CONNECTICUT SITING COUNCIL

DRAFT FINDINGS OF FACT

~FOR~

DOCKET NO. 461 - Eversource Energy application for a Certificate of Environmental Compatibility and Public Need for the construction, maintenance, and operation of a 115-kilovolt (kV) bulk substation located at 290 Railroad Avenue, Greenwich, Connecticut, and two 115-kV underground transmission circuits extending approximately 2.3 miles between the proposed substation and the existing Cos Cob Substation, Greenwich, Connecticut, and related substation improvements.

May 12, 2016

Table of Contents

Findings of Fact - Docket 461

Section		Page Number
I.	Introduction	1
	Council Procedures	2
	Municipal Consultation and Community Outreach	3
	State Agency Comments	4
	System Planning and Mandatory Reliability Standards	4
II.	Project Need	5
	Needs Assessment	5
	Greenwich Area Electric System	7
	Electric System Interim Measures	9
	Current Electric System Reliability and Capacity Issues	9
	Load Forecasting	12
	GSLP Reliability and Capacity Improvements	13
III.	Project Alternatives	15
	No Action Alternative	15
	Transmission Alternatives	15
	Non-Transmission Alternatives	16
IV.	Project Description	26
	Proposed Greenwich Substation	28
	Other Potential Substations Evaluated	31
	Cos Cob Substation Modifications	33
	Byram and Prospect Substation	34
	New 115 kV Transmission Line – Potential Routes	34
	Preferred Underground Route	34
	Northern Alternative	35
	Southern Alternative	35
	Hybrid Alternative	35
	Other Routes Examined and Rejected	37
	Underground Transmission System Design	38
V.	GSLP Construction Procedure	38
	HPFF Underground Cable System	39
	Horizontal Directional Drilling	40
VI.	Public Safety	41
VII.	Environmental Considerations	43
	Land Use	43
	Soil and Earthwork	44
	Water Resources	46
	Inland Wetlands and Watercourses	47
	Coastal Area Resources	47

Flood Hazard Areas 47
Groundwater 47
Vegetation 48
Fish and Wildlife 48
Historic Resources 49
Air Quality 49
Noise 49

VIII. Electric and Magnetic Fields 50

IX. Project Cost and Cost Allocation 52

ATTACHMENTS

1. Summary of GSLP Substation Additions and Retirements 54
2. Preferred Route 55
3. Preferred Route – Bruce Pak Variations 56
4. Southern and Northern Alternative Routes 57
5. Hybrid Alternative Route 58

DOCKET NO. 461 - Eversource Energy application for a Certificate of Environmental Compatibility and Public Need for the construction, maintenance, and operation of a 115-kilovolt (kV) bulk substation located at 290 Railroad Avenue, Greenwich, Connecticut, and two 115-kV underground transmission circuits extending approximately 2.3 miles between the proposed substation and the existing Cos Cob Substation, Greenwich, Connecticut, and related substation improvements.	}	Connecticut Siting Council May 12, 2016

Findings of Fact

Introduction

1. Pursuant to Connecticut General Statutes (C.G.S.) §16-50g et seq., on June 26, 2015, The Connecticut Light and Power Company doing business as Eversource Energy (Eversource), applied to the Connecticut Siting Council (Council) for a Certificate of Environmental Compatibility and Public Need (Certificate) for the construction, maintenance, and operation of a new 115-kilovolt (kV) bulk substation located at 290 Railroad Avenue, Greenwich, Connecticut, and two 115-kV underground transmission circuits extending approximately 2.3 miles between the proposed substation and the existing Cos Cob Substation including related substation improvements in Greenwich, Connecticut. (Greenwich Substation and Line Project or GSLP). (Eversource 1, p. ES-1)

2. The GSLP is a reliability project, the purpose of which is to provide immediate load relief and add transformer capacity to the electric distribution supply system in the Town of Greenwich by:
   a) establishing a new bulk substation near the center of the customer electrical demand (or "load") to avoid overloads on system equipment;
   b) installing two separate 115-kV transmission circuits that would extend approximately 2.3 miles from Cos Cob Substation on Sound Shore Drive to connect to the new bulk substation at 290 Railroad Avenue; and,
   c) modifications at Cos Cob Substation.

   (Eversource 1, p. A-1)

3. The parties in this proceeding are Eversource, the Office of Consumer Counsel (OCC) and the Town of Greenwich (Town). The intervenors are Parker Stacy; Pet Pantry Super Discount Stores LLC; Field Point Estate Townhouses, Inc.; Christine Edwards; Richard Granoff; Bella Nonna Restaurant and Pizzeria; Cecilia Morgan; Greenwich Chiropractic & Nutrition; Joel Paul Berger; and Meg Glass. (Transcript, September 1, 2015, 3:00 p.m. [Tr. 1], pp. 4-5 and 6:30 p.m. [Tr. 2], p. 3; Transcript, October 6, 2015, 11:00 a.m. [Tr. 3] p. 3; Transcript, December 21, 2015, 11:00 a.m. [Tr. 4] pp. 2-4; Transcript, January 12, 2016, 11:00 a.m. [Tr. 5] pp. 2-3); Transcript, February 23, 2016, 11:00 a.m. [Tr. 6] pp. 3, 4)

4. During the public hearing held on September 1, 2015, a public meeting held on September 17, 2015 and a public meeting held on October 1, 2015 the Council grouped the following intervenors with the same interests pursuant to C.G.S. §16-50n(c): Bella Nonna Restaurant and Pizzeria, Greenwich Chiropractic & Nutrition, Joel Paul Berger and Meg Glass. (Council Memorandum dated September 2, 2015; Council Meeting Minutes of September 17, 2015 and Council Meeting Minutes of October 1, 2015)

5. Pursuant to CGS §16-50/(b), Eversource provided legal service and notice of the application. This included notice to the Town; federal, state, local and regional agencies; elected officials; and abutters to the existing Cos Cob Substation, as well as abutters to the proposed site and an alternate site of the new Greenwich Substation. Eversource published notice of the application filing in the Greenwich

Time on June 24, 2015 and The Stamford Advocate on June 25, 2015. Eversource included a project information insert in one or more of its monthly bills to customers in the Town located within the vicinity of the Preferred Route, Preferred Route with Variation and Alternate Routes within 60 days before submission of the application to the Council. (Eversource 1, p. Q-15; Bulk Filing #2; Affidavit of Service of Application; Affidavit Regarding Publication of Legal Notice; Affidavit Regarding Notice Provided to Customers)

6. On or before June 26, 2015, Eversource provided project notice to property owners abutting the proposed substation at 290 Railroad Avenue, a proposed alternate substation location at 281 Railroad Avenue, and the Cos Cob Substation. (Eversource 1, pp. Q-14, Q-15; Eversource 3, R. 14)

7. Of the 34 certified mail notices sent to the substations' abutting property owners, Eversource received 24 return receipts and two undeliverable. Eversource sent an additional notice via first class mail to the 10 abutters from whom return receipts were not received. (Eversource 3, R. 14)

8. In accordance with the Council's Application Guides for an Electric Substation Facility and for an Electric and Fuel Transmission Line Facility, Eversource provided notice to a number of community groups including Chambers of Commerce, land trusts, environmental groups, trail organizations, river protection organizations, historic preservation groups, advocacy groups for the protection of Long Island Sound, and the water company with a watershed within the GSLP area. (Eversource 1, p. Q-14; Eversource 9, p. 55; Affidavit Regarding Notice to Community Groups; Affidavit Regarding Notice to Water Company)

Council Procedures

9. On June 30, 2015, the Council sent a letter to the State Treasurer, with a copy to the Chief Elected Official of the Town stating that $25,000 was received from Eversource and deposited in the Office of State Treasurer's Municipal Participation Account for the Town to apply for a portion of the funds if they became a participant in the proceeding, pursuant to C.G.S. § 16-50bb. (Record)

10. During a regular Council meeting on July 23, 2015, the application was deemed complete pursuant to Regulations of Connecticut State Agencies (R.C.S.A.) § 16-50*l*-1a and the public hearing schedule was approved by the Council. (Council Meeting Minutes of July 23, 2015)

11. Pursuant to C.G.S. § 16-50m, on July 24, 2015, the Council sent a letter to the Town to provide notification of the scheduled public hearing and to invite the Town to participate in the proceeding. (Record)

12. Pursuant to C.G.S. §16-50m, the Council published legal notice of the date and time of the public hearing in The Greenwich Time on July 28, 2015. (Record)

13. On August 5, 2015, the Council held a pre-hearing conference at the Council's office at 10 Franklin Square in New Britain, Connecticut. The conference was in regards to the Council's procedures and process for the GSLP hearing and field review scheduled for September 1, 2015. (CSC Pre-Hearing Conference Memoranda, dated July 31, 2015 and August 6, 2015)

14. Pursuant to R.C.S.A. §16-50j-21, Eversource installed six, four-foot by six-foot signs notifying the public of the type of facility proposed, the public hearing date and contact information for the Council. The signs were posted at:
    a) Proposed Greenwich Substation Site at 290 Railroad Avenue-along Field Point Road;
    b) Alternate site at 281 Railroad Avenue-south side fence, and north side adjacent to Woodland Drive (two signs);

c) Cos Cob Substation on Sound Shore Drive-on the fence at the entrance to the substation;
d) Intersection of Bruce Park Drive and Kinsman Lane; and
e) Arch Street parking lot-on east side of Arch Street.

(Eversource 6; Eversource 9, p. 56, Attachments 7 and 8)

15. The Council and its staff conducted a public inspection of the proposed GSLP on September 1, 2015, beginning at 1:00 p.m. Eversource provided bus transportation to the existing Cos Cob substation, proposed substations and along the various proposed transmission line routes. (Council Hearing Notice dated July 24, 2015; Eversource 7; Eversource 19; Tr. 1, p. 12)

16. Pursuant to C.G.S § 16-50m, the Council, after giving due notice thereof, held a public hearing on Tuesday, September 1, 2015, beginning with an evidentiary session at 3:00 p.m., and continued with a public comment session at 6:30 p.m., at the Greenwich Library, Cole Auditorium, 101 West Putnam Avenue, Greenwich, Connecticut. (Council Hearing Notice; Tr. 1, pp. 1-5; Tr. 2, p. 3)

17. The Council continued the public evidentiary hearing sessions on October 6, 2015; December 1, 2015; January 12, 2016; February 23, 2016; and March 10, 2016 at the office of the Council at 10 Franklin Square, New Britain, Connecticut. (Tr. 3, p. 1; Tr. 4, p. 1; Tr. 5, p. 1; Tr. 6, p. 1; Transcript, March 10. 2016, 1:00 p.m. [Tr. 7] p. 1)

Municipal Consultation and Community Outreach

18. Eversource initiated a meeting with the Town on June 11, 2011 to announce plans for a new substation to address distribution system reliability issues. Eversource and various Town officials met several times between January 2012 and January 2015. (Eversource 1, p. N-1)

19. Pursuant to C.G.S §16-50*l*(e), Eversource delivered a Municipal Consultation Filing (MCF) to the Town First Selectman on February 6, 2015 to begin the 60-day municipal consultation process for the GSLP. There is no other municipality within 2,500 feet of the proposed Project. (Eversource 1, p. ES-10; Eversource 9, p. 53)

20. Pursuant to C.G.S §16-50x(d), Eversource filed a Location Review Filing with the Town of Greenwich Planning and Zoning Commission, and Inland Wetlands and Watercourses Agency on February 6, 2015. (Eversource 1, Bulk Filing #2; Eversource 9, p. 54)

21. Eversource developed a project website, email address and hotline through which residents and stakeholders could communicate with project representatives. Copies of the filing were placed in the Greenwich Library, as well as the Byram and Cos Cob Library branches. (Eversource 9, p. 56)

22. On March 3, 2015 and July 15, 2015 Eversource sponsored two open houses at the Greenwich Town Hall. Invitations were mailed to all property owners along the Preferred Route and abutting property owners to the 290 and 281 Railroad Avenue substation sites. (Eversource 3, R. 1; Eversource 9, p. 55)

23. Eversource appeared before the Town's Inland Wetlands and Watercourse Agency on March 23, 2015, Architectural Review Committee on March 24, 2015, and the Planning and Zoning Commission of March 10 and March 24, 2015. (Eversource 1, p. ES -10)

24. On April 6, 2015, the Town of Greenwich Planning and Zoning Commission submitted correspondence to the Council and Eversource with the following recommendations regarding the GSLP:
    a) If the Council determines that 290 Railroad Avenue is the appropriate location for the new substation, that the site be designed by a local architect;

b) Further exploration of the location and pre-and post-construction considerations of the transmission line routes;
c) Additional information should be provided to the Council about the appropriateness of the proposed substation site; and
d) Avoid any impacts to Cos Cob Park located at 22 Sound Shore Drive.

(Town 1)

25. On January 11, 2016, the Town requested party status, which was granted during the evidentiary hearing session held on January 12, 2016. The Town participated in the proceeding by submitting exhibits and having the opportunity to cross examine the applicant and other parties and intervenors. (Town 5; Tr. 5, p. 5)

State Agency Comment

26. Pursuant to C.G.S § 16-50j(g), on July 24, 2015 and March 11, 2016, the following State agencies were solicited by the Council to submit written comments regarding the proposed facility: Department of Energy and Environmental Protection (DEEP); Department of Public Health (DPH); Council on Environmental Quality (CEQ); Public Utilities Regulatory Authority (PURA); Office of Policy and Management (OPM); Department of Economic and Community Development (DECD); Department of Agriculture (DOAg); Department of Transportation (DOT); Connecticut Airport Authority (CAA); Department of Emergency Services and Public Protection (DESPP); and State Historic Preservation Office (SHPO). (Council Hearing Package dated July 24, 2015; Council State Agency Memorandum, dated March 11, 2016)

27. The Council did not receive any comments from any state agencies. (Record)

System Planning and Mandatory Reliability Standards

28. The Independent System Operator of New England (ISO-NE), a regional reliability council, is responsible for the reliable and economical operation of New England's electric power system, which includes managing the comprehensive, long-term planning of the regional power system to identify the region's electricity needs and plans for meeting those needs. The planning process involves the preparation of an annual Regional System Plan (RSP) that provides forecasts of annual energy use and peak loads for a 10-year planning horizon; information about amounts, locations, and characteristics of market responses; and descriptions of transmission projects for the region that could meet the identified needs, as summarized in the RSP Project List. (Council Administrative Notice 13, Eversource Administrative Notice 3)

29. The RSP Project List is a summary of needed transmission projects for the region and includes the status of reliability transmission upgrades, market efficiency transmission upgrades, elective transmission upgrades and generator interconnection upgrades. The proposed GSLP is identified on the RSP Project List as a planned reliability transmission upgrade that received Proposed Plan Application/I.3.9 Approval from ISO-NE on February 11, 2014, revised on May 1, 2015, with a projected in service date of June 2017. (Council Administrative Notice 13; Eversource Administrative Notice 3)

30. Connecticut's Comprehensive Energy Strategy proposes further investments in grid reliability and identifies three important components to grid reliability: resource adequacy, transmission security and distribution resiliency. (Council Administrative Notice 35, pp. 71, 97)

31. The United Nations Intergovernmental Panel on Climate Change Fourth Assessment, released in 2007, concludes that the earth's climate is warming. The findings of the Northeast Climate Impacts Assessment show that the Northeast has been warming at an average rate of nearly 0.5 degrees F per

decade since 1970. Winter temperatures are rising faster, at an average rate of 1.3 degrees F per decade since 1970. This warming trend correlates with an increased number of days where summertime temperatures exceed 90 degrees F. The number of such days is anticipated to increase from ca. 15 days per annum in 2010 to ca. 25 days per annum by 2040. (Council Administrative Notice Item 47, p. 9)

32. Several actions to conserve energy and reduce emissions, while planning to ensure an ample supply of energy, were contemplated and noted as contributing to an adaptive strategy to mitigate some effects of expected climate change.
    a. Encourage towns to assess energy footprints;
    b. Encourage energy conservation;
    c. Construct alternative energy sources to reduce emissions, e.g. solar, wave energy, wind, etc.;
    d. Evaluate current system capacity, fuel sources and efficiencies;
    e. Update and expand electric grids; and,
    f. Update interstate transmission to facilitate import of energy from renewable resources.

(Council Administrative Notice Item 47, p. 89)

Project Need

Needs Assessment

33. In 2011, ISO-NE engaged in a long term reliability needs assessment for the Southwest Connecticut (SWCT) area for year 2018. A solutions study was later completed to address the criteria violations in the needs assessment and focused on developing solutions for five study subareas, including the Stamford-Greenwich subarea. The Stamford Reliability Cables Project (SRCP) was developed as a solution to address independent subarea needs whereas other solution alternatives were developed to address interdependent subarea needs. (Council Administrative Notice 13, p. 108; Eversource Administrative Notice 3, p. 15)

34. In 2013, ISO-NE engaged in a new needs assessment and solutions study for the SWCT area for 2022 to account for changes, such as 2013 non-price retirement requests from several generation resources in Connecticut, including Bridgeport Harbor Unit #2 that is already retired and Norwalk Harbor Units #1, 2 and 10 to retire by June 2017. The 2022 needs assessment indicated needs present in all SWCT subareas with the exception of the Glenbrook-Stamford subarea as the SRCP mitigated all the violations found in the 2018 needs assessment. (Council Administrative Notice 13, p. 109)

35. The SRCP entered service on November 21, 2014 and implemented an important component of long-range plans for the expansion of Connecticut's electric power grid in the Stamford-Greenwich area that include a new substation in Greenwich and additional transmission connections to this substation. (Eversource Administrative Notice 15, Docket 435 FOF # 40)

36. The next step in the long range plan for the expansion of Connecticut's electric power grid in the Stamford-Greenwich 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. (Eversource 1, p. E-22)

37. The GSLP was listed in Eversource's *2012 Forecast of Loads and Resources for the Period 2012-2021* as a concept substation, dated March 1, 2012, in CL&P's *2013 Forecast of Loads and Resources for the Period 2013-2022* as a concept substation and concept 115-kV transmission line from Cos Cob to the new Greenwich substation, dated March 1, 2013, in Eversource's *2014 Forecast of Loads and Resources for the Period 2014-2023* as a planned substation and planned 115-kV transmission line from Cos Cob to the new Greenwich substation, dated February 28, 2014 and in Eversource's *2015 Forecast of Loads and Resources for the Period 2015-2024* as a planned substation and planned 115-kV transmission line from

Cos Cob to the new Greenwich substation, dated March 2, 2015. (Eversource Administrative Notice 26-29)

38. The GSLP was listed in the Council's *2012/2013 Review of the Ten Year Forecast of Connecticut Electric Loads and Resources* as a concept substation and associated 115-kV transmission line from Cos Cob Substation to the new Greenwich Substation with an in service date of 2017. ISO-NE defines a concept project as being considered by its proponent as a potential solution to meet a need identified by ISO in a Needs Assessment or the RSP, but for which there is little or no analysis available to support the transmission project. (Council Administrative Notice 16)

39. The GSLP was listed in the Council's *2014/2015 Review of the Ten Year Forecast of Connecticut Electric Loads and Resources* as a planned new substation, a planned addition of a circuit breaker at the existing Cos Cob substation and a planned 2.4 mile 115-kV transmission line from Cos Cob Substation to the new Greenwich Substation, all with an in service date of 2017. ISO-NE defines a planned project as a transmission upgrade that has been approved by ISO-NE. (Council Administrative Notice 16; Eversource Administrative Notice 39)

40. The new Greenwich substation was included in the DEEP 2012 Integrated Resource Plan as a planned new substation. The DEEP 2014 Integrated Resource Plan listed both the new Greenwich substation and two new 115-kV transmission lines as planned. (Eversource 1, p. E-3; Council Administrative Notice 34; Eversource Administrative Notice 16)

41. On June 13, 2011, following a string of cascading outages on the 27.6-kV system supplying the distribution substations in Greenwich, Eversource announced plans to build a new substation in Greenwich to serve the customer load and provide additional capacity beyond the existing Cos Cob Substation. The GSLP addresses the need for capacity to avoid transformer overloads at Cos Cob Substation, eliminates potential distribution feeder overloads supplying power to Prospect Substation from Cos Cob Substation and addresses the need for capacity to reduce the risk of transformer overloads at Prospect Substation. (Eversource 1, p. E-10; Eversource 32, pp. 1-2; Tr. 1, p. 56)

42. Southwest Connecticut is the largest load area in the state that comprises 54 towns and accounts for 50% of Connecticut's peak electric load demand. The Town of Greenwich has the third highest electrical usage for the 149 municipalities served by Eversource in Connecticut. Greenwich is the third largest user of electricity in Eversource's service territory, behind Hartford and Stamford. (Eversource 1, p. E-1; Eversource 25, p. 6; Tr. 3 p. 85-86)

43. Although the population of Greenwich has grown by 2,700 persons from 1990 (58,441 population) to 2010 (61,171 population), customer electric usage increased by 45 percent. In the last few years, usage growth has been modest overall, fluctuating up and down. (Tr. 7, pp. 50-52)

44. Greenwich customer usage, based on electric meter data, increased 1.5 percent from 2014 to 2015. (Tr. 7, pp. 140-141)

45. As of 2015, Eversource customers in the Town of Greenwich are 90.3% residential and 9.7% commercial/manufacturing. (Eversource 27, R. 17)

46. In Eversource's service territory, Greenwich residential customers use more than two times the electricity of the average Connecticut residential customer. (Eversource 9, p. 31)

47. As of March 2016, Eversource was processing 115 applications for new or upgraded service in Greenwich. A majority of the service requests are related to reconstruction of existing residential

homes where the new electric service request is on par with what would be considered a medium sized commercial building in other areas of the State. (Tr. 3, p. 77; Tr. 4, pp. 47-49; Tr. 7, p. 52)

48. The GSLP will provide increased electrical capacity to serve existing load and future growth of customer load in the Town of Greenwich only. The Prospect and Byram Substations do not supply any customers outside of the Town of Greenwich and there is no plan to extend existing circuits or add new circuits that would supply customers outside of Greenwich. (Eversource 25, pp. 6-7; Eversource 27, R. 17, R. 22, R. 28, R. 49)

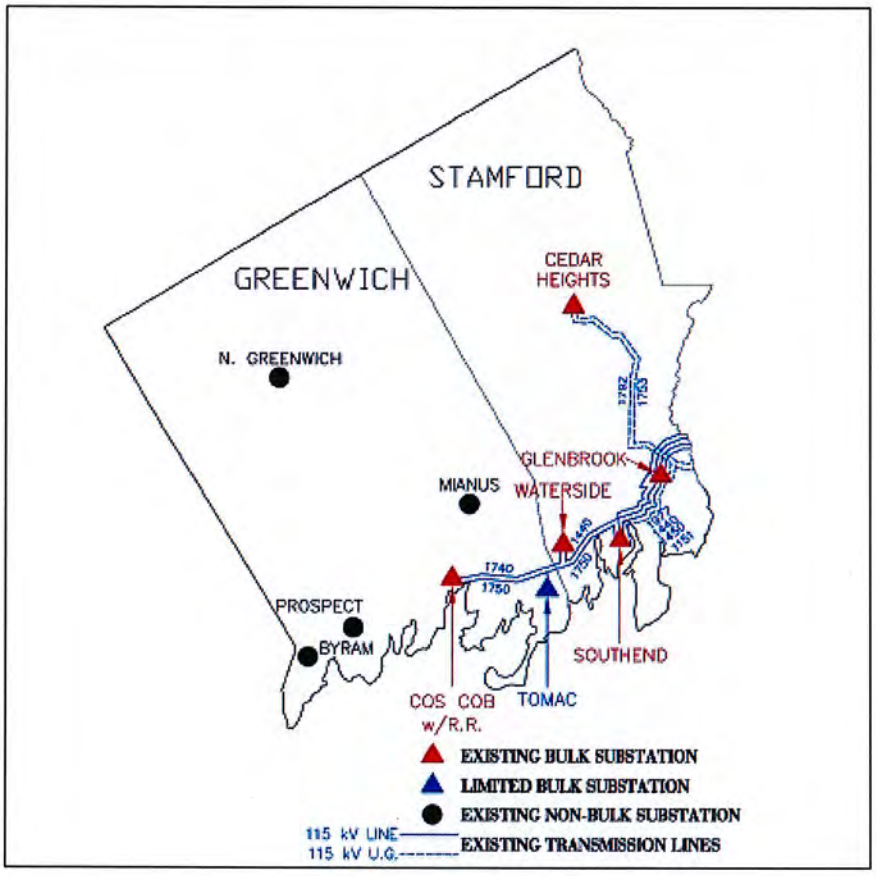
Greenwich Area Electric System

49. The electric distribution system in Greenwich was designed over 50 years ago to serve much lower load levels than those that exist today. (Eversource 1, p. E-6)

50. Greenwich is at the farthest extent of Eversource's electric network in southwest Connecticut. Greenwich is electrically isolated and relies heavily on one bulk substation, the Cos Cob Substation, to provide power to three distribution substations in Greenwich; the Prospect, Byram and North Greenwich Substations. (Eversource 1, p. E-12; Eversource 9, p. 31, 36)

51. A small portion of Greenwich load, in the southeast area of town, is served by the Tomac Substation from a single 115-kV to 13.2-kV transformer. (Tr. 5, p. 90)

52. The drawing below shows the approximate location of the various substations in the Greenwich and Stamford area. (Eversource 1, E-13)



53. The approximate linear distance and direction from Cos Cob Substation to the Byram, Prospect and North Greenwich Substations are 3.0 miles west, 1.9 miles west and 5.3 miles northwest, respectively. (Eversource 1, p. E-13; Tr. 7, p. 80)

54. The Cos Cob Substation serves approximately 176 megavolt ampere (MVA) of load, and as such, is the most heavily loaded substation in Connecticut. (Eversource 1, pp. E-3, E-9)

55. The Cos Cob Substation provides 130.5 MVA of power at 27.6 kV to the Prospect, North Greenwich and Byram Substations. An additional 29.5 MVA of peak load is provided out of Cos Cob on 13.2 kV distribution feeders. The remaining 16.4 MVA of peak load is provided at 115-kV to an adjacent Metro North Railroad (MNRR) substation. (Eversource 1, pp. E-3, E-9)

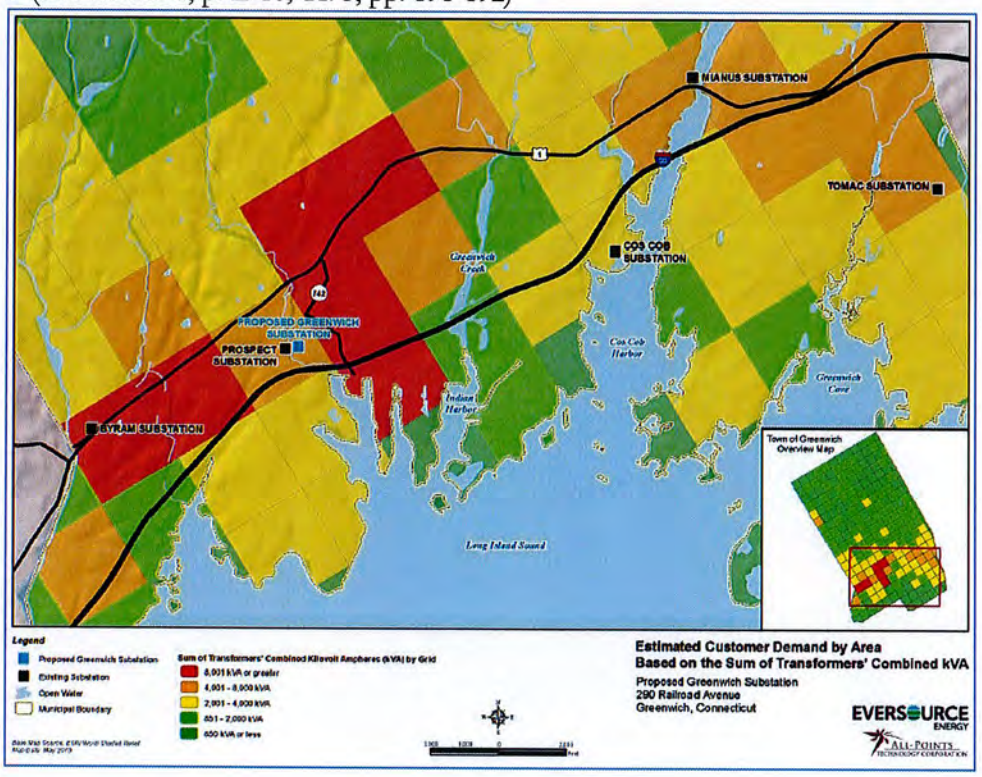
56. The Cos Cob Substation is one of two bulk substations in Eversource's service area that has three transformers serving 27.6-kV load. No bulk substation in Eversource's service area has four or more transformers serving 27.6-kV load. (Eversource 15, R. 15)

57. Approximately 76 percent of the Western Greenwich area is served by the 27.6-kV system. There are no other nearby substations that can serve load at 27.6-kV. (Eversource 14, R. 11; Tr. 3, p. 192)

58. Eversource does not favor expanding the 27.6-kV system as many of the existing components are over 50 years old. The transformers and substation bus at Byram and Prospect Substations are obsolete and without the GSLP, would have to be replaced at a significant cost to maintain a voltage system no longer being installed in Eversource's service territory. (Eversource 38, R. 10; Tr. 3, pp. 79-80)

59. The Cos Cob Substation also serves as a backup to the Tomac and Mianus Substations. (Eversource 1, pp. E-11) ,

60. The area of Greenwich with the greatest load demand occurs west of Indian Harbor, as shown in red below. (Eversource 1, p. E-10; Tr. 3, pp. 191-192)



61. Typically, areas with large customer load have two or more bulk substations with multiple transmission supply lines to serve that load. Such a design allows for the transfer of load from one station to another if one of the transmission sources were interrupted. (Eversource 1, pp. E-5, E-6)

62. A contingency event, an event causing the loss of one or more system components, would require the remaining system components to carry higher loads, leading to potential system damage due to component overloads. The Greenwich electric system needs additional capacity to avoid overloads during contingency events. (Eversource 1, pp. E-1, E-7)

Electric System Interim Measures

63. Eversource identified a need for a new substation in Greenwich in 1989. At that time, it was projected that the Cos Cob Substation would reach capacity in 1994. (Eversource 1, p. E-9)

64. Further analysis by Eversource resulted in an upgrade project at the existing Tomac Substation in 1994, delaying the need for a new bulk power substation. The upgrades included a connection to an existing 115-kV line, allowing for capacity relief at Cos Cob Substation. (Eversource 1, p. E-9)

65. Subsequent incremental load growth at Cos Cob Substation was addressed in 2000 by adding a 25-MVA transformer. (Council Administrative Notice 23; Eversource 1, p. E-9)

66. Additional measures implemented between 2010 to 2012 to improve system reliability and increase capacity of the substations and distribution systems in the Greenwich area are listed below:
    a) Cos Cob Substation – upgrade switchgear, new tie connection between transformers, new 30 MVA transformer;
    b) Byram Substation – upgrade equipment, two reclosers;
    c) Mianus Substation – upgrade equipment by installing underground cable and switching;
    d) North Greenwich Substation – new aerial feed, upgrade right-of-way, replace three distribution transformers;
    e) Distribution Feeders – replacement of distribution cables between Cos Cob and Prospect Substations; and
    f) Underground Distribution Cables- replace underground cable from Cos Cob Substation to Sound Shore Drive.

    Collectively, these measures cost approximately $36.3 million. (Council Administrative Notice 26; Eversource 1, p. E-16; Tr. 3, p. 42)

67. During 2011 to 2013, Eversource was able to move load to Waterside Substation in Stamford to relieve capacity at the Tomac Substation. (Eversource 1, p. E-10)

68. Although these measures have delayed the need for a new substation, first identified in 1989, none of these measures would be a suitable long-term solution for the need of a new substation west of Indian Harbor, closer to the load center of Greenwich. (Eversource 1, p. E-10)

69. There are no additional cost-effective measures that could be undertaken to address both the reliability of the Greenwich distribution system and capacity issues at Cos Cob Substation. (Tr. 4, pp. 70-71)

Current Electric System Reliability and Capacity Issues

70. Eversource publically announced its intent to construct a new substation west of Indian Harbor in 2011 in response to reliability concerns that were exposed by storm events in June 2011. (Eversource 1, pp. E-10)

71. The 2011 storm event caused underground feeder faults resulting in overloaded and subsequent failures of underground circuits emanating from Cos Cob Substation. The feeder loss knocked out service to 5,100 North Greenwich customers. Due to this loss, load shedding to protect electrical system components from overloading affected an additional 2,300 customers served by the North Greenwich Substation. (Eversource 1, pp. E-10, E-11)

72. Additionally, Eversource requested that Greenwich customers conserve power and use on-site generation, if available. Other measures included load shifting and the mobilization of an emergency bulk transformer to mitigate the risk of additional contingency events. (Eversource 1, pp. E-10, E-11)

73. The 2011 event demonstrated inadequate supply of power during contingency events, an unacceptable interruption of service (over 5,000 customers lost power) and cascading effects from the interruption in service, and the inability to recover from the interruption in a timely manner (75 minutes to 18 hours). (Eversource 44, R. 24; Tr. 7, pp. 132-133)

74. A fire occurred at the Cos Cob Station in June 2015. It occurred within a pole mounted 27.6-kV transformer that feeds the substation. It tripped the circuits and busses within the substation. (Tr. 3, pp. 24-25)

75. An additional distribution related reliability event occurred in October 2011 at Cos Cob Substation when all three 27.6-kV transformers went out of service as a result of animal contact with the 27.6-kV bus. All customers fed by the 27.6-kV transformers were without service for 1 to 2.5 hours including customers supplied by the North Greenwich, Prospect and Byram substations. (Eversource 44, R. 24)

76. In July 2015, three different underground 27.6-kV cable failures on three different days occurred on the 27.6-kV system from Cos Cob Substation to Prospect Substation. These failures were not related to peak loading. The outages caused the remaining distribution cables to enter into their emergency ratings. Operating equipment beyond their normal operation rating can lead to damage and reduction in service life. (Eversource 27, R. 57; Eversource 36, R. 42; Eversource 44, R. 24; Tr. 3, pp. 52: Tr. 4, pp. 70-73)

77. In the last five years, Greenwich is the only town served by Eversource where customer load needed to be shed during peak conditions to prevent overloads on the distribution circuits. (Tr. 7, pp. 75-76)

78. The Prospect and Byram substations are supplied via 27.6-kV feeders from Cos Cob Substation. As such, these substations are subject to the limited capacity at Cos Cob Substation as well as the unreliable distribution feeder system emanating from Cos Cob Substation. (Eversource 38, R. 10)

79. Four 27.6-kV distribution circuits from Cos Cob Substation provide power to the Prospect Substation. If one or more of these circuits is out, the remaining circuits must carry the load. If two of the circuits are out during summer peak conditions, load would have to be shed to protect system components. (Eversource 1, p. E-7)

80. The Prospect Substation is a non-bulk substation with a 55 MVA capacity. It is only served by Cos Cob Substation and only has about a one percent backup from other sources in the event of an outage of the entire substation. (Eversource 1, p. E-8)

81. Eversource is projecting that the Prospect Substation would not be able to meet summer peak load demand beginning in 2021. (Eversource 1, p. E-8)

82. The 27.6-kV existing distribution equipment used in Greenwich is obsolete. If the GSLP is constructed, Eversource intends to phase out the 27.6-kV system in Greenwich over a 10 to 20 year time frame. (Eversource 38, R. 10; Tr. 3, pp. 79-80)

83. In addition to reliability concerns, the Cos Cob Substation saw an increase in summer peak demand on the 27.6-kV transformers from 96.4 MVA in 2004 to a maximum of 130.5 MVA in 2013. The summer peak demand from 2004 to 2015 is presented in the table below. (Eversource 24, R. 22)

Cos Cob 27.6-kV System Peak- actual values											
2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
96.8	117.9	125	116.1	112.1	107.7	119.7	121.8	128.2	130.5	107.7	114.8

84. The 2013 peak occurred over a sustained period of high temperatures combined with high humidity. Summer peak demand declined from 130.5 MVA to 107.7 MVA in 2014 but increased to 114.8 MVA in 2015 MVA. In 2014 and 2015, although some periods were hot, the same type of prolonged heat wave did not occur, thus lessening the summer peak demand for those years. (Eversource 25, p. 4; Tr. 3, p. 153; Tr. 4, p. 40; Tr. 6, p. 95)

85. Summer peak demand is contingent on the weather, leading to year to year demand variations. In addition to the 17.5 percent decrease in demand from 2013 to 2014 at the Cos Cob Substation, the peak loads all across Connecticut dropped by approximately 14 percent, further indicating the lack of successive high heat index days that summer. Summer peak demand tends to occur during the third or fourth day of consecutive hot days, usually in the late afternoon. (Eversource 25, p. 4; Tr. 3, pp. 62-65; Tr. 4, pp. 40-41)

86. Peak demand during a particular month or year has no correlation to average temperature of that period. Peak demand is correlated with peak temperatures, peak humidity and the peak heat index on the particular day it occurs. (Eversource 38, R. 2)

87. The Cos Cob Substation has three 115-kV to 27.6-kV transformers; one with a nameplate rating of 50.4 MVA, and two with a nameplate rating of 46.7 MVA. Nameplate ratings are designed for continuous operation under normal conditions. (Eversource 38, R. 9; Tr. 5, pp. 71-72)

88. The permissible load rating at Cos Cob is 135 MVA for the 27.6-kV system. It is based on the loss of the largest transformer (50.4 MVA), where the remaining two transformers would have to operate 145 percent above their nameplate rating in order to maintain electric service. After two hours at 145 percent above nameplate operation, the load on the remaining two transformers must be reduced to a 22 hour rating. To maintain power supply to the area at a 22-hour rating, 11 MVA of power would be shifted to the 13.2-kV system originating out of Cos Cob Substation. (Eversource 1, p. E-5; Eversource 38, R. 9)

89. Electric power at 27.6-kV cannot be transferred to another substation to reduce power demand on the transformers, thus causing electrical components to go into emergency ratings. Although Eversource is willing to operate equipment above nameplate ratings for short intervals, it cannot operate its equipment in their emergency ratings for extended periods of time without permanent damage to equipment. As the age of the equipment increases, the more likely permanent damage would occur if operated above its nameplate rating. (Eversource 38, R. 9; Tr. 5, pp. 73-76)

90. Eversource does set a transformer emergency rating, but operating in this rating has the potential to create a one percent loss of service life for each emergency occurrence. The maximum short-term emergency loading during contingency events is 135 MVA on two transformers for a maximum of two hours. (Eversource 36, R. 47; Tr. 7, pp. 55-56)

91. A transformer failure is the most damaging to an electric system in that load provided by a failed transformer must be transferred to another transformer to maintain electric service. Additionally, transformer repair times can be long. A transformer failure at Cos Cob Substation would stress the existing electric system since there is no other bulk substation that can receive and handle additional load in the event of an emergency. (Eversource 42, R. 67)

92. Overloads on the current electric system could lead to loss of service to Greenwich customers through equipment failures or through targeted electric curtailments to protect system components. (Eversource 1, p. E-1)

93. Under existing circumstances, with no increase in capacity, there is a possibility that there would be an overload at the Cos Cob Substation. (Tr. 7, p. 47)

94. Eversource is mandated by PURA to provide reliable electric service to communities. If service was repeatedly deficient in parts of Eversource's service area, PURA could apply financial penalties or issue an order to improve electric service. (Tr. 3, pp. 145-147)

Load Forecasting

95. Eversource developed projected summer peak loads based on the highest peak load value recorded in the study period of 2010 to 2014. The maximum peak load in the study was 130.5 MVA that occurred in 2013. (Eversource 24, R. 22; Eversource 3, R. 12; Tr. 5, pp. 102-103; Tr. 3, pp. 153-153; Tr. 7, pp. 38-39)

96. Load projections do not include customer usage values or historical trends. (Eversource 35, R. 31)

97. Eversource applied a one percent growth rate using the 130.5 MVA value to develop future summer load projections. The load projections for 2016 to 2022 are presented in the table below :

Cos Cob 27.6-kV System LOAD [MVA]							
Transformers	Projected Peak Demand						
	2016 MVA	2017 MVA	2018 MVA	2019 MVA	2020 MVA	2021 MVA	2022 MVA
11R-1X	27.6	27.9	28.2	28.4	28.7	29.0	29.3
11R2X+3X	106.8	107.9	108.9	110.0	111.1	112.2	113.4
Total MVA	134.4	135.7	137.1	138.5	139.9	141.3	142.7

(Eversource 3, R. 12; Tr. 5, pp. 102-103; Tr. 7, pp. 38-39)

98. A portion of the one percent growth projection assumes a certain amount of distributed generation and a certain amount of energy efficiency. (Tr. 3, p. 70)

99. The one percent growth rate was derived for the average load increase from actual metered data obtained from transformers located at Cos Cob Substation and surrounding substations in the Norwalk –Stamford sub area. Examining usage at several transformers in the area rather than a single data point provides a better understanding of economic conditions. (Eversource 35, R. 31; Tr. 3, pp. 155, 159; Tr. 4, pp. 62-66)

100. The one percent growth rate used in the planning projections is not weather-normalized, a standard practice for Eversource's distribution planning. Weather-normalized data removes the effect of

weather on load growth to better understand economic load growth conditions. (Tr. 4, pp. 62-64, Tr. 5, pp. 103-104)

101. ISO-NE established a weather-normalized load growth rate of 1.2 percent for the Southwest Connecticut Forecast Area for the period of 2013 to 2022. (Eversource 38, R. 9; Tr. 4, pp. 62-64)

102. Underlying customer usage has been consistent over many years even during low peak demand periods. Due to the lack of customer load curtailment, summer peak load would most likely increase during periods of high heat and humidity. (Eversource 25, p. 4; Tr. 4, pp. 60-61)

103. The variations in peak load are mostly dependent on the weather as opposed to a decrease in demand. Although there was a decrease in peak demand at Cos Cob Substation by 17.5 percent from 2013 to 2014, customer usage declined by less than one percent. (Eversource 25, p. 4; Tr. 4, pp. 93-94)

104. Some peak load variation can be attributed to situations such as a company increasing production and another undertaking energy efficiency measures. (Tr. 3, pp. 162-163)

105. To maintain electric service to all customers, Eversource has to develop a planning forecast that accounts for loads that could occur in a certain period of time. (Tr. 4. pp. 61-62)

106. Based on current and projected loads, the transformation capacity and distribution feeders are at or near maximum operational ratings under peak or near peak conditions. (Eversource 1, p. E-6)

107. Eversource is projecting that the 2017 summer peak load on the Cos Cob 27.6-kV system would be 135.8 MVA under certain contingency conditions, exceeding the permissible load rating of 135 MVA. (Eversource 1, p. E-5)

108. The new Greenwich Substation should be in service by 2018 to prevent potential future summer peak overloading. (Eversource 1, p. E-5)

GSLP Reliability and Capacity Improvements

109. Eversource's charge is to provide reliable electrical power to its customers at all times and under all conditions, except during extreme events. (Tr. 3, pp. 136-137; Tr. 7, p. 132)

110. Reliability can be looked at in three parts - assuring adequate supply; frequency of interruptions; and duration of outages. The existing electric system in the Town of Greenwich is unacceptable in all three aspects. (Tr. 7, pp. 132-133)

111. The Town acknowledges reliable electric service in Greenwich is essential for use by residents and businesses as well as future development. It is the utility's responsibility to provide this service. (Tr. 6, pp. 47-48, 103)

112. In its 2011 evaluation, Eversource determined that the existing electric system is limited and cannot be strengthened without a new bulk substation west of Indian Harbor. The new bulk substation would lessen the load on the Cos Cob Substation. (Eversource 1, pp. E-10, E-11, E-14; Eversource 9, p. 32)

113. Eversource determined it was more cost effective to construct a new substation in Greenwich with three new larger capacity transformers than to replace three smaller capacity transformers and related obsolete switchgear at both the Byram and Prospect Substations. The new substation would be fed directly from two new transmission lines and would be more reliable than the existing 27.6-kV

distribution feeders that serve Byram and Prospect Substations from Cos Cob Substation. (Eversource 38, R. 10)

114. The new substation would extend transmission level supply to the area of highest customer load, transferring about half of the load from Cos Cob Substation to the new Greenwich Substation. This would reduce reliance on the 27.6-kV feeder system currently serving the Prospect Substation reducing potential overloads on these feeders, some of which are over 50 years old. (Eversource 1, p. E-2; Eversource 9, pp. 32-33; Tr. 3, pp. 31, 53-54, 78-79)

115. The proposed Greenwich Substation would provide a permissible load capacity of 134 MVA (refer to Attachment 1). It would only serve customers in Greenwich. (Eversource 1, p. E-17; Eversource 27, R. 22; Eversource 31, R. 29)

116. After the new substation is functional, Eversource would remove the transformers at Byram and Prospect Substations, retiring 80 MVA of capacity (refer to Attachment 1). (Eversource 42, R. 65; Eversource 43, R. 81; Tr. 7, pp. 98-99)

117. Although the potential forecasted overloads on the Cos Cob Substation are less than 10 MVA in forecast year 2023, the proposed Greenwich Substation is being constructed with a much larger capacity to accommodate projected peak load demand, future loading due to economic growth and to allow for load transfers between the Cos Cob Substation, thus increasing reliability of the Greenwich electric system under contingency conditions. (Eversource 1, pp. E-1, E-5, E-6; Tr. 7, pp. 97-99)

118. The GSLP would allow Eversource the capability to transfer load between the Cos Cob Substation and proposed Greenwich Substation and provide automatic electric supply backup to most of the customers in Greenwich in the event of an outage. There is no capability in the current electric system for this redundancy. This capability is consistent with Eversource's current electric system design in that if one power supply source is unavailable, the remaining bulk substation would be able to supply necessary power. (Eversource 38, R. 9; Tr. 3, p. 139; Tr. 4, pp. 68-69; Tr. 7, pp. 72-73)

119. Eversource's design criteria provides for a backup source to customers supplied by a bulk substation. For distribution substations, Eversource has a program approved by PURA to provide a backup source to these substations or to remove islanded distribution substations from service. (Eversource 43, R. 78)

120. In the event of storm-related outages, the new substation would improve reliability by being a component of a backup distribution network where power can be shifted from the Cos Cob, North Greenwich, and new Greenwich Substations through the use of automatic reclosers that provide more effective circuit sectionalization. (Tr. 7, pp. 74- 78)

121. Although load transfers can occur, if one of the substations was out of service, neither the proposed Greenwich Substation nor the Cos Cob Substation by itself could serve 100 percent of customers at peak load. (Tr. 7, pp. 72-75)

122. The new substation would reduce the load on the existing 27.6-kV feeders, allowing the electric system to handle a double contingency event on the feeders going forward. (Tr. 3, pp. 78-79)

123. The loss of transmission service to Cos Cob Substation would also result in the loss of electric service to the proposed Greenwich Substation. (Tr. 3, p. 50)

124. The GSLP would allow operational flexibility by providing a primary distribution circuit as well as an alternate distribution circuit on a 13.2-kV system, allowing Eversource to ultimately retire the 27.6-kV distribution system. The 13.2-kV system is currently used in Greenwich. (Tr. 3, p. 79; Tr. 4, pp. 70-71)

125. The proposed Greenwich Substation would be designed to accommodate a future transmission line. The potential third transmission line is in a 30-40 year planning horizon and could originate from the Glenbrook, Cedar Heights or Southend Substations. (Tr. 3, pp. 142-147)

126. The Town of Greenwich expressed concern about the issue of "storm hardening" and indicated that the proposed project will not address the fact that older overhead distribution lines would remain susceptible to storm damage. (Town 6, R. 5; Tr. 6, pp. 64-68)

127. Although 13.2-kV distribution system improvements are not part of this project, the Town had been working with Eversource for many years to develop solutions for storm related outages on the overhead electric distribution supply, including a Town policy of allowing Eversource to access trees to do necessary trimming, with certain limits on the amount of trimming that can be done. (Eversource 1, p. ES-1; Tr. 6, pp. 66-67, 163-164; Tr. 7, pp. 42-43)

128. Greenwich instituted a capital project from 2011 to 2013 to pay for the removal of hazardous trees throughout town, including trees that were both a risk to overhead utilities and the general public at large. (Tr. 6, pp. 164-165)

129. The proposed project would enable the distribution system to back itself up between North Greenwich Substation and Cos Cob Substation allowing Eversource to resupply those customers from the proposed Greenwich Substation. Additional reclosers and more effective sectionalization are part of Eversource's Storm Hardening Program and would be used as part of the substation upgrade to interconnect the substation, which is not technically "storm hardening," but would use the same methodology that would result in the same benefits. (Tr. 7, pp. 75-77)

130. With regard to distribution reliability, the proposed Greenwich Substation would allow Eversource to restore approximately 85 percent of the customers now served from Cos Cob Substation automatically and instantaneously. If the proposed Greenwich Substation were to be lost for any reason, 67 percent of the customers fed from the proposed Greenwich Substation would be restored automatically and instantaneously. Depending on the time of year, 100 percent of the customers would be backed up by either Cos Cob Substation or the proposed Greenwich Substation. (Tr. 7, pp. 43-44)

Project Alternatives

No Action Alternative

131. Eversource considered and rejected a "no action" alternative to the GSLP because without additional capacity, Greenwich would be at increased risk in 2017 when, under certain contingencies, the transformers at Cos Cob substation are projected to reach their capacity limits and anticipated future demand growth could not be reliably served. Doing nothing would undermine Eversource's obligation to serve the load in Greenwich. (Eversource 1, p. F-1; Tr. 3, p. 84; Eversource 9, p. 33)

Transmission Alternatives

132. Eversource considered and rejected transmission alternatives involving new or upgraded transmission facilities utilizing the existing substations because this would not resolve the identified reliability need and would not add the additional source of capacity to meet the existing and growing demand that the proposed Greenwich substation would provide. (Eversource 1, p. F-1; Eversource 9, p. 33)

133. Eversource identified 12 potential route options with several variations, including four overhead routes, five underground options, one marine route and two combination routes. The all overhead route options were rejected based on one or more of the following factors: absence of existing ROW/required public and private property acquisitions/easements, substantial clearing, impacts to historic districts, impacts on densely populated areas and restrictions that would increase the cost of the project, lengthen the construction schedule and jeopardize the project in-service date. (Eversource 1, p. H-13; Eversource 9, p. 23)

Non-Transmission Alternatives

134. On June 6, 2014, the state statutory requirement under C.G.S. §16a-7c for initiation by the Connecticut Energy Advisory Board of a reactive request for proposal process to seek non-transmission alternatives to the need addressed by an application for a proposed facility that is submitted to the Council was repealed. (State of Connecticut Public Act 14-94; Council Administrative Notice 34, Eversource 1, pp. F-20, F-22)

135. In the 2014 IRP, DEEP outlines criteria used for illustrating reliability projects that may be viable candidates for the consideration of non-transmission alternatives - Category A consists of new substations; Category B consists of infrastructure upgrades; and Category C consists of new transmission lines and new infrastructure considered in reliability studies. Categories A and B are identified as unlikely to have viable non-transmission alternatives. (Council Administrative Notice 34, Eversource 1, p. F-22)

136. Eversource analyzed a range of non-transmission alternatives including distribution alternatives, generation alternatives and demand side management alternatives, as well as several combinations thereof. Non-transmission alternatives could provide incremental load relief benefits, but could not provide enhanced reliability of the distribution system in the location near the center of customer demand in Greenwich and are not cost-effective. (Eversource 1, pp. F-1, F-2, F-18; Eversource 9, p. 34)

137. As a result of the analysis, Eversource determined that non-transmission alternatives are not currently available or not currently available in sufficient amounts to meet the immediate needs the GSLP would address. Non-transmission 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 bulk power transmission infrastructure closer to the demand center. Therefore, issuance and analysis of requests for proposals for non-transmission alternatives to the proposed GSLP would not be a prudent exercise. (Eversource 1, p. F-18; Eversource 24, R. 35)

Distribution Alternatives

138. Eversource considered improvements to the distribution system comprising of: establishment of a substation expansion module at Cos Cob substation, increasing transformer capacity at Prospect Substation and enhancing the existing duct bank systems and loop schemes. (Eversource 1, p. F-2)

139. The specific components of the distribution alternative identified by Eversource include:
    a. Expanding Cos Cob substation by installation of two 60 MVA 115-kV to 13.2-kV transformers and switch gear, installation of two new 115-kV underground cable connections between the existing Cos Cob substation yard and the adjacent substation expansion area;
    b. Modifications to Prospect substation by removing four transformers, adding two 47 MVA, 27.6-kV to 13.2-kV transformers, replacement of switchgear and installation of flood protection measures;

c. Adding to the distribution bank system by constructing 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; and
d. Modifications to the current distribution loop schemes by redesigning and constructing loop schemes between the new expansion area, Cos Cob substation and Prospect substation.

(Eversource 1, p. F-3)

140. Eversource rejected the distribution alternative because the cost would be $190 million, it would achieve 60 MVA less than the proposed project, it requires acquisition of a commercial building adjacent to Cos Cob substation, and it would not achieve the reliability needs that are met by the proposed GSLP by adding capacity and bringing a reliable power supply to the center of customer demand. (Eversource 1, pp. F-2, F-3; Eversource 9, pp. 36-37; Tr. 3, pp. 37-38)

141. The Town suggested that the proposed project would not be needed if Eversource performs upgrades to the distribution system. (Tr. 6, pp. 67-68)

142. Serving only to allow for a temporary deferral of the need for the GSLP, the respective costs of distribution alternatives to address the need are as follows:

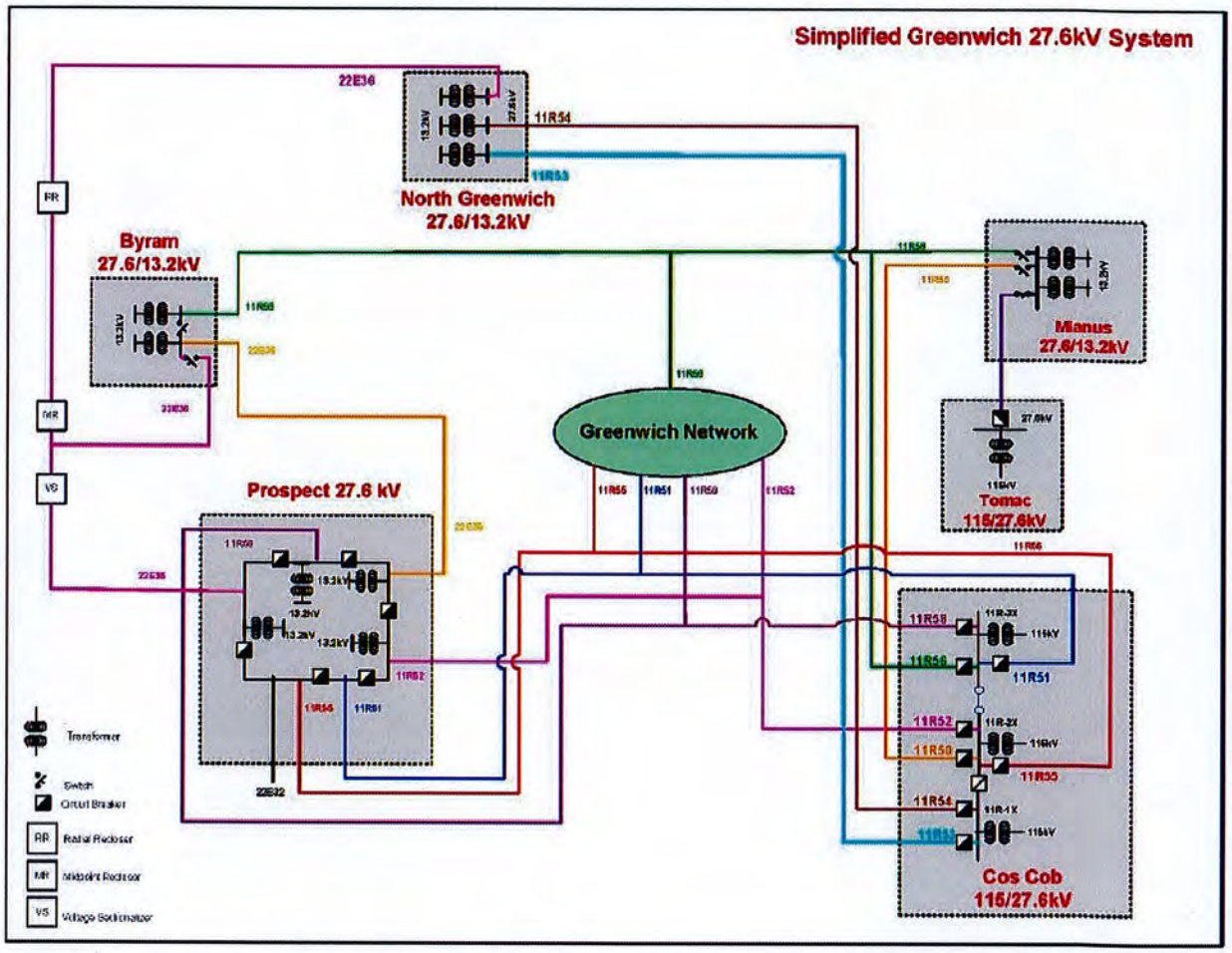
Distribution Alternative	Reduce Loading on Cos Cob Substation	Increase Distribution Feeder Capacity	Reduce Loading on Prospect Substation	Replace Prospect Substation Switchgear
Cost	$65 to $75 million	$33 to $37 million	$6 to $8 million	$11 to $14 million

(Eversource 33, Q-LF-001)

Existing Substations in Greenwich

143. Electric load in Greenwich is currently served primarily by one bulk substation. Cos Cob Substation was built in 1964 on two properties owned by Eversource and DOT. It is located over two miles east of the current load pocket and is constrained by a public road, DOT property, an office building and a town park. Cos Cob Substation serves approximately 130.5 MVA of electric load at 27.6-kV and feeds three substations at 27.6 kV in Greenwich (Prospect Substation, Byram Substation and North Greenwich Substation). It also provides a backup power source at 27.6-kV to two other substations in Greenwich (Mianus Substation and Tomac Substation). The diagram below shows the interconnections between theses existing substations:

(continued next page)



(Eversource 1, pp. E-1, E-2, E-4, E-15; Eversource 9, p. 32)

144. Prospect Substation is a non-bulk distribution substation that was built in 1934 and partially located within a 500 year flood zone. It is bounded by public roads and bisected by an underground brook within a concrete culvert and municipal sewer main. Prospect Substation has four transformers that are served only by the 27.6-kV supply from Cos Cob Substation with backup limited to about one percent of the load (refer to figure in FOF #52). (Eversource 1, pp. E-7, E-13, E-15)

145. Byram Substation is a non-bulk distribution substation that was built in 1955 on a 0.2 acre portion of a 1.17 acre property that has severe slopes and is bounded by residential properties on the north, a public road on the west, a commercial property on the east and Route 1 on the south. It is too far west of Cos Cob Substation and at the western extent of the current load pocket (refer to figures in FOF #52 & 60). (Eversource 1, pp. E-13, E-15)

146. North Greenwich Substation is a non-bulk distribution substation that was built in 1972 on an approximately 0.47 acre property that is constrained to the west and to the north by Converse Pond Brook and associated wetlands. To the east and south is owned and maintained by DOT as part of the Merritt Parkway ROW corridor. It is too far from the center of the load pocket (refer to figures in FOF #52 & 60). (Eversource 1, pp. E-13, E-15; Eversource 41, Q-LF-11)

147. Mianus Substation is a non-bulk distribution substation that was built in 1956 on an approximately 0.31 acre property that is bounded by the Mianus River, a senior care facility, public road and a commercial business. It is too far from the center of the load pocket (refer to figures in FOF #52 & 60). (Eversource 1, pp. E-13, E-15; Council Administrative Notice 20)

148. Tomac Substation is a limited bulk substation on a 0.45 acre portion of an approximately 0.86 acre property subject to a railroad easement. It is bounded by wetlands, a golf course, a railroad and a public road. Tomac Substation is too far from the center of the load pocket (refer to figures in FOF #52 & 60). (Eversource 1, pp. E-13, E-15; Council Administrative Notice 22)

Load Transfer Between Existing Substations in Greenwich

149. The 27.6-kV system at Cos Cob Substation is the source of power to the North Greenwich, Prospect and Byram Distribution Substations. Shifting the 13.2-kV load between any of these distribution substations would not change the load at Cos Cob Substation. The load supplied by these distribution substations is located west of Cos Cob Substation. The 13.2-kV load surrounding Cos Cob Substation and the area to the east is supplied by Cos Cob Substation and Mianus Substation, which is fed from Tomac Substation. Tomac Substation is a single transformer bulk substation and a portion of Tomac Substation's load was off-loaded to Waterside Substation in Stamford as the supply source between 2013 and 2014. (Eversource 36, R. 59; Eversource 38, R. 10)

150. Due to additional available capacity on the 27.6-kV to 13.2-kV transformers at the North Greenwich Substation, Eversource considered transferring load from Prospect Substation to North Greenwich Substation. Since both the Prospect Substation and North Greenwich Substation are supplied from Cos Cob Substation at 27.6-kV, transferring load from Prospect Substation to North Greenwich Substation will not provide any load reduction benefits for Cos Cob Substation. (Eversource 36, R. 57)

151. It is not possible to build a 115-kV cable to Prospect Substation to supply an additional 27.6-kV feeder without completely rebuilding Prospect Substation. (Tr. 3, p. 33)

152. Eversource considered and rejected transferring load from Cos Cob Substation to Tomac Substation, which is geographically between Cos Cob Substation and Waterside Substation in Stamford, because Tomac Substation has constrained space and this would require building nine distribution circuits several miles from Waterside Substation in Stamford. (Tr. 3, pp. 35-36)

153. Additional transformation could be added to Cos Cob Substation but that would require acquisition of a developed commercial property at 8 Sound Shore Drive to expand the substation. Additionally two new 13.2-kV duct banks would have to be installed from Cos Cob Substation to Prospect Substation. The approximate cost of expansion of the substation and new duct banks is approximately $85 million. (Tr. 3; pp. 37-39; Tr. 7, pp. 127-128)

154. Eversource analyzed transferring 20 MVA from Cos Cob Substation to Tomac Substation via a single 27.6-kV circuit. Tomac Substation does not have 20 MVA of available spare capacity and could not provide a source into the 27.6-kV network. When supplying a network system, all transformers must be supplied from a common 115-kV supply and also must have their secondary side tied together in a common bus with special voltage controls that link all transformers resulting in maintenance of a common voltage with minimum circulating current. (Eversource 36, R. 48; Tr. 3, pp. 36-37)

155. No additional distribution level interim measures could provide reliable service other than construction of a new substation in Greenwich because Greenwich is electrically isolated – the transmission lines end at Cos Cob substation and the distribution substations that serve customer load are fed by distribution feeders that originate at Cos Cob substation. (Eversource 1, pp. E-17- E-22; Tr. 3, p. 139; Tr. 4, p. 147; Eversource 9, p. 36)

Existing Substations in Stamford

156. Cedar Heights Substation is a bulk substation located in the northern part of Stamford, just south of the Merritt Parkway (refer to figure in FOF #52). (Eversource 1, p. E-13)

157. Waterside Substation is a bulk substation located in the western part of Stamford that abuts Waterside Power Station, the railroad, and a street with several residences on the other side (refer to figure in FOF #52. (Eversource 1, p. E-13)

158. South End Substation is a bulk substation located in the south central part of Stamford just south of the railroad corridor utilized by Amtrak and Metro North (refer to figure in FOF #52). I-95 is on the other side of the rail corridor. (Eversource 1, p. E-13; Eversource Administrative Notice 15)

159. Glenbrook Substation is a bulk substation located in the southeastern part of Stamford (refer to figure in FOF #52). (Eversource p. E-13; Eversource Administrative Notice 15)

Load Transfer Between Existing Substations in Stamford

160. Eversource considered and rejected a 27.6-kV supply solution from Stamford into Greenwich that would require construction of a new bulk substation, as well as construction of additional distribution circuits to transfer load from Cos Cob substation to Waterside substation. Unlike the proposed Greenwich substation, a new substation in Stamford could not efficiently serve the load pocket in Greenwich. (Tr. 3, pp. 34-35; Eversource 27, R. 18; Eversource 36, R. 59)

161. A new substation located in the Stamford area could not redistribute electrical transmission more efficiently nor reduce any need for additional service in Greenwich. The proposed Greenwich substation is planned to be located in the area of the greatest demand in Greenwich and will efficiently serve the load pocket in Greenwich. (Eversource 27, R. 18)

162. Eversource considered and rejected transferring load from Cos Cob Substation to Waterside, South End and Glenbrook Substations as it would require one bulk substation at 115 to 27.6-kV at the Waterside Substation, one distribution substation at 27.6- kV to 13.2-kV at the proposed Greenwich Substation, nine distribution feeders at double the length for the closest substation source, be more costly, not meet the GSLP need, difficult to construct and constitutes a technically inferior design option. (Eversource 15, R. 9; Tr. 3, pp. 34-37)

163. Waterside Substation could not provide a source into the 27.6-kV network because it does not have 115-kV to 27.6 kV-transformers. Like Tomac Substation, if a 115-kV to 27.6-kV transformer were installed at Waterside Substation, it would not be able to supply the Greenwich 27.6-kV network since it does not have 20 MVA of available spare capacity. (Eversource 36, R. 48; Tr. 3, pp. 36-37)

164. Cedar Heights Substation has about 15 MW of spare capacity available to share with North Greenwich Substation. Eversource further considered feeding North Greenwich Substation from Cedar Heights Substation at 27.6-kV with a capacity of 50 MVA that would require significant modifications to the transmission and distribution systems at Cedar Heights Substation including upgrading two transmission cables, adding ten miles of underground distribution feeders from Cedar Heights

Substation to North Greenwich Substation and related modifications to Cedar Heights Substation and Prospect Substation. The total cost of this alternative would be approximately $202 million and would not address the feeder capacity issues or provide the same reliability benefits as the GSLP. (Eversource 41, Q-LF-011; Eversource 44, Q-LF-021; Tr. 5, pp. 116-117, 140-145; Tr. 7, pp. 35-36)

165. Within Eversource service territory in Connecticut, the average distance from a bulk substation to a distribution substation is 4.01 miles. The circuit mile distance from Cedar Heights Substation to the North Greenwich Substation is 10.3 miles. The circuit mile distance from Cos Cob Substation to North Greenwich Substation is 6.55 miles. (Eversource 43, R. 74, R. 76)

166. Although it would be less expensive to extend three 27.6-kV lines between the Cedar Heights Substation and Prospect Substation when compared to underground, this option is not preferable as new sets of utility poles would have to be installed on both sides of the road route between the substation to support five or six circuits. Towns do not prefer this type of installation as it creates visibility concerns. Eversource typically uses this type of installation only in very specific locations such as a circuit junction or exit from a substation. This type of installation would be subject to vehicle collision or outages related to storm damage from larger trees. (Tr. 7, pp. 61-62, 128-129)

Larger Transformers at Cos Cob Substation

167. Cos Cob Substation and the associated distribution feeder circuits could not be operated in their emergency ratings for extended periods of time without permanent damage to the equipment. Use of water cooling on the transformers, which is a stop gap measure for a very short-term peak, would mitigate the temperature of the oil, but would not prohibit the windings from being overloaded. (Eversource 38, R. 9; Tr. 3, pp. 74-75)

168. Eversource previously uprated transformers at Cos Cob Substation by approximately 30 percent. Additional uprates would be minimal or require remanufacturing by removal of the transformer, sending it to the manufacturer for design analysis, retrofitting the transformer and temperature testing to verify that desired thermal performance has been achieved. (Council Administrative Notice 26; Eversource 36, R. 56)

169. With regard to the addition of capacitors to correct the power factor at Cos Cob Substation, Eversource determined that the power factor on the projected peak load day of 135.8 MVA is 0.998. As a result, there is no advantage of putting in capacitors at Cos Cob to go to unity as the additional equipment would not reduce the loading of the transformers. (Tr. 3, pp. 75-76, 148-149)

170. Eversource considered removing the existing transformers at Cos Cob Substation and replacing them with larger transformers, specifically 36/48/60 MVA or 48/64/80 MVA, but there is insufficient space to accommodate the larger transformers and associated feeders at the existing Cos Cob Substation without acquiring additional property. The Cos Cob Substation is a fully utilized property. (Eversource 1, p. E-15; Eversource 39, p. 1; Tr. 5, pp. 66-69)

171. Eversource adopted the Institute of Electrical and Electronic Engineers (IEEE) standard of a 50-foot minimum clearance between energized electrical parts and grounded electrical parts, components and related equipment. If the 60 MVA transformers were installed at Cos Cob Substation within the existing footprint of the 27.6-kV transformers, they would be too close for operation and maintenance. If the 80 MVA transformers were installed within the existing footprint of the 27.6-kV transformers, they would physically contact each other. (Eversource 36, R. 56; Eversource 39, p. 3; Tr. 3, pp. 30-31; Tr. 5, pp. 66-69)

172. As an alternative to the proposed GSLP, the Town of Greenwich e-mailed multiple transformer manufacturers inquiring as to whether larger capacity transformers, specifically two 80 MVA transformers, could be added within the dimensions of the existing Cos Cob substation. The Town provided the transformer manufacturers with a copy of the drawings of the Cos Cob Substation prepared by Eversource in response to OCC Interrogatory No. 62. Two manufacturers, Toshiba and WEG, responded with plans demonstrating that the larger capacity transformers could physically fit within the dimensions of the existing Cos Cob Substation. (Town 6, R. 1)

173. Eversource investigated the response of Toshiba and WEG to the Town's inquiry regarding installation of two 80 MVA transformers within the existing footprint of Cos Cob Substation. The Toshiba transformer is not an equivalent transformer design because it does not have a load tap changer required for voltage control. The WEG transformer design is similar in size to the transformer design of ABB, the manufacturer that Eversource currently uses, but the ABB transformer design is actually smaller. If the 80 MVA ABB transformers were installed within the existing footprint of the Cos Cob Substation, they would physically hit each other and not comply with the IEEE and Eversource standards for electrical clearances. (Tr. 7, pp. 129-130)

174. For the proper functioning of the equipment at Cos Cob Substation, any replacement transformers would require voltage regulating equipment in order for Eversource to maintain proper voltage for the network. (Eversource 39, p. 3)

175. Use of larger transformers at Cos Cob Substation would address only the issue of transformer overloads at Cos Cob Substation and would not address the risk of potential distribution feeder overloads or potential transformer overloads at Prospect Substation. (Eversource 39, p. 4; Tr. 7, pp. 93-94)

Generation Alternatives

176. There are no existing or planned large scale generation units for the downtown Greenwich area nor are there any generation projects in the interconnection process awaiting approval. Development of any new generating units would not likely meet the GSLP in-service date of second quarter 2018. (Council Administrative Notice 13; Eversource Administrative Notice 3; Eversource 1, p. F-5)

177. Eversource considered generation alternatives to provide capacity similar to the capacity provided by the GSLP, which would require the new generation to be available when a contingency event occurs, in the right amounts equal to the overloads and at the right location to reduce loads on the impacted/overloaded equipment. The minimum amount of new generation that could eliminate the projected Cos Cob transformer overloads and the Cos Cob substation to Prospect substation feeder overloads is as follows:

Table F-1 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***
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.

** The most severe N-2 contingency was considered. The loss of two of the four existing parallel 27-kV distribution feeders was approximately 40 MVA.

*** The 20% Operating Reserve Requirement is a percentage estimate of the quantity of Operating Reserves required to be scheduled, where this quantity is set in accordance with ISO New England Operating Procedure No. 8 and ISO New England Operating Procedure No. 19.

(Eversource 1, pp. F-3 – F-5)

178. There are five peaking generating units outside the Cos Cob Substation with a nameplate rating of approximately 19 MW each. To meet the need for 48 MW in 2018, four additional units similar to those at Cos Cob would need to be installed in close proximity to the center of the load pocket in downtown Greenwich. This would solve a capacity deficiency on the transmission system, but would not solve a capacity or reliability issue with the distribution system. (Eversource 1, p. F-3; Tr. 3, pp. 39-41)

179. Costs to develop a site for a generation facility would be substantially higher than the proposed GSLP due to the amount of land required, high cost of property in Greenwich, cost of generating equipment and plant construction, costs for interconnections to one of the substations and required distribution upgrades. (Eversource 1, p. F-10)

180. There is no space and limited available cable capacity of the 27.6 kV feeder cables at Prospect Substation, which is located in the 500-year flood zone, for interconnection of generation facilities and additional substation equipment. A limited amount of generation could be connected to Byram Substation, but a large amount of generation that could exceed the load being served from Byram Substation would result in power flows back into the distribution circuits supplying Byram Substation, which would require additional relay equipment and challenges to system protection and voltage control. (Eversource 1, pp. F-9, F-10)

181. New generation could provide incremental load relief benefits that would require additional units over time, but it could not provide enhanced reliability of the distribution system or extend the bulk power transmission system to the center of customer demand in Greenwich. (Eversource 1, p. F-10)

Renewable Generation Alternatives

182. In order to meet a required 20 percent reserve capacity in 2018, renewable energy generation facilities must meet the following criteria:
    a. 264 MW of solar capacity covering approximately 8,800 acres would be required in proximity to the load center assuming all panels are optimally placed;

b. 188 MW of on-shore wind capacity or 107 MW of off-shore wind capacity would be required in proximity to the load center; and
c. Greenwich does not have a large suitable reservoir for a geothermal system.

(Eversource 1, pp. F-7, F-8; Eversource 25, p. 15; Eversource 9, p. 38)

183. Due to its future capacity needs, Greenwich was selected for Solarize Connecticut, a Green Bank project to promote solar energy in 2013. Eversource interconnected 92 solar installations in Greenwich since 2010 and there are currently 28 pending applications for solar energy in Greenwich that accounts for 400 kW of peak load. This accounts for less than one-half of one percent of the projected peak load at Cos Cob Substation. (Eversource 9, pp. 37-38; Transcript 3, pp. 62-66)

184. Solar generation curtails peak in the early afternoon hours, but drops off dramatically in the midafternoon hours. Solar generation typically provides less than 40 percent of nameplate capacity when the hours of need are greatest. (Tr. 3, pp. 62-66)

185. Renewable generation, such as large scale solar, wind or geothermal facilities, require larger footprints than natural gas-fired generation at higher capital costs. (Eversource 1, p. F-10)

Microgrids

186. Pursuant to C.G.S. §16-243y, a microgrid is defined 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." Microgrid generation assets range from 400 kW to 5 MW, which is well below the capacity needed in Greenwich to provide demand relief starting in 2018 and to accommodate future load growth. (C.G.S. §16-243y; Eversource 1, pp. F-10, F-11; Eversource 9, p. 37; Tr. 3, pp. 182-183)

187. A microgrid consists of either a single customer or a group of customers that have generation and can operate independent of the electric grid when needed and return to the electric grid when it is either reliable to do so or economic to do so. On a small-scale basis, a microgrid might defer the need for a period of time, but it is not an alternative to the capacity of a new substation. (Tr. 3, pp. 182-183)

188. In order to reduce peak load, a microgrid must have a generation component. A "green solution" could be driven by fuel cells, which have a baseload capacity and a thermal capability, but must be sized at a sufficient capacity to satisfy the need. (Tr. 3, pp. 183-184)

189. Eversource participated in the CT DEEP Microgrid Program in 2013, 2014 and 2015. No responses were received from the Town of Greenwich. The generation assets considered in the Microgrid Program included projects ranging from 400 kW to 5 MW, which is significantly less than the capacity needed in Greenwich. (Eversource 1, p. F-11; Tr. 3; pp. 140-141)

Generation Interconnection Alternatives

190. 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. (Eversource 1, F-8)

191. Eversource reviewed options to interconnect generation as follows:
    a. Cos Cob Substation at 115-kV – this would not reduce overloads on the 115-kV to 27.6-kV transformers at Cos Cob Substation because the demand is connected to the 27.6-kV distribution system. Demand on the transformers would remain exactly the same.
    b. Cos Cob Substation at 27.6-kV – demand would be reduced if generation were interconnected at the 27.6-kV bus, but the demand on the distribution feeders would remain exactly the same.
    c. Prospect Substation – physical space constraints prohibit the required interconnection facilities, additional substation equipment and development of generation at the substation. Prospect Substation is also located in the 500 year flood zone.
    d. Prospect Substation at 27.6-kV Network Feeder Level – there is limited available cable capacity of the 27.6-kV feeder cables and therefore, very limited available locations to site the new generation.
    e. Prospect Substation Network Feeder 208 Volt Level – generation connected to a secondary network system is limited to 50 kW of inverter based equipment at any customer location under the "Connecticut Light & Power Company and The United Illuminating Company Generator Interconnection Technical Requirements," which were approved by PURA on May 10, 2010.
    f. Byram Substation at 27.6-kV Level – installation of a large amount of generation that could exceed the load being served from Byram Substation would result in power flows back into the distribution circuits supplying Byram Substation, would require additional relay equipment and result in challenges to system protection and voltage control.

    (Eversource 1, pp. F-8, F-9)

New York Interconnection Alternatives

192. There is no transmission tie to New York in the Greenwich area and the GSLP would not extend existing circuits, add new circuits or provide any electrical connections or electrical supply to New York or any other area beside the Town of Greenwich. (Tr. 3, p. 264; Eversource 25, p. 7; Eversource 27, R. 17)

193. Any interconnection of the New York and Connecticut systems would require ISO-NE and the New York Independent System Operator (NY ISO) interregional system coordination planning studies to determine the impact on existing transfer limits between the two systems. (Eversource 41, Q-LF-013)

194. Eversource reviewed an alternative of using distribution facilities to supply 50 MW of load from New York and an alternative of supplying the Greenwich substation at the transmission level from New York. This alternative would require building a new 13.2-kV substation at the New York border initially serving 50 MVA of load in Connecticut because Consolidated Edison Company of New York (ConEd) does not presently have 50 MVA of capacity at the distribution level at the New York border. (Eversource 41, Q-LF-013; Tr. 5, pp. 78-82)

195. Eversource reviewed an alternative involving supply for the new Greenwich Substation from two transmission supplies from the New York transmission system. The closest New York transmission source to the proposed new Greenwich Substation is approximately 10 miles at Eastview Substation located in Hawthorne, New York. This alternative would require 20 circuit miles of the lines via roads, extensive substation improvements required for the interconnection to New York and the time and cost of permitting in New York. (Eversource 41, Q-LF-013, Tr. 5, pp. 78-82)

196. If Connecticut load is radially fed from ConEd, the load would obtain its capacity and energy requirements from the NYISO rather than ISO-NE. Charges would be based on New York costs rather than ISO-NE costs. It is possible ConEd would include charges for use of their distribution and/or transmission system to transmit power to the NY/CT border, as well as certain allocations of

general and administrative costs, which appears to be in conflict with the deregulated electricity structure in Connecticut where ratepayers have the option to purchase their generation services directly from competitive suppliers. (Eversource 41, Q-LF-013)

Demand Side Management Alternatives

197. Distributed Generation (DG) would typically include smaller generation units located closer to areas of higher demand. Properly sized, properly located, available and dispatchable DG that is interconnected to either utility-side distribution feeders or customer-side facilities, such as combustion turbines, small biomass based generators, fuel cells, wind turbines or solar photovoltaic systems, can help mitigate the pressures on local electric distribution facilities from demand growth. (Eversource 1, pp. F-14, F-15)

198. The State of New York Public Service Commission developed an order on December 12, 2014 that established the Brooklyn/Queens Demand Management Program (BQDMP) as a solution to the need for a new substation in the New York City metropolitan area. The ConEd proposals for the electrical upgrades in Brooklyn reflect 41 MW of customer-side non-traditional solutions and 11 MW of utility-side non-traditional solutions, which only defers the need for a new substation by five years at a cost of $200 million. (OCC Administrative Notice 1; Tr. 3, pp. 179-180, 186-187)

199. According to the BQDMP, the 41 MW of customer-side non-traditional solutions would cost approximately $150 million or $3.7 million per MW. The 11 MW of utility-side non-traditional solutions would cost approximately $50 million or $4.7 million per MW. The proposed GSLP would cost approximately $140 million or $1 million per MW. (OCC Administrative Notice 1; Tr. 3, pp. 179-180, 186-187)

200. Under the BQDMP, ConEd must develop backup plans which will include additional utility-side solutions or advancement of the deferred traditional utility infrastructure to meet the need in the event that the customer-side non-traditional solution checkpoints are not met. (OCC Administrative Notice 1; Tr. 3, pp. 186-187)

201. For DG proposals to reduce demand on the distribution system in Greenwich, an adequate number of generators would be needed, reliable interconnections to the distribution network must be established and integration with multiple power supply sources must be carefully planned. (Eversource 1, F-15)

202. There are currently 6 natural-gas fueled and 102 solar photovoltaic DG units installed in Greenwich. Additional DG units might assist in reducing a small amount of demand on the substations and feeders presently serving Greenwich, but the current forecasted amount of DG could not provide the reduction levels necessary to eliminate the need for the proposed Greenwich Substation. (Eversource 1, p. F-15)

203. Real-Time Emergency Generation or Demand Response Generation are activated in instances of system outages in a specific location and are used for back-up generation. These types of resources are only activated during ISO-NE Operating Procedure No. 4 during a capacity deficiency to operate under certain system operating conditions and are otherwise not available. There is one demand response generator at the Fairview Country Club that is capable of providing 200 kW of demand response. 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 activated extensively and repeatedly in hot weather to decrease demand. (Eversource 1, pp. F-15, F- 16)

204. Load curtailment could include measures where it would be necessary to interrupt electric service to customers without notice or preparation to forestall overloads of the transformers at Cos Cob if a contingency event occurs under peak demand conditions in order to sustain the operability of the

electric system in Greenwich. There are no Eversource customers participating in the Load Curtailment Program with the ability to curtail demand during peak periods when called upon. (Eversource 1, p. F-17)

205. If the proposed Greenwich substation was delayed, Eversource may have to install emergency generation at one or more of the Greenwich distribution substations to meet load demands. A typical emergency generator is mounted on a tractor trailer and provides about 2 MW of output. Eversource does not use emergency generation in planning solutions for baseload growth. Emergency generation is reserved for emergencies. (Tr. 3, p. 133-134; Tr. 4, pp. 60-62)

206. Delaying the GSLP would be associated with inflation rates of 1-1 ½ %. If Eversource were to delay the GSLP for five years, which would require use of emergency generation, the cost would be approximately $10 to 20 million dollars per year. Overall, this would likely cost more than the proposed project. (Tr. 3, pp. 127-128)

Energy Efficiency

207. Energy efficiency resources are both passive and active demand resources that result in demand reductions through the conservation of energy use and/or the addition of distributed generation at the source of the demand. An energy efficiency program may provide for more efficient operation of existing equipment through better management or maintenance of that equipment, but because these resources provide limited, incremental effects, there is no basis to reasonably conclude that new energy efficiency measures in Greenwich could be a comprehensive alternative to provide adequate relief to the distribution system. (Eversource 1, pp. F-12 – F-14)

208. Eversource energy efficiency programs are provided for all residents in the state of Connecticut, but cannot force residents to conserve energy, convert fuel sources or install more efficient appliances or lighting. Incentives are offered for installation of high-efficiency equipment. (Eversource 1, p. F-13; Eversource 32, p. 4; Tr. 3, pp. 88-90)

209. Only about 5% of homeowners in Greenwich have participated in Eversource sponsored residential energy efficiency programs from January 2010 to July 2015. In Eversource's service territory, Greenwich has the lowest participation rate for Residential Program and Residential Rebate Participation at 5.8% and the second lowest participation rate for Business and Municipal Program Participation at 8.8%. (Eversource 32, p. 4; Eversource 44, Q-LF-017; Tr. 5, p. 96)

210. Eversource already has energy efficiency programs available to Greenwich customers and energy efficiency is already factored into the load forecasts. While additional energy efficiency efforts might reduce customer demand by small increments, it would not be able to offset the need for the GSLP. (Eversource 27, R. 21)

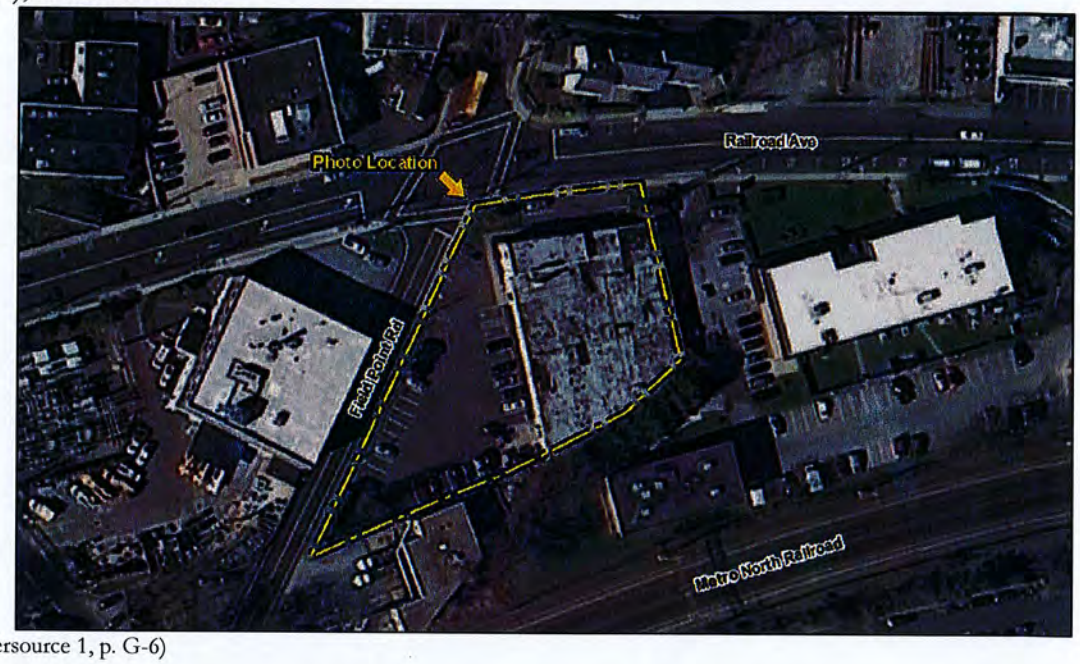
Project Description

211. The GSLP consists of the installation of a new 115-kV bulk power substation, referred to as the Greenwich Substation, a new 115-kV electric transmission line, and modifications to the existing Cos Cob, Prospect, and Byram Substations. Details of each portion of the Project are described in the following subsections. (Eversource 1, pp. ES-1, G-9)

Proposed Greenwich Substation – 290 Railroad Avenue

212. The proposed Greenwich Substation is located on a 0.81-acre parcel within a General Business Zone at 290 Railroad Avenue in Greenwich. (Eversource 1, pp. G-1, G-2)

213. The parcel is located on the corner of Railroad Avenue (to the north) and Field Point Road (to the west), as shown below.



(Eversource 1, p. G-6)

214. The parcel is approximately 40 feet above mean sea level and is generally flat. (Eversource 1, p. I-9)

215. The parcel is almost entirely developed with a commercial building and associated parking lot. Developed commercial properties are located across both roads and abut the parcel directly to the east and south. (Eversource 1, pp. G-1 - 2, G-6, I-19)

216. The area in the vicinity of the site is heavily developed consisting of a mix of industrial, commercial and residential land uses. The MNRR and Interstate 95 are to the south. (Eversource 1, p. I-22, Figure ES-2, Appendix A)

217. Eversource entered a lease with the landlord on March 1, 1971 for a 50 year term to utilize the property as a potential future location for a substation. The lease grants Eversource the right to construct improvements on the property during the lease term, as well as the right to demolish the existing building without any obligation to replace it. (Eversource 1, pp. G-1, G-2)

218. Under the lease, Eversource also has the option to purchase the property after the end of the lease term, which is February 28, 2021, provided Eversource provides notice to the landlord not less than six months prior to February 28, 2021. (Eversource 1, p. G-1; Eversource 29, R. 60; Tr. 5, pp. 125-128)

219. Since 1971, Eversource has subleased the property to Pet Pantry Discount Stores, LLC (Pet Pantry), the assignee of the original sub-lessee, Pet Pantry Products, Incorporated. In 1995, the sublease was amended and the term extended through February 1, 2008, including two five year renewal options. Pet Pantry exercised both renewal options in 2003. The sublease expires on February 1, 2018 unless it is terminated or cancelled. (Eversource 1, p. G-2)

220. The 1995 amendment of the sublease includes a cancellation provision that allows Eversource to cancel the sublease term at any time by serving 24-month prior written notice to Pet Pantry for the purpose of the following uses: substation, power transformers, pads, switching and sensing structures, enclosures for relaying and controls and indoor switchgear and/or communication equipment. On October 7, 2013, Eversource provided written notice of cancellation in accordance with the sublease provision resulting in a sublease term end date of October 8, 2015. (Eversource 1, p. G-2; Tr. 5, pp. 125-128)

221. Eversource proposes to demolish the existing commercial building on the property to facilitate construction of the new 115-kV bulk power substation. (Eversource 1, pp. G-1 to G-3, J-4)

222. Bulk electric supply to the new substation would be from two underground high pressure fluid filled (HPFF) 115-kV transmission cables originating from the existing Cos Cob Substation. (Eversource 1, p. G-2)

223. The substation yard would be surfaced with crushed stone and enclosed by an eight-foot wrought iron-style fence. (Eversource 1, p. G-3)

224. The substation would be accessed from a new 20-foot wide gated entrance from Field Point Road. (Eversource G-3)

225. The new substation would use Gas Insulated Switchgear (GIS) technology to allow for the substation to fit within the dimensions of the parcel. GIS technology uses hexafluoride gas within sealed piping to insulate certain 115-kV substation components. The gas provides insulation for the substation buses and conductors. The GIS design has a smaller footprint than an air insulated substation design. (Eversource 1, Glossary)

226. GIS insulated termination structures would transition the two underground 115-kV transmission lines to the substation bus. (Eversource 1, p. K-6)

227. GIS equipment at the proposed substation would be enclosed in a 32-foot by 121-foot long by 32-foot high building that fronts Railroad Avenue. It would house six 115-kV circuit breakers and associated disconnect switches, protective relay and control equipment, and transmission battery and charger equipment. (Eversource 1, pp. G-2, G-3)

228. The GIS substation design was selected to accommodate the potential for a future third transmission line to the substation. A third transmission line would require a six-breaker substation bus ring. The GIS design also allows for the substation bus to be enclosed within a building, not visible to the surrounding highly urbanized area. (Tr. 3, pp. 142-143)

229. The portion of the substation to the south of the GIS building would consist of an exterior yard containing three 115-kV circuit switchers, three 60 MVA power transformers, a metal switchgear enclosure, and a free standing pump house. (Eversource 1, p. ES-3)

230. The 60 MVA transformers would contain non-PCB insulation oil. Each transformer would be mounted on concrete foundations and each would have a secondary containment sufficient to contain 110 percent of the volume of the insulation oil in the transformer. (Eversource 1, p. G-3)

231. The transformers would supply step down power from 115-kV to 13.2 kV. (Eversource 1, p. ES-3)

232. The transformers would be separated from each other by concrete block firewalls approximately eight feet in height. The firewalls can be covered with brick veneer to match the existing GIS building (Eversource 1, p. K-14; Tr. 3, pp. 17-18; Tr. 7, p. 126)

233. There would be enough space in the substation yard to accommodate a future mobile transformer for use during emergency situations. (Eversource 1, p. G-3)

234. The metal control enclosure would house the switching and relay and control equipment for the 13.2 - kV distribution feeders and measures approximately 108-feet long, 24 feet wide and 14 feet tall. (Eversource 1, p. G-3)

235. The substation pump house measures approximately 50 feet long by 12 feet wide by 12 feet high and would contain circulating pumps, valves and other controls to support the high pressure fluid filled (HPFF) 115-kV transmission cables entering the substation. (Eversource 1, p. G-4)

236. The pump house would be designed to contain 110 percent of the fluid capacity of the pump house reservoir. Pressurizing pump operation can indicate a leak on the HPFF system. (Eversource 25, p. 14)

237. The substation would have low level lighting installed around access areas for security. Additional lighting would be installed for use on an as needed basis to facilitate night work. (Eversource 1, p. G-3; Tr. 3, p. 18)

238. Two or three 65-foot tall lightning masts would be installed within the substation yard for equipment protection. (Eversource 1, p. G-3)

239. The preliminary substation layout is show below. (Eversource 1, p. G-5)

240. At the request of the Town during the MCF, the building would include an angled façade so that it is set back further from Railroad Avenue. (Eversource 1, p. ES-2)

241. The preliminary design of the GIS building would include concrete panels with brick accents. The main portion of the building would be flanked by building towers on the east and west ends. (Eversource 1, pp. ES-3, G-2, G-6)

242. Two other GIS building designs were proposed during the proceeding; one that attempted to mimic the existing Pet Pantry building to the greatest extent possible and one that has as modern, contemporary appearance. (Eversource 20, R. 11; Granoff 1)

243. The Town favors the modern contemporary design submitted by Intervenor Granoff. Eversource believes it can design something similar in appearance for minimal additional project cost. (Tr. 7, pp. 124-127)

244. Eversource would be willing to modify the substation fence design along Field Point Road to include a low solid wall with a brick veneer. The Town favors this alternate fence design. (Eversource 20, R. 11; Tr. 7, pp. 125-127)

245. Eversource is committed to working with the Town to develop designs for the GIS building, substation fence and appropriate landscaping. (Tr. 4, pp. 172-174; Tr. 7, pp. 125-127)

246. Construction of the new substation would require some earthwork to prepare the site and install foundations but no substantive changes in site topography or grades are anticipated. (Eversource 1, p. J-2)

247. The substation and supporting infrastructure would have a service life of approximately 40 years. (Eversource 1, p. G-1)

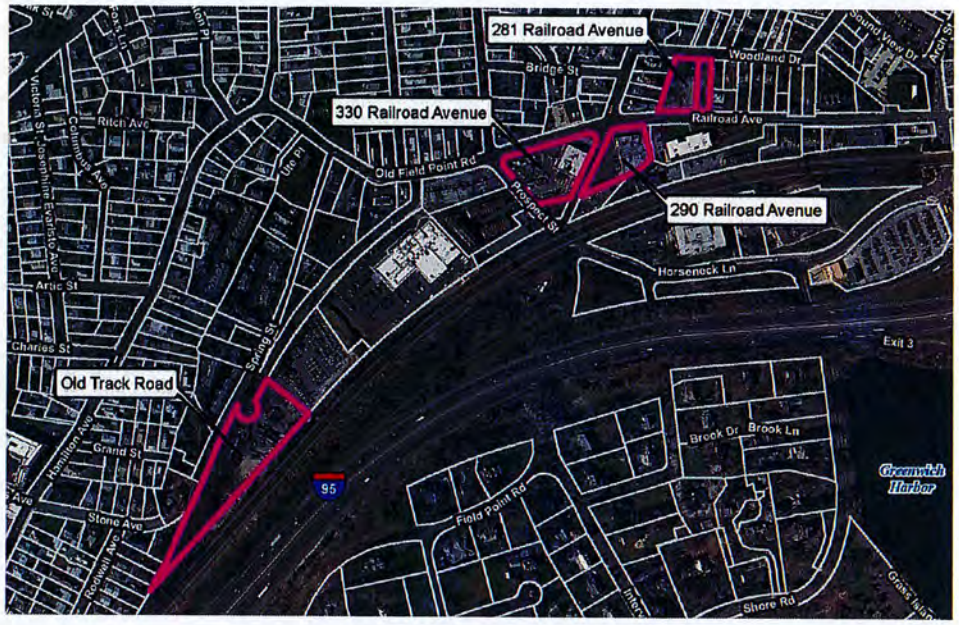
Other Potential Substation Locations Evaluated

248. In addition to the proposed site, Eversource evaluated other potential substation locations in the Greenwich customer load pocket. Site considerations included engineering, environmental, community, and economic factors. (Eversource 1, p. H-3)

249. Potential substation locations must have a minimum lot size of 0.5-acre with two sides of the parcel extending 150 feet in depth in order to accommodate substation design. (Eversource 1, H-3)

250. A potential site had to be near the customer demand, in this case, west of Indian Harbor and be proximate to existing distribution feeders. (Eversource 1, pp. E-14, H-3)

251. In addition to the proposed site at 290 Railroad Avenue, three other sites were evaluated, as presented in the figure and descriptions that follow. (Eversource 1, pp. H-4, H-5)



Alternate Site - 281 Greenwich Avenue

252. The Alternate Greenwich Substation site is located at 281 Railroad Avenue, northwest of the proposed substation site and within the customer load pocket. (Eversource 1, p. H-7)

253. The property is 0.75-acre in size and is zoned General Business. (Eversource 1, p. H-7)

254. The property is owned by Eversource and is used for material storage. (Eversource 1, p. H-7)

255. The property is encumbered by two utility easements. (Eversource 1, p. H-7)

256. A GIS substation could be constructed at the site but three abutting parcels would need to be acquired in order to meet noise criteria. (Eversource 1, p. H-7)

257. The property is closer to residential development along Woodland Drive to the north when compared to the proposed 290 Railroad Avenue site. (Eversource 1, p. I-2, Figure I-1)

258. Eversource determined that the 281 Railroad Avenue property could be developed into a substation but was not preferable when compared to the proposed 290 Railroad Avenue site due to the need to acquire adjacent developed properties and the site's proximity to residential areas. (Eversource 1, p. H-8, H-12; Eversource 9, p. 8)

330 Railroad Avenue

259. The property at 330 Railroad Avenue was considered as a substation alternative. The property is zoned General Business, 0.92-acres in size, and contains a multistory brick office building that once housed an Eversource work center. (Eversource 1, p. H-8, H-12)

260. An underground culvert, 16 feet wide and 200 feet long, is located in the middle of the property. The culvert was installed in 1934 and carries Horseneck Brook under the property. Additionally, a Town sewer pipe runs along the east side of the culvert. Both the culvert and sewer pipe would have to be relocated to accommodate construction of a substation. (Eversource 1, pp. H-8, H-9; Tr. 3, pp. 266-267)

261. The property is located within a 500-year floodplain and would require significant grading to raise the ground elevation and substation equipment out of the flood zone. (Eversource 1, pp. H-8, H-9, H-12; Tr. 3, p. 268)

262. Due to the existing underground utilities and the flood zone designation on part of the property, Eversource determined the 281 and 290 Railroad Avenue sites were more suitable for a substation than this property. (Eversource 1, p. H-8)

Old Track Road

263. The property on Old Track Road was suggested by the Town as an alternative. (Eversource 1, p. H-10)

264. The property is 2.5 acres in size and is zoned General Business. (Eversource 1, p. H-10)

265. There is no direct access into the parcel thus requiring multiple easements for both access and new distribution feeders. (Eversource 1, p. H-10)

266. New distribution feeders would have to be extended 0.25 miles to reach existing feeders east of the site. (Eversource 1, pp. H-10, H-12)

267. The 115-kV transmission line would have to be extended an additional 0.25 mile to the site. If the installation was underground, complications could arise where the line intersects with the Horseneck Brook culvert. (Eversource 1, p. H-10)

268. Residential properties are located 100 feet from the site property. Additionally, a condominium complex is located on higher terrain to the west so that residents would be able to look down into the substation. (Eversource 1, p. H-10)

269. Eversource did not consider the site viable due to the engineering and construction factors, cost, and visual impact to abutting residents. (Eversource 9, p. 9)

Cos Cob Substation Modifications

270. Cos Cob Substation was built in 1964 and is located off Sound Shore Drive. A separate substation operated by MNRR is located immediately west of the substation. Both substations are bound by Cos Cob Park to the east and south and a shared access drive to the north. A developed commercial property is located to the west of the Cos Cob Substation. (Eversource 1, Attachment H, Mapsheet 1; Tr. 1, p. 23)

271. Modifications to Cos Cob Substation are necessary to support the proposed 115-kV transmission lines. The substation would be expanded approximately 140 feet to the south onto property owned by the State of Connecticut to accommodate the new equipment. Consistent with the comments from the Town, the expansion area would not encumber adjacent Cos Cob Park, a public park owned by the Town of Greenwich. (Eversource 1, p. G-9, Appendix C, Abutters Mapsheet 1; Tr. 1, pp. 21-23)

272. Modifications include, but are not limited to, the addition of the following: two 115-kV circuit breakers; five manual disconnect switches; two motor driven disconnect switches, new bus work, two sets of cable termination structures; one new A-frame line structure (45 feet tall), one new monopole line structure (85 feet tall), underground cables; six potential transformers; relays, and control and communication equipment. (Eversource 1, p. G-8)

273. Existing equipment that would be removed includes, but is not limited to, the following: two steel A-frames, one wood A-frame, bus sections, one disconnect switch, one wood pole, and one lattice structure. (Eversource 1, p. G-8)

Byram and Prospect Substations

274. Modifications at the Prospect Substation include the removal of four 27.6 kV to 13.2-kV transformers and associated 13.2-kV switchgear. The estimated cost of this work is $250,000. Remaining equipment in the substation would allow it to function as a 27.6-kV switching station. (Eversource 1, p. E-20; Eversource 43, R. 77)

275. Modifications to the Byram Substation include the removal of two 27.6 kV to 13.2-kV transformers and associated 13.2-kV switchgear. The estimated cost of this work is $600,000. After modifications, the substation would function as a voltage regulation station. (Eversource 1, p. E-20; Eversource 43, R. 77)

New 115-kV Transmission Line – Potential Routes

276. The new substation would be supplied by two new 115-kV transmission circuits originating from the Cos Cob Substation located on Sound Shore Drive in Greenwich. (Eversource 1, p. ES-2)

277. The installation of two lines would allow one line to serve as a backup power source if one of the lines is out of service. (Eversource 1, p. ES-2)

278. As part of the application filing, Eversource initially determined that three potential transmission routes were viable: Preferred Route, Northern Alternative, and Southern Alternative. During the proceeding, a fourth route, the Hybrid Alternative, was developed and deemed viable. The four viable routes are described in the following sections. (Eversource 1, p. H-20; Eversource 34, LF-003; Tr. 5, pp. 83-84)

Preferred Route

279. The Preferred Route, Preferred Route, 2.3 miles long, would exit Cos Cob Substation, head north under the MNRR, turn west along Station Drive to Town-owned property north of the MNRR and west of Indian Field Road. From the town-owned property, horizontal directional drilling (HDD) would be used to install the lines under the MNRR, exiting at the end of Kinsman Lane adjacent to Bruce Park. From Kinsman Lane, an open trench would be used to install the lines through along Bruce Park Drive, through two tidal ponds adjacent to Bruce Park Drive, along Davis Drive, Indian Harbor Drive, Museum Drive, Arch Street, and Railroad Avenue to the substation. Refer to Attachment 2. (Eversource 1, pp. G-15, G-21)

280. The Preferred Route has a HDD variation to avoid trench installation along a portion of Kinsman Lane, Bruce Park Drive, and through the Bruce Park tidal ponds and along Davis Avenue. (Eversource 1, pp. G-15, G-21)

281. An additional three variations in the Bruce Park area were developed as a result of the MCF (refer to Attachment 3). Two involve different open trench variations leading to a HDD entry location in the northeast corner of the ball field. The third variation involves starting the MNRR HDD Segment east of Indian Field Road, exiting adjacent to the Town maintenance garage located south of the MNRR or exiting at the end of Kinsman Lane adjacent to Bruce Park. (Eversource 1, p. G-22)

Northern Alternative

282. The Northern Alternative would exit Cos Cob Substation, head north under the MNRR, and follow Strickland Street north to Route 1. The route would follow Route 1 west to Field Point Road, extending south to the new substation (refer to Attachment 4). (Eversource 1, p. H-24)

283. The Northern Alternative is unfavorable when compared to the Preferred Route given its longer length (3.1 miles), and installation within existing roadways. Complications include working around existing underground utilities, finding suitable locations and obtaining private property easements for splice vaults and disruption of traffic patterns. (Eversource 1. pp. H-23, H-24; Tr. 1, pp. 68-69)

Southern Alternative

284. The Southern Alternative would exit Cos Cob Substation and head west along Sound Shore Drive. A HDD segment would pass under I-95 to the end of Kinsman Lane. From there, the Southern Alternative would follow the Preferred Route using one of the route variations through Bruce Park (refer to Attachment 4). (Eversource 1, p. H-20)

285. The Southern Alternative is approximately 2.2 to 2.3 miles long depending on the variation used. (Eversource 1, p. H-20)

286. The Southern Alternative is unfavorable when compared to the Preferred Route due to the presence of existing utilities within Sound Shore Drive that would need to be relocated to accommodate the new underground transmission lines. Relocation of underground utilities would require the acquisition of private property leases. (Eversource 1, p. H-21; Tr. 3, pp. 72-73)

Hybrid Alternative

287. During the proceeding, a combination underground/overhead route was recommended by the Council that followed either the I-95 or the MNRR transportation corridors as much as possible. Although Eversource conducted preliminary investigations of overhead route options in this area prior to the submission of the application, Eversource re-examined potential routes including an overhead route only along the north edge of Bruce Park, and several overhead/underground route options along the north and south sides of the MNRR. (Eversource 33, LF-002; Tr. 3, pp. 90-112, 120-123, 134-135, 148)

288. One of the routes examined, the Hybrid Alternative, was deemed viable and Eversource is presenting it as a construction option. It contains two separate underground segments and an overhead segment (refer to Attachment 5). (Eversource 34, LF-003; Tr. 5, pp. 83-84)

289. In summary, the Hybrid Alternative begins underground at the Cos Cob Substation property, transitioning to overhead to cross I-95 and the MNRR. It then extends overhead along the north side of the MNRR to the west side of Indian Field Road. From there, it crosses overhead to the south side of the MNRR, and continues west between the MNRR and I-95 to Steamboat Road. At Steamboat Road, the route transitions to underground following Steamboat Road and Railroad Avenue to the new substation. (Eversource 34, LF-003; Eversource 41, LF-008 Segments 1A, 1B, 2B, 3B, 4B)

290. Two options for the transmission line to exit Cos Cob Substation were presented: Option 1A exits underground along the east side of the substation and extends underground along the shared driveway to the substation and adjacent Cos Cob Park, then transitions to overhead at the edge of a MNRR parking lot; Option 1 B extends underground along the west side of the substation, goes under Sound Shore Drive, and transitions to overhead at the edge of a MNRR parking lot. (Eversource 34, LF-003)

291. The underground portions of the route would use cross-linked polyethylene (XLPE) cable. Splice vaults are not anticipated as both installations are less than 2,500 feet, the maximum length of XLPE cable installation before a splice vault is necessary. The XLPE installation at the Cos Cob Substation property is approximately 500 feet and the underground segment west from Steamboat Road is approximately 2,400 feet. (Eversource 40, R. 1; Eversource 41, LF-008 Segment 1A, 4B; Tr. 4, pp. 129-130; Tr. 5, p. 83)

292. Maintenance issues with underground XLPE cables are rare, usually resulting from a faulty cable splice or an unauthorized excavation. (Tr. 4, p. 169)

293. Transition riser structures would be used to support the two proposed XLPE circuits as they transition from overhead to underground. The transition riser structures would have a foundation and would feature a covering over the XLPE cables as they rise to the top of the structure. (Eversource 34, LF-003; Tr. 4, pp. 129-130)

294. The Town requested that the westernmost transition structure be located as far as technically possible from Steamboat Road. Eversource may be able to relocate the structure another 100 feet to the east but would have to look at the technical limitations of the XLPE cable before determining how far it can be moved. The additional project cost for this 100-foot relocation is approximately a half a million dollars. (Tr. 7, pp. 111-114)

295. The overhead portion of the Hybrid Alternative would be located mostly within the MNRR right-of-way. Some private property easements would be required in the Segment 1 area - Cos Cob Substation to Indian Field Road. Eversource has received preliminary approval of its design from the DOT but would be required to obtain a license agreement with DOT for the final design. The proposed installation would be out of the DOT's taking line for future expansion of I-95. (Eversource 34, LF-003; Tr. 4, pp. 128-12)

296. The Hybrid Alternative is consistent with the Federal Energy Regulatory Commission (FERC) Guidelines for the Protection of Natural, Historic, Scenic and Recreational Values in the Design and Location of Rights-of-Way and Transmission Facilities as this proposed, alternate route jointly utilizes existing rights-of-way that are occupied by different kinds of utility services. (Council Administrative Notice 9)

297. The overhead portion would require a 50-foot right-of-way to maintain proper clearances for conductor "blowout" - the sway of the line during high winds. In some areas a 40-foot right-of-way would be suitable as long as there were no other tall structures in the area that could potentially interfere with the conductors. (Eversource 34, LF-003; Tr. 4, pp. 127-128)

298. The overhead portion of the route would require 19 steel monopole structures varying in height from 95 feet to 140 feet. The structures would be located approximately 500-600 feet apart and would be directly embedded into the ground. The structure heights are at the minimum height required to maintain proper clearance to adjacent structures and vegetation. (Eversource 34, LF-003; Eversource 40, R, 1; Eversource 44, LF 23; Tr. 4, p. 144; Tr. 5, pp. 62-63)

299. For the overhead portion of the Hybrid Alternative, Eversource would install two 556 kcmil steel supported aluminum conductors in a restrained configuration. A single circuit 556 kcmil conductor can transmit 267 MVA, thus meeting the requirements of the new substation (134 MVA). (Eversource 34, LF-003, Tr. 4, pp. 126-128; Tr. 5, pp. 84-85)

300. Construction would be coordinated with MNRR and DOT and would attempt to take advantage of previously scheduled railroad outages not related to the GSLP. (Tr. 5, pp. 65-66)

301. The Town maintains a sewer force main located along a portion of the Hybrid Alternative route where it extends south of the MNRR tracks. The Town is currently under a federal consent decree requiring it to replace and upgrade the force main. If the Hybrid Alternative is approved, the overhead portion to the south of the MNRR tracks would require Eversource to construct the line in a way that would allow the Town to replace and upgrade its force main in accordance with the federal consent decree. Eversource would ensure that the Town would be able to access the force main to perform maintenance work. (Tr. 7, pp. 105-106)

302. Construction of the Hybrid Alternative would be less than two years. (Tr. 5, p. 66)

303. Metro-North is planning a series of railroad outages over the next few years for both their work and work related to a United Illuminating project. Eversource would coordinate overhead line work with these outages to the greatest extent possible. However, additional outages specific to Eversource's work may be required. (Tr. 4, p. 172; Tr. 5, p. 65)

New 115-kV Transmission Line – Other Routes Examined and Rejected

304. An underground route from Cos Cob Substation following Station Drive and Circle Drive to a HDD segment that would go under MNRR, I-95 and Indian Harbor to Davis Avenue where it would follow the remaining portion of the Preferred Route. This alternative was rejected due to community impact concerns and the acquisition of 10 or more private property easements and several private properties. (Eversource 1, p. H-24)

305. An underground route from Cos Cob following Station Drive to an existing Eversource distribution right-of-way that extends through private properties north of the MNRR. At the north end of Woodside Drive, just a HDD segment would go under MNRR, I-95 and Indian Harbor to Davis Avenue where it would follow the remaining portion of the Preferred Route. This alternative was rejected due to construction directly impacting 21 residential properties. Additionally, 18 private property easements and 6 properties would need to be acquired. (Eversource 1, p. H-26)

306. A marine route that would involve submarine cables in Long Island Sound west to the Shore Road area, then following an underground trench route along Horseneck Lane, Arch Street and Railroad Avenue was rejected due to its significantly longer length, difficulty in obtaining necessary environmental permits, installation complications and associated costs and the risk of line damage from potential future dredging operations. (Eversource 1, pp. H-26, H-27)

307. A marine/underground combination route was examined using HDD from Cos Cob Park under Cos Cob Harbor, exiting on private property on Mead Point, then following an underground trench route on private property and town property to Bruce Park Drive where a second HDD segment would go under Bruce Park and Indian Harbor. The HDD would exit on Davis Avenue where the route would follow the remaining portion of the Preferred Route. This route was rejected due to construction challenges and more feasible alternatives. (Eversource 1, p. H-28)

308. An overhead/underground combination route that would use overhead lines from Cos Cob Substation to Bruce Park Avenue north of the MNRR, then transition into an underground trench route following roadways to the new substation was rejected due to impacts to 50 residential properties and the removal of trees that serve to screen the MNRR from residential properties. (Eversource 1, p. H-28)

Underground Transmission System Design

309. Underground transmission lines would utilize HPFF technology where dielectric fluid is used to insulate the transmission cables and to prevent moisture and contaminants from affecting the cable. The HPFF system effectively circulates the dielectric fluid to mitigate hot spots along the cable route, increasing circuit capacity. (Eversource 1, p. G-12)

310. The 115-kV HPFF transmission lines would consist of 3500-kcmil copper cable installed within an 8-inch carbon steel pipe filled with dielectric fluid. (Eversource 1, pp. G-10, G-12)

311. The dielectric fluid would be under high pressure, typically 200 psi or greater. (Eversource 1, p. G-12)

312. The HPFF system would consist of three 8-inch pipes, one for each transmission line and one for dielectric fluid circulation. (Eversource 1, p. G-9)

313. A single circuit would consist of three 3500-kcmil copper conductors within each eight-inch carbon steel pipe. (Eversource 1, p. G-12)

314. Five fiber optic cables would be installed within PVC conduits located adjacent to the three HPFF pipes to provide remote protection, and for temperature monitoring of the transmission cables and fluid return pipe. (Eversource 1, p. G-9)

315. The HPFF piping would be encased in low strength concrete slurry, then covered in high strength concrete. The low strength concrete would allow easier access to the HPFF pipe, if necessary in the future. (Eversource 1, p. G-9; Tr. 3, p. 117)

316. The underground HPFF system would not be affected by stray DC voltage. (Eversource 36, R. 52)

317. For the Preferred Route, Eversource examined the possibility of using a XLPE underground cable system instead of the HPFF system to supply the necessary power to the new substation. Eversource rejected this type of cable for the Preferred Route due to the following issues:

    a) XLPE would require more splicing to connect cable sections, thus decreasing overall reliability;
    b) XLPE would require more excavation for splicing than HPFF, thus increasing community impact;
    c) XLPE would require a larger trench for underground installation, increasing the project cost by $16 million;
    d) HPFF cables are advantageous using HDD applications or in areas where other heat sources are present, enabling a smaller conductor size whereas XLPE cables must be a larger size to account for the worst case thermal conditions.

(Eversource 1, pp. H-29, H-30; Tr. 3. pp. 55-56, 205-207)

GSLP Construction Procedures

318. During construction, Eversource would require support areas for temporarily storing and staging construction materials and equipment in the vicinity of the transmission route. These areas would include one or more primary construction yards and several, smaller staging areas. (Eversource , p. K-9)

319. To the extent possible, storing and staging areas would be located on Eversource property, previously developed sites (such as paved parking lots), vacant land or properties previously used for construction

support, depending on the parcel size requirements and location in relation to the GSLP route. (Eversource 1, p. K-9)

320. Once storage and staging areas are no longer needed, they would be restored substantially to their previous conditions. (Eversource 1, p. K-10)

321. Prior to the commencement of construction, Eversource would conduct studies and surveys to develop procedures aimed at minimizing adverse impacts on the environment and the public. Pre-construction planning activities would include: surveys to identify underground and overhead infrastructure that would be affected by the GSLP; studies of soil and groundwater conditions along the transmission line route; and identifying potential locations for construction support areas. (Eversource 1, p. K-10)

322. Prior to construction activities within public roads, details of methods and procedures would be reviewed with the Town, the MNRR, and the DOT for any work that is near or impacts their facilities. (Eversource 1, p. K-8)

323. Excavated material would be located off-site for disposal or for reuse as backfill. (Eversource 1, p. K-1)

324. In the event bedrock is encountered during excavation, drilling or pneumatic hammer would be the preferred method of rock removal. Blasting would only occur if necessary and would be conducted by a certified blasting specialist and in accordance with applicable regulations. (Eversource 1, pp. J-3, J-13)

325. If groundwater is encountered during excavation, dewatering would be performed in accordance with applicable regulatory agencies. Water may be discharged to nearby catch basins, temporary basins or into holding tanks or trucks. (Eversource 1, p. K-11)

326. Construction of the new substation would require the removal of the existing building and rough grading. Once erosion and sedimentation controls are established, foundation excavation would occur followed by the GIS building and substation component construction. During construction of the substation, the site would be enclosed by temporary security fencing. (Eversource 1, pp. K-13 to K-15)

327. Once started, the project is anticipated to be completed within 18 months. Construction would be divided into multiple components so that different work crews can work on various aspects of the project at one time. (Eversource 1, p. K-10)

Underground HPFF Transmission System Construction

328. Mechanical excavation would be required of the topsoil, asphalt and subgrade materials to the desired dimension, typically a minimum excavation of 4.5 feet wide by 5.5 feet deep and 200 feet long. (Eversource 1, pp. G-9, K-1, K-11)

329. It is expected that a trenching work crew can complete 35 feet of trenching, and installation of pipe and conduits per day under favorable conditions. (Eversource 1, p. K-10)

330. Once a trench has been excavated to the desired depth and shoring installed, 10 to 20 foot sections of pipes and PVC conduit would be lowered into the trench and connected to other sections. Concrete would then be installed to encase the pipes/conduits, followed by backfill once the concrete has set. (Eversource 1, p. K-11)

331. Work zones around active trench areas range from approximately 600 to 800 feet. (Eversource 1, p. K-11)

332. During non-work hours, steel plates would be installed over open trench areas to maintain traffic flow and to mitigate fall hazards. (Eversource 1, p. K-11)

333. Once completed, trenches in roadways would be repaved using temporary asphalt patch. Final restoration would include permanent repaving. (Eversource 1, p. K-12)

334. Two of the proposed routes, the Preferred Route and the Northern Alternative, would require 880 feet of pipe jacking to cross under the MNRR. The jacking uses an auger within a 10-foot deep pit. The auguring operation simultaneously or pushes a 42-inch diameter casing pipe into the cavity being excavated. Casing segments are added as the excavation progresses forward to remove soil. Once the casing is installed, the HPFF pipe segments and associated conduits can be pulled through. For both proposed routes using this method, the jacking operation would be established near the driveway of Cos Cob Park and would require 12,000 square feet of space. (Eversource 1, pp. J-5, K-4 , K-5)

335. Pre-fabricated concrete splice vaults would be installed along the underground GSLP route at intervals of up to 2,800 feet. Locations would be determined by maximum allowed cable pulling tension, maximum allowed side wall pressure, and the maximum length of cable that could be transported on a cable reel. (Eversource 1, p. K-12)

336. Splice vault excavations measure approximately 12 feet deep, 16 feet wide and 24 feet long. The excavations would be shored and fenced and may be demarcated by temporary concrete barriers. (Eversource 1, pp. G-14, K-12)

337. Where possible, splice vaults would be installed off roadways to avoid existing underground utilities and to minimize traffic disruption. Off roadway locations may require the removal or pruning of trees to accommodate construction. (Eversource 1, pp. G-13, J-9)

338. Once completed, the top of the splice vault would be three feet below grade, accessible by two manhole chimneys. (Eversource 1, p. G-14)

339. Cable would be pulled through the previously installed pipes and conduits using truck-mounted winches and cable handling equipment. (Eversource 1, p. K-12)

340. Cable splicing would occur within the splice vault. An enclosure or a large truck would be located over the manhole area to create a clean environment for the cable splicing operation. The splicing operation would occur 24 hours/day, 7 days/week for two to three weeks. (Eversource 1, p. K-5)

341. The area needed for the installation of a splice vault typically requires an excavation area approximately 13 feet wide by 13 feet deep by 30 feet long. (Eversource 1, p. E-2)

Horizontal Directional Drilling

342. For sections of an underground transmission route where trenching is not practical, such as under transportation corridors, sensitive environmental resources or congested areas, HDD technology would be used. (Eversource 1, p. K-2)

343. Two routes proposed in this application use HDD: the Preferred Route and the Southern Alternative. Both routes have segments that utilize HDD to cross under the MNRR and I-95 transportation

corridors. Additionally, both routes have segments that could use HDD to cross under Bruce Park. (Eversource 1, pp. ES-5, ES-8, K-2)

344. HDD requires a sending area, approximately 100 feet wide by 150 feet long, and a receiving area that is approximately 25 feet wide and 750 feet long. A drill rig would bore three individual holes 14 to 20 inches in diameter and 10 feet apart. (Eversource 1, p. K-2)

345. Once the holes are established and the openings stabilized, eight-inch pipes with PVC conduits attached to them would be pulled through the holes, followed by cable pulling operations. (Eversource 1, p. K-2)

346. HDD operations would take four to six months depending on the route selected, with typical work hours of six 12-hour days a week. Cable and pipe pulling would require 24-hour work periods. (Eversource 1, p. K-3; Eversource 20, R. 7)

Public Safety

347. Eversource would hold periodic meetings with Town officials and any utility companies potentially impacted by the project to ensure coordination with appropriate entities. (Eversource 25, p. 12; Tr. 7, pp. 106-107)

348. The SRCP is similar to the GSLP in that it required construction of a HPFF system in roadways located in densely populated commercial and residential areas. Constant coordination and communication to the City of Stamford as well as affected businesses and residents was required. Eversource would employ a similar approach for the GSLP. (Eversource Administrative Notice 15; Eversource 25, pp. 14-15)

349. The GSLP would be constructed in full compliance with the National Electric Safety Code, standards of the IEEE, American Concrete Institute, American Society of Civil Engineers, and the American National Standards Institute. (Eversource 1, p. J-17)

350. Protective relaying equipment would be incorporated into both the substation and transmission line design to automatically detect abnormal operational conditions. Circuit breakers would automatically be triggered to isolate and remove the failed equipment from service, thereby protecting other electrical components and areas around the failed equipment. (Eversource 1, p. J-17)

351. Protective relay mechanisms include redundant primary and back up equipment to ensure continuous operational monitoring. (Eversource 1, p. J-17)

352. Protective relay equipment would be remotely controlled and monitored by the Connecticut Valley Electric Exchange System Operator, a central monitoring installation, using digital metering systems and a Supervisory Control and Data Acquisition system installed at the new substation. (Eversource 1, p. J-18)

353. Interruption of transmission service to the Cos Cob Substation would also affect the proposed Greenwich Substation since transmission level power to the new substation is only fed from Cos Cob Substation. (Eversource 1, p. L-4)

354. If one of the new transmission lines is out of service, the other line would be able to continue to operate and supply power to the proposed substation, thus maintaining electric supply to Greenwich. (Eversource 1, p. L-4)

355. The new substation would be designed in accordance with appropriate fire protection measures. Fire and smoke detection systems would be installed within the new substation control house. If triggered, these detection systems would automatically activate an alarm at the Connecticut Valley Electric Exchange System, where further appropriate action would be taken such as dispatch of personnel to the substation. (Eversource 1, p. J-18)

356. The substation design includes acceptable physical separation distances from substation equipment to abutting properties. (Tr. 7, p. 34)

357. Eversource personnel responsible for emergency events for all of the Greenwich substations would be dispatched from an Eversource work center facility in Norwalk. An additional work center is located in Stamford. If additional personnel and/or/equipment is necessary. Drive time form the work centers to the proposed Greenwich substation is estimated at 15-30 minutes. (Eversource 37, R. 7)

358. Substation incident notification to Eversource would be from a substation alarm or by phone call reporting an issue at a substation. The Operation Center would determine the nature of the incident and dispatch appropriate personnel as well as notification to other personnel. (Eversource 31, R. 32)

359. Eversource would provide substation safety and fire training to local emergency responders. (Eversource 1, p. J-18)

360. Eversource participates in DESPP's emergency preparedness training, exercises and conference events. (Eversource 1, p. L-6)

361. To deter unauthorized entry to the substations, the substations would be enclosed by fencing that deters unauthorized access and security cameras would monitor substation areas. Access to the substation compound is through a locked gate. In addition, the GIS building would be locked. Appropriate signage is in place around each substation indicating the presence of high-voltage equipment. (Eversource 1, pp. J-18, L-5)

362. The proposed substation would have low-level security lighting as well as additional lighting for any necessary night work. Lighting is already installed at the Cos Cob Substation. (Eversource 1, p. L-2)

363. The Cos Cob Substation is classified as a low risk site per NERC Physical Security Standards. Additional security upgrades for Cos Cob would be completed by the end of 2016. (Council Administrative Notice 8; Eversource 1, p. L-3)

364. Physical security of the proposed facilities is consistent with the Council's *White Paper on the Security of Siting Energy Facilities*. The white paper guidelines focused on Planning, Preparedness, Response and Recovery procedures related to intentional physical destruction of substation equipment. (Council Administrative Notice Item 17; Eversource 1, p. L-2)

365. In December 2009, President Obama proclaimed power grids as critical infrastructure vital to the United States. The Department of Homeland Security, in collaboration with other federal stakeholders, state, local, and tribal governments, and private sector partners, has developed the National Infrastructure Protection Plan (NIPP) to establish a framework for securing our resources and maintaining their resilience from all hazards during an event or emergency. (Council Administrative Notice 3)

366. On February 12, 2013, President Obama signed Executive Order 13636 on Improving Cyber Security for Critical Infrastructure, along with an accompanying Presidential Policy Directive on Critical Infrastructure Security and Resilience. The order established the U.S. policy to "enhance the security

and resilience of the nation's critical infrastructure." The Secretary of Homeland Security has been given the overall responsibility for critical infrastructure protection, and identifies the Department of Energy as the sector-specific agency responsible for the energy sector. The Department of Energy may draw upon the North American Electric Reliability Corporation's (NERC) expertise. (Council Administrative Notice 4; Council Administrative Notice 40, p. 9)

367. NERC developed Physical Security Reliability Standard CIP-014-1 to address threats and vulnerabilities to the physical security of critical infrastructure on the bulk power system. CIP-014-1 consists of standards and requirements related to security of electronic perimeters, protection of critical cyber assets including personnel, training, security management and disaster recovery planning. CIP-014-1 requires transmission owners to deploy systems for monitoring security events and to have comprehensive contingency plans for cyberattacks, natural disasters and other unplanned events. (Council Administrative Notice 8; Council Administrative Notice 40, p. 9)

Environmental Considerations

368. The GSLP is consistent with the *Conservation and Development Policies Plan for Connecticut 2005-2010* in that it serves a public need for a reliable source of electricity to the Town of Greenwich. (Eversource 1, p. J-10)

369. The GSLP is consistent with the future land use and planning objectives of the Southwestern Regional Planning Agency's *2006-2015 Regional Plan of Conservation and Development* in that it improves the regions electric transmission grid. (Eversource 1, p. J-11)

370. For construction of the GSLP, Eversource would adhere to *Northeast Utilities Transmission Group Best Management Practices Manual for the State of Connecticut, Construction & Maintenance Environmental Requirements* – December 2011. (Eversource 1, p. J-1)

371. The GSLP area contains numerous statutory facilities—as defined under C.G.S § 16-50p(a)(3)(D) to include residential areas, private or public schools, licensed child day care facilities, licensed youth camps or public playgrounds. Construction and operation of the GSLP would have no long term permanent effects on these facilities. Temporary effects would include the disruption of land use such as park and recreation areas proximate to construction activities. (Eversource 1, pp. I-14, J-15, J-16)

Land Use

372. The proposed Greenwich Substation is located in a highly urbanized area and is developed as a commercial property. (Eversource 1, p. I-22)

373. Expansion of the Cos Cob Substation would occur to the south of the existing fence line in an area containing a lattice transmission structure and a wood pole transmission structure. (Eversource 3, R. 18)

374. The Cos Cob Substation expansion would remain on Eversource and State of Connecticut property and would not affect recreational facilities in Cos Cob Park. (Eversource 3, R. 18)

375. All four proposed transmission line routes would be installed within heavily developed areas of Greenwich. Predominate land uses include transportation corridors, commercial development and residential areas. (Eversource 1, pp. ES-8, I-34; Eversource 44, LF-15)

376. The Preferred Route and Southern Alternative pass portions of Bruce Park as a trench option, and HDD option, or a combination of both. (Eversource 1, pp. I-29, I-34)

377. Bruce Park is Greenwich's oldest park and was established in 1908. It consists of 60-acres of maintained lawn, woodland, picnic areas, roadways, athletic fields and two tidal ponds. (Town 6, R. 11)

378. The Bruce Museum is located in the western section of the park. The Southern Alternative would be installed in a trench in a public road in front of the Museum. (Eversource 1, Mapsheet ES-2; Town 6, R. 11)

379. If need for the GSLP has been demonstrated, the Town would prefer the Hybrid Alternative. The Town is opposed to any transmission line option that includes Bruce Park. (Tr. 6, p. 38; Tr. 7, pp. 41, 101-102)

380. The Northern Alternative and Hybrid Alternative do not traverse any portion of Bruce Park. (Tr. 7, p. 41)

381. Of all of the transmission routes proposed, potential environmental impacts of the GSLP would be greatly reduced by using the Hybrid Alternative. (Tr. 7, p. 119)

Soil and Earthwork

382. Eversource would deploy erosion and sedimentation controls in accordance with the *2002 Connecticut Guidelines for Soil Erosion and Sediment Control* at the limits of work, adjacent to sensitive areas, and around adjacent catch basins. Erosion controls would be maintained until construction is completed and exposed soils in the work area have stabilized. (Eversource 1, pp. J-1, K-15)

383. Minimal grading would be required for construction at both the proposed Greenwich Substation site and Cos Cob Substation. (Eversource 1, pp. I-20, I-25)

384. Trench construction in roads would be similar to other types of construction projects that occur in roads such as water main replacements or natural gas line installations. (Tr. 3, pp. 59-62)

385. Trench and splice vault excavation would have minimal environmental effect as construction activities would be temporary and limited to the area in and adjacent to the trench. (Eversource 1, p. J-8)

386. Excavated soils would be placed in designated areas, surrounded by appropriate erosion and sedimentation controls. (Eversource 1, pp. J-2, J-8)

387. In areas where trench routes are adjacent to wetlands and watercourses, appropriate erosion and sedimentation controls would be established and maintained to prevent any potential runoff from reaching these sensitive areas until the trench is backfilled and the ground surface has stabilized. (Eversource 1, p. J-2)

388. Excess excavated material or materials not suitable for backfilling would be removed from the construction area and disposed of in accordance with applicable regulations and per a pre-existing DEEP agreement regarding excavated soils. (Eversource 1, p. J-2; Tr. 3, p. 120)

389. Trench backfill would be compacted to avoid subsidence. In road areas, backfilling and compaction would have to meet DOT standards. In non-paved areas, 12 to 18-inches of topsoil would be included to allow for enough soil for re-vegetation. (Tr. 3, pp. 118-119)

390. Due the highly urbanized nature of the Greenwich area, construction of the GSLP may encounter contaminated soils and/or contaminated groundwater. (Eversource 1, H-15)

391. The Hybrid Alternative 1A Option exits the Cos Cob Substation underground and proceeds along the shared driveway that accesses the substation and Cos Cob Park. The driveway may be on a portion of an existing capped landfill in part of Cos Cob Park and it is possible the proposed trenching would disturb contaminated soils. Any disturbance to the capped landfill and associated contaminated soils would be conducted appropriately and in accordance with regulatory criteria and permits. (Tr. 7, pp. 121-122)

392. As part of the preliminary design of the GSLP, Eversource obtained 40 soil and water samples along portions of the Project routes to obtain baseline data. Once a final route has been selected, additional soil boring would be taken to determine construction and installation design techniques. (Eversource 27, R. 7; Eversource 37, R. 8; Tr. 3, pp. 43-46)

393. In areas where bedrock that is partially excavated or exposed above ground would be loosened by a commercially available expanding grout compound. This technique is used in sensitive areas to avoid noise and vibrations caused by hydraulic hammer equipment. Eversource used expanding grout multiple times on a previous project at the Cos Cob Substation. (Eversource 20, R. 5)

394. Of the three trench variations in Bruce Park, the Preferred Route- HDD Variation 2 is the most likely candidate for blasting. Blasting is not expected in Bruce Park for the other two alternative trench routes. (Eversource 36, R. 55)

HDD and XLPE Work Considerations

395. The transmission lines installed under portions of Bruce Park using HDD would reach depths of 30-40 feet below the ground surface. The underground lines beneath the MNRR and I-95 would be 20 to 50 feet depending on location. (Eversource 36, R. 52; Tr. 4, pp. 31-32)

396. HDD operations would use bentonite as drill mud to coat the drill hole walls, preventing the loss of fine particles and drill hole leaks. Bentonite is a clay material and is widely used in HDD operations as it performs better than other drill mud products. (Eversource 31, R. 39)

397. The HDD contractor would have a leak detection system in place during the HDD operation. Clean-up equipment would also be staged at the HDD site, if needed. (Tr. 3, pp. 200-201)

398. The insulation fluid is enclosed with a pipe casing, coated with epoxy. The HDD pipe sections are welded together with the welds verified by a form of x-ray. An additional coating for cathodic protection is applied to the pipe before it is encased in two layers of concrete and covered with backfill. (Eversource 36, R. 52; Tr. 3, pp. 124-125)

399. The HDD pipe casing coatings are resistant to salt water. (Tr. 3, p. 197)

400. The HPFF system would use polybutene, a synthetic insulation fluid. The fluid is a non-toxic, non-cancerous, non-hazardous substance. (Eversource 25, Attachment 1; Tr. 3, pp. 123-124)

401. The HPFF system has three types of leak detection systems: a fluid level alarm, a low-pressure alarm, and equipment to monitor pump operations. (Eversource 20, R. 9; Tr. 3, pp. 125-126)

402. Underground cable leaks are usually related to contractor dig-ins. One leak occurred in Stamford adjacent to the Glenbrook Substation in the early 2000's when a cable was damaged during a subsurface environmental survey. (Tr. 7, pp. 48-49)

403. If there was a fluid leak into soil, the soil would not be considered a hazardous waste. The soil must be treated and or removed and disposed of as a solid waste in accordance with applicable regulatory criteria. (Eversource 20, R. 9)

404. If repair of a cable was necessary within the pipe casing installed in the bed of a tidal basin, Eversource may be able to pull the cable out and install a new cable. If repair was needed where access to the casing pipe is necessary, Eversource would have to use cofferdams and excavation to access the section of damaged cable. (Eversource 20, R. 2; Tr. 3, p. 204)

405. The HPFF system has a life span of 40 years; however, some of Eversource's existing HPFF systems have been in operation for almost 60 years. Ongoing maintenance and constant system analysis assures longevity to the system. (Eversource 20, R. 8)

406. At retirement, the dielectric fluid and cable would be removed from the casing pipe for disposal. The casing pipe is then cleaned capped and abandoned or reused for other electric facilities. (Eversource 20, R. 8)

407. XLPE cables do not contain oil. This type of cable is limited to the Hybrid Alternative and would be installed within previously disturbed areas. (Eversource 25, Attachment 2)

Water Resources

Coastal Area Resources

408. Portions of the GSLP are located within the coastal resource boundary, as defined by the Connecticut Coastal Management Act (CCMA). However, none of the coastal resources identified by the CCMA would be adversely affected by GSLP. (Eversource 1, pp. I-20, I-21, I-23, I-28, I-31, I-33, J-5 to J-8)

409. Bruce Park contains a complex of open water estuarine tidal water features. (Eversource 1, pp. I-7, I-8)

410. The Preferred Route- Open Trench through Bruce Park would cross Indian Harbor and a small tidal basin east of Indian Harbor. Both crossings within the park would utilize coffer dams to dewater and segregate water resources from the construction activities. Water would be continually pumped out of the construction area. (Eversource 20, R. 2)

411. For the Indian Harbor trench crossing, two coffer dams would be used, one from each shore and extending partially across the harbor. Coffer dam construction would not affect the tidal fluctuations (a few feet) within the harbor of the small tidal basin to the east. (Tr. 4, pp. 166-167)

412. Tidal basin sediment would be removed by excavator and stored in a stockpile area. Trench excavation would not exceed eight feet below the water surface. Once cable construction is complete, the stockpiled sediments would be used as backfill to restore disturbed areas to their pre-construction surface condition. Excess sediment would be removed from the site and disposed of accordingly. (Eversource 20, R. 2; Eversource 37, R. 17)

413. Disturbance to biological habitats and fish and wildlife resources would be temporary. There would be no effect on tidal fluctuations. (Eversource 20, R. 2)

414. Restoration of disturbed shore areas adjacent to the harbor and small tidal pond would take one full growing season. (Tr. 7, p. 118)

415. Trench work within the tidal ponds would require a permit from DEEP Office of Long Island Sound Programs. The permit would detail the effects on benthic habitats and typically requires a three to one mitigation ratio for restoration activities. (Eversource 20, R. 2)

416. The Preferred Route and the Southern Alternative HDD options would not impact the tidal basins within Bruce Park. (Tr. 7, p. 117)

417. In March of 2015, the Town Inland Wetlands and Watercourses Agency indicated to Eversource that the Preferred Route -HDD would have the least potential of causing adverse wetland impact when compared to the Preferred Route-Trench. (Eversource 9, pp. 25-26)

418. The Town is concerned about the effects of HDD drilling and HPFF operation within the park, believing these activities would be detrimental to the soil and waterbodies within the park. (Town 6, R. 11)

Inland Wetlands and Watercourses

419. None of the proposed GSLP routes or substation work would directly affect any inland wetlands or watercourses. (Eversource 1, Mapsheet I-20, pp. I-20, I-21, I-25)

420. A wetland area is located in close proximity to the Preferred Route - HDD I-95 crossing end point at the end of Kinsman Lane. It is an isolated forested wetland that has been impacted by adjacent land use. It does not exhibit vernal pool characteristics. (Eversource 1, p. I-8; Eversource 9, Attachment 6)

421. Eversource would implement site specific wetland mitigation measures during the final design of the GSLP to minimize potential adverse effects to any wetlands adjacent to construction work areas. (Eversource 1, pp. G-18, I-8, I-32, J-3, J-4)

Flood Hazard Areas

422. The proposed substation site is not within a 100-year or 500 year flood zone as determined by the Federal Emergency Management Agency. The southern portion of the site is 10 feet from the edge of a designated 500 year flood zone associated with Horseneck Brook. (Eversource 1, pp. H-9, I-19)

423. Trench installation within Bruce Park would not affect flood storage capacity since the cables and associated concrete casing are located underground. (Tr. 3, pp. 223-224)

Groundwater

424. The GSLP area has groundwater classified as GA or GB. No GSLP facilities are located within a designated Aquifer Protection area. Construction of GSLP wound not affect groundwater resources or quality. (Eversource 1, pp. I-19, I-23, I-27 to I-33, J-3)

425. There are no public or private water supply wells in the GSLP area. (Eversource 1, p. I-4)

426. Preliminary soil borings in Bruce Park indicate depth to groundwater is shallow due to underlying bedrock and groundwater would flow towards Indian Harbor. Once construction of trench segments within the park are completed, ground water would most likely follow the route of the trench backfill material towards Indian Harbor thus not altering overall existing drainage patterns. If trench installation causes drainage issues on adjacent residential properties, subsurface work such as curtain drains could be constructed to remediate specific issues. (Stacy 2; Tr. 3, pp. 222-228)

Vegetation

427. Trees adjacent to the work zones may need to be trimmed to accommodate construction equipment. All trimming would be conducted by licensed tree crews and supervised by a licensed arborist. (Eversource 1, p. J-9; Tr. 5, pp. 62-63)

428. Trench construction activities, pipe jacking activities, HDD set up areas, and overhead line installation would require the removal of trees within the construction work zone to accommodate both the work area and related construction equipment. Once construction is completed, Eversource would install plantings where appropriate. (Eversource 1, pp. J-8, J-9; Tr. 5, pp. 62-63)

429. The Preferred Route - HDD Variation 2, (orange route) includes a trench route through a small wooded area of Bruce Park, east of Kinsman Lane. Approximately 15,000 square feet of woodland would be removed to accommodate a 25-foot wide, 600-foot long trench construction area. After construction is complete, the trench area would be maintained as a field area by Eversource to prevent regrowth of trees over the trench installation. (Eversource 20, R. 1, R. 4; Tr. 3, pp. 15-16, 106)

430. Construction of the Hybrid Alternative or Northern Alternative would avoid disruption of the existing landscape of the Bruce Park, including the removal or trimming of ornamental plants, large diameter trees, and wooded areas. (Eversource 1, p. ES-8; Town 6, R. 14; Tr. 7, p. 115)

431. Eversource would work with the Town and affected landowners to develop a post-construction vegetation restoration plan for areas disturbed by construction. For permanent easement areas, drought resistant plantings may be installed above the ductbank to prevent plants from taking too much water out of the soil around the cable, affecting its performance. In addition installation of deep rooting species would be discouraged to reduce potential root damage to the underground ductbank. (Eversource 1, p. J-8; Eversource 31, R. 36)

Fish and Wildlife

432. Development of the GSLP would not impact any fishery resources. (Eversource 1, pp. I-11, J-10)

433. Bruce Park is part of the Atlantic flyway and is an important stop for migrating birds. Over 120 bird species have been recorded in the park. (Town 6, R. 11)

434. None of the GSLP routes or associated substation work would impact any USFWS or State-listed endangered, threatened, or special concern species. The river herring, listed by the National Oceanic and Atmospheric Administration as a special concern species, migrates in tidal waters in Greenwich, including Indian Harbor in Bruce Park. (Eversource 1, pp. I-11, J-10'; Town 6, R. 11; Tr. 7, pp. 116-117)

435. The GSLP would not impact any DEEP designated critical habitats. (Eversource 1, pp. I-11, J-10)

436. Preferred Route - HDD Variation 2, (orange route) includes a trench route through a wooded area of Bruce Park, east of Kinsman Lane. This wooded area is considered a fragment and has little wildlife value given its size and proximity to I-95. (Eversource 20, R. 1, R. 4; Tr. 3 pp. 105-106)

437. The Hybrid Alternative and Northern Alternative would not require a route through Bruce Park, thus avoiding direct and/or potential impacts to fish and wildlife and related habitats within the park. (Eversource 1, p. ES-8; Tr. 7, pp. 115, 118-119)

Historic Resources

438. Construction of the Project would not permanently impact any historic resources. Several properties and historic districts on the National Register of Historic Places occur near some of the proposed Project routes. To minimize impacts to these identified resources, the State Historic Preservation Office, recommends minimizing ground vibrations for any work that may occur near the Cos Cob Railroad Station (Preferred Route and Southern Alternative) and near several historic properties along Strickland Avenue and Route 1 (Northern Alternative). (Eversource 1, Figure I-1, p. J-12)

439. An evaluation of archeological resources along the various routes indicates two archeological sites with the potential to retain intact archeological deposits occur in the Sound Shire Drive area (Southern Alternative) and the Bruce Park area (Preferred Route Open Trench). If these deposits are within the final construction route, Eversource would conduct subsurface investigations of the affected identified areas prior to construction. (Eversource 1, pp. J-11, J-12)

Air Quality

440. The sulfur hexafluoride gas used as the GIS insulator is nontoxic and any release would not impact air quality. The gas is classified as a greenhouse gas and as such, Eversource is required to monitor and annually report releases. The proposed GIS equipment would be new and would have the latest leak prevention designs. Once operational, continual maintenance activities would reduce the potential for gas leaks. (Eversource 31, R. 33)

441. Construction of the Project would have short-term, localized effect on air quality, mostly from dust and equipment emissions. In order to minimize dust, Eversource would limit the extent of exposed/disturbed areas and install temporary gravel tracking pads wherever necessary to prevent dirt from being tracked onto public roadways. Water may be used to control dust emissions, as needed. (Eversource 1, pp. J-14, J-15)

Noise

442. Eversource expects only short-term and highly localized construction-related noise effects from the GSLP, including noise from truck traffic, drill rigs, jackhammers. The existing noise environment along most of the GSLP is dominated by urban noise related to local traffic, transportation corridors, and commercial uses. Construction activities are exempt from noise regulations. (Council Administrative Notice Item 33; Eversource 1, pp. I-13, I-22, I-26, I 29, I 32, I-35, J-12, J-13)

443. Noise associated with HDD would be constant, mainly from the drill rig, truck engines and compressors. (Tr. 1, p. 28)

444. The Preferred Route - HDD Variations 1 and 2 were developed after consultations with the Town to move HDD operations and associated noise away from residences on Kinsman Lane. (Tr. 1, p. 35)

445. Substation operations at the 281 Railroad Alternate Site would exceed state and local noise criteria. Eversource would have to purchase two residential properties and one commercial property west of the substation to meet noise criteria. The substation equipment would be constructed to the edge of the property lines. The concrete GIS building would attenuate substation noise towards the residential areas. (Tr. 1, pp. 47, 58-60)

446. Once operational, noise from GSLP operations would be minimal and would meet applicable noise standards. (Eversource 1, p. J-12)

Electric and Magnetic Fields

447. Electric fields (EF) and magnetic fields (MF) are two forms of energy that surround an electrical device. Transmission lines are a source of both EF and MF. In North America, electric utilities provide power at 60 hertz (oscillates 60 times per second). (Council Administrative Notice Item 15; Eversource 1, p. M-1)

448. Electric fields result from voltages applied to electrical conductors and equipment. Appliances within homes and the workplace are the major sources of electric fields indoors, and power lines are the major sources of electric fields outdoors. EF levels decrease rapidly with distance from the source, diminishing even faster when interrupted by conductive materials, such as buildings and vegetation. The scientific community does not regard EF levels to be a concern to the general public and thus studies of health effects from electrical transmission lines and equipment has focused on MF. (Council Administrative Notice Item 15; Eversource 1, p. M-1)

449. Magnetic fields are produced by the flow of electric currents. The level of a magnetic field is commonly expressed as magnetic flux density in units called gauss, or in milliGauss (mG). The magnetic field level at any point depends on characteristics of the source, which can include the arrangement of conductors, the amount of current flow through the source, and its distance from the point of measurement. MF levels decrease rapidly with distance from the source but are not easily interrupted as they pass through most materials. (Council Administrative Notice Item 15; Eversource 1, p. M-1)

450. In the United States, no state or federal exposure standards for 60-hertz MF based on demonstrated health effects have been established. Nor are there any such standards established world-wide. However, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) has established a level of 2,000 mG, based on extrapolation from scientific experimentation, and the International Committee on Electromagnetic Safety (ICES) has calculated a guideline of 9,040 mG for exposure to workers and the general public. (Council Administrative Notice Item 15; Eversource 1, Appendix G-3, pp. 4, 9; Eversource 23, R. 4)

451. The Council has developed its *"Electric and Magnetic Field Best Management Practices for the Construction of Electric Transmission Lines in Connecticut"* (EMF BMPs) to address concerns regarding potential health risks from exposure to EMF from transmission lines. The document presents scientific knowledge about health risks, outlines the Council's policy of prudent avoidance, and describes a wide range of best-practice MF management designs. (Council Administrative Notice Item 15; Eversource Administrative Notice Item 14, DO 424 Finding of Fact No. 359)

452. In accordance to the Council's *Electric and Magnetic Fields Best Management Practices for the Construction of Electric Transmission Lines in Connecticut* guidelines (EMF BMP), Eversource is required to provide an analysis of recent scientific literature regarding MF exposure, an analysis of pre and post construction MF levels, and develop a Field Management Design Plan and associated MF reduction strategies in areas of particular interest, as long as such designs do not compromise system reliability or worker safety, or environmental and aesthetic project goals. (Council Administrative Notice Item 15)

453. Eversource has complied with the Council's EMF BMP by reviewing recent scientific literature and exposure standards related to MF, provided pre- construction measurement and post construction calculations, and reviewed the need for a Field Management Design Plan with MF reduction strategies. (Eversource 9, pp. 51-52)

454. As required by the Council's EMF BMP's, Eversource provided an analysis of recent scientific literature regarding MF exposure and determined there were no relevant changes in current research conclusions or the recommended exposure standards established by ICES and ICNIRP. (Eversource 1, Appendix G-3, pp. 3-10; Eversource 23, R. 5, R. 6)

455. The major sources of MF associated with the GSLP are the proposed underground transmission lines, overhead transmission lines associated with the Hybrid Alternative and nearby overhead and underground distribution lines. (Eversource 9, p. 46; Tr. 7, pp. 147-148)

456. Transformers and other equipment at the Cos Cob Substation and proposed Greenwich Substation are potential EMF sources. These sources, however, would be expected to cause little or no exposure to the general public because the strength of fields from typical substation equipment decreases rapidly with distance and reaches very low levels at relatively short distances beyond the substation perimeter. The exception to the normally low levels of EMF associated with substations is where transmission and distribution lines enter the substation. (Eversource 9, p. 47)

457. Eversource conducted existing MF field measurements in three locations along select locations of the Preferred Route using industry protocols, the Cos Cob access road, Arch Street near Greenwich Harbor, and around the proposed Greenwich Substation site. Maximum measured MF levels were 12.2 mG, 2.9 mG, and 26.6 mG, respectively. These measurements only represent MF conditions at the time of measurement. MF levels from MF sources would fluctuate based on ever changing power flows through the source. (Eversource 1, pp. M-7 to M-12; Eversource 9, pp. 48-49)

458. A calculation of MF first requires determining the currents that will flow on the affected lines under each set of conditions to be studied. For these transmission lines, because there are no large generators on the Greenwich side of the proposed transmission lines, generator dispatch will have almost no impact on the current flow of the transmission lines. As such, different generator dispatches were not evaluated and current flows were determined based on the load assumed at the proposed Greenwich Substation. Eversource calculated magnetic fields for the proposed lines under post-Project conditions in 2023. The calculations for Average Annual Load are the most useful for comparing before and after field levels for any 'typical' day. (Eversource 1, p. M-13)

459. Three of the four proposed routes use the HPFF design; the Preferred Route, Northern Alternative and the Southern Alternative. Calculated MF levels associated with the HPFF installation at the top of the cable trench would be a 0.52 mG during average annual load. (Eversource 2; Eversource 1, p. M-6)

460. The XLPE underground portion of Hybrid Alternative would also have minimal MF levels at ground level. Calculated MF level ten feet from the center of the XLPE underground line would be 1 mG or less during average annual load. (Tr. 4, p. 129, Tr. 7, pp. 143-144)

461. The underground cable leaving the proposed substation would not contribute significant MF to the building at 280 Railroad Avenue (less than 1 mG). MF levels within the 280 Railroad Avenue building would be primarily from existing electrical wiring and equipment within the building and on the property. (Eversource 22, R. 6; Tr. 4, p. 129; Tr. 7, pp. 143-144)

462. As stated in the Council's EMF BMP's, the use of XLPE and HPFF underground cable designs reduces MF to the greatest extent practicable due to the placement of the cable underground, cable proximity and in the case of HPFF material, characteristics of a steel pipe. No special circumstances exist along the underground routes that would require a Field Management Design Plan for additional MF mitigation beyond the projected levels. (Council Administrative Notice No. 15; Eversource 9, p. 52)

463. Post-construction calculated MF levels along the perimeter of the proposed Greenwich Substation are 1 mG or lower along the north and south property boundaries and 2 mG or lower along the east and west property boundaries. The contribution of the substation equipment to existing MF levels to adjacent buildings is less than 1 mG. (Eversource 23, R. 1)

464. Calculated maximum MF levels for the overhead portion of the Hybrid Alternative under average annual load conditions are 6.6 mG directly under the lines and less than 1.0 mG at the edge of the right-of-way. With the exception of the portion of the line traversing parking lots for the MNRR along Station Drive and Sound Shore Drive, the transmission right-of-way is in between the MNRR and I-95 and not accessible to the public. (Eversource 34, LF-003; Eversource 41, LF-008; Tr. 7, pp. 143-144)

Project Cost and Cost Allocation

465. The proposed GSLP costs are summarized below :

GSLP Project Cost				
Transmission Line	*Preferred Route*	*Southern Alternative*	*Northern Alternative*	*Hybrid Alternative*
	$72 million	$71 million	$87 million	$50 million
Cos Cob Modifications /distribution upgrades	$16 million	$16 million	$16 million	$16 million
New Greenwich Substation	$52 million	$52 million	$52 million	$52 million
Total	$140 million	$139 million	$155 million	$118 million

(Eversource 1, p. G-23; Eversource 3, R. 9; Eversource 44, LF 16)

466. The cost of the double circuit underground routes utilizing HPFF cable installation is approximately $28.1 to $31.3 million/circuit mile. By comparison, the SRCP, which involved the installation of a 1.4 mile long single circuit XLPE cable in roadways in Stamford, cost approximately $24.2 million/mile. (Eversource Administrative Notice Item 15)

467. GSLP costs would be recovered by Connecticut ratepayers through FERC and DEEP rate recovery formulas. If the cost of the GSLP was $140 million, cost would be recovered, as follows:

a. Regional transmission costs of $12 million associated with the Cos Cob Substation. This cost would be regionalized, with Connecticut customers paying 25 percent;
b. Distribution costs, estimated at $21 million, would be recovered 100 percent from Eversource customers; and
c. Local Network Service costs, costs associated with the new substation and the new transmission line, are estimated at $107 million and would be recovered 64 percent from Connecticut ratepayers.

(Eversource 9, pp. 29-30; Eversource 44, LF-16; Tr. 1, pp. 59-63)

468. Depending on the transmission route selected, the annual GSLP cost to Connecticut retail and non-retail customers is approximately $22 million. (Eversource 44, LF 16)

469. In summary, given the GSLP mostly improves electric service at the local level, approximately 67 percent of GSLP cost recovery would be borne by Connecticut ratepayers. (Eversource 3, R. 11)

470. Eversource's life cycle cost analysis for the preferred transmission line route is $121.6 million. The resulting life cycle cost per mile is $52.9 million. There is no directly comparable data within the Council's 2012 Life Cycle Cost Analysis Report as the Preferred Route consists of a double circuit HPFF 115-kV transmission line that includes two HDD installations. The Council's 2012 Life Cycle Cost Analysis Report only provides an estimate for the life cycle cost of a single circuit underground HPFF line - $15 million/circuit mile. (Council Administrative Notice 18; Eversource 1, p. G-23)

471. No Life Cycle costs were provided for the Hybrid Alternative. (Record)

Attachment 1: Summary of GSLP Substation Additions and Retirements

Existing Substations

Existing Substation Transformer	Transformer nameplate rating (MVA)	Transformer Voltage	Disposition of existing transformer if Greenwich Substation is built
Cos Cob 1X	50.4	115-27.6kV	Continue to supply customer load at 27.6kV
Cos Cob 2X	46.7	115-27.6kV	Continue to supply customer load at 27.6kV
Cos Cob 3X	46.7	115-27.6kV	Continue to supply customer load at 27.6kV
Cos Cob 5X	25	115-13.2kV	Continue to supply customer load at 13.2kV
Cos Cob 6X	30	115-13.2kV	Continue to supply customer load at 13.2kV
North Greenwich 1X	25	27.6-13.2kV	Continue to supply customer load at 13.2kV
North Greenwich 2X	25	27.6-13.2kV	Continue to supply customer load at 13.2kV
North Greenwich 3X	25	27.6-13.2kV	Continue to supply customer load at 13.2kV
Prospect 1X	15	27.6-13.2kV	Transformer removed
Prospect 2X	12.5	27.6-13.2kV	Transformer removed
Prospect 3X	12.5	27.6-13.2kV	Transformer removed
Prospect 4X	15	27.6-13.2kV	Transformer removed
Byram 1X	12.5	27.6-13.2kV	Transformer removed
Byram 2X	12.5	27.6-13.2kV	Transformer removed

Proposed Substation

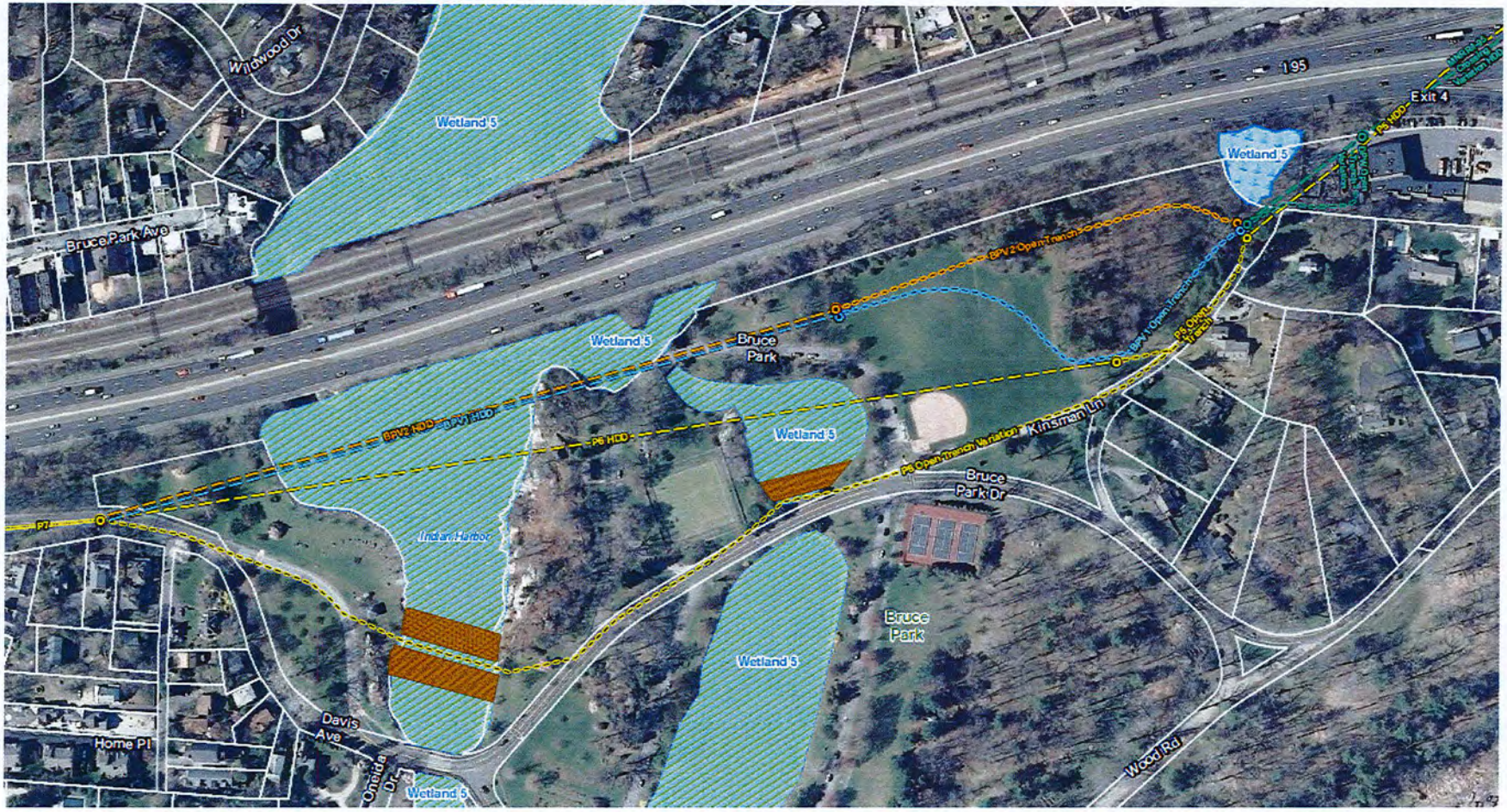
Proposed Substation Transformer	Transformer nameplate rating (MVA)	Transformer Voltage	Existing transformer(s) being replaced
Greenwich 1X	60	115-13.2kV	Various transformers at Prospect and Byram Substations
Greenwich 2X	60	115-13.2kV	Various transformers at Prospect and Byram Substations
Greenwich 3X	60	115-13.2kV	Various transformers at Prospect and Byram Substations

(Eversource 43, R. 81, R. 83)

Attachment 2: Preferred Route

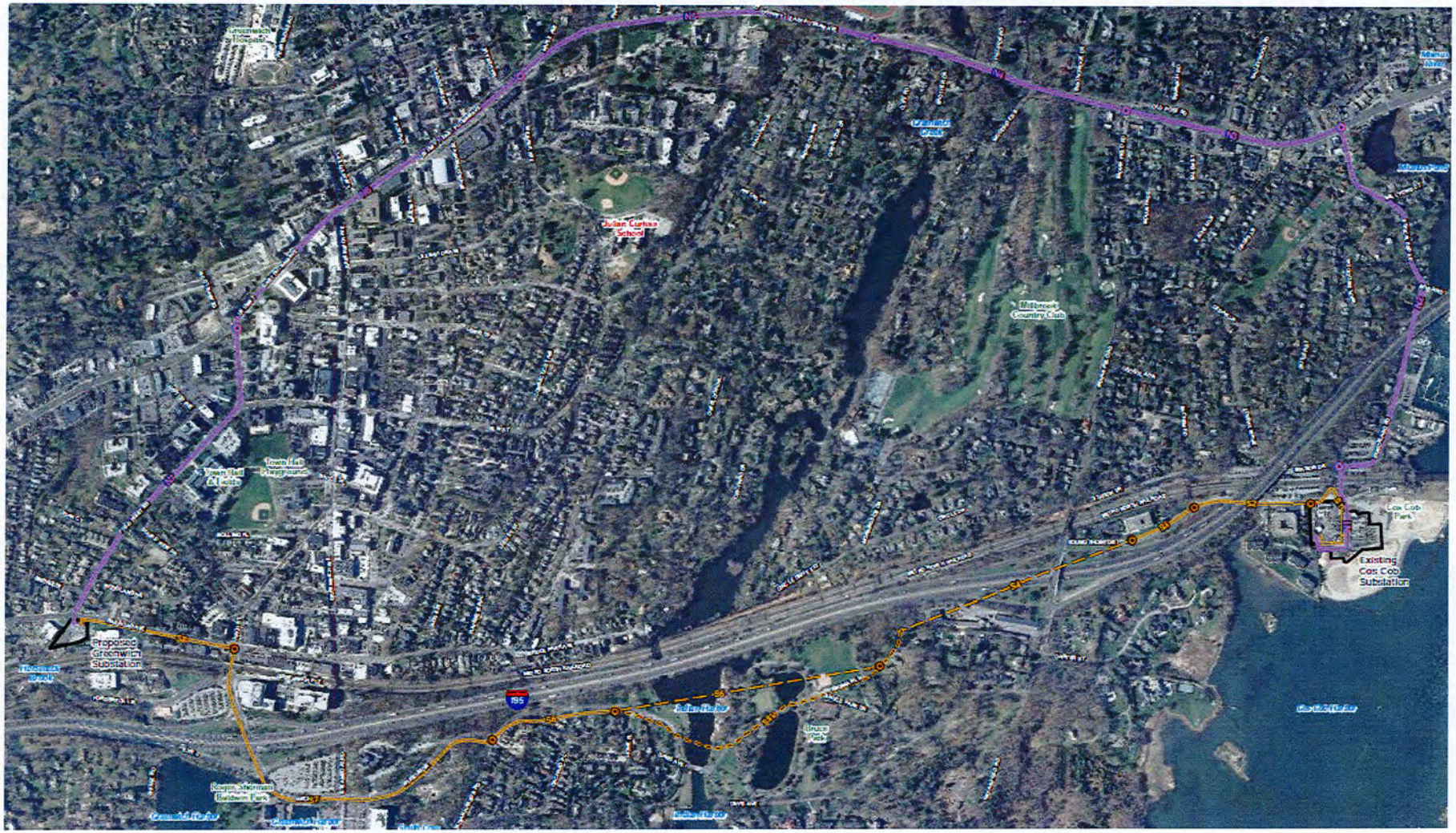
(Eversource 1, Mapsheet ES-1)

Attachment 3: Preferred Route Bruce Park Variations



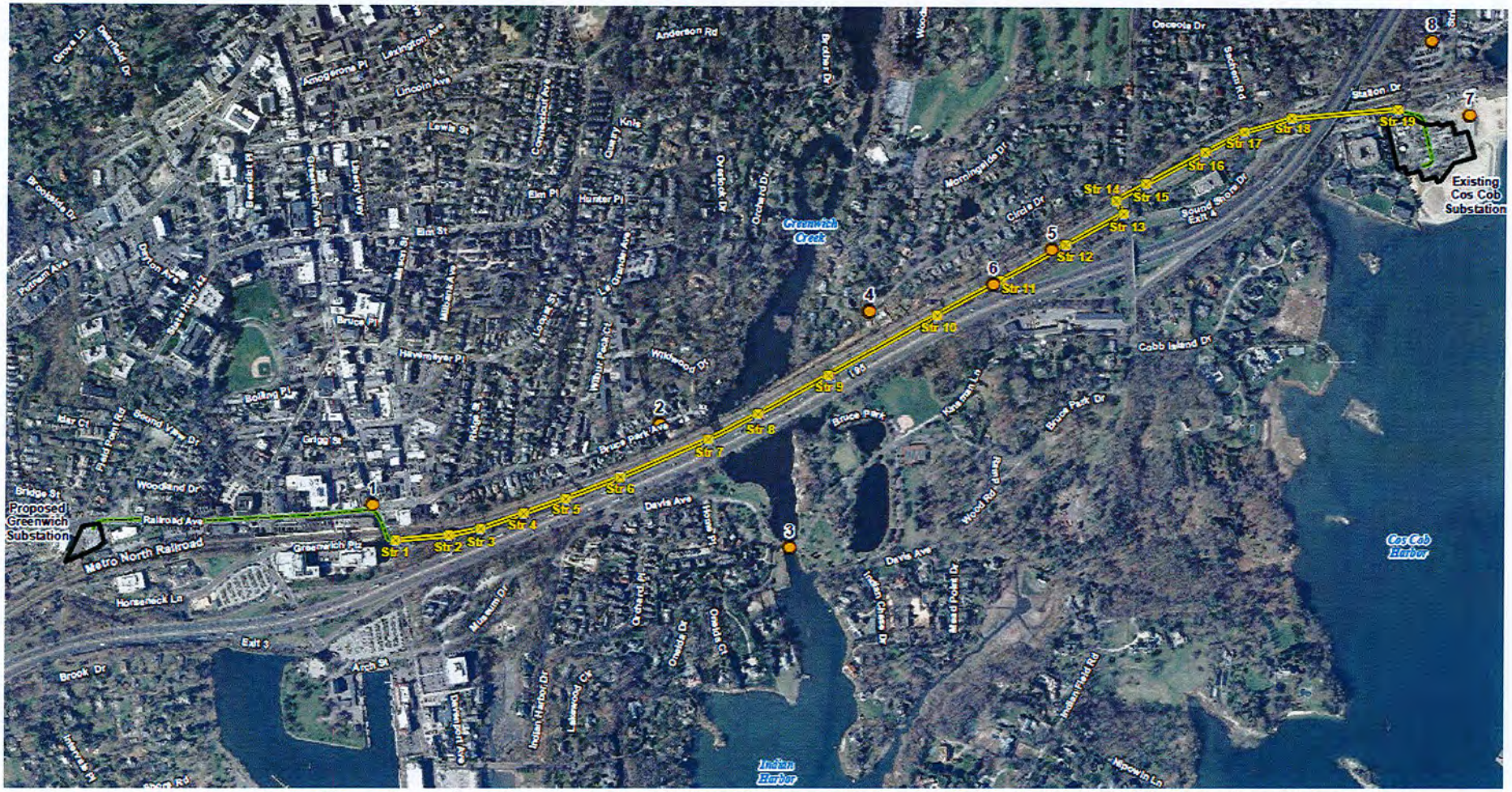
(Eversource 1, Mapsheet G-8B)

Attachment 4: Southern Alternative (orange) and Northern Alternative (purple) Routes



(Eversource 1, Mapsheet ES-2)

Attachment 5: Hybrid Route



Green denotes underground cable section, yellow denotes overhead line section. - proposed structure locations are round yellow dots. (Eversource 44, LF-025)