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November 15, 2018

M. Kathryn Sedor, Esq., Presiding Officer
Energy Facilities Siting Board
One South Station, 2nd Floor
Boston, MA 02110

Re: NSTAR Electric Company d/b/a Eversource Energy, EFSB14-04/D.P.U. 14-153/14-154

Dear Ms. Sedor:

I am writing on behalf of NSTAR Electric Company d/b/a Eversource Energy ("Eversource" or the "Company") to submit a proposed project change (the "Project Change Filing") with regard to the facilities approved by the Energy Facilities Siting Board (the "Siting Board") in its December 1, 2017 Final Decision in the above-referenced proceeding. NSTAR Electric Company d/b/a Eversource Energy, EFSB14-04/D.P.U. 14-153/14-154 (2017) ("Mystic-East Eagle"). In Mystic East Eagle, the Siting Board approved Eversource's petition to construct, operate and maintain two new, 115-kilovolt underground transmission lines through the Massachusetts cities of Boston, Everett, and Chelsea and a new substation in East Boston (the "East Eagle Street Substation" or the "Substation") and to make modifications to existing substations in Everett and Chelsea (the "Project"). As approved, the East Eagle Street Substation would be located on an approximately 16,800-square-foot, vacant, Company-owned parcel of land in the interior of a larger parcel owned by City of Boston ("City") ("City Parcel") at 338 East Eagle Street in East Boston ("Original Substation Site").

As is the case in all final decisions of the Siting Board, Mystic East Eagle includes the following language:

> In addition, the Siting Board notes that the findings in this decision are based upon the record in this case. A project proponent has an absolute obligation to construct and operate its facility in conformance with all aspects of its proposal as presented to the Siting Board. Therefore, the Siting Board requires Eversource, or its successors in interest, to notify the Siting Board of any changes other than minor variations to the proposals so that the Siting Board may decide whether to inquire further into a particular issue. Eversource, or its successors in interest are obligated to provide the Siting Board with sufficient information on changes to the proposed project to enable the Siting Board to make these determinations.

Mystic East Eagle at 170.

In addition to complying with the above-referenced requirement, the Project Change Filing also addresses a separate directive from the Siting Board in Condition A of the Final Decision, which provides as follows:

> The Siting Board directs the Company to enter into discussions with the City of Boston, focusing on the ability of the Company to relocate the East Eagle Substation on the City Parcel and to acquire an easement across the City Parcel, if necessary, for the installation of the New Lines, and to provide an update to the Board on the status of such discussions (preferably, including a letter from the City of Boston regarding its position), within six months of this Final Decision, and prior to the commencement of any construction on the City Parcel.

Mystic East Eagle at 167.

In compliance with Condition A, the Company entered in discussions with the City with the goal of relocating the Substation on the City Parcel. In furtherance of those discussions, the City issued a request for proposals for disposition of property on the western side of the City Parcel. The Company's proposal was accepted and the City conveyed to the Company a parcel of land on the west side of the City Parcel (the "New Substation Site") and the Company conveyed the Original Substation Site back to the City. Now that the Company has acquired the New Substation Site from the City, the Company is seeking approval to construct the East Eagle Street Station at this location. This Project Change Filing reflects the relocation and evidences Eversource's continued commitment to optimize the Project from a reliability, cost and environmental-impact perspective in accordance with the Siting Board's statutory mandate.

As the Project Change Filing demonstrates, the relocation of the Substation to the New Substation Site will not result in any increase in potential environmental impacts and will, in fact, reduce the amount of proposed activity within jurisdictional wetland resource areas and in City streets. Reliability of the Project at the New Substation Site will be unchanged, and while the design and equipment being proposed for the Substation at the New Substation Site is largely the same as the design and equipment for the Original Substation Site, the Company anticipates that the relocation will result in a slight increase in costs. However, on balance, the New Substation Site is superior to the Original Substation Site.

The relocation of the East Eagle Street Substation furthers the Siting Board's statutory mandate to ensure that the Project will contribute to a reliable energy supply consistent with the minimization of environmental impacts and costs. Accordingly, Eversource's Project Change Filing responds fully to the Siting Board's directives and complies with the Siting Board's governing standards under G.L. c. 164, § 69J. Based upon the analysis included herewith, Eversource seeks approval of this Project Change Filing from the Siting Board.

Eversource submits an original and five (5) copies of the Project Change Filing. Please contact me if you have any questions or require any additional information. Thank you for your attention to this matter.

Very truly yours,

Catherine Keuthen

Catherine Keuthen

Enclosures

cc: Service List

COMMONWEALTH OF MASSACHUSETTS
ENERGY FACILITIES SITING BOARD

NSTAR Electric Company d/b/a Eversource Energy	))))	EFSB 14-04/D.P.U. 14-153/154

CERTIFICATE OF SERVICE

I hereby certify that, pursuant to 980 C.M.R. 1.03(4), I have on this day served a true copy of the enclosed documents, by first class mail or electronically, upon all parties of record in this proceeding.

Dated at Boston, Massachusetts this 15th day of November, 2018.

Catherine Keuthen

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COMMONWEALTH OF MASSACHUSETTS
ENERGY FACILITIES SITING BOARD

NSTAR Electric Company d/b/a Eversource Energy	)	EFSB 14-4/D.P.U. 14-153/14-154

PROJECT CHANGE FILING OF
NSTAR ELECTRIC COMPANY d/b/a EVERSOURCE ENERGY

Submitted by:

NSTAR ELECTRIC COMPANY
d/b/a EVERSOURCE ENERGY

By its attorneys,

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Dated: November 15, 2018

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1.0 PROJECT CHANGE OVERVIEW

1.1 Introduction and Procedural Background

This Notice of Project Change presents NSTAR Electric Company d/b/a Eversource Energy's ("Eversource" or the "Company") proposed modification of plans that were approved in a prior proceeding, NSTAR Electric Company d/b/a Eversource Energy, EFSB 14-04/D.P.U. 14-153/14-154 (2017) ("NSTAR Mystic-East Eagle"). The modifications relate to the relocation of the new substation that was approved in that proceeding, including the layout of substation components at the new site and the interconnection of the substation to transmission and distribution facilities.

On December 23, 2014, pursuant to G.L. c. 164, § 69J ("Section 69J"), the Company filed a petition with the Energy Facilities Siting Board (the "Siting Board") to construct, operate and maintain: (1) a new 115/14-kilovolt ("kV") substation on an approximately 16,800-square-foot, vacant, Company-owned parcel of land located at 338 East Eagle Street in East Boston, Massachusetts (the "East Eagle Street Substation" or the "Substation"); and (2) two new 115-kV underground transmission lines totaling approximately 4.7 miles – one line from Eversource's Mystic Substation #250 ("Mystic Substation") in Everett to the proposed East Eagle Street Substation ("East Eagle-Mystic Line") and one line from the proposed East Eagle Street Substation to the Chelsea Substation ("East Eagle-Chelsea Line") (together, the "New Lines"), along with modifications to the Mystic and Chelsea Substations in connection with the New Lines (the "Mystic-East Eagle-Chelsea Reliability Project" or the "Project") (the "Siting Board Petition"). Also, on December 23, 2014, the Company filed a petition with the Department of Public Utilities (the "Department") requesting a determination that the New Lines are necessary and will serve the public convenience and are consistent with the public interest in accordance with G.L. c. 164, § 72 (the "Section 72 Petition"). Lastly, on December 23, 2014, pursuant to the provisions of Section 6 of Chapter 665 of the Acts of 1956, the Company filed a petition with the Department seeking individual and comprehensive zoning exemptions from the operation of applicable provisions of the Boston Zoning Code (the "Boston Zoning Code") to construct the East Eagle Street Substation. The Section 72 and Zoning Petitions were referred to the Siting Board by the Department and consolidated with the Siting Board Petition and the Siting Board conducted a single adjudicatory proceeding and developed a single evidentiary record for the consolidated petitions (the "Initial Proceeding").

After conducting 12 days of evidentiary hearings, beginning on January 6, 2016 and ending on March 23, 2016, the Siting Board issued a final decision in the Initial Proceeding on December 1, 2017, approving the Project subject to certain specified conditions (the "Final Decision"). NSTAR Mystic-East Eagle). The Final Decision approved the construction of the East Eagle Street Substation on a Company-owned parcel of land located on the eastern side of a larger tract of land owned by the City of Boston ("City Parcel") ("Original Site" or "Original Substation Site"). Final Decision at 166-167. The Original Substation Site is approximately 18 feet to the west of property owned by Channel Fish Company, Inc. (“Channel Fish”), an intervenor in the Initial Proceeding.

Regarding the Substation, Condition A of the Final Decision directed the Company to:

> enter into discussions with the City of Boston, focusing on the ability of the Company to relocate the East Eagle Street Substation on the City Parcel and to acquire an easement across the City Parcel, if necessary, for the installation of the New Lines, and to provide an update to the Board on the status of such discussions (preferably, including a letter from the City of Boston regarding its position), within six months of this Final Decision, and prior to the commencement of any construction on the City Parcel.

Final Decision at 167.

In compliance with Condition A, the Company entered in discussions with the City of Boston with the goal of relocating the Substation on the City Parcel. On November 28, 2017, the City of Boston issued a request for proposals (“RFP”) for disposition of property on the western side of the City Parcel. Eversource timely responded to that RFP and the Company’s proposal to purchase the property in exchange for the Original Substation Site was accepted by the City. On July 25, 2018, the City of Boston conveyed to the Company a parcel of land on the west side of the City Parcel with an address of 338 East Eagle Street & Condor Street, Boston (the “New Site” or “New Substation Site”) and the Company conveyed the Original Substation Site back to the City. The Company is herein requesting approval to relocate the East Eagle Street Substation from the Original Substation Site on the east side of the City Parcel to the New Site on the west side of the City Parcel, further away from the property of Channel Fish. An aerial overview showing the Original and New Substation Sites is provided as Appendix A.

1.2 Project Status

The Mystic-East Eagle-Chelsea Reliability Project is a comprehensive solution to address the need for substation capacity in East Boston and reliability needs identified in an extended transmission study process conducted by ISO New England, Inc. and its Greater Boston Working Group that identified the reliability needs of the transmission system that serves the Greater Boston/Metro West regions of Massachusetts as well as southern New Hampshire. The Project’s primary purposes are to: (1) provide additional substation capacity in East Boston to reliably serve anticipated load growth in East Boston and Chelsea; (2) resolve a low-voltage violation of regional planning criteria; and (3) eliminate a contingent load loss of 87,000 Eversource and New England Power Company customers in several cities and towns served by the Chelsea, Revere and Lynn Substations.

In the Final Decision, the Siting Board found that additional energy resources were needed to maintain a reliable supply of electricity in the Chelsea/East Boston/Lynn Load Area. Final Decision at 29. Construction of the Project will serve the public interest by increasing the reliability and capacity of the regional electric transmission system over the long term and provide substation capacity to support the load growth in both Chelsea and East Boston, while minimizing environmental impacts and costs. Final Decision at 150-151. As the evidentiary record in the Initial Proceeding demonstrates, there is a risk of an excessive amount (over 300 MW) of consequential load loss and inadequate post-contingency voltage performance in the area that would be served by the East Eagle Street Substation. Further, the Company's existing Chelsea Substation, which currently serves the load in the area, has pre- and post-contingency capacity constraints and poses an increasing risk of post-contingency load shedding beginning in 2016. Final Decision at 10-19. To address the capacity and reliability needs in the Chelsea/East Boston/Lynn area, the Company proposed, and the Siting Board approved, the construction of the New Lines and the East Eagle Street Substation. Final Decision at 150-151, 166-167. The New Lines will be located primarily in city streets and will use existing ducts in some locations.

The Company began the construction of the East Eagle-Mystic Line on May 14, 2018. The construction of this line is currently ongoing and has been active for approximately six months. During this time, portions of the ductbank have been installed in Everett and Chelsea. Based on the current progress, this portion of the Project is scheduled to be completed by June 2019. The tie-in of the East Eagle-Mystic Line to the new East Eagle Street Substation will not be completed by June 2019, as that portion of the Project will take place in conjunction with the Substation construction schedule.

The construction of the East Eagle-Chelsea Line is scheduled to start in the November 2018 timeframe with installation of cable in existing ducts. This work is also scheduled to be completed by June 2019. The tie-in of the East Eagle-Chelsea Line to the new East Eagle Street Substation has similar timing constraints as the East Eagle-Mystic Line and will be completed in conjunction with the construction of the East Eagle Street Substation.

Work to modify the Mystic Substation for the interconnection of the East Eagle-Mystic Line began on May 20, 2018. The work at the Mystic Substation is currently ongoing and scheduled to be completed in December 2018. Work to modify the Chelsea Substation for the interconnection of the transmission line will begin in the spring of 2019 and be completed in the fall of 2019.

1.3 Reasons for Project Change Filing

The Company's proposed relocation of the East Eagle Street Substation to the New Substation Site arises out of Channel Fish's intervention in the Initial Proceeding. Channel Fish opposed the location of the Substation near its property asserting, among other reasons, that the operation of the Substation at the Original Substation Site would produce magnetic fields that would disrupt its fish processing equipment. Since the issuance of the Final Decision, the Company and Channel Fish have had ongoing discussions regarding the Substation location and Channel Fish supports the Project with the proposed relocation of the East Eagle Street Substation to the New Site. See Appendix B. As the Final Decision demonstrates by its approval of the East Eagle Street Substation at the Original Substation Site and the grant of the requested zoning exemptions required for its construction at that location, a comprehensive record was established in the Initial Proceeding that showed that the Project met each element of the Siting Board's review under G.L. c. 164, §§ 69H et seq. and the Department's review under G.L. c. 164, § 72 and Section 6 of Chapter 665 of the Acts of 1956, including that potential impacts from magnetic fields were appropriately minimized and mitigated. See Final Decision at 62-63, 122-123. Nevertheless, "[i]t is the Siting Board's clear intent, as expressed in Condition A and at the November 30, 2017 Siting Board meeting, to support and foster the possibility that Eversource, Channel Fish, and the City of Boston may be able to reach a mutually satisfactory resolution regarding the location of the new Eversource substation on the City Parcel." Presiding Officer Ruling re Motion To Extend Final Decision Appeal Period at 4 (December 20, 2017).

To comply with the Siting Board's request in Condition A of the Final Decision, rather than commence construction on the Substation at the Original Substation Site, the Company evaluated the potential of the New Substation Site to accommodate the East Eagle Street Substation and, after determining that it would be feasible to construct the Substation on the New Site (from both constructability and electrical perspectives), the Company responded to the City's RFP. The process also involved the design and engineering of a new substation layout, negotiations with the City, and the preparation of legal documents for the reciprocal conveyances, which occurred in July 2018. Now that the Company has acquired the New Substation Site from the City, the Company is seeking approval to construct the East Eagle Street Station at that location. While construction of line work has proceeded during this process, the construction of the Substation is now imminently needed to implement the Project, all to ensure that the Project meets the need identified in the Initial Proceeding.

1.4 Summary of Project Changes

The New Substation Site is an 27,389-square-foot parcel of land. As described in more detail below, the Substation will contain the same components as were proposed at the Original Substation Site. The Substation layout is shown in Appendix C. As shown in Appendix C and described in more detail in Section 2.2, the New Lines will be connected to the Substation via the existing Chelsea Creek Crossing, which is located immediately adjacent to the New Substation Site on a Company easement to the south of the Substation.

1.5 Community Outreach

The Company has been in communication with various municipal officials, elected representatives and community organizations throughout the Substation relocation process. Company community relations representatives have been in regular contact with the City's officials and representatives to discuss various aspects of the Project and to coordinate with the City's planned development of the adjacent City Parcel. The City departments the Company has communicated with include the Mayor's Office of Neighborhood Services, Public Facilities, Boston Planning & Development Agency, and the Office of Environment, Energy and Open Space. The Company will continue to work with the City throughout the remainder of the Substation relocation and overall Project construction.

On September 20, 2018, Company representatives met with East Boston's elected officials, State Senator Joseph Boncore, State Representative Adrian Madaro and the chief of staff for Boston City Councilor Lydia Edwards, to update them on the status of the Project and discuss community outreach. The Company will continue to provide updates to the East Boston elected representatives to keep them informed of Project status and community outreach efforts.

The Company has been in contact with the community organization Greenroots to discuss the Project. On October 15, 2018, Company representatives met with the Attorney General's ("AG") office as a result of communications the AG's office received from Greenroots. Following a meeting with the AG's office, the Company met with Greenroots on October 23, 2018, to discuss the Project and Greenroots' concerns, which included community safety and resiliency. The Company will continue to have discussions with Greenroots in an effort to address their concerns.

1.6 Project Change Standard of Review

In determining whether additional inquiry is necessary regarding a proposed project change, the Siting Board evaluates the proposed changes and does not conduct additional inquiry if the change does not alter in any substantive way either the assumptions or conclusions reached in its analysis of the project in the underlying proceeding. Sithe Mystic Development LLC, 13 DOMSB 118, 124 (2001); Sithe Edgar Development, LLC, 13 DOMSB 81, 88-89 (2001); Berkshire Power Decision on Compliance, 7 DOMSB 423, at 437 (1997). Even where project modifications result in substantive changes to the original facility approval, the Siting Board will approve such modifications if they continue to satisfy the Siting Board's standards of ensuring a reliable supply of energy, at the minimum cost and with the minimum environmental impact. Id. In the following sections of this Project Change filing, the Company describes the Project refinements as referenced above. Based upon the evidence and the modest level of impacts, the Company believes that the Siting Board should find that the relocation of the Substation from the Original Substation Site to the New Substation Site does not change the assumptions and conclusions reached by the Siting Board in the Initial Proceeding. For the reasons presented herein, the proposed relocation of the Substation is consistent with the Siting Board's initial approval of the Mystic-East Eagle-Chelsea Reliability Project and should be approved as in accordance with G.L. c. 164, §§ 69H, 69J.

2.0 SUBSTATION RELOCATION

2.1 Description of New Substation Site and New Substation Configuration

As shown in Appendix A, the New Substation Site is located approximately 190 feet to the west of the Original Substation Site in East Boston. Like the Original Substation Site, the New Substation Site was part of the City Parcel, a larger tract of developed land that is owned by the City of Boston. The New Site is generally level, clear of structures and sparsely vegetated. The City Parcel surrounds the New Substation Site to the north, south, and east. The City Parcel to the east and south of the New Substation Site is currently used by the Boston Department of

Public Works ("DPW") for storage of equipment, vehicles and salt storage. The City of Boston is proposing to construct a new police station on the City Parcel south of the New Substation Site. The New Substation Site abuts Condor Street to the west. A recreational area that includes playing fields and basketball courts abuts the other side of Condor Street. To the north of the New Substation Site, beyond the 80-foot wide strip of City-owned land that abuts the New Site, is Chelsea Creek. The New Substation Site will be accessed via the Company's existing easement on East Eagle Street.

As was proposed on the Original Substation Site, the Substation on the New Site will include two bays of 115-kV gas-insulated switchgear ("GIS") with six 115-kV circuit breakers in a breaker-and-a-half configuration; a control enclosure measuring 30 feet by 40 feet that will contain protective relay and control equipment, communication equipment and control batteries; two 62.5-MVA, 115/14-kV transformers; two sections of distribution switchgear; and two 14-kV, 9.6-MVAR capacitor banks. There will be room reserved for an additional future transformer, switchgear, and capacitor bank.

In addition to installing the above equipment, construction activities will include:

- Clearing and grading the yard;
- Installing footings, foundations, and underground electric raceway;
- Installing grounding in the yard area;
- Installing lighting in the yard area;
- Spreading crushed stone in the yard area;
- Installing an architectural screen;
- Installing miscellaneous associated protective relaying, metering, control wiring, and related equipment; and
- Constructing isolation/fire barriers and oil spill containment systems for each of the transformers.

2.2 Changes to Transmission and Distribution Line Locations as a Result of Substation Relocation

Since the existing Chelsea Creek Crossing infrastructure is located beneath the New Substation Site, the New Lines will be able to connect to the Substation directly within the Substation property without having to be routed onto public streets. This is an advantageous change from the Original Substation Site design, where approximately 650 feet of both New Lines were routed on Condor and East Eagle Streets to connect to the Chelsea Creek Crossing. In addition, the proposed distribution network for services from the Substation will be shortened. The Substation's new location, therefore, will reduce the construction duration on the public streets, thereby lessening traffic impacts, particularly on East Eagle Street.

2.3 Permitting of the Substation at the New Substation Site

The Substation will require the submission of a Notice of Intent ("NOI") under the United States Environmental Protection Agency National Pollutant Discharge Elimination System Construction General Permit for Discharges from Construction Activities as there is the potential for the Project to create over an acre of land disturbance. A Stormwater Pollution Prevention Plan will be developed and submitted in connection with permitting.

The New Substation Site is within filled tidelands and requires a license pursuant to G.L. c. 91 ("Chapter 91"). In November 2014, the Company applied for a Chapter 91 license with the Massachusetts Department of Environmental Protection ("MassDEP"), which detailed the Project's compliance with the applicable standards and requirements under MassDEP's waterways regulations at 310 CMR 9.00. MassDEP assigned a Waterways License Application number and issued its Public Notice on November 25, 2014, wherein it determined that the construction of the Project within filled tidelands is a water-dependent use project. Following the receipt of public comments on the Project, the Company requested a hold on MassDEP review while the Company coordinated with local abutters and stakeholders to respond to comments on the Chapter 91 license application. The Company met with MassDEP on August 29, 2018 to discuss re-initiating MassDEP's review of the Chapter 91 license application. In the fourth quarter of 2018, the Company will submit a response to the comments received on the license application, along with updated plans reflecting the New Substation Site. Upon receipt of this information, the Company anticipates that MassDEP will issue a public notice initiating a second 30-day comment period for the license application. Within 90 days of MassDEP's receipt of the Company's response to comments, it is anticipated MassDEP will issue a draft written determination on the license application subject to a 21-day appeal period before it can be finalized.

The Massachusetts Historical Commission ("MHC") issued a determination on August 24, 2015 that there were no historic properties included in MHC's Inventory nor listed in the State Register of Historic Places within the area of potential impact associated with the Original Substation Site, and that the entire Project would have "no effect" on historic or archaeological resources. A notification describing the Substation relocation including updated plans depicting the New Substation Site will be submitted to MHC for review in Q4 2018. No change in MHC's "no effect" determination is anticipated.

A portion of the New Substation Site is within the 100-foot Buffer Zone to Coastal Bank. No jurisdictional wetland resource areas will be impacted. The Company will file a Request for Determination of Applicability ("RDA") with the Boston Conservation Commission, rather than a Notice of Intent ("NOI"), because the Project meets the eligibility requirements for a Negative Determination of Applicability for work that occurs solely in the Buffer Zone.

Construction of the Project will also require approval by the Boston Water & Sewer Commission of a site plan, and a Building Permit from the Boston Inspectional Services

Department. In addition, the architectural screening and landscaping plan for the Substation will require approval by the Boston Planning & Development Agency.

Tables 1, 2, and 3 below summarize the permit requirements and status.

Table 1: Federal Permit/Consultation Requirements

Regulatory Agency	Program	Permit Jurisdiction	Status
USEPA	National Pollutant Discharge Elimination System General Permit for Storm Water Discharges from Construction Activities	Land Disturbance greater than one Acre	Will submit one month prior to start of construction

Table 2: State Permit/Consultation Requirements

Regulatory Agency	Program	Permit Jurisdiction	Status
MassDEP	Chapter 91 Waterways Regulations	New license required for East Eagle Street Substation	Chapter 91 license submitted on 12/9/14 and review will be re-initiated in Q4 2018 or Q1 2019
MHC	G.L. c. 9, § 27C, effect on historic and archaeological properties	Historic and prehistoric cultural resources	New plans will be submitted Q4 2018

Table 3: Local Permit Requirements

Regulatory Agency	Program	Permit Jurisdiction	Status
Boston Conservation Commission	Massachusetts Wetlands Protection Act	Buffer zone work and Request for Determination of Applicability	Q4 2018
Boston Planning & Development Agency	Architectural screening and Substation landscaping plan	Coordination with City	Q4 2018 or Q1 2019
Boston Water/Sewer Commission	Site Plan Approval	Connection to storm drain, cutting and capping existing sewer, water connection for fire protection	Will submit 2-3 months prior to start of construction
Inspectional Services Department	State Building Code	Building permit	Will submit 2-3 months prior to start of construction

2.4 Construction Overview and Schedule

The Company anticipates commencing construction of the Substation following receipt of Siting Board approval of this Project Change and receipt of all other necessary permits and plans to complete construction with an in-service date 24 months thereafter.

To facilitate re-design of the Substation in the new location, the Company has begun geotechnical borings for use in the civil/structural design and soil and groundwater sampling for environmental characteristics. In advance of construction, the Company also plans to conduct environmental remediation on the New Substation Site, as discussed in Section 2.5.5 below.

The Substation construction process, as well as the underground conduit and cable construction for the transmission and distribution infrastructure necessary to connect the Substation to the existing electric grid at the New Substation Site, will remain as described for the Substation at the Original Substation Site.

The construction, testing and commissioning of the Substation at the new location will not require any service interruptions to Eversource retail customers. After the commissioning of the East Eagle Street Substation, distribution cut-overs will commence. The distribution systems have sufficient capability so that any required distribution line outage to support the load transfers can be performed without the interruption of service to customers. There will also be no service interruptions to interconnect the new Mystic-East Eagle and East Eagle-Chelsea Lines to the Substation.

2.5 Environmental Impacts and Mitigation at New Substation Site

Although the Substation is moving only 190 feet to the west of the Original Substation Site, there are some benefits of the relocation and no potential impacts will be increased. First, due to the location of the New Substation Site directly above the Chelsea Creek Crossing, the New Lines will not need to be constructed in streets adjacent to the Substation and the length of required distribution lines will be shorter. As a result, the duration of construction and resulting impacts to traffic will be decreased. Also, the potential for wetland impacts will be reduced because the New Site is located outside of jurisdictional resource areas. A summary of the potential for environmental impacts is summarized below.

2.5.1 Land Use

As described above in Section 2.1, the New Substation Site, like the Original Site, was once part of the City Parcel; accordingly, the land use of the New and Original Sites is virtually identical. The New Substation Site is configured to facilitate the City of Boston's planned construction of a new East Boston Police Station on the corner of Condor and East Eagle Streets on the City Parcel immediately south of the New Substation Site. Residential neighborhoods are located south and west of the City Parcel, across from East Eagle and Condor Streets, respectively. See Appendix D, a map that identifies the abutters to the New Substation Site. A fish processing facility owned by Channel Fish and other industrial uses are located to the east of the City Parcel. There is a total of 17 residential buildings within 300 feet of the New Substation Site. The nearest residential abutter will be 246 feet away from the New Substation Site, whereas the nearest residential abutter would have been approximately 233 feet away from the Original Substation Site and the nearest industrial abutter only 18 feet away. Exh. EFSB-LU-1(1).

2.5.2 Visual

Visual impacts from the Substation at the New Site will be mitigated in the same manner as proposed at the Original Site. Although the Substation, once built, will be a new visual element on the New Substation Site, it is not inconsistent with the existing industrial nature of the site. The Substation directly abuts the public way along Condor Street and is adjacent to the public sidewalk. Potential visual impacts from the location of the Substation at the New Substation Site were assessed from residential neighborhoods (consisting of mainly triple-decker multi-family homes) located to the south of Eagle Street and from recreation areas located to the west (including the American Legion Park and Condor Street Urban Wild). Locations determined to have views of the New Substation Site include:

- Partial views of the Substation from the first floor of residences located along East Eagle Street;
- Full views and partial views of the Substation from upper floors of residences on East Eagle Street;
- Full views and partial views from a limited number of residences on other nearby streets (i.e., Glendon Street), where there is no intervening structure in the line of sight;
- Full and partial views from Condor Street between Glendon Street and East Eagle Street, including the interior of American Legion Park; and
- Full view and partial views from the surrounding City Parcel, depending on location vis-à-vis an existing salt shed, vehicles and trailers, and contingent on development of the proposed police station.

Depending on the location and height of the vantage point, receptors may have views of the Substation through the City Parcel or views may be blocked or modified by uses on the surrounding City Parcel, including the existing chain-link fence, trailers, parked school buses, DPW vehicles, and a large salt shed. As noted above, the City of Boston plans to build out the City Parcel at some point in the future. Plans reviewed to date currently include a Police Station at the corner of East Eagle Street and Condor Street. See Appendix E, page, 5, 13-15. The Company and its consulting engineers are engaged in an ongoing coordination process with the City to ensure that the two projects are compatible both from a technical and aesthetic standpoint. Based on the plans provided to the Company thus far, it appears that the new buildings proposed by the City will block views of the Substation from many of the nearby residences.

Previously, the Company and the City of Boston had agreed on the design of an architectural wrapping to screen views of the Substation. The Company has renewed discussions with the City regarding this architectural screening, which is proposed to be similar in nature and style as to what was previously proposed. The proposed architectural screening for the New Substation Site is shown in Appendix E. The design of the Substation screening is intended to provide a functional enclosure for the safety and security of the equipment, site workers, and neighbors. The screening will incorporate varied heights, spans, and cladding materials designed to create rhythm and visual interest, while remaining consistent with the industrial and maritime uses of the surrounding area.

A rendering of the proposed East Eagle Street Substation at the New Site as viewed from the intersection of East Eagle Street at Condor Street is provided on page 15 of Appendix E. As shown, precast concrete and fiberglass panels screening the transformer bays and electrical equipment will be visible from the street. Page 14 of Appendix E shows that views of the Substation from Condor Street and American Legion Park (when the viewer is standing west of the City Parcel and is looking east) will predominantly be of the architectural screening outside the fire walls surrounding the transformer bays and the architectural screen of the control house.

2.5.3 Traffic

A reduction in potential traffic impacts from the construction of the Substation at the New Site will be realized through elimination of the underground construction of transmission lines within the roadway on East Eagle and Condor Streets because the transmission lines will now enter directly into the Substation as they exit the existing conduits under Chelsea Creek. Table 4 below provides a summary of existing traffic conditions and the presence of private and public transportation features near the New Substation Site. Even though the existing traffic volumes on East Eagle and Condor Streets are low, the design of the New Substation Site will reduce the overall impacts to traffic during construction when compared to the previously approved Original Substation Site design, which would have been required transmission line installation in East Eagle Street and Condor Street. In addition, the extent of the underground distribution line construction associated with the New Substation Site will be somewhat shorter on East Eagle Street than that which was previously proposed for the Original Substation Site, thereby decreasing the construction period and impact on traffic. Post construction traffic will not be impacted by the Substation because the Substation will be unmanned.

Table 4: Traffic, Parking and MBTA Bus Routes at New Substation Site

Location	Road Width (ft.)	Existing Traffic and Parking	Public Transportation
East Eagle Street between Substation and Condor Street (0.09 mi.)	38	Low Traffic Volume Parking on South Side	None
Condor Street between East Eagle Street and Boston DPW Yard (0.03 mi.)	34	Low traffic volume No parking	None

To ensure that impacts from construction will be minimized, Eversource will develop a construction Traffic Management Plan with input from all appropriate City of Boston Departments.

2.5.4 Sound

Both construction and operation sound impacts from the proposed East Eagle Street Substation at the New Site will be substantially the same as they would have been at the Original Site. The Substation still will include two transformers, and each will be installed within a three-walled concrete bay with the opening of the bay on the interior of the site, furthest away from nearby residences.

A noise study was conducted for the Substation at the Original Substation Site and updated in May 2018 for the New Substation Site using the same methodology ("Updated Noise Study"). <u>See</u> Appendix F. The Updated Noise Study was conducted to assess the impact of transformer noise on the surrounding environment. The assessment included an ambient noise survey to quantify the existing acoustical environment (measured at a location on the New Substation Site and at locations throughout the adjacent City Parcel), noise modeling to predict sound levels in the community resulting from the operation of the Substation, and a comparison of pre- and post- construction noise levels.

As with the original noise study, the Updated Noise Study concluded that operation of the Substation at the New Substation Site will comply with all applicable regulations, and further, that noise increases would be minimal and, in most cases, unlikely to be audible.

During the construction period, abutters may experience elevated noise levels associated with a typical construction site; however, these impacts will be temporary in nature and will end when Project construction ends. Moreover, the nearest residential abutters are further away from the New Site than residential abutters are to the Original Site.

Nevertheless, Eversource recognizes that during the construction period, nearby residents may experience elevated noise levels associated with a construction site and accordingly, the Company will mitigate the impacts to the extent reasonable as proposed for construction at the Original Substation Site

2.5.5 Construction Soils/Dust Control/Air Quality/Erosion Control

During any land disturbance or excavation activities associated with construction of the Substation, Eversource will implement the same best management practices ("BMPs") for the control of erosion, sedimentation and generation of dust at the work site as proposed for the Original Substation Site.

Regarding known contaminated soils and groundwater conditions at the New Substation Site, at the time of the conveyance of the New Site by the City of Boston, Release Tracking Numbers ("RTN") 3-30299 and RTN 3-33978 had been assigned to the former City of Boston storage yard, a portion of which was located on the New Site. The RTNs were assigned for petroleum hydrocarbons, volatile organic compounds, and metals in soil and metals in groundwater. The contaminants identified at the New Substation Site are similar to those identified at the Original Substation Site, however the levels are higher and the area requiring remediation to ensure site closure under the Massachusetts Contingency Plan ("MCP") is larger. A review of the Phase II Comprehensive Site Assessment ("CSA") Report, Supplemental Phase II CSA Report and Phase IV Remedy Implementation Plan prepared by Weston & Sampson identified three areas of contamination at the New Substation Site where levels of lead and cadmium were detected in concentrations above MassDEP Upper Concentration Limits in soil and cadmium in groundwater. Due to the contamination identified at the New Substation Site, the construction activities will be conducted as a Release Abatement Measure ("RAM"). The purpose of the RAM will be to manage soil and groundwater, as well as outline construction worker BMPs to be implemented during construction. Remediation of the site will be done in a manner that does not jeopardize public health and safety during cleanup. The planned remediation will improve soil and groundwater quality and mitigate future potential exposure to contaminants from this site.

Based on the initial review of the levels of soil contamination identified at the New Substation Site, the volume of soil requiring remediation has increased from 200 tons required at the Original Substation Site to greater than 10,000 tons required at the New Substation Site. Additional soil characterization work is scheduled to be completed in the Fall of 2018 to further refine the hot spot areas requiring remediation at the New Substation Site. Moreover, additional groundwater remediation will be required to achieve permanent site closure.

2.5.6 Historic and Archaeological Resources

The Company anticipates no differences in impacts to historic or archaeological resources as a result of the relocation of the Substation. An extensive cultural resource investigation was conducted for the overall Mystic-East Eagle-Chelsea Reliability Project area to identify historic and archaeological resources in the vicinity of the New Lines and the Original Substation Site. As stated in Section 2.3 above, the MHC previously issued a final determination finding that the entire Project would have "no effect" on historic or archaeological resources.

The Company will notify the MHC of the Substation relocation to the New Substation Site and will provide the MHC with updated plans for the Substation on the New Substation Site. The New Substation Site was part of the same City Parcel as the Original Substation Site, is located approximately 190 feet to the west of the Original Substation Site as measured from adjacent property lines, and has similar existing, disturbed conditions as the Original Substation Site. It is also located within the same general area of potential impact that was previously reviewed by MHC for the Original Substation Site. As such, no change in MHC's "no effect" determination for the Original Substation Site is anticipated associated with the New Substation Site.

2.5.7 Wetlands and Waterways

2.5.7.1 Wetlands

The New Substation Site is located adjacent to Condor Street just south of Chelsea Creek. While portions of the Original Substation Site were located within jurisdictional resource areas under the Massachusetts Wetlands Protection Act ("WPA"), including the 25-foot Riverfront Area adjacent to Chelsea Creek, the 100-foot buffer zones to coastal bank and coastal beach, and the Designated Port Area ("DPA") associated with the Chelsea Creek, the New Substation Site is not located in any jurisdictional resource areas, thereby reducing potential wetland impacts.

A portion of the New Substation Site is located within the outer 100-foot Buffer Zone to Coastal Bank associated with Chelsea Creek and the Chelsea Creek DPA. Proposed mitigation measures will consist of the installation of appropriate erosion and sedimentation BMPs and the use of "clean construction" techniques (i.e., no stockpiling of soils), which will further minimize the potential for water quality impacts to nearby waterways. There will be no direct temporary or permanent impact to wetland resource areas or the nearby Chelsea Creek resulting from the construction of the Substation on the New Substation Site.

2.5.7.2 Waterways

As with the Original Substation Site, the New Substation Site is located within filled tidelands and requires a license pursuant to Chapter 91. As discussed above, the Company will re-initiate MassDEP's review of its Waterways License Application and will meet all applicable standards and requirements under MassDEP's waterways regulations at 310 CMR 9.00.

2.5.7.3 Flood Elevation

Although the Substation is not located within the 100-year floodplain of the adjacent Chelsea Creek., the Company considered sea level rise impacts due to the Substation's proximity to the Chelsea River and Boston Harbor. The Company engaged the engineering firm of Burns & McDonnell to review flood elevation information, the results of which are provided in the Flood Elevation Study provided as Appendix G. The Flood Elevation Study concluded that the New Substation Site is higher in elevation than the highest recorded Boston Harbor water surface elevation and outside the annual floodplain chance probability. The Flood Elevation Study recommended that anticipated sea level rise be considered when determining the Design Flood Elevation ("DFE"), to be used in design of the Substation. The DFE is the lowest elevation at which the Substation equipment should sit on the site, usually the same as top of concrete foundation elevation.

At the time the Project was in the conceptual design phase, the Company and industry in general were in the early stages of developing design criteria for climate readiness impacts. Due to this lack of criteria, when selecting the DFE, the Company took a conservative approach and chose a base flood elevation equal to the maximum water elevation with a 0.2 percent annual probability of exceedance (sometimes referred to as a "500-year storm", meaning the water elevation predicted to occur once in 500 years), plus a three foot sea level rise (as recommended by the City of Boston Local Floodplain Administrator) and added one foot as an additional safety factor. The selected DFE also accounted for the existing elevation and variation in grades at the site, the need to maintain a nearly level substation yard, manage stormwater runoff and balance earthwork, and therefore, a DFE of 23 feet 0 inches mean lower water vertical datum was established for setting the elevations of electrical equipment at the New Substation Site. The final elevations of all electrical equipment will meet or exceed the conservative DFE selected by the Company.

2.5.8 Electric and Magnetic Fields

The Company engaged Gradient to provide an estimate of the magnetic field ("MF") impact around the fenceline perimeter of the East Eagle Street Substation at the New Substation Site. Gradient prepared a preliminary estimate based on the fact that the Substation at the New Substation Site will have similar wiring and components as proposed at the Original Substation Site. That is, the primary power input will still be the 115-kV underground New Lines traveling from Mystic Substation and Chelsea Substation, and the primary outputs will remain the secondary distribution lines that run out from the East Eagle Street Substation underground, at a voltage of 13.8-kV. The MF associated with the Substation, at locations outside the New

Substation Site derive almost entirely from these transmission and distribution currents as they travel to and from the Substation and make connections with Substation components. Magnetic fields associated with specific Substation equipment, such as transformers, reactors, capacitor banks, and GIS, *per se* decay rapidly with distance such that MF beyond the Substation fence line are comparable to ambient levels along city streets. As was the case with the Substation at the Original Site, outside the area of influence of the distribution and transmission lines entering and leaving the Substation at the New Substation Site driveway, the point at which MFs resulting from these line connections at the Substation fall off to below ambient levels (below approximately 1 milligauss ("mG")) ranges from between 12 feet to 36 feet beyond the Substation fence.

The previous analysis of MF produced around the perimeter of the Original Substation Site showed peak values at the fenceline that were below 16 mG for perimeter locations that did not cross over the distribution lines exiting the Substation and below 55 mG for locations on the perimeter that are directly above the distribution line exit routes. The peak value estimates for the Substation at the New Substation Site are consistent with these findings. For the New Substation Site, Gradient found the following:

- On the West side (transformer, Condor Street side), MF are estimated to range from 4 to 16 mG along the fenceline and decrease below these levels with increasing distance from the fenceline. Further to the West, beyond Condor Street, MF levels are expected to below 0.5 mG.

- On the North side, MF are estimated to range from 2.5 to 5 mG along the fenceline and decrease below these levels with increasing distance from the fenceline.

- On the East side (switchgear side), MF are estimated to range from 3 to 8 mG along the fenceline and decrease below these levels with increasing distance from the fenceline.

- On the South side (assuming this is the distribution line exit side), MF are estimated to range from 14 to 55 mG along the fenceline and decrease below these levels with increasing distance from the fenceline.

These magnetic fields are quite low and are consistent with levels found in typical residences where electricity is used and electric appliances are operating. There are no U.S. health-based limits on 60-Hz MF, and the international health-based standard for acceptable general public exposure to 60-Hz MF, which is not expected to cause adverse health effects, is 2,000 mG, as set by the International Commission on Non-Ionizing Radiation Protection ("ICNIRP"), and as endorsed by the World Health Organization ("WHO").

Notably, entry of the New Lines to the Substation via a route along East Eagle Street, which would have been required at the Original Site, is no longer necessary, because the New

Lines will now enter the Substation within the fence line of the New Site, from below ground, rising up from the Chelsea Creek Crossing. Given the low levels of MF estimated to be produced at the Substation, the underground placement of the distribution lines will provide sufficient MF mitigation. Electric fields are reduced to zero for underground lines, and magnetic fields are considerably mitigated by the underground placement of the new distribution lines. The distribution cables will be arranged such that the three phase conductors are in as close a proximity to each other as possible and also rotated so as to "continuously transpose" the phase conductors. In addition, within the Substation, the use of GIS and metal clad switchgear places the bus bars (phase conductors) as close as is practicable, ensuring mitigation of MF from substation internal circuitry.

2.5.9 Vegetation Management

During construction, all vegetation within the Substation footprint will be cleared. The New Substation Site is previously developed, and generally sparsely vegetated with grass, some overgrown plants or bushes and a few small trees. Accordingly, as with the Original Substation Site, minimal tree clearing will be necessary at the New Substation Site. Transmission lines running from the Substation will pass underground to the existing Chelsea Creek transmission line manhole and will not require tree clearing.

As with the Original Substation Site, following construction at the New Substation Site, the Company's vegetation management practices for substation facilities will be followed and include the periodic control of vegetation along the perimeter.

2.5.10 Safety and Public Health Considerations

Eversource will design, build, and maintain all facilities for the Substation at the New Substation Site so that the health and safety of the public are protected in the same manner previously proposed for the Original Site. This will be accomplished through adherence to all Federal, state, and local regulations, as well as industry standards and guidelines established for protection of the public. More specifically, Substation will be designed, built, and maintained in accordance with the Massachusetts Code for the Installation and Maintenance of Electric Transmission Lines (220 CMR 125.00) and the National Electrical Safety Code. The facilities will be designed in accordance with sound engineering practices using established design codes and guides published by, among others, the Institute of Electrical and Electronic Engineers, the American Society of Civil Engineers, the American Concrete Institute, and the American National Standards Institute.

During construction, the Company will contractually require each contractor to submit a Project Safety Plan that meets the safety requirements of Eversource, as well as those of OSHA and other regulatory agencies. For all elements of construction work, construction workers will be subject to all Company safety protocols, including safety meetings, pre-work briefings, insulation and isolation of electrical equipment, and sheeting of excavations. Work in the public way will be subject to the above, plus any needed police details. The general public will be protected during construction of the Substation by fencing that is kept locked unless open during work hours, at which time a construction company or Eversource representative will be on site. The police details and work zone demarcation in the public way will serve to protect the general public as well as workers.

When completed, the general public will be barred from accessing the Substation by fencing and by not having objects available (i.e., trees and plantings) in locations that would aid entry.

Once in operation, the new Substation will include equipment that contains substances that if released may have negative impacts on the environment. These substances include Sulfur Hexafluoride gas ("SF_6") in the gas-insulated switching equipment, Mineral Oil Dielectric Fluid ("MODF") in the transformers, and electrolytes containing sulfuric acid in batteries. The Company's processes and practices will minimize the potential for releases and, if they occur, will ensure that impacts are minimized and mitigated.

2.5.11 Summary of Potential Environmental Impacts

Construction of the Substation at the New Substation Site will comply with all applicable Federal, state and municipal regulations, ordinances and standards regarding noise, construction soils and land disturbance, historic and archeological resources, EMF, and safety and public health. The environmental impacts associated with the construction of the Substation at the New Substation Site will be minor and/or temporary in nature and will be minimized to the maximum extent possible. The relocation of the Substation to the New Substation Site will not result in any increase in potential environmental impacts and will, in fact, reduce the amount of proposed activity within jurisdictional wetland resource areas and in the streets. The New Substation Site is an improvement to the prior location in that it is further from adjacent wetland resource areas and reduces the amount of proposed activity within jurisdictional areas. In addition, as discussed above, the design of the New Substation Site will reduce anticipated traffic impacts during construction when compared to the Original Substation Site design. Lastly, in coordination with the City of Boston, Eversource has committed to cleaning up a contaminated brownfield site that has remained impacted for many years. Remediation of the site will be done in a manner that does not jeopardize public health or safety during cleanup. The planned remediation will improve the soil and groundwater quality and mitigate future potential exposure to contaminants from this site.

Table 5 below provides a summary comparison of potential environmental impacts at the Original and New Substation Sites.

Table 5: Environmental Comparison of Original Substation Site and New Substation Site

Environmental Impacts	Original Site	New Site
Land Use	=	=
Visual	=	=
Traffic	-	+
Noise	=	=
Construction Soils/Dust Control/Air Quality	=	=
Historic/Archaeological Resources	=	=
Wetlands/Waterways	-	+
Electric and Magnetic Fields	=	=
Land Disturbance/Erosion Control	=	=
Vegetation Management	=	=
Safety and Public Health Consideration	=	=

Notes:
+ indicates less potential for impact
= indicates no change in impacts between Original and New Sites
– indicates more potential for impact

2.6 Cost of Substation at New Substation Site

The design and equipment being proposed for the Substation at the New Substation Site is essentially the same as the design and equipment for the Original Substation Site. However, the Company anticipates that the relocation of the Substation from the Original Site to the New Substation Site will result in an approximately $6.2 million increase in costs due to two primary drivers: i) the need for design and engineering revisions ($1.5 million); and ii) costs associated with additional sitework, demolition and environmental remediation efforts applicable to the New Substation Site as discussed in Section 2.5.5 above ($4.7 million).

2.7 Reliability of Substation at New Substation Site

The East Eagle Street Substation will provide additional capacity to relieve the heavily loaded Chelsea Substation and improve the reliability to Chelsea and East Boston. The Company anticipates that the relocation of the Substation to the New Substation Site will result in no change to the reliability of the Project.

2.8 Conclusion on Substation at New Substation Site

As described above, the Company has demonstrated that the construction and operation of the Substation at the New Site will result in a reduction in potential traffic and wetland impacts and that the Company will appropriately minimize other impacts as it would have done at the Original Site. While the relocation will result in a slight increase in cost (approximately 3.6%), reliability will be the same and on balance, the New Site is superior to the Original Site.

3.0 ZONING

As part of the Initial Proceeding, the Siting Board evaluated the Company's request for exemptions from the operation of applicable provisions of the City of Boston's zoning regulations, the Boston Zoning Code, for the construction of the Substation on the Original Substation Site. After a full evaluation, the Siting Board found that the Company qualified as a public service corporation, had established that it requires exemption from five provisions of the Boston Zoning Code, and had demonstrated that the Project is reasonably necessary for public convenience and welfare and, accordingly, granted the five individual zoning exemptions the Company had requested. Final Decision at 161. The Siting Board also found that the Company had actively engaged with the City of Boston to discuss the applicability of the Boston Zoning Code to the Project and any local concerns, and that the City supported the granting of both individual and comprehensive zoning exemptions for the Project. Thus, the Siting Board found that a comprehensive zoning exemption from certain provisions of the Boston Zoning Code would avoid substantial public harm by serving to prevent delay in the construction and operation of the Project and granted the Company's request for a comprehensive exemption from Articles 1 through 25 and Article 53 of the Boston Zoning Code. Final Decision at 163.

The New Substation Site is located 190 feet to the west of the Original Substation Site. Both parcels of land were part of the City Parcel located on East Eagle Street. The New Substation Site is in the same zoning district, the Eagle Square Waterfront Manufacturing ("WM") Subdistrict of the East Boston Neighborhood District, as the Original Substation Site. As noted above, the Substation at the New Substation Site will have the same components as were proposed at the Original Substation Site. As a result, the New Substation Site is subject to the same restrictions on development as the Original Substation Site and construction of the Substation on the New Substation Site requires zoning relief from the same provisions of the Boston Zoning Code as did the proposed construction on the Original Substation Site.

As with the construction of the Substation at the Original Substation Site, the Project at the New Substation Site physically cannot, or may not, meet the substantive requirements of four of the five zoning provisions from which exemption is requested, and without such exemptions, the Company would need to seek variances from the City of Boston Zoning Board of Appeal. These provisions of the Boston Zoning Code are: (1) Section 53-15 and Use Table C regarding prohibited use; (2) Section 53-17 regarding open space requirements; (3) Section 53-18 regarding waterfront yard requirements; and (4) Section 11-2(b) regarding signage. The fifth exemption is from Section 53-13, which provides standards for the issuance of a recommendation by the Boston Redevelopment Authority as part of the Chapter 91 licensing process. As evidenced by its conveyance of the New Substation Site and the letter of support provided as Appendix H, the City of Boston supports the relocation of the Substation to the New Substation Site.

Based on the above, the Company requests that the Siting Board grant the individual and comprehensive zoning exemptions for the New Substation Site as previously granted for the Substation in the Initial Proceeding. The same reliability, cost and environmental impact considerations evaluated by the Siting Board with respect to the requested zoning relief for the Original Substation Site apply with equal force to granting zoning relief at the New Substation Site location.

4.0 CONCLUSION

Following the Siting Board's directive, Eversource succeeded in obtaining a new parcel on which to locate the East Eagle Street Substation on the City Parcel. Based upon the analysis included herewith, Eversource's Project Change Filing responds fully to the Siting Board's directives and complies with the Siting Board's governing standards under G.L. c. 164, § 69J. The relocation of the Substation to the New Site will further the Siting Board's statutory mandate to ensure that the Project will contribute to a reliable energy supply consistent with the minimization of environmental impacts and costs. For the foregoing reasons and consistent with precedent, Eversource respectfully requests that the Siting Board approve the Company's proposal to relocate the East Eagle Street Substation to the New Site.

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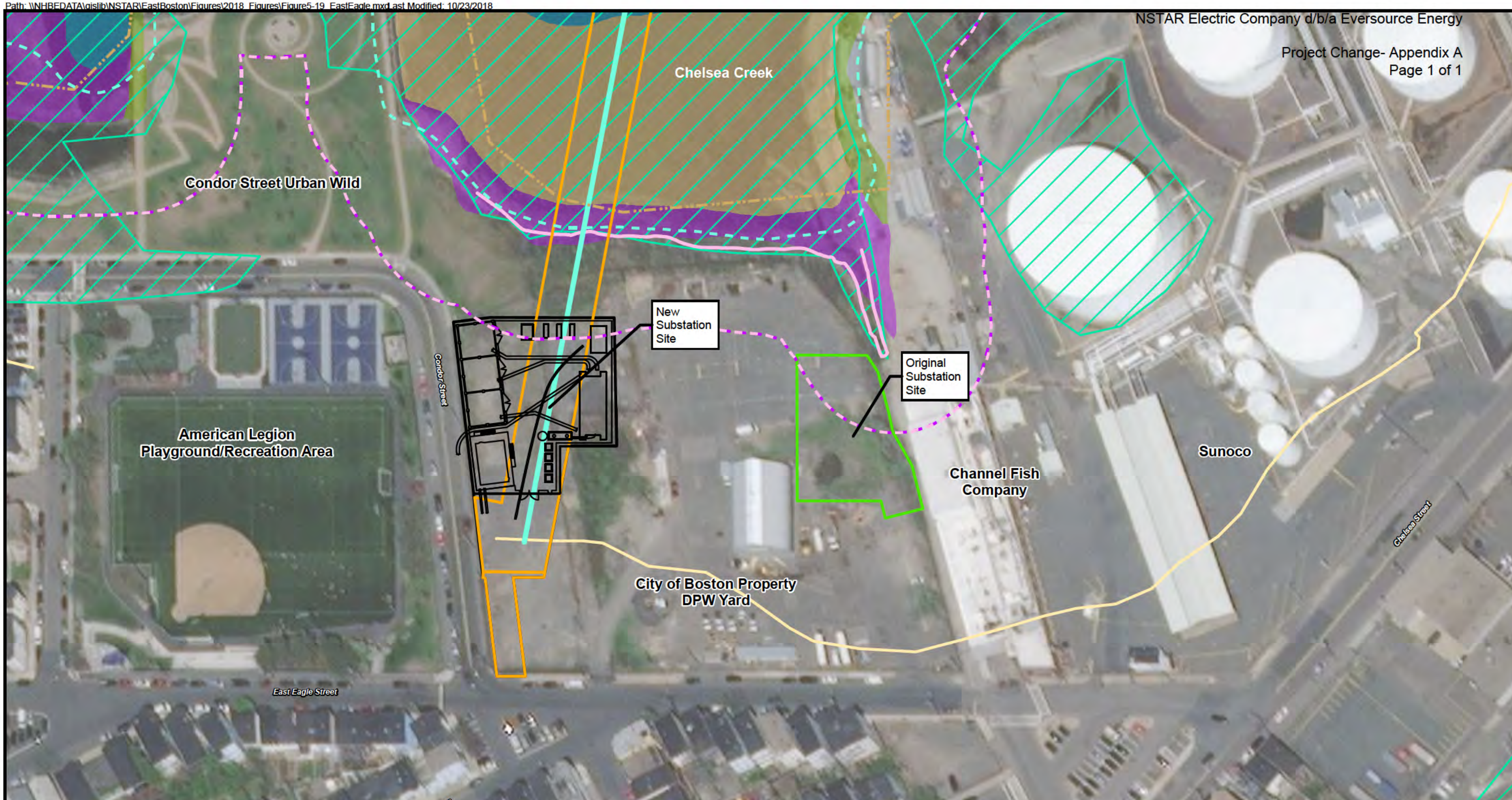


Inset Map

- Proposed Substation Layout
- Chelsea Creek Crossing (Existing)
- Substation Area
- Original Substation Site
- NSTAR Easement
- Municipal Boundary
- Approximate Limit of Ch. 91 Jurisdiction
- Mean High Water Line
- 25-ft Riverfront Area
- 100-ft Buffer Zone to Bank
- 100-ft Wetlands Buffer
- 100yr Floodplain
- Coastal Bank Bluff or Sea Cliff
- Coastal Beach
- Open Water
- Tidal Flat

1 Inch = 100 Feet

0 50 100 200

Feet

Source: MassGIS VHB

Mystic-East Eagle-Chelsea Reliability Project

New Substation Site

EVERSOURCE ENERGY

vhb

THIS DOCUMENT IS INTENDED FOR GENERAL PLANNING & INFORMATION PURPOSES ONLY. ALL MEASUREMENTS & LOCATIONS ARE APPROXIMATE

(617) 569-3200
FAX (617) 561-8471

CHANNEL FISH CO., INC.
370 EAST EAGLE STREET
EAST BOSTON, MASSACHUSETTS 02128-2571

November 5, 2018

By First Class Mail

M. Kathryn Sedor, Esq.
Energy Facilities Siting Board
One South Station
Boston, MA 02110

Re: NSTAR Electric Company d/b/a Eversource Energy,
EFSB 14-04/D.P.U. 14-153/14-154

Dear Ms. Sedor:

On December 1, 2017, the Energy Facilities Siting Board (the "Siting Board") issued a final decision (the "Final Decision") approving, with conditions, the petition of NSTAR Electric Company d/b/a Eversource Energy ("Eversource") to construct, operate and maintain two new, 115-kilovolt underground transmission lines through the Massachusetts cities of Boston, Everett, and Chelsea and a new substation in East Boston (the "East Eagle Substation") and to modify existing substations in Everett and Chelsea ("Project"). The Final Decision approved the construction of the East Eagle Street Substation on a Company-owned 0.38-acre parcel of land, located at 338 East Eagle Street in East Boston ("Original Substation Site"), on the eastern side of a larger tract of land owned by the City of Boston ("City Parcel").

Channel Fish Company, Inc. ("Channel Fish"), as the owner of a fish processing facility located at 370 East Eagle Street in East Boston, intervened in the above-refenced proceeding. Channel Fish had opposed approval of the Company's petitions to construct the Project primarily based on concerns with the proximity of the Original Substation Site to Channel Fish's property and the potential impact from associated electric and magnetic fields on its fish processing equipment.

Channel Fish understands that Eversource plans to file a Notice of Project Change with the Siting Board to seek approval to relocate the East Eagle Substation further away from the property of Channel Fish. Eversource is proposing to relocate the East Eagle Substation from the Original Substation Site to property purchased from the City of Boston on the west side of the City Parcel with an address of 338 East Eagle Street & Condor Street (the "New Site").

(617) 569-3200
FAX (617) 561-8471

CHANNEL FISH CO., INC.

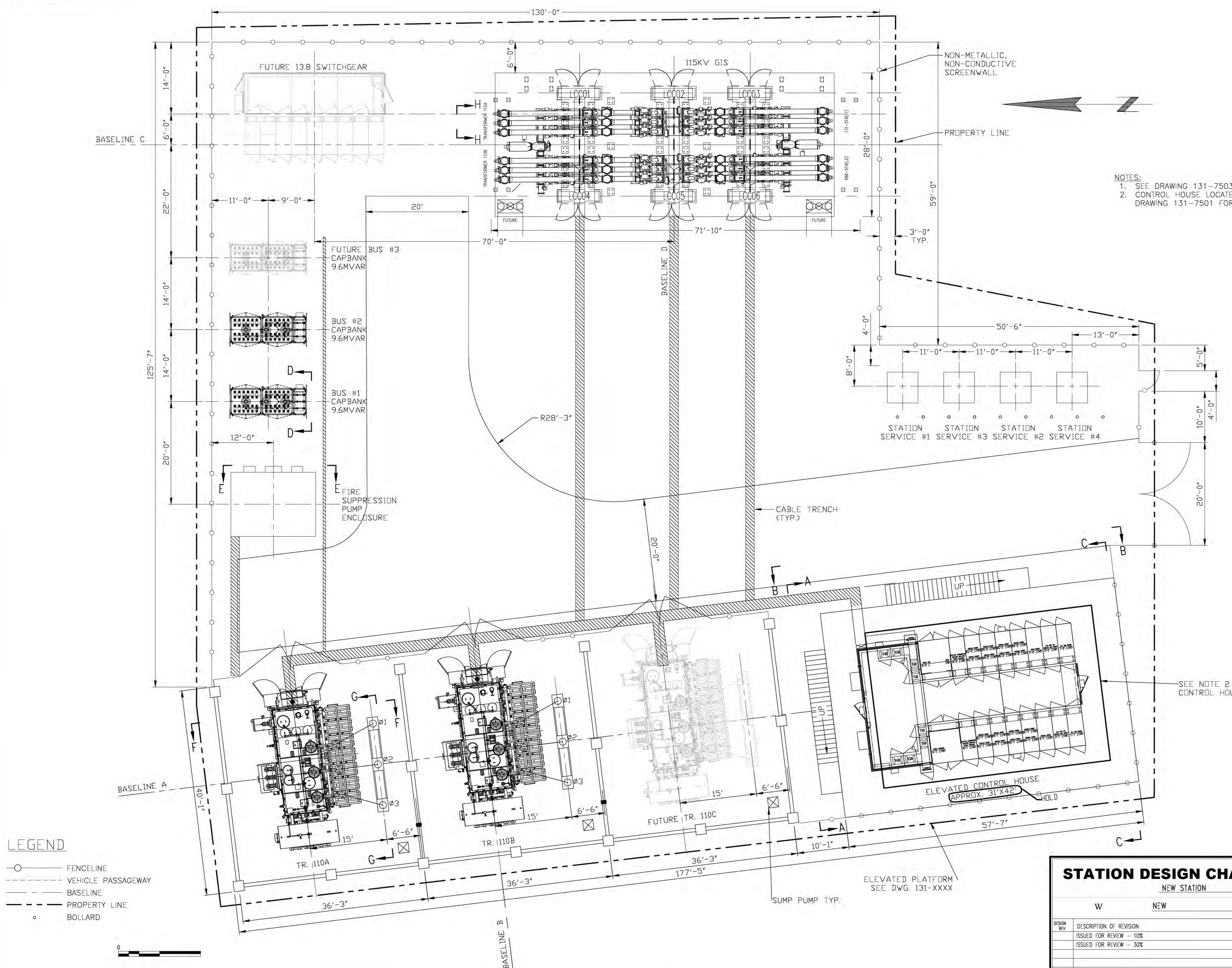
370 EAST EAGLE STREET
EAST BOSTON, MASSACHUSETTS 02128-2571

Channel Fish appreciates the efforts that Eversource and the City of Boston have made to facilitate the relocation of the East Eagle Substation from the Original Substation Site to the New Site. Channel Fish supports and endorses: (a) the Project with the Substation located at the New Site; and (b) Eversource's request for approval by the Siting Board to relocate the East Eagle Substation to the New Site.

Very truly yours,

Louis A. Silvestro
President,
Channel Fish Co., Inc.

131-7502



NOTES:
1. SEE DRAWING 131-7503, 7504, AND 7505 FOR SECTION VIEWS.
2. CONTROL HOUSE LOCATED ON ELEVATED PLATFORM, NOT SHOWN FOR CLARITY. SEE DRAWING 131-7501 FOR CONTROL HOUSE LAYOUT

LEGEND

- FENCELINE
- VEHICLE PASSAGEWAY
- BASELINE
- PROPERTY LINE
- BOLLARD

STATION DESIGN CHANGE No 14-056

NEW STATION

W NEW W NEW

DESIGN REV	DESCRIPTION OF REVISION	DESIGNER	REVIEWED/APPROVED	DATE	ISSUE TO	DATE
	ISSUED FOR REVIEW - 10%	SM	JOHN ZICKO	5/21/18	NSTAR	5/21/18
	ISSUED FOR REVIEW - 30%	NJM	JOHN ZICKO	8/17/18	NSTAR	8/17/18

YARD LAYOUT ELEVATIONS AND DETAILS	131-7504
YARD LAYOUT ELEVATIONS AND DETAILS	131-7503
115KV & 14KV ONE LINE DIAGRAM	131-1000 SH.1

SSUED OR REVIEW ON Y

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Burns & McDonnell

NSTAR ELECTRIC

YARD LAYOUT
GENERAL PLAN

131-7502

131 N CONDOR STREET

ED

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MapID	Relation to the Sub	Distance to Sub (ft)	Parcel ID	Street Address	Use	Owner
1	Includes Sub Location	0	103711002	CONDOR ST	Exempt	CITY OF BOSTON
2	Includes Sub Location	0	103711003	338 E EAGLE ST	Exempt	CITY OF BOSTON
3	East	192	103711020	E EAGLE ST	Commercial Land	NSTAR ELECTRIC COMPANY
4	East	269	103711004	370 E EAGLE ST	Industrial	CHANNEL FISH CO INC
5	North	70	103711001	300 CONDOR ST	Exempt	CITY OF BOSTON
6	West	50	100312000	SWS CONDOR ST	Exempt	CITY OF BOSTON
7	South	290	100258000	327 E EAGLE ST	Residential Three Family	LOPEZ MAX
8	South	276	100257000	325 E EAGLE ST	Residential Three Family	CAIN JOHN G JR TS
9	South	273	100256000	317 LEXINGTON ST	Residential Three Family	CHAVEZ ALMA
10	South	273	100255000	2 4 SHELBY ST	Residential Three Family	NIL NATALIA
11	South	299	100281000	6 SHELBY ST	Residential Three Family	ALBARO CARMELLA
12	South	298	100176000	313 LEXINGTON ST	Residential Three Family	JANISZEWSKI KAZIMIERZ
13	South	279	100232000	306 308 LEXINGTON ST	Apartments 4-6 Units	GRADUS DAVID
14	South	262	100231000	2 LEXINGTON SQ	Residential Single Family	ALVISURIZ MARCOS B
15	South	288	100233000	302 LEXINGTON ST	Residential Single Family	SCHETTINO JOSEPH
16	South	299	100234000	300 LEXINGTON ST	Residential Single Family	RODRIGUEZ SUSAN
17	South	246	100230000	1 LEXINGTON SQ	Residential Single Family	ZHENG JINGWEN
18	South	252	100229000	317 E EAGLE ST	Residential Single Family	BONILLA FRANCISCO
19	South	257	100228000	315 E EAGLE ST	Residential Single Family	DORLANDO DIANE B TS
20	South	264	100227000	313 E EAGLE ST	Residential Three Family	OBARA CHRISTOPHER M
21	South	271	100226000	311 E EAGLE ST	Residential Three Family	OBARA CHRISTOPHER M
22	South	281	100225000	309 E EAGLE ST	Residential Single Family	SCOPPETTULO JULIA
23	South	292	100224000	307 E EAGLE ST	Residential Single Family	DEL MUTO LUCY

Mystic-East Eagle-Chelsea Reliability Project

Proposed East Eagle Street Substation
Abutters Map

EVERSOURCE ENERGY

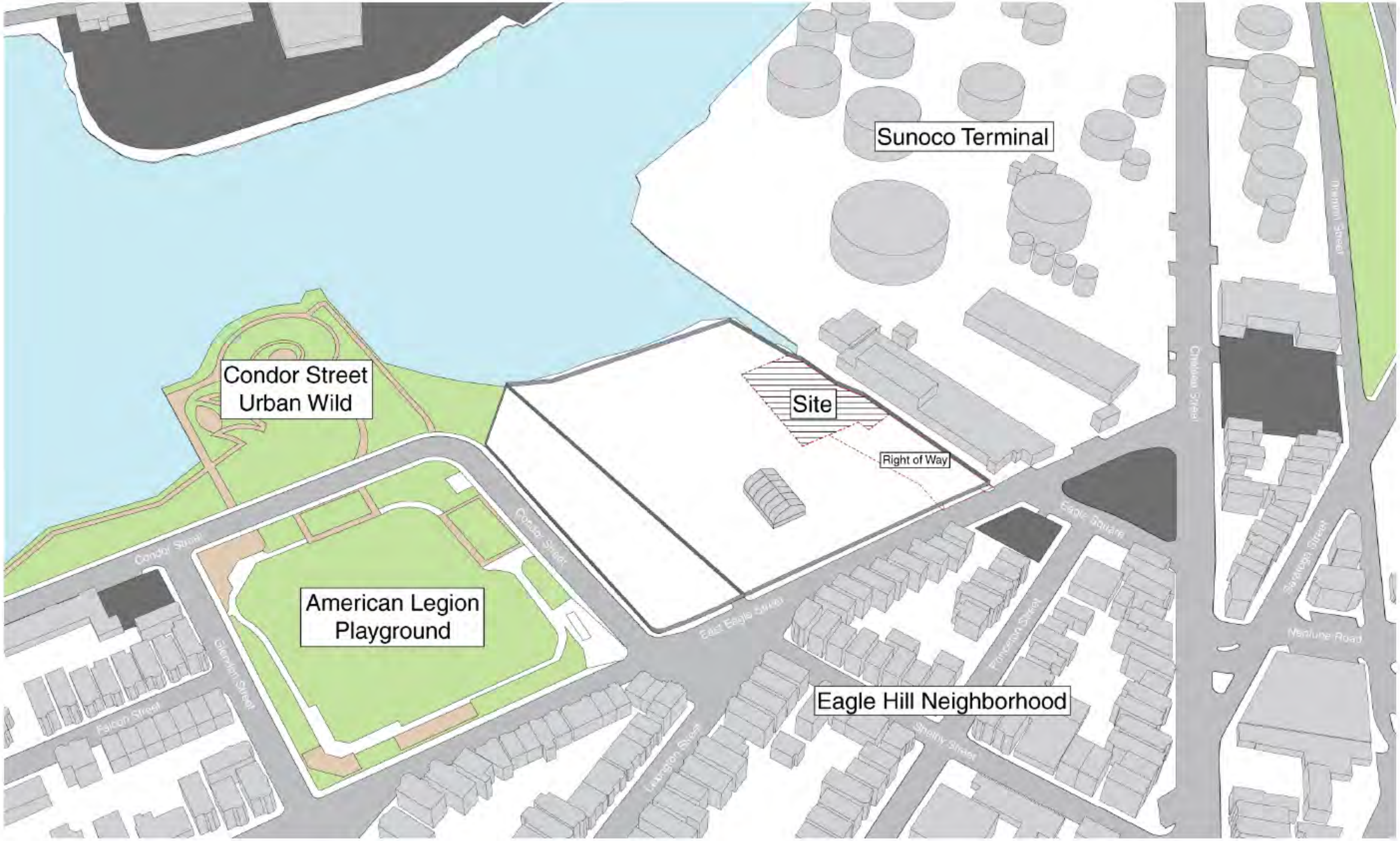
vhb

STATION 131

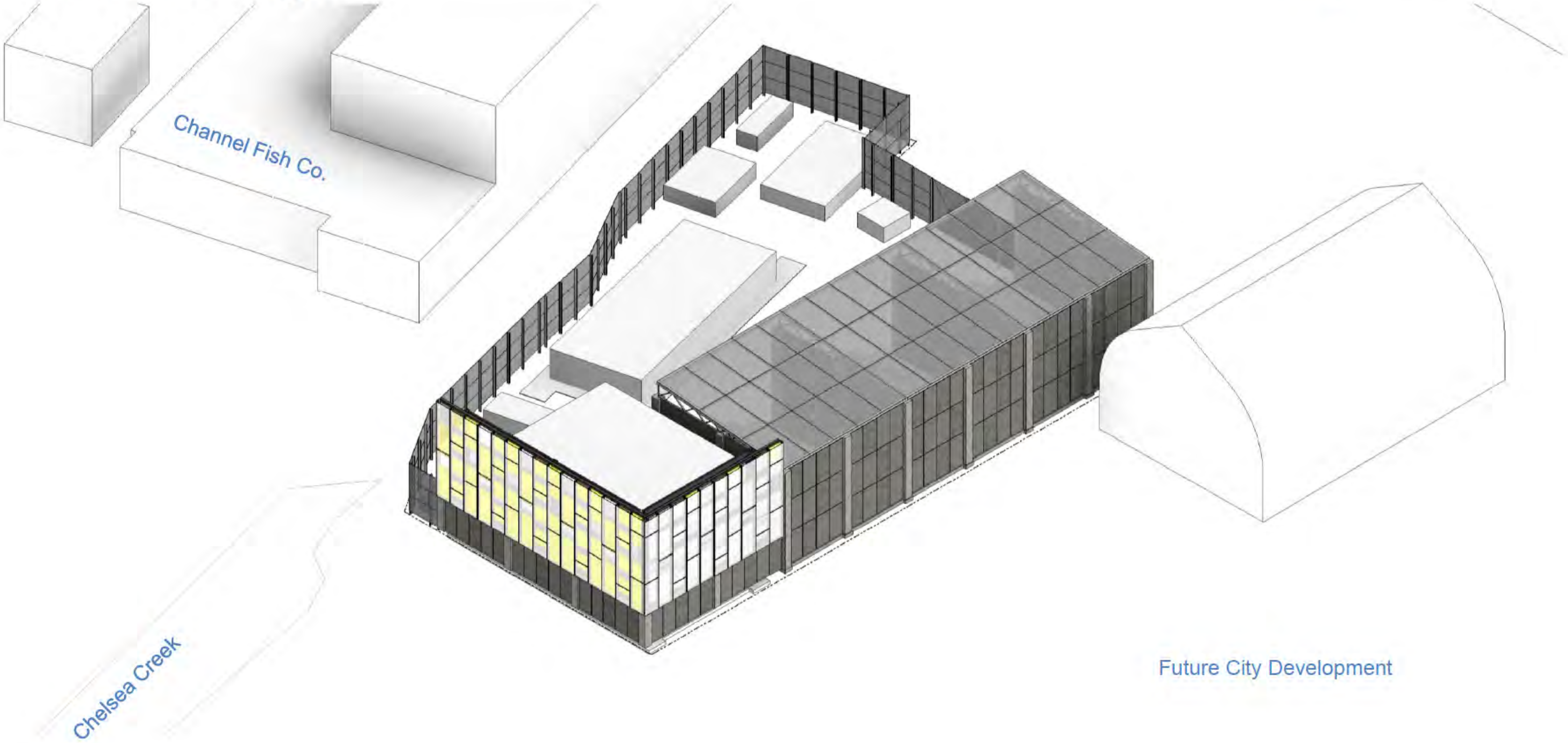
REVISED Concept Design

Eversource | Burns & McDonnell
Utile, Inc. Architecture and Planning
September 28, 2018

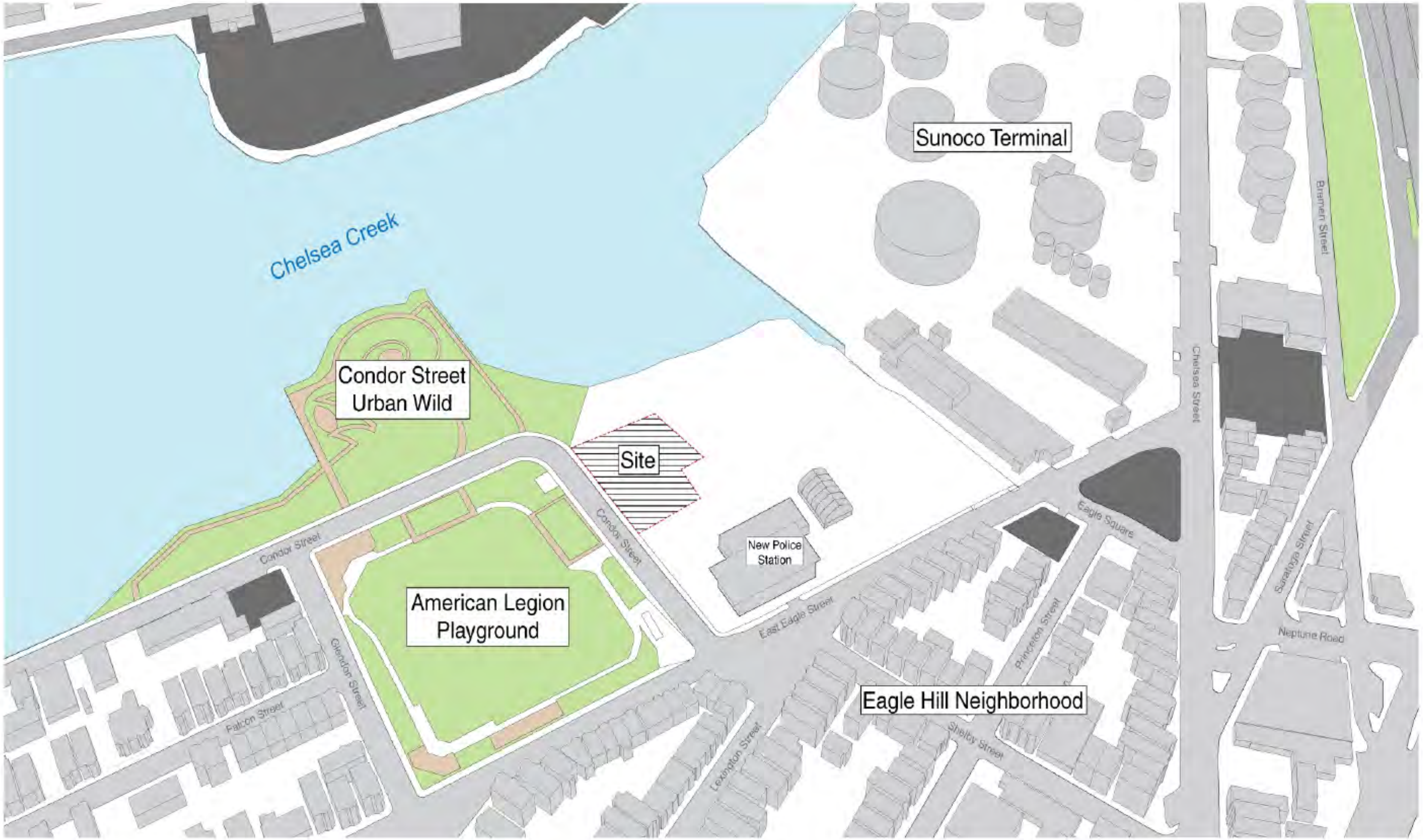
Previous Site



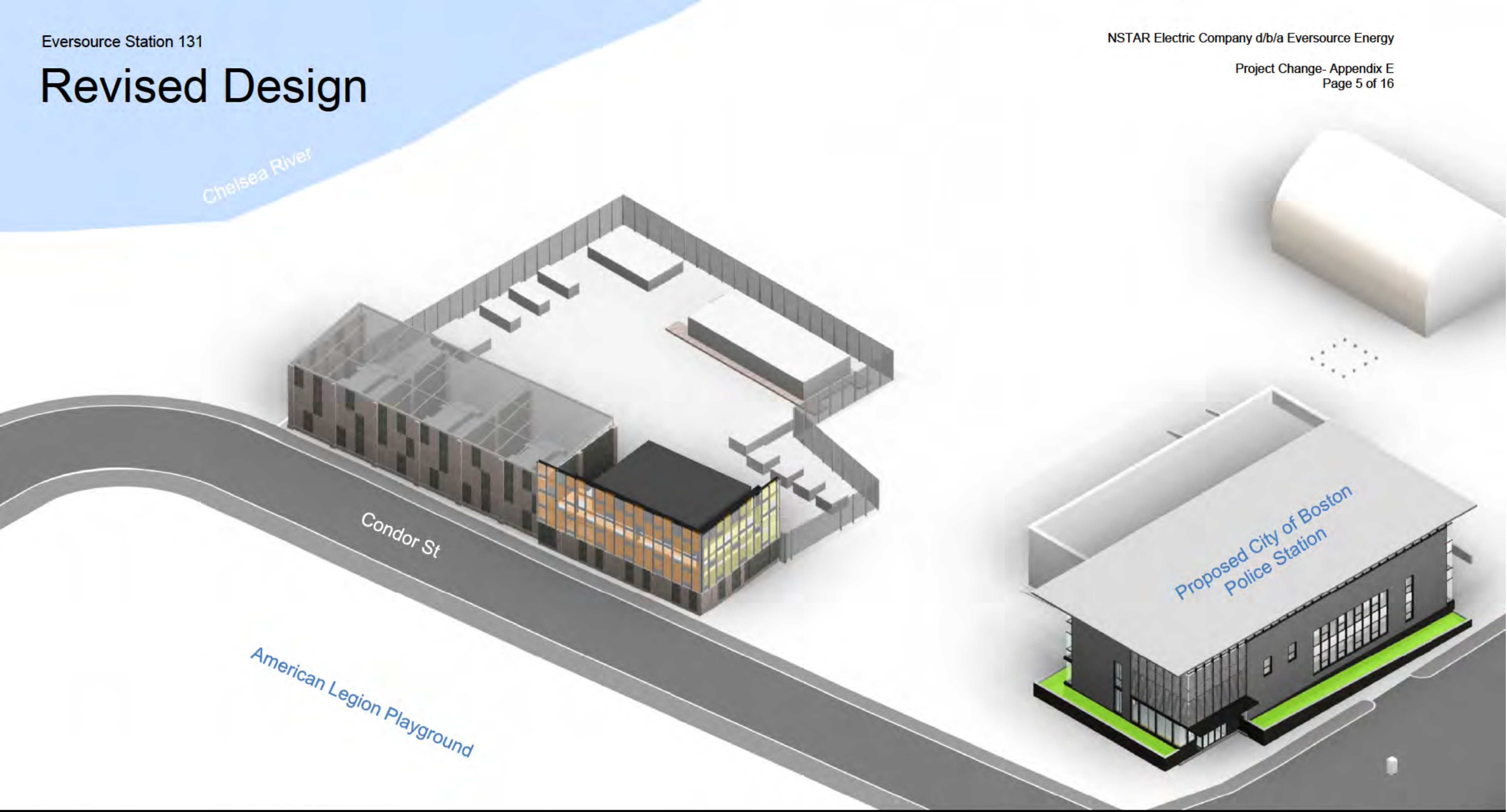
Previous Design



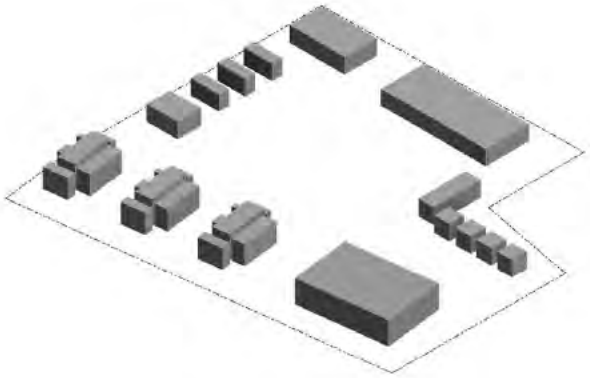
Revised Site



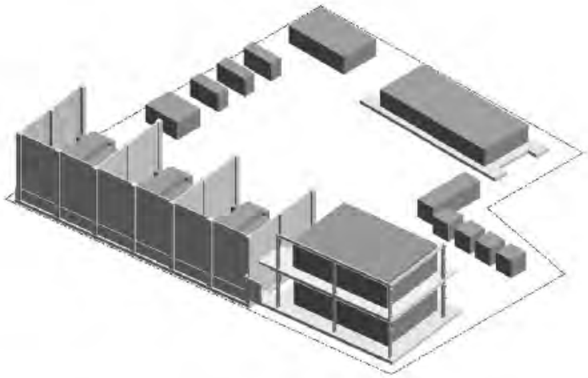
Revised Design



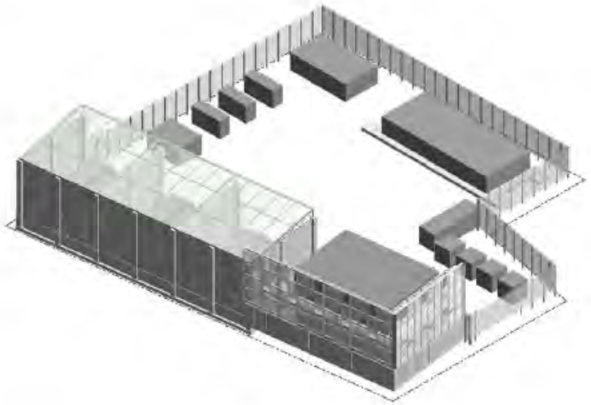
Scope



EQUIPMENT
(Eversource Scope)



FRAMING & TRANSFORMER WALLS
(Burns & McDonnell Scope)



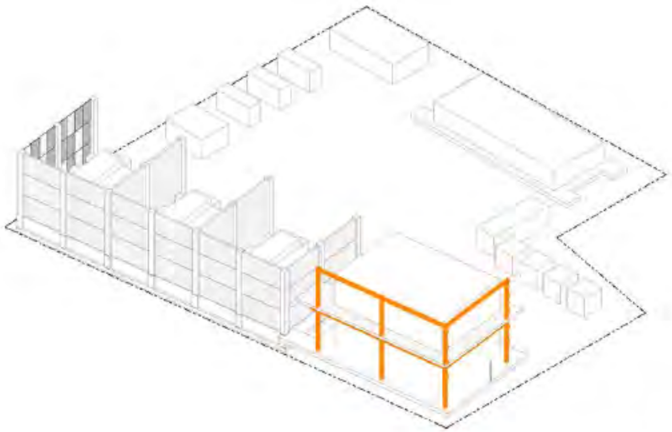
ENCLOSURE
(Utile Scope)

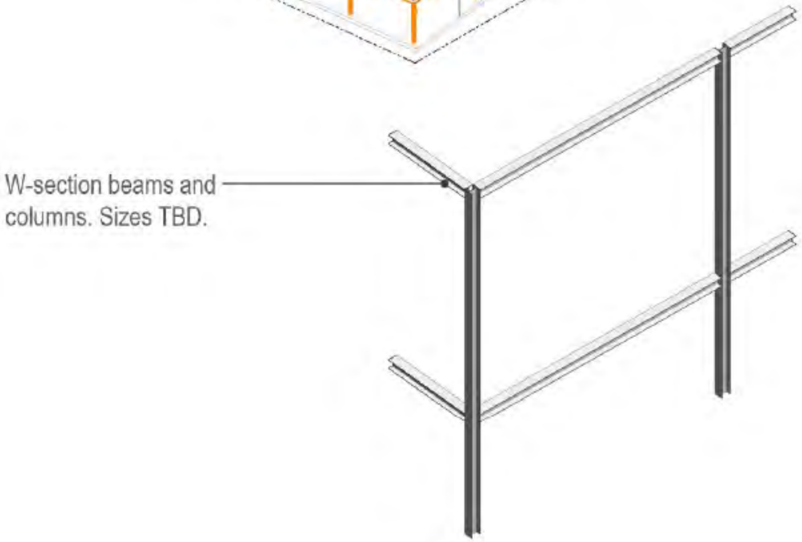
Components

EXTERIOR FRAME

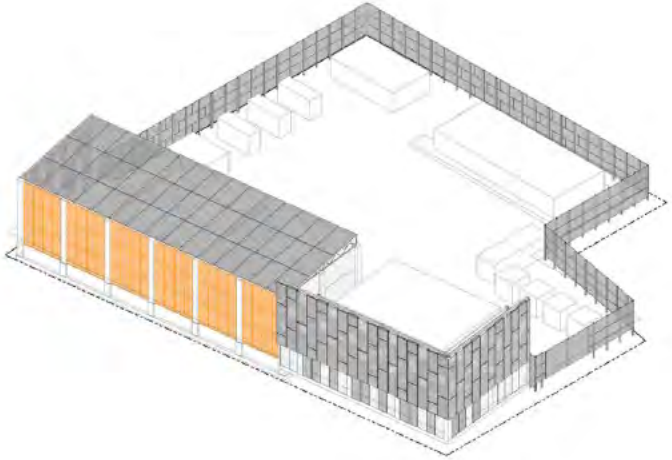
STRUCTURAL STEEL QTY. TBD

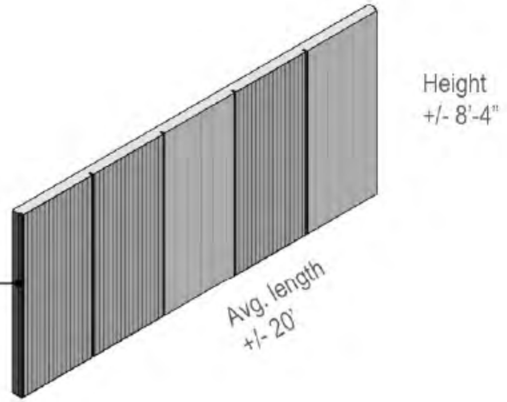
Layout and design by Burns & McDonell. Wide-flange steel frame with bolted connections. Color galvinized coating at exterior framing to coordinate with architectural screen. Color TBD.





Components





CONCRETE
(24) UNITS TOTAL

PRECAST TRANSFORMER WALL WITH FINISH — 3,216 SF

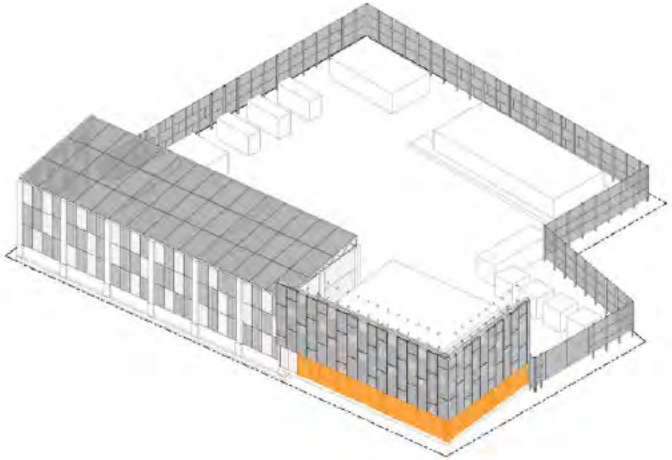
Precast concrete transformer wall panels with integral architectural finishes. Finishes and colors TBD.

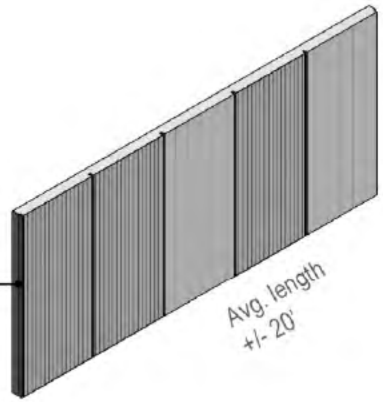
Components

CONCRETE
(5.5) UNITS TOTAL

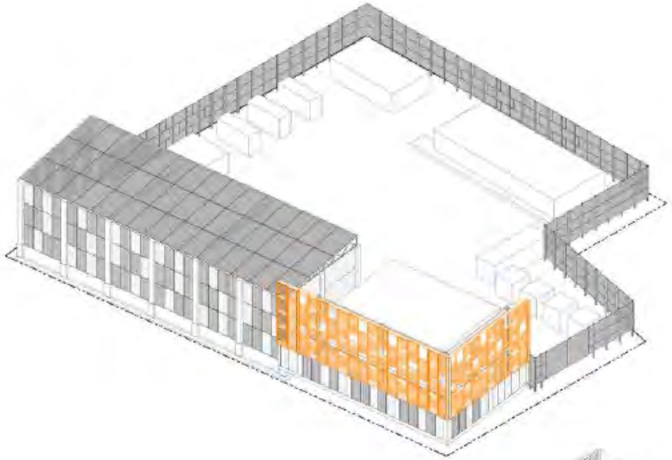
PRECAST CONCRETE WALL PANEL — 835 SF

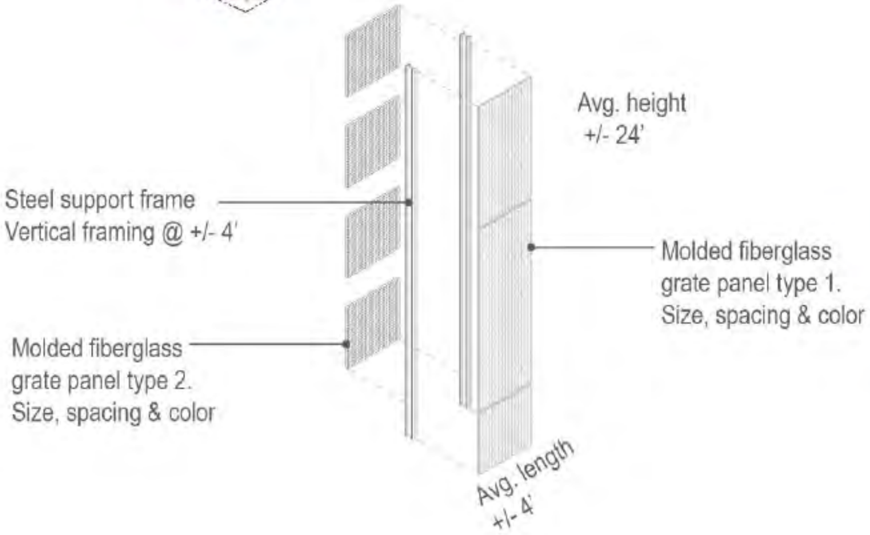
Precast concrete wall panels supported by primary structural steel frame and foundation below. Finishes & colors TBD.





Components





FIBERGLASS PANEL WALL

(28) UNITS TOTAL

Panelized system consisting of support frame molded fiberglass grate panels. Standard panel sizes to be mounted to primary structural frame.

SUPPORT FRAME	2,812 SF

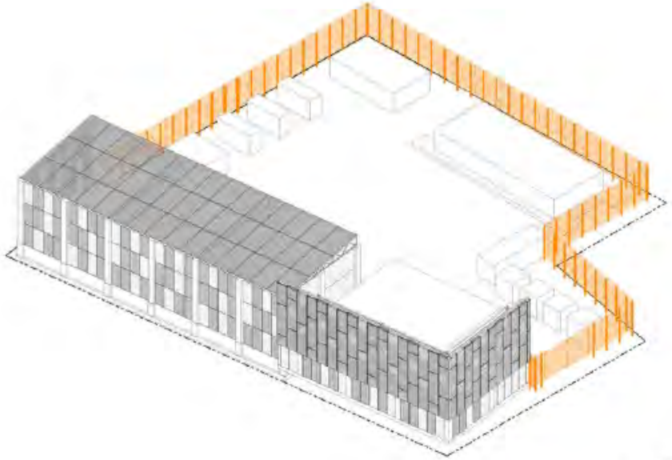
Prefabricated steel frame. Color galvinized coating. Profiles and color TBD.

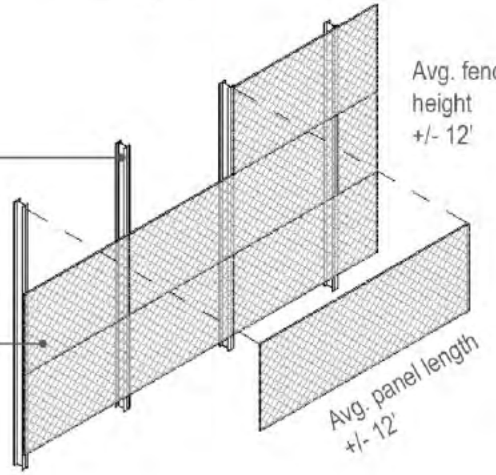
FIBERGLASS GRATE

TYPE 1	2,812 SF
TYPE 2	1,406 SF

Molded fiberglass grate panel. Grate size,spacing and coverage to vary between cladding types.

Components





NON-CONDUCTIVE FENCE

Panelized fiberglass grate screen with support structure.

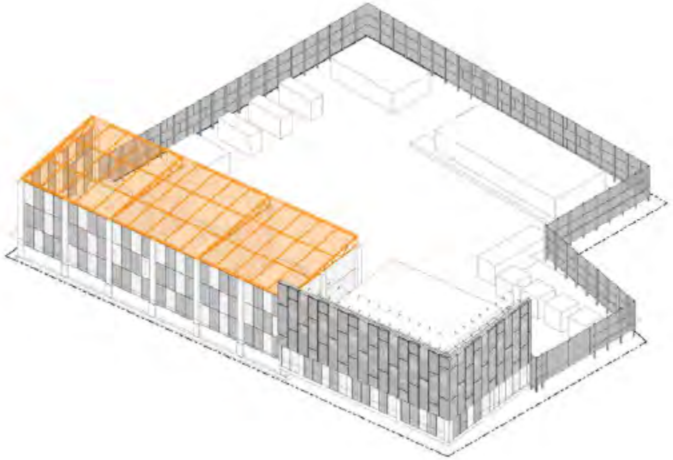
SUPPORT STRUCTURE 4,376 SF

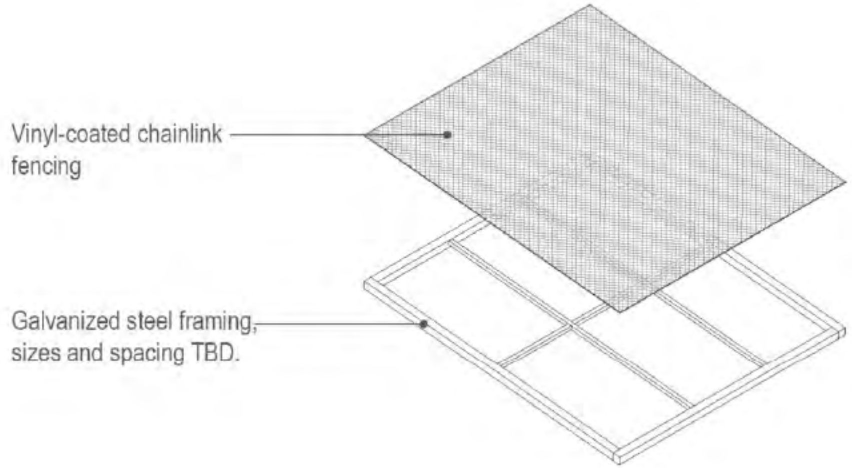
Non-conductive vertical members. Profiles and color TBD.

SKIN 4,376 SF

Molded fiberglass grate panels with 1/2" x 1/2" openings. Color to be black.

Components





CHAINLINK SREEN

(3) UNITS TOTAL

Panelized system consisting of support frame and chainlink fencing. To be assemled offsite and mounted to primary structural frame.

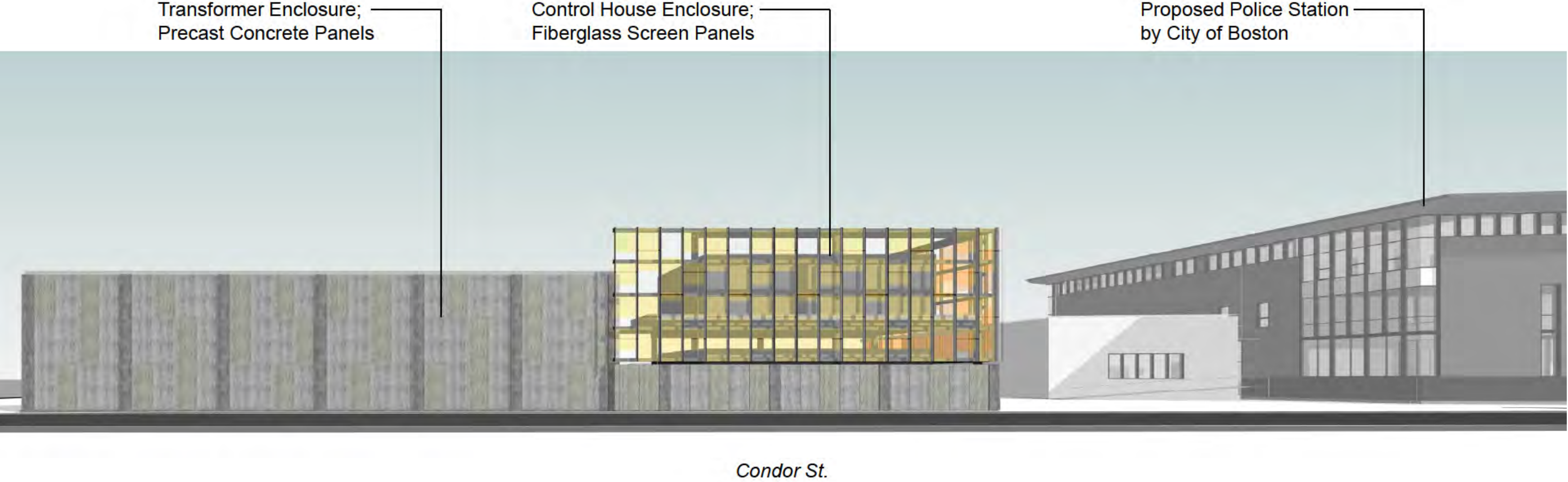
SUPPORT FRAME 4,400 SF

Prefabricated steel frame. Color galvinized coating. Profiles and color TBD.

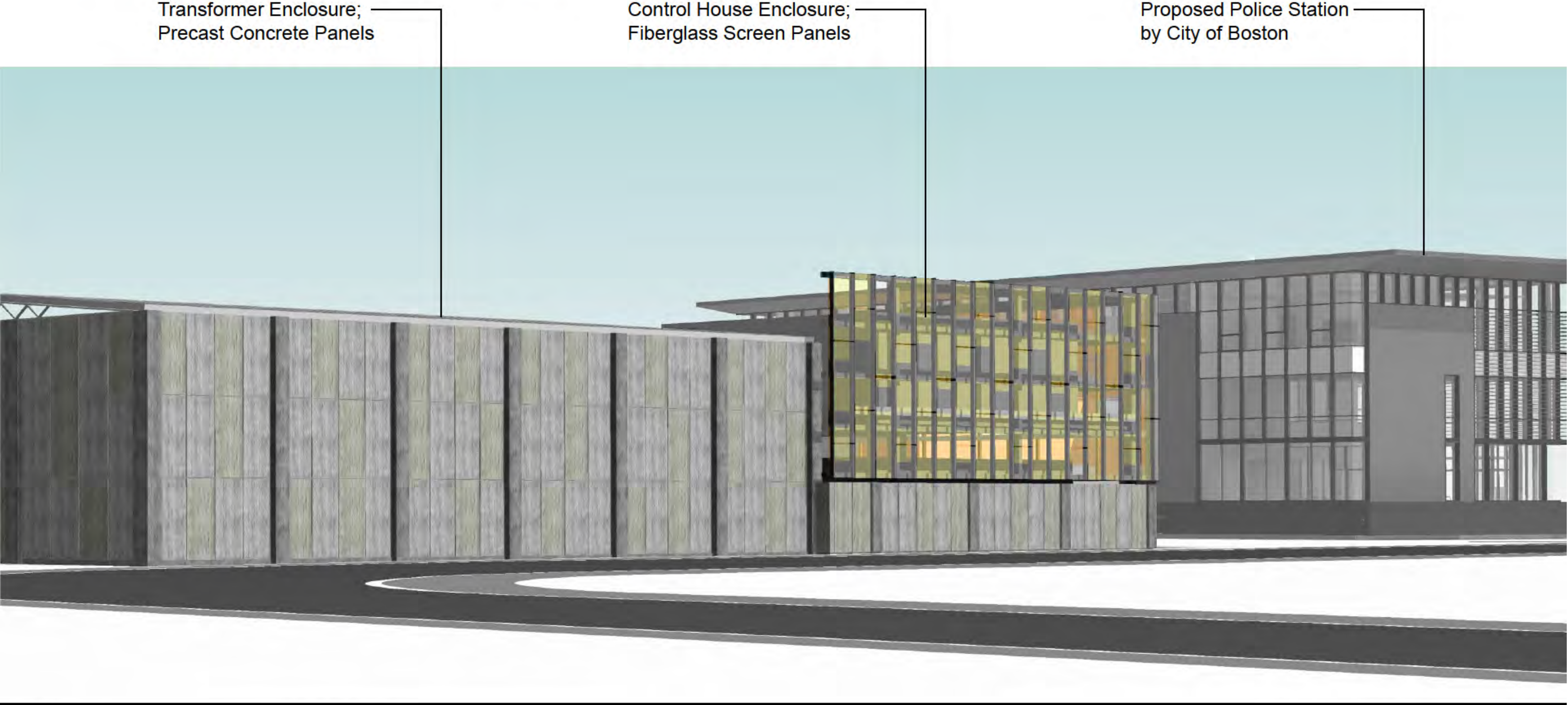
CHAINLINK SCREEN 4,400 SF

Standard vinyl-coated chainlink fencing. Color to be black.

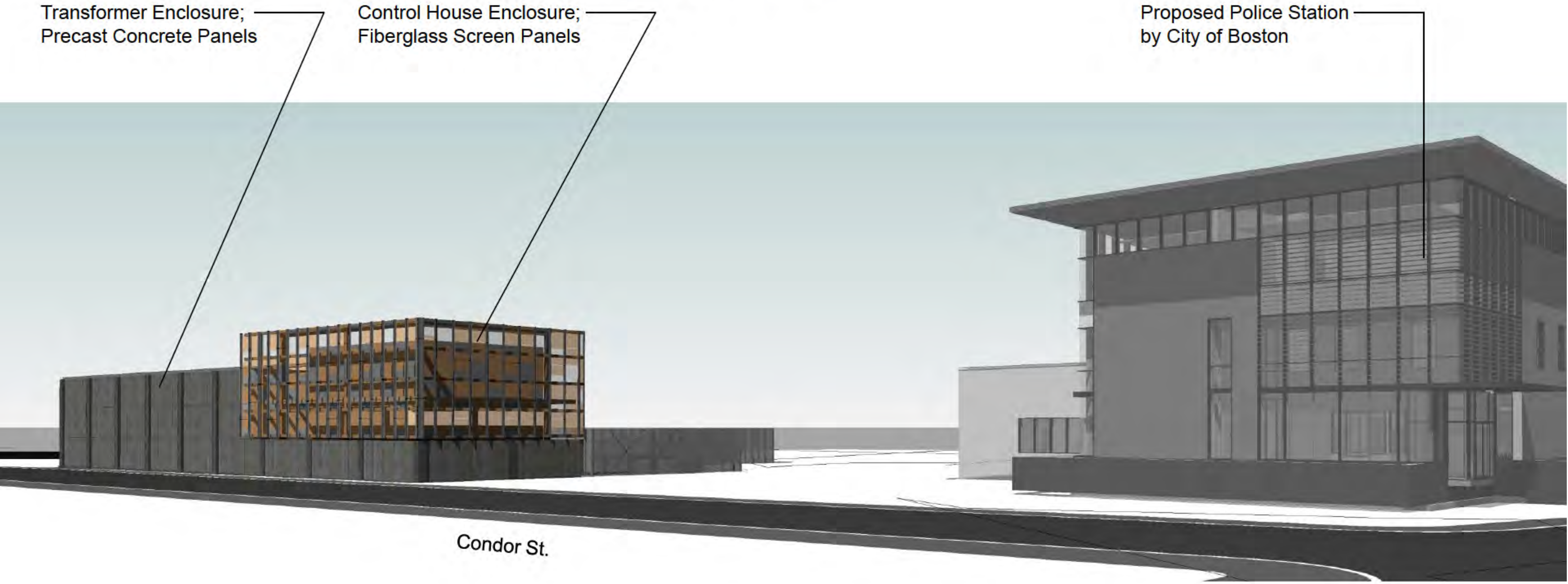
View of West Elevation



View from Condor St. Urban Wild



View from Condor St. & E. Eagle St.



View Close Up

Control House Enclosure;
Fiberglass Screen Panels

Transformer Enclosure;
Precast Concrete Panels

BURNS McDONNELL

STA131 Substation Sound Study

NSTAR

NSTAR Electric Company d/b/a Eversource Energy

STA131 Substation
Project No. 106085

Revision 0
9/27/2018

STA131 Substation Sound Study

prepared for

NSTAR Electric Company
d/b/a Eversource Energy
STA131 Substation
Boston, Massachusetts

Project No. 106085

Revision 0
9/27/2018

prepared by

Burns & McDonnell Engineering Company, Inc.
Kansas City, Missouri

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LIST OF ABBREVIATIONS

Abbreviation	Term/Phrase/Name
ANSI	American National Standards Institute
APCC	City of Boston Air Pollution Control Commission
Burns & McDonnell	Burns & McDonnell Engineering Company, Inc.
CadnaA	Computer Aided Design for Noise Abatement
Company	the construction company selected by Eversource at a future date
dB	decibel
dBA	A-weighted decibels
Eversource	Eversource Energy
Hz	hertz
ISO	International Organization for Standardization
L_{eq}	equivalent-continuous sound level
L_x	exceedance sound level
L_{10}	10-percentile exceedance sound level
L_{90}	90-percentile exceedance sound level
MADEP	Massachusetts Department of Environmental Protection
MVA	megavolt ampere
NEMA	National Electrical Manufacturers Association
NSTAR	NSTAR Electric Company d/b/a Eversource Energy
SPL	sound pressure level
Substation	NSTAR STA131 East Eagle Street Substation
SWL	sound power level

1.0 EXECUTIVE SUMMARY

Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell) conducted a sound study for the proposed STA131 substation (Substation), to be owned and operated by NSTAR Electric Company d/b/a Eversource Energy (Eversource) in Boston, Massachusetts. The Substation will be located near the intersection of East Eagle Street and Condor Street. The proposed Substation will consist of two transformers, capacitor banks, and switchyard equipment.

The objectives of this study were to identify State and local regulations that are applicable to the Substation; measure existing ambient noise levels near the proposed Substation; develop an operational noise model; and determine if the Substation, as designed, will meet the applicable sound level regulations.

Ambient noise monitoring was completed for the proposed Substation from August 11 to 12, 2014. The short-term discrete measurements established daytime and nighttime ambient sound levels near the proposed Substation in the directions of neighboring residences and noise sensitive locations.

The Massachusetts Department of Environmental Protection (MADEP), the City of Boston Air Pollution Control Commission (APCC), and the Boston Municipal Code all have noise policies which establish sound level limits for the Substation.

Noise modeling was completed for the Substation to estimate sound level impacts with the Substation energized. Predictive modeling results were analyzed for compliance with both the MADEP and APCC noise policies. Based on the ambient measurements collected and the predictive modeling results, the operation of the Substation will comply with the applicable State and City noise regulations.

Construction noise will be addressed during construction, and sound dampening material may be used if necessary. Construction noise will be handled by the construction company completing the work and will be limited to levels below the City of Boston APCC regulation for construction in an industrial area. Construction noise will comply with City and State requirements, regulations, and ordinances.

The following sections describe the study in further detail.

2.0 ACOUSTICAL TERMINOLOGY

The term "sound level" is often used to describe two different sound characteristics called sound power and sound pressure. Every source that produces sound has a sound power level. The sound power level is the acoustical energy emitted by a sound source and is an absolute number that is not affected by the environment. The acoustical energy produced by a sound source propagates through a media as pressure fluctuations. These pressure fluctuations, also called sound pressure, are what human ears hear and microphones measure.

Sound is physically characterized by amplitude and frequency. The amplitude of sound is measured in decibels (dB) as the logarithmic ratio of a sound pressure to a reference sound pressure (20 microPascals). The reference sound pressure corresponds to the typical threshold of human hearing. Less than a 3-dB change in continuous broadband sound is generally considered "not noticeable" to the average listener. A 5-dB change is generally considered "clearly noticeable" and a 10-dB change is generally considered a doubling (or halving) of the apparent loudness.

Frequency is measured in hertz (Hz), which is the number of cycles per second. The typical human ear can hear frequencies ranging from approximately 20 to 20,000 Hz. Normally, the human ear is most sensitive to sounds in the middle frequencies (1,000 to 8,000 Hz) and is less sensitive to sounds in the low and high frequencies. As such, the A-weighting scale was developed to simulate the frequency response of the human ear to sounds at typical environmental levels. The A-weighting scale emphasizes sounds in the middle frequencies and de-emphasizes sounds in the low and high frequencies. Any sound level to which the A-weighting scale has been applied is expressed in A-weighted decibels or dBA. For reference, the A-weighted sound pressure level and subjective loudness associated with some common sound sources are listed in Table 2-1.

Table 2-1 Typical Sound Pressure Levels Associated with Common Sound Sources

Sound Pressure Level (dBA)	Subjective Evaluation	Environment	
		Outdoor	Indoor
140	Deafening	Jet aircraft at 75 feet	--
130	Threshold of pain	Jet aircraft during takeoff at a distance of 300 feet	--
120	Threshold of feeling	Elevated train	Hard rock band
110		Jet flyover at 1,000 feet	Inside propeller plane
100	Very loud	Power mower, motorcycle at 25 feet, auto horn at 10 feet, crowd sound at football game	--
90	--	Propeller plane flyover at 1,000 feet, noisy urban street	Full symphony or band, food blender, noisy factory
80	Moderately loud	Diesel truck (40 mph) at 50 feet	Inside auto at high speed, garbage disposal, dishwasher
70	Loud	B-757 cabin during flight	Close conversation, vacuum cleaner
60	Moderate	Air-conditioner condenser at 15 feet, near highway traffic	General office
50	Quiet	--	Private office
40	--	Farm field with light breeze, birdcalls	Soft stereo music in residence
30	Very quiet	Quiet residential neighborhood	Inside average residence (without TV and stereo)
20	--	Rustling leaves	Quiet theater, whisper
10	Just audible	--	Human breathing
0	Threshold of hearing	--	--

Source: Adapted from *Architectural Acoustics*, M. David Egan, 1988 and *Architectural Graphic Standards*, Ramsey and Sleeper, 1994.

Sound in the environment is constantly fluctuating; for example, when a car drives by, a dog barks, or a plane passes overhead. Therefore, sound metrics have been developed to quantify fluctuating environmental sound levels. These metrics include the exceedance sound level. The exceedance sound level, L_x, is the sound level exceeded during “x” percent of the sampling period and is also referred to as a statistical sound level. The most common L_x values are L_{eq}, L_{90}, and L_{10}. L_{eq} is the arithmetic average of the varying sound over a given time period, and L_{10} and L_{90} are the sound levels exceeded 10 and 90 percent of the time during a given time period, respectively. The L_{90} sound level is commonly considered the background sound level, as it removes spikes in sound that dissipate quickly. L_{10} is commonly used to measure construction noise. These three metrics are the levels presented in this report.

3.0 APPLICABLE REGULATIONS

3.1 Operational Noise Regulations

The regulation of noise falls within the responsibilities of the MADEP, the City of Boston APCC, and the Boston Municipal Code (Chapter 16, Section 26). Where applicable, the most strict noise ordinance will be followed.

MADEP's Air Pollution Control Regulations (310 CMR 7.00) define "noise" as "sound of sufficient intensity and/or duration as to cause a condition of air pollution." MADEP has the following noise pollution policy:

> A noise source will violate MADEP's noise regulation (310 CMR 7.10) if the source:
>
> 1. Increases the broadband sound level by more than 10 dB(A) above ambient, or
> 2. Produces a "pure tone" condition – when any octave band center frequency sound pressure level exceeds the two adjacent center frequency sound pressure levels by 3 dB or more.
>
> These criteria are measured both at the property line and at the nearest inhabited residence. Ambient is defined as the background A-weighted sound level that is exceeded 90 percent of the time, measured during equipment operating hours.

The Substation is proposed to be within the city limits of Boston, Massachusetts. Therefore, it will be subject to the noise ordinances of the City of Boston APCC and the Boston Municipal Code (Chapter 16, Section 26). These noise policies are discussed in the following subsections. The APCC limits are stricter than the Boston Municipal Code limits. Therefore, compliance with operational noise limits will be determined using the APCC limits.

3.1.1 Air Pollution Control Commission

According to the applicable Boston Redevelopment Authority zoning map, the proposed Substation is located in the Waterfront Manufacturing district of East Boston. Uses in the immediate vicinity of the Substation parcel are industrial in nature. There are nearby residences and a park adjacent to the Waterfront Manufacturing district. The Table of Zoning District Noise Standards found in Section 2.5 of the APCC's Regulations for the Control of Noise in the City of Boston is reproduced as Table 3-1 of this report. As shown in the table, noise generated by the Substation and measured at the lot line of an affected parcel is limited to 70 dBA for industrial properties and 50 dBA for residential properties.

Table 3-1 Maximum Allowable Octave Band Sound Pressure Levels

Octave Band Center Frequency (Hz)	Residential		Residential / Industrial		Business	Industrial
	Daytime	All Other Times	Daytime	All Other Times	Anytime	Anytime
31.5	76	68	79	72	79	83
63	75	67	78	71	78	82
125	69	61	73	65	73	77
250	62	52	68	57	68	73
500	56	46	62	51	62	67
1,000	50	40	56	45	56	61
2,000	45	33	51	39	51	57
4,000	40	28	47	34	47	53
8,000	38	26	44	32	44	50
Single Number Equivalent	**60 dBA**	**50 dBA**	**65 dBA**	**55 dBA**	**65 dBA**	**70 dBA**

Source: City of Boston Air Pollution Control Commission – Regulation for the Control of Noise

3.1.2 Boston Municipal Code Chapter 16, Section 26

According to the Boston Municipal Code, a noise source will be considered unreasonable or excessive if the source:

1. Produces noise measured at the lot line of a residential lot in excess of 50 dBA between the hours of 11:00 p.m. and 7:00 a.m., or in excess of 70 dBA at all other hours; or
2. In the absence of an applicable noise level standard or regulation of the Air Pollution Control Commission, any noise plainly audible at a distance of 300 feet or, in the case of loud amplification devices of similar equipment, noise plainly audible at a distance of 100 feet from its source by a person of normal hearing.

3.2 Construction Noise Regulations

The Substation is proposed to be within the city limits of Boston, MA. Therefore, it will be subject to the City of Boston APCC and the Boston Municipal Code (Chapter 16, Section 26) policies for construction noise. These policies are discussed in the following subsections.

3.2.1 Air Pollution Control Commission

According to the City of Boston APCC, it shall be unlawful for any person to operate any construction device or devices on the construction site if the operation of such device or devices emits noise, measured at the lot line of the affected property, in excess of the values as shown below in Table 3-2:

Table 3-2 Maximum Allowable Construction Sound Pressure Levels

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

Source: City of Boston Air Pollution Control Commission – Regulation for the Control of Noise

3.2.2 Boston Municipal Code Chapter 16, Section 26

Boston Municipal Code Chapter 16, Sections 26.4 and 26.5 limit erection, demolition, alteration and repair of any building and excavation to between the hours of 7:00 A.M. and 6:00 P.M. on weekdays. Other construction activities are allowed during nighttime hours and are limited to 50 dBA at the lot line of a residence.

4.0 SOUND ENVIRONMENT

Existing ambient sound levels were established for the Substation in 2014. Though measurements were taken four years ago, the area surrounding the Substation Site is highly developed and no new significant noise emitters have been added to the area. The existing background sound levels onsite were the result of local traffic, industrial facilities to the east, and people in the park and surrounding community. All of these sources are still present and background sound levels are expected to be approximately the same.

The ambient measurement locations were selected in 2014 for a Substation to be located approximately 240 feet to the east of where the Substation is currently proposed to be located. The ambient measurement locations selected for the Substation at the original location provide adequate ambient sound levels on all sides of the Substation at the new location in the direction of neighboring residences and noise sensitive areas. Therefore, the ambient sound levels established in 2014 are suitable to use for the new analysis.

Burns & McDonnell personnel took sound measurements near the proposed Substation during four time periods on August 11 and 12, 2014. These measurements were taken to establish sound levels in the area of the proposed Substation. The land uses immediately surrounding the Substation are mostly industrial, with residential housing and a park across the street.

All four sets of measurements were taken when meteorological conditions were favorable for conducting ambient sound measurements. The skies were clear, winds were low and there was no precipitation during the measurement periods. Average meteorological conditions during the measurement periods were obtained from published Boston weather data and are presented in Table 4-1.

Table 4-1 Meteorological Conditions During Sound Measurements

Date	Time Period	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Sky Cover
August 11, 2014	5:00 P.M. - 7:00 P.M.	84	65	1-5	Clear
August 11, 2014	11:00 P.M. - 1:00 A.M.	71	71	1-5	Clear
August 12, 2014	5:00 A.M. - 7:00 A.M.	65	90	Calm	Clear
August 12, 2014	11:00 A.M. - 1:00 P.M.	74	71	Calm	Clear

Ambient sound level measurements – which generally refer to measurements taken at the Substation fence line and beyond – were made at six locations, as shown in Figure 4-1. The measurement locations were selected because they were accessible, close to the proposed Substation, and representative of sound levels on multiple sides of the proposed Substation. MADEP requires the Substation not increase the broadband sound level at any location outside the property line by more than 10 dB(A) above ambient. The ambient measurement points are all located on the adjacent property owned by the City of Boston.

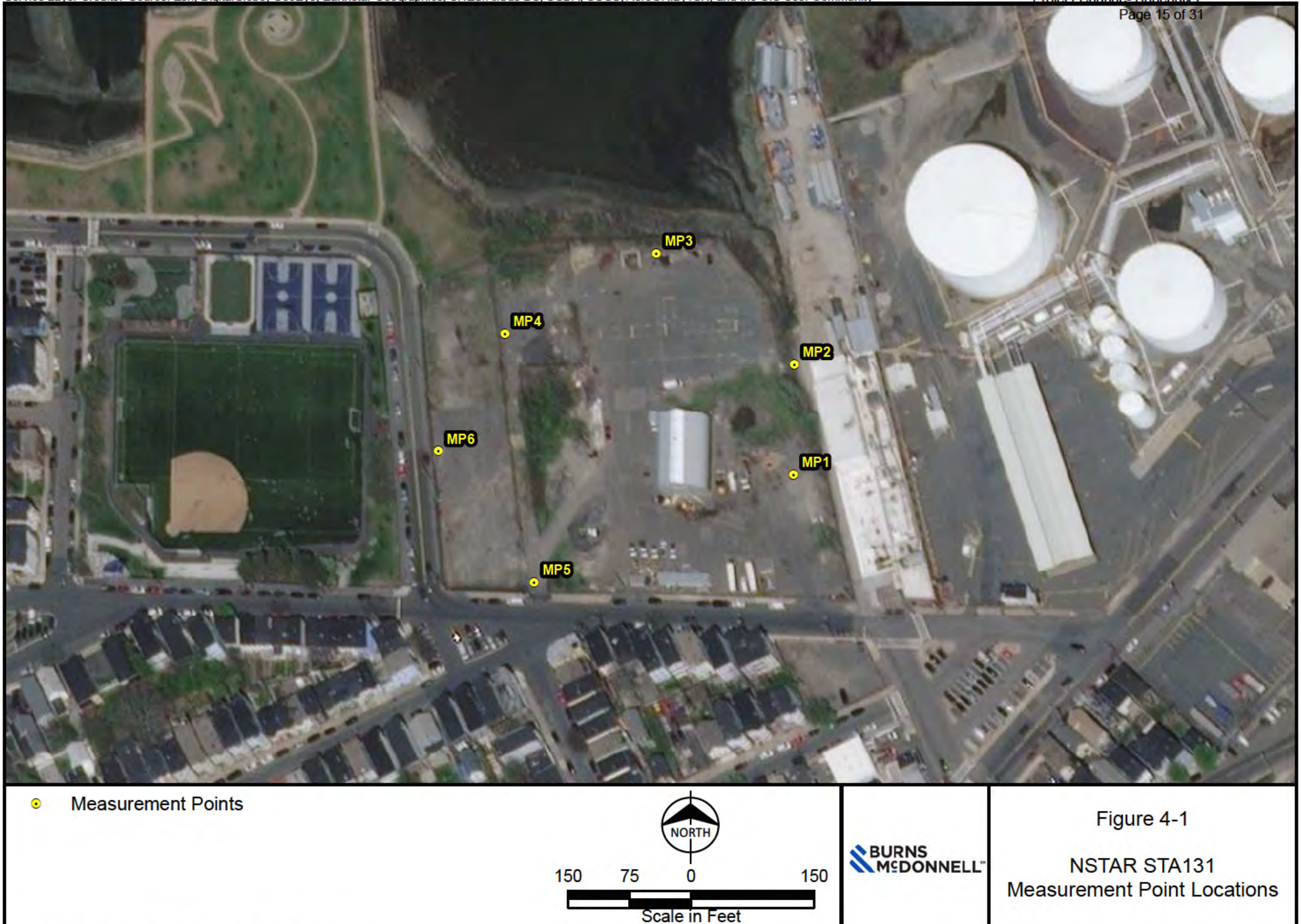
Measurements were taken using an American National Standards Institute (ANSI) type 1 sound-level meter (Larson-Davis Model 831). The sound level meter was calibrated before and after each set of measurements. None of the calibration level changes exceeded ± 0.5 dB. A windscreen was used at all times on the microphone, and the meter was mounted on a tripod. The microphone was located approximately 5 feet above ground with the microphone angled per the manufacturer's recommendation.

The ambient sound level measurement periods were 5 minutes long, and measured values were logged by the sound meter at each measurement location. The sound levels varied at each measurement point due to the extraneous sounds that occurred during each measurement. The measurement points were located at approximately the same ground level elevation as the substation with the microphone mounted on a tripod five feet above the ground.

Extraneous sounds during the measurement periods included sound associated with vehicular traffic from nearby roads and highways (including large trucks) and airplanes taking off and landing at the nearby Logan Airport. The measured, A-weighted L_{eq} and L_{90} sound levels are presented in Table 4-2. Ambient sound levels varied during the measurements due to background sources in the area.

Table 4-2 Ambient Sound-Level Measurements

Time Period	Measurement Point	Measured L_{eq} (dBA)	Measured L_{90} (dBA)	Extraneous Noises
August 11, 2014 5:00 PM - 7:00 PM	MP1	58.5	56.2	Traffic dominant, car horn, police siren, air brakes, car alarm, semi idle on adjacent property, motorcycle
	MP2	66.5	65.9	Semi idle dominant, seagulls, traffic barely audible over semi, airplane
	MP3	59.9	58.2	Semi idle, people cheering in park, airplane, light traffic, seagulls, wind in trees
	MP4	56.8	53.9	Traffic, motorcycle, people at park playing basketball, police siren
	MP5	59.7	50.7	Traffic dominant, people at park, heavy trucks, air brakes, car stereo
	MP6	58.2	52.3	Traffic dominant, people at park, fence rattle, car stereo, kids on bikes, plane distant, loud car
August 11, 2014 11:00 PM - 1:00 AM	MP1	50.2	48.9	Insects, traffic, wind in trees, car door, air brakes
	MP2	51.0	50.0	Insects, traffic, wind in trees, distant motorcycle, pumps on adjacent property
	MP3	50.8	49.2	Insects, pumps, light traffic, wind in trees, tires squeal, airplane
	MP4	49.6	48.2	Insects, traffic, car horn, airplane, train horn distant
	MP5	52.8	48.7	Traffic dominant, car stereo, insects, brakes squeal, diesel idle
	MP6	52.2	46.8	Traffic, insects, pumps, air brakes, loud motorcycle, airplane
August 12, 2014 5:00 AM - 7:00 AM	MP1	53.0	51.0	Traffic, airplane, pumps, heavy truck, car horn, birds close by, motorcycle, loud car
	MP2	52.5	50.7	Traffic, seagulls, pumps, airplane x3
	MP3	53.8	51.9	Traffic, pump, heavy trucks on adjacent property, airplane x3, seagulls
	MP4	52.8	50.5	Traffic, pumps, seagulls, airplane, brakes squeal, heavy truck
	MP5	56.4	49.5	Traffic, car horn, seagulls, airplane, police siren, helicopter distant, scooter
	MP6	60.1	49.9	Traffic, seagulls, airplane, diesel truck onsite, heavy trucks
August 12, 2014 11:00 AM - 1:00 PM	MP1	56.3	51.2	Traffic, jack hammer distant, men working, diesel truck onsite, car horn
	MP2	56.3	54.0	Traffic, diesel truck idling, airplane x4, men working, brakes squeal, train horn distant, train distant, back up beeping
	MP3	56.6	55.8	Traffic, men working, airplane x2, back up beeping, truck onsite, truck unloading on adjacent property
	MP4	54.2	51.4	Traffic, diesel truck idle, back up beeping, men yelling at park, airplane
	MP5	59.7	52.7	Traffic dominant, airplane, heavy trucks, brakes squeal
	MP6	60.2	51.0	Traffic dominant, close heavy trucks, airplane, motorcycle



BURNS McDONNELL

Figure 4-1

NSTAR STA131
Measurement Point Locations

5.0 NOISE MODELING

To estimate property line sound emitted by the Substation, Burns & McDonnell modeled the sound sources included as part of the Substation. The Substation was modeled based on vendor-provided data for the transformers and estimated sound levels for the capacitor banks. The model was then used to estimate project-related sound levels at the nearest property lines for both industrial and residential properties.

5.1 Noise Modeling Methodology

Noise modeling was performed using the industry-accepted sound modeling software Computer Aided Design for Noise Abatement (CadnaA), version 2018. The software is a scaled, three-dimensional program, which considers air absorption, terrain, ground absorption, and reflections and shielding for each piece of noise-emitting equipment, and then predicts sound pressure levels at discrete locations and over a gridded area. The model calculates sound propagation based on International Organization for Standardization (ISO) 9613-2:1996, General Method of Calculation. ISO 9613-2 assesses the sound level propagation based on the octave band center-frequency range from 31.5 to 8,000 Hz.

The ISO standard considers sound propagation and directivity. The sound-modeling software calculates omnidirectional, downwind sound propagation using worst-case directivity factors. In other words, the model assumes that each piece of equipment propagates its maximum sound level in all directions at all times. Empirical studies accepted within the industry have demonstrated that modeling may over-predict sound levels in certain directions, and as a result, modeling results generally are considered a conservative measure of the Substation’s actual sound level.

The modeled atmospheric conditions were assumed to be calm, and the temperature and relative humidity were left at the program’s default values. Reflections and shielding were considered for sound waves encountering physical structures. Sound levels around the site can be influenced by the sound reflections from physical structures onsite. Obstacles onsite were modeled with structured facades, which accounts for sound reflected and the amount of sound absorbed by the structure itself. The area surrounding the Project has mild elevation changes, which scatter and absorb the sound waves. Thus, terrain was included to account for surface effects such as ground absorption. Ground absorption was set at a value of 0.5 for areas surrounding the Substation. Taking this approach, the modeled results should be conservative. The modeling assumptions are outlined in Table 5-1.

Table 5-1 Sound Modeling Parameters

Model Input	Parameter Value
Ground Absorption	G = 0.5
Number of Reflections	2
Receptor Height	5 feet above grade
Terrain	USGS topographic land data
Temperature	50 °F
Humidity	70%
Transformer Sound Levels	62 dBA SPL at 1 foot
Capacitor Bank Sound Levels	80 dBA SWL

Predicted sound pressure levels and overall expected sound pressure levels were estimated by scaling the National Electrical Manufacturers Association (NEMA) standard transformer sound profiles to an average of 62 dBA, 1 foot from the equipment envelope. The 62.5-megavolt ampere (MVA) Hyosung transformers have a guaranteed average sound level of 61.6 dBA, measured 1 foot from the equipment envelope, as seen in Appendix A. Eversource will be installing three-walled concrete bays for each of the three transformers with the open sides facing the east property boundary. The sound levels for the capacitor banks are based on historical sound data for capacitor banks of this size. Each capacitor bank was set to a sound power level of 80 dBA. The modeling layout is presented in Figure 5-1.

In order to evaluate the expected worst-case sound pressure level impacts from the Substation, ambient measurements were added logarithmically to the model-predicted sound levels of the Substation. This provides an overall sound level after the Substation is in operation. The differentials between the existing ambient and predicted overall sound levels are shown in Table 5-2. These values can be used to conservatively approximate future noise levels at each of the measurement points, although future sound levels could vary depending on proximity to extraneous noise sources not associated with the Substation.

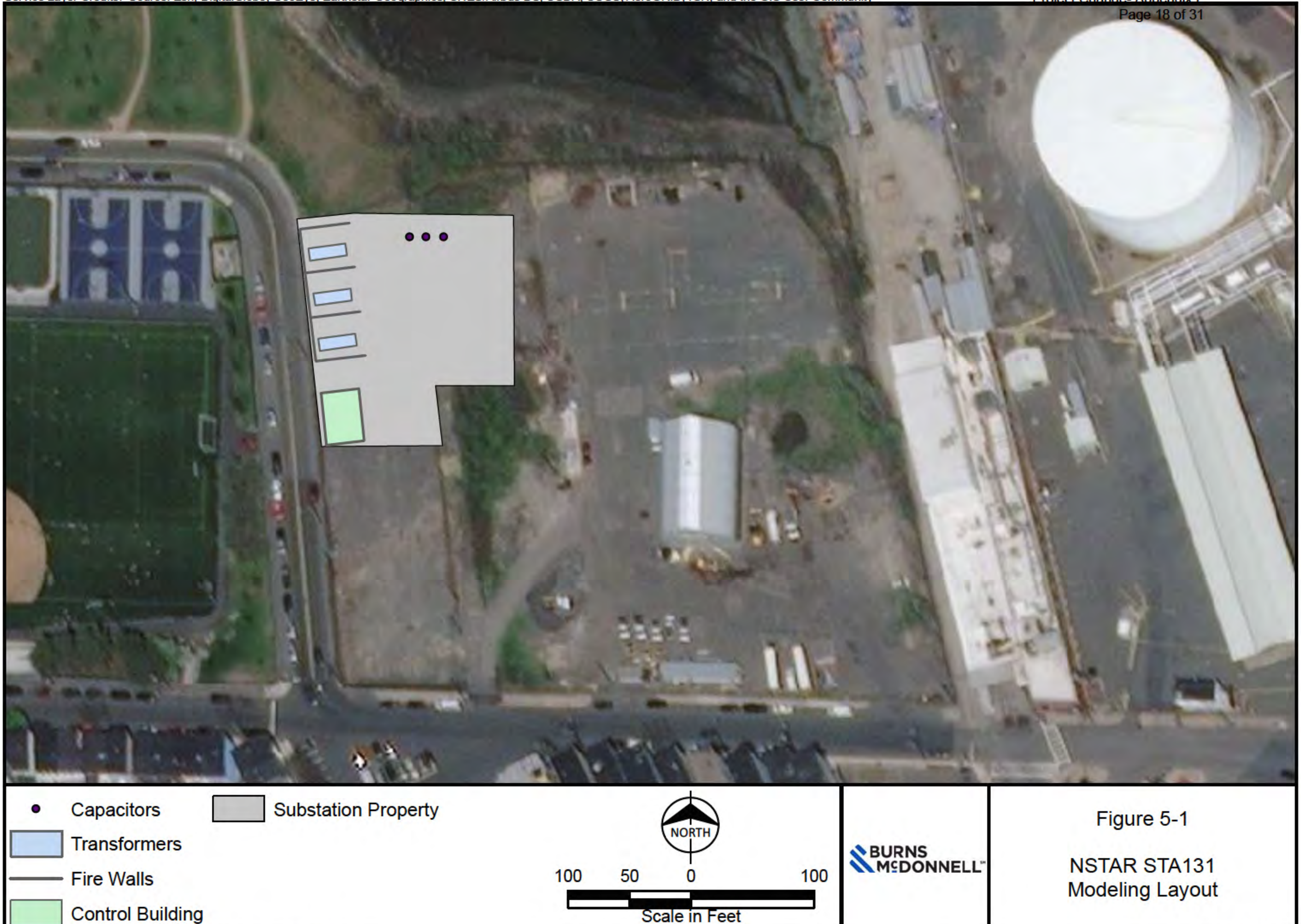


Figure 5-1

NSTAR STA131
Modeling Layout

Source: ESRI, Burns & McDonnell Engineering Company, Inc.

Issued: 4/10/2018

Table 5-2 Substation Sound Levels

Ambient Period	Measurement Point	Measured L_{90} Sound Levels (Ambient) (dBA)	Predicted Substation Sound Level (dBA)	Overall Sound Levels (Ambient + Substation) (dBA)	Differential (dBA)
Quietest Ambient	MP01	48.9	31.9	49.0	0.1
	MP02	50.0	38.5	50.3	0.3
	MP03	49.2	43.0	50.1	0.9
	MP04[A]	48.2	53.6	54.7	6.5
	MP05	48.7	37.8	49.0	0.3
	MP06	46.8	40.3	47.7	0.9
Loudest Ambient.	MP01	56.2	31.9	56.2	0.0
	MP02	65.9	38.5	65.9	0.0
	MP03	58.2	43.0	58.3	0.1
	MP04[A]	53.9	53.6	56.8	2.9
	MP05	52.7	37.8	52.8	0.1
	MP06	52.3	40.3	52.6	0.3

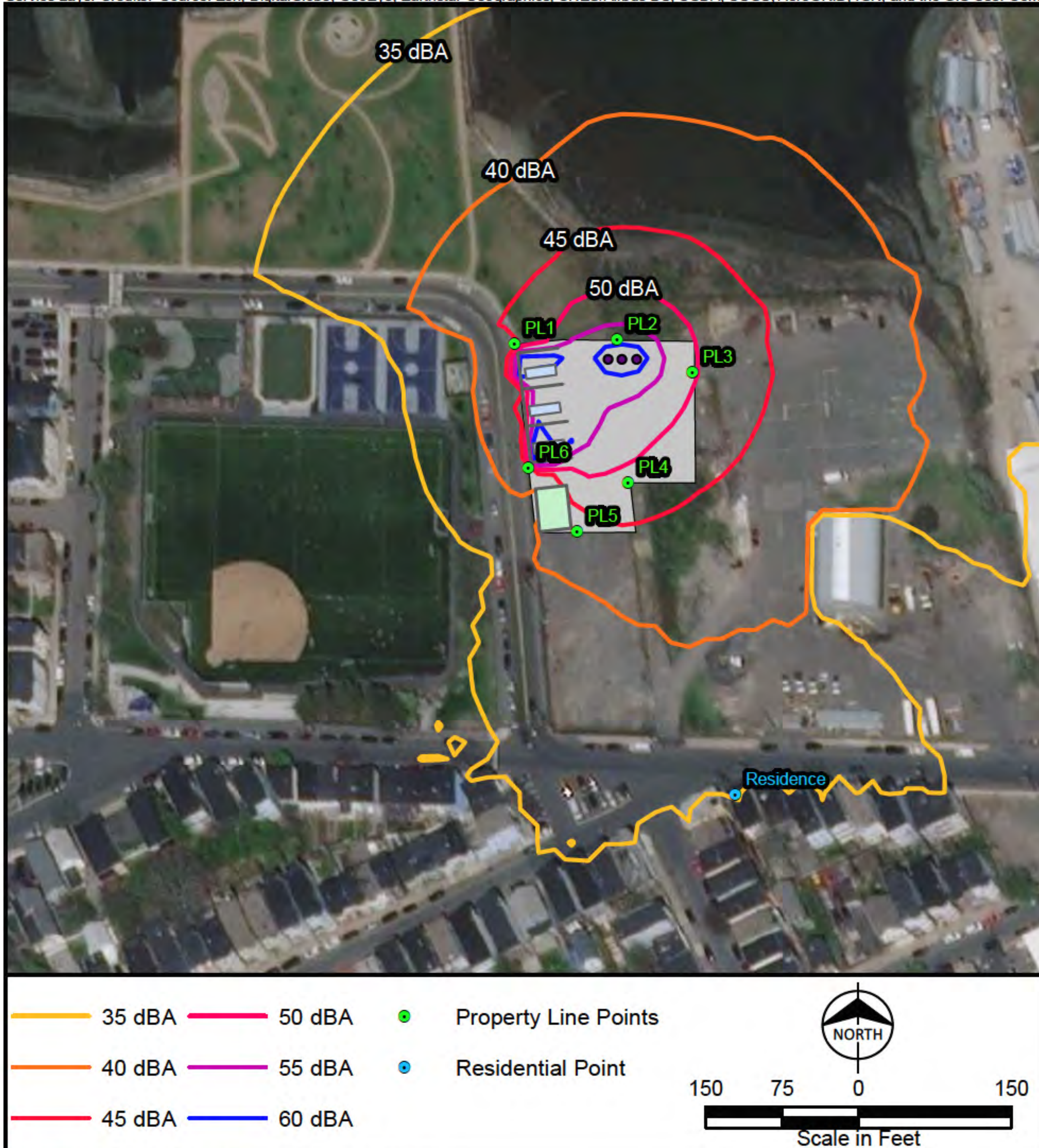
(a) MP4 is located within the Substation property line and would not be subject to MADEP limits.

Table 5-2 shows that predicted sound levels are not expected to violate the MADEP noise policy with regards to sound level increases. The table shows how the sound environment could be potentially affected by the operation of the Substation based on the range of ambient sound levels measured at each location. With the installation of the Substation, it is expected that the noise levels beyond the property lines would increase by less than 3 dB. With the high volume of traffic on nearby roads and the Substation's proximity to Logan Airport, it is expected that the proposed equipment would not cause a generally noticeable increase in overall sound levels.

The Substation model was run to determine future sound impacts from the Substation at locations along the Substation property line as shown in Figure 5-2. Distinct octave band analyses for the predicted sound pressure levels along the Substation property line were completed for the Substation equipment and are presented below in Table 5-3.

Path: G:\Projects\Air-Noise Dept\Project Files\NSTAR\STA131&819\STA 131\GIS\Figure 5-2 Sound Level Contours.mxd gweger 4/10/2018

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



BURNS McDONNELL

Figure 5-2

NSTAR STA131
Sound Level Contours

Source: ESRI, Burns & McDonnell Engineering Company, Inc.

Issued: 4/10/2018

Table 5-3 Modeled Industrial Octave Band Sound Pressure Levels

Octave Band Center Frequency (Hz)	Industrial APCC Limit (dB)	Model Results at Property Line Receptors					
		PL1 (dB)	PL2 (dB)	PL3 (dB)	PL4 (dB)	PL5 (dB)	PL6 (dB)
31.5	83	74	78	74	75	71	76
63	82	65	71	67	67	62	66
125	77	53	61	58	58	51	55
250	73	38	47	43	44	35	39
500	67	29	42	38	38	27	31
1,000	61	19	34	31	30	16	22
2,000	57	13	27	24	23	8	15
4,000	53	8	22	18	18	2	10
8,000	50	1	14	9	10	--	4
Single Number Equivalent	**70 dBA**	**44 dBA**	**59 dBA**	**51 dBA**	**48 dBA**	**43 dBA**	**44 dBA**

The Substation's predicted sound level impacts are shown in 5-dBA noise contours in Figure 5-2. The figure shows that the overall sound levels are not expected to exceed 70 dBA at any point along the property line. The predicted octave band data, as shown in Table 5-3, demonstrates that pure tones are not expected to occur per the MADEP noise policy. Table 5-3 also shows the Boston APCC industrial octave band limits are not expected to be exceeded at any of the property line points.

Though the Substation is located in an industrial zoning district, there are residences nearby that are located just outside of the industrial zone. The Boston APCC has lower sound level limits with regards to residential zoning districts. Therefore, the applicable APCC residential limits were analyzed for all three floors of the closest impacted residence and are provided in Table 5-4. The Substation was modeled to determine sound levels at the most impacted residence, as shown in Figure 5-2.

Table 5-4 Modeled Residential Octave Band Sound Pressure Levels

Octave Band Center Frequency (Hz)	Residential APCC Limit (dB)	Closest Residence Model Results		
		1st Floor (dB)	2nd Floor (dB)	3rd Floor (dB)
31.5	68	62	61	62
63	67	55	55	55
125	61	45	45	45
250	52	30	31	32
500	46	24	26	26
1,000	40	16	16	16
2,000	33	9	9	9
4,000	28	1	1	1
8,000	26	--	--	--
Single Number Equivalent	**50 dBA**	**37 dBA**	**37 dBA**	**38 dBA**

The modeling results show the predicted Substation sound levels will be below any of the applicable regulatory limits at the Substation's property line and at the nearest residential properties.

6.0 CONSTRUCTION NOISE

Construction of the proposed project is expected to last approximately 24 months and will involve a minimal amount of site clearing, excavation, placement of concrete and the use of typical industrial construction practices. Construction will be performed to limit the impact to the area to the extent possible. A construction company (the Company) will be selected and will be expected to complete construction using a 6-day per week schedule, generally during the hours of 7:00 a.m. to 6:00 p.m. in order to minimize the length of calendar time that temporary construction impacts affect the area. The Company will implement, where appropriate, construction methods that reduce construction noise. Because the project involves work on an existing power system that serves customers, there may also be times that work needs to occur outside of these proposed work hours. In addition, there are certain operations that, due to their nature or scope, must be accomplished in part outside the specified working hours. Such work generally consists of activities that must occur continuously, once begun (such as filling the transformer). Construction noise will comply with city and state requirements, regulations and ordinances.

In addition, construction will comply with state law (M.G.L. Chapter 90, Section 16A) and MADEP regulations (310 CMR 7.11(1)(b)), which limit vehicle idling to no more than 5 minutes, with permissible exceptions for vehicles being serviced, vehicles making deliveries that need to keep their engines running and vehicles that need to run their engines to operate accessories.

The impacts that various construction-related activities might have will vary considerably based on the proximity to the fence line. Generic sound data ranges are available for various types of equipment at certain distances. Impact levels from the construction activities are compared to the City of Boston APCC regulation for construction in an industrial area. The City of Boston APCC limits construction activity to a L_{10} of 85 dBA at the affected property. The Boston APCC requires the L_{10} sound level be measured every 10 seconds, on the mark, until 100 observations have been made. Table 6-1 lists generic activities and their minimum and maximum instantaneous sound levels at 50 feet.

The L_{10} sound level metric represents the sound level exceeded 10 percent of the time during a given period. The L_{10} is commonly used to measure construction noise, as construction noise levels constantly vary. Because the L_{10} is a statistical sound metric, it is not an instantaneous limit. Instantaneous construction sound levels could exceed the 85-dBA limit as long as the overall L_{10} remains below 85 dBA on average.

Table 6-1 Range of Typical Construction Equipment Noise Levels (dBA)*

Generic Construction Equipment	Minimum Noise at 50 feet	Maximum Noise at 50 feet
Backhoes	74	92
Compressors	73	86
Concrete Mixers	76	88
Cranes (movable)	70	94
Dozers	65	95
Front Loaders	77	96
Generators	71	83
Graders	72	91
Jack Hammers and Rock Drills	80	98
Pumps	69	71
Scrapers	76	95
Trucks	83	96

** Values taken from FHWA Highway Construction Noise and the HEARS database*

The types of equipment listed in the table above may be used at various times and for various amounts of time. The construction of the Substation may involve driving piles. Pile driving has not been included in the table as impact activities are exempt from construction noise limits (City of Boston APCC Regulation 3, Section 3.4). Equipment noise would be addressed during construction, and sound dampening material may be used if necessary. Most activities would not occur at the same time. There would be periods where concrete needs to dry and no construction occurs. Sound levels are expected to be quieter for areas where activities are occurring at distances greater than 50 feet from the fence line.

7.0 CONCLUSION

A sound assessment was performed for Eversource's proposed STA131 Substation at East Eagle Street and Condor Street in Boston, Massachusetts. The assessment included an ambient noise survey to quantify the existing acoustical environment, noise modeling to predict sound levels in the community resulting from the operation of the Substation, and an overall noise analysis.

The regulation of noise falls within the scope of the MADEP, the City of Boston APCC, and the Boston Municipal Code. Each respective noise ordinance was analyzed.

Measured ambient noise levels varied at each measurement point depending on the proximity to local traffic on roads, airplanes flying close by, birds in the area and other extraneous sources. The measured existing noise levels were common for an industrial area.

The CadnaA model was used to predict sound levels from the Substation. Using manufacturer-provided sound levels for the transformers and conservatively estimated sound levels for the capacitor banks, it is expected that operation of the Substation will produce overall sound levels below the applicable regulatory limits when measured at the property line and beyond. The Substation is not expected to produce pure tones as defined by MADEP or increase ambient sound levels by greater than 10 dBA. Therefore, it is not anticipated that operation of the proposed Substation would cause any violations of the applicable noise regulations.

Construction noise will be addressed during construction, and sound dampening material may be used if necessary. Most activities would not occur at the same time, and construction noise would vary throughout the project. There would be periods where no construction occurs, and periods where multiple types of construction are completed at the same time. Construction noise will be handled by the Company and will be limited to levels below the City of Boston APCC regulation for construction in an industrial area. Construction noise will comply with City and State requirements, regulations and ordinances.

APPENDIX A TRANSFORMER SOUND LEVELS

EN 29001/ISO 9001/BS 5750 APPROVED BY BVQI
NATIONAL ACCREDITATION OF CERTIFICATION BODIES

TEST REPORT of POWER TRANSFORMER

CUSTOMER : NSTAR (MA주 Boston시 소재 Utiltiy)

ORDER NO. : TP80034301

RATING	
Phase	3 Φ
Frequency	60 Hz
Capacity	37/50/62.5 MVA
Rating voltage	117/15.12 kV
Vector group	DY1
Cooling type	ONAN / ONAF / ONAN
Applied standard	ANSI

TEST DATE : 2004-03-25 ~ 2004-03-27

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CHECKED BY : W.C.JEON

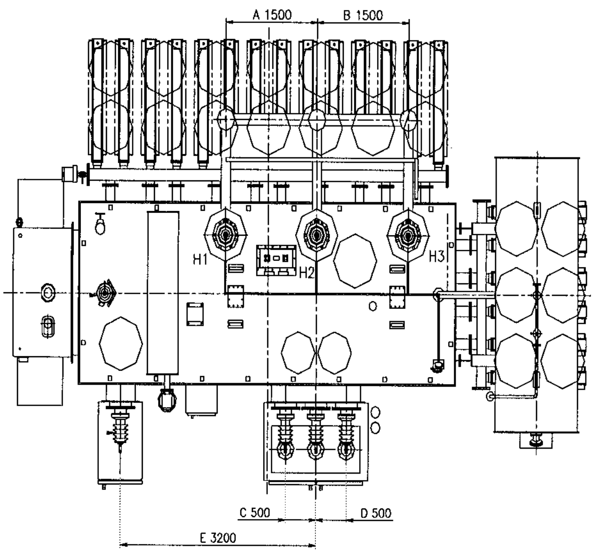
APPROVED BY: J.S.JANG

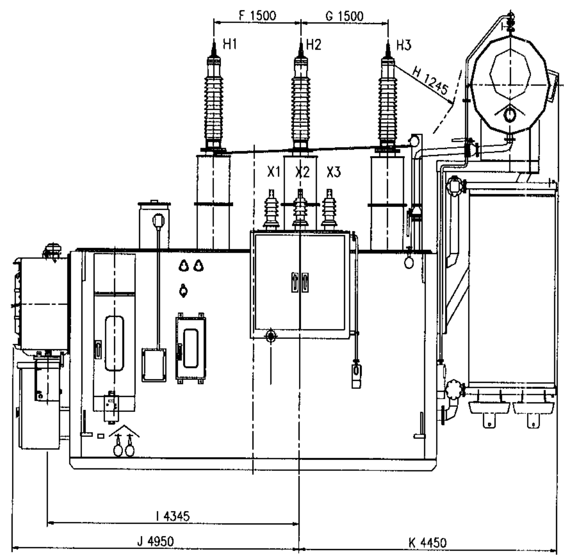
주식회사 효성 HYOSUNG CORPORATION	TEST REPORT 시험성적서	Customer or Project NSTAR (MA주 Boston시 소재 Utiltiy)
	Product No. TP80034301	Number of Sheets /

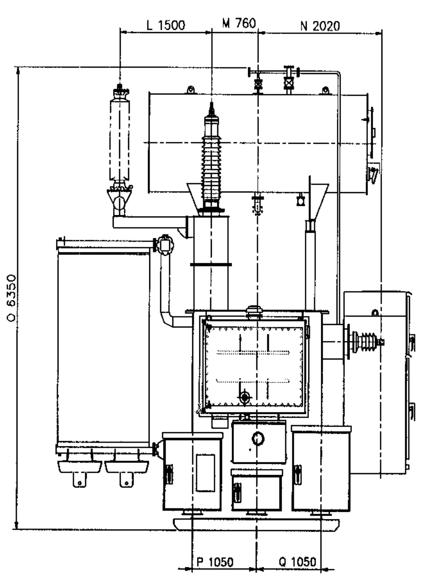
Dimension Check(치수검사)

Unit : mm

Check Points	A	B	C	D	E	F	G
Value on Drawing	1500	1500	500	500	3200	1500	1500
Measured Value	1495	1500	500	495	3215	1495	1500
Check Points	H	I	J	K	L	M	N
Value on Drawing	1245	4345	4950	4450	1500	760	2020
Measured Value	1360	4320	4900	4445	1498	755	2015
Check Points	O	P	Q				
Value on Drawing	6350	1050	1050				
Measured Value	6440	1040	1050				







Test Date	2004-03-25	Acceptance Criteria
Tested By	S.K.KIM	+ 5 % - 5 %
Used Instruments	TAPE RULE 016804-0031	Result Good

▣ Audible Sound Level Measurement

unit : dB

Point No.	ONAN [37 MVA]		ONAF [50 MVA]		ONAF [62.5 MVA]		Ambient Noise
	1/3h	2/3h	1/3h	2/3h	1/3h	2/3h	
1	58.7	57.1	58.5	58.2	62.2	62.5	55.3
2	58.2	58.4	58.0	58.4	61.5	62.2	
3	57.4	55.4	58.4	58.8	61.5	61.6	
4	56.3	56.4	58.5	58.6	61.4	61.3	
5	56.5	53.7	58.7	57.4	60.7	61.1	
6	66.4	55.6	57.4	57.3	61.9	61.4	
7	57.4	53.3	58.2	57.8	62.2	61.6	
8	53.9	55.2	58.8	58.8	62.4	62.4	53.1
9	54.5	52.8	62.4	60.5	62.7	62.8	
10	55.6	56.3	60.2	59.4	63.0	63.1	
11	55.5	56.4	60.4	59.5	63.2	63.0	
12	55.3	56.3	60.7	60.2	62.6	62.5	
13	56.4	55.1	60.0	59.9	62.8	62.8	
14	56.2	55.6	61.0	59.6	62.7	62.9	53.9
15	57.1	55.3	60.5	58.7	63.1	63.2	
16	57.5	55.8	58.9	59.6	63.2	63.2	
17	57.8	57.3	61.0	59.1	63.1	62.9	
18	57.7	55.6	60.2	60.0	62.8	62.9	
19	58.5	57.7	59.0	59.4	62.5	62.3	
20	58.3	57.3	59.8	59.5	63.0	62.7	
21	56.7	61.6	60.1	59.2	63.0	62.9	54.7
22	57.2	55.5	59.9	58.9	62.5	62.5	
23	59.4	57.2	59.4	59.5	62.0	61.8	
24	60.2	58.6	58.2	58.1	61.7	60.9	
25	56.3	55.5	57.7	58.1	61.9	61.6	
26	57.2	57.1	57.8	57.8	62.0	62.2	
Average	57.4	56.2	59.4	58.9	62.4	62.3	54.3
	56.2		58.6		61.6		

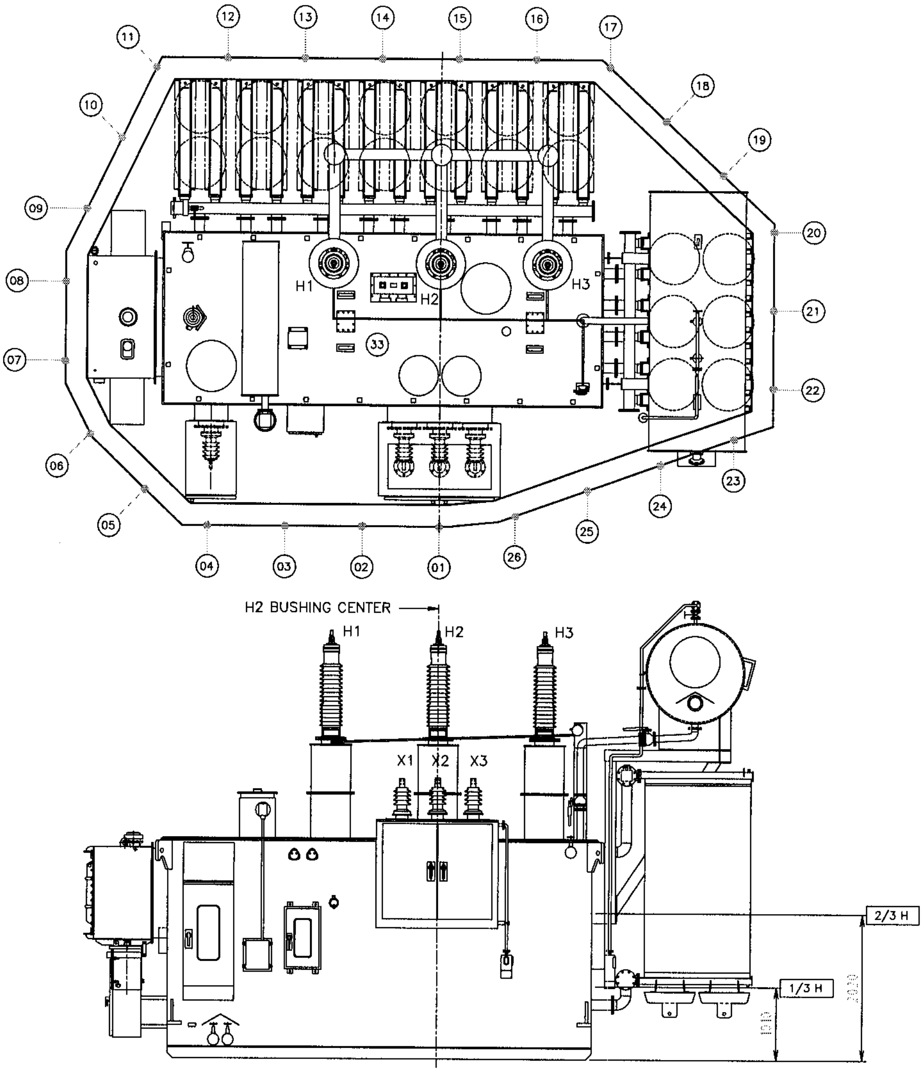
Remark

Measured Interval	:	1.0 m
Position of Starting Point	:	Drain Valve
Direction of Measuring	:	Clockwise

▣ Acceptance Criteria : Below 60/62/62 dB
[ONAN/ONAF/ONAF]

▣ Result : GOOD

-. Measured Points on Drawing



CREATE AMAZING.

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BURNS McDONNELL

Station #131
Flood Elevation Study

Eversource Energy

Station #131
Project No. 106085

~~**Revision 0**~~
~~**May 2, 2014**~~

Revision 1
October 4, 2018

Station #131
Flood Elevation Study

prepared for

Eversource Energy
Station #131
Boston, Massachusetts

Project No. 106085

~~Revision 0~~
~~May 2, 2014~~

Revision 1
October 4, 2018

prepared by

Burns & McDonnell Engineering Company, Inc.
Wallingford, Connecticut

Eversource Energy
Station #131
Flood Elevation Study
Project No. 106085

Certification

I hereby certify, as a Professional Engineer in the Commonwealth of Massachusetts, that the information in this document was assembled under my direct personal charge. This report is not intended or represented to be suitable for reuse by Eversource Energy or others without specific verification or adaptation by the Engineer.

Digitally signed by Maurer, Brendan W
Date: 2018.11.09 10:25:59-05'00'

Brendan William Maurer, P.E.
MA License #52922

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LIST OF ABBREVIATIONS

Abbreviation	**Term/Phrase/Name**
BH-FRM	Boston Harbor Flood Risk Model
BMcD	Burns & McDonnell
BPDA	Boston Planning and Development Agency
BRAG	Boston Research Advisory Group
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
GIS	Gas-Insulated Switchgear
DFE	Design Flood Elevation
BFE	Base Flood Elevation
Massport	Massachusetts Port Authority
MLLW	Mean Low Low Water
SF	Square Feet
SLR	Sea Level Rise
SLR-BFE	Sea Level Rise Base Flood Elevation
FT	Feet

Abbreviation	**Term/Phrase/Name**
LiMWA	Limit of Moderate Wave Action
NFIP	National Flood Insurance Program

1.0 EXECUTIVE SUMMARY

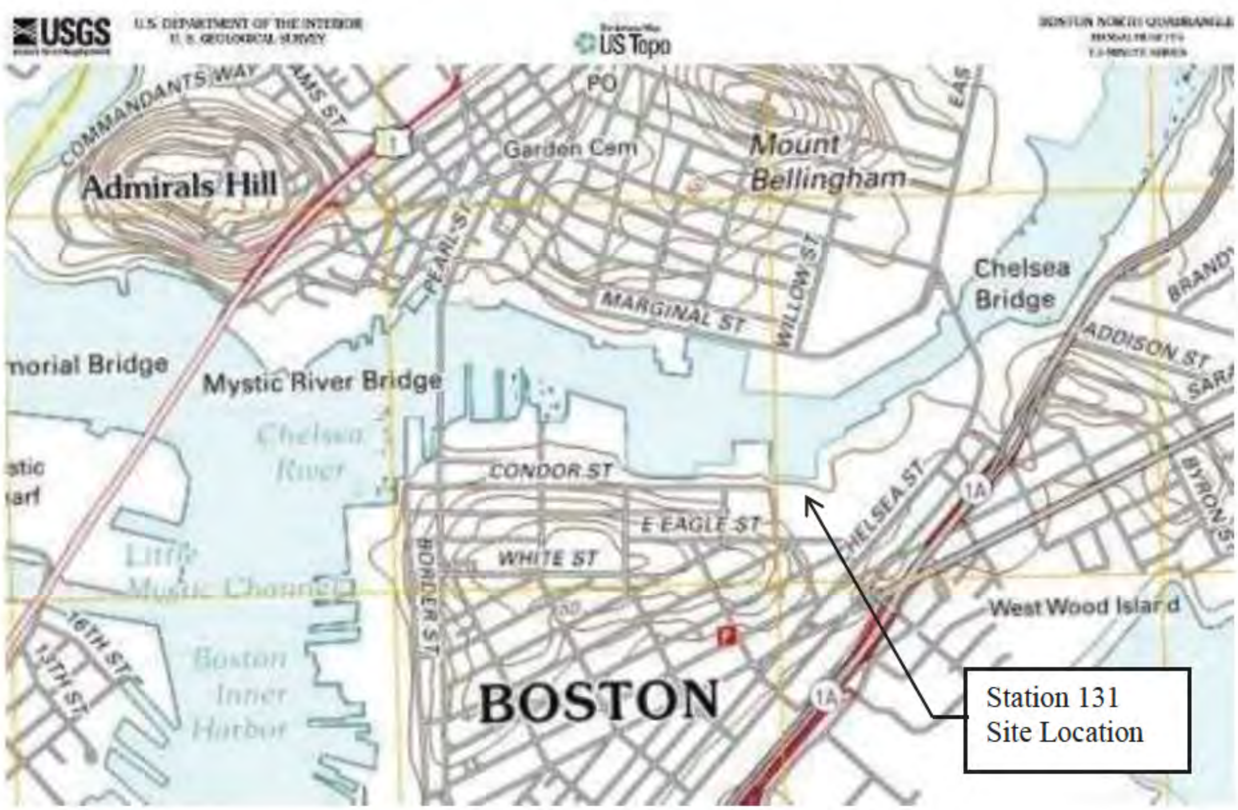
1.1 Introduction

Eversource Energy (Client) is proposing a new electrical substation, Station 131 (Project), to be located in Suffolk County at 338 East Eagle Street & Condor Street in East Boston, Massachusetts (Site), refer to Figure 1-1 below. The Client has requested Burns & McDonnell (Consultant) to review and report flood elevation information for the Site due to its proximity to the Chelsea River and Boston Harbor. It is understood that the Client will use this information to determine the Design Flood Elevation (DFE), which the Consultant will use in design of the Site. The DFE is the lowest elevation at which the substation equipment will sit on the site, usually the same as top of concrete foundation elevation.

Update March/April 2018: The Client has requested that the Consultant review, verify, and update the flood elevation data due to a relocation of the proposed substation site.

Elevations referenced herein refer to the Mean Low Low Water (MLLW) vertical datum. For reference: MLLW = NAVD88 + 5.51-ft. This conversion is necessary to convert the tidal gauging station data and FEMA elevations to MLLW.

Figure 1-1 USGS Site Location Map



1.2 Methodology

The topographic survey of the Site was reviewed in conjunction with the available flood elevation data gathered from Federal Emergency Management Agency (FEMA), City of Boston, Massachusetts Department of Transportation, Massachusetts Port Authority, and National Oceanic and Atmospheric Administration (NOAA) and also with ASCE-SEI 24-14 standards for flood resistant design and construction.

FEMA publishes Flood Insurance Rate Maps (FIRM) and Flood Insurance Studies (FIS) that provide information on the existence and severity of flood hazards within specified geographic areas. The FIS for Suffolk County, Massachusetts pertains to this Project Site.

The City of Boston, Massachusetts Department of Transportation, and Massachusetts Port Authority have published sea level rise (SLR) predictions and recommendations for areas adjacent to the Boston Harbor. This information is useful to aid in risk assessment projections.

NOAA operates tidal gauge stations located near the Site in the Boston Harbor, which has historical and predicted data that is valuable in determining storm surge and flood elevations. The stations are called National Ocean Service (NOS) Station No. 8443970 and No. 8443725.

American Society of Civil Engineers standards for flood resistant design and construction are not presently applicable due to the Site's location outside a FEMA annual chance floodplain area but are relevant to help during risk assessment and DFE determination because during the service life of the equipment, the flood elevation may increase with SLR.

Further descriptions, narratives, and backup information are located in Section 2.0 of this Report.

1.3 Flood Elevation Summary

The Project Site is outside the 1% and 0.2% annual chance floodplains (ACF) and is higher in elevation than the highest recorded Boston Harbor water surface elevation. The Site is adjacent to the Boston Harbor and its FEMA Special Flood Hazard Area (SFHA) Zone "AE". Zone AE areas are subject to inundation by the 1% annual chance floodplain with BFE=15.51-ft. The Site's proximity to the Boston Harbor results in susceptibility to potential sea level rise. Over time, the base flood elevations may rise and impact the Site. Anticipated SLR becomes the main criteria to consider when determining the minimum elevations of Station 131 and its DFE. The City of Boston anticipates that sea levels will rise between 2-ft and 6-ft by the year 2100. When considering impacts to and design of critical infrastructure, Massachusetts Department of Transportation and Massachusetts Port Authority utilize a SLR of 40-inches by the year 2070.

When reviewing Table 1-1, keep in mind that although the Site is above any immediate flooding threat, it may see flooding during its service life span due to the unpredictable nature of weather patterns and storm events.

Table 1-1 summarizes flood elevations as they relate to the Project Site. The elevations indicated are relative to the Mean Low Low Water (MLLW) vertical datum.

Table 1-1: Flood Elevation Summary

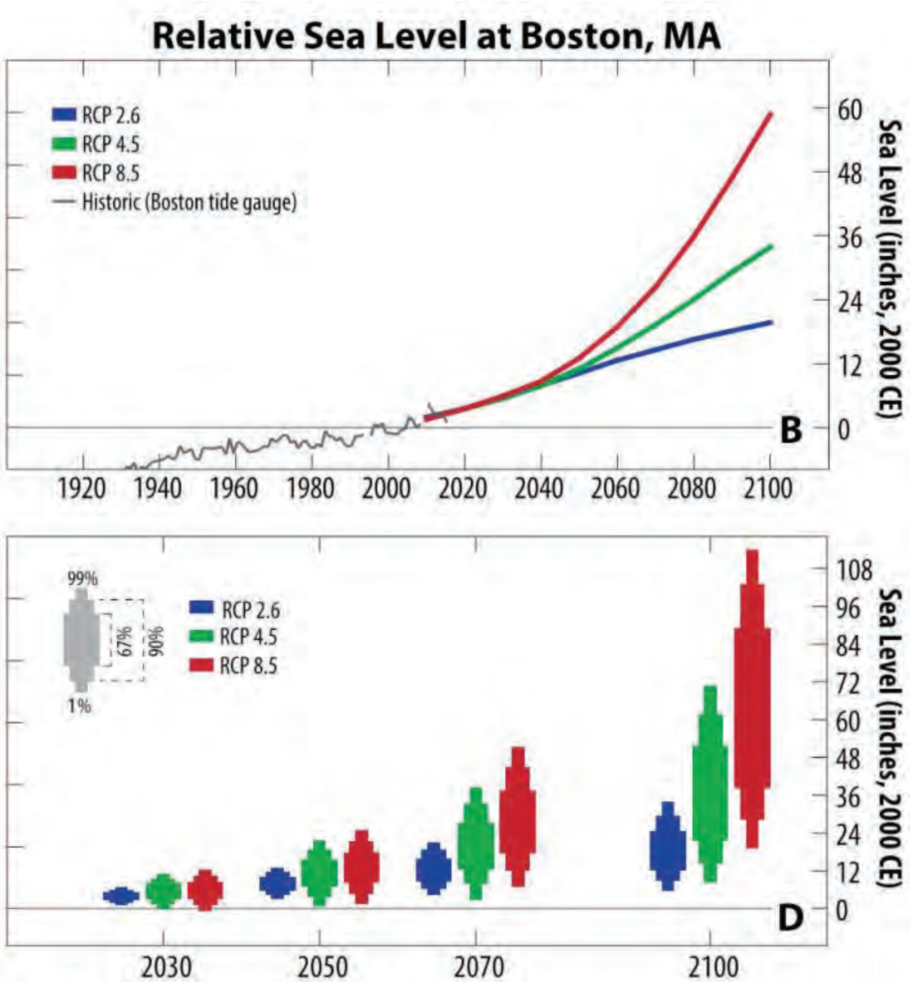
Description	Elevation (MLLW Vertical Datum)
Highest Elevation Onsite (+/-)(1)	23.74-ft
Lowest Elevation Onsite (+/-)(1)	16.57-ft
0.2% Annual Chance Flood Elevation per the FIS(2)	15.71-ft
1% Annual Chance Flood Elevation per the FIS(2)	14.91-ft
Boston Planning and Development Agency SLR-BFE(3)	18.52-ft
Massport DFE for New Facilities(4)	22.58-ft
NOAA Highest Recorded Water Level (NOS Station #8443970)(5)	15.16-ft
Mean High Water(1)	9.90-ft

(1) Source: Survey Map "Topographic Survey – 338 East Eagle Street & Condor Street, Boston, MA" (Appendix I).
(2) Source: "FIS Table 9: Summary of Revised Coastal Stillwater Elevations", the "Boston Inner Harbor, Entire shoreline in the City of Boston" (Appendix A).
(3) Source: BPDA Interactive Zoning Viewer. http://maps.bostonredevelopmentauthority.org/zoningviewer (Appendix D)
(4) Source: Massport Floodproofing Design Guide. (Appendix E)
(5) Source: NOAA Data from Table 2-2: NOAA NOS Station No. 8443970 – Historical Stage Data. (Appendix H)

Note that the lowest point of the Site is 0.86-ft higher than the 0.2% annual chance present day FEMA floodplain elevation and 1.41-ft higher in elevation than the NOAA highest recorded water level of the Boston Harbor.

The City of Boston has an ongoing initiative referred to as Climate Ready Boston. As part of this effort, studies have been completed to understand and predict sea level rise. The Boston Research Advisory Group published "Climate Change and Sea Level Rise Projections for Boston" on June 1, 2016. This report is now commonly referred to as the BRAG report. Figure 1-2 below depicts a range of sea level rise heights over time based on multiple emissions scenarios. This figure will be useful in projecting the anticipated sea level rise as it relates to the planned lifespan of the Project.

Figure 1-2 Sea Level Rise Projections for Boston



Source: Figure 1-4, *Climate Change and Sea Level Rise Projections for Boston*, The Boston Research Advisory Group Report, June 1, 2016

Based on the report, by 2070, there is a potential sea level rise of 0.6-ft up to a maximum of 4.8 ft. The likely range is 1.5-ft to 3.1-ft. Refer to Appendix B for additional data from the BRAG report.

1.4 Determining Design Flood Elevation

The following is the general equation and elevation criteria to consider for determining DFE for the installation of the electrical substation equipment and components for the Project Site. Note that the Client selects the BFE, SLR, and freeboard they are comfortable with. Multiple methods may be used to arrive at a DFE. Method 1, which was presented in the original study, uses FEMA to determine the starting BFE. Method 2 follows the Eversource Substation Site Development Standard. Method 3, which is independent of FEMA, but specific to the City of Boston, uses the BH-FRM to determine the starting BFE, which includes sea level rise.

Method 1 - FEMA

BFE (Selected by Client in 2014) = 0.2% ACF Elevation =	15.71 ft
Plus Sea Level Rise (Selected by Client in 2014) =	+ 3.00 ft
Plus Freeboard (Selected by Client in 2014) =	+ 1.00 ft
Subtotal =	19.71 ft
Minimum Design Flood Elevation (DFE) for = Top of Foundations of Electrical Equipment At MLLW datum (Selected by Client in 2014)	**22.00 ft**

Method 2 – Eversource Substation Site Development Standard SUB 010 Rev. 5

BFE = 1% ACF Elevation =	14.91-ft
Plus Freeboard =	+ 2.00-ft
Minimum Design Flood Elevation (DFE) for = Top of Foundations of Electrical Equipment At MLLW datum (Selected by Client)	**16.91 ft**

Method 3 – Boston Planning & Development Agency

SLR-BFE in 2070 = 1% ACF Elevation =	18.52-ft
Plus Freeboard =	+ 2.00-ft
Subtotal =	**20.52-ft**

Due to variation in grades of the site, the need to maintain a nearly level substation yard, manage stormwater runoff, and balance earthwork, it is likely that the final elevations of the equipment will exceed the minimum DFE.

Additionally, it is recommended that watertight substation components are provided where applicable. Where components cannot be watertight or are not preferred to be watertight and outside of flood prone elevations, they should be elevated on piers or stilts, so the bottom of the components are at or above the DFE.

Factors such as the impacts resulting from the loss of operation at the station, impacts on the area serviced by the station, impacts on critical facilities identified by the City, State, and/or Federal Government resulting from loss of operation of the station, as examples, should be considered for each station when selecting SLR and freeboard. Factors such as those outlined demonstrate it is conceivable the level of risk that is deemed appropriate at one station may not be so at another station.

It is recommended that close consideration be given to elevating the DFE to an elevation specific to its lifespan versus projected sea level rise (refer to Figure 1-2 Sea Level Rise Projections for Boston).

The Client should consider the information and recommendations provided herein, and determine a comfortable safety factor and risk they are willing to incur. The client shall have the final decision as to the elevations at which the electrical substation components will be set.

2.0 BACKGROUND OF STUDY

2.1 Existing Conditions

The Site is located at 338 East Eagle Street & Condor Street in Boston, Massachusetts. The property consists of two parcels with the western parcel owned by the City of Boston and the eastern parcel owned by the City of Boston Public Facilities Department. From a portion of these parcels, Eversource will acquire a +/- 0.62-acre Site, which abuts Condor Street to the west and the City of Boston properties to the north, east and south.

Two survey plans were provided for this Site which can be found in Appendix I. They are entitled:

- Survey: "Topographic Survey – 338 East Eagle Street & Condor Street, Boston, MA – (East Boston District) (Suffolk County) – Prepared for NSTAR Electric", Scale 1"=40', Dated 3/2/2016, By SMC Surveying and Mapping Consultants – 325 Wood Road, Suite 109, Braintree, MA 02184, (781) 380-7766, Fax (781) 380-7757. (Elevations reference MLLW Vertical Datum)

- Survey: "Plan of Land – 338 East Eagle Street & Condor Street, Boston, MA – (East Boston District) (Suffolk County) – Prepared for NSTAR Electric", Scale 1"=40', Dated 01/31/2011, By SMC Surveying and Mapping Consultants – 325 Wood Road, Suite 109, Braintree, MA 02184, (781) 380-7766, Fax (781) 380-7757. (Elevations reference MLLW Vertical Datum)

Existing site elevations (Mean Low Low Water vertical datum) range from approximately 16.57-ft to 23.74-ft. The lowest elevation onsite is higher than the reported flood elevations, refer to Table 1-1.

The existing Site is in an urban setting with surface features consisting of bituminous concrete pavement, grass, and vegetated areas. According to the available surveys, the Site does not appear to have any utilities present, except for the underground transmission lines located in an existing easement. Multiple utilities are located adjacent to the site in the street.

At its closest point, the Site is approximately 70-ft from the Chelsea River top of bank.

None of the Site is within the 25-ft riverfront buffer area. Approximately 4,050-sf of the northern portion of the Site is within the 100-ft riverfront buffer area.

According to FEMA FIRM Map No. 25025C0019J (Panel 19 of 176) dated March 16, 2016, for Suffolk County, Massachusetts, the Site is determined to be in Zone X, outside the 0.2% annual chance floodplain. Refer to Appendix A.

2.2 Proposed Conditions

It is proposed to construct a new GIS substation (Station 131) on the Site. Station 131 will be comprised of three transformers, three capacitor banks, metalclad switchgear, GIS system, and a control enclosure. This Site will be surrounded with a fence, enclosing the proposed substation equipment. The substation ground surface will be finished with a specified thickness of gravel. The substation equipment will be supported by concrete foundations on helical piles dependent upon the specific equipment and DFE. Electrical transmission and distribution lines entering and exiting the Site will be underground.

Conceptually, the Site will be graded in a way to provide a flat surface for the substation equipment and shall meet regulatory/reviewing agency requirements. The surface will be pitched to provide positive stormwater drainage. The Site is located outside the FEMA present day 0.2% annual chance floodplain but within an area where flooding might be possible in the future. For substation equipment prone to damage by flood water, the top of foundation on which that component rests should be elevated above the BFE. The height above BFE is ultimately selected by the Client, and variables which should be considered when selecting the height are described further below.

2.3 Flood Protection Considerations

Several resources including standards, codes, regulatory requirements, and data from public agencies have been reviewed during this assessment and are listed below.

- Federal Emergency Management Agency (FEMA)
- City of Boston Sea Level Recommendations
- Boston Harbor Flood Risk Model (BH-FRM)
- Massachusetts Building Code
- ASCE-SEI 24-14 Flood Resistant Design and Construction
- National Oceanic and Atmospheric Administration (NOAA)

2.3.1 Federal Emergency Management Agency (FEMA)

FEMA publishes Flood Insurance Rate Maps (FIRM) that are based on Flood Insurance Studies (FIS) which provide information on the existence and severity of flood hazards within specified geographic areas. The FIS for Suffolk County, Massachusetts pertains to this Project Site.

FEMA published Flood Insurance Rate Maps (FIRM) are designed for flood insurance and floodplain management applications. Insurance agents use zones and BFE's in conjunction with information on structures and their contents to assign premium rates for flood insurance policies. The BFE on the FIRM has been checked against the Flood Insurance Study (FIS) for Suffolk County. The FIRM's are developed based on FIS's that FEMA conduct. FIS's explain and report the 'detailed' or 'approximate' engineering design methods, along with historical and other pertinent data, that were used to arrive at the results published on the FIRM's. FIS's include pertinent engineering information and background that will be considered for Site recommendations. Some local jurisdictions conduct their own flood insurance studies and investigations, however the City of Boston does not. The City of Boston relies on the Massachusetts Office of Coastal Zone Management (CZM), which relies on the National Flood Insurance Program (NFIP) and FEMA for Flood Insurance Studies (FIS).

Tidal flooding sources for the Boston Harbor were studied by FEMA using detailed hydrologic and hydraulic methods to determine the flood hazard criteria (FIS Table 2: Flooding Sources Studied By Detailed Methods). The term 'detailed' is still only relative to this FIS. Surface feature and cover type characteristics are gathered from MassGIS, orthographic photography and aerial photography, all of which are limited in precision due to their large scale. Similarly, the Site topographic information is interpolated from 5-ft interval contours compiled from MassGIS and LiDAR. The data accumulation survey with topography would provide the detail necessary to best understand how the Site related to the 1% annual chance floodplain BFE and other storm surge elevation concerns. Information used from the FIS must be kept in perspective with relation to its precision.

FEMA FIRM 'A' Zones do not differentiate between coastal and non-coastal zones. The defining line between coastal and non-coastal areas is the 'Limit of Moderate Wave Action' (LiMWA) located on the Digital Flood Insurance Rate Map (DFIRM). The landward side of the LiMWA is the non-coastal zone and seaward side of the LiMWA is the coastal zone. In this scenario, there is no LiMWA delineation on the DFIRM, so it can be concluded that this Site is within a non-coastal Flood Hazard Zone AE where the BFE is the stillwater elevation. The 1% and 0.2% annual chance flood levels are based on computer models that simulate historic storm surges with wind and pressure fields that include astrological tide records.

Additionally, in cases where the 1% and 0.2% annual chance floodplain boundaries are close together, only the 1% annual chance floodplain boundary has been shown. For this Site, the limit of the 1% annual chance floodplain is also the boundary for the 0.2% annual chance floodplain and as a result, both 1% and 0.2% annual chance flood elevations should be considered in design.

Base Flood Elevation defined by FEMA is "The elevation of surface water resulting from a flood that has a 1 percent chance of equaling or exceeding that level in any given year in relation to a specified datum (100-year storm) and is the basis of the insurance and flood plain management requirements of the National Flood Insurance Program."

The FEMA website was searched for "Pending or Preliminary FEMA Issued Flood Maps or Flood Insurance Studies" for the City of Boston/Suffolk County. The website indicated that no pending or preliminary products are available. Search results are located in Appendix A.

2.3.2 City of Boston Sea Level Recommendations

The City of Boston has an ongoing initiative referred to as Climate Ready Boston. The purpose is to create resiliency solutions and prepare the City for climate change. As part of this effort, studies have been completed to understand and predict sea level rise. The Boston Research Advisory Group published "Climate Change and Sea Level Rise Projections for Boston" on June 1, 2016. This report is now commonly referred to as the BRAG report. Figure 1-2 included in this study is taken from the BRAG report.

The BRAG report establishes sea level rise scenarios for 2030, 2050, 2070, and 2100 for the City of Boston. The amount of SLR depends on future emissions. The report uses three different emissions scenarios. RCP8.5, the highest emissions scenario, or the least reduction in emissions, is the most relevant scenario for the purposes of this study, because it results in the highest sea level rise. This is a conservative approach which is appropriate when planning for critical infrastructure.

Based on the report, by 2070, there is a potential sea level rise of 0.6-ft up to a maximum of 4.8 ft. The likely range is 1.5-ft to 3.1-ft. Refer to Appendix B for additional data from the BRAG report.

2.3.3 Boston Harbor Flood Risk Model (BH-FRM)

Massachusetts Department of Transportation received federal funding for Pilot Projects: Climate Change and Extreme Weather Vulnerability Assessments and Adaptation Options Analysis. One of the project's goals was to determine impacts to the Central Artery/Tunnel from sea level rise. The project team developed a detailed model for the entire Boston Harbor which simulates the effects of tides, storm surge, wind, waves, river discharge, sea level rise, and future climate change scenarios. The model simulates storm surge induced flooding that could occur from hurricanes and nor'easter storm events. Refer to Appendix C for additional background data on the BH-FRM.

The sea level rise scenario used in the BH-FRM for 2070 is 3.2-ft above 2013 tide levels plus 2.5-inches of land subsidence. The BH-FRM has chosen the most conservative emissions scenario, which is appropriate when planning for critical infrastructure such as a substation. It is worth noting that the 2070 SLR with the highest emissions scenario is nearly equivalent to the 2100 SLR with the intermediate emissions scenario.

The BH-FRM outputs a future Base Flood Elevation which is based on sea level rise and increased intensity of future storms. Multiple regional agencies are utilizing the future BFE in their planning and design requirements. The Boston Planning and Development Agency (BPDA) created an interactive web-based map which graphically depicts the Sea Level Rise – Base Flood Elevation (SLR-BFE) in the City of Boston. Output from the map is included in Appendix D. For the Project Site, the SLR-BFE for a 1% annual chance flood event with 40-inches SLR in 2070 is 18.52 MLLW. BPDA requires critical facilities, such as this Project, to use a DFE = SLR-BFE + 2-ft freeboard.

The Massachusetts Port Authority (Massport) regulates development at various locations in the Boston Regional Area, including Logan International Airport, which is in close proximity to the Site. Massport has published a Floodproofing Design Guide, which was reissued in April 2015, so that Massport's design guidance could reflect the BH-FRM. Massport requires new facilities at Logan and South Boston Maritime Facilities to use a DFE of 22.58 MLLW. This DFE is defined as the maximum water elevation for a 0.2% annual chance flood event in 2070 plus 3-ft freeboard. Massport's guidance does not specifically state what Base Flood Elevation is being used, so deriving the actual BFE for the 0.2% storm event may not be exact, as some rounding may have been used in Massport's final determination of their DFE.

Table 2-1 below summarizes Base Flood Elevations based on the Boston Harbor Flood Risk Model. These elevations are relevant to this study because both the State Building Code and ASCE 24-14 base the Design Flood Elevation on the Base Flood Elevations.

Table 2-1: Boston Harbor Flood Risk Model Sea Level Rise-BFE

Agency	100-year Storm BFE (feet MLLW)	500-year Storm BFE (feet MLLW)
Boston Planning and Development Agency	18.52	--
Massachusetts Port Authority	--	19.58[a]

[a]Massport only provided DFE so BFE is calculated 22.58 DFE = 19.58 BFE + 3-ft freeboard

2.3.4 Massachusetts Building Code

The City of Boston relies on the Massachusetts Building Code, which refers to the International Code Council's International Building Code 2015 (IBC 2015). The Massachusetts Amendments to IBC 2015 require construction to be in accordance with ASCE 24-14 Flood Resistant Design and Construction. According to the Massachusetts Amendments to IBC 2015 Section 1612.4, the DFE for Utilities and Equipment is as follows:

Flood Design Class 3 DFE = BFE + 1-ft

Flood Design Class 4 DFE = BFE + 2-ft or 500-year flood elevation, whichever is greater

ASCE 24-14 defines Flood Design Class. Substations are often classified as Flood Design Class 3, "other utilities, which, if their operations were interrupted by a flood, would cause significant disruption in day-to-day life or significant economic losses in a community". However, the public infrastructure in close proximity to the Site, such as Logan Airport and multiple fuel storage tanks, would be deemed as essential facilities that would be required to function during and after an emergency. Any ancillary structures such as electrical substations that would allow for these types of facilities to function during and after an emergency, would then be deemed essential, so this project would likely qualify as a Flood Design Class 4 project. The final determination of Flood Design Class should be made by the Client, based on this Project's overall role in supplying power to surrounding infrastructure.

2.3.5 ASCE-SEI 24-14 Flood Resistant Design and Construction

ASCE-SEI 24-14 is the standard for flood resistant design and construction. This standard is incorporated into the Massachusetts State Building Code. For this Site, The ASCE/SEI 24-14 Table 7-1 "Minimum Elevation of Utilities and Attendant Equipment Relative to Base Flood Elevation (BFE) or Design Flood Elevation (DFE)" is consistent with the Massachusetts State Building Code, as discussed in the previous Section.

Although the Site is outside the immediately delineated flood hazard area on the FEMA FIRM, it is in an area where flood hazards are possible in the future, and the freeboard recommendations can be applied to future Base Flood Elevations.

2.3.6 National Oceanic and Atmospheric Administration (NOAA)

NOAA operates a tide gauge station located near the intersection of Atlantic Avenue and Northern Avenue in Boston, MA in the Boston Harbor, which has valuable information that indicates water surface levels including times of storm surge and flood elevations. The station is called National Ocean Service (NOS) Station No. 8443970. This is the only tide gauge in the greater Boston area where historical tide information was measured, recorded and available to the public. It is located approximately three miles downstream of the Station 131 Site. Historical monthly extreme high and low tide data is available from August 1921 through February 2018, with only 14 occurrences where tide data was missing (Missing 4 months each in 1945 and 1956; one month each in 1968, 1969, 1971, and 2004; and 2 months in 2009).

The monthly extreme tide dataset for the Boston tide gauge (NOAA Station No. 8443970) was downloaded and scanned to develop an annual extreme dataset, Table 2-2, that contains the highest and lowest tides each year.

There are tide gauges in the greater Boston area where NOAA publishes predicted tide data. One of these, the Chelsea tide gauge (NOAA Station No. 8443725), is located at the Chelsea Street Bridge, which crosses the Chelsea River about 0.3 mile upstream of Eversource Station 131.

Although the Chelsea tide gauge is located closer to the Eversource Station 131 site, there is no historical data available for use in frequency analyses. However, the available predicted tide data for 2014 was downloaded and compared for the Boston and Chelsea gauges to see how they relate to one another. For 2014, the predicted high tides at Chelsea range from 0.4 foot lower to 0.4 foot higher than at the Boston tide gauge. The average and median differences for all 705 of the predicted high tides in 2014 shows the Chelsea high tides to be 0.01 foot lower or zero, respectively. In essence, the tides at both locations can be considered to be equal. Based on this analysis, it appears the frequency data calculated for the Boston tide gauge can be used as a surrogate to estimate high tides at the Chelsea tide gauge and the Eversource Station 131 site.

Table 2-2 below depicts the monthly highest stage data for NOS Station 8443970 (Boston, MA) with period of record for these data from August 1921 to February 2018. The NOAA reported values are in the MLLW vertical datum.

Table 2-2: NOAA NOS Station No. 8443970 – Historical Stage Data

Year	Maximum Annual Stage (feet MLLW)	Minimum Annual Stage (feet MLLW)
1921	12.374	-2.524
1922	12.076	-3.525
1923	11.774	-3.623
1924	11.876	-3.525
1925	11.574	-3.026
1926	12.374	-2.924
1927	12.076	-2.924
1928	12.276	-3.725
1929	12.174	-3.026
1930	11.876	-3.525
1931	13.477	-3.026
1932	12.374	-3.026
1933	12.975	-3.124
1934	11.774	-2.724
1935	11.974	-2.724
1936	12.374	-3.325
1937	12.574	-2.724
1938	12.574	-2.724
1939	12.676	-3.124
1940	13.575	-3.725
1941	12.076	-2.924
1942	12.174	-3.226
1943	12.174	-3.226
1944	13.477	-3.026
1945	12.574	-2.626
1946	12.374	-2.324
1947	12.876	-2.826
1948	12.476	-2.924
1949	11.974	-2.524
1950	12.574	-3.026
1951	12.276	-2.626
1952	12.876	-2.724
1953	12.774	-2.826
1954	12.876	-3.226
1955	12.676	-3.623
1956	13.276	-3.124
1957	12.276	-3.124
1958	13.175	-2.924

Year	Maximum Annual Stage (feet MLLW)	Minimum Annual Stage (feet MLLW)
1959	13.975	-2.724
1960	12.855	-2.445
1961	13.555	-3.045
1962	13.155	-2.845
1963	12.965	-3.435
1964	12.465	-2.935
1965	12.265	-3.035
1966	12.565	-2.435
1967	13.675	-2.625
1968	12.475	-3.025
1969	12.575	-2.425
1970	12.485	-2.515
1971	12.725	-2.305
1972	13.885	-2.215
1973	13.085	-2.015
1974	13.135	-2.745
1975	12.115	-2.895
1976	13.405	-3.395
1977	12.705	-3.395
1978	15.095	-3.255
1979	14.035	-2.565
1980	12.456	-3.374
1981	12.765	-3.056
1982	12.505	-2.445
1983	12.715	-2.396
1984	12.565	-2.596
1985	12.745	-2.324
1986	12.555	-2.705
1987	14.195	-2.275
1988	12.637	-2.836
1989	12.036	-2.865
1990	13.004	-2.285
1991	14.136	-2.606
1992	14.024	-2.304
1993	12.805	-2.515
1994	12.837	-2.754
1995	13.336	-2.344
1996	12.404	-2.550
1997	13.267	-2.406
1998	12.791	-2.393

Year	Maximum Annual Stage (feet MLLW)	Minimum Annual Stage (feet MLLW)
1999	12.227	-2.908
2000	12.860	-3.101
2001	12.998	-3.000
2002	13.454	-2.737
2003	13.398	-2.383
2004	12.758	-2.035
2005	13.778	-2.170
2006	13.572	-2.091
2007	13.795	-2.793
2008	12.653	-2.347
2009	13.034	-2.052
2010	13.696	-2.622
2011	13.040	-2.068
2012	13.578	-2.002
2013	13.070	-2.380
2014	13.834	-2.573
2015	13.611	-3.164
2016	13.011	-2.340
2017	13.401	-2.121
2018	15.163	-2.764

Mean, standard deviation, and skew statistics were calculated for the annual extreme data series for the Boston tide gauge for use in frequency analyses.

Table 2-3 below depicts the Historical Stage Frequency Analysis for the MLLW data from Table 2-2.

Table 2-3: NOAA NOS Station No. 8443970 – Historical Stage Frequency Analysis (feet MLLW)

Minimum	11.574	-3.725
Maximum	15.163	-2.002
Mean	12.874	-2.780
Std. Dev.	0.684	0.422
Skew	0.819	-0.210

Table 2-4 below shows results of the maximum stage elevation (in MLLW vertical datum) with respect to annual probability through the log-Pearson Type 3 frequency distribution statistical technique for fitting frequency distribution data to predict the base flood elevation at the Project Site.

Table 2-4: NOAA NOS Station No. 8443970 – Historical Stage Frequency Results

Return Interval (Years)	Annual Exceedance Probability (Percent)	Skew	Pearson Type III k-value	Boston Tidal Gauge Peak High Tide Elevations (feet MLLW)
2	50	0.819	-0.135	12.78
5	20	0.819	0.778	13.41
10	10	0.819	1.337	13.79
25	4	0.819	1.998	14.24
50	2	0.819	2.462	14.56
100	1	0.819	2.904	14.86
200	0.5	0.819	3.330	15.15
500	0.2	0.819	3.873	15.52
1000	0.1	0.819	4.272	15.80
5000	0.05	0.819	4.663	16.06

3.0 CONCLUSIONS

As previously stated, the Project Site is outside the 1% and 0.2% annual chance floodplains and is higher in elevation than the highest recorded Boston Harbor water surface elevation. The Site's proximity to the Boston Harbor results in susceptibility to potential sea level rise. Over time, the base flood elevations may rise and impact the Site. Anticipated sea level rise becomes the main criteria to consider when determining the minimum elevations of Station 131 and its DFE. It's recommended that close consideration be given to elevating the DFE to an elevation specific to its lifespan versus projected sea level rise (refer to Figure 1-2 Sea Level Rise Projections for Boston). The Client should consider the information and recommendations provided herein, to determine a comfortable safety factor and risk they are willing to incur and shall have the final decision as to the elevations at which the electrical substation components will be set.

Update October 2018: Eversource selected a DFE for top of foundations of electrical equipment of 23.00 at MLLW datum.

4.0 REFERENCES

1. ASCE/SEI 24-14 Flood Resistant Design and Construction

2. Climate Change and Extreme Weather Vulnerability and Adaptation Options for the Central Artery/Tunnel System, Massachusetts Department of Transportation, June 2015. http://www.massdot.state.ma.us/highway/Departments/EnvironmentalServices/EMSSustainabilityUnit/ClimateChangeResiliency.aspx

3. Climate Change and Sea Level Rise Projections for Boston, Boston Research Advisory Group Report, June 1, 2016. https://www.boston.gov/sites/default/files/document-file-12-2016/brag_report_-_final.pdf

4. Coastal Resilience Solutions for East Boston and Charlestown, Climate Ready Boston, October 2017. https://www.boston.gov/sites/default/files/climatereadyeastbostoncharlestown_finalreport_web.pdf

5. Flood Insurance Study, Suffolk County, Massachusetts (All Jurisdictions) by Federal Emergency Management Agency, Flood Insurance Study Number 25025CV000B, Dated March 16, 2016.

6. International Code Council (ICC) International Building Code 2015

7. Massachusetts 780 CMR: State Board of Building Regulations and Standards – Massachusetts Amendments to the International Building Code 2015

8. Massachusetts Port Authority Floodproofing Design Guide, Revised April 2015. https://www.massport.com/media/1149/massport-floodproofing-design-guide-revised-april-2015.pdf

9. NOAA Tides and Currents for NOS Station No. 8443725: http://tidesandcurrents.noaa.gov/stationhome.html?id=8443725

10. NOAA Tides and Currents for NOS Station No. 8443970: http://tidesandcurrents.noaa.gov/stationhome.html?id=8443970

11. Official Web Site of the City of Boston – "Climate Ready Boston" page: https://www.boston.gov/departments/environment/climate-ready-boston

APPENDIX A – FEMA MAP AND DOCUMENTATION

National Flood Hazard Layer FIRMette

FEMA

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) *Zone A, V, A99*
		With BFE or Depth
		Regulatory Floodway *Zone AE, AO, AH, VE, AR*
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
		Future Conditions 1% Annual Chance Flood Hazard *Zone X*
		Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
		Area with Flood Risk due to Levee *Zone D*
OTHER AREAS	NO SCREEN	Area of Minimal Flood Hazard *Zone X*
		Effective LOMRs
		Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES	B 20.2 / 17.5	Cross Sections with 1% Annual Chance Water Surface Elevation
	8	Coastal Transect
	513	Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped

N

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The base map shown complies with FEMA's base map accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 2/13/2018 at 1:44:13 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: base map imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

TABLE 9 – SUMMARY OF REVISED COASTAL STILLWATER ELEVATIONS - continued

FLOODING SOURCE AND LOCATION	ELEVATION (NAVD 88)[1] 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
Boston Inner Harbor				
Entire shoreline in the City of Boston	*	*	9.4	10.2
Dorchester Bay				
At Old Harbor	*	*	9.7	10.5
West of Thompson Island	*	*	9.9	10.7
At Neponset River	*	*	10.6	11.4
Massachusetts Bay				
At Deer and Lovell Islands	*	*	9.2	10.1
Mystic River				
Immediately upstream of Mystic River Bridge	*	*	9.5	*

[1]North American Vertical Datum of 1988 (NAVD 88)
*Data not available

3.4 Coastal Hydraulic Analyses

The hydraulic methods described in this section are those used for the 2013 coastal study.

As a result of incorporating appeals received during the study, there are different coastal hydraulic methods used based upon the source of the studied transect. Table 10, "Summary of Transect Methodology" contains the wave climatology and wave setup information used on each transect along with the study source.

TABLE 10 – SUMMARY OF TRANSECT METHODOLOGY

TRANSECT	1-PERCENT-ANNUAL-CHANCE STILLWATER[1]	SIGNIFICANT WAVE HEIGHT[1]	PEAK PERIOD	HOW DETERMINED	WAVE SETUP	HOW DETERMINED
1	9.2	2.3	12.5	SWAN 2D	0.46	SWAN 1D
2	9.2	5.8	12.5	SWAN 2D	0.94	SWAN 1D
3	9.2	21.22	12.5	SWAN 2D	1.76	SWAN 1D
4	9.2	21.22	12.5	SWAN 2D	1.76	SWAN 1D
5	9.2	21.22	12.5	SWAN 2D	1.86	SWAN 1D
6	9.2	21.22	12.5	SWAN 2D	1.9	SWAN 1D
7	9.8	21.22	12.5	STWAVE	3.12	DIM

[1]North American Vertical Datum of 1988 (NAVD 88)

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APPENDIX B – CITY OF BOSTON SEA LEVEL RISE RECOMMENDATIONS

UMASS BOSTON

CLIMATE READY BOSTON

Climate Change and Sea Level Rise Projections for Boston

The Boston Research Advisory Group Report

JUNE 1, 2016

City of Boston
Mayor Martin J. Walsh

BOSTON Green Ribbon COMMISSION

C. BRAG Findings

1. Sea Level Rise

a. Key findings

- The overall trend in relative sea level rise (RSLR) in Boston between 1921 and 2015 has been about 2.8 mm/yr (0.11 in/yr).
- Due to the influence of regional-scale processes such as ocean dynamics and the gravitational effect of melting ice sheets, RSLR in Boston will likely exceed the global average throughout the 21st century, regardless of which emissions trajectory is followed.
- The amount and rate of RSLR in Boston during the first half of the 21st century is nearly independent of emissions. The most likely estimates of RSLR from 2000 to 2050 (associated with exceedance probabilities of 83%, 50%, and 17%) are 19, 32 and 45 cm (7.5, 13 and 18 in), thus a 2050 range of 19 cm to 45 cm (7.5 to 18 in) can be considered, but higher RSLR approaching 75 cm (30 in) is possible.
- After ~2050 the scenarios diverge sharply, with substantially more RSLR under the higher emissions pathways. Under the highest emissions pathway (RCP8.5), the most likely estimates of RSLR from 2000 to 2100 in Boston are 97, 149 and 226 cm (3.2, 4.9 and 7.4 ft). Under the moderate-emissions RCP4.5 pathway, RSLR estimates from 2000 to 2100 are 74, 111 and 156 cm (2.4, 3.6 and 5.1 ft). Thus a 2100 range of 74 cm to 226 cm (2.5 to 7.4 ft) can be considered.
- Sea-level rise will not stop in 2100, and because some long-lived infrastructure and land use plans will likely extend into the 22nd century, changes in RSL should be considered beyond 2100. If the high RCP8.5 emission scenario is followed, the rate of RSL rise by the end of the 21st century may be 19-48 mm/yr (0.75-1.9 in/yr), an order of magnitude faster than today, and will continue to accelerate.
- The accelerating rate of RSLR that will characterize RSL change in Boston during the 21st century will soon make salt-marsh drowning events more frequent and widespread. Eventually salt marshes such as those located at Quincy, Neponset, and Belle Isle will be converted to tidal flats and sub-tidal bays, because the ecological limits of in situ organic sediment production and the very low suspended sediment concentration in Boston Harbor are insufficient to keep pace with the projected rates of RSL rise.
- The maximum physically plausible sea-level rise from 2000 to 2100 at Boston was estimated to range from 1.9 m and 3.2 m (6.2 and 10.5 ft) in this analysis. This is substantially more than the maximum RSLR of 2.08 m (6.83 ft) from 2003 to 2100 under the highest emissions scenario reported in a recent study by CZM (2013).
- RSL rise will increase tidal range, wave energy, and tidal inundation, resulting in increased erosion of existing geomorphic features and existing or planned coastal engineering works such as flood defenses. It will also increase the elevation of coastal storm surges.

b. Review of existing science

1. Definitions

Relative sea level (RSL) is the difference in elevation between the sea surface and land surface at a specific place and time (Farrell & Clark, 1976). By convention, the reference time period is a multi-year average; this minimizes the effect of tidal and seasonal cycles, and multi-annual climate variability (e.g. Shennan, Milne, & Bradley, 2012). We use a 19-year period centered on the year 2000 as a baseline, such that negative and positive values denote periods when RSL was either lower or higher than the reference period, respectively. Previous analyses of Boston sea-level trends have used the mid-point (1992) of the 1983-2001 National Tidal Datum Epoch (NTDE) as their reference point. About 3cm (1.2 in) of sea-level rise occurred between 1992 and the 2000 reference point used here. Additionally, between 1990 and 2010, the average rate of sea-level rise at Boston was 5.3 cm (2.1 in) per decade, so RSL in 2015 is about 7.9 cm (3.1 in) above the 2000 reference level. As discussed below, there is considerable annual to decadal variability in RSL. For example, average annual RSL in Boston has varied from the long-term average (over the duration of the tide gauge record since 1921) with 1σ standard deviation of ~±5.8 cm (2.3 in). We note that projections of future RSL are provided specifically for the location of the Boston, MA tide gauge station (#8443970) operated by the National Ocean and Atmospheric Administration (NOAA).

2. Processes causing relative sea-level change in Boston

Changes in RSL are caused by multiple, complex, simultaneous processes that vary both spatially and through time (Kopp et al., 2015). As a result, making reliable predictions of future RSL at specific times and locations is difficult. Nonetheless, recent advances in understanding and modeling the dominant processes that control RSL are leading to improved estimates of the potential range of future sea-level change over the next century and beyond, with important implications for coastal planning and management.

a. Thermal expansion and ice-sheet melt

Over the 21st century and beyond, RSL in Boston will be affected by several local to regional-scale processes in addition to the projected rise in global mean sea level (GMSL). Over the 20th and early 21st century, the two primary contributors to changes in GMSL have been the thermal expansion of seawater and the loss of land ice. When the ocean warms, the volume of water in the ocean increases, raising GMSL. When land ice melts, water is added to the ocean, which also increases GMSL. Human activity has also altered the Earth's natural water cycle, leading to additional changes in the mass of the ocean. For example, storage of water on land in reservoirs and behind dams causes RSL to fall, while pumping of water from aquifers for irrigation and consumption ultimately transfers water to the ocean, causing RSL to rise (e.g. Chao, Wu, & Li, 2008; Konikow, 2011; Wada et al., 2012). Over the last two decades, thermal expansion has been responsible for about 40% of global mean sea-level rise, land-ice shrinkage for about 50%, and changes in land water storage for about 10% (Church et al., 2013). Later in this century, land ice on Greenland and Antarctica are expected to play an increasingly important, and likely a dominant role in GMSL rise (Rignot et al., 2011).

b. Gravitational effect of ice sheet melt

The melting of land-based ice does not cause globally uniform sea-level rise. The dispersion of mass, previously concentrated in glaciers and ice sheets, into the ocean changes the Earth's gravitational field and rotation, and it causes the Earth to deform. As a result, locations near a melting ice sheet experience less sea-level rise than more distant locations (Mitrovica et al., 2001, 2009, 2011). The resulting spatial pattern of sea-level rise driven by a given loss of ice mass from a specific source is shown in Figure 1-1. The implications for Boston are significant, because of Boston's relative proximity to Greenland and great distance from Antarctica. Boston will experience proportionally less than the global average sea-level rise due to melting of the Greenland Ice Sheet (GIS; about 35% of the global mean sea-level signal), but more than the global average for sea-level rise due to mass loss on the West Antarctic Ice Sheet (WAIS; about 125%) or the East Antarctic Ice Sheet (EAIS; about 105%).

Smaller, globally distributed alpine glaciers and ice caps (GIC) also produce non-uniform changes in sea-level, but their total potential contribution to long-term sea-level rise (~0.6m) is small relative to the potential sea-level rise from retreat of continental-scale ice sheets on Greenland (~7m), West Antarctica (~5m), and East Antarctica (~53m). Previous efforts to project RSL change in Boston (CZM, 2013; Bosma et al., 2015) did not include the non-uniform effects of ice sheet and glacier mass loss and may, therefore, substantially over- or underestimate sea-level rise depending on the source of meltwater. Most importantly for Boston, if the WAIS becomes the largest source of glacial meltwater to the global ocean in the 21st century, Boston will experience a sea-level rise ~125% of the global mean. Not accounting for this effect could lead to a substantial underestimate of 21st century sea-level change.

c. Ocean dynamics

Changes in the location and strength of ocean currents and/or prevailing winds, as well as in the distribution of heat and salt in the ocean, can induce "dynamic sea-level" changes. Along the U.S. Atlantic coast at locations north of Cape Hatteras, NC (including Boston), a regional-scale dynamic sea-level rise can be caused by a reduction in the strength of the Gulf Stream and/or a migration of the current toward the coastline (e.g. Ezer et al., 2013; Kopp, 2013; Sallenger et al., 2012; Yin and Goddard, 2013; Yin et al., 2009). A reduction in the strength of the Gulf Stream system is projected by many climate models for the 21st century (Yin, 2012; Yin and Goddard, 2013), largely as a response to warming and freshening of North Atlantic surface waters and a weakening of the Atlantic Meridional Overturing Circulation. Persistent trends in the North Atlantic Oscillation, the dominant mode of North Atlantic inter-annual climate variability, can also have an effect via the influence of persistent northeasterly wind-stress anomalies on upper ocean (Ekman) transports toward the New England coast (Goddard et al., 2015). Combined with thermal expansion, these ocean dynamical mechanisms have the potential to produce >10 cm (3.9 in) RSL rise along the Massachusetts coast by 2100 (Yin, 2012).

d. Vertical land movement

RSL is also affected by changes in the elevations of both the land and sea surfaces due to a process known as glacial isostatic adjustment (GIA; e.g., Peltier, 2004). GIA reflects the response of the solid Earth to the loading and unloading of continental

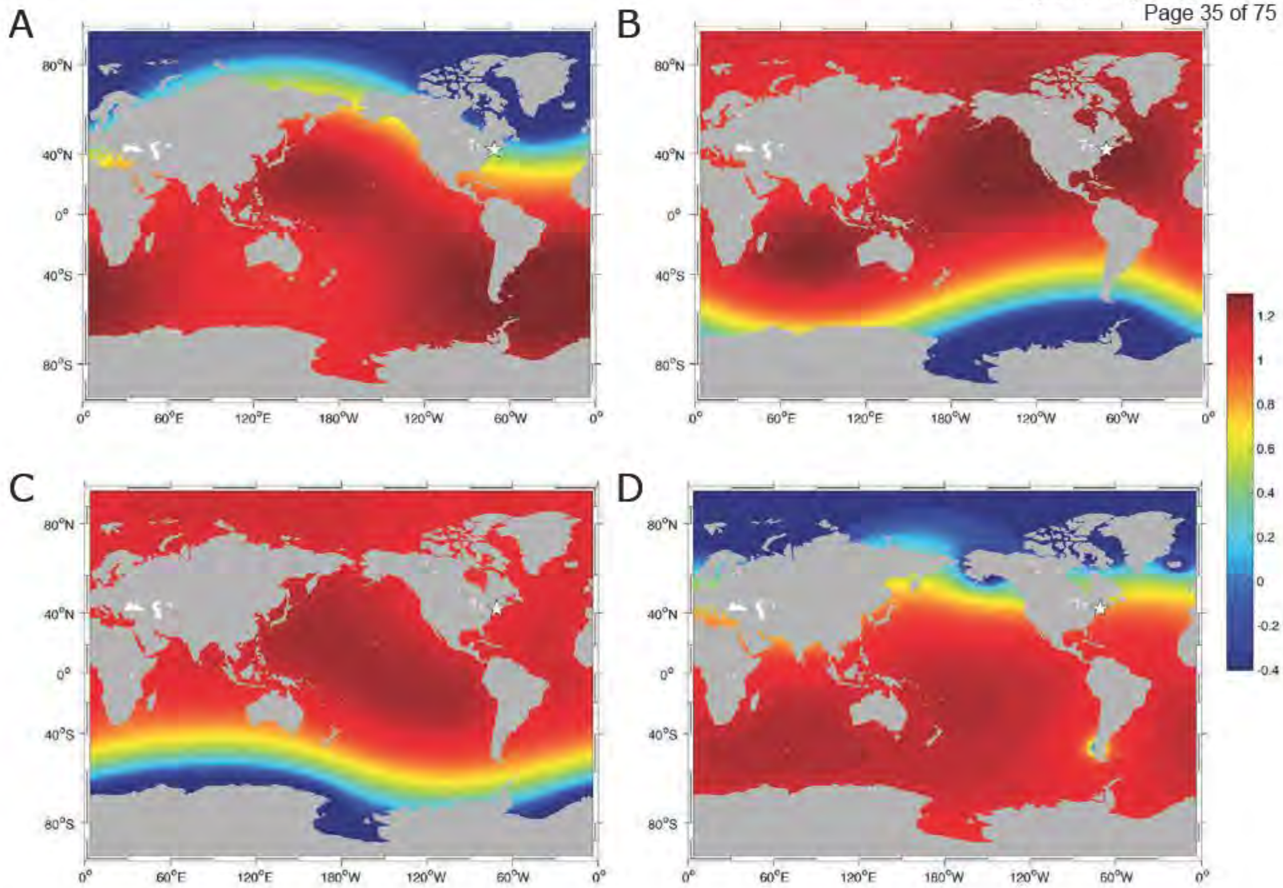


Figure 1-1. *Spatially variable sea-level change arising from melting of the Greenland Ice Sheet (A), the West Antarctic Ice Sheet (B), the East Antarctic Ice Sheet (C) and alpine glaciers and ice caps (D). The location of Boston is shown with a star. Shading represents the meters (arbitrary units) of sea-level rise that would occur if each of these land-based ice reservoirs were to contribute a meter of equivalent GMSL rise. Locations with values greater than 1 would experience more sea-level rise than the global average, while locations with values less than 1 would experience less. Boston is particularly vulnerable to sea-level rise caused by melting of the WAIS (125% of the expected sea-level rise). Conversely, Boston only experiences ~35% of the expected sea-level rise from meltwater sourced from Greenland.*

ice during glacial and interglacial periods, which continues for thousands of years after ice growth or retreat. During the last glacial period (~20,000 years ago), Boston was on a flexural forebulge near the periphery of the ice sheet that covered North America. The relaxation (lowering) of the land surface bulge and the reshaping of the Earth's gravitational field (and consequently the sea surface) by viscous movement of material in Earth's mantle continue to produce a net RSL increase in Boston today. These processes have been the primary driver of land-level change at bedrock locations on the passive margin of the U.S. Atlantic coast for the last 2,000-4,000 years, and they will continue to impact land-level and RSL in Boston for centuries to come. Other geodynamical processes including plate tectonics (e.g. van de Plassche et al., 2014) and dynamic topography (convective mantle processes) can also cause changes in land levels and hence RSL (e.g. Moucha et al., 2008; Rowley et al., 2013), but on tectonically passive margins like the U.S. Atlantic coast, they operate on long (many tens to hundreds of millennia) timescales that can be considered negligible or zero in the context of the 21st century. Additional land movement and RSL rise can be caused by landscape-scale sediment compaction (e.g. Miller et al., 2013). In many instances, the net effect of GIA, tectonics, and sediment compaction has been loosely termed "subsidence" (Figure 1-2) because of the difficulty in isolating and accurately quantifying the contribution from each component. The Boston tide gauge is resting on bedrock (not soft sediment), hence future land subsidence is likely to be dominated by GIA rather than the effects of local compaction.

Several approaches yield similar estimates of net subsidence for Boston using different approaches, datasets and assumptions. Earth-ice models predict that the sea-level increase due to ongoing GIA in Boston is ~1.0 mm/yr (e.g., Peltier, 2004). Engelhart and Horton (2012) compiled and standardized geological RSL reconstructions from the period between 4,000 years ago and 1900 and concluded that the linear rate of RSL rise (~0.7 mm/yr; Figure 1-3) could be entirely attributed to subsidence. Using a global statistical model that included high-resolution geological records, Kopp et al. (2016) found a rate of RSL rise of 0.5 ± 0.1 mm/yr at Wood Island and 0.6 ± 0.1 mm/yr at Revere from 0 to 1700. Kopp et al. (2016) attributed these rates of RSL change to local subsidence and ongoing GIA. A short time series of measurements made by permanent global positioning satellite stations around Boston also estimates that subsidence produces a RSL rise of 0.7 ± 0.2 mm/yr (Karegar et al., submitted). Zervas et al. (2013) processed RSL measurements made at the Boston tide gauge to remove monthly variability caused by oceanographic effects and an assumed rate of global average sea-level rise (1.7 mm/yr; Church and White, 2011). They attributed the residual signal (0.84 mm/yr) in the tide-gauge record to subsidence. Kopp (2013) applied a statistical model to RSL measurements made by a global network of tide gauges to partition local RSL trends into a global component (common to all locations), a regional, linear component (broadly equivalent to an estimate of subsidence), and a regional non-linear component. For Boston, this analysis yields an estimate of RSL rise due to subsidence of 0.8 ± 0.3 mm/yr. Within its uncertainty, this estimate captures the range of estimates from other studies, including GIA modeling and observations. Previous projections of RSL in Boston (e.g., CZM, 2013; Bosma et al., 2015) assumed subsidence resulted in RSL rates of 0.84 mm/yr (based the analysis of Zervas, 2013) and 1.1 mm/yr (based on Kirshen et al., 2008). The convergence of estimates from different sources and approaches suggest that an assumed RSL rate due to subsidence of 0.8 ± 0.3 mm/yr is robust. On the timescale considered here, subsidence at the Boston tide gauge location will be independent of climate change, so this rate and its uncertainty is applied to all of our future projections, regardless of which climate scenario is followed (Figure 1-2).

c. *Projections*

1. Spatial and temporal scales of RSL projections

Estimating future RSL for specific locations at the local-neighborhood spatial scale and/or for individual years requires consideration of local and annual-scale processes that are not explicitly estimated in our approach or projections (Figure 1-2). As noted above, the Boston tide gauge is situated on bedrock and is therefore not subject to local-scale subsidence. In contrast, much of the city is prone to autocompaction of underlying sediment composed of fill, providing a potential additional source of RSL rise. The composition, thickness, age and loading history of filled areas is spatially variable and poorly quantified, meaning that detailed geotechnical investigations will be needed to estimate an appropriate adjustment to our sea-level projections for specific neighborhoods or locales. However, we anticipate that the rate of autocompaction will likely be <1 mm/yr and could be approximated as linear over coming decades, provided no significant changes in loading (e.g. new construction).

The projections of RSL provided here are averages across an interval of 19 contiguous years, centered on 2030, 2050, 2070, and 2100. For example, projections for 2050 are the average of the period 2041-2059. RSL may depart from this average for any specific day, season, year, or decade due to a number of processes. Firstly, tide-gauge measurements show substantial "noise" around the overall RSL trend. This variability is caused by short-lived weather patterns that can push water onto or away from the coast (Goddard et al., 2015) and into or out of Boston Harbor. Analysis of multiple tide gauges demonstrates that this variability is generally regional in scale (e.g. Wahl et al., 2013). The Boston tide-gauge record indicates that this contribution to annual RSL was up to ~±5.8 cm for the period since 1921, and that this variability contributed ~±3.3 cm to decadal-average sea level over this time period (Figure 1-3).

Secondly, tides follow annual, monthly, seasonal and multi-annual cycles, and the predicted timing of these cycles will help determine the elevation attained by a particular high tide occurring on top of the projected sea-level rise, and the potential for storm-induced flooding superposed on a specific tidal cycle and projected RSL estimate (see Coastal Storms section). Thirdly, RSL rise will modify the bathymetry of Boston Harbor resulting in an altered tidal range and wave climate. Other factors affecting astronomical and meteorological tidal amplitude include geomorphic evolution of Boston Harbor, sediment dredging, trends in freshwater input from fluvial systems, and the construction of coastal defenses (Figure 1-4). In the future, ongoing hydrodynamic modeling (e.g., Bosma et al., 2015) will be necessary to quantify the influence of these processes on local and annual RSL in and around Boston.

2. Projections of 21st-century relative sea-level change in Boston

Previous studies of RSL change in Boston (e.g., CZM, 2013; Bosma et al., 2015) considered four discrete, future climate scenarios. A limitation of this approach is the "inability to assign likelihood to any particular scenario" (Bosma et al., 2015). With future sea-level scenarios presented as a series of discrete pathways, end users and stakeholders are left to decide which outcomes are the most likely to be realized (e.g., Parris et al., 2012). Furthermore, projections generated by summing multiple and uncertain sea-level contributions often fail to formally propagate uncertainty into the analysis. Previous analyses

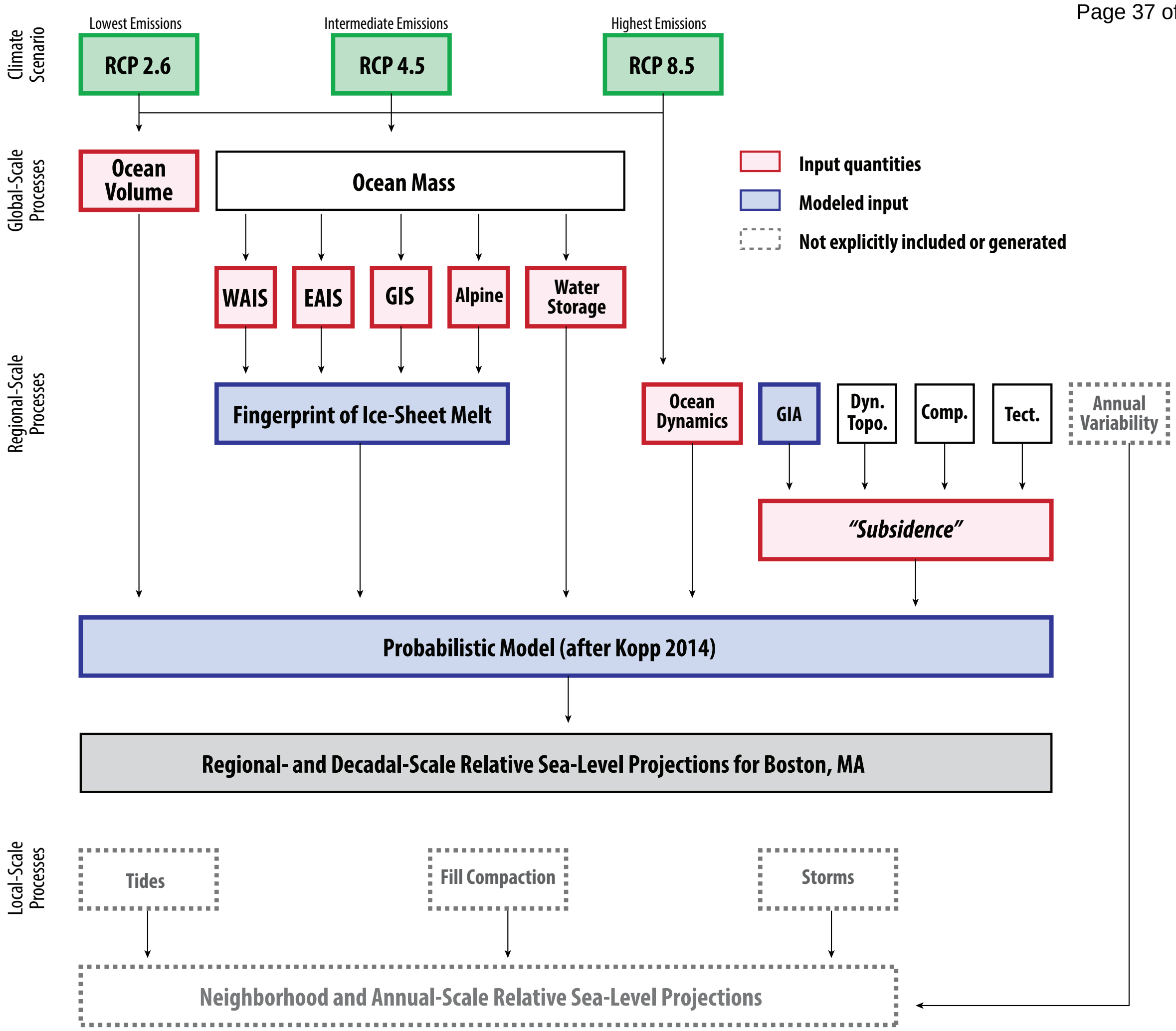


Figure 1-2. *Schematic representation of how RSL projections for Boston were developed to incorporate a suite of regional and global scale processes. Three Representative Concentration Pathways (RCPs; green boxes) were used as climate scenarios. Estimates of the contributions made by individual processes and their uncertainties (pink boxes) were derived for each RCP from existing literature such as IPCC AR5 or climate model archives as described in Kopp et al. (2014). Projections of WAIS and EAIS retreat are provided by a new ice-sheet modeling study (DeConto and Pollard, accepted). The blue boxes represent components of the analysis with model treatments specific to Boston. The processes shown in dashed boxes were not explicitly accounted for here and should be included to generate annual or local (neighborhood)-scale projections. The superposed effect of storms and tides are treated statistically in Section 2 (Coastal Storms), but explicit hydrodynamical modeling of storm surge and wave setup (Bosma et al., 2015) is not attempted in this analysis.*

of RSL change in Boston also ignored the gravitational and rotational effects of changing land-ice mass (Fig. 1-1), ocean dynamical effects, and plausible scenarios of land-water storage. Here, we address these limitations by adopting a probabilistic approach, closely following the methodology developed by Kopp et al. (2014). Rather than providing a few discrete scenarios, this approach produces a continuum of Boston-specific probability distributions, informed by state-of-the-art process modeling, expert assessment, and expert elicitation. Probabilities have the advantage of predicting RSL in any particular year along with its uncertainty (e.g., 90% confidence interval), which is particularly useful for adaptive response planning and municipal decision-making in cases where risk tolerances, uncertainties, and time frames should be considered. Probabilities of future RSL can also be linked to the analysis of specific threats such as storm surge (see Coastal Storms, Section 2b) and the time-evolving flood protection appropriate for specific assets (e.g., Buchanan et al., in review). Additionally, as new projections for individual contributions to future sea level become available (e.g., revised scenarios of melting ice sheets), they can be readily incorporated into this framework to generate updated RSL estimates for Boston.

Our Boston RSL projections aggregate the individual components of sea-level change summarized above (Figure 1-2), including global mean thermal expansion of the ocean; regional ocean dynamics; changes in the mass

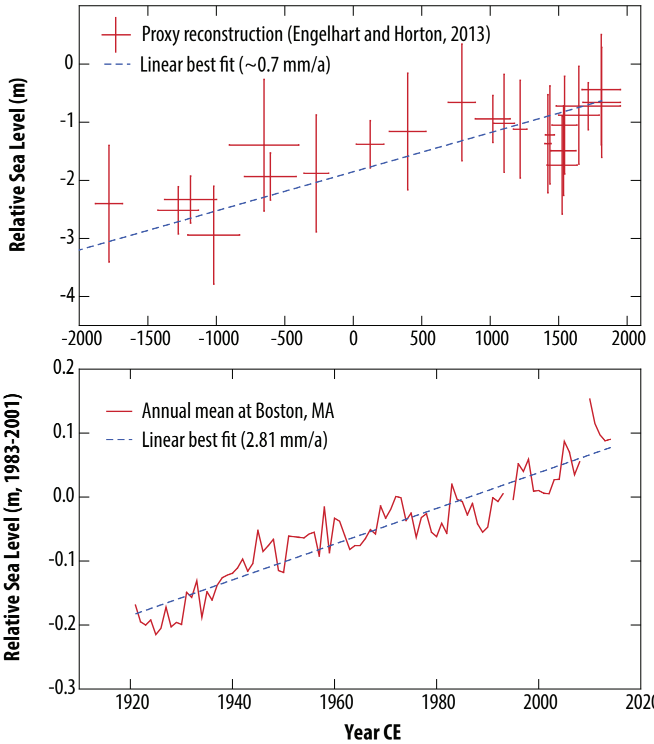


Figure 1-3. *Observed RSL in and around Boston. The upper panel shows reconstructions of RSL change during the last ~4,000 years from the region around Boston. The reconstructions were produced using salt marsh sediment and the red crosses represent sediment age and vertical uncertainty. The lower panel shows annual measurements of RSL from the Boston tide gauge compared to the average of sea level between 1983 and 2001. The overall trend (blue dashed line) indicates a rate of RSL rise between 1921 and 2015 of about 2.8 mm/yr.*

of the West Antarctic Ice Sheet (WAIS), East Antarctic Ice Sheet (EAIS), Greenland Ice Sheet (GIS), and alpine glaciers and ice caps (GIC); land-water storage; and the 0.8 ± 0.3 mm/yr of subsidence as described above. As in Kopp et al. (2014), Coupled Model Intercomparison Project Phase 5 (CMIP5) climate models provide projections of thermal expansion and ocean dynamics, and they serve as an input to a model of the mass balance of alpine glaciers and ice caps (GIC); expert elicitation and AR5's expert assessment provide GIS projections; population projections (United Nations, 2012) and historical data are used for land water storage contributions; and tide-gauge data yield the subsidence rate estimate. Latin hypercube sampling (10,000 samples) is used to generate time-dependent probability distributions of RSL in Boston that consider the cumulative contribution of the individual components and their uncertainties (Kopp et al., 2014). The analysis presented here differs from Kopp et al. (2014), in that projections of future Antarctic Ice Sheet retreat come from a new, physically based modeling study (DeConto and Pollard, 2016) that considers ice-sheet dynamical processes (climate-ice sheet coupling, meltwater-induced hydrofracturing of buttressing ice shelves and structural collapse of marine-terminating ice cliffs) not considered in previous model studies. These new Antarctic ice sheet simulations, calibrated against past episodes of ice-sheet retreat, show the potential for much greater 21st century Antarctic ice sheet retreat (mostly in West Antarctica) than previously published. This is particularly important for Boston, due to the amplified sensitivity of western North Atlantic sea level to ice loss on West Antarctica (Figure 1-1).

We focus on RCPs 8.5, 4.5, and 2.6. We do not consider RCP6.0, because it yields 21st century sea-level projections nearly identical to those of RCP4.5 (Church et al., 2013). Our projections for GMSL and RSL in Boston under the three RCP scenarios are presented in Figure 1-4 and Table 1-1. Consistent with Kopp et al. (2014), we consider the maximum possible RSL rise to be the 99.9th percentile (equal to an exceedance probability of 0.001 or 0.1%) of our projections. Results are also presented for the median (50th percentile), 67% probability range (16.7th to 83.3th percentiles) and 90% probability range (5th to 95th percentiles). In the terminology used by the IPCC, the 67% and 90% ranges are respectively called "likely" and "very likely." Due to the influence of regional-scale processes described previously, RSL in Boston will likely exceed the global average throughout the 21st century, regardless of which emissions trajectory is followed.

Figure 1-4 and Table 1-1 show that the amount and rate of RSL rise in Boston during the first half of the 21st century are nearly independent of emissions (likely 21 to 45 cm under RCP8.5, 20 to 43 cm under RCP4.5, and 19 to 42 cm under RCP2.6). Figure 1-4 H reveals that the magnitudes of the individual contributions to sea-level rise are almost independent of the climate scenario for the first half of the 21st century. However, after ~2050, the predicted Antarctic Ice Sheet contribution becomes strongly dependent on the climate scenario, largely due to the potential for widespread retreat of marine-based ice in West Antarctic in the RCP4.5 scenario, and retreat of both West and East Antarctic marine-based ice in the RCP8.5 scenario (DeConto and Pollard, 2016). This results in a sharp divergence of the RSL predictions in the second half of the 21st century. Under RCP8.5, RSL will likely (67% probability) rise in Boston by 97 to 226 cm by 2100, compared to 89 to 202 cm in the global mean. Under the moderate-emissions RCP4.5 pathway, RSL will likely rise by 75 to 156 cm, compared to 71 to 138 cm in the global mean. Under the low-emissions RCP2.6 pathway, RSL will likely rise by 56 to 117 cm, compared to 31 to 62 cm in the global mean.

Sea-level rise will not stop in 2100, and because some long-lived infrastructure and land use plans will likely extend into the 22nd century, changes in RSL should be considered beyond 2100. If the high RCP8.5 emission scenario is followed, our projections suggest that the rate of RSL rise by the end of the 21st century will be 19-48 mm/yr (an order of magnitude faster than today) and will continue to accelerate. A far more modest, but ongoing rate of 6-16 mm/yr is projected under RCP2.6, in part because sea level is a

Table 1-1. *RSL projections for Boston, MA (in ft, relative to 2000) categorized by exceedance probabilities.*

			Likely range					Maximum
	0.99	0.95	0.833	0.5	0.167	0.05	0.01	0.001
RCP8.5								
2030	-0.1	0.1	0.3	0.5	0.7	0.9	1.0	1.2
2050	0.1	0.4	0.7	1.1	1.5	1.8	2.1	2.4
2070	0.6	1.0	1.5	2.2	3.1	3.7	4.3	4.8
2100	1.6	2.4	3.2	4.9	7.4	8.6	9.5	10.5
2200	18.9	19.9	21.4	26.1	32.8	34.1	35.3	36.9
RCP4.5								
2030	-0.1	0.1	0.3	0.5	0.7	0.9	1.0	1.2
2050	0.1	0.4	0.7	1.0	1.4	1.7	2.0	2.3
2070	0.4	0.9	1.3	1.9	2.6	3.1	3.6	4.1
2100	0.9	1.7	2.4	3.6	5.1	6.1	7.0	8.0
2200	5.5	6.2	7.2	10.9	16.5	18.0	19.3	20.9
RCP2.6								
2030	-0.1	0.1	0.3	0.5	0.7	0.9	1.0	1.2
2050	0.1	0.4	0.6	1.0	1.4	1.7	2.0	2.3
2070	0.3	0.7	1.1	1.7	2.3	2.7	3.1	3.6
2100	0.4	1.2	1.8	2.8	3.8	4.6	5.3	6.2
2200	3.6	4.4	5.2	6.4	7.7	8.8	9.9	11.8

slow-responding component of the climate system, resulting in a multi-century commitment to RSL rise even beyond the initial forcing (e.g., Rahmstorf et al., 2012; Dutton et al., 2015). Ice sheets in particular may take centuries to millennia to approach equilibrium to a perturbed climate state (e.g., Dutton et al., 2015). Under RCP8.5, RSL rise in Boston will likely be 6.5 to 10 m by 2200. Under RCP4.5, this is reduced to 2.2 to 5.0 m; and under RCP 2.6, it is further reduced to 1.6-2.4 m. Under RCP2.6, the 90% confidence interval for RSL rise in Boston by 2200 is 1.3-2.70 m, with a maximum possible rise of 3.60 m (Figure 1-4). For RCP8.5, we project RSL in Boston at 2200 to be 6.00-10.40 m (90% confidence interval) above the 2000 baseline, with a maximum possible rise of 11.2 m.

These projections are not the final word on sea-level rise in Boston. Just as the Kopp et al. (2014) projections have been updated using the new Antarctic modeling results of DeConto and Pollard (2015), projections used for planning purposes should be periodically revisited as constraints on the contributing processes continue to improve. Various techniques exist in the literature for making decisions under "deep uncertainty," where probability estimates are themselves uncertain (e.g., McInerney et al., 2009), and these have been adapted for use with probabilistic sea-level rise projections (Buchanan et al., in review). Estimates of the maximum physically possible sea-level rise are useful for some of the approaches. For comparison, Kopp et al. (2014) estimated a maximum physically plausible sea-level rise at Boston of 80 cm by 2050 and 3.0 m by 2100 versus 74 cm and 3.2 m, respectively, in this analysis. The recent study by CZM (2013) estimated a maximum RSL rise of 2.0 m in 2100, substantially less than estimated here.

3. Coastal response to projected relative sea-level change

Because coastal systems respond dynamically to water levels, projections of RSL rise cannot be imposed on a static landscape characterized by the bathymetry and topography that is observed in and around Boston today. Importantly, rates of RSL rise, as well as the absolute magnitude of RSL, are important for considering coastal evolution because faster rates of rise inhibit the ability of coastal systems to achieve and maintain geomorphic equilibrium. Here we identify several potential feedbacks between RSL rise and coastal landscape processes in Boston Harbor.

RSL rise will increase tidal range, wave energy, and tidal inundation, resulting in increased erosion of existing geomorphic features and existing or planned coastal engineering works such as flood defenses (e.g., FitzGerald et al., 2011a; FitzGerald et al., 2011b; Himmelstoss et al., 2006; Mawdsley et al., 2015). Based on historical records, we anticipate that the increase in tidal range will likely be modest (<2% change, i.e. ~5 cm; Fig. 1-5) and that the magnitude of

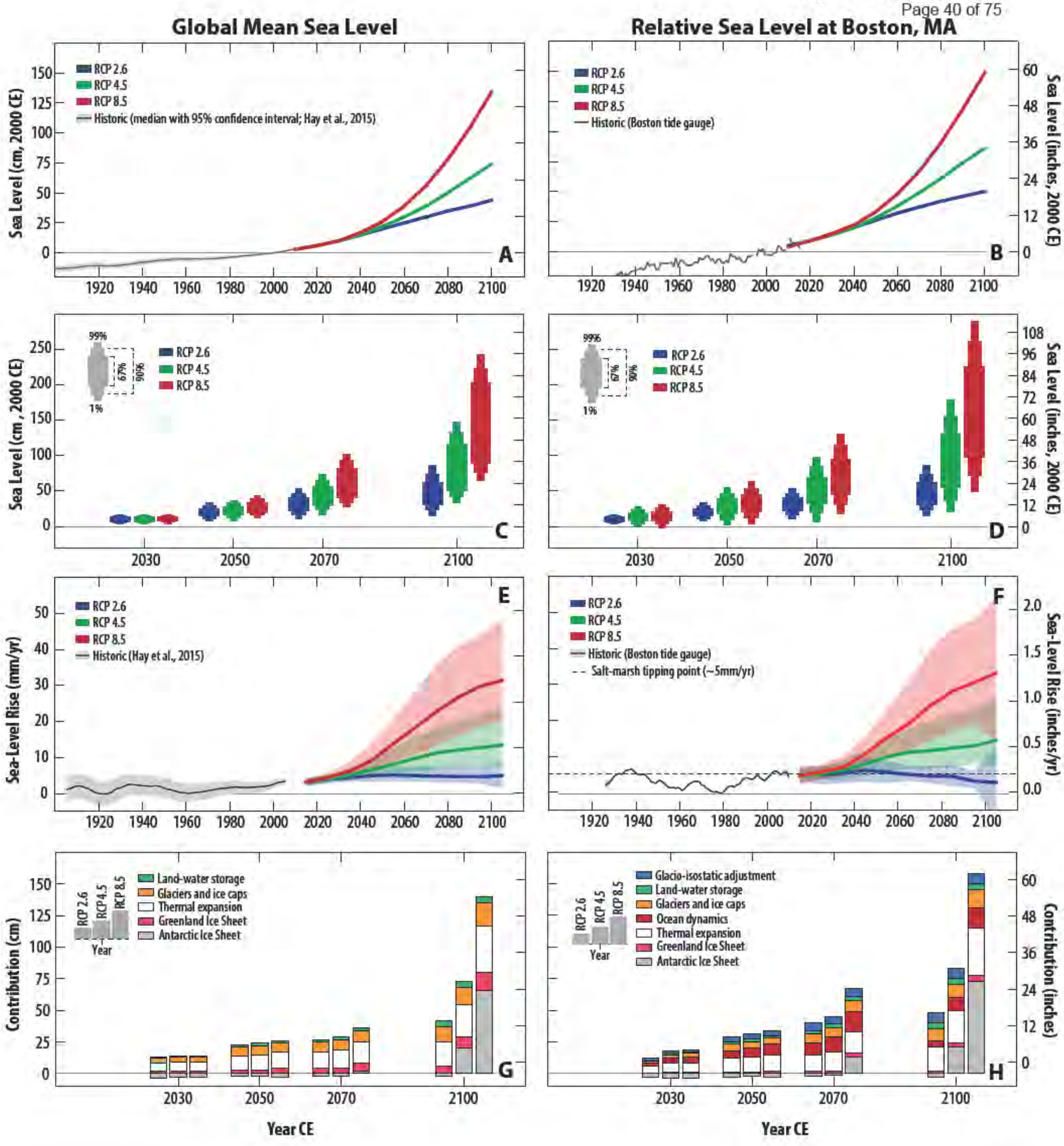


Figure 1-4. *Projections of global mean sea level change (left panels) and relative sea-level change in Boston (right panels) during the 21st century. (A,B) Median projections under three climate scenarios (RCPs 2.6, 4.5, and 8.5). Historic trends measured by tide gauges are shown in grey. (C,D) Projections for key time points during the 21st century (2030, 2050, 2070, and 2100) under the three RCP climate scenarios. The modified box plots present probabilistic estimates of future RSL changes in Boston. (E,F) Projected rates of RSL rise for the 21st century relative to 2000 under the three climate scenarios. Historical global rates (Hay et al., 2015) and in Boston are shown in grey. Based on ambient suspended sediment supply and local tidal range, marshes in New England are predicted to begin an irreversible decline once rates of sea-level rise exceed 5 mm/yr (Kirwan et al., 2010), which is predicted to occur in the near future (F, dashed line) for even the most conservative emission scenario. (G, H) The breakdown of the individual contributions responsible for the projected sea-level changes under the three climate scenarios.*

any astronomically-driven tides is unlikely to change. Wave heights will increase due to deepening of Boston Harbor, but more importantly, waves will break higher up the shorelines even during average storm conditions, causing increased rates of retreat. Higher RSL will focus wave energy on the top of existing sea walls that are susceptible to being dismantled as individual granite blocks are dislodged, resulting in the collapse of adjoining structures. Greater wave energy will also increase the potential for beach erosion and breaching of low and/or narrow barriers (at Winthrop and Nantasket Beach, for example). These impacts are likely to have the greatest impact on the outer islands and peninsula shorelines of Boston Harbor with diminishing effects toward the Boston proper shoreline.

Erosion of islands in Boston Harbor is important because they help to defend the city during northeast coastal storms by substantially reducing wave energy (Bosma et al., 2015). This is achieved by partially refracting storm waves that propagate into Boston Harbor along deep sea floor features such as the President's Roads and Nantasket Roads channels. Islands in the harbor are largely glacial drumlin structures that are prone to erosion and will retreat under a regime of rapid RSL rise, resulting in a diminished coastal defense, unless they are protected by natural boulder retreat platforms or man-made coastal defenses ("hardened shorelines").

Salt marshes are able to maintain their position in the tidal frame by producing subsurface biomass and accumulating sediment at a rate that is equal to, or greater than the rate of RSL rise (e.g., Kirwan and Murray, 2008; Morris et al., 2002). The accelerating rate of RSL rise that will characterize RSL change in Boston during the 21st century will soon make salt-marsh flooding events more frequent and widespread. Eventually salt marshes such as those located at Quincy, Neponset, and Belle Isle will be converted to tidal flats and sub-tidal bays, because the ecological limits of in situ organic sediment production and the very low suspended sediment concentration in Boston Harbor are insufficient to keep pace with the projected rates of RSL rise (Fig. 1-4B). This will result in the loss of a wave-dampening ecosystem and less tangible impacts, including loss of habitat for species such as wading birds and young fish and contribution of nutrients and detritus to the harbor and coastal oceans. Other low-lying sites (e.g., Winthrop Golf Course) will also experience more frequent inundation by salt water and conversion to wetlands or tidal flats.

d. *Open questions and data gaps*

Clearly, uncertainty in future RSL projections is dominated by the unknown emission scenario that will be followed (Fig. 1-4), and by the uncertain magnitude and rate of future ice-sheet retreat. This second factor is particularly relevant for Boston in the second half of the 21st century, when the future RSL trajectory will largely be controlled by the sea-level contribution of the Antarctic Ice Sheet (Fig. 1-1).

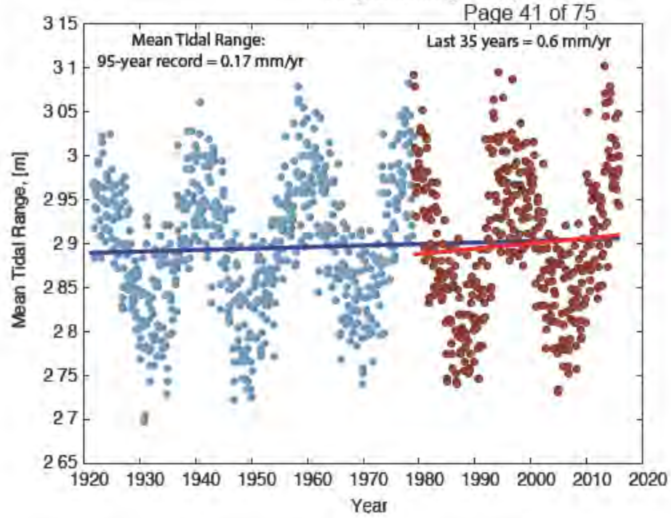


Figure 1-5. *The increase in mean tidal range for Boston Harbor over the last 95 years. Data were obtained from the NOAA tide gauge website for Boston (Station #8443970). Regressions were run to determine the long (95-year) and short (35-year) term rates of tidal range increase. Based on these regressions the projected increase in tidal range by 2100 would be expected to be between ~0.5% (based on the 95-year record) and 1.8% (based on the higher rate from the 35-year regression).*

Early in the 21st century, the uncertain ocean dynamical response to a warming world and the potential for a more persistent negative phase of the North Atlantic Oscillation index in the future (Goddard et al., 2015; Yin et al., 2012) also provide substantial uncertainty in RSL projections along the North American East Coast, but less so than greenhouse-gas emissions or the uncertain timing of Antarctic ice-sheet response. A strength of the approach followed here is the potential for periodic updating of Boston-specific RSL predictions, particularly as constraints on physical ice-sheet processes and rates improve, and/or the range of likely future emissions scenarios begins to narrow.

2. Coastal Storms

a. *Key findings*

- Extratropical storms have been and will continue to be the dominant cause of flooding in Boston even for the lowest probability, highest impact events. Recent reports indicate a negligible trend in frequency and possibly a slight weakening of extratropical systems. Projections of changes in extratropical storm characteristics remain highly uncertain, due in part to "a lack of adequate knowledge of the mechanisms responsible for producing these changes." Hence there are currently no robust estimates of changes in extratropical cyclone

Projected Sea Level Rise and 1% Annual Chance Flood Elevations

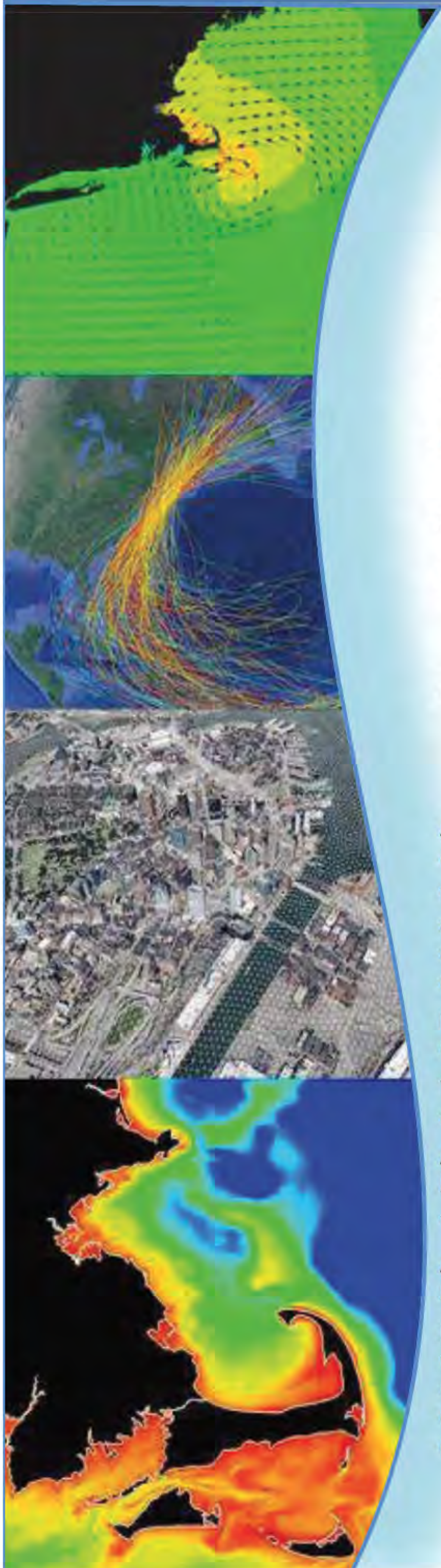
Data sources: Climate Ready Boston projections and BH-FRM. Elevations are in Boston City Base (NAVD 88 elevations are 6.5 feet lower than Boston City Base)

	CURRENT (2000)	2030S	2050S	2070S
RELATIVE SEA LEVEL RISE		9 inches	21 inches	36 inches
1% ANNUAL CHANCE FLOOD ELEVATION (BOSTON CITY BASE)	15.7 feet	17 feet	18 feet	19.5 feet
TARGET FLOOD PROTECTION ELEVATION (BOSTON CITY BASE)	16.7 feet	18 feet	19f eet	20.5 feet

Datum Conversion: MLLW = BCB - 0.88-FT

Source: Coastal Resilience Solutions for East Boston and Charlestown Final Report, Climate Ready Boston, October 2017

APPENDIX C – BOSTON HARBOR FLOOD RISK MODEL



MassDOT-FHWA Climate Resilience Pilot Project

Modeling Overview and Frequently Asked Questions

Overview

The Massachusetts Department of Transportation (MassDOT) and the Federal Highway Administration (FHWA) have commissioned a pilot project to assess and improve the resiliency of the Central Artery and Tunnel System (CA/T) by analyzing its vulnerability to sea level rise and extreme weather events, investigating options for adaptation to the identified vulnerabilities, and establishing an emergency response plan for tunnel protection. A major component of the pilot project is a detailed modeling effort that simulates extreme weather events under both present and future climate conditions. The project is being managed by the MassDOT Highway Division Environmental Services Section and being executed by UMass-Boston, Woods Hole Group, Inc. and University of New Hampshire. The MassDOT Boston Harbor Flood Risk Model (BH-FRM) model is being developed and used to determine inundation risk and flooding pathways; and to simulate the dynamic nature of flooding in the City of Boston that serve as flood pathways affecting the CA/T. BH-FRM is an advanced model that simulates the effects of tides, storm surge, wind, waves, wave setup, river discharge, sea level rise, and future climate change scenarios.

FAQ

Are the results of the BH-FRM applicable to the entire City of Boston and City of Cambridge?

Yes, flood risks results will be available throughout the City of Boston and Cambridge. All parts of the City of Boston and Cambridge that are at an elevation low enough for storm surge-induced flooding to occur are included.

Why does the BH-FRM model include detailed results in the City of Cambridge?

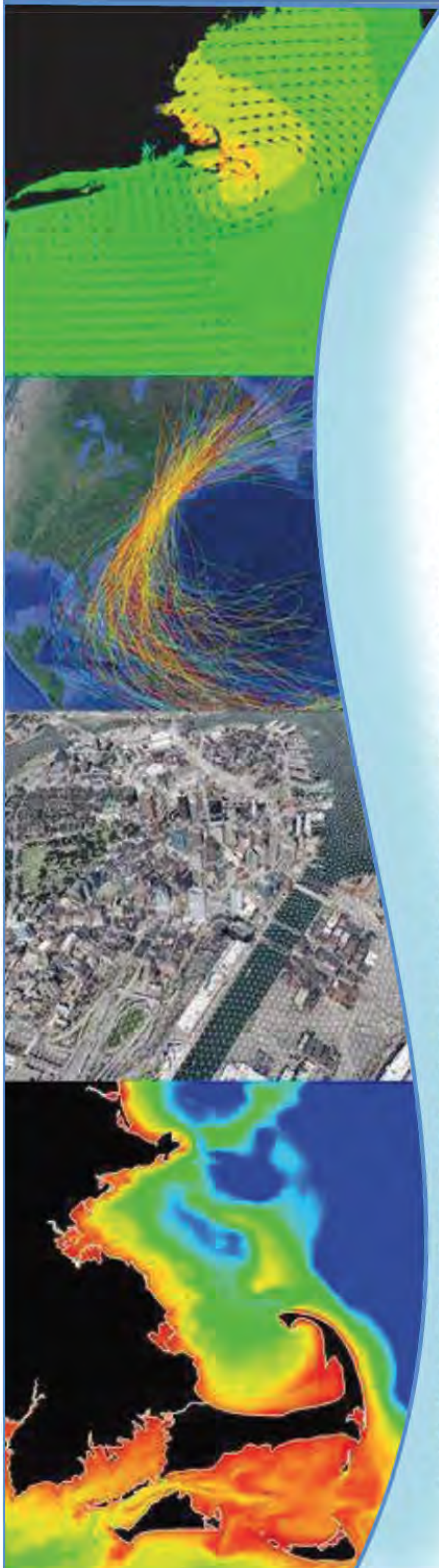
The City of Cambridge provided additional funding to extend the focus area of the BH-FRM model.

Are the BH-FRM results applicable to a specific building or structure located in Boston or Cambridge?

Yes.

Are the results of the BH-FRM applicable to the areas outside the Boston and Cambridge?

BH-FRM provides information for adjacent areas in Massachusetts, as well as Rhode Island, New Hampshire, Maine, and Connecticut, but will not be able to identify risk associated with specific assets for locations outside of the focus area (Boston & Cambridge). However, the model can be extended to do so in the future.



MassDOT Climate Change Adaptation Pilot Project

Modeling Overview and Frequently Asked Questions

What is the resolution of the BH-FRM model grid?

BH-FRM uses an unstructured grid that allows for the grid resolution to vary across the model domain. In the BH-FRM focus area (Boston, Cambridge and Boston Harbor), the model resolution ranges from five to thirty meters for both inland areas and coastal waters. In areas beyond the focus area (Atlantic Ocean), the resolution increases to 100 to 500 meters. Most of the coastal areas in New England have a resolution between 50 to 100 meters.

What is the complete extent of the BH-FRM model domain?

The BH-FRM domain extends from the Gulf Coast to Newfoundland (see attached map).

What is the specific extent of the BH-FRM and the detailed focus area?

See the attached map.

What types of storms does BH-FRM simulate?

BH-FRM simulates storm surge induced flooding that could occur from both tropical (hurricanes) or extra-tropical (nor'easter) storm events. The model also includes climate-change induced increases in river discharge from precipitation and storm water run-off. A statistically robust approach is used to capture variations in storms.

Does the BH-FRM include freshwater flooding?

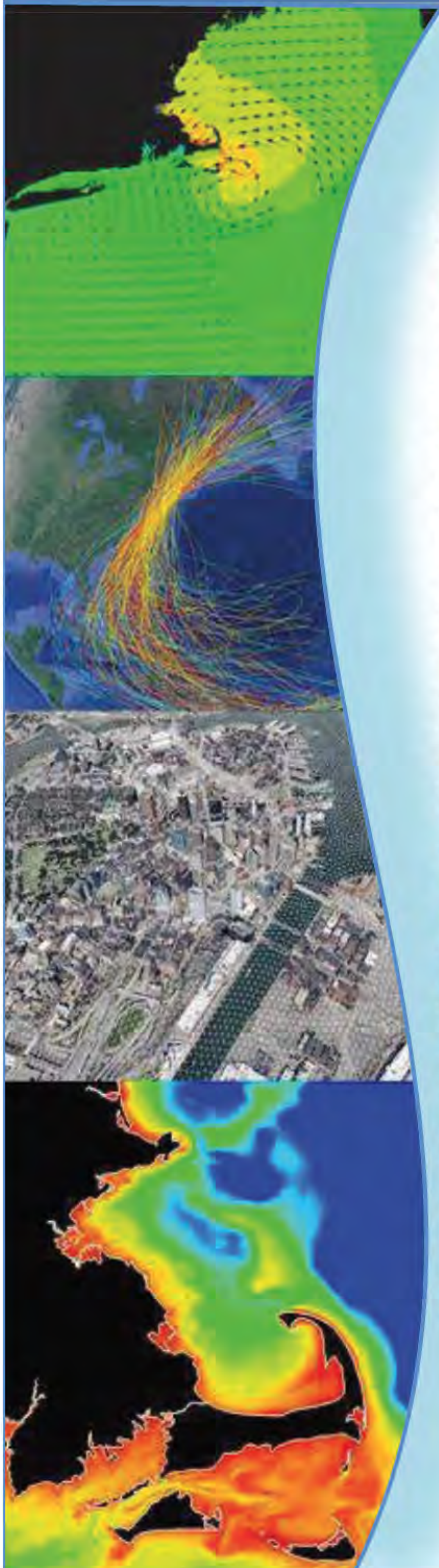
To some extent the Charles and Mystic Rivers are incorporated into the BH-FRM because the freshwater outflows of the rivers interact with storm-surge induced flooding. However, freshwater storm flooding events that have no ocean-based component are not included in the risk analysis (for example, while the flow contribution of precipitation in the upper reaches of the Mystic to flooding in the coastal area are included, the local freshwater flooding in the upper Mystic is not).

Are the Charles River Dam and Amelia Earhart Dam included in the model?

Yes.

What makes BH-FRM more accurate than other inundation models and flood maps that have been created for the region?

The BH-FRM is a more accurate representation of flooding risk because it is (1) a dynamic model that includes the critical processes associated with storm induced flooding (winds, waves, wave-setup, storm surge, river discharge, etc.), (2) calibrated to historical storm events with observed high water data, (3) high enough resolution to capture flood pathways in the complex urban topography of Boston and Cambridge, and (4) able to capture the net effect of varying storm types, magnitudes, and parameters.



MassDOT Climate Change Adaptation Pilot Project

Modeling Overview and Frequently Asked Questions

How do BH-FRM results relate to other existing Sea Level Rise inundation maps (e.g., The Boston Harbor Association flood maps)?

BH-FRM is a dynamic model that includes relevant flooding processes and their interaction. The model includes the dynamic effects of tides, storm surge, land effects, winds, waves, wave setup, etc. Results also include changes in climate to assess variations in storm intensity, etc. These processes can result in significant differences in the magnitude and extent of flooding throughout a region. For example, flooding caused by tropical storm events (such as Hurricane Sandy) are typically not well represented by non-dynamic models based on the expected water surface elevation overlain on land elevation. Flood mapping approaches, such as the TBHA bathtub flood maps, do not include the influence of the storm track, winds, and waves.

How do BH-FRM results relate/compare to the recently released FEMA Preliminary Flood Insurance Rate Maps (FIRMs)?

BH-FRM results are focused on present and future flooding projections, while FEMA results estimate present flood risk based on historical events. The methods used to produce the FIRMs are also substantially different. BH-FRM is also being used to assess present day conditions, simulate historic storm events, and can potentially provide improved input to the FEMA models and mapping.

Will the BH-FRM model show flooding propagating down streets and through buildings?

Flood risk and water depths will be available for individual buildings and streets with this model. However, the model does not currently intend to show flooding into buildings or the detailed flow down every street. An extension to the model is being considered to provide visualizations of flood propagation down streets and flood pathways, but it will not model flooding into structures.

Will the BH-FRM results of flooding risk be publically available?

Yes. Full model results for the focus area (Boston and Cambridge) will be publicly available.

What is needed to extend the BH-FRM focus area to my town/area?

To extend the BH-FRM into any specific area requires additional grid development and may also require additional climate input conditions determined by your project requirements.

APPENDIX D – BOSTON PLANNING AND DEVELOPMENT AGENCY

0103711003

Climate Resiliency

SLR-BFE: 19.4 ft.

Sea Level Rise - Base Flood Elevation (Boston City Base datum).

...003
Address : ...E EAGLE ST, 02128
Owner : CITY OF BOSTON
More Info : Assessor's Report
See Also : Property Viewer

Zoning

Zoning District : East Boston Neighborhood
Zoning Subdistrict : WM
Subdistrict Type : Waterfront Manufacturing
Overlays : None,
Map No. : 3A-3C
Article : 53 (Table; Appendix)

Other Layers

Parking Freeze Zone: East Boston

0103711003

Climate Resiliency

SLR-BFE: 19.4 ft.

Assess...

The listed SLR-BFE is the highest for the selected parcel based upon a 1% annual chance flood event with 40 inches of SLR as derived from the data of the MassDOT-FHWA Boston Harbor Flood Risk Model. For more information about The Resiliency Checklist please visit Article 37 Green Building and Climate Resiliency Guidelines.

...2128

Zoning

Zo...
Zonin...
Subdistrict Type : Waterfront Manufacturing
Overlays : None,
Map No. : 3A-3C
Article : 53 (Table; Appendix)

Other Layers

Parking Freeze Zone: East Boston

Source: maps.bostonredevelopmentauthority.org/zoningviewer
2/15/2018

Projects should first evaluate if the location and site conditions are vulnerable to flooding:

- To determine if the Project site is within a FEMA SFHA, visit: https://msc.fema.gov/portal.
- To determine if the Project site is within a BPDA Sea Level Rise - Flood Hazard Area (SLR-FHA) use the online BPDA SLR-FHA Mapping Tool, visit: http://maps.bostonredevelopmentauthority.org/zoningviewer/?climate=true

Project sites and buildings located in either the FEMA SFHA or the BPDA SLR-FHA may be vulnerable to flooding due to either present or future conditions, including rising sea levels.

If the Project site is located in either the FEM SFHA or the BPDA SLR-FHA, use the online BPDA SLR-FHA Mapping Tool to determine the highest Sea Level Rise - Base Flood Elevation (SLR-BFE) for the project site and calculate the Sea Level Rise - Design Flood Elevation (SLR-DFE) by adding at minimum 24" of freeboard for critical facilities and infrastructure and buildings with ground floor residential units OR at minimum 12" of freeboard for all other buildings and uses. Include the SLR-BFE and SLR-DFE determinations for the project site in the Resiliency Report.

The SLR-DFE should be used as the minimum performance target for assessing sea level rise impacts and for reducing or eliminating flood risk, potential damage, and related adverse impacts.

New building projects should be planned and designed to reduce or eliminate flood risk and potential damage. Strategies include raising the elevation of the site and access routes, elevating building ground floors, dry and wet flood proofing, locating critical building equipment and systems above potential flood elevations, and deploying temporary barricades.

Additionally, project planning and design should identify future adaptation strategies that might be necessary for meeting and exceeding the SLR-DFE and adapting to higher SLR conditions.

Disclaimer

The Sea Level Rise - Flood Hazard Areas (SLR-FHA) and Sea Level Rise - Base Flood Elevations (SLR-BFE) depicted in these maps are for planning purposes. The 40-inch SLR forecast and resulting SLR-BFE's do not represent a worst case SLR scenario. Project proponents are encouraged to reference the 2016 Boston Research Advisory Group Report and evaluate their own tolerance for risk given the specifics of the project site, location, and use(s) to determine what, including additional, flood hazard mitigation and prevention measures should be incorporated into their project. Compliance with these guidelines does not guarantee against present or future flooding and resulting damages.

This mapping information is not intended for flood insurance determinations, nor should it be directly related to FEMA Flood Insurance Rate Maps or Flood Insurance Studies.

APPENDIX E – MASSACHUSETTS PORT AUTHORITY

translates to an elevation of 13.7 ft (NAVD88) for facilities at Logan Airport and in South Boston (Table 1).

For projects at existing facilities, the DFE shall be used to determine the following design elements:

- Design loads and structural calculations for evaluating and designing dry and wet floodproofing options
- Minimum effective level of protection provided by dry and wet floodproofing designs
- Elevation below which Floodproofing Performance Standards in Section 6.2 shall be applied.

3.3 DFE FOR NEW FACILITIES AND ADDITIONS

For new facilities, the DFE will be defined by the maximum water elevation with a 0.2% annual probability of exceedance in 2070 (as modeled by BH-FRM) plus 3 ft. of freeboard. This translates to an elevation of 17.0 ft (NAVD88) for facilities at Logan Airport and in South Boston (Table 1).

For new facilities, the DFE shall be used to determine the following design elements:

- Design loads and structural calculations
- Elevation of the lowest floor of the lowest enclosed space
    - Excludes certain access, storage spaces, and areas used solely for parking vehicles which may be wet floodproofed
- Minimum effective level of protection provided by dry and wet floodproofing designs
- Elevation below which Floodproofing Performance Standards in Section 6.1 shall be applied.

Table 1 – Design Flood Elevations for New and Existing Massport Facilities

Location	Existing Facilities	New Facilities
Logan International Airport; South Boston Maritime Facilities	13.7 ft. (NAVD88)	17.0 ft. (NAVD88)

*Add 0.81 ft. to NAVD88 elevations to convert to NGVD29 elevations.
*Add 6.46 ft. to NAVD88 elevations to convert to BCB elevations.

APPENDIX C

Explanation of April 2015 Revisions

In March 2015, subsequent to Massport's issuance of the Floodproofing Design Guide (November 2014), the Massachusetts Department of Transportation (MassDOT) completed a probabilistic flood model for the Boston Harbor region (Boston Harbor Flood Risk Model, BH-FRM) using a coupled hydrodynamic and wave model. MassDOT's BH-FRM model is comprised of the ADvanced CIRCulation (ADCIRC) model to simulate storm surge flooding and the Simulated WAves Nearshore (SWAN) model to simulate wave generation and transformation. MassDOT invested significant resources into the development of BH-FRM in order to evaluate the vulnerability to flooding of the Central Artery Tunnel system and other MassDOT assets. The model explicitly and quantitatively incorporates climate change influences on sea level rise, tides, waves, river discharge, storm track, and storm intensity for the present (2013), 2030, and 2070 time horizons. It models a statistically-robust sample of storms, including tropical (hurricanes) and extra-tropical (nor'easters), based on the region's existing and evolving climatology, calculates associated water elevations, and runs mathematical and geospatial analyses on the water elevations generated to estimate the probability of different water elevations being exceeded at nodal points within the model boundary. The resulting flood risk maps and probability curves can be interpreted using geographic information systems (GIS) to identify the estimated annual probability, or likelihood, that any nodal point within the model will experience flooding, and if so, up to what elevation.

In an exemplary case of interagency cooperation, MassDOT shared its BH-FRM results with Massport so that Massport could compare them with the results from the Sea, Lake, and Overland Surge from Hurricanes (SLOSH) model, developed by the National Weather Service to assist in hurricane emergency planning and forecasting. SLOSH model results were used to assess the coastal flooding exposure of critical infrastructure assets at Logan Airport and Maritime facilities in South Boston as part of the Disaster and Infrastructure Resiliency Planning (DIRP) study, and were the basis for the Design Flood Elevations (DFEs) published in the November 2014 version of the Massport Floodproofing Design Guide. The results of this comparison showed that DFEs initially selected for Logan Airport and Maritime facilities as part of the DIRP study were higher and more conservative than the maximum water elevations generated by the BH-FRM.

This was expected, as the models differ in key aspects which predispose SLOSH to produce more conservative results. Unlike SLOSH, BH-FRM's maximum predicted water elevations do not correspond to a particular storm intensity (e.g., Category 2 hurricane), storm type (BH-FRM also includes nor'easters), landfall (e.g., direct hit to Boston) or tide-surge scenario (e.g., coincidence of peak storm surge and high tide), but rather incorporates these variables probabilistically. For example, the likelihood of a Category 2 hurricane striking at high tide and low tide are technically equal, with drastically different impacts on flooding (Boston Harbor's tidal range is roughly 10 ft.). BH-FRM takes these probabilities into account when determining what flood levels are likely to be experienced, while SLOSH assumes the worst without considering probability. The maximum water elevations from BH-FRM therefore represent worst-likely scenarios, whereas SLOSH results represent worst-possible scenarios.

Because it was understood that the SLOSH-based DFEs were based on conservative assumptions and therefore encompassed a comfortable safety factor, no freeboard was added to the SLOSH outputs when determining the DFEs. The BH-FRM water elevations do not incorporate any explicit safety factors other than the inclusion of the effects of climate change.

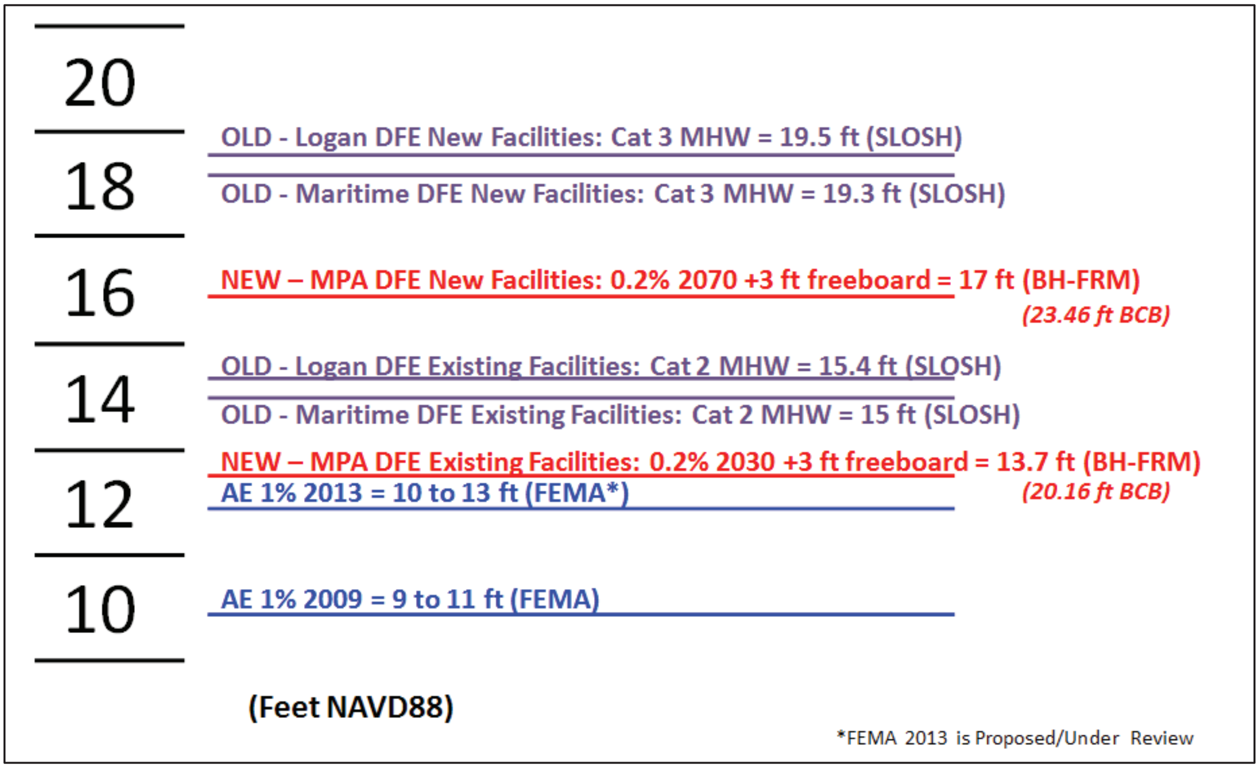
Bearing in mind the BH-FRM results and the underlying reasons for differences between BH-FRM and SLOSH results, Massport decided to adjust the DFEs set in the November 2014 version of the Floodproofing Design Guide. The revised Design Flood Elevations are equal to the maximum water elevation with a 0.2% annual probability of exceedance (1-in-500 years water elevation) predicted by BH-FRM, plus 3 ft. of freeboard as a safety factor. For existing facilities, the revised DFE is based on the 2030 BH-FRM results, and the revised DFE for new facilities is based on the 2070 BH-FRM results.

The revised DFEs for Logan Airport and Maritime facilities in South Boston are:

- Revised DFE for Existing Facilities: 13.7 ft. NAVD88 (14.5 ft. NGVD29, 23.46 ft. BCB)
- Revised DFE for New Facilities: 17 ft. NAVD88 (17.8 ft. NGVD29, 20.16 BCB)

The 3 ft. freeboard safety factor is in line with existing ASCE/SEI 24 (Flood Resistant Design and Construction) guidance for floodproofing highly critical facilities, as well as Federal Executive Order 11988 (amended on January 30, 2015) establishing a Federal Flood Risk Management Standard, which requires critical facilities be designed with 3 ft. of freeboard when receiving federal assistance.

Figure C-1 – Comparison of Old (November 2014) and New (April 2015) DFEs



Use of the BH-FRM results will align Massport and MassDOT's respective resiliency efforts by ensuring a shared foundation for vulnerability assessments and resiliency planning and design. Such coordination will help promote consistency among the region's critical transportation infrastructure owners and operators. It is expected that the BH-FRM will be the coastal flood risk model for the region for the foreseeable future, as MassDOT seeks to expand the model boundaries to the entire Massachusetts coast over the coming years.

In addition, to conform with Massport's policy to transition from NGVD29 to NAVD88 vertical datum, all elevations noted in the Massport Floodproofing Design Guide Revision 1, including DFEs, have all been standardized to NAVD88. This aligns Massport's elevation datum with others, including FAA, FEMA, NOAA, and MassDOT. Elevations in NAVD88 can be converted back to NGVD29 using a simple conversion factor of NAVD88 +0.81 ft. Elevations in NAVD88 can also be converted to Boston City Base (BCB) using a conversion factor of NAVD88+6.46 ft.

APPENDIX F – MASSACHUSETTS BUILDING CODE

Massachusetts Amendments to ASCE 24

ASCE 24 Tables for flood-resistant materials and wet and dry flood-proofing - Revised

		Flood Design Class 1	Flood Design Class 2	Flood Design Class 3	Flood Design Class 4
Minimum Elevation* of Lowest Floor (Zone A: ASCE 24-14 Table 2-1)	Zone A	BFE + 1 ft	BFE + 1 ft	BFE + 1ft	BFE + 2 ft or 500-year flood elevation, whichever is higher
Minimum Elevation of Bottom of Lowest Horizontal Structural Member (Zone V: ASCE 24-14 Table 4-1)	Zone V	BFE + 2 ft	BFE + 2 ft	BFE + 2 ft	BFE + 2 ft or 500-year flood elevation, whichever is higher
Minimum Elevation Below Which Flood-Damage-Resistant Materials Shall be Used (Table ASCE 24-14 5-1)	Zone A	BFE + 1 ft	BFE + 1 ft	BFE + 1ft	BFE + 2 ft or 500-year flood elevation, whichever is higher
	Zone V	BFE + 2 ft	BFE + 2 ft	BFE + 2 ft	BFE + 2 ft or 500-year flood elevation, whichever is higher
Minimum Elevation** of Utilities and Equipment (ASCE 24-14 Table 7-1)	Zone A	BFE + 1 ft	BFE + 1 ft	BFE + 1ft	BFE + 2 ft or 500-year flood elevation, whichever is higher
	Zone V	BFE + 2 ft	BFE + 2 ft	BFE + 2 ft	BFE + 2 ft or 500-year flood elevation, whichever is higher
Minimum Elevation of Dry Floodproofing of non-residential structures and non-residential portions of mixed-use buildings (ASCE 24-14 Table 6-1)	Zone A	BFE + 1 ft	BFE + 1 ft	BFE + 1ft	BFE + 2 ft or 500-year flood elevation, whichever is higher
	Zone V	Not Permitted	Not Permitted	Not Permitted	Not Permitted
Minimum Elevation of Wet Floodproofing*** (ASCE 24-14 Table 6-1)	Zone A	BFE + 1 ft	BFE + 1 ft	BFE + 1ft	BFE + 2 ft or 500-year flood elevation, whichever is higher
	Zone V	Not Permitted	Not Permitted	Not Permitted	Not Permitted

*Flood Design Class 1 structures shall be allowed below the minimum elevation if the structure meets the wet floodproofing requirements of ASCE 24-14 Section 6.3.

**Unless otherwise permitted by ASCE 24-14 Chapter 7.

***Only if permitted by ASCE 24-14 Section 6.3.1.

Note: In V zones location of utilities and equipment to the indicated level is required. Protection of utilities and equipment below the indicated level is not accepted.

APPENDIX G – ASCE 24-14

American Society of Civil Engineers

Flood Resistant Design and Construction

This document uses both the International System of Units (SI) and customary units.

AMERICAN SOCIETY OF CIVIL ENGINEERS

STRUCTURAL ENGINEERING INSTITUTE

Published by the American Society of Civil Engineers

Table 1-1 Flood Design Class of Buildings and Structures

Use or Occupancy of Buildings and Structures	Flood Design Class
Buildings and structures that normally are unoccupied and pose minimal risk to the public or minimal disruption to the community should they be damaged or fail due to flooding. Flood Design Class 1 includes (1) temporary structures that are in place for less than 180 days, (2) accessory storage buildings and minor storage facilities (does not include commercial storage facilities), (3) small structures used for parking of vehicles, and (4) certain agricultural structures.[a]	1
Buildings and structures that pose a moderate risk to the public or moderate disruption to the community should they be damaged or fail due to flooding, except those listed as Flood Design Classes 1, 3, and 4. Flood Design Class 2 includes the vast majority of buildings and structures that are not specifically assigned another Flood Design Class, including most residential, commercial, and industrial buildings.	2
Buildings and structures that pose a high risk to the public or significant disruption to the community should they be damaged, be unable to perform their intended functions after flooding, or fail due to flooding. Flood Design Class 3 includes (1) buildings and structures in which a large number of persons may assemble in one place, such as theaters, lecture halls, concert halls, and religious institutions with large areas used for worship; (2) museums; (3) community centers and other recreational facilities; (4) athletic facilities with seating for spectators; (5) elementary schools, secondary schools, and buildings with college or adult education classrooms; (6) jails, correctional facilities, and detention facilities; (7) healthcare facilities not having surgery or emergency treatment capabilities; (8) care facilities where residents have limited mobility or ability, including nursing homes but not including care facilities for five or fewer persons; (9) preschool and child care facilities not located in one- and two-family dwellings; (10) buildings and structures associated with power generating stations, water and sewage treatment plants, telecommunication facilities, and other utilities which, if their operations were interrupted by a flood, would cause significant disruption in day-to-day life or significant economic losses in a community; and (11) buildings and other structures not included in Flood Design Class 4 (including but not limited to facilities that manufacture, process, handle, store, use, or dispose of such substances as hazardous fuels, hazardous chemicals, hazardous waste, or explosives) containing toxic or explosive substances where the quantity of the material exceeds a threshold quantity established by the authority having jurisdiction and is sufficient to pose a threat to the public if released.[b]	3
Buildings and structures that contain essential facilities and services necessary for emergency response and recovery, or that pose a substantial risk to the community at large in the event of failure, disruption of function, or damage by flooding. Flood Design Class 4 includes (1) hospitals and health care facilities having surgery or emergency treatment facilities; (2) fire, rescue, ambulance, and police stations and emergency vehicle garages; (3) designated emergency shelters; (4) designated emergency preparedness, communication, and operation centers and other facilities required for emergency response; (5) power generating stations and other public utility facilities required in emergencies; (6) critical aviation facilities such as control towers, air traffic control centers, and hangars for aircraft used in emergency response; (7) ancillary structures such as communication towers, electrical substations, fuel or water storage tanks, or other structures necessary to allow continued functioning of a Flood Design Class 4 facility during and after an emergency; and (8) buildings and other structures (including, but not limited to, facilities that manufacture, process, handle, store, use, or dispose of such substances as hazardous fuels, hazardous chemicals, or hazardous waste) containing sufficient quantities of highly toxic substances where the quantity of the material exceeds a threshold quantity established by the authority having jurisdiction and is sufficient to pose a threat to the public if released.[b]	4

[a] Certain agricultural structures may be exempt from some of the provisions of this standard; see Section C1.4.3.
[b] Buildings and other structures containing toxic, highly toxic, or explosive substances shall be eligible for assignment to a lower Flood Design Class if it can be demonstrated to the satisfaction of the authority having jurisdiction by a hazard assessment as described in Section 1.5.3 of *Minimum Design Loads for Buildings and Other Structures* that a release of the substances is commensurate with the risk associated with that Flood Design Class.

APPENDIX H – NOAA NOS STATION INFORMATION

Search

PRODUCTS (/products.html) Data, Analyses, and Publications
PROGRAMS (/programs.html) Serving the Nation
EDUCATION (/education html) Tides, Currents, and Predictions
HELP & ABOUT (/about html) Info and how to reach us

Home (/) / Stations (stations.html) / 8443970 Boston, MA

Station Info | Tides/Water Levels | Meteorological Obs. (/met html?id=8443970) | Phys. Oceanography (/physocean html?id=8443970)

Boston, MA - Station ID: 8443970

Station Info | Today's Tides | Photos | Sensor Information | Observations | Directions and Map | Available Products

Established:	May 3 1921
Time Meridian:	75° W
Present Installation:	
Date Removed:	N/A
Water Level Max (ref MHHW):	4 82 ft. (02/07/1978)
Water Level Min (ref MLLW):	-3.72 ft. (03/24/1940)
Mean Range:	9.49 ft.
Diurnal Range:	10 27 ft.
Latitude	42° 21.2' N
Longitude	71° 3.2' W
NOAA Chart#:	13272 (http://www.charts.noaa.gov/OnLineViewer/13272.shtml)
Met Site Elevation:	11.1 ft. above MSL

Today's Tides (LST/LDT)

next tide at
5:52 PM
low

5:39 AM	low	-1.02 ft.
11:55 AM	high	10.35 ft.
5 52 PM	**low**	**-0.03** ft.

Boston, MA

9 more station photos available, click to view.

(stationphotos.html?id=8443970)

NSTAR Electric Company d/b/a Eversource Energy
Project Change- Appendix G
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Sensor Information

Sensor	Sensor ID	DCP#	Sensor Height	Status
Water Level	A1	1	N/A	Enabled
Air Temp	D1	1	15.7 ft. above site elevation	Enabled
Water Temp	E1	1	4.4 ft. below MLLW	Enabled
Air Pressure	F1	1	19.4 ft. above MSL	Enabled

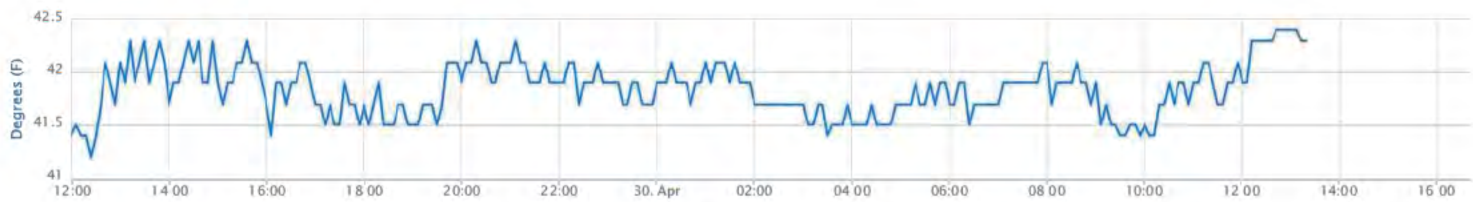
For questions about disabled sensors, please contact CO-OPS User Services (mailto:co-ops.userservices@noaa.gov).

Observations

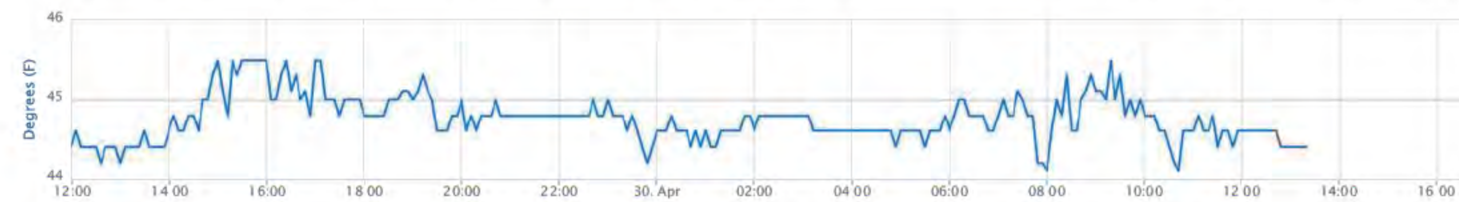
Standard Metric

Water Levels
10.37ft.
above MLLW
as of 04/30/2014 13:18 LST/LDT

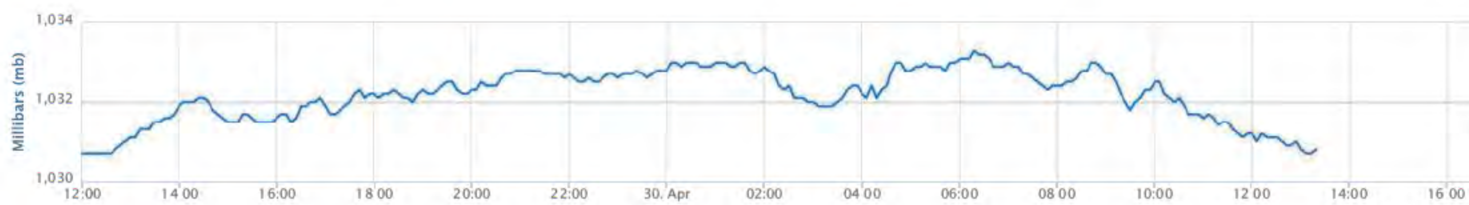
Air Temp
42.3°F
as of 04/30/2014 13:18 LST/LDT



Water Temp
44.4°F
as of 04/30/2014 13:18 LST/LDT



Air Pressure
1030.8
millibars
as of 04/30/2014 13:18 LST/LDT



How to reach To reach the tidal bench marks from north bound lane of U.S. Interstate Highway 93 and the Atlantic and Northern Aven to the U.S. Coast Guard Building at the intersection of Atlantic and Northern Avenues. The bench marks are in the vicinity of the U.S. Cc Custom House, U.S. Post Office and at the intersection of Purchase and High Streets. The tide station is located on the right side of the adjacent to Northern Avenue Bridge.

Show nearby stations

Products available at 8443970 Boston, MA

TIDES/WATER LEVELS

Water Levels (/waterlevels.html?id=8443970)

NOAA Tide Predictions (/noaatidepredictions/NOAATidesFacade jsp?Stationid=8443970)

Harmonic Constituents (/harcon.html?id=8443970)

Sea Level Trends (/sltrends/sltrends_station shtml?stnid=8443970)

Datums (/datums.html?id=8443970)

Benchmarks (/benchmarks.html?id=8443970)

Extreme Water Levels (/est/est_station shtml?stnid=8443970)

Reports (/reports html?id=8443970)

METEOROLOGICAL/OTHER

Meteorological Observations (/met.html?id=8443970)

Water Temp/Conductivity (/physocean.html?id=8443970)

PORTS®

This station is not a member of PORTS®

OPERATIONAL FORECAST SYSTEMS

This station is not a member of OFS

INFORMATION

Station Home Page (/stationhome.html?id=8443970)

Data Inventory (/inventory html?id=8443970)

Measurement Specifications (/measure.html)

Information

About CO-OPS (/about.html)
Disclaimers (/disclaimers.html)
Contact Us (/contact.html)
Privacy Policy (/privacy html)

Products

PORTS (/ports.html)
OFS (/models.html)
Tide Predictions (/tide_predictions html)
Currents (/cdata/StationList?type=Current+Data&filter=active)
More about products... (/products.html)

Programs

Mapping and Charting Support (/mapping html)
Maritime Services (/maritime.html)
COASTAL (/coastal html)
More about programs... (/programs.html)

Partners

Hydrographic Survey Support (/hydro html)
Marsh Restoration (/marsh html)
GoMOOS (/gomoos.html)
TCOON (/tcoon.html)

Revised: 10/15/2013
NOAA (http //www.noaa.gov) / National Ocean Service (http://oceanservice noaa.gov)
Web site owner: Center for Operational Oceanographic Products and Services

TIDES & CURRENTS

PRODUCTS
Data, Analyses, and Publications

PROGRAMS
Serving the Nation

EDUCATION
Tides, Currents, and Predictions

HELP & ABOUT
Info and how to reach us

- Home /
- Products /
- Datums /
- 8443970 Boston, MA
-
  - 8443970 Boston, MA
  - 8443725 Chelsea, MA
  - Manage Favorites

- Station Info
  - Station Home Page
  - Data Inventory
- Tides/Water Levels
  - Water Levels
  - Harmonic Constituents
  - Datums
  - Benchmarks
  - NOAA Tide Predictions
  - Sea Level Trends
  - Extreme Water Levels
  - Reports
- Meteorological Obs.
- Phys. Oceanography

Datums for 8443970, Boston MA

Elevations on Station Datum
Station: 8443970, Boston, MA
Status: Accepted (Apr 17 2003)
Units: Feet
T.M.: 75 W
Epoch: 1983-2001
Datum: STND

Datum	Value	Description
MHHW	13.80	Mean Higher-High Water
MHW	13.36	Mean High Water
MTL	8.61	Mean Tide Level
MSL	8.73	Mean Sea Level
DTL	8.66	Mean Diurnal Tide Level
MLW	3.86	Mean Low Water
MLLW	3.52	Mean Lower-Low Water
NAVD88	9.03	North American Vertical Datum of 1988
STND	0.00	Station Datum
GT	10.27	Great Diurnal Range

MN	9.49	Mean Range of Tide
DHQ	0.44	Mean Diurnal High Water Inequality
DLQ	0.34	Mean Diurnal Low Water Inequality
HWI	3.74	Greenwich High Water Interval (in hours)
LWI	9.93	Greenwich Low Water Interval (in hours)
Maximum	18.62	Highest Observed Water Level
Max Date & Time	02/07/1978 10:36	Highest Observed Water Level Date and Time
Minimum	-0.20	Lowest Observed Water Level
Min Date & Time	03/24/1940 00:00	Lowest Observed Water Level Date and Time
HAT	15.95	Highest Astronomical Tide
HAT Date & Time	11/05/1998 16:30	HAT Date and Time
LAT	1.25	Lowest Astronomical Tide
LAT Date & Time	12/23/1999 22:30	LAT Date and Time

Tidal Datum Analysis Periods

01/01/1983 - 12/31/2001

To refer water level heights to NAVD88 (North American Vertical Datum of 1988), apply the values located at National Geodetic Survey.

Created with Highcharts 3.0.6

Datums for 8443970, Boston, MA

DHQ: 0.44DLQ: 0.34MN: 9.49GT: 10.27MHHW: 13.80MHW: 13.36DTL: 8.66MTL: 8.61MSL: 8.73MLW: 3.86MLLW: 3.52NAVD88: 9.03Datums468101214NOAA/NOS/CO-OPS

Showing datums for 8443970 Boston, MA

Data Units

Feet Meters

Epoch

Present (1983-2001) Superseded (1960-1978)

Submit

Search

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EDUCATION (/education.html) Tides, Currents, and Predictions

HELP & ABOUT (/about.html) Info and how to reach us

Home (/) / Stations (stations.html) / 8443725 Chelsea, MA

Station Info Tides/Water Levels Meteorological Obs. Phys. Oceanography

Chelsea, MA - Station ID: 8443725

Station Info Today's Tides Photos Sensor Information Observations Directions and Map Available Products

Established:	Jun 11 2002
Time Meridian:	75° W
Present Installation:	
Date Removed:	Oct 19 2002
Water Level Max (ref MHHW):	ft. ( )

Today's Tides (LST/LDT)

12:11 AM	high	11.02 ft.
6:25 AM	low	-0.51 ft.
12:43 PM	**high**	**9.9 ft.**
6:38 PM	low	0.6 ft.

No photos are available for this station. (stationphotos.html?id=8443725)

NSTAR Electric Company d/b/a Eversource Energy
Project Change- Appendix G
Page 67 of 75

Water Level Min (ref MLLW):	ft. ( )
Mean Range:	9.56 ft.
Diurnal Range:	10.35 ft.
Latitude	42° 23.2' N
Longitude	71° 1.4' W
NOAA Chart#:	13272 (http://www.charts.noaa.gov/OnLineViewer/13272.shtml)
Met Site Elevation:	N/A

Sensor Information

Sensor	Sensor ID	DCP#	Sensor Height	Status

For questions about disabled sensors, please contact CO-OPS User Services (mailto:co-ops.userservices@noaa.gov).

Observations

Standard Metric

How to reach: To reach the tidal bench marks from the intersection of I-93 and Highway 16 in Boston, proceed east on Highway 16 for 7.1 km (4.4 mi) to Broadway (Highway 107), take the exit for Broadway and continue 0.3 km (0.2 mi) to Eastern Avenue, bear left and proceed south on Eastern Avenue for 1.6 km (1.0 mi) to Chelsea Street, then bear left and continue south on Chelsea Street for 0.3 km (0.2 mi) to the Chelsea Street Bridge. The bench marks are along Chelsea Street south of the bridge, and the tide gage was located on the bumper pier below the bridge.

Show nearby stations

Products available at 8443725 Chelsea, MA

TIDES/WATER LEVELS

Water Levels

NOAA Tide Predictions (/noaatidepredictions/NOAATidesFacade.jsp?Stationid=8443725)

Harmonic Constituents (/harcon.html?id=8443725)

Sea Level Trends

Datums (/datums.html?id=8443725)

Benchmarks (/benchmarks.html?id=8443725)

Extreme Water Levels

METEOROLOGICAL/OTHER

Meteorological Observations

Water Temp/Conductivity

PORTS®

This station is not a member of PORTS®

OPERATIONAL FORECAST SYSTEMS

This station is not a member of OFS

INFORMATION

Station Home Page (/stationhome.html?id=8443725)

Data Inventory (/inventory.html?id=8443725)

Measurement Specifications (/measure.html)

TIDES & CURRENTS

Datums for 8443725, Chelsea MA

Elevations on Station Datum
Station: 8443725, Chelsea, MA
Status: Accepted (Oct 7 2003)
Units: Feet
T.M.: 75 W
Epoch: 1983-2001
Datum: STND

Datum	Value	Description
MHHW	24.07	Mean Higher-High Water
MHW	23.62	Mean High Water
MTL	18.84	Mean Tide Level
MSL	18.96	Mean Sea Level
DTL	18.89	Mean Diurnal Tide Level
MLW	14.06	Mean Low Water
MLLW	13.72	Mean Lower-Low Water
NAVD88		North American Vertical Datum of 1988
STND	0.00	Station Datum
GT	10.35	Great Diurnal Range

MN	9.56	Mean Range of Tide
DHQ	0.45	Mean Diurnal High Water Inequality
DLQ	0.34	Mean Diurnal Low Water Inequality
HWI	3.74	Greenwich High Water Interval (in hours)
LWI	9.93	Greenwich Low Water Interval (in hours)
Maximum		Highest Observed Water Level
Max Date & Time		Highest Observed Water Level Date and Time
Minimum		Lowest Observed Water Level
Min Date & Time		Lowest Observed Water Level Date and Time
HAT		Highest Astronomical Tide
HAT Date & Time		HAT Date and Time
LAT		Lowest Astronomical Tide
LAT Date & Time		LAT Date and Time

Tidal Datum Analysis Periods

07/01/2002 - 09/30/2002

To refer water level heights to NAVD88 (North American Vertical Datum of 1988), apply the values located at National Geodetic Survey.

Created with Highcharts 3.0.6

Datums for 8443725, Chelsea, MA

DHQ: 0.45DLQ: 0.34MN: 9.56GT: 10.35MHHW: 24.07MHW: 23.62DTL: 18.89MTL: 18.84MSL: 18.96MLW: 14.06MLLW: 13.72Datums141618202224NOAA/NOS/CO-OPS

Showing datums for 8443725 Chelsea, MA

Data Units

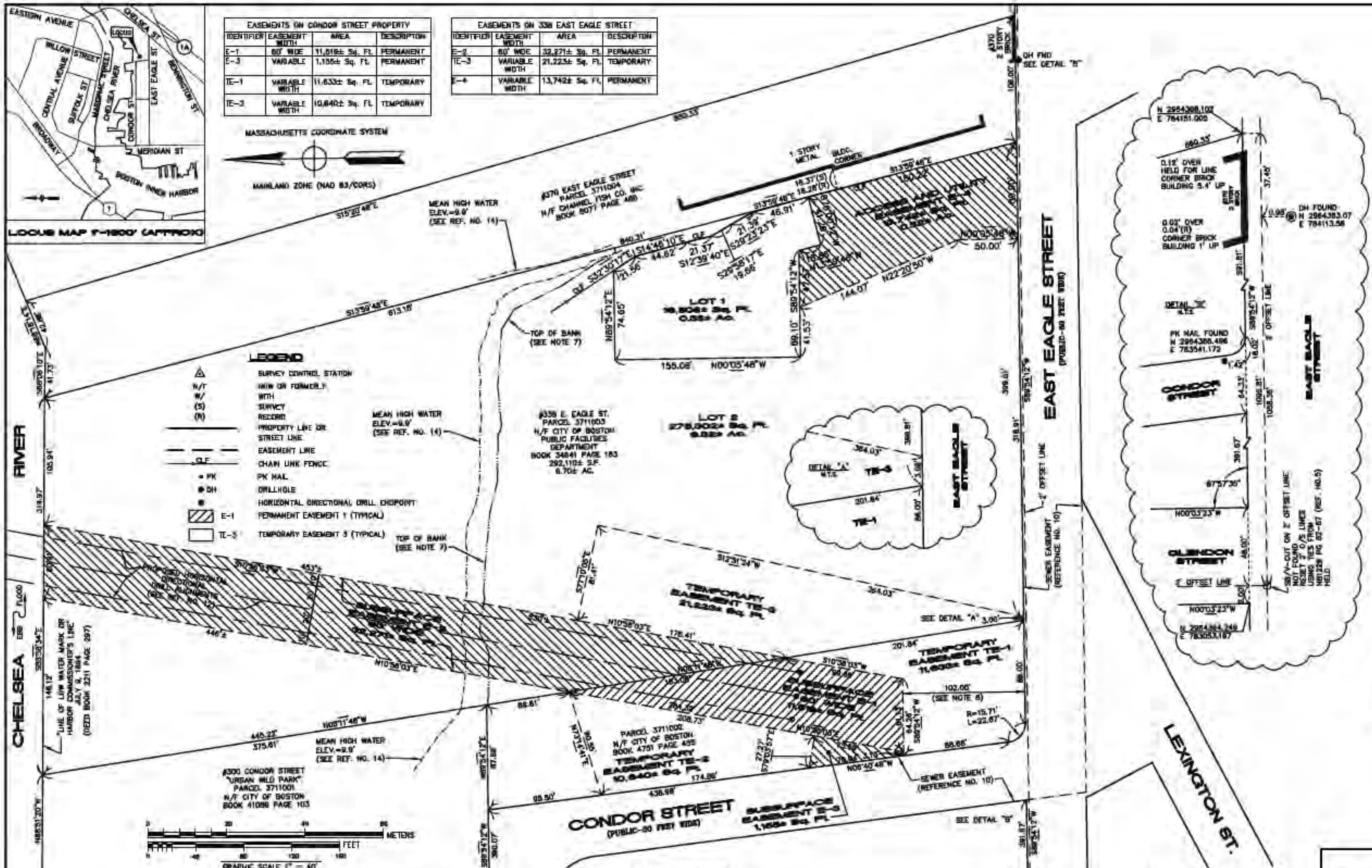
Feet Meters

Epoch

Present (1983-2001) Superseded (1960-1978)

Submit

APPENDIX I – SURVEY MAPS



EASEMENTS ON CONDOR STREET PROPERTY			
IDENTIFIER	EASEMENT WIDTH	AREA	DESCRIPTION
E-1	60' WIDE	11,519± Sq. Ft.	PERMANENT
E-3	VARIABLE	1,155± Sq. Ft.	PERMANENT
TE-1	VARIABLE WIDTH	11,633± Sq. Ft.	TEMPORARY
TE-2	VARIABLE WIDTH	10,640± Sq. Ft.	TEMPORARY

EASEMENTS ON 338 EAST EAGLE STREET			
IDENTIFIER	EASEMENT WIDTH	AREA	DESCRIPTION
E-2	60' WIDE	32,271± Sq. Ft.	PERMANENT
TE-3	VARIABLE WIDTH	21,223± Sq. Ft.	TEMPORARY
E-4	VARIABLE WIDTH	13,742± Sq. Ft.	PERMANENT

FOR REGISTRY USE ONLY

NOTES

1. THIS PLAN IS BASED ON THE CITED RECORD DESCRIPTIONS, ADDITIONAL REFERENCES, AND AN ON-THE-GROUND, INSTRUMENT SURVEY MADE MARCH 20-31, 2009.

2. COORDINATES, IN U.S. SURVEY FEET, ARE IN THE MASSACHUSETTS COORDINATE SYSTEM, MAINLAND ZONE, REFERENCED TO THE NORTH AMERICAN DATUM OF 1983, CONTINUOUSLY OPERATING REFERENCE STATIONS ADJUSTMENT (NAD 83/CORS), AS DETERMINED BY SMC'S PROJECT NETWORK OF G.P.S. OBSERVATIONS MADE MARCH 24, 2009, AND TOTAL STATION TRAVERSING. THIS NETWORK IS BASED UPON THE KeyNet GPS VIRTUAL REFERENCE STATION SYSTEM (VRS).

3. ELEVATIONS, IN U.S. SURVEY FEET, ARE REFERENCED TO THE MEAN LOW LOW WATER VERTICAL DATUM (MLLW), AS DETERMINED BY SMC'S PROJECT NETWORK OF G.P.S. OBSERVATIONS, TOTAL STATION TRAVERSING AND DIFFERENTIAL LEVELING (SEE NOTE 2). THIS VERTICAL DATUM IS BASED ON TIDAL BENCH MARK NO. 1 1945, A U.S. COAST & GEODETIC SURVEY DISK AT THE SOUTHWESTERLY CORNER OF THE CHELSEA STREET BRIDGE:

BM NO. 1 1945: ELEV. = 15.18 FT. MLLW (REFERENCE NO. 14)

4. THE BOUNDARIES OF THE DEPICTED PROPERTIES, EASEMENTS AND ABUTTING WAYS WERE RETRACED FROM THE REFERENCED PLANS AND SURVEYED MONUMENTATION.

5. THE PUBLIC OR PRIVATE STATUS OF THE DEPICTED WAYS IS ACCORDING TO "BOSTON'S STREETS" FROM THE PUBLIC WORKS DEPARTMENT, JANUARY 1, 1999.

6. PROPERTY OWNERSHIPS AND TITLE CITATIONS WERE OBTAINED FROM THE CITY OF BOSTON ASSESSORS' ON-LINE DATA BASE IN JULY, 2009.

7. THE TOP OF BANK, AS SHOWN APPROXIMATELY HEREON, WAS MARKED BY TRC JULY 10, 2009, AND DECEMBER 8, 2010, AND LOCATED BY INSTRUMENT SURVEY.

8. THE 102.00 FT. SETBACK LINE IS ACCORDING TO THE CITY OF BOSTON'S "CHARLESTOWN" DESIGN FOR THE DEVELOPMENT OF THESE TWO PROPERTIES, AUGUST, 2010.

9. NO SUBSURFACE UTILITY LINES HAVE BEEN COMPILED FOR THIS PLAN, AND SMC ASSUMES NO RESPONSIBILITY FOR DAMAGES INCURRED AS A RESULT OF UTILITIES NOT SHOWN.

SMC ASSUMES NO RESPONSIBILITY FOR DAMAGES INCURRED AS A RESULT OF UTILITIES OMITTED OR INACCURATELY SHOWN. BEFORE CONSTRUCTION, ALL UTILITIES, PUBLIC AND PRIVATE MUST BE NOTIFIED (SEE MASSACHUSETTS GENERAL LAWS, CHAPTER 82 SECTION 40.) CALL "DIG SAFE" 1 (888) 344-7233 HTTP://WWW.DIGSAFE.COM.

THIS PLAN HAS BEEN PREPARED IN CONFORMANCE WITH THE RULES AND REGULATIONS OF THE REGISTERS OF DEEDS OF THE COMMONWEALTH OF MASSACHUSETTS.

STEPHEN E. SPRINGER, PLS
MASSACHUSETTS REG. No. 31728

REFERENCES

1. CONDOR STREET, EAST BOSTON, MA
PREPARED BY: CITY OF BOSTON
STREET LAYING OUT DEPARTMENT
DATED: SEPTEMBER 1, 1914, SCALE: 1"=40'
LAYOUT NO. L4753

2. CONDOR STREET/ EAST EAGLE STREET
EAST BOSTON, MA
PREPARED BY: CITY OF BOSTON
STREET LAYING OUT DEPARTMENT
DATED: JUNE 12, 1924, SCALE: 1"=40'
LAYOUT NO. L5734

3. CONDOR STREET/ EAST EAGLE STREET
EAST BOSTON, MA
PREPARED BY: CITY OF BOSTON
STREET LAYING OUT DEPARTMENT
DATED: DECEMBER 9, 1925, SCALE: 1"=20'
LAYOUT NO. L5814

4. WIDENING AND SPECIFIC REPAIR
CONDOR STREET FROM MERIDIAN STREET
TO EAST EAGLE STREET
CITY OF BOSTON PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION
DATED: MARCH 2, 1964, SCALE: 1"=20'
LAYOUT NO.S L9653 AND L9652

5. CITY OF BOSTON ENGINEERING DEPARTMENT
SURVEY NOTEBOOK 1250, PAGE 129
SURVEY NOTEBOOK 1229, PAGES 83-89
SURVEY NOTEBOOK 848, PAGES 22-23

6. PLAN OF LAND IN EAST BOSTON, MASS.
OWNED BY BOSTON NATURAL AREAS FUND, INC.
SHOWING BOSTON EDISON COMPANY UTILITY EASEMENT
DATED: MAY 28, 1980, SCALE 1"=40'
BOOK 9500, PAGE 12

7. PLAN OF LAND IN
EAST BOSTON, MASS. (SUFFOLK COUNTY)
PREPARED FOR PUBLIC FACILITIES DEPARTMENT
CITY OF BOSTON
PREPARED BY: BRYANT ASSOCIATES, INC.
DATED: DECEMBER 29, 2001, SCALE 1"=40'
BOOK 34641, PAGE 183

8. RECORD CONDITIONS PLAN OF LAND
LOCATED IN EAST BOSTON, MASS.
PREPARED FOR BOSTON WATER AND SEWER COMM.
PREPARED BY: GEOD CONSULTING, INC.
DATED: APRIL 1, 2003, SCALE 1"=40'
PLAN# K-2528

9. ACTIVITY AND USE LIMITATION PLAN
300 CONDOR STREET, URBAN WILD, EAST BOSTON, MA.
PREPARED FOR CITY OF BOSTON PARKS
AND RECREATION DEPARTMENT
PREPARED BY: COLER & COLANTONIO, INC.
DATED: SEPTEMBER 19, 2008, SCALE 1"=30'
PLAN NO. 973 OF 2008

10. EAST BOSTON BRANCH SEWER RELIEF PROJECT EASEMENT PLAN
MASSACHUSETTS WATER RESOURCES AUTHORITY
CONDOR STREET AND EAST EAGLE STREET, BOSTON, MA
PREPARED BY: NITSCH ENGINEERING, INC.
DATED: MAY 2008, SCALE: 1"=40'
PLAN NO. 386 OF 2008

11. SITE PLAN, CHELSEA RIVER CROSSING
EAST EAGLE STREET, EAST BOSTON, MA
MARGINAL STREET, CHELSEA, MA
PREPARED BY: SURVEYING AND MAPPING CONSULTANTS, INC.
DATED: NOVEMBER 24, 2009, LAST REVISED MARCH, 2010
SCALE: 1"=40', DRAWING NO. 013606 SITE PLAN.DWG

12. TRIPLE HDD ALIGNMENT IN AUTOCAD FILE ALIGNMENT SHIFT-WORKSPACE 112409.DWG, RECEIVED NOV. 24, 2009, FROM J.D. HAIR & ASSOCIATES, TULSA, OK.

13. TEMPORARY WORK SPACES IN AUTOCAD FILE, JDH WORKSPACE AND ALIGNMENTS 111309.DWG, RECEIVED NOVEMBER 13, 2009 FROM J.D. HAIR & ASSOCIATES, TULSA, OK.

14. NOAA BENCHMARK DATA SHEETS, CHELSEA, MA STATION I.D. 8443725 CHELSEA ST. BRIDGE. PUBLICATION DATE: OCTOBER 7, 2003 (1983-2001 TIDAL EPOCH)

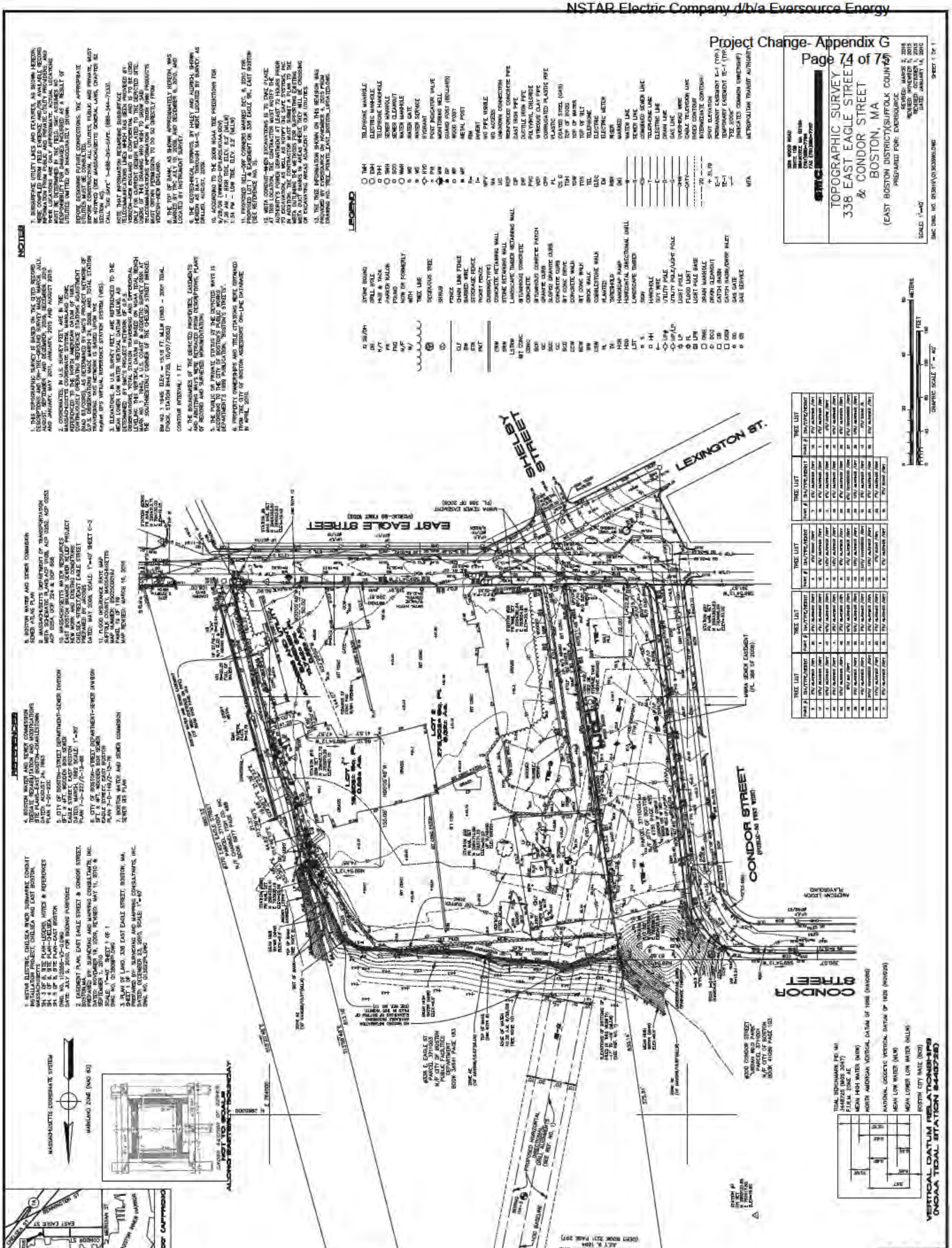
SMC
325 WOOD ROAD
SUITE 109
BRAINTREE MA 02184
(781)380-7799
FAX (781)380-7787

PLAN OF LAND
338 EAST EAGLE STREET AND CONDOR STREET BOSTON, MA

(EAST BOSTON DISTRICT)(SUFFOLK COUNTY)
PREPARED FOR: CITY OF BOSTON

SCALE: 1"=40'
JANUARY 31, 2011

SMC DWG. NO. 013822PL+EASE.DWG
SHEET 1 OF 1


NOTES
REFERENCES
LEGEND
TOPOGRAPHIC SURVEY
338 EAST EAGLE STREET
& CONDOR STREET
BOSTON, MA
(EAST BOSTON DISTRICT)(SUFFOLK COUNTY)
EAST EAGLE STREET
CONDOR STREET
SHELBY STREET
LEXINGTON ST.
CHELSEA RIVER
LOCUS MAP
VERTICAL DATUM RELATIONSHIPS
TREE LIST
GRAPHIC SCALE

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CITY OF BOSTON
Inspectional Services Department
Mayor Martin J. Walsh
1010 Massachusetts Ave., Boston, MA 02118

October 26th, 2018

Duane Boyce, Project Manager
Eversource Energy
247 Station Drive
Westwood, MA 02090

Re: Eversource Energy - East Eagle Substation

Dear Mr. Boyce:

By letter dated November 3, 2015, the City of Boston confirmed its support of the petition of NSTAR Electric Company d/b/a Eversource Energy ("Eversource" or the "Company") for individual and comprehensive zoning exemptions from the operation of the Boston Zoning Act and Code for the Company's proposed transmission substation at 338 East Eagle Street (the "East Eagle Substation") in East Boston, Massachusetts.

The East Eagle Substation is part of the Company's "Mystic-East Eagle-Chelsea Reliability Project" ("Project"), which also includes the construction of two 115-kV underground transmission lines that would connect existing substations with the East Eagle Substation. On March 23, 2016, the Energy Facilities Siting Board ("Siting Board") approved the Project, which included the grant of the requested zoning exemptions and the approval of the location of the Substation on East Eagle Street (the "Final Decision"). NSTAR Electric Company d/b/a Eversource Energy, EFSB 14-04/D.P.U. 14-153/14-154 (2017).

Condition A of the Final Decision directed the Company to evaluate the relocation of the East Eagle Street Substation further to the west of the approved location. Discussions between the City and the Company resulted in the Company's purchase of City-owned land at East Eagle Street and Condor Street, which is approximately 240 feet to the west of the approved location. The Company is seeking necessary approvals from the Siting Board to relocate the Substation.

The City has participated in various conversations and meetings with Eversource about the relocation of the Substation. We understand and appreciate that Eversource has hosted meetings with East Eagle Street neighbors and stakeholders and that Eversource remains actively engaged in soliciting input from community members about the Project.

This letter confirms the City's continued support of the grant of zoning exemptions by the Siting Board pursuant to Section 6 of Chapter 665 of the Acts of 1956 for the construction of the Substation at the new location on East Eagle Street and Condor Street.

If you have any questions, please feel free to contact me.

Very truly yours,

William Christopher,
Commissioner