly, the Council decided to "continue its cautious approach to transmission line siting that has guided its Best Management Practices since 1993." As the Council states in the EMF BMP Document:

> [t]*his continuing policy is based on the Council's recognition of an agreement with conclusions shared by a wide range of public health consensus groups, and also, in part, on a review which the Council commissioned as to the weight of scientific evidence regarding possible links between power-line MF and adverse health effects. Under this policy, the Council will continue to advocate the use of effective no-cost and low-cost technologies and management techniques on a project-specific basis to reduce MF exposure to the public while allowing for the development of efficient and cost-effective electrical transmission projects*.

Pursuant to this policy, the EMF BMP Document requires an applicant proposing to build an overhead electric transmission line to develop and present a Field Management Design Plan that identifies design features to mitigate MF that would otherwise occur along an electric transmission ROW, particularly where the line will be "adjacent to residential areas, public or private schools, licensed child day care facilities, licensed youth camps, or public playgrounds."

The EMF BMP Document also requires transmission line applicants to present calculations of magnetic fields under pre-project and post-project conditions, assuming the use of different transmission line design alternatives. The purpose of this requirement is to "allow for an evaluation of how magnetic fields levels differ between alternative power line configurations," in order to "achieve reduced magnetic fields levels when possible through practical design changes." However, the reduction of magnetic fields is only one of the factors that the Council will consider in approving particular line designs. Other factors include "cost, system reliability, aesthetics, and environmental quality."

The EMF BMP Document is provided as Appendix G.

The Company prepared initial calculations of predicted magnetic fields from the transmission lines along the Preferred Route under average annual load conditions. The results of these calculations are included in Figure J-1. The graph illustrates the anticipated magnetic fields under a projected average annual loading condition in the year 2022, with respect to distance from the centerline of the transmission line trench. These calculations apply at 1 meter (3.28 feet) above grade, and assuming that the depth below grade of the uppermost cable is 3.5 feet. The graph shows that the magnetic fields is highest at 0.44 mG directly above the line and will drop to below 0.1 mG within 15 feet on either side of the transmission line.

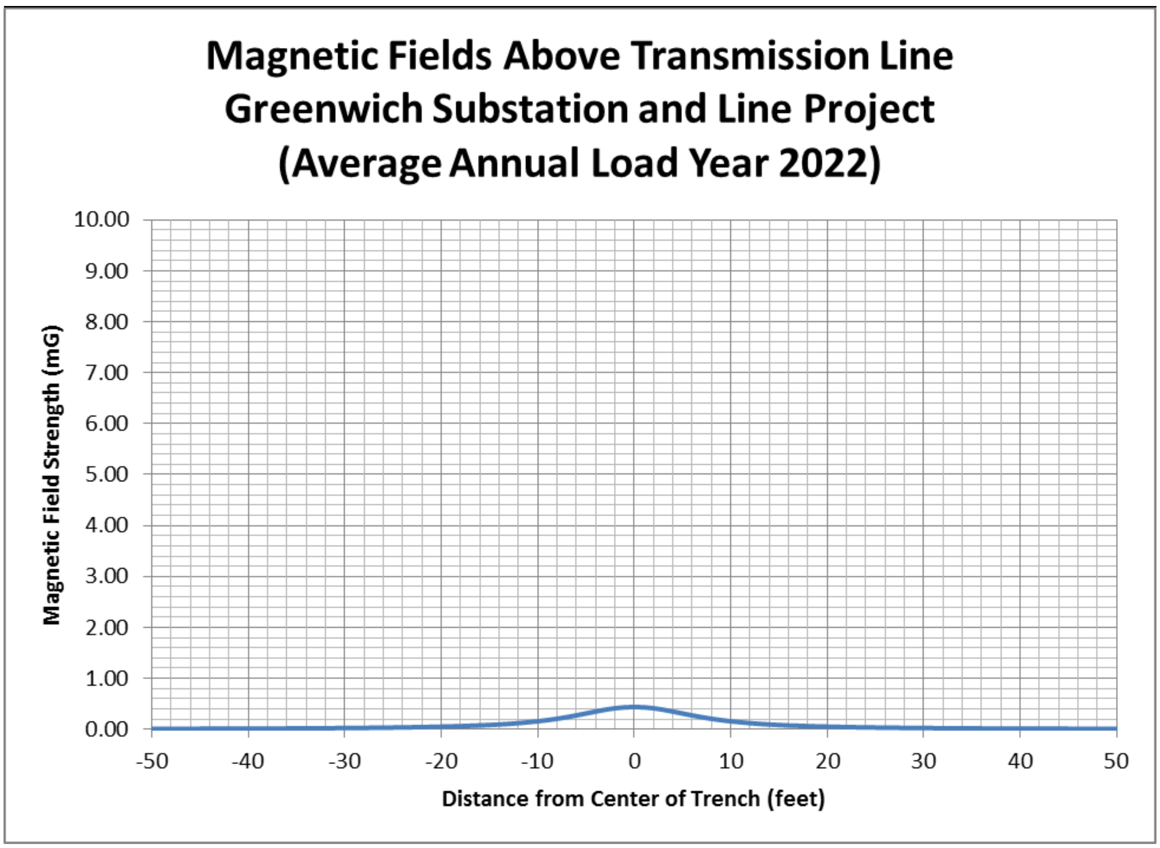


Figure J-1 Projected Magnetic Fields Along the Preferred Route

In addition to specific information about a proposed transmission line, the Council considers certain general EMF information in the course of a proceeding on a transmission line application, including “evidence of any new developments in scientific research addressing MF [magnetic fields] and public health effects or changes in scientific consensus group positions regarding MF.” Accordingly, the Company commissioned an independent expert to prepare a report concerning any such developments, which it will present with its application.

K. Project Schedule and Costs

K.1 Project Schedule

Major milestones established for the Project are as follows:

- Municipal Consultation Filing Submittal – First Quarter, 2015
- Open House – First Quarter, 2015
- Connecticut Siting Council Filing – Second Quarter, 2015
- Decision and Order – Second Quarter, 2016
- Construction Start – Third Quarter, 2016
- Construction Complete and In-Service Date – Fourth Quarter, 2017

K.2 Estimated Costs of the Project

The estimated cost for the siting, design, and construction of the Project, including the Greenwich Substation, transmission lines and Cos Cob Substation modifications is approximately $140,000,000.

General Glossary of Terms

(All terms may not be used in this document)

115 kV:	115 kilovolts or 115,000 volts.
AC:	Alternating Current. An electric current which reverses its direction of flow periodically. (In the United States this occurs 60 times a second -60 cycles or 60 Hertz). This is the type of current supplied to homes and businesses.
ACI:	American Concrete Institute.
Alternate Routes:	Underground routes described in Section E.4.
Ampacity:	The maximum amount of electrical current a conductor or device can carry before sustaining immediate or progressive deterioration; a current rating or current-carrying capacity.
Ampere (Amp):	A unit measure for the flow (current) of electricity. A typical home service capability (i.e., size) is 100 amps; 200 amps is required for homes with electric heat.
ANSI:	American National Standards Institute.
Arrester:	Protects lines, transformers and equipment from transient overvoltages due to lightning and switching surges by carrying the charge to ground. Arresters serve the same purpose on a line as a safety valve on a steam boiler.
ASCE:	American Society of Civil Engineers.
BMP:	Best Management Practices.
Bus:	A conductor capable of carrying large amounts of current in a substation.
C&D Plan:	*Conservation and Development Policies Plan for Connecticut 2005 – 2010.*
Cable:	A fully insulated conductor usually installed underground but in some circumstances can be installed overhead.
CCMA:	Connecticut Coastal Management Act.
CCVT:	Capacitor coupling voltage transformer.
Certificate:	Certificate of Environmental Compatibility and Public Need issued by the Connecticut Siting Council.

CGS:	Connecticut General Statutes.
Circuit:	A system of conductors (three conductors or three bundles of conductors) through which an electric current is intended to flow and which may be supported above ground by transmission structures or placed underground.
Circuit Breaker:	A switch that automatically disconnects power to the circuit in the event of a fault condition. Located in substations. Performs the same function as a circuit breaker in a home.
CL&P:	The Connecticut Light and Power Company.
ConnDOT:	Connecticut Department of Transportation.
Conductor:	A metallic wire, busbar, rod, tube or cable which serves as a path for electric current to flow.
Conduit:	Pipes, usually PVC plastic, typically encased in concrete, for underground power cables.
Contingency:	The unexpected failure or outage of a system component, such as a generator, transmission line, circuit breaker, switch or other electrical element
CONVEX:	Connecticut Valley Electric Exchange.
Council:	Connecticut Siting Council.
CT DEEP:	Connecticut Department of Energy and Environmental Protection.
dBA:	Decibel, on the A-weighted scale.
Demand:	The total amount of electric power required at any given time by an electric distribution company's customers.
D&M Plan:	Development and Management Plan (required by the Connecticut Siting Council).
Disconnect Switch:	Equipment installed to isolate circuit breakers, transmission lines or other equipment for maintenance or sectionalizing purposes.
Distribution:	Line, system. The facilities that transport electrical energy from the transmission system to the customer.
Duct:	Pipe or tubular runway for underground power cables (see also Conduit).

Duct Bank: A group of ducts or conduit usually encased in concrete in a trench.

Electric Field (EF): Produced by voltage applied to conductors and equipment. The electric field is expressed in measurement units of volts per meter (V/m) or kilovolts per meter (kV/m); 1 kV/m is equal to 1,000 V/m.

Electric Transmission: The facilities (69-kV+) that transport electrical energy from generating plants to distribution substations.

EMF: Electric and magnetic fields.

EPA: United States Environmental Protection Agency.

E&S: Erosion and sedimentation.

Eversource: The Connecticut Light and Power Company doing business as Eversource Energy.

Fault: A failure (short circuit) or interruption in an electrical circuit.

FEMA: Federal Emergency Management Agency.

FERC: Federal Energy Regulatory Commission.

FTB: Fluidized thermal backfill.

G: Gauss; 1G = 1000 mG (milliGauss); the unit of measure for magnetic fields.

GIS: Gas-Insulated Substation; a substation design consisting of 3 phases of electrical bus bar that is contained within sealed piping (about 2 feet in diameter) that is filled with insulating SF6 gas (Sulfur Hexafluoride) to provide the insulation required for the substation buses and conductors. The GIS design reduces the substation foot print significantly when compared to the equivalent sized Air Insulated Design.

Glacial till: These deposits are predominantly nonsorted, nonstratified sediment and are deposited directly by glaciers. These deposits consist of boulders, gravel, sand, silt, and clay mixed in various proportions.

Ground continuity conductor: A conductor laid parallel to a cross-bonded or single point bonded cable circuit to provide a continuous metallic ground connection between the grounding systems at the ends of the cable route and along the run.

Ground Wire: Cable/wire used to connect wires and metallic structure parts to the earth. Sometimes used to describe the lightning shield wire.

HAER:	Historic American Engineering Record.
HDD:	Horizontal Directional Drilling.
HPFF:	High-pressure fluid-filled; a type of underground transmission line.
Hz:	Hertz, a measure of the frequency of alternating current; one cycle/second.
IEEE:	Institute of Electrical and Electronic Engineers.
ISO:	Independent System Operator.
ISO-NE:	ISO New England, Inc.; referred to as New England's Independent System Operator.
kcmil:	1000 circular mils, approximately 0.0008 sq. in.
kV:	kilovolt, equals 1000 volts.
kV/m:	Electric field strength measurement (kilovolts/meter).
Line:	A series of overhead transmission structures which support one or more circuits; or in the case of underground construction, a subsurface installation housing one or more cable circuits.
Load:	Amount of power delivered as required at any point or points in the system. Load is created by the power demands of customers' equipment (residential, commercial, and industrial).
Load Pocket:	Load area that has insufficient transmission import capacity and must rely on out-of merit order local generation.
Magnetic Field (MF):	Produced by the flow of electric current; usually measured as magnetic flux density in units called gauss (G) or milliGauss (mG) – 1/1000 Gauss.
Magnetic Flux Density:	Level of magnetic field.
MCF:	Municipal Consultation Filing (Connecticut Siting Council).
mG:	milliGauss (see Magnetic Field) – 1/1000 Gauss.
MOD:	Motor-Operated Disconnect switch.
MVA:	Megavolt Ampere) Measure of electrical capacity equal to the product of the voltage times the current times the square root of 3. Electrical equipment capacities are sometimes stated in MVA.

MW: Megawatt. Megawatt equals 1 million watts, measure of the work electricity can do.

NAAQS: National Ambient Air Quality Standards.

NDDB: Natural Diversity Data Base (CT DEEP).

NERC: North American Electric Reliability Council, Inc..

NESC: National Electrical Safety Code.

NPCC: Northeast Power Coordinating Council.

NRCS: Natural Resources Conservation Service.

NRHP: National Register of Historic Places.

NWI: National Wetlands Inventory.

OH (Overhead): Electrical facilities installed above the surface of the earth.

OPGW: Optical groundwire (a shield wire containing optical glass fibers for communication purposes)

Phases: Transmission (and some distribution) AC circuits are comprised of three phases that have a voltage differential between them.

PCBs Polychlorinated biphenyls

Preferred Route: The underground route described in this document.

PUESA: Public Utility Environmental Standards Act.

Pump House: Maintains the required liquid pressure for HPFF cables under all loading conditions.

PURA: Public Utilities Regulatory Authority.

PVC: Polyvinyl Chloride.

RCSA: Regulations of Connecticut State Agencies.

RFP: Request for Proposal.

ROW: Rights-of-way; corridor of land within which a utility company holds legal rights necessary to build, operate and maintain power lines.

Riser Pole: Transmission structure, used to transition from underground cable to overhead conductor, consisting of a single tubular steel column with horizontal arms to support cable terminations.

SCADA: Supervisory Control and Data Acquisition.

SF_6: (Sulfur Hexafluoride) A colorless gas soluble in alcohol and ether, slightly soluble in water. A greenhouse gas used primarily in electrical transmission and distribution systems and as a dielectric in electronics.

SHPO: State Historic Preservation Office (State of Connecticut Commission on Culture and Tourism, Historic Preservation and Museum Division).

Splice: A device to connect together the ends of bare conductor or insulated cable.

Splice Vault: A buried concrete enclosure where underground cable ends are spliced and cable-sheath bonding and grounding are installed.

SRHP: State Register of Historic Places.

SSURGO: Soil Survey Geographic database.

Substation: A fenced-in yard containing switches, transformers, line-terminal structures, and other equipment enclosures and structures. Adjustments of voltage, monitoring of circuits and other service functions take place in this installation.

SWCT: Southwest quadrant of the State of Connecticut.

SWRPA: South Western Regional Planning Agency.

Terminal: The substation or switching station at which a transmission line terminates.

Terminal Structure: Structure typically within a substation that ends a section of transmission line.

Transformer: A device used to transform voltage levels to facilitate the efficient transfer of power from the generating plant to the customer. A step-up transformer increases the voltage while a stepdown transformer decreases it.

Transmission Line: Any line operating at 69,000 or more volts.

UG (Underground): Electrical facilities installed below the surface of the earth.

USDA: United States Department of Agriculture.

USGS: United States Geological Survey (U.S. Department of the Interior).

UI: The United Illuminating Company

USFWS: United States Fish and Wildlife Service.

Vault: See Splice Vault.

V/m: Volts per meter; kilovolt per meter; 1000 V/m = 1 kVm.

Voltage: A measure of the push or force which transmits electricity. Usually given as the line-to-line root-mean square magnitude for three-phase systems.

Watercourse: Rivers, streams, brooks, waterways, lakes, ponds, marshes, swamps, bogs, and all other bodies of water, natural or artificial, public or private.

Wetland: An area of land consisting of soil that is saturated with moisture, such as a swamp, marsh, or bog.

Wire: See Conductor.

XLPE: Cross-linked polyethylene (solid dielectric) insulation for transmission.