CITY *of* BOSTON
Martin J. Walsh, Mayor

April 28, 2020

Ms. Tori Kim
Assistant Secretary, Executive Office of Energy and Environmental Affairs
Director, MEPA
100 Cambridge St
Boston, MA 02110

RE: Northern Avenue Bridge Replacement Project

Dear Ms. Kim,

I am pleased to submit to the MEPA Office the Environmental Notification Form (ENF) for the Northern Avenue Bridge. The City of Boston's Public Works Department (BPWD) is looking forward to officially beginning the state permitting and public notification and comment process for this exciting public realm project.

The new Northern Avenue Bridge will provide a vital, vibrant, people-centric link between Downtown Boston, Atlantic Avenue and the Rose Kennedy Greenway and the South Boston Waterfront. The new bridge, a public destination project, was designed with the history of the original bridge, and the historic Boston waterfront as its inspiration. It will once again link the Harborwalk from Rowes Wharf to the Federal Courthouse without the need to travel along Atlantic Avenue and the Evelyn Moakley Bridge. It will serve as a beacon of welcome into the Fort Point Channel and with its open space promenade the bridge invites the public to the waterfront.

Getting to this permitting phase of the project did, however, take some time. Mayor Martin J. Walsh established the Mayor's Northern Avenue Bridge Task Force, which met from May of 2018 until December of 2019. In addition to the Task Force meetings, the BPWD convened three Community meetings, held individual stakeholder meetings and, most recently, has engaged in pre-filing meetings with affected regulatory agencies. With the filing of the ENF, BPWD now embarks on the state regulatory and public comment phase of the project.

As the ENF states, the project meets three MEPA thresholds relative to Historical Resources and Wetlands, Waterways and Tidelands: 11:03 (10) (b) 1 & 2 and; 11:03 (3) (b) 1 a and 6. The Massachusetts permits that will be required for the bridge include a Wetlands Protection Act Order of Conditions; a Water Quality Certification (CWA Section 401); and a Chapter 91 License and Dredge Permit. The BPWD has begun agency consultations as required for the Massachusetts Historic Commission's administrative process.

PUBLIC WORKS DEPARTMENT
Boston City Hall • 1 City Hall Sq Rm 714 • Boston MA 02201-2024
CHRIS OSGOOD • Chief of Streets, Transportation, and Sanitation
Phone (617) 635-2854 • Fax (617) 635-7499

I understand that a virtual site visit will be scheduled and I look forward to continuing to work with you and your staff on this vital public realm project.

Sincerely,

Para Jayasinghe

City Engineer

Cc: Chris Osgood, Chief of Streets, Transportation & Sanitation, City of Boston

Chris Cook, Chief of Environment, Energy, and Open Space, City of Boston

Sam Moffett, TRC Companies, Inc.

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Commonwealth of Massachusetts
Executive Office of Energy and Environmental Affairs
Massachusetts Environmental Policy Act (MEPA) Office

Environmental Notification Form

For Office Use Only

EEA#: ____________________

MEPA Analyst: _____________

The information requested on this form must be completed in order to submit a document electronically for review under the Massachusetts Environmental Policy Act, 301 CMR 11.00.

Project Name: Northern Avenue Bridge Replacement Project		
Street Address: Northern Avenue Bridge		
Municipality: Boston	Watershed: Boston Harbor	
Universal Transverse Mercator Coordinates: 331212.55 E 4691169.61 N, Zone 19T	Latitude: 42.354484° N Longitude: -71.049435° W	
Estimated commencement date: 01/2020	Estimated completion date: 2022	
Project Type: Bridge Replacement	Status of project design: 25 %complete	
Proponent: City of Boston Public Works Department		
Street Address: Boston City Hall, One City Hall Square, Room 710		
Municipality: Boston	State: MA	Zip Code: 02110
Name of Contact Person: Para Jayasinghe		
Firm/Agency: Boston Public Works Department	Street Address: 1 City Hall Square, Room 710	
Municipality: Boston	State: MA	Zip Code: 02110
Phone: (617) 635-4968	Fax:	E-mail: para.jayasinghe@boston.gov

Does this project meet or exceed a mandatory EIR threshold (see 301 CMR 11.03)?
☐Yes ☒No

If this is an Expanded Environmental Notification Form (ENF) (see 301 CMR 11.05(7)) or a Notice of Project Change (NPC), are you requesting:

a Single EIR? (see 301 CMR 11.06(8)) ☐Yes ☒No
a Special Review Procedure? (see 301CMR 11.09) ☐Yes ☒No
a Waiver of mandatory EIR? (see 301 CMR 11.11) ☐Yes ☒No
a Phase I Waiver? (see 301 CMR 11.11) ☐Yes ☒No
(Note: Greenhouse Gas Emissions analysis must be included in the Expanded ENF.)

Which MEPA review threshold(s) does the project meet or exceed (see 301 CMR 11.03)?
301 CMR 11.03(3)(b)(6) Construction, reconstruction or expansion of an existing solid fill structure of 1,000 or more sf base area or of a pile-supported or bottom-anchored structure of 2,000 or more sf base area, except a seasonal, pile-held or bottom-anchored float, provided the structure occupies flowed tidelands or other waterways.

301 CMR 11.03(3)(b)(1)(a) alteration of coastal bank.

301 CMR 11.03(10)(b)(1) demolition of all or any exterior part of any Historic Structure listed in or located in any Historic District listed in the State Register of Historic Places or the Inventory of Historic and Archaeological Assets of the Commonwealth;

Which State Agency Permits will the project require?
MA Wetlands Protection Act Order of Conditions, MADEP Water Quality Certification (CWA Section 401); MADEP Chapter 91 License and Dredge Permit, CZM Consistency Certification; MHC PNF, Determination of Adverse Effect

Identify any financial assistance or land transfer from an Agency of the Commonwealth, including the Agency name and the amount of funding or land area in acres:
There is no financial assistance or land transfer from any Agency of the Commonwealth. The City of Boston is funding 100% of the project

Summary of Project Size & Environmental Impacts	**Existing**	**Change**	**Total**
LAND			
Total site acreage	2.0 +/-		
New acres of land altered		0	
Acres of impervious area	1.16	0.57	1.73
Square feet of new bordering vegetated wetlands alteration		NA	
Square feet of new other wetland alteration		2,488, but since there is 3,913 in restoration from existing pile and pier removal, there is actually a net increase of 1,425 SF of Land Under the Ocean	
Acres of new non-water dependent use of tidelands or waterways		NA	
STRUCTURES			
Gross square footage	50,525	25,051	75,576
Number of housing units	NA	0	NA
Maximum height (feet)	59.33	8.42	67.75
TRANSPORTATION			
Vehicle trips per day	0	110 bus trips (potential for occasional emergency vehicles)	110 bus trips (potential for occasional emergency vehicles)
Parking spaces	0	0	0
WASTEWATER			
Water Use (Gallons per day)	NA	NA	NA
Water withdrawal (GPD)	NA	NA	NA
Wastewater generation/treatment (GPD)	NA	NA	NA
Length of water mains (miles)	NA	NA	NA
Length of sewer mains (miles)	NA	NA	NA

Has this project been filed with MEPA before?
☐ Yes (EEA #__________) ☒ No

Has any project on this site been filed with MEPA before?
☐ Yes (EEA #__________) ☒ No

Note: Existing bridge does not have an impervious surface.

GENERAL PROJECT INFORMATION – all proponents must fill out this section

PROJECT DESCRIPTION:

Describe the existing conditions and land uses on the project site:

The Northern Avenue Bridge is a steel four-span, 643-foot long, pivot swing bridge with a steel truss span. The bridge was constructed between 1905 and 1908 by the City of Boston's Engineering Department. The bridge was closed to vehicular traffic in 1997 because of severe deterioration and was repurposed as a pedestrian and cycle bridge as part of the Boston Harbor Walk with pedestrian traffic using the north bay. It was closed to pedestrian traffic in December 2014 for safety concerns and hazard concerns for vessel traffic below, so it was left in its current an open position. In addition, the bridge underside is submerged in water during larger storm events.

The existing Northern Avenue Bridge is located over the Fort Point Channel in Boston, Massachusetts that connects Downtown to the Seaport District in South Boston. The Fort Point Channel is a tidally influenced waterbody that is approximately one mile in total length and 600 feet in width at the Northern Avenue Bridge site. The Northern Avenue Bridge is located at the mouth of the Fort Point Channel where it empties into Boston Harbor. The water depth of the Fort Point Channel in the area of the Northern Avenue Bridge ranges from approximately 10 to 20 feet and is deeper within the portion of the navigable area on the eastern, South Boston, side of channel (please see Figures 1-5 for additional detail.)

The bridge rests on granite block piers and abutments which are supported by concrete foundations and friction piles. The center swing pier, approximately 69-feet in diameter, is a massive concrete and granite structure which supports the swing span operating equipment set in a three-foot thick concrete turntable pit. A large draw/swing pier is located within the middle/central portion of the channel that contains the existing main portion of the bridge that previously pivoted open and close. There are two abutments and three piers comprised of large granite block walls located on each side of the channel and also within the channel. There is also an existing fender system and wooden piles (including remnant deteriorated piles) scattered within the middle/central portion of the channel.

An existing Bridge Tender's House is located to the north of the bridge.

The surrounding land use includes densely developed areas of commercial office buildings, residential apartment buildings and restaurants.

Describe the proposed project and its programmatic and physical elements:

The City of Boston Public Works Department (PWD) proposes to replace the Northern Avenue Bridge as a stationary pedestrian and bicycle bridge that would also allow potential transit (bus) and emergency vehicle access. The new bridge will be closed to other private vehicular traffic.

The project purpose is to re-establish, for public enjoyment, the connection of the Downtown and the South Boston Waterfront neighborhoods of Boston via a new bridge in the footprint of the old bridge. An ancillary project purpose is to raise the bridge to improve its climate resilience during future storm events. The ends of the bridge on both sides of the channel will be raised for both climate resilience and navigational purposes. It will be raised slightly more at the navigable channel in order to match the navigable clearance of the adjacent Seaport Boulevard Bridge (Moakley Bridge) of 16 feet above Mean High Water, allowing the bridge to remain stationary.

The project features a "Promenade" located where the old bridge swung open, which will be utilized as open space to enhance public access to and enjoyment of the waterfront.

Different conceptual designs for a new bridge were developed during the public participation and planning process for this project that was led by the City of Boston. To varying degrees, these conceptual designs reflected the history of the existing bridge and its historical context within the rich history of the Fort Point Channel and surrounding locales. The proposed new bridge design takes its inspiration from its Fort Point Channel location as a current and historical focal point of Boston Harbor.

The existing superstructure will be dismantled in place and loaded intact onto barges, which will then make their way to Dry Dock 4 where the superstructure will be deleaded. It is anticipated that the dismantling of the superstructure will be accomplished via barge mounted cranes.

Physical Elements of the Proposed New Northern Avenue Bridge

The Project will incorporate existing bridge elements into decorative, but not structural, components of the new bridge. Intended to be seen as an iconic beacon at the entrance of the Fort Point Channel, the new bridge is designed to be bold and unique, representing the future of the City as it celebrates the history of the City.

The proposed horizontal clearance will exceed the existing 75-foot wide clearance offered by the existing structure. The vertical clearances of the new bridge will match the clearances of the Evelyn F. Moakley Bridge (Seaport Boulevard Bridge), which is located to the south of the proposed bridge.

The proposed bridge will range in width, as it will be split into two separate travel lanes in the middle portion of the bridge over the Promenade. The bridge approaches to the East and West of the Promenade will begin at 44 feet and 63 feet in width, respectively, and gradually widen as they approach the promenade. The bisected lanes will each be 24 feet wide.

The bridge will be approximately 690 feet in length and will span the Fort Point Channel using new proposed piers located within the same alignment. Two of the new piers will be constructed immediately adjacent to the existing Piers 2 and 3 (on the landward side of the existing piers), and a new pier will be constructed in the footprint of the existing Pier 3. Additionally, new piers will be installed immediately adjacent to the center swing pier. Due to the structural deterioration and instability of the existing piers they cannot be reused to support the new bridge structure (see Attachment 6 – Substructure Inspection Report).

The Promenade will be built in three phases as depicted on the plans located in Attachment 2 and will be approximately 432 feet in length and 80 feet in width once complete. Phase 1, which measures 124 feet in length and 80 feet in width, will be constructed at the same time as the replacement bridge, and Phases 2 and 3 will be constructed as additional funding becomes available. Phase 1, the Promenade, will be constructed within the footprint of the existing fender pile field which supports the bridge as it is swung in the open position., and the Bridge Tenders house. The Promenade will not extend beyond the limits of the current bridge and its supporting elements. The waterfront Promenade will be located in the middle of the channel for the public to gather and view the harbor. It will provide a connection to adjacent public spaces, providing an inviting vibrant waterfront park envisioned to include with benches, swings, and grassy patches for lounging, a boardwalk area, and a long staircase lined with bushes and shrubs.

The project will result in temporary and permanent impacts to waters of the U.S. within the Commonwealth and include minor dredging for the purposes of new pier construction, existing pier demolition, and reconstruction of the western and eastern abutments. The dredging is required for construction purposes only, and no maintenance dredging will be required. It is not anticipated that dredging activities for construction will encroach into the federal navigational channel.

The construction will cause temporary and permanent impacts to coastal wetland resource areas including Land Under the Ocean, Land Containing Shellfish, Coastal Bank, Land Subject to Coastal Storm Flowage (LSCSF) and the 100-foot buffer zone to Coastal Bank that will be associated with construction of the new piers and new piles that will be placed in the Fort Point Channel. Mitigation for these impacts will be provided through the removal of the existing granite Piers 2 and 3, as well as the removal of wooden piles within draw fender pier those supporting the Bridge Tender's House.

Removal of the bridge will also require removal of lead and asbestos containing material (ACM) from the bridge superstructure and the Bridge Tenders House, respectively. The lead will be removed from the bridge superstructure after it has been transported to Dry Dock 4, and the ACM will be removed from the Bridge Tenders House prior to demolition. All materials will be handled with appropriate Best Management Practices (BMPs) and in accordance with any directives issued by MADEP.

Construction of the project is anticipated to begin in February 2021 with an approximate construction duration of 14 months and has a planned in-service date of April 2022. During this time period the existing bridge superstructure will be demolished and replaced in its entirety, and a pile supported promenade will be constructed in the area currently occupied by the draw fender pier and Bridge Tender's House. The bridge will be a fixed (non-movable) structure with the navigational channel configured to match the adjacent Seaport Boulevard Bridge (Moakley Bridge).

The project will generally include the following elements:

- Removal of existing superstructure and transport of the superstructure to Dry Dock 4;
- Demolition of the three granite and concrete side span piers and new piers constructed in similar
- locations;
- Replacement of the western bridge abutment and reconstruction of the eastern bridge abutment;
- Removal of existing timber piles (cut off below the mudline) within the draw fender pier and pile
- installation for the promenade;
- Construction of bridge superstructure;
- Removal of the Bridge Tender's House and draw fender pier over which the swing span sits when in
- the open position;
- Construction of the promenade; and,
- Configuration of the approaches to the bridge to accommodate the bridge profile and to make connections to the harbor walk.

NOTE: The project description should summarize both the project's direct and indirect impacts (including construction period impacts) in terms of their magnitude, geographic extent, duration and frequency, and reversibility, as applicable. It should also discuss the infrastructure requirements of the project and the capacity of the municipal and/or regional infrastructure to sustain these requirements into the future.

Describe the on-site project alternatives (and alternative off-site locations, if applicable), considered by the proponent, including at least one feasible alternative that is allowed under current zoning, and the reasons(s) that they were not selected as the preferred alternative:

The evaluation criteria and alternatives considered for the Project were established based on stakeholder input received through a series of community meetings and Mayoral Advisory Task Force (MATF) meetings held in 2018 and 2019. The PWD set four guiding principles on the framework of the conceptual development of alternatives, which were 1) improving mobility, 2) honoring history, 3) strengthening resiliency, and 4) creating a destination.

In addition to the framework, the concepts developed took into consideration style, size, uses and cost and were grouped into the following style options: Restore, Reinterpret, Contextual and Basic. A comprehensive alternatives analysis was then completed.

Each alternative that met the overall project purpose was evaluated based on practicability and environmental impacts to determine the Least Environmentally Damaging Practicable Alternative

(LEDPA). Practicability was determined by cost and technical and logistical factors. Environmental impacts included both adverse and beneficial effects on aquatic ecosystems and the overall environment before any minimization or mitigation efforts were considered. Once the LEDPA was determined, minimization of impacts and mitigation efforts were evaluated for the LEDPA only.

Project Alternatives

Five alternatives were considered for recreating the bridge crossing over Fort Port Channel: 1) No action; 2) Removal of the existing bridge (No build); 3) Rehabilitation of the existing bridge; 4) Replacement of the bridge incorporating the existing pier footing into the design of the new bridge; and 5) Complete replacement of the existing bridge and piers using staged construction (Preferred alternative).

Project Alternative 1 – No-Action Alternative: The No Action alternative does not meet the Purpose and Need of the project and is not an acceptable alternative given the bridge has reached the end of its service life and has been closed to pedestrian and vehicular traffic since 2014. Maintenance costs would continue to increase over time and the various issues associated with the obsolete features would not be addressed. The No Action alternate would likely result in the catastrophic failure of the bridge, causing the structure to collapse into Fort Point Channel. In addition to the safety concerns for people using Fort Point Channel for recreational boating and/ or travel, the US Coast Guard has previously requested to remove the old bridge to avoid potential safety and navigational concerns, and the falling structure would result in direct impacts to marine habitat greater than those that would occur with the benefit of controlled dismantling. For these reasons, the No Action Alternative is not feasible.

Project Alternative 2 –Removal of Existing Bridge: Removal of the existing bridge without the construction of a replacement bridge does not meet the Purpose and Need of the project, as the intent of the project is re-open the bridge for public enjoyment, provide additional means of pedestrian access across Fort Point Channel, provide a dedicated bus lane to reduce traffic congestion in Downtown Boston, and provide an alternate route for emergency vehicles if the need arises. The removal of the existing bridge without the construction of a replacement would likely result adverse impacts on the Fort Point Channel Historical District. Therefore, Project Alternative 2 is not an acceptable alternative. A controlled dismantling of the existing bridge would likely result in temporary environmental impacts similar to those that would occur during construction of a replacement bridge.

Project Alternative 3 – Rehabilitate Existing Bridge: The bridge has reached the end of its service life, and the existing steel superstructure has steel elements that are severely corroded and would require extensive and expensive rehabilitation that would not provide a 75-year design life. Rehabilitation of the bridge would require the replacement of the steel members and portions of members that are deteriorated and/or do not meet the load carrying capacity and re-using certain parts of the truss that meet load criteria. Rehabilitation would include splicing new steel to the existing steel members and reconstruction of the pin jointed connections which is anticipated not to be feasible since this complexity of steel fabrication is not easily performed and locating a fabricator capable of performing the work may not be possible. Certain load carrying members of the existing truss (for example tension only members) will require replacement due to fatigue life considerations.

Additionally, the bridge piers are in a state of disrepair and would require stabilization. The mechanical components that allow the swing bridge to open and close no longer function and would need to be replaced in their entirety. Rehabilitation of the existing bridge would result in temporary environmental impacts due to the placement of barges and/or work platforms and dredging to repair bridge piers. Rehabilitation of the existing bridge is not an acceptable alternative as the cost for conducting the required repairs would be prohibitive.

Project Alternative 4 – Bridge Replacement Using Existing Pier Footings: Constructing a new bridge along a similar horizontal and vertical alignment while using the existing pier footings would not provide a 75-year design life for the new bridge superstructure. The footings are currently 112 years old and would likely require continual inspections and costly maintenance activities throughout the lifespan of the new bridge. The existing bridge superstructure would be dismantled in a controlled manner and moved via barge to Dry Dock 4, the three existing piers would be demolished, and three new piers would be constructed in the same location. Permanent and temporary construction related environmental impacts would be similar to a complete bridge replacement. The reuse of the existing pier footings is not an acceptable alternative as the cost for conducting the future inspections and maintenance would be prohibitive.

Project Alternative 5 – Complete Bridge Replacement (LEDPA): The selected alternative is to construct a new bridge along a similar horizontal and vertical alignment. Full bridge replacement results in the removal of three existing piers and the construction of two new piers, thereby reducing the permanent environmental impacts and restoring a portion of the channel bottom. The existing bridge superstructure would be dismantled in a controlled manner and moved via barge to Dry Dock 4. The three existing piers would be demolished, and two new piers would be constructed along the same horizontal alignment. This approach has advantages with respect to the speed with which bridge reconstruction could be accomplished as the demolition of the existing piers and construction of the new piers would happen nearly simultaneously. The faster that the proposed bridge can be completed, the fewer impacts will be realized to the surrounding area. Full replacement of the bridge will provide safe passage of pedestrian and vehicular traffic, fulfilling the requirements of the Purpose and Need.

Complete Bridge Replacement Design Alternatives Considered

Complete Bridge Replacement design concepts were developed through the public planning process by evaluating specific bridge styles that would also accommodate realistic uses. Potential uses of the bridge are related to the size (width) of the bridge. All concepts evaluated and designed are to withstand a 75-year design life. All concepts would allow for the bridge to be raised for resiliency both in the center and at the approaches and were developed in the context of Boston Planning and Development Agency's climate resiliency design checklist.

Several design alternatives for bridge replacement were evaluated for the Project, reflecting architectural styles with different approaches to honoring the history of the existing bridge and the historical context of the project location including the maritime history of the Fort Point Channel and surrounding area. The design alternatives evaluated relate to the architectural elements and appearance of the bridge including a basic bridge, a sail, single arch, double arch, and truss appearance.

Replication

This concept involves building a truss bridge with all new steel following the same design as the existing bridge. This assumes the truss is replicated and is functional to support the current required loads but is a fixed bridge.

Reinterpret

This concept reinterprets the former Northern Avenue Bridge through the use of a modern truss structure, reflecting the scale, profile, and silhouette of the old bridge; merging a modern structural design with the historical spirit of the old bridge. It is designed to be in scale with the surrounding bridges at the Fort Point Channel.

Contextual

This concept draws inspiration from the location of Fort Point Channel as a focal point of the Boston Harbor. Historical and current maritime elements are incorporated into the design, evoking sails and movements. This bridge is intended to be seen as an iconic beacon at the beginning of the channel representing the history of the Fort Point Channel. It is designed to be bold and unique, representing the future of the City.

Basic

The Basic concept was developed to provide the minimum design of a structurally sound crossing of the Fort Point Channel. This bridge meets resiliency challenges and navigational clearance for the future. This structure is designed to be understated, creating a ribbon that cuts across the horizon and evokes the undulating patterns of the waves beyond relating it to the Fort Point Channel and Boston Harbor beyond in an uncluttered and simple way.

Conclusion of Alternatives Analysis

Project Alternative 5 is the preferred alternative and the LEDPA. The unsuitable and deteriorated condition of the existing substructure and structurally obsolete superstructure for the Northern Avenue Bridge over Fort Point Channel combine to make the complete superstructure and substructure replacement the only practicable alternative. This determination is based on the condition of the bridge elements and structural analysis, as well as evaluation of the risks associated with rehabilitating the steel in terms of schedule, cost and design life considerations. The selected design of the bridge was determined via several community meetings and stakeholder meetings held by the MATF beginning in late 2018. Public feedback received by the MATF indicated that there was overwhelming support for limiting bridge traffic to pedestrians, bikes, and emergency vehicles. PWD moved forward with a design that would meet the purpose and need of the project while addressing the needs of the local community and stakeholders.

NOTE*: The purpose of the alternatives analysis is to consider what effect changing the parameters and/or siting of a project, or components thereof, will have on the environment, keeping in mind that the objective of the MEPA review process is to avoid or minimize damage to the environment to the greatest extent feasible. Examples of alternative projects include alternative site locations, alternative site uses, and alternative site configurations.*

Summarize the mitigation measures proposed to offset the impacts of the preferred alternative:

Mitigation for environmental impacts will be provided through the removal of the existing granite Piers 2 and 3, as well as the removal of wooden piles within draw fender pier those supporting the Bridge Tender's House. Construction BMPs consisting of turbidity curtains will installed in the channel during construction and dredging to provide mitigation for the potential suspension of sediment in the water column. Additional erosion and sedimentation controls to be used on the site include compost filter tubes installed in upland areas. Silt sacks will also be installed in the existing catch basins downstream and adjacent to the Project area. Non-structural BMPs to be used during construction include dust control and pavement sweeping (if necessary). Removal of the bridge will also involve removal of lead at dry dock in order to protect water resources.

An increase in ambient noise within the project area will be caused by construction equipment. There are no known sensitive receptors adjacent to the project limits; however, Fan Pier Park and the Federal Courthouse are located nearby within close proximity. Fort Point Channel supports the spawning and juvenile development of winter flounder (*Pseudopleuronectes americanus*), which will be using the waterway for spawning during the time of construction. Mitigation for noise and acoustical underwater impacts will be provided through the use of vibratory hammers and/or a casing oscillator will be used where feasible (i.e. for cofferdam sheet pile installation) in lieu of impact hammers. When impact hammers are required for pile capacity (i.e. new pier piles within cofferdam), nylon or wood blocks will be used and acoustic ramp-up procedures will be followed. As described above, turbidity curtains will be installed around all in-water work activities, thereby further reducing acoustical under water impacts. Constructions activities are anticipated to occur during regular business hours. Noise levels will return to normal upon the completion of the project.

Mitigation for potential historical impacts will be provided through the thorough documentation of the existing bridge and the incorporation of existing bridge elements into decorative, but not structural, components of the project.

If the project is proposed to be constructed in phases, please describe each phase:

The project will generally include the following phases:

- Removal of existing superstructure and transport of superstructure to Dry Dock 4;

- Demolition of the three granite and concrete side span piers and new piers constructed in similar locations;
- Replacement of the western bridge abutment and reconstruction of the eastern bridge abutment;
- Removal of existing timber piles (cut off below the mudline) within the draw fender pier and pile installation for the promenade;
- Construction of bridge superstructure;
- Removal of the Bridge Tender's House and draw fender pier over which the swing span sits when in the open position;
- Construction of the promenade; and,
- Configuration of the approaches to the bridge to accommodate the bridge profile and to make connections to the harbor walk.

AREAS OF CRITICAL ENVIRONMENTAL CONCERN:
Is the project within or adjacent to an Area of Critical Environmental Concern?
☐Yes (Specify__________________________________)
☒No
if yes, does the ACEC have an approved Resource Management Plan? ___ Yes ___ No;
If yes, describe how the project complies with this plan.
____
Will there be stormwater runoff or discharge to the designated ACEC? ___ Yes ___ No;
If yes, describe and assess the potential impacts of such stormwater runoff/discharge to the designated ACEC.
____

RARE SPECIES:
Does the project site include Estimated and/or Priority Habitat of State-Listed Rare Species? (see http://www.mass.gov/dfwele/dfw/nhesp/regulatory_review/priority_habitat/priority_habitat_home.htm)
☐Yes (Specify__________________________________) ☒No

HISTORICAL /ARCHAEOLOGICAL RESOURCES:
Does the project site include any structure, site or district listed in the State Register of Historic Place or the inventory of Historic and Archaeological Assets of the Commonwealth?
☒Yes (Specify: The Northern Avenue Bridge (BOS.9000) and its Tender House (BOS.15356) are considered eligible for listing on the National Register of Historic Places (NRHP) and are contributing resources to the NRHP-listed Fort Point Channel Historic District (BOS.WZ). ☐No
If yes, does the project involve any demolition or destruction of any listed or inventoried historic or archaeological resources? ☒Yes (Specify: The Northern Avenue Bridge (BOS.9000) and its Tender House (BOS.15356) will be demolished. The existing bridge superstructure will be dismantled and transported via barge to Dry Dock 4. The preferred alternative includes potential incorporation of existing bridge elements into decorative, but not structural, components of the project.

☐No

WATER RESOURCES:
Is there an Outstanding Resource Water (ORW) on or within a half-mile radius of the project site? ___Yes _X_No;
if yes, identify the ORW and its location. ____

(NOTE: Outstanding Resource Waters include Class A public water supplies, their tributaries, and bordering wetlands; active and inactive reservoirs approved by MassDEP; certain waters within Areas of Critical Environmental Concern, and certified vernal pools. Outstanding resource waters are listed in the Surface Water Quality Standards, 314 CMR 4.00.)

Are there any impaired water bodies on or within a half-mile radius of the project site? _X_Yes ___No; if yes, identify the water body and pollutant(s) causing the impairment: Boston Inner Harbor (MA70-02)

- Dissolved Oxygen
- Enterococcus
- Fecal Coliform
- PCBs in fish tissue

Is the project within a medium or high stress basin, as established by the Massachusetts Water Resources Commission? ___Yes _X__No

STORMWATER MANAGEMENT:

Generally describe the project's stormwater impacts and measures that the project will take to comply with the standards found in MassDEP's Stormwater Management Regulations:

The proposed bridge replacement project is considered to be a "redevelopment project" under the Massachusetts Stormwater Standards, as the project will involve the replacement of the existing bridge with new structures maintaining the same alignment as the present bridge, and carrying the same number of travel lanes as the existing bridge. As a redevelopment project, the proposed work is required to meet the conditions of the Stormwater Standards to the maximum practicable extent.

Currently all of the existing runoff is collected by catch basins and directed either to the East or to the West, and away from the bridge.

The existing mainline drainage network will remain the same except that the catch basins within the project limits will be replaced to include deep sumps and new catch basins will be installed along the reconfigured access ramps. In the proposed condition, alignment/travel lane catch basins will continue to drain and discharge through a drainage network similar to the existing network. PWD proposes to retain the existing direct discharges from the scuppers of permanent bridge.

MASSACHUSETTS CONTINGENCY PLAN:
Has the project site been, or is it currently being, regulated under M.G.L.c.21E or the Massachusetts Contingency Plan?
Yes ___ No X ; if yes, please describe the current status of the site (including Release Tracking Number (RTN), cleanup phase, and Response Action Outcome classification):_Not Applicable_________________

Is there an Activity and Use Limitation (AUL) on any portion of the project site? Yes ___ No X;
if yes, describe which portion of the site and how the project will be consistent with the AUL:
_____________________.

Are you aware of any Reportable Conditions at the property that have not yet been assigned an RTN?
Yes ___ No _X__ ; if yes, please describe:____________________________________

SOLID AND HAZARDOUS WASTE:

If the project will generate solid waste during demolition or construction, describe alternatives considered for re-use, recycling, and disposal of, e.g., asphalt, brick, concrete, gypsum, metal, wood:

The disposal of demolition debris is still being evaluated based on the types and amounts generated. The granite blocks and bricks are anticipated to be reused elsewhere. The steel truss superstructure will be deleaded and reuse of the materials will be determined during negotiations with MHC. Wood from the bridge Tender's House and existing pilings will be disposed of properly. Asbestos containing materials (ACM) from the Tender's House will be disposed of properly.

Alternatives will be considered as the project moves forward during the on-going design process.

(NOTE: Asphalt pavement, brick, concrete and metal are banned from disposal at Massachusetts landfills and waste combustion facilities and wood is banned from disposal at Massachusetts landfills. See 310 CMR 19.017 for the complete list of banned materials.)

Will your project disturb asbestos containing materials? Yes X No ___ ;
if yes, please consult state asbestos requirements at http://mass.gov/MassDEP/air/asbhom01.htm

The Bridge Tender's house shingles are ACM. An Asbestos Work Plan will be prepared and implemented for this project.

Describe anti-idling and other measures to limit emissions from construction equipment:

Massachusetts General Law (MGL Chapter 90, Section 16A) and the MassDEP idling reduction regulation (310 CMR 7.11(1)(b)) both prohibit unnecessary vehicle idling by stating that the engine must be shut down if the vehicle will be stopped for more than five minutes. Anti-idling will be implemented as part of the project.

This project involves temporary construction activities which will not permanently impact air, noise, or water quality levels as a result of using appropriate construction best management practices. Dust from construction operation and construction equipment exhaust emissions may adversely affect local air quality during construction; however, air monitoring will occur, and these potential air quality impacts will be temporary and will cease upon completion of the work. It is not anticipated that the project will violate the Massachusetts Air Quality Standards.

DESIGNATED WILD AND SCENIC RIVER:

Is this project site located wholly or partially within a defined river corridor of a federally designated Wild and Scenic River or a state designated Scenic River? Yes ___ No X ;
if yes, specify name of river and designation:

If yes, does the project have the potential to impact any of the "outstandingly remarkable" resources of a federally Wild and Scenic River or the stated purpose of a state designated Scenic River?
Yes ___ No ___ ; if yes, specify name of river and designation: _____________;
if yes, will the project will result in any impacts to any of the designated "outstandingly remarkable" resources of the Wild and Scenic River or the stated purposes of a Scenic River.
Yes ___ No ___ ;
if yes, describe the potential impacts to one or more of the "outstandingly remarkable" resources or stated purposes and mitigation measures proposed.

ATTACHMENTS:

1. List of all attachments to this document.

   Attachment 1 – Figures (USGS Map, Aerial Photo, FEMA Map)
   Attachment 2 –Plans (25% Design)
   Attachment 3 – ENF Distribution List
   Attachment 4 – Permit List
   Attachment 5 – Previous Correspondence with MHC
   Attachment 6 – Substructure Inspection Report
   Attachment 7 – Existing Condition Report

2. U.S.G.S. map (good quality color copy, 8-½ x 11 inches or larger, at a scale of 1:24,000) indicating the project location and boundaries. **See Attachment 1**

3.. Plan, at an appropriate scale, of existing conditions on the project site and its immediate environs, showing all known structures, roadways and parking lots, railroad rights-of-way, wetlands and water bodies, wooded areas, farmland, steep slopes, public open spaces, and major utilities. **See Attachment 1**

4 Plan, at an appropriate scale, depicting environmental constraints on or adjacent to the project site such as Priority and/or Estimated Habitat of state-listed rare species, Areas of Critical Environmental Concern, Chapter 91 jurisdictional areas, Article 97 lands, wetland resource area delineations, water supply protection areas, and historic resources and/or districts. **See Attachment 1**

5. Plan, at an appropriate scale, of proposed conditions upon completion of project (if construction of the project is proposed to be phased, there should be a site plan showing conditions upon the completion of each phase). **See Attachment 2**

6. List of all agencies and persons to whom the proponent circulated the ENF, in accordance with 301 CMR 11.16(2). **See Attachment 3 (ENF Distribution List)**

7. List of municipal and federal permits and reviews required by the project, as applicable. **See Attachment 4 (Permit List)**

LAND SECTION – all proponents must fill out this section

I. Thresholds / Permits

A. Does the project meet or exceed any review thresholds related to **land** (see 301 CMR 11.03(1)
___ Yes _X__ No; if yes, specify each threshold:

II. Impacts and Permits

A. Describe, in acres, the current and proposed character of the project site, as follows:

	Existing	Change	Total
Footprint of buildings	NA	None	NA
Internal roadways	NA	None	NA
Parking and other paved areas	NA	None	NA
Other altered areas	2.0 acres	None	2.0 acres
Undeveloped areas	NA	None	NA
Total: Project Site Acreage	2.0 acres	None	2.0 acres

B. Has any part of the project site been in active agricultural use in the last five years?
___ Yes _X_ No; if yes, how many acres of land in agricultural use (with prime state or locally important agricultural soils) will be converted to nonagricultural use?

C. Is any part of the project site currently or proposed to be in active forestry use?
___ Yes _X_ No; if yes, please describe current and proposed forestry activities and indicate whether any part of the site is the subject of a forest management plan approved by the Department of Conservation and Recreation:

D. Does any part of the project involve conversion of land held for natural resources purposes in accordance with Article 97 of the Amendments to the Constitution of the Commonwealth to any purpose not in accordance with Article 97? ___ Yes _X_ No; if yes, describe:

E. Is any part of the project site currently subject to a conservation restriction, preservation restriction, agricultural preservation restriction or watershed preservation restriction? ___ Yes_X_ No; if yes, does the project involve the release or modification of such restriction? ___ Yes ___ No; if yes, describe:

F. Does the project require approval of a new urban redevelopment project or a fundamental change in an existing urban redevelopment project under M.G.L.c.121A? ___ Yes _X_ No; if yes, describe:

G. Does the project require approval of a new urban renewal plan or a major modification of an existing urban renewal plan under M.G.L.c.121B? Yes ___ No _X_; if yes, describe:

III. Consistency

A. Identify the current municipal comprehensive land use plan
Title: Imagine Boston 2030 Date July 2017

B. Describe the project's consistency with that plan with regard to:

1. Economic development –The South Boston Waterfront area of Boston has experienced dramatic growth in the past two decades. An area that once contained large open parking lots is now a destination for, and a home to, restaurants, retail, office spaces and residential buildings. The new Northern Avenue Bridge is designed to add to the public's access and enjoyment of this now vibrant neighborhood by reestablishing a much needed pedestrian link but does not, in itself, foster additional economic development.

2. Adequacy of infrastructure – The new Northern Avenue Bridge will not require any new infrastructure for viability. The existing utility infrastructure is sufficient to provide the bridge lighting which will be attached to the structure. The new bridge itself will be an infrastructure improvement to the area as it will improve the public realm.

3. Open space impacts – The project is consistent with Boston's goal of promoting a healthy environment and investing in open space and recreational facilities. Once the bridge is open to the public, safe pedestrian and bicycle access to the waterfront will be improved. As Boston's Land Use and Planning works towards initiating growth and meeting citywide policy goals, the need for more accessible open spaces becomes more crucial.

4. Compatibility with adjacent land uses – The project will create a functional and useful open space compatible with Boston's waterfront and a vital link in the Harborwalk. Once the bridge is open to the public, it will provide a link between the Seaport District and existing downtown neighborhood locations. The area also will continue to provide a buffer to storms and be resilient to climate change since the bridge height will be raised for anticipated sea level rise (SLR), specifically to accommodate increased flooding.

C. Identify the current Regional Policy Plan of the applicable Regional Planning Agency (RPA)
RPA: Metropolitan Area Planning Council

Title: Strategic Plan 2015 - 2020 Date November 2014

D. Describe the project's consistency with that plan with regard to:

1. Economic development –The South Boston Waterfront area of Boston has experienced dramatic growth in the past two decades. An area that once contained large open parking lots is now a destination for, and a home to, restaurants, retail, office spaces and residential buildings. The new Northern Avenue Bridge is designed to add to the public's access and enjoyment of this now vibrant neighborhood by reestablishing a much-needed pedestrian link but does not in itself foster additional economic development but re-opening the bridge to the public once again will attract visitors and residents to Boston, thereby encouraging tourism and promote economic benefits to surrounding businesses.

2. Adequacy of infrastructure –The new Northern Avenue Bridge will not require any new infrastructure for viability. The existing utility infrastructure is sufficient to provide the bridge lighting which will be attached to the structure. The new bridge itself will be an infrastructure improvement to the area as it will improve the public realm. Approaches to the bridge will be reconstructed to accommodate the new height of the bridge, as it is being raised in anticipation of SLR.

3. Open space impacts – The project is consistent with Boston's goal of promoting a healthy environment and investing in open space and recreational facilities. Once the bridge is open to the public, safe pedestrian and bicycle access to the waterfront will be improved. As Boston's Land Use and Planning works towards initiating growth and meeting citywide policy goals, the need for more accessible open spaces becomes more crucial.

RARE SPECIES SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to **rare species or habitat** (see 301 CMR 11.03(2))? ___ Yes _X_ No; if yes, specify, in quantitative terms: Note: Winter Flounder (*Pseudopleuronectes americanus*) is not a state listed rare species; however, the project area is within the Winter Flounder Spawning Closure Area, and discussions with the Massachusetts Division of Marine Fisheries and other stakeholders will address potential time-of-year restrictions and other measures to avoid effects.

(NOTE: If you are uncertain, it is recommended that you consult with the Natural Heritage and Endangered Species Program (NHESP) prior to submitting the ENF.)

B. Does the project require any state permits related to **rare species or habitat**? ___ Yes _X_ No

C. Does the project site fall within mapped rare species habitat (Priority or Estimated Habitat?) in the current Massachusetts Natural Heritage Atlas (attach relevant page)? ___ Yes _X_ No.

D. If you answered "No" to all questions A, B and C, proceed to the **Wetlands, Waterways, and Tidelands Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Rare Species section below.

II. Impacts and Permits

A. Does the project site fall within Priority or Estimated Habitat in the current Massachusetts Natural Heritage Atlas (attach relevant page)? ___ Yes ___ No. If yes,

1. Have you consulted with the Division of Fisheries and Wildlife Natural Heritage and Endangered Species Program (NHESP)? ___Yes ___No; if yes, have you received a determination as to whether the project will result in the "take" of a rare species? ___ Yes ___ No; if yes, attach the letter of determination to this submission.

2. Will the project "take" an endangered, threatened, and/or species of special concern in accordance with M.G.L. c.131A (see also 321 CMR 10.04)? ___ Yes ___ No; if yes, provide a summary of proposed measures to minimize and mitigate rare species impacts

3. Which rare species are known to occur within the Priority or Estimated Habitat?

4. Has the site been surveyed for rare species in accordance with the Massachusetts Endangered Species Act? ___ Yes ___ No

4. If your project is within Estimated Habitat, have you filed a Notice of Intent or received an Order of Conditions for this project? ___ Yes ___ No; if yes, did you send a copy of the Notice of Intent to the Natural Heritage and Endangered Species Program, in accordance with the Wetlands Protection Act regulations? ___ Yes ___ No

B. Will the project "take" an endangered, threatened, and/or species of special concern in accordance with M.G.L. c.131A (see also 321 CMR 10.04)? ___ Yes ___ No; if yes, provide a summary of proposed measures to minimize and mitigate impacts to significant habitat:

WETLANDS, WATERWAYS, AND TIDELANDS SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to **wetlands, waterways, and tidelands** (see 301 CMR 11.03(3))? _X_ Yes ___ No; if yes, specify, in quantitative terms:

The applicable review threshold exceeded by the project is as follows.

301 CMR 11.03(3)(b)(1)(a) alteration of coastal bank – the reconstruction of the existing abutments will require the temporary alteration of the granite seawall, which serves as the coastal bank of Fort Point Channel. The seawall will be restored upon completion of the project.

301 CMR 11.03(3)(b)(6) Construction, reconstruction or expansion of an existing solid fill structure of 1,000 or more sf base area or of a pile-supported or bottom-anchored structure of 2,000 or more sf base area, except a seasonal, pile-held or bottom-anchored float, provided the structure occupies flowed tidelands or other waterways. – The Promenade will be a pile supported structure with a base area of 34,560 sf (0.79 acres). The waterfront Promenade will be constructed within the existing footprint of the bridge's draw fender pier and Bridge Tender's House.

B. Does the project require any state permits (or a local Order of Conditions) related to **wetlands, waterways, or tidelands**? _X_ Yes ___ No; if yes, specify which permit:

The City of Boston will be filing a Notice of Intent (NOI) with the City of Boston Conservation Commission, filing a Section 401 Water Quality Certification application with MassDEP and also filing a Chapter 91 License and dredge permit application with MassDEP.

C. If you answered "No" to both questions A and B, proceed to the **Water Supply Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Wetlands, Waterways, and Tidelands Section below.

II. Wetlands Impacts and Permits

A. Does the project require a new or amended Order of Conditions under the Wetlands Protection Act (M.G.L. c.131A)? _X_ Yes ___ No; if yes, has a Notice of Intent been filed? ___ Yes X No; if yes, list the date and MassDEP file number: TBD_____; if yes, has a local Order of Conditions been issued? ___ Yes ___ No; Was the Order of Conditions appealed? ___ Yes ___ No. Will the project require a Variance from the Wetlands regulations? ___ Yes _X_ No.

B. Describe any proposed permanent or temporary impacts to wetland resource areas located on the project site:

The project will result in temporary and permanent impacts to waters of the U.S. within the Commonwealth. The impacts include minor dredging for the purposes of new pier construction, existing pier demolition, and reconstruction of the western and eastern abutments. The dredging is required for construction purposes, and not for the navigation channel; no maintenance dredging will be required. It is not anticipated that dredging for construction will encroach into the federal navigational channel or the channel presently used by navigation. Mitigation will be accomplished through the removal of the existing piers, thereby decreasing the current impact of the existing piers.

Construction will cause temporary and permanent impacts to coastal wetland resource areas including Land Under the Ocean, Land Containing Shellfish, Coastal Bank, Land Subject to Coastal Storm Flowage (LSCSF) and the 100-foot buffer zone to Coastal Bank. The Project will result in temporary and permanent impacts to these resource areas due to construction of the two new piers and permanent impacts due to the fill material associated with the new piles placed in the Fort Point Channel.

The coastal wetland resource area impacts for the project are provided in the summary table below.

C. Estimate the extent and type of impact that the project will have on wetland resources, and indicate whether the impacts are temporary or permanent:

Coastal Wetlands	Area (square feet) or Length (linear feet)	Temporary or Permanent Impact
Land Under the Ocean	2,488/40,459/3,913 SF	Perm/Temp/Restoration
Designated Port Areas		
Coastal Beaches		
Coastal Dunes		
Barrier Beaches		
Coastal Banks	170 LF	Temporary
Rocky Intertidal Shores		
Salt Marshes		
Land Under Salt Ponds		
Land Containing Shellfish	2,488/40,459/3,913 SF	Perm/Temp/Restoration
Fish Runs		
Land Subject to Coastal Storm Flowage	2,590 SF	Permanent
Inland Wetlands		
Bordering Vegetated Wetlands		
Isolated Vegetated Wetlands		
Land under Water		
Isolated Land Subject to Flooding		
Bordering Land Subject to Flooding		
Riverfront Area		

D. Is any part of the project:

1. proposed as a **limited project**? ___ Yes _X_ No; if yes, what is the area (in sf)?____
2. the construction or alteration of a **dam**? ___ Yes _X_ No; if yes, describe:
3. fill or structure in a **velocity zone** or **regulatory floodway**? _X_Yes ___ No
4. dredging or disposal of dredged material? _X_ Yes ___ No; if yes, describe the volume of dredged material and the proposed disposal site:

Approximately 2,368 cubic yards of material will be dredged from Fort Point Channel. The proposed disposal site has not yet been determined but will have the necessary permits to accept the dredged material.

5. a discharge to an **Outstanding Resource Water (ORW)** or an **Area of Critical Environmental Concern (ACEC)**? ___ Yes _X_ No
6. subject to a wetlands restriction order? ___ Yes _X_ No; if yes, identify the area (in sf):
7. located in buffer zones? _X_Yes ___No; if yes, how much (in sf) 28,665

E. Will the project:

1. be subject to a local wetlands ordinance or bylaw? _X_ Yes ___ No
2. alter any federally-protected wetlands not regulated under state law? ___ Yes _X_ No; if yes, what is the area (sf)?

III. Waterways and Tidelands Impacts and Permits

A. Does the project site contain waterways or tidelands (including filled former tidelands) that are subject to the Waterways Act, M.G.L.c.91? _X_ Yes ___ No; if yes, is there a current Chapter 91 License or Permit affecting the project site? _X_ Yes ___ No; if yes, list the date and license or permit number and provide a copy of the historic map used to determine extent of filled tidelands:

Please note due to the MassDEP Waterways Chapter 91 office closure as a result of the Coronavirus, the applicant has not been able to conduct a file review to determine existing Chapter 91 license information and is not able to provide the historic maps that the ENF requires; however, the following licenses may be associated with the project site:

License Number 250, dated 8/18/1922 (piles at Northern Avenue Bridge)
License Number 335, dated 7/5/1923 (piles and bracing of Northern Avenue Bridge)
License Number 449, dated 7/17/1924 (pile supports for draw bridge of Northern Avenue Bridge)
License Number 540, dated 5/25/1925 (piles near Northern Avenue Bridge)
License Number 207 dated 3/28/1952 (Install and maintain a 1" Submarine Pipeline in and across the Tidewaters of Fort Point Channel at the Northern Avenue Bridge)

Please note the license information presented above still needs to be confirmed once the MassDEP Waterways Chapter 91 office re-opens and a file review can be conducted.

B. Does the project require a new or modified license or permit under M.G.L.c.91? _X_ Yes ___ No; if yes, how many acres of the project site subject to M.G.L.c.91 will be for non-water-dependent use? Current _0__ Change _0__ Total _0__

If yes, how many square feet of solid fill or pile-supported structures (in sf)? 2,488

The new bridge will remain within the existing bridge footprint to the extent necessary, but a net decrease in square footage of impacts to the resource is anticipated from the removal of the 860 SF of existing piles and 3,054 SF of existing piers, such that a net gain of 1,425 SF of Land Under the Ocean will result.

C. For non-water-dependent use projects, indicate the following:

Area of filled tidelands on the site:_____________________

Area of filled tidelands covered by buildings:____________

For portions of site on filled tidelands, list ground floor uses and area of each use: ______________

Does the project include new non-water-dependent uses located over flowed tidelands? Yes ___ No ___

Height of building on filled tidelands________________

Also show the following on a site plan: Mean High Water, Mean Low Water, Water-dependent Use Zone, location of uses within buildings on tidelands, and interior and exterior areas and facilities dedicated for public use, and historic high and historic low water marks.

D. Is the project located on landlocked tidelands? ___ Yes _X_ No; if yes, describe the project's impact on the public's right to access, use and enjoy jurisdictional tidelands and describe measures the project will implement to avoid, minimize or mitigate any adverse impact:

E. Is the project located in an area where low groundwater levels have been identified by a municipality or by a state or federal agency as a threat to building foundations? ___Yes _X_ No; if yes, describe the project's impact on groundwater levels and describe measures the project will implement to avoid, minimize or mitigate any adverse impact:

F. Is the project non-water-dependent **and** located on landlocked tidelands **or** waterways or tidelands subject to the Waterways Act **and** subject to a mandatory EIR? ___ Yes _X_No; *(NOTE: If yes, then the project will be subject to Public Benefit Review and Determination.)*

G. Does the project include dredging? _X_ Yes ___ No; if yes, answer the following questions:
What type of dredging? Improvement ___ Maintenance X_ Both ____

The dredging required to remove the three existing piers and, install the new bridge piers and pile supports for the Promenade will occur within the Fort Point Channel, which has previously been dredged, and will not extend beyond the originally dredged depth, width or length. The removal of the existing wood piles will reposition sediment on the channel bottom, but will not result in the removal of sediment from the channel.

What is the proposed dredge volume, in cubic yards (cys) 2,407
What is the proposed dredge footprint (varies) length (ft) (varies) width (ft) 2 depth (ft);
The length and widths are variable depending on specific location of the dredging areas
Will dredging impact the following resource areas?
Intertidal Yes__ No_X_; if yes, ___ sq ft
Outstanding Resource Waters Yes__ No_X_; if yes, ___ sq ft
Other resource area (i.e. shellfish beds, eel grass beds) Yes__ No_X_; if yes __ sq ft
If yes to any of the above, have you evaluated appropriate and practicable steps to: 1) avoidance; 2) if avoidance is not possible, minimization; 3) if either avoidance or minimize is not possible, mitigation?

The Fort Point Channel is located within a portion of Boston Harbor that is currently closed (prohibited) for shellfishing (Massachusetts Division of Marine Fisheries Shellfish Growing Area GBH4). The project area is within the Winter Flounder Spawning Closure Area, and discussions with the Massachusetts Division of Marine Fisheries and other stakeholders will address potential time-of-year restrictions and other measures to avoid effects.

The dredging activity cannot be avoided as it is required for the installation of the new bridge piers. Due to the structural instability of the existing piers they cannot be reused to support the new bridge structure. Mitigation will be accomplished through the removal of the existing piers.

If no to any of the above, what information or documentation was used to support this determination?
Provide a comprehensive analysis of practicable alternatives for improvement dredging in accordance with 314 CMR 9.07(1)(b). Physical and chemical data of the sediment shall be included in the comprehensive analysis.
Sediment Characterization
Existing gradation analysis results? __Yes _X_No: if yes, provide results.
Existing chemical results for parameters listed in 314 CMR 9.07(2)(b)6? ___Yes _X_No; if yes, provide results.
Do you have sufficient information to evaluate feasibility of the following management options for dredged sediment? If yes, check the appropriate option.

Beach Nourishment ___
Unconfined Ocean Disposal ___
Confined Disposal:
Confined Aquatic Disposal (CAD) ___
Confined Disposal Facility (CDF) ___
Landfill Reuse in accordance with COMM-97-001 ___
Shoreline Placement ___
Upland Material Reuse____

In-State landfill disposal_X___
Out-of-state landfill disposal _X___
(NOTE: This information is required for a 401 Water Quality Certification.)

The proposed disposal site has not yet been determined but will have the necessary permits to accept the dredged material.

IV. Consistency:

A. Does the project have effects on the coastal resources or uses, and/or is the project located within the Coastal Zone? _X_ Yes ___ No; if yes, describe these effects and the projects consistency with the policies of the Office of Coastal Zone Management:

As designed, the project is consistent with the nine Massachusetts Coastal Zone Management (CZM) policies. The City of Boston will coordinate with CZM during the permitting process, as necessary, to confirm this understanding. The following table summarizes the project's consistency with and applicability to each of the policies.

Policy	Positive or Neutral Effect	Negative Effect	Not Applicable
Coastal Hazards Policy #1			√
Coastal Hazards Policy #2	√		
Coastal Hazards Policy #3	√		
Coastal Hazards Policy #4			√
Energy Policy #1			√
Energy Policy #2			√
Growth Management Policy #1	√		
Growth Management Policy #2	√		
Growth Management Policy #3			√
Habitat Policy #1			√
Habitat Policy #2			√
Ocean Resources Policy #1			√
Ocean Resources Policy #2			√
Ocean Resources Policy #3			√
Ports and Harbors Policy #1	√		
Ports and Harbors Policy #2			√
Ports and Harbors Policy #3			√
Ports and Harbors Policy #4	√		
Ports and Harbors Policy #5			√
Protected Areas Policy #1			√
Protected Areas Policy #2			√
Protected Areas Policy #3	√		
Public Access Policy #1	√		
Public Access Policy #2	√		
Public Access Policy #3	√		
Water Quality Policy #1			√
Water Quality Policy #2			√
Water Quality Policy #3			√

B. Is the project located within an area subject to a Municipal Harbor Plan? X Yes ___ No; if yes, identify the Municipal Harbor Plan and describe the project's consistency with that plan:

Downtown Waterfront Municipal Harbor Plan

The updated Downtown Waterfront Municipal Harbor Plan (MHP) for the area located adjacent and west of the Northern Avenue bridge is currently being developed by the City of Boston. The City will need to amend its zoning to be consistent with the MHP that includes the Boston Inner Harbor Downtown Waterfront Subdistrict where the Northern Avenue Bridge connects to the Hook Site. Linking neighborhoods together with public access to Boston's waterfront and open spaces, recreational, residential and commercial properties is a planning objective in the MHP. The goals of the Northern Ave Bridge rehabilitation and competition were to improve the mobility between the Downtown and South Boston Waterfronts; honor the history of the existing structure; and create a destination on the Fort Point Channel that unites neighborhoods and celebrates Boston's connection to the sea. The re-opening of the Northern Avenue bridge will provide that and be consistent with those goals. The Northern Avenue section is a key gateway between the historic center of the city and the city's newer destination neighborhoods, the South Boston Waterfront. This area is the gateway between these destinations. The re-opening of the bridge will create a sense of entrance or arrival to the area. The planned replacement of the Northern Avenue Bridge offers the chance to strengthen pedestrian and bike links to the South Boston Waterfront and South Boston. Creating an accessible Harborwalk path along the waterfront at the Northern Avenue Bridge will allow more people to enjoy the waterfront. In addition, these accessible connections might present an opportunity to expand the public space along the waterfront, which is very narrow in this area.

Fort Point Downtown Waterfront MHP

The current Fort Point Downtown Waterfront MHP (2003) which includes adjacent areas located to the south of the Northern Avenue Bridge, promotes the re-opening of the bridge for pedestrian use across the channel. The MHP promotes the strong relationship and connectivity between downtown areas, financial district and the seaport district. The bridge will enhance this connection by attracting people to the Fort Point Channel area including the seaport district and be consistent with the planning goals of the MHP. Limiting the use of the bridge by vehicular traffic is consistent with the planning strategies of the MHP by reducing reliance on automobiles and reducing the number of vehicle trips by promoting a pedestrian-friendly design that encourages park-once and walk behavior. The Fort Point Downtown Waterfront MHP goals are to create open spaces as close to the water as possible, while providing view corridors, pedestrian ways that physically and visually connect inland open space systems and neighboring areas to the water and the water's edge. The Northern Ave bridge will be designed for open spaces that promote compatibility between public activities and the needs of navigation, water transportation and other water-dependent uses which is consistent with the Fort Point Downtown Waterfront MHP goals.

WATER SUPPLY SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to **water supply** (see 301 CMR 11.03(4))? ___ Yes _X_ No; if yes, specify, in quantitative terms:

B. Does the project require any state permits related to **water supply**? ___ Yes _X_ No; if yes, specify which permit:

C. If you answered "No" to both questions A and B, proceed to the **Wastewater Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Water Supply Section below.

II. Impacts and Permits

A. Describe, in gallons per day (gpd), the volume and source of water use for existing and proposed activities at the project site:

	Existing	Change	Total
Municipal or regional water supply	________	________	________
Withdrawal from groundwater	________	________	________
Withdrawal from surface water	________	________	________
Interbasin transfer	________	________	________

(NOTE: Interbasin Transfer approval will be required if the basin and community where the proposed water supply source is located is different from the basin and community where the wastewater from the source will be discharged.)

B. If the source is a municipal or regional supply, has the municipality or region indicated that there is adequate capacity in the system to accommodate the project? ___ Yes ___ No

C. If the project involves a new or expanded withdrawal from a groundwater or surface water source, has a pumping test been conducted? ___ Yes ___ No; if yes, attach a map of the drilling sites and a summary of the alternatives considered and the results. ______________

D. What is the currently permitted withdrawal at the proposed water supply source (in gallons per day)? _____Will the project require an increase in that withdrawal? ___Yes ___No; if yes, then how much of an increase (gpd)? ____________________

E. Does the project site currently contain a water supply well, a drinking water treatment facility, water main, or other water supply facility, or will the project involve construction of a new facility? ___ Yes ___No. If yes, describe existing and proposed water supply facilities at the project site:

	Permitted Flow	Existing Avg Daily Flow	Project Flow	Total
Capacity of water supply well(s) (gpd)	_______	________	________	________
Capacity of water treatment plant (gpd)	_______	________	________	________

F. If the project involves a new interbasin transfer of water, which basins are involved, what is the direction of the transfer, and is the interbasin transfer existing or proposed?

G. Does the project involve:

1. new water service by the Massachusetts Water Resources Authority or other agency of the Commonwealth to a municipality or water district? ___ Yes ___ No
2. a Watershed Protection Act variance? ___ Yes ___ No; if yes, how many acres of alteration?

3. a non-bridged stream crossing 1,000 or less feet upstream of a public surface drinking water supply for purpose of forest harvesting activities? ___ Yes ___ No

III. Consistency

Describe the project's consistency with water conservation plans or other plans to enhance water resources, quality, facilities and services:

WASTEWATER SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to **wastewater** (see 301 CMR 11.03(5))? ___ Yes _X_ No; if yes, specify, in quantitative terms:

B. Does the project require any state permits related to **wastewater**? ___ Yes _X_ No; if yes, specify which permit:

C. If you answered "No" to both questions A and B, proceed to the **Transportation -- Traffic Generation Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Wastewater Section below.

II. Impacts and Permits

A. Describe the volume (in gallons per day) and type of disposal of wastewater generation for existing and proposed activities at the project site (calculate according to 310 CMR 15.00 for septic systems or 314 CMR 7.00 for sewer systems):

	Existing	Change	Total
Discharge of sanitary wastewater	________	________	________
Discharge of industrial wastewater	________	________	________
TOTAL	________	________	________

	Existing	Change	Total
Discharge to groundwater	________	________	________
Discharge to outstanding resource water	________	________	________
Discharge to surface water	________	________	________
Discharge to municipal or regional wastewater facility	________	________	________
TOTAL	________	________	________

B. Is the existing collection system at or near its capacity? ___ Yes ___ No; if yes, then describe the measures to be undertaken to accommodate the project's wastewater flows:

C. Is the existing wastewater disposal facility at or near its permitted capacity? ___ Yes___ No; if yes, then describe the measures to be undertaken to accommodate the project's wastewater flows:

D. Does the project site currently contain a wastewater treatment facility, sewer main, or other wastewater disposal facility, or will the project involve construction of a new facility? ___ Yes ___ No; if yes, describe as follows:

	Permitted	Existing Avg Daily Flow	Project Flow	Total
Wastewater treatment plant capacity (in gallons per day)	_______	________	________	________

E. If the project requires an interbasin transfer of wastewater, which basins are involved, what is the direction of the transfer, and is the interbasin transfer existing or new?

(NOTE: Interbasin Transfer approval may be needed if the basin and community where wastewater will be discharged is different from the basin and community where the source of water supply is located.)

F. Does the project involve new sewer service by the Massachusetts Water Resources Authority (MWRA) or other Agency of the Commonwealth to a municipality or sewer district? ___ Yes ___ No

G. Is there an existing facility, or is a new facility proposed at the project site for the storage, treatment, processing, combustion or disposal of sewage sludge, sludge ash, grit, screenings, wastewater reuse (gray water) or other sewage residual materials? ___ Yes ___ No; if yes, what is the capacity (tons per day):

	Existing	Change	Total
Storage	________	________	________
Treatment	________	________	________
Processing	________	________	________
Combustion	________	________	________
Disposal	________	________	________

H. Describe the water conservation measures to be undertaken by the project, and other wastewater mitigation, such as infiltration and inflow removal.

III. Consistency

A. Describe measures that the proponent will take to comply with applicable state, regional, and local plans and policies related to wastewater management:

B. If the project requires a sewer extension permit, is that extension included in a comprehensive wastewater management plan? ___ Yes ___ No; if yes, indicate the EEA number for the plan and whether the project site is within a sewer service area recommended or approved in that plan:

TRANSPORTATION SECTION (TRAFFIC GENERATION)

I. Thresholds / Permit

A. Will the project meet or exceed any review thresholds related to **traffic generation** (see 301 CMR 11.03(6))? ___ Yes _X_ No; if yes, specify, in quantitative terms:

B. Does the project require any state permits related to **state-controlled roadways**? ___ Yes _X No; if yes, specify which permit:

C. If you answered "No" to both questions A and B, proceed to the **Roadways and Other Transportation Facilities Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Traffic Generation Section below.

II. Traffic Impacts and Permits

A. Describe existing and proposed vehicular traffic generated by activities at the project site:

	Existing	Change	Total
Number of parking spaces	_______	________	_______
Number of vehicle trips per day	________	________	________
ITE Land Use Code(s):	________	________	________

B. What is the estimated average daily traffic on roadways serving the site?

Roadway	Existing	Change	Total
1. ___________________	________	________	________
2. ____________________	________	________	________
3. ____________________	________	________	________

C. If applicable, describe proposed mitigation measures on state-controlled roadways that the project proponent will implement:

D. How will the project implement and/or promote the use of transit, pedestrian and bicycle facilities and services to provide access to and from the project site?

C. Is there a Transportation Management Association (TMA) that provides transportation demand management (TDM) services in the area of the project site? ____ Yes ____ No; if yes, describe if and how will the project will participate in the TMA:

D. Will the project use (or occur in the immediate vicinity of) water, rail, or air transportation facilities? ____ Yes ____ No; if yes, generally describe:

E. If the project will penetrate approach airspace of a nearby airport, has the proponent filed a Massachusetts Aeronautics Commission Airspace Review Form (780 CMR 111.7) and a Notice of Proposed Construction or Alteration with the Federal Aviation Administration (FAA) (CFR Title 14 Part 77.13, forms 7460-1 and 7460-2)?

III. Consistency

Describe measures that the proponent will take to comply with municipal, regional, state, and federal plans and policies related to traffic, transit, pedestrian and bicycle transportation facilities and services:

TRANSPORTATION SECTION (ROADWAYS AND OTHER TRANSPORTATION FACILITIES)

I. Thresholds

A. Will the project meet or exceed any review thresholds related to **roadways or other transportation facilities** (see 301 CMR 11.03(6))? ___ Yes _X_No; if yes, specify, in quantitative terms:

B. Does the project require any state permits related to **roadways or other transportation facilities**? ___ Yes _X_ No; if yes, specify which permit:

C. If you answered "No" to both questions A and B, proceed to the **Energy Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Roadways Section below.

II. Transportation Facility Impacts

A. Describe existing and proposed transportation facilities in the immediate vicinity of the project site:

B. Will the project involve any

1. Alteration of bank or terrain (in linear feet)? ____________
2. Cutting of living public shade trees (number)? ____________
3. Elimination of stone wall (in linear feet)? ____________

III. Consistency -- Describe the project's consistency with other federal, state, regional, and local plans and policies related to traffic, transit, pedestrian and bicycle transportation facilities and services, including consistency with the applicable regional transportation plan and the Transportation Improvements Plan (TIP), the State Bicycle Plan, and the State Pedestrian Plan:

ENERGY SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to **energy** (see 301 CMR 11.03(7))? ___ Yes _X_ No; if yes, specify, in quantitative terms:

B. Does the project require any state permits related to **energy**? ___ Yes _X_ No; if yes, specify which permit:

C. If you answered "No" to both questions A and B, proceed to the **Air Quality Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Energy Section below.

II. Impacts and Permits

A. Describe existing and proposed energy generation and transmission facilities at the project site:

	Existing	Change	Total
Capacity of electric generating facility (megawatts)	________	________	________
Length of fuel line (in miles)	________	________	________
Length of transmission lines (in miles)	________	________	________
Capacity of transmission lines (in kilovolts)	________	________	________

B. If the project involves construction or expansion of an electric generating facility, what are:

1. the facility's current and proposed fuel source(s)?
2. the facility's current and proposed cooling source(s)?

C. If the project involves construction of an electrical transmission line, will it be located on a new, unused, or abandoned right of way? ___Yes ___No; if yes, please describe:

D. Describe the project's other impacts on energy facilities and services:

III. Consistency

Describe the project's consistency with state, municipal, regional, and federal plans and policies for enhancing energy facilities and services:

AIR QUALITY SECTION

I. Thresholds

A. Will the project meet or exceed any review thresholds related to **air quality** (see 301 CMR 11.03(8))? ___ Yes _X_ No; if yes, specify, in quantitative terms:

B. Does the project require any state permits related to **air quality**? ___ Yes _X_ No; if yes, specify which permit:

C. If you answered "No" to both questions A and B, proceed to the **Solid and Hazardous Waste Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Air Quality Section below.

II. Impacts and Permits

A. Does the project involve construction or modification of a major stationary source (see 310 CMR 7.00, Appendix A)? ___ Yes ___ No; if yes, describe existing and proposed emissions (in tons per day) of:

	Existing	Change	Total
Particulate matter	________	________	________
Carbon monoxide	________	________	________
Sulfur dioxide	________	________	________
Volatile organic compounds	________	________	________
Oxides of nitrogen	________	________	________
Lead	________	________	________
Any hazardous air pollutant	________	________	________
Carbon dioxide	________	________	________

B. Describe the project's other impacts on air resources and air quality, including noise impacts:

III. Consistency

A. Describe the project's consistency with the State Implementation Plan:

B. Describe measures that the proponent will take to comply with other federal, state, regional, and local plans and policies related to air resources and air quality:

SOLID AND HAZARDOUS WASTE SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to **solid or hazardous waste** (see 301 CMR 11.03(9))? ___ Yes _X_ No; if yes, specify, in quantitative terms:

B. Does the project require any state permits related to **solid and hazardous waste**? ___ Yes _X No; if yes, specify which permit:

C. If you answered "No" to both questions A and B, proceed to the **Historical and Archaeological Resources Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Solid and Hazardous Waste Section below.

II. Impacts and Permits

A. Is there any current or proposed facility at the project site for the storage, treatment, processing, combustion or disposal of solid waste? ___ Yes ___ No; if yes, what is the volume (in tons per day) of the capacity:

	Existing	Change	Total
Storage	________	________	________
Treatment, processing	________	________	________
Combustion	________	________	________
Disposal	________	________	________

B. Is there any current or proposed facility at the project site for the storage, recycling, treatment or disposal of hazardous waste? ___ Yes ___ No; if yes, what is the volume (in tons or gallons per day) of the capacity:

	Existing	Change	Total
Storage	________	________	________
Recycling	________	________	________
Treatment	________	________	________
Disposal	________	________	________

C. If the project will generate solid waste (for example, during demolition or construction), describe alternatives considered for re-use, recycling, and disposal:

D. If the project involves demolition, do any buildings to be demolished contain asbestos?
___ Yes ___ No

E. Describe the project's other solid and hazardous waste impacts (including indirect impacts):

III. Consistency

Describe measures that the proponent will take to comply with the State Solid Waste Master Plan:

HISTORICAL AND ARCHAEOLOGICAL RESOURCES SECTION

I. Thresholds / Impacts

A. Have you consulted with the Massachusetts Historical Commission? _X_ Yes ___ No; if yes, attach correspondence. For project sites involving lands under water, have you consulted with the Massachusetts Board of Underwater Archaeological Resources? ____Yes _X_ No; if yes, attach correspondence

Correspondence with MHC has commenced and is ongoing. A Project Notification Form (PNF) was previously submitted to MHC (see Attachment 5).

B. Is any part of the project site a historic structure, or a structure within a historic district, in either case listed in the State Register of Historic Places or the Inventory of Historic and Archaeological Assets of the Commonwealth? _X_ Yes ___ No; if yes, does the project involve the demolition of all or any exterior part of such historic structure? _X_ Yes ___ No; if yes, please describe:

Desktop review of MHC's Massachusetts Cultural Resource Information System (MACRIS) was conducted to determine the presence of previously documented historic architectural resources within the Area of Potential Effects (APE). An examination of MACRIS revealed a total of 8 previously documented historic resources in the proposed APE. Of the 8 resources in the proposed APE, one is an NHL-listed vessel, one is the National Register of Historic Places (NRHP) listed Fort Point Channel Historic District; one is the locally designated Fort Point Channel Landmark District; three are inventoried buildings that have not been evaluated for NRHP eligibility; and two are inventoried buildings that have been demolished. In addition, all resources listed in NRHP are also listed in the Massachusetts's State Register of Historic Places (SRHP). The preferred alternative would result in the demolition of the NRHP-listed Northern Avenue Draw Bridge and the Bridge Tender's House.

C. Is any part of the project site an archaeological site listed in the State Register of Historic Places or the Inventory of Historic and Archaeological Assets of the Commonwealth? ___ Yes _X__ No; if yes, does the project involve the destruction of all or any part of such archaeological site? ___ Yes ___ No; if yes, please describe:

D. If you answered "No" to all parts of both questions A, B and C, proceed to the **Attachments and Certifications** Sections. If you answered "Yes" to any part of either question A or question B, fill out the remainder of the Historical and Archaeological Resources Section below.

II. Impacts

Describe and assess the project's impacts, direct and indirect, on listed or inventoried historical and archaeological resources:

The preferred alternative proposes to demolish the NRHP-listed Northern Avenue Draw Bridge and Bridge Tender's House, and it is anticipated that the project would result in an adverse effect.

Archaeological sensitivity for the project area has not yet been established; as such, impacts to archaeological resources is not yet known. The closest previously recorded archaeological site is recorded 500 feet south of the proposed project.

III. Consistency

Describe measures that the proponent will take to comply with federal, state, regional, and local plans and policies related to preserving historical and archaeological resources:

To evaluate the parameters of the potential effects of the selected design on all historic properties, a Determination of Effects Report will be prepared for review and comment by MHC. The analysis will consider direct physical effects such as the demolition of the bridge and Bridge Tender's House, as well as direct visual effects that may cause changes to the viewshed of adjacent historic properties. Preparation of a Memorandum of Agreement (MOA) is anticipated to mitigate adverse effects to these historic resources

A Phase I Intensive (Reconnaissance) Survey is proposed in order to establish the current terrestrial archaeological sensitivity and to make recommendations for additional terrestrial archaeological studies as necessary, including Phase I Intensive (Locational) Survey. A qualified archaeologist meeting the Secretary of the Interior (SOI) qualification standards would prepare and submit a completed State Archaeologist's Permit application (950 CMR 70) for review by the State Archaeologist for any permitted archaeological activities. Following consultation with MA BUAR, an application for a Reconnaissance Permit (312 CMR 2) will be prepared.

CERTIFICATIONS:

1. The Public Notice of Environmental Review will be published in the following newspapers in accordance with 301 CMR 11.15(1):

   (Name) Boston Herald and Boston Globe (Date) April 30, 2020

2. This form has been circulated to Agencies and Persons in accordance with 301 CMR 11.16(2).

Signatures:

4/28/2020	
Date Signature of Responsible Officer or Proponent	Date Signature of person preparing ENF (if different from above)
Para Jayasinghe	Thomas J. Keough
Name (print or type)	Name (print or type)
City of Boston	AECOM Technical Services, Inc.
Firm/Agency	Firm/Agency
One City Hall Square	250 Apollo Drive
Street	Street
Boston 02110	Chelmsford, MA 01824
Municipality/State/Zip	Municipality/State/Zip
617-635-4968	978-905-2270
Phone	Phone

Attachment 1

Figures

Portion of Boston South USGS Quadrangle 1987
Source: MassGIS.

July 2019

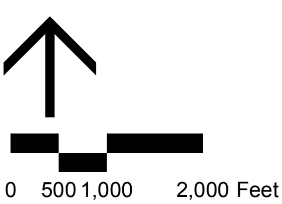

Figure 1
Locus Map
Northern Avenue Bridge Replacement
Boston

AECOM Imagine it. Delivered.

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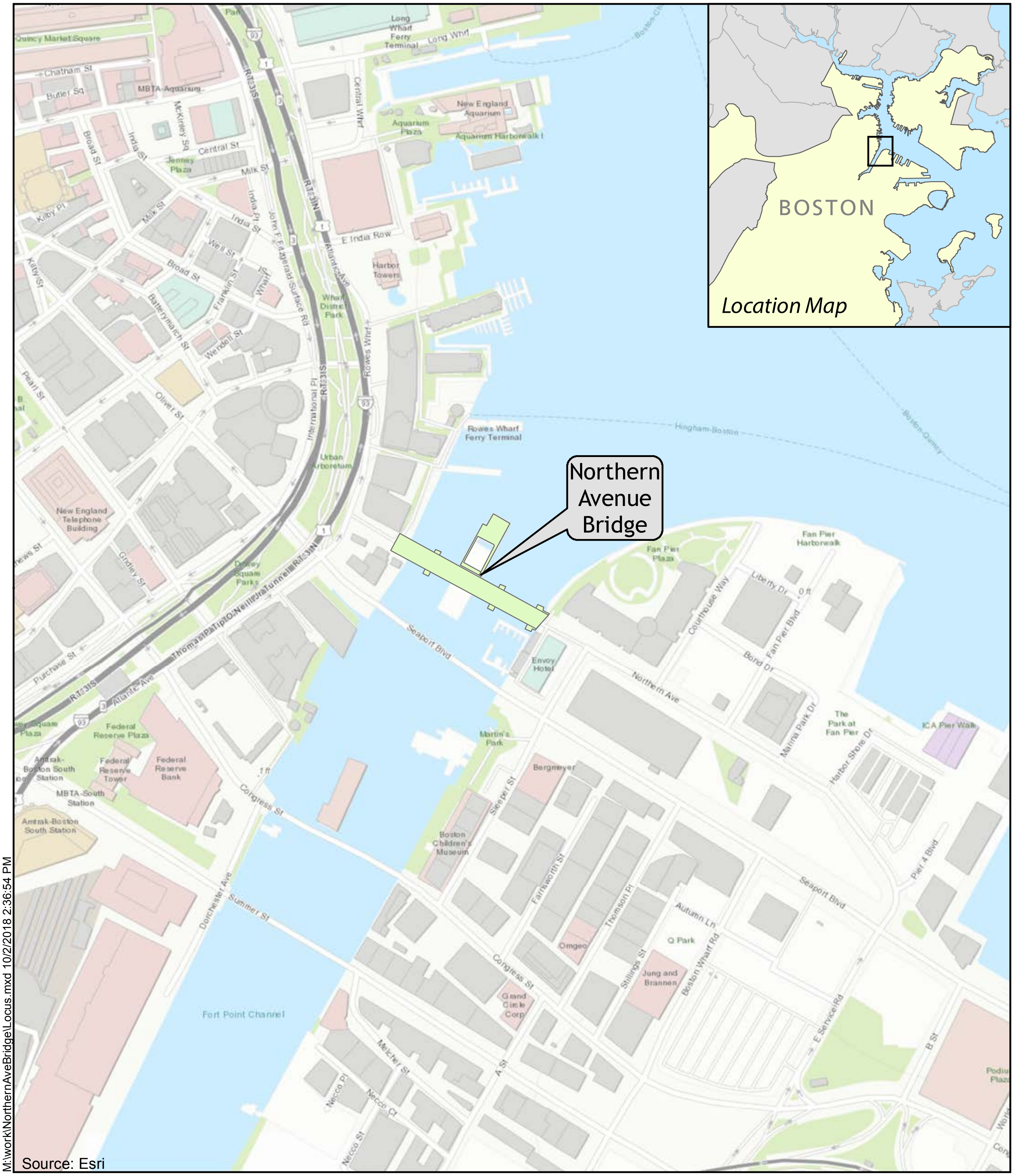

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October 2018

Figure 2

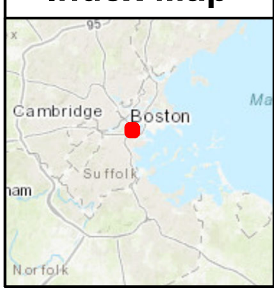
Street Map

Northern Avenue Bridge Replacement
Boston

0 250 500 1,000 Feet

AECOM Imagine it. Delivered.

Index Map



Legend

Project Area

1:3,600

0 125 250 500 Feet

N S E W

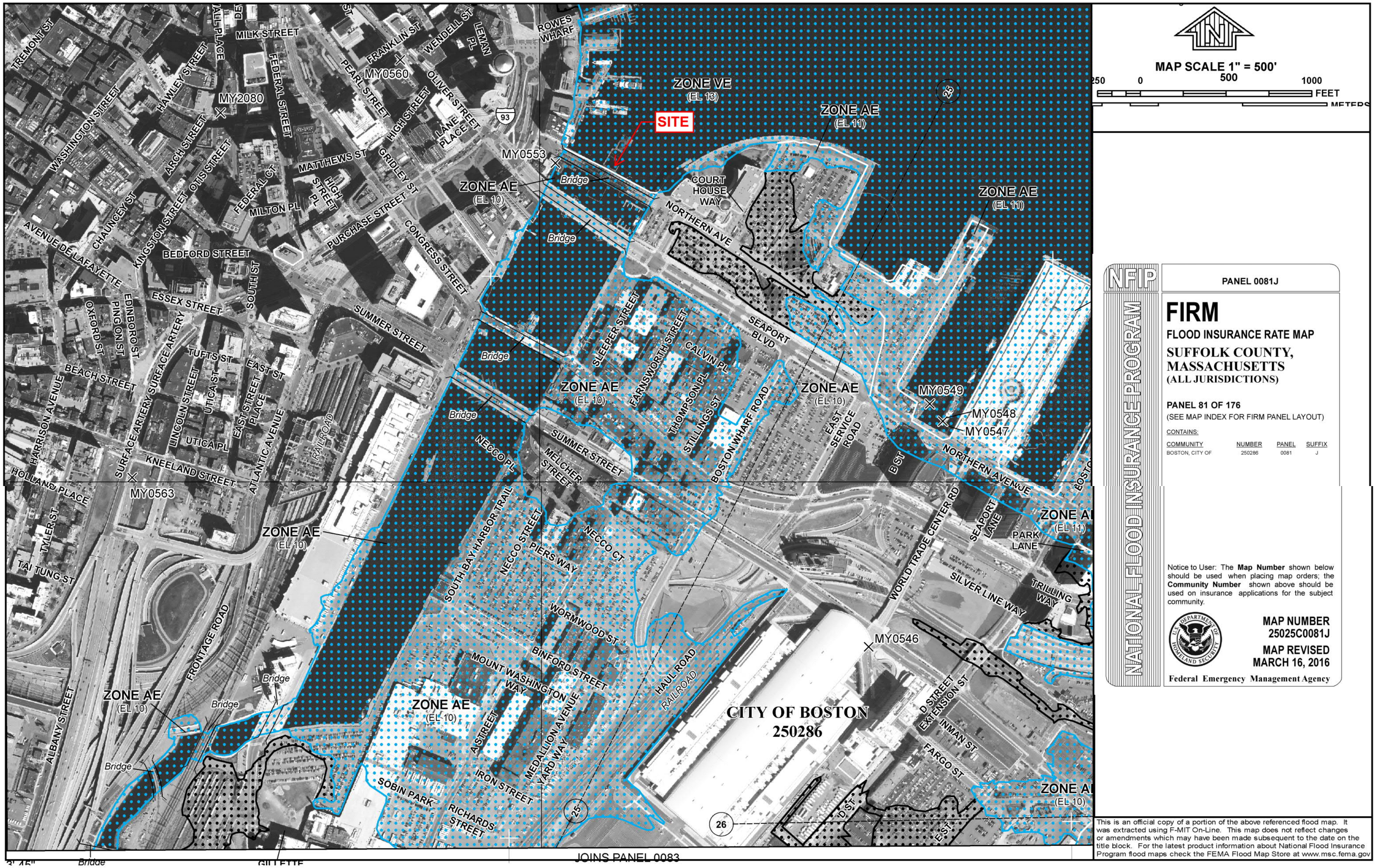
Northern Avenue Bridge Replacement Project

Boston MA

CITY of BOSTON

Figure 3

AECOM


MAP SCALE 1" = 500'
250 0 500 1000
FEET
METERS
ZONE VE
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SITE
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CITY OF BOSTON
250286
MY2080
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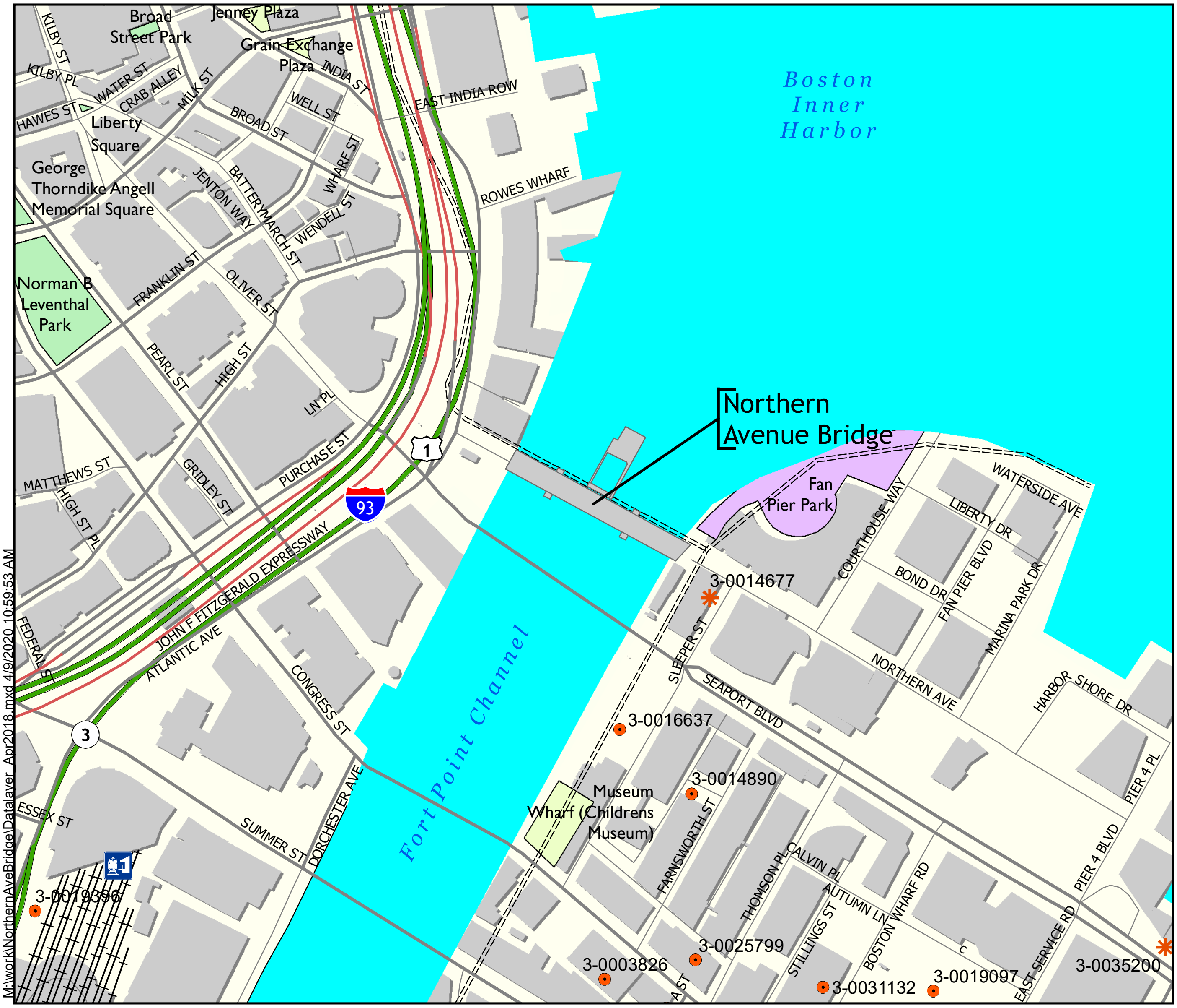
MY0563
MY0549
MY0548
MY0547
MY0546
MILK STREET
TREMONT ST
FRANKLIN ST
WENDELL ST
PEARL STREET
FEDERAL STREET
HAWLEY STREET
WASHINGTON STREET
ARCH STREET
OTIS STREET
HIGH STREET
OLIVER STREET
LANE PLACE
ROWES WHARF
MATTHEWS ST
GRIDLEY ST
FEDERAL CT
MILTON PL
PURCHASE STREET
CONGRESS STREET
CHAUNCEY ST
KINGSTON STREET
BEDFORD STREET
SOUTH ST
AVENUE DE LAFAYETTE
ESSEX STREET
SUMMER STREET
EDINBORO ST
PING ON ST
OXFORD ST
TUFTS ST
EAST ST
BEACH STREET
SURFACE ARTERY
LINCOLN STREET
UTICA ST
EAST STREET PLACE
UTICA PL
ATLANTIC AVENUE
KNEELAND STREET
HARRISON AVENUE
HOLLAND PLACE
TYLER ST
TAI TUNG ST
ALBANY STREET
FRONTAGE ROAD
RAILROAD
Bridge
COURT HOUSE WAY
NORTHERN AVE
SEAPORT BLVD
SLEEPER STREET
FARNSWORTH STREET
CALVIN PL
THOMPSON PL
STILLINGS ST
BOSTON WHARF ROAD
EAST SERVICE ROAD
B ST
NORTHERN AVENUE
NECCO PL
MELCHER STREET
SUMMER STREET
SOUTH BAY HARBOR TRAIL
NECCO STREET
PIERS WAY
NECCO CT
WORMWOOD ST
BINFORD STREET
MOUNT WASHINGTON WAY
A STREET
MEDALLION AVENUE
YARD WAY
IRON STREET
SOBIN PARK
RICHARDS STREET
HAUL ROAD
WORLD TRADE CENTER RD
SEAPORT LANE
PARK LANE
SILVER LINE WAY
TRILLING WAY
D STREET EXTENSION ST
INMAN ST
FARGO ST
D ST
E ST
25
26
JOINS PANEL 0083
GILLETTE
NFIP
NATIONAL FLOOD INSURANCE PROGRAM
PANEL 0081J
FIRM
FLOOD INSURANCE RATE MAP
SUFFOLK COUNTY, MASSACHUSETTS (ALL JURISDICTIONS)
PANEL 81 OF 176
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
BOSTON, CITY OF 250286 0081 J
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.
MAP NUMBER 25025C0081J
MAP REVISED MARCH 16, 2016
Federal Emergency Management Agency
This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

FIGURE 4



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Water Supplies

- Emergency Surface Water
- Community Groundwater Well
- Non-Transient Non-Community
- Proposed Well
- Community Surface Water Source
- Transient Non-Community
- DEP Approved Zone II Protection Area
- Interim Zone II Protection Area
- DEP Permitted Solid Waste Facility
- Zone A
- Zone B
- Zone C

Surface Water Protection Areas

Aquifers

- High Yield Aquifer
- Medium Yield Aquifer
- Non-Potential Drinking Water Source Area (High Yield)
- Non-Potential Drinking Water Source Area (Medium Yield)
- Sole Source Aquifer

Natural Heritage & Endangered Species

- NHESP Certified Vernal Pools
- NHESP Priority Habitats for Rare Species
- NHESP Estimated Habitats for Rare Wildlife
- ACECS

Open Space

- Federal
- State
- Municipal
- Other Public
- Private

Drainage Basin Divide

MassDEP Integrated List of Waters

- Category 5
- Category 4C
- Category 4A
- Category 3
- Category 2

- MassDEP Tier Classified Oil and/or Hazardous Material Site
- MassDEP Oil and/or Hazardous Material Sites with Activity and Use Limitations (AUL)

Map compiled by AECOM, April 2020 from data supplied by MassGIS.

1:6,000

0 250 500 1,000

Feet

GIS Data Layer Map
Northern Avenue Bridge

April 2020

FIGURE 5

AECOM

Attachment 2

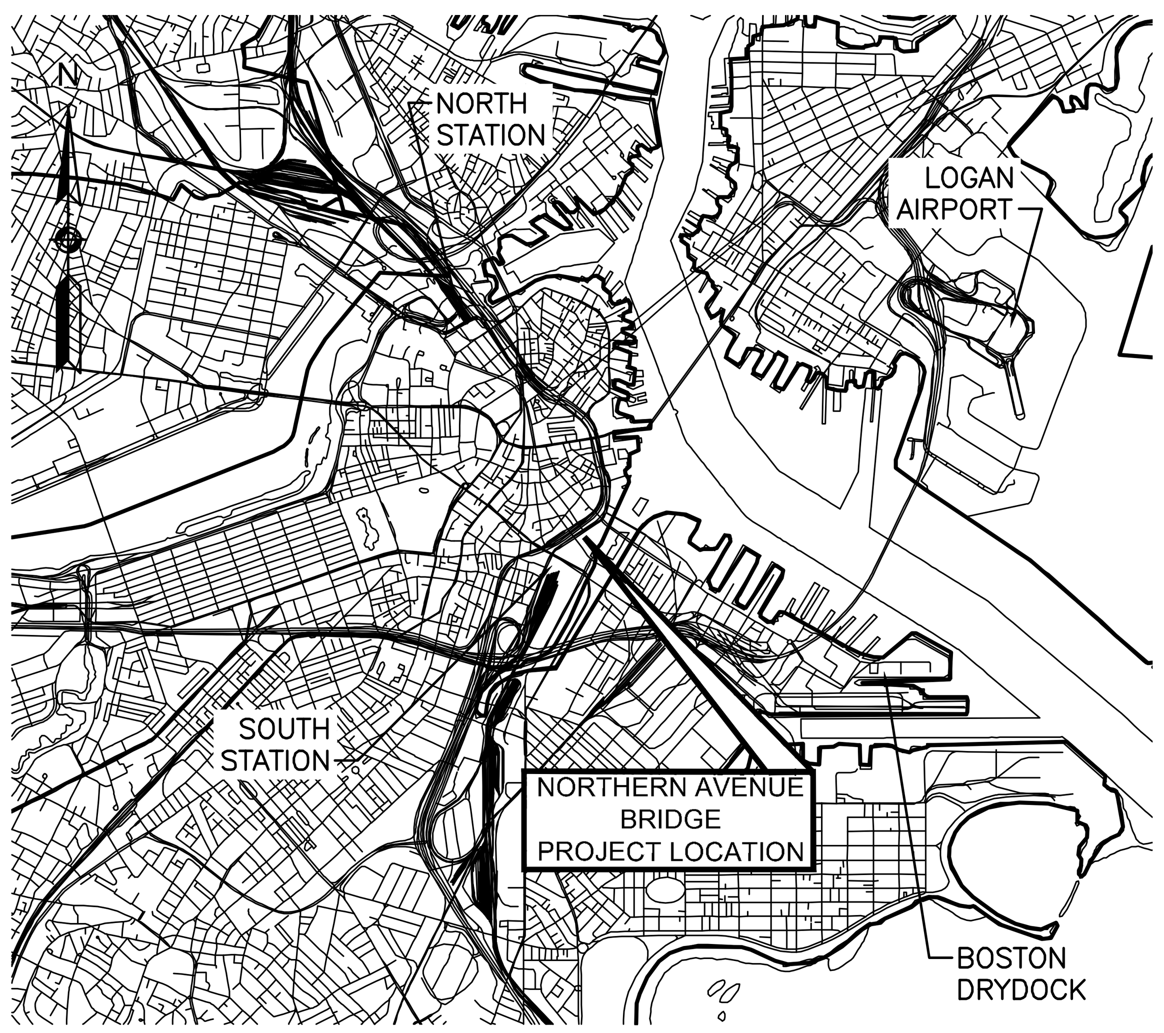
25% Design Plans

CITY OF BOSTON
PUBLIC WORKS DEPARTMENT

HON. MARTIN J. WALSH - MAYOR

CHRIS OSGOOD - CHIEF OF STREETS, TRANSPORTATION, AND SANITATION

CAPITAL IMPROVEMENT PROJECT XX-XX
NORTHERN AVENUE BRIDGE REPLACEMENT PROJECT



LOCUS
SCALE: 1"=1000"

PLAN INDEX

SHEET NO.	DESCRIPTION
1	COVER
2-17	CIVIL PLANS
18-20	LANDSCAPE PLANS
21	TRAFFIC PLAN
22-27	UTILITY PLANS
28-48	BRIDGE PLANS

25% PLANS SUBMISSION
APRIL 21, 2020

PLANS PREPARED BY:

AECOM
ONE FEDERAL STREET - EIGHTH FLOOR
BOSTON, MASSACHUSETTS 02110

APPROVED:

CHIEF OF STREETS, TRANSPORTATION, AND SANITATION

DATE

GENERAL SYMBOLS

EXISTING	PROPOSED	DESCRIPTION
JB	JB	JERSEY BARRIER
CB	CB	CATCH BASIN
		CATCH BASIN CURB INLET
FP	FP	FLAG POLE
GP	GP	GAS PUMP
MB	MB	MAIL BOX
		POST SQUARE
		POST CIRCULAR
WELL	WELL	WELL
EHH	EHH	ELECTRIC HANDHOLE
		FENCE GATE POST
GG	GG	GAS GATE
BHL #	BHL #	BORING HOLE
MW #	MW #	MONITORING WELL
TP #	TP #	TEST PIT
		HYDRANT
		LIGHT POLE
CO.BD.		COUNTY BOUND
		GPS POINT
		CABLE MANHOLE
		DRAINAGE MANHOLE
		ELECTRIC MANHOLE
		GAS MANHOLE
		MISC MANHOLE
		SEWER MANHOLE
		TELEPHONE MANHOLE
		WATER MANHOLE
MHB	MHB	MASSACHUSETTS HIGHWAY BOUND
MON		MONUMENT
SB		STONE BOUND
TB		TOWN OR CITY BOUND
		TRAVERSE OR TRIANGULATION STATION
TPL or GUY	TPL or GUY	TROLLEY POLE OR GUY POLE
HTP		TRANSMISSION POLE
UFB	UFB	UTILITY POLE W/ FIREBOX
UPDL	UPDL	UTILITY POLE WITH DOUBLE LIGHT
ULT	ULT	UTILITY POLE W / 1 LIGHT
UPL	UPL	UTILITY POLE
		BUSH
•SIZE & TYPE		TREE
		STUMP
		SWAMP / MARSH
WG	WG	WATER GATE
PM	PM	PARKING METER
		OVERHEAD CABLE/WIRE
		CURBING
100 99		CONTOURS (ON-THE-GROUND SURVEY DATA)
100 99		CONTOURS (PHOTOGRAMMETRIC DATA)
		UNDERGROUND DRAIN PIPE (DOUBLE LINE 24 INCH AND OVER)
		UNDERGROUND ELECTRIC DUCT (DOUBLE LINE 24 INCH AND OVER)
		UNDERGROUND GAS MAIN (DOUBLE LINE 24 INCH AND OVER)
		UNDERGROUND SEWER MAIN (DOUBLE LINE 24 INCH AND OVER)
		UNDERGROUND TELEPHONE DUCT (DOUBLE LINE 24 INCH AND OVER)
		UNDERGROUND WATER MAIN (DOUBLE LINE 24 INCH AND OVER)
		BALANCED STONE WALL
		GUARD RAIL - STEEL POSTS
		GUARD RAIL - WOOD POSTS
		GUARD RAIL - DOUBLE FACE - STEEL POSTS
		GUARD RAIL - DOUBLE FACE - WOOD POSTS
		CHAIN LINK OR METAL FENCE
		WOOD FENCE
		SEDIMENT CONTROL BARRIER
		TREE LINE
		SAWCUT LINE
		TOP OR BOTTOM OF SLOPE
		LIMIT OF EDGE OF PAVEMENT OR COLD PLANE AND OVERLAY
		BANK OF RIVER OR STREAM
		BORDER OF WETLAND
		100 FT WETLAND BUFFER
		200 FT RIVERFRONT BUFFER
		STATE HIGHWAY LAYOUT
		TOWN OR CITY LAYOUT
		COUNTY LAYOUT
		RAILROAD SIDELINE
		TOWN OR CITY BOUNDARY LINE
		PROPERTY LINE OR APPROXIMATE PROPERTY LINE
		EASEMENT

TRAFFIC SYMBOLS

EXISTING	PROPOSED	DESCRIPTION
1	1	CONTROLLER PHASE ACTUATED
		TRAFFIC SIGNAL HEAD (SIZE AS NOTED)
		WIRE LOOP DETECTOR (6' x 6' TYP UNLESS OTHERWISE SPECIFIED)
		VIDEO DETECTION CAMERA
		MICROWAVE DETECTOR
		PEDESTRIAN PUSH BUTTON, SIGN (DIRECTIONAL ARROW AS SHOWN) AND SADDLE
		EMERGENCY PREEMPTION CONFIRMATION STROBE LIGHT
		VEHICULAR SIGNAL HEAD
		VEHICULAR SIGNAL HEAD, OPTICALLY PROGRAMMED
		FLASHING BEACON
		PEDESTRIAN SIGNAL HEAD, (TYPE AS NOTED OR AS SPECIFIED)
RRSG	RRSG	RAILROAD SIGNAL
OR		SIGNAL POST AND BASE (ALPHA-NUMERIC DESIGNATION NOTED)
	20'	MAST ARM, SHAFT AND BASE (ARM LENGTH AS NOTED)
		HIGH MAST POLE OR TOWER
		SIGN AND POST
		SIGN AND POST (2 POSTS)
	20'	MAST ARM WITH LUMINAIRE
		OPTICAL PRE-EMPTION DETECTOR
		CONTROL CABINET, GROUND MOUNTED
		CONTROL CABINET, POLE MOUNTED
		FLASHING BEACON CONTROL AND METER PEDESTAL
		LOAD CENTER ASSEMBLY
		PULL BOX 12"x12" (OR AS NOTED)
		ELECTRIC HANDHOLE 12"x24" (OR AS NOTED)
		TRAFFIC SIGNAL CONDUIT

PAVEMENT MARKINGS SYMBOLS

EXISTING	PROPOSED	DESCRIPTION
		PAVEMENT ARROW - WHITE
ONLY	ONLY	LEGEND "ONLY" - WHITE
	SL	STOP LINE
	CW	CROSSWALK
	SWL	SOLID WHITE LINE
	SYL	SOLID YELLOW LINE
	BWL	BROKEN WHITE LINE
	BYL	BROKEN YELLOW LINE
	DWL	DOTTED WHITE LINE
	DYL	DOTTED YELLOW LINE
	DWLEx	DOTTED WHITE LINE EXTENSION
	DYLEx	DOTTED YELLOW LINE EXTENSION
	DBWL	DOUBLE WHITE LINE
	DBYL	DOUBLE YELLOW LINE

ABBREVIATIONS

GENERAL

AADT	ANNUAL AVERAGE DAILY TRAFFIC
ABAN	ABANDON
ADJ	ADJUST
APPROX.	APPROXIMATE
A.C.	ASPHALT CONCRETE
ACCM PIPE	ASPHALT COATED CORRUGATED METAL PIPE
BIT.	BITUMINOUS
BC	BOTTOM OF CURB
BD.	BOUND
BL	BASELINE
BLDG	BUILDING
BM	BENCHMARK
BO	BY OTHERS
BOS	BOTTOM OF SLOPE
BR.	BRIDGE
CB	CATCH BASIN
CBCI	CATCH BASIN WITH CURB INLET
CC	CEMENT CONCRETE
CCM	CEMENT CONCRETE MASONRY
CEM	CEMENT
CI	CURB INLET
CIP	CAST IRON PIPE
CLF	CHAIN LINK FENCE
CL	CENTERLINE
CMP	CORRUGATED METAL PIPE
CSP	CORRUGATED STEEL PIPE
CO.	COUNTY
CONC	CONCRETE
CONT	CONTINUOUS
CONST	CONSTRUCTION
CR GR	CROWN GRADE
DHV	DESIGN HOURLY VOLUME
DI	DROP INLET
DIA	DIAMETER
DIP	DUCTILE IRON PIPE
DW	STEADY DON'T WALK - PORTLAND ORANGE
DWY	DRIVEWAY
ELEV (or EL.)	ELEVATION
EMB	EMBANKMENT
EOP	EDGE OF PAVEMENT
EXIST (or EX)	EXISTING
EXC	EXCAVATION
F&C	FRAME AND COVER
F&G	FRAME AND GRATE
FDN.	FOUNDATION
FLDSTN	FIELDSTONE
GAR	GARAGE
GD	GROUND
GG	GAS GATE
GI	GUTTER INLET
GIP	GALVANIZED IRON PIPE
GRAN	GRANITE
GRAV	GRAVEL
GRD	GUARD
HDW	HEADWALL
HMA	HOT MIX ASPHALT
HOR	HORIZONTAL
HYD	HYDRANT
INV	INVERT
JCT	JUNCTION
L	LENGTH OF CURVE
LB	LEACH BASIN
LP	LIGHT POLE
LT	LEFT
MAX	MAXIMUM
MB	MAILBOX
MH	MANHOLE
MHB	MASSACHUSETTS HIGHWAY BOUND
MIN	MINIMUM
NIC	NOT IN CONTRACT
NO.	NUMBER
PC	POINT OF CURVATURE
PCC	POINT OF COMPOUND CURVATURE
P.G.L.	PROFILE GRADE LINE
PI	POINT OF INTERSECTION
POC	POINT ON CURVE
POT	POINT ON TANGENT
PRC	POINT OF REVERSE CURVATURE
PROJ	PROJECT
PROP	PROPOSED
PSB	PLANTABLE SOIL BORROW
PT	POINT OF TANGENCY
PVC	POINT OF VERTICAL CURVATURE
PVI	POINT OF VERTICAL INTERSECTION
PVT	POINT OF VERTICAL TANGENCY
PVMT	PAVEMENT
PWW	PAVED WATER WAY

ABBREVIATIONS (cont.)

GENERAL

R	RADIUS OF CURVATURE
R&D	REMOVE AND DISPOSE
RCP	REINFORCED CONCRETE PIPE
RD	ROAD
RDWY	ROADWAY
REM	REMOVE
RET	RETAIN
RET WALL	RETAINING WALL
ROW	RIGHT OF WAY
RR	RAILROAD
R&R	REMOVE AND RESET
R&S	REMOVE AND STACK
RT	RIGHT
SB	STONE BOUND
SHLD	SHOULDER
SMH	SEWER MANHOLE
ST	STREET
STA	STATION
SSD	STOPPING SIGHT DISTANCE
SHLO	STATE HIGHWAY LAYOUT LINE
SW	SIDEWALK
T	TANGENT DISTANCE OF CURVE/TRUCK %
TAN	TANGENT
TEMP	TEMPORARY
TC	TOP OF CURB
TOS	TOP OF SLOPE
TYP	TYPICAL
UP	UTILITY POLE
VAR	VARIES
VERT	VERTICAL
VC	VERTICAL CURVE
WCR	WHEEL CHAIR RAMP
WG	WATER GATE
WIP	WROUGHT IRON PIPE
WM	WATER METER/WATER MAIN
X-SECT	CROSS SECTION

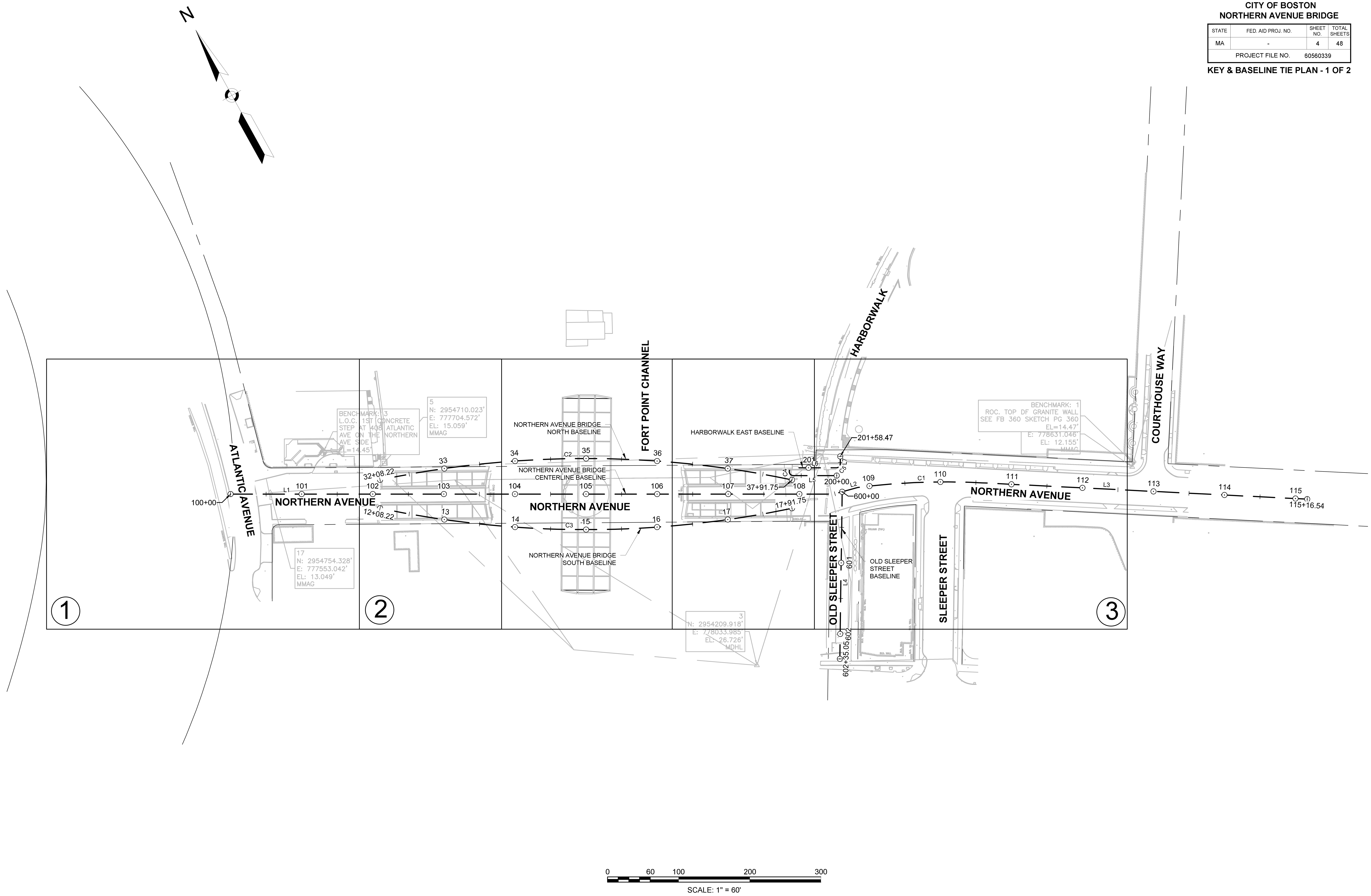
TRAFFIC SIGNAL ABBREVIATIONS

CAB	CABINET
CCVE	CLOSED CIRCUIT VIDEO EQUIPMENT
DW	STEADY UPRAISED HAND
FDW	FLASHING UPRAISED HAND
FR	FLASHING CIRCULAR RED
FRL	FLASHING RED LEFT ARROW
FRR	FLASHING RED RIGHT ARROW
FY	FLASHING CIRCULAR YELLOW
FYL	FLASHING YELLOW LEFT ARROW
FYR	FLASHING YELLOW RIGHT ARROW
G	STEADY CIRCULAR GREEN
GL	STEADY GREEN LEFT ARROW
GR	STEADY GREEN RIGHT ARROW
GSL	STEADY GREEN SLASH LEFT ARROW
GSR	STEADY GREEN SLASH RIGHT ARROW
GV	STEADY GREEN VERTICAL ARROW
OL	OVERLAP
PED	PEDESTRIAN
PTZ	PAN, TILT, ZOOM
R	STEADY CIRCULAR RED
RL	STEADY RED LEFT ARROW
RR	STEADY RED RIGHT ARROW
TR SIG	TRAFFIC SIGNAL
TSC	TRAFFIC SIGNAL CONDUIT
W	STEADY WALKING PERSON
Y	STEADY CIRCULAR YELLOW
YL	STEADY YELLOW LEFT ARROW

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	4	48
PROJECT FILE NO. 60560339			

KEY & BASELINE TIE PLAN - 1 OF 2



Plotted on 21-Apr-2020 9:26 AM
60560339_HD_KEY PLAN.DWG

60560339_HD_KEY PLAN.DWG Plotted on 21-Apr-2020 9:27 AM

NORTHERN AVENUE BRIDGE CENTERLINE BASELINE CONSTRUCTION BASELINE DATA

NUMBER	STARTING STATION	NORTHING	EASTING	CURVE DATA	LINE DATA	ENDING STATION	NORTHING	EASTING
L1	100+00.00	2954779.609	777503.291		S61°00'00"E 848.62'	108+48.62	2954368.190	778245.510
L2	108+48.62	2954368.190	778245.510		S76°26'01"E 35.07'	108+83.69	2954359.964	778279.599
C1	108+83.69	2954359.964	778279.599	R=1000.00' Δ=10°00'11" L=174.59' T=87.52'		110+58.27	2954281.161	778435.140
L3	110+58.27	2954281.161	778435.140		S58°07'48"E 458.26'	115+16.54	2954039.201	778824.318

OLD SLEEPER STREET CONSTRUCTION BASELINE DATA

NUMBER	STARTING STATION	NORTHING	EASTING	CURVE DATA	LINE DATA	ENDING STATION	NORTHING	EASTING
L4	600+00.00	2954365.358	778257.218		S29°47'09"W 235.05'	602+35.05	2954161.358	778140.454

NORTHERN AVENUE BRIDGE NORTH BASELINE CONSTRUCTION BASELINE DATA

NUMBER	STARTING STATION	NORTHING	EASTING	CURVE DATA	LINE DATA	ENDING STATION	NORTHING	EASTING
C2	32+08.22	2954695.139	777696.932	R=1413.75' Δ=23°38'56" L=583.53' T=295.98'		37+91.75	2954414.242	778203.683

NORTHER AVENUE BRIDGE HARBORWALK RAMP - EAST CONSTRUCTION BASELINE DATA

NUMBER	STARTING STATION	NORTHING	EASTING	CURVE DATA	LINE DATA	ENDING STATION	NORTHING	EASTING
L5	200+00.00	2954389.031	778261.542		N61°00'00"W 61.17'	200+61.17	2954418.686	778208.042
C4	200+61.17	2954418.686	778208.042	R=5.50' Δ=180°00'00" L=17.28' T=8571031.51'		200+78.45	2954428.307	778213.375
L6	200+78.45	2954428.307	778213.375		S61°00'00"E 61.17'	201+39.62	2954398.651	778266.875
C5	201+39.62	2954398.651	778266.875	R=5.00' Δ=90°00'02" L=7.85' T=5.00'		201+47.47	2954400.601	778273.672
L7	201+47.47	2954400.601	778273.672		N28°59'59"E 11.00'	201+58.47	2954410.221	778279.005

NORTHERN AVENUE BRIDGE SOUTH BASELINE CONSTRUCTION BASELINE DATA

NUMBER	STARTING STATION	NORTHING	EASTING	CURVE DATA	LINE DATA	ENDING STATION	NORTHING	EASTING
C3	12+08.22	2954660.154	777677.539	R=1413.75' Δ=23°38'56" L=583.53' T=295.98'		17+91.75	2954379.258	778184.290

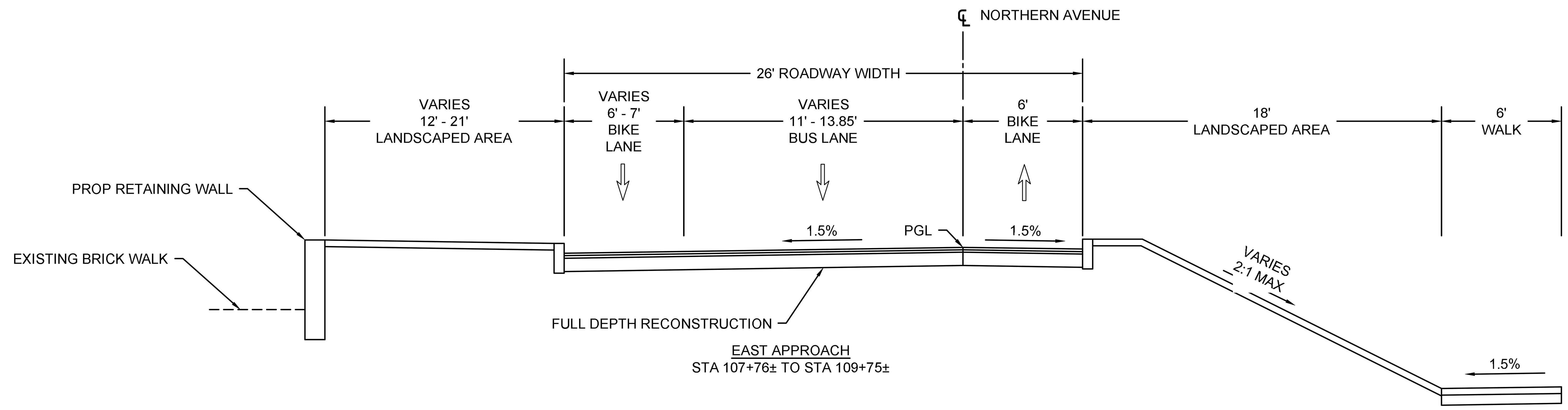
0 60 100 200 300

SCALE: 1" = 60'

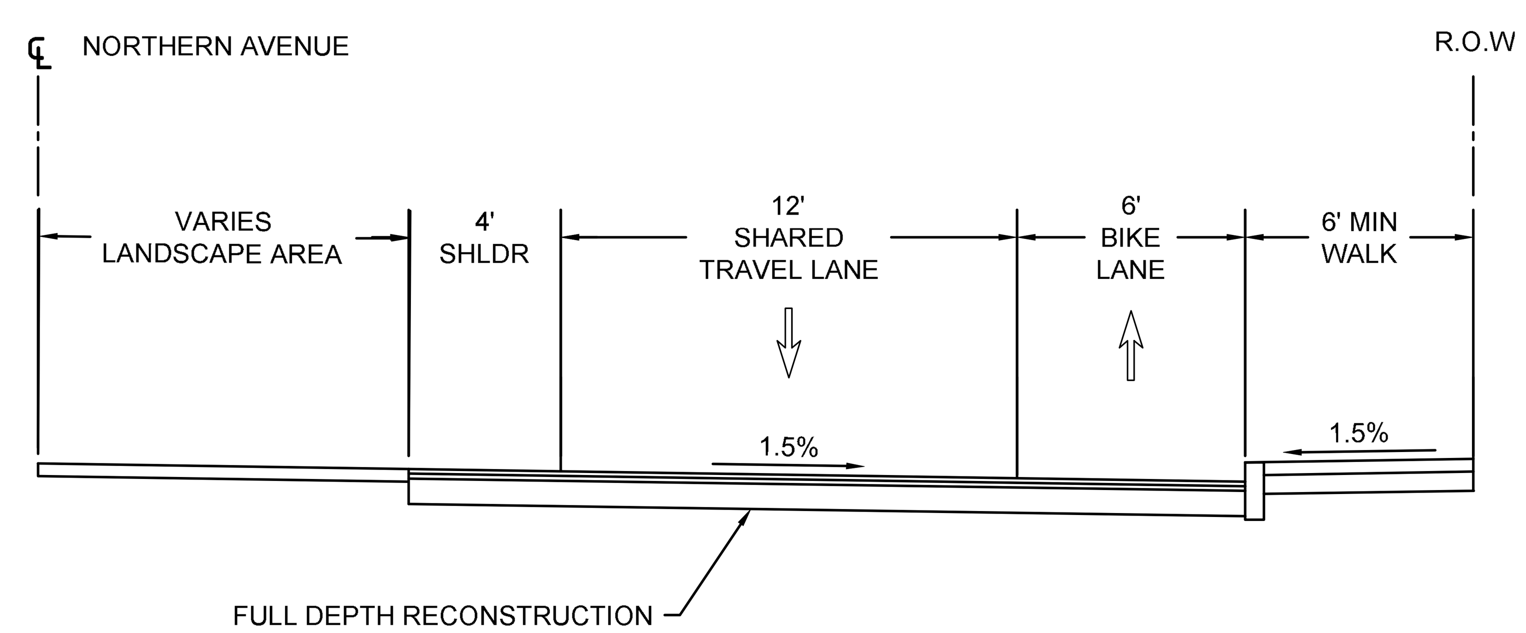
CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	6	48
PROJECT FILE NO.	60560339		

TYPICAL SECTIONS - 1 OF 1



EAST APPROACH
STA 107+76± TO STA 109+75±



WEST APPROACH (STA ±101)

HOR. SCALE IN FEET
4 0 4 8
4 0 4 8
VER. SCALE IN FEET

60560339_HD(TYPICALS).DWG Plotted on 21-Apr-2020 9:42 AM

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	7	48
PROJECT FILE NO. 60560339			

EXISTING CONDITIONS PLAN - 1 OF 3

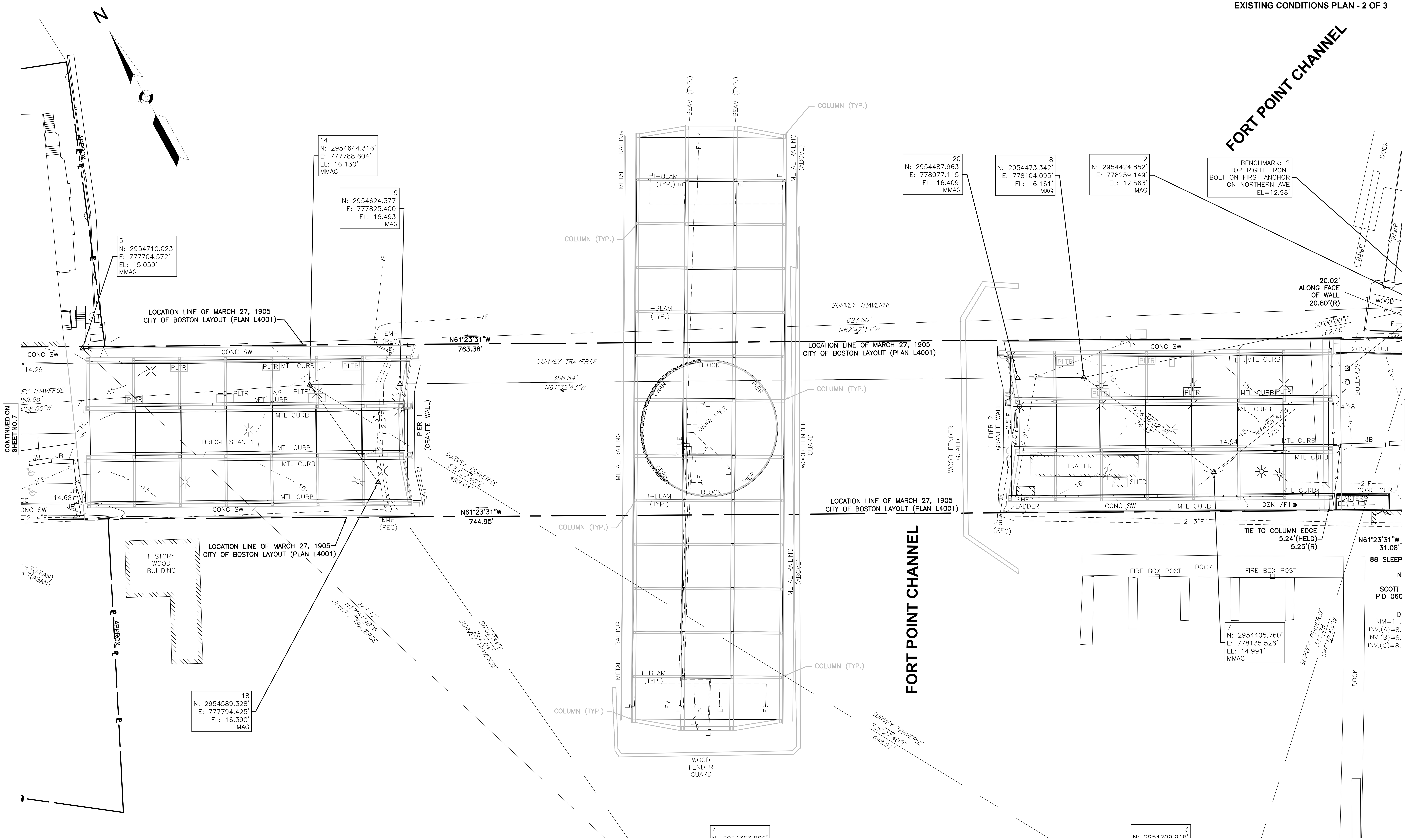
Plotted on 21-Apr-2020 9:27 AM

60560339_SV(EXIST COND).DWG

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	8	48
PROJECT FILE NO.	60560339		

EXISTING CONDITIONS PLAN - 2 OF 3



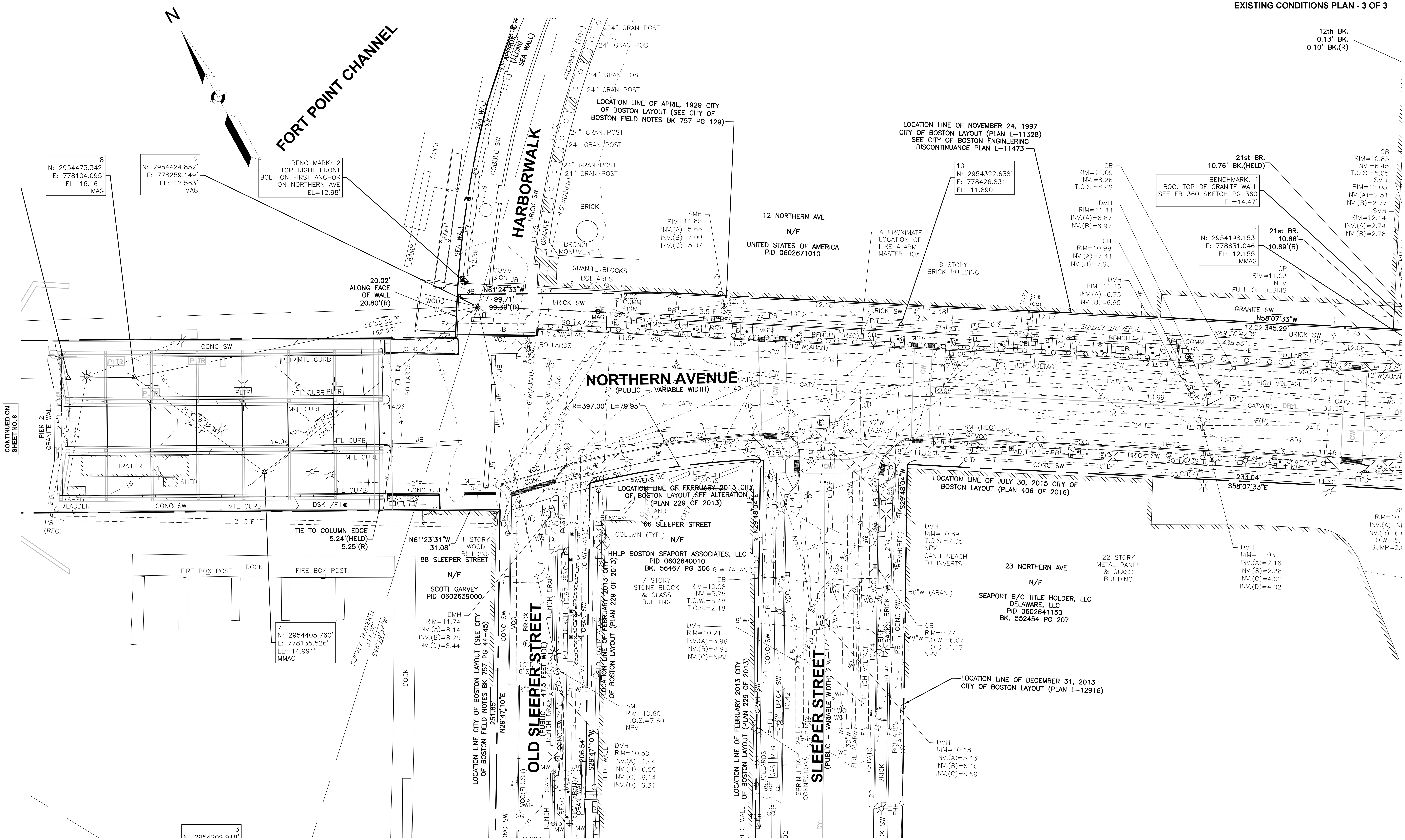
0 20 50 100
SCALE: 1" = 20'

Plotted on 21-Apr-2020 9:27 AM
60560339_SV(EXIST COND).DWG

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	9	48
PROJECT FILE NO. 60560339			

EXISTING CONDITIONS PLAN - 3 OF 3



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SCALE: 1" = 20'

60560339_SV(EXIST COND).DWG Plotted on 21-Apr-2020 9:27 AM

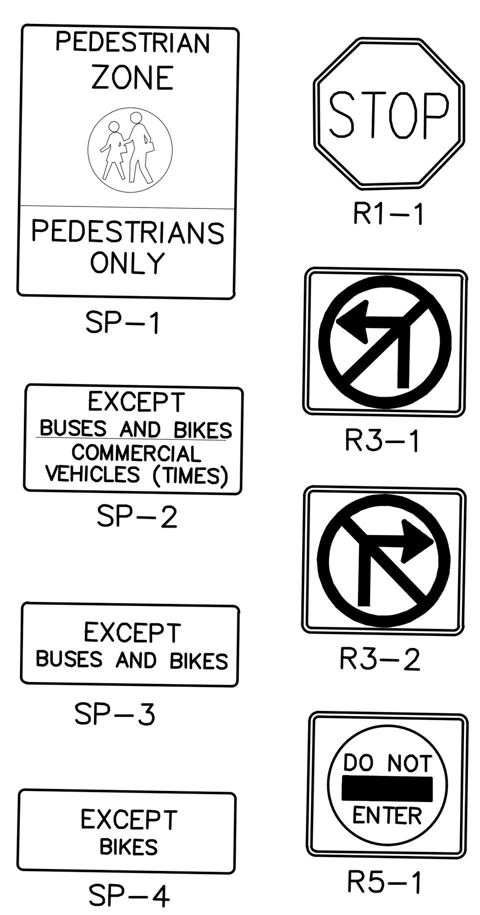
CITY OF BOSTON
NORTHERN AVENUE BRIDGE

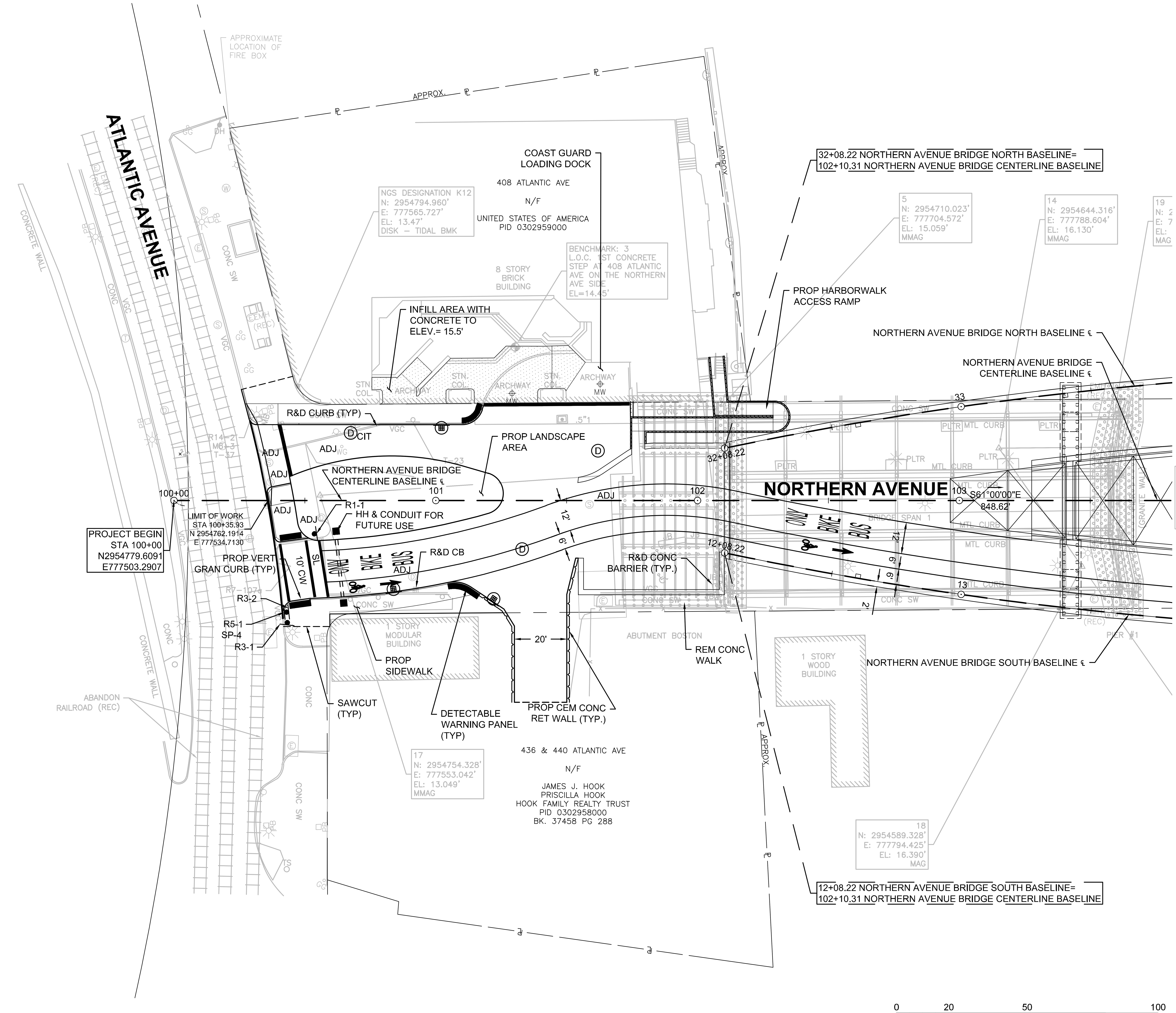
STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	10	48
PROJECT FILE NO. 60560339			

CONSTRUCTION PLAN - 1 OF 3

HIGHWAY GUARD DETAILS	TRAFFIC SIGNAL CONDUIT	WATER SUPPLY ALTERATIONS	DRAINAGE DETAILS
NONE	SEE BELOW	SEE UTILITY PLANS	SEE DRAINAGE PLANS

PROPOSED SIGNS:





CONTINUED ON SHEET NO. 11

NOTES:

1. REFER TO SEE LANDSCAPE PLANS FOR ALL SURFACE MATERIALS

60560339_HD(CONSTRUCTION).DWG Plotted on 21-Apr-2020 9:28 AM

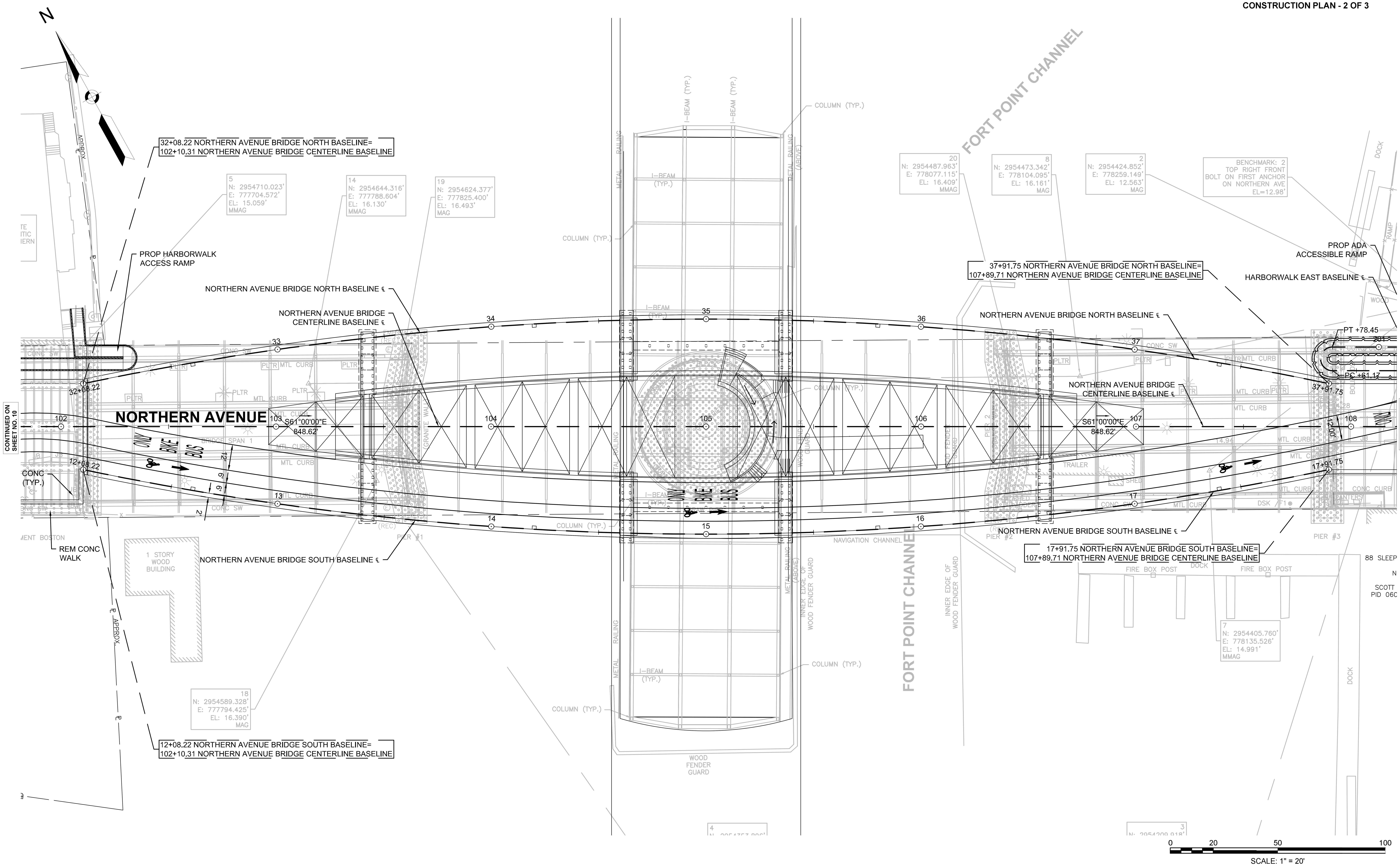
HIGHWAY GUARD DETAILS	TRAFFIC SIGNAL CONDUIT	WATER SUPPLY ALTERATIONS	DRAINAGE DETAILS
NONE	SEE BELOW	SEE UTILITY PLANS	SEE DRAINAGE PLANS

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	11	48
PROJECT FILE NO.	60560339		

CONSTRUCTION PLAN - 2 OF 3

Plotted on 21-Apr-2020 9:28 AM
60560339_HD(CONSTRUCTION).DWG



CITY OF BOSTON
NORTHERN AVENUE BRIDGE

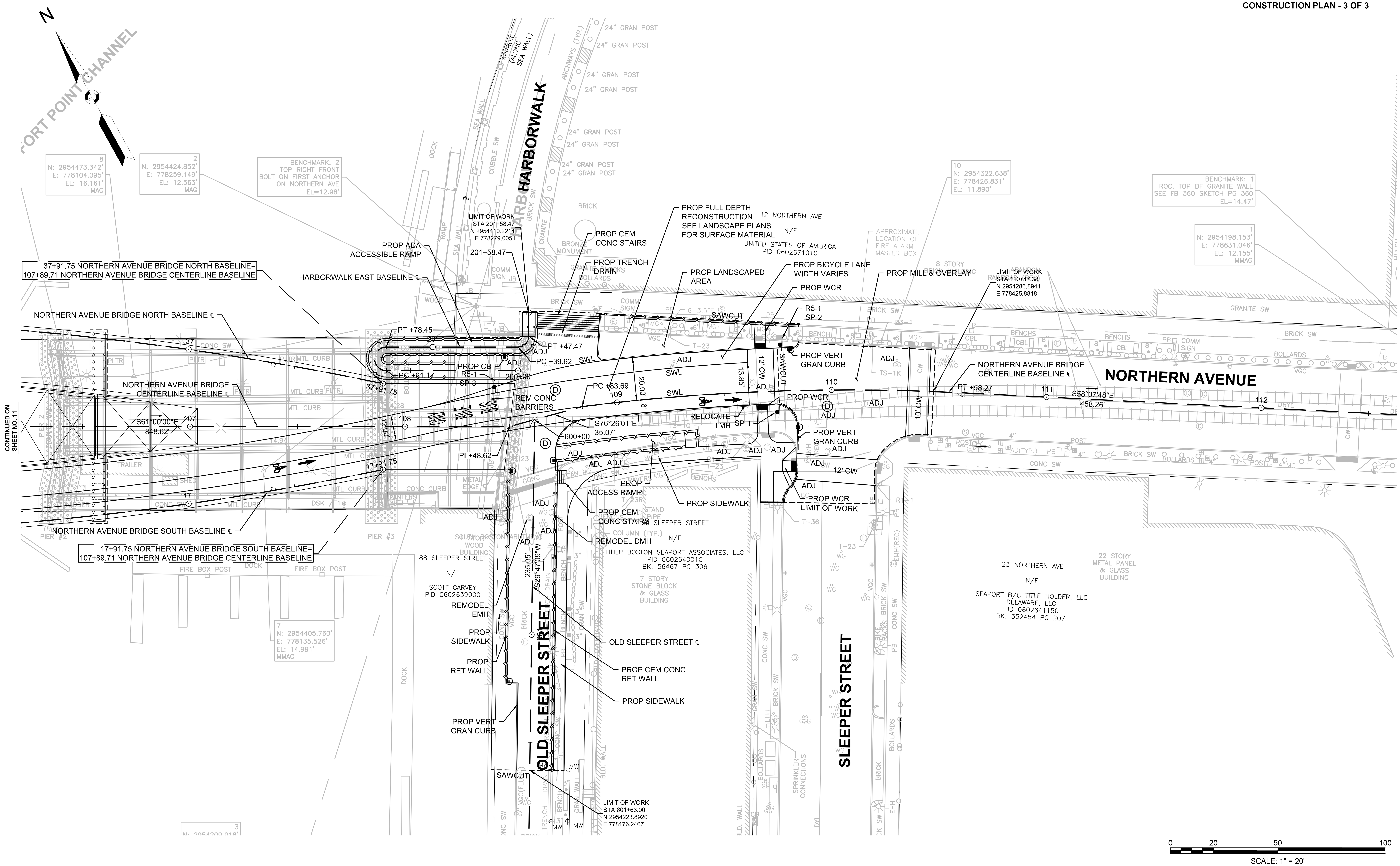
STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	12	48
	PROJECT FILE NO. 60560339		

CONSTRUCTION PLAN - 3 OF 3

Plotted on 21-Apr-2020 9:28 AM

60560339_HD(CONSTRUCTION).DWG

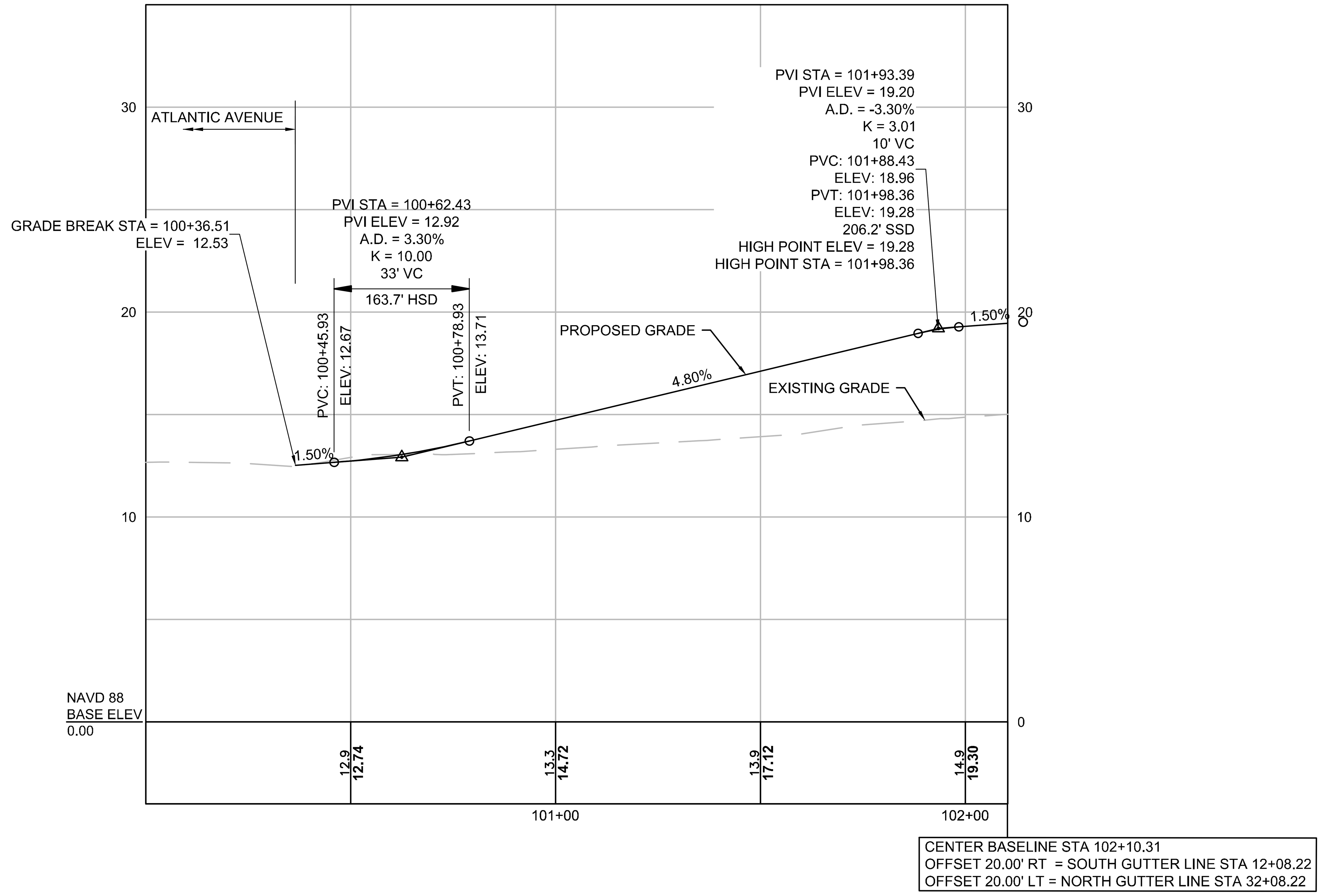
HIGHWAY GUARD DETAILS	TRAFFIC SIGNAL CONDUIT	WATER SUPPLY ALTERATIONS	DRAINAGE DETAILS
NONE	SEE BELOW	SEE UTILITY PLANS	SEE DRAINAGE PLANS



CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	13	48
PROJECT FILE NO.	60560339		

PROFILES - 1 OF 5
NORTHERN AVE CENTER, WEST APPROACH



NORTHERN AVENUE CENTER LINE ALIGNMENT AT WEST BRIDGE APPROACH

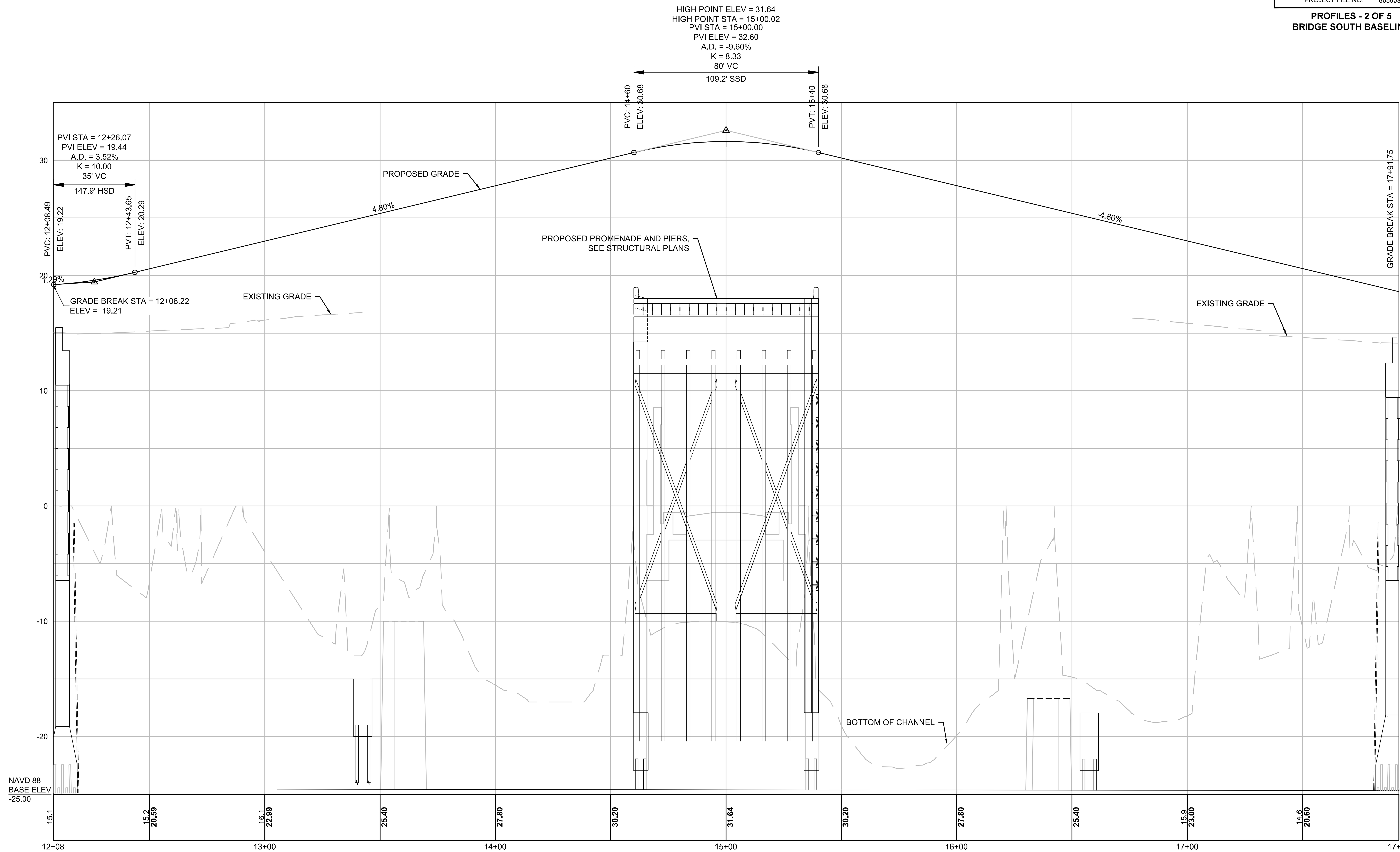
HOR. SCALE IN FEET
20 0 20 40
4 0 4 8
VER. SCALE IN FEET

60560339_HD_PROFILES.DWG Plotted on 21-Apr-2020 11:35 AM

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	14	48
PROJECT FILE NO. 60560339			

PROFILES - 2 OF 5
BRIDGE SOUTH BASELINE



SOUTH GUTTER LINE STA 12+08.22 =
CENTER BASELINE STA 102+10.31 OFFSET 20.00' RT

SOUTH GUTTER LINE STA 17+91.75 =
CENTER BASELINE STA 107+89.71 OFFSET 20.00' RT

NORTHERN AVENUE BRIDGE SOUTH BASELINE ALIGNMENT

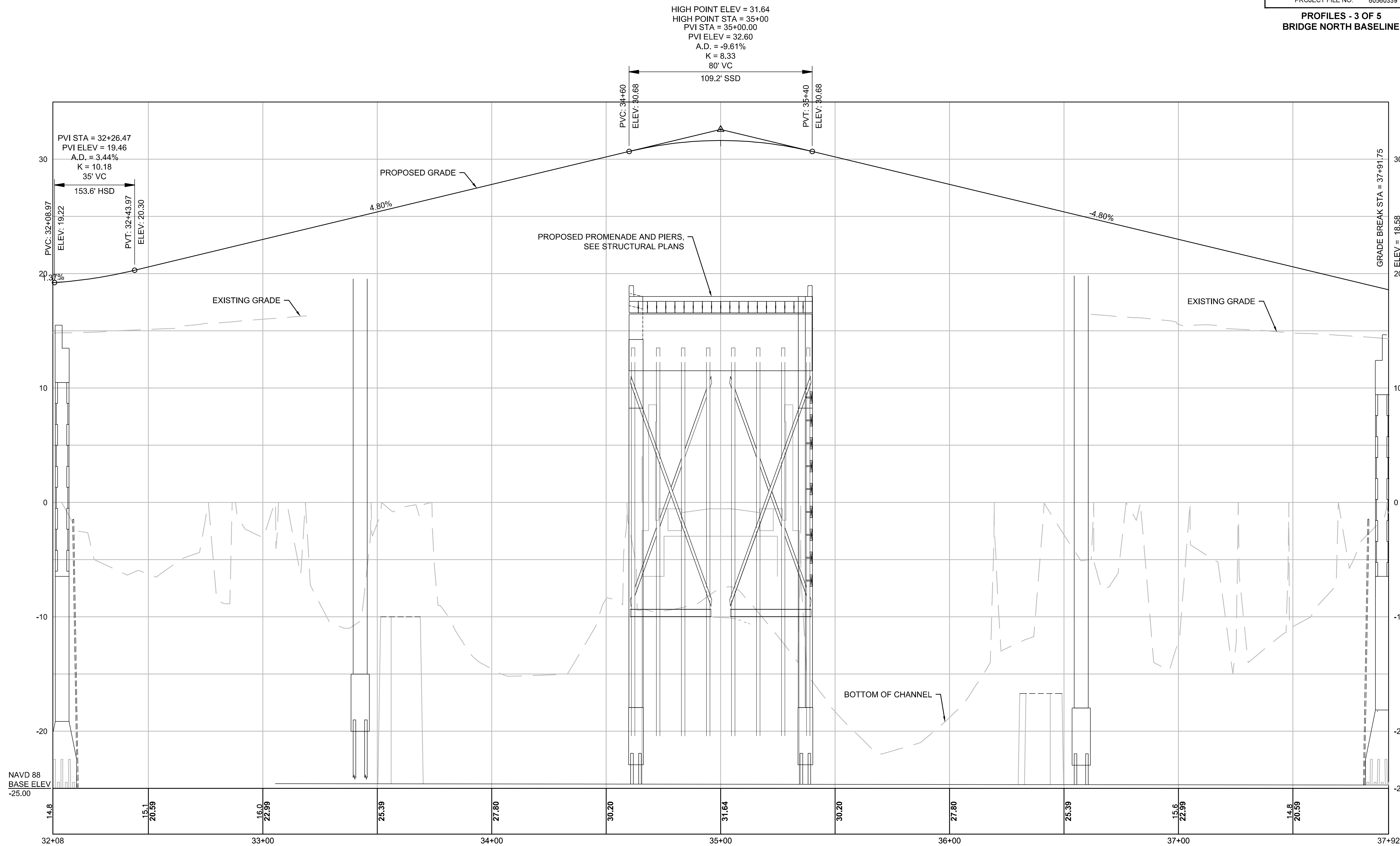
HOR. SCALE IN FEET
20 0 20 40
4 0 4 8
VER. SCALE IN FEET

60560339_HD_PROFILES.DWG Plotted on 21-Apr-2020 11:04 AM

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	15	48
PROJECT FILE NO.	60560339		

PROFILES - 3 OF 5
BRIDGE NORTH BASELINE



NORTH GUTTER LINE STA 32+08.22 =
CENTER BASELINE STA 102+10.31 OFFSET 20.00' LT

NORTH GUTTER LINE STA 37+91.75 =
CENTER BASELINE STA 107+89.71 OFFSET 20.00' LT

NORTHERN AVENUE BRIDGE NORTH BASELINE ALIGNMENT

HOR. SCALE IN FEET
20 0 20 40
4 0 4 8
VER. SCALE IN FEET

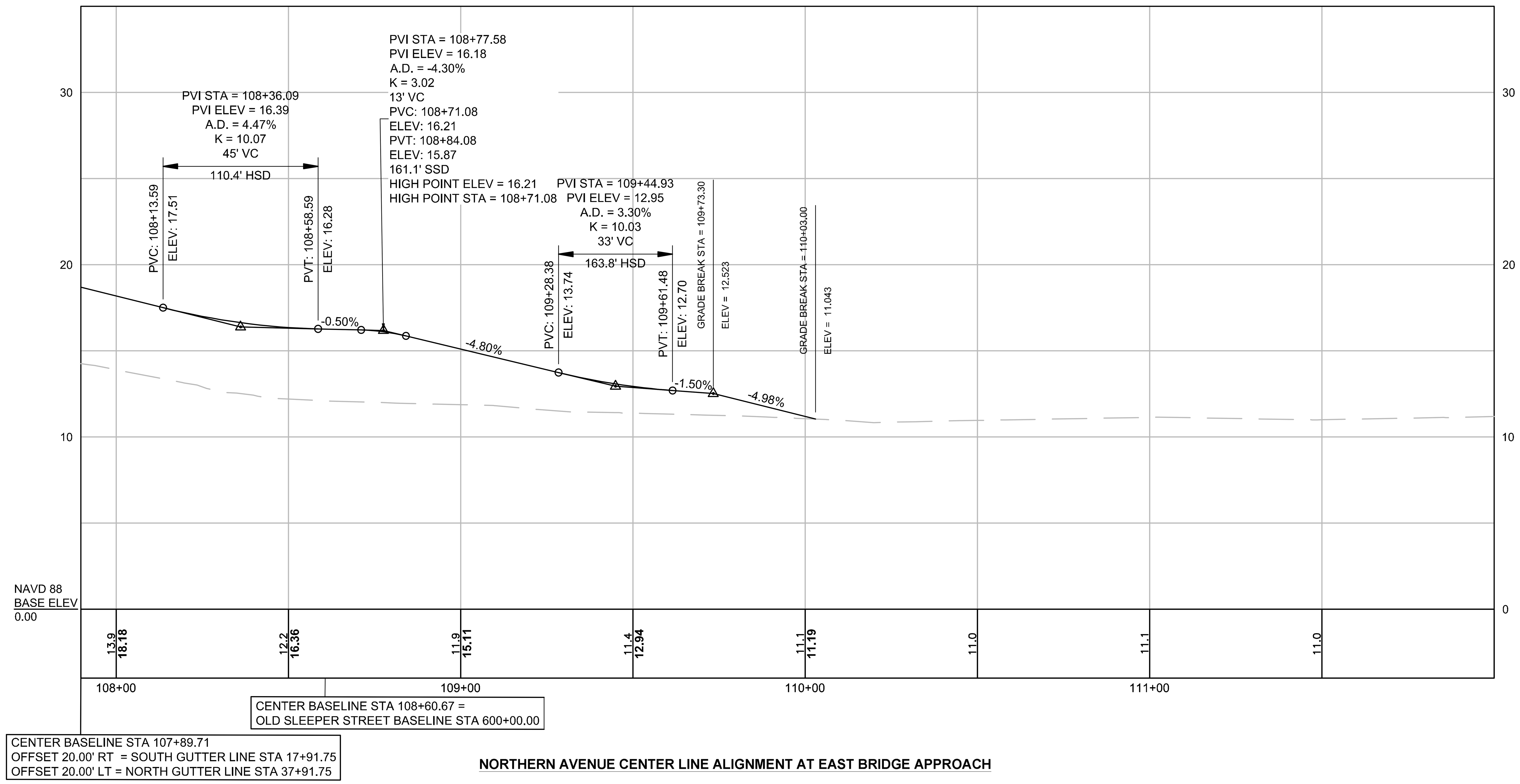
60560339_HD_PROFILES.DWG Plotted on 21-Apr-2020 11:04 AM

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

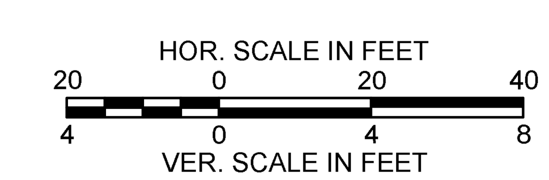
STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	16	48
PROJECT FILE NO. 60560339			

PROFILES - 4 OF 5
NORTHERN AVE CENTER, EAST APPROACH

Plotted on 21-Apr-2020 11:04 AM
60560339_HD_PROFILES.DWG



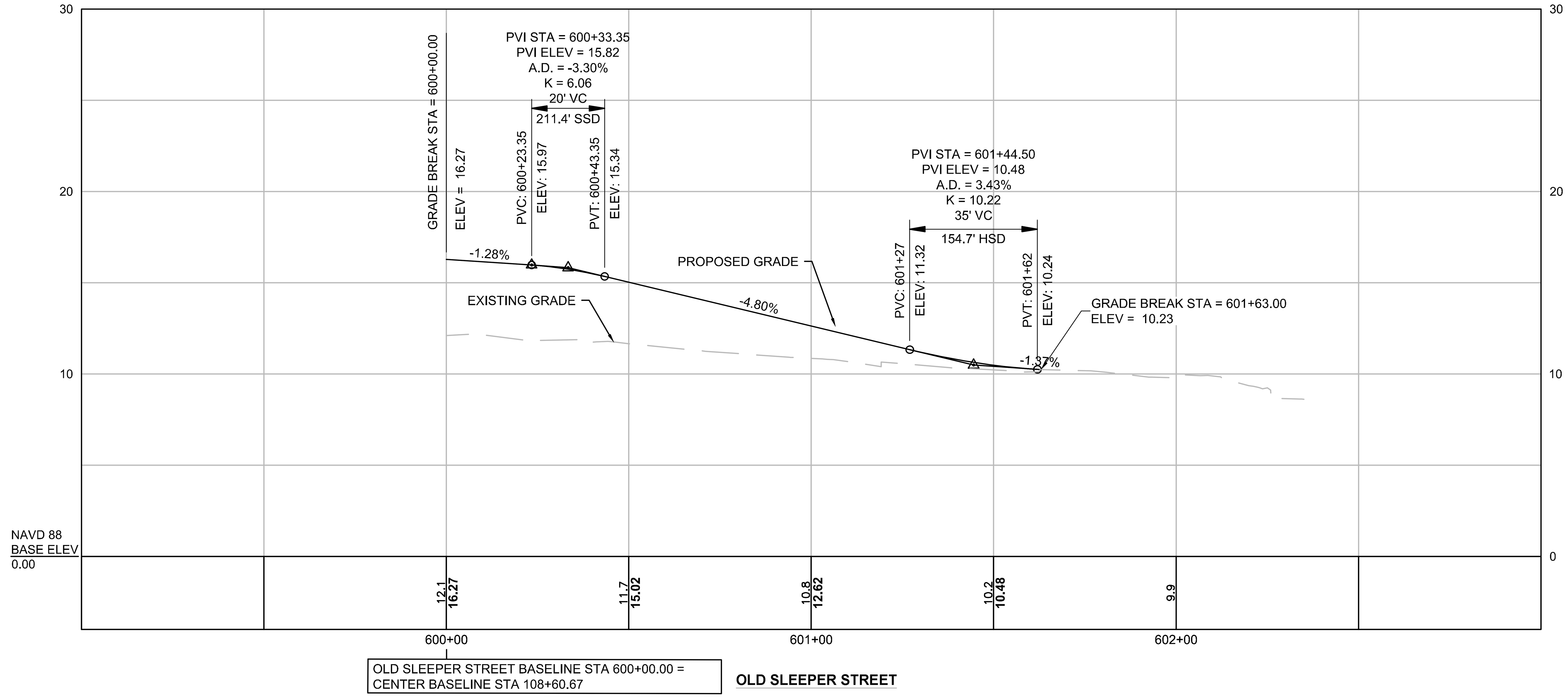
NORTHERN AVENUE CENTER LINE ALIGNMENT AT EAST BRIDGE APPROACH



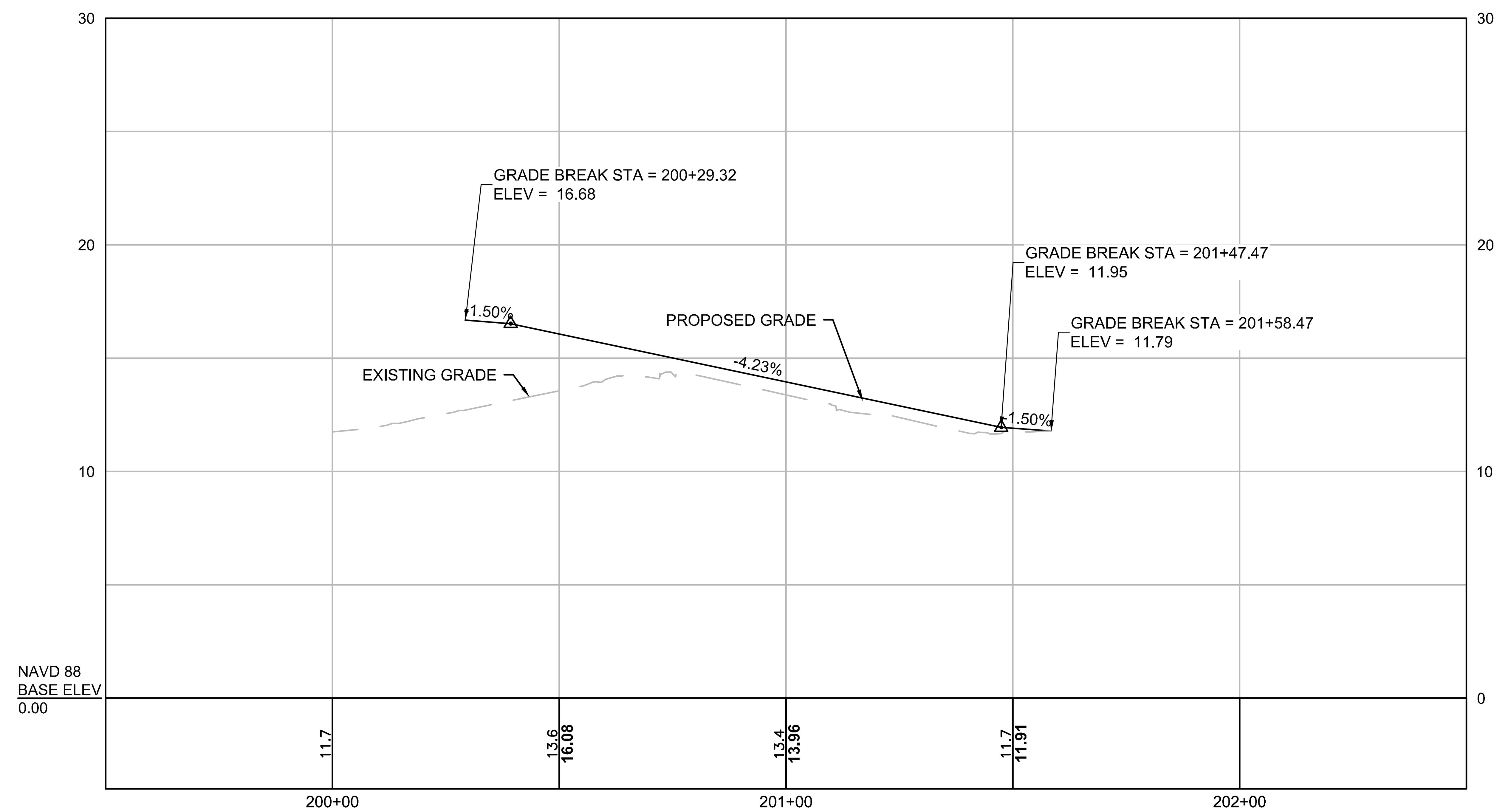
CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	17	48
PROJECT FILE NO.	60560339		

PROFILES - 5 OF 5
OLD SLEEPER ST. & NORTHEAST RAMP



OLD SLEEPER STREET



HARBORWALK RAMP AT NORTHEAST QUADRANT

HOR. SCALE IN FEET
20 0 20 40
4 0 4 8
VER. SCALE IN FEET

Plotted on 21-Apr-2020 11:04 AM

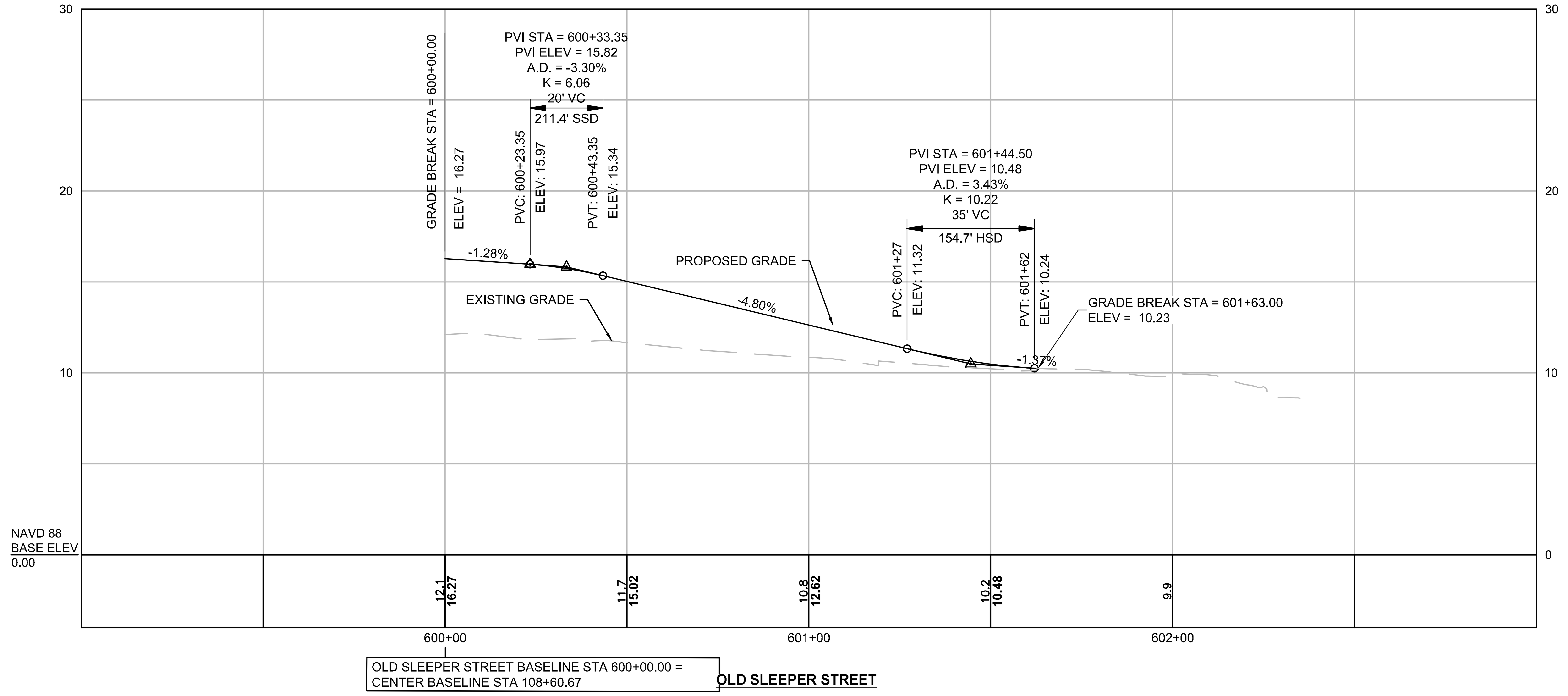
60560339_HD_PROFILES.DWG

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

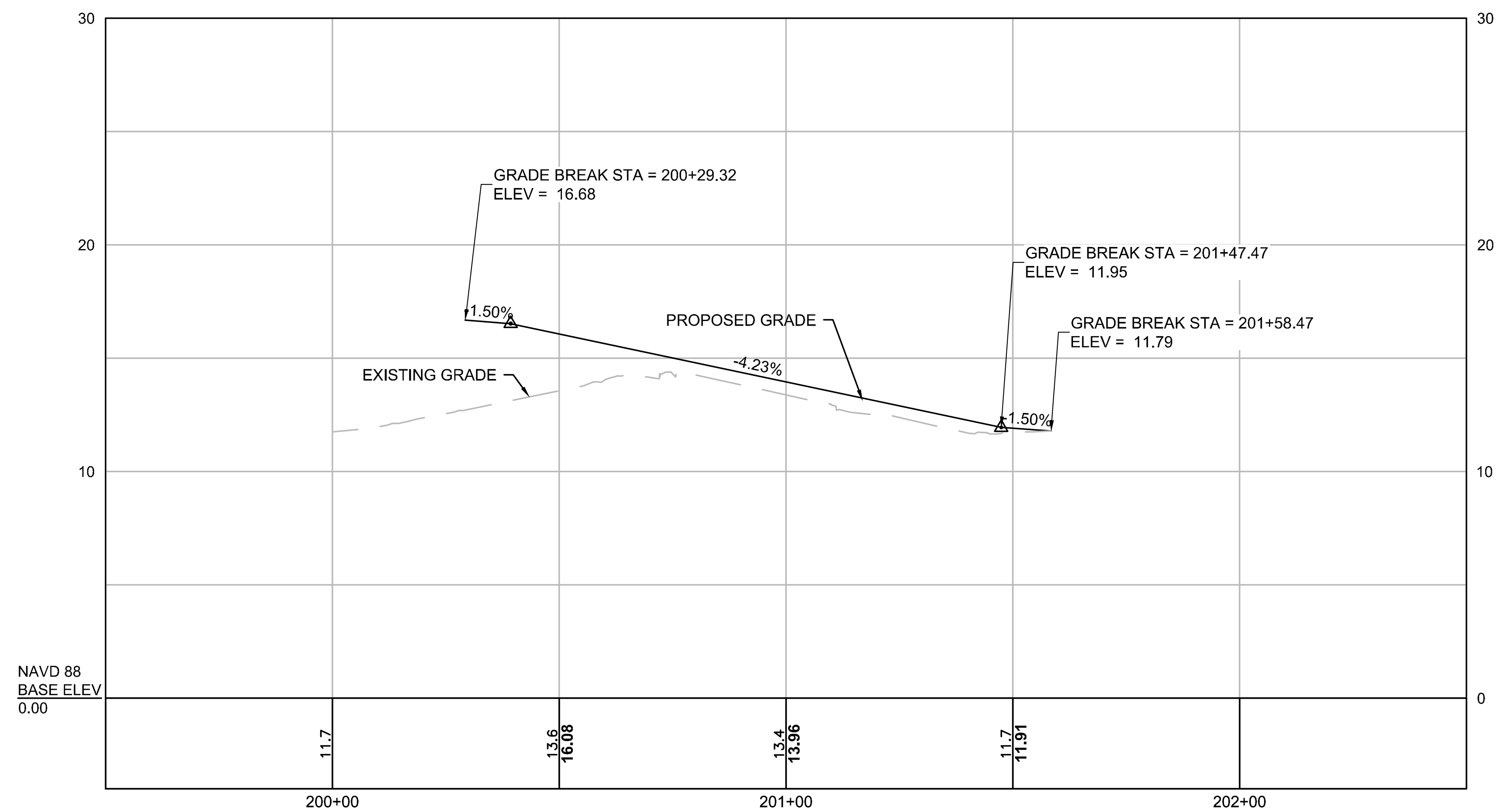
STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	17	XX
PROJECT FILE NO. 60560339			

PROFILES - 5 OF 5
OLD SLEEPER ST. & NORTHEAST RAMP

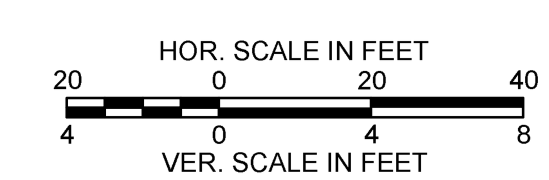
Plotted on 21-Apr-2020 10:33 AM
60560339_HD_PROFILES.DWG



OLD SLEEPER STREET



HARBORWALK RAMP AT NORTHEAST QUADRANT

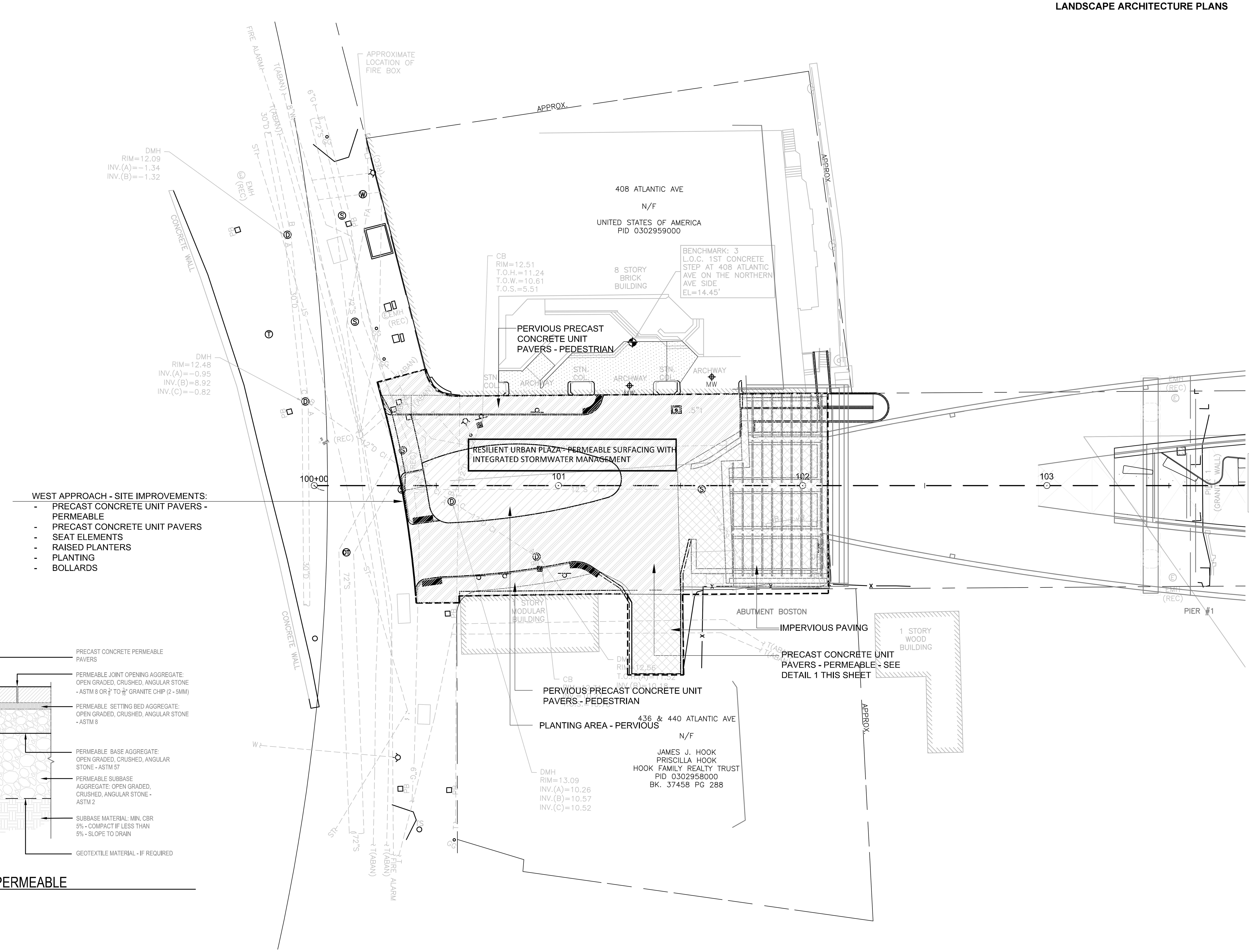


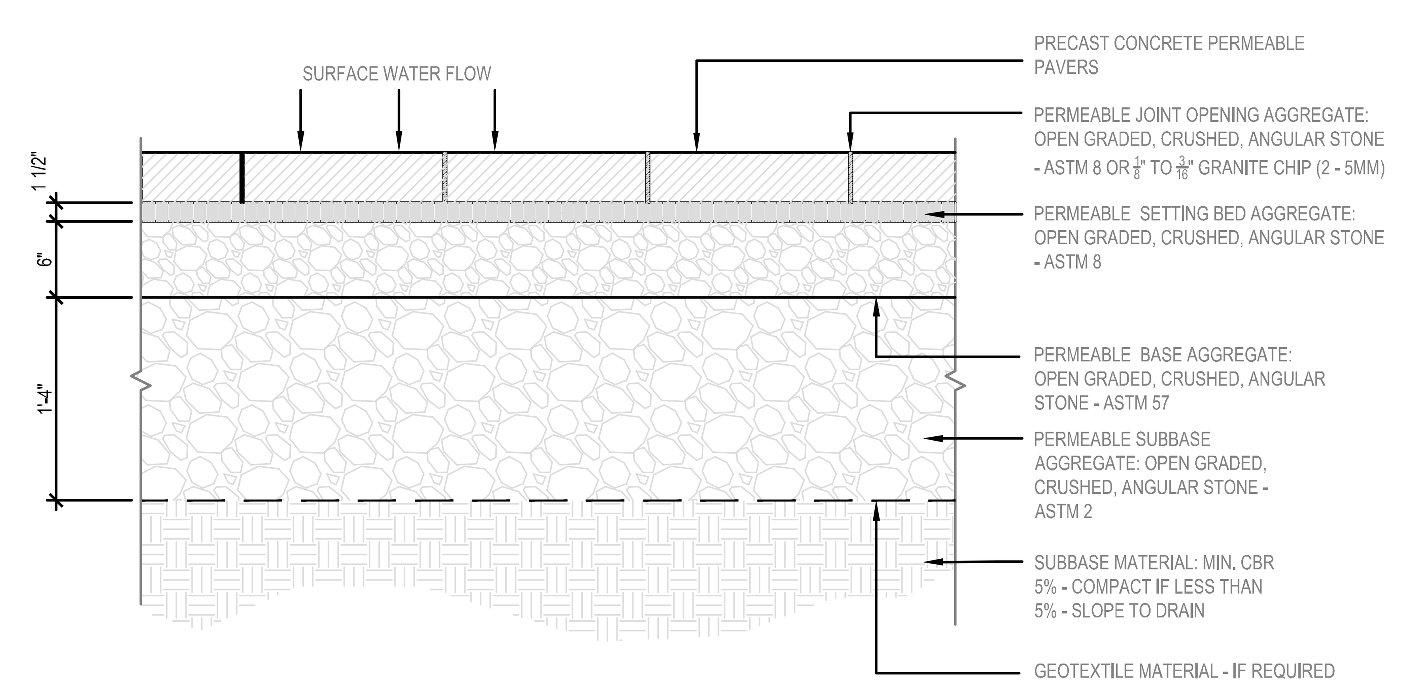
CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	18	48
PROJECT FILE NO.	60560339		

LANDSCAPE ARCHITECTURE PLANS

Plotted on 21-Apr-2020 9:36 AM
25% LANDSCAPE ARCHITECTURE_2.DWG



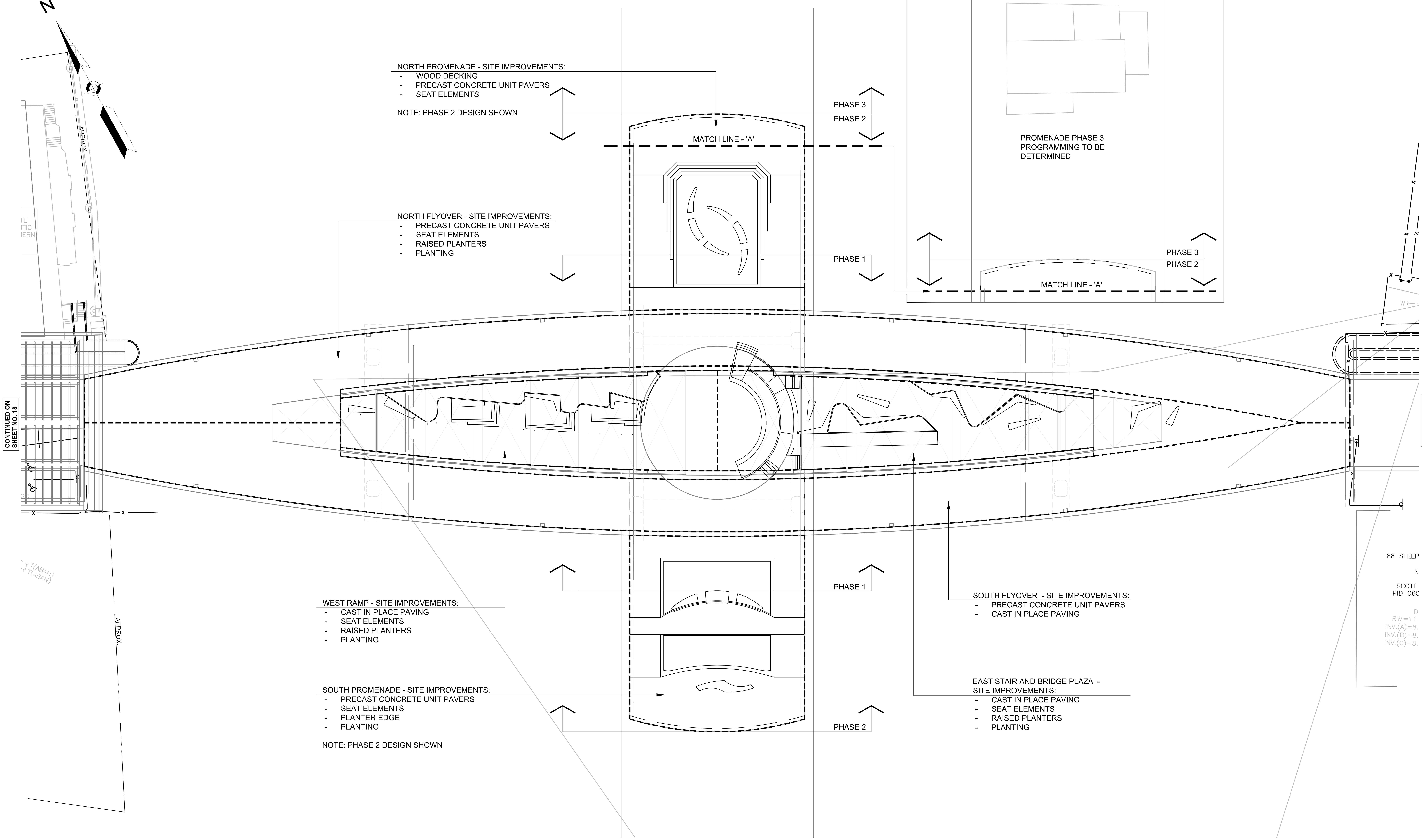


1 PRECAST CONCRETE UNIT PAVERS - PERMEABLE
Scale: 1"=1'-0"

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	19	48
PROJECT FILE NO.	60560339		

LANDSCAPE ARCHITECTURE PLANS



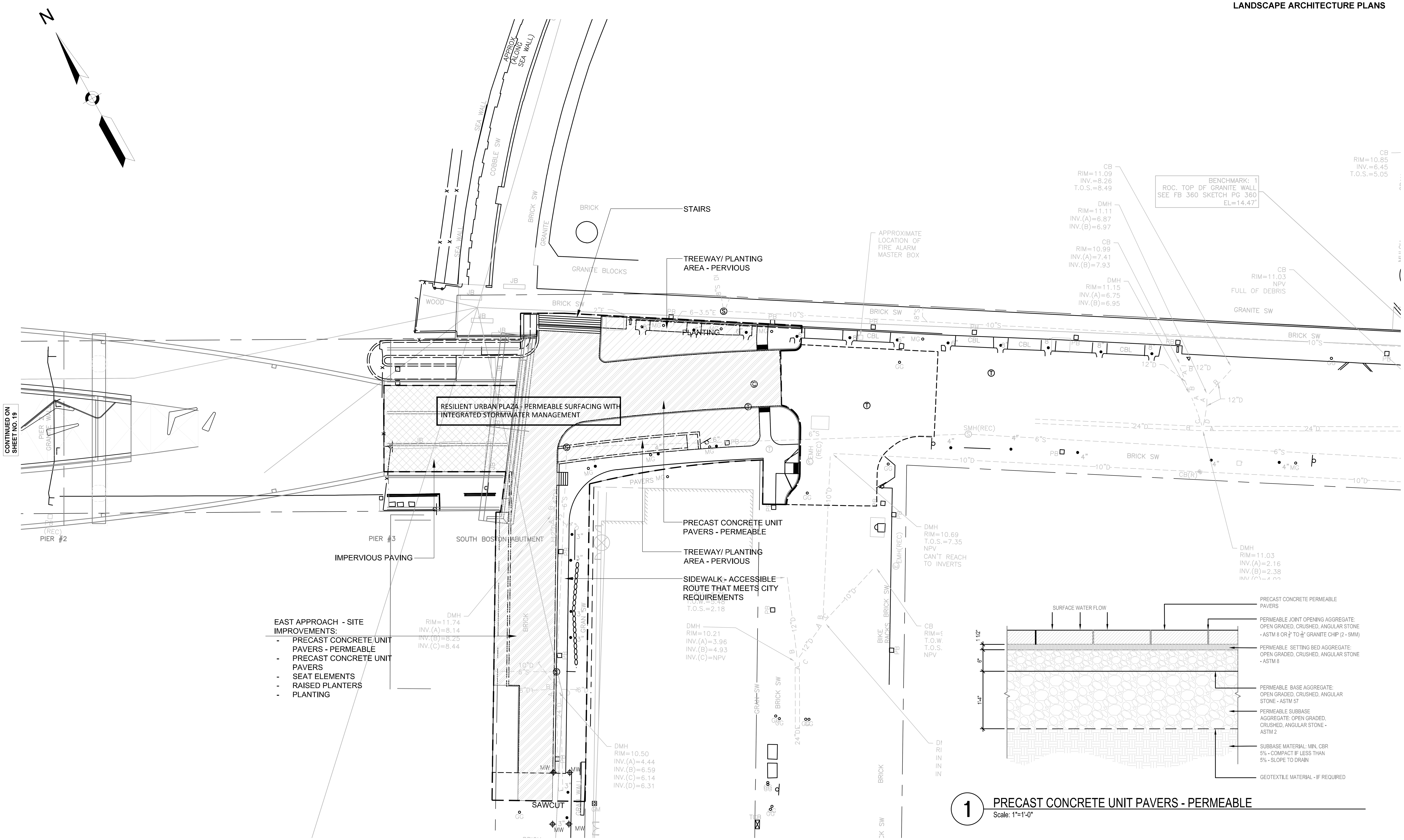
0 20 50 100
SCALE: 1" = 20'

Plotted on 21-Apr-2020 9:33 AM
25% LANDSCAPE ARCHITECTURE_2.DWG

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	20	48
PROJECT FILE NO.	60560339		

LANDSCAPE ARCHITECTURE PLANS



1 PRECAST CONCRETE UNIT PAVERS - PERMEABLE
Scale: 1"=1'-0"

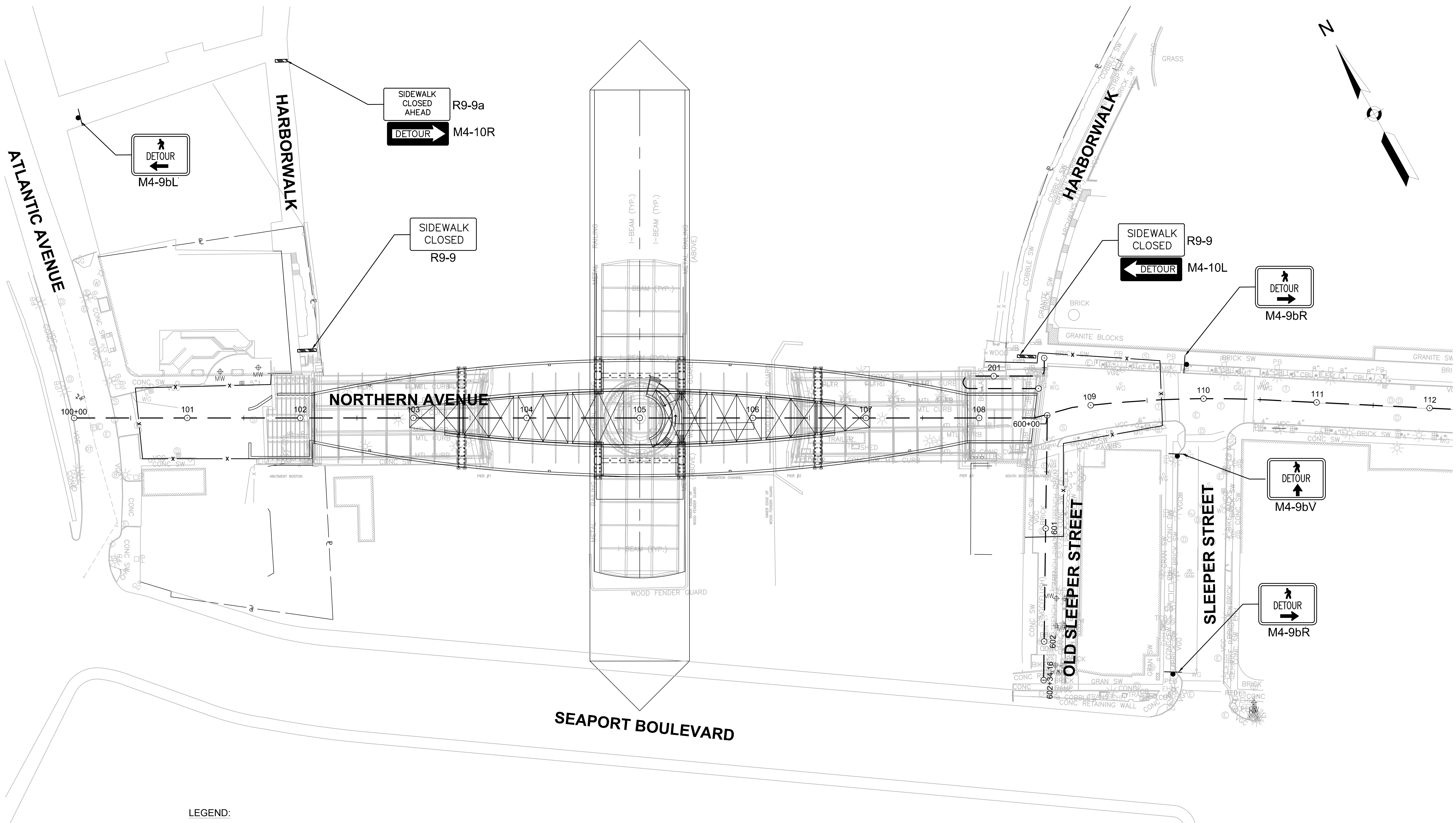
0 20 50 100
SCALE: 1" = 20'

25% LANDSCAPE ARCHITECTURE_2.DWG Plotted on 21-Apr-2020 10:14 AM

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	21	48
PROJECT FILE NO.	60560339		

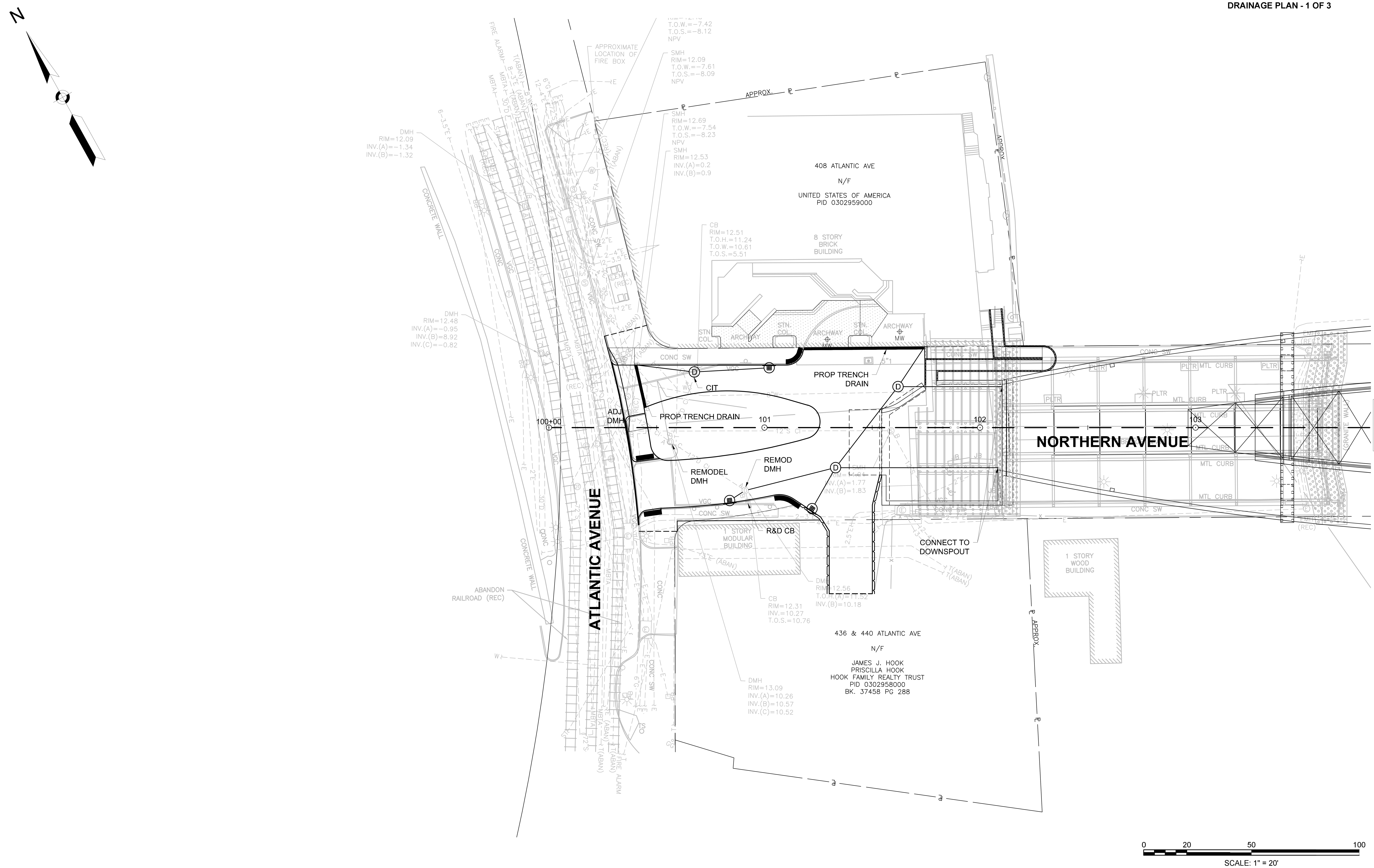
PEDESTRIAN DETOUR PLAN



LEGEND:
- TYPE III BARRICADE
- SIGN
- TEMPORARY FENCE

0 40 100 160
SCALE: 1" = 40'

60560339_TR(DETOUR-1).DWG Plotted on 21-Apr-2020 10:56 AM



CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	22	48
PROJECT FILE NO.	60560339		

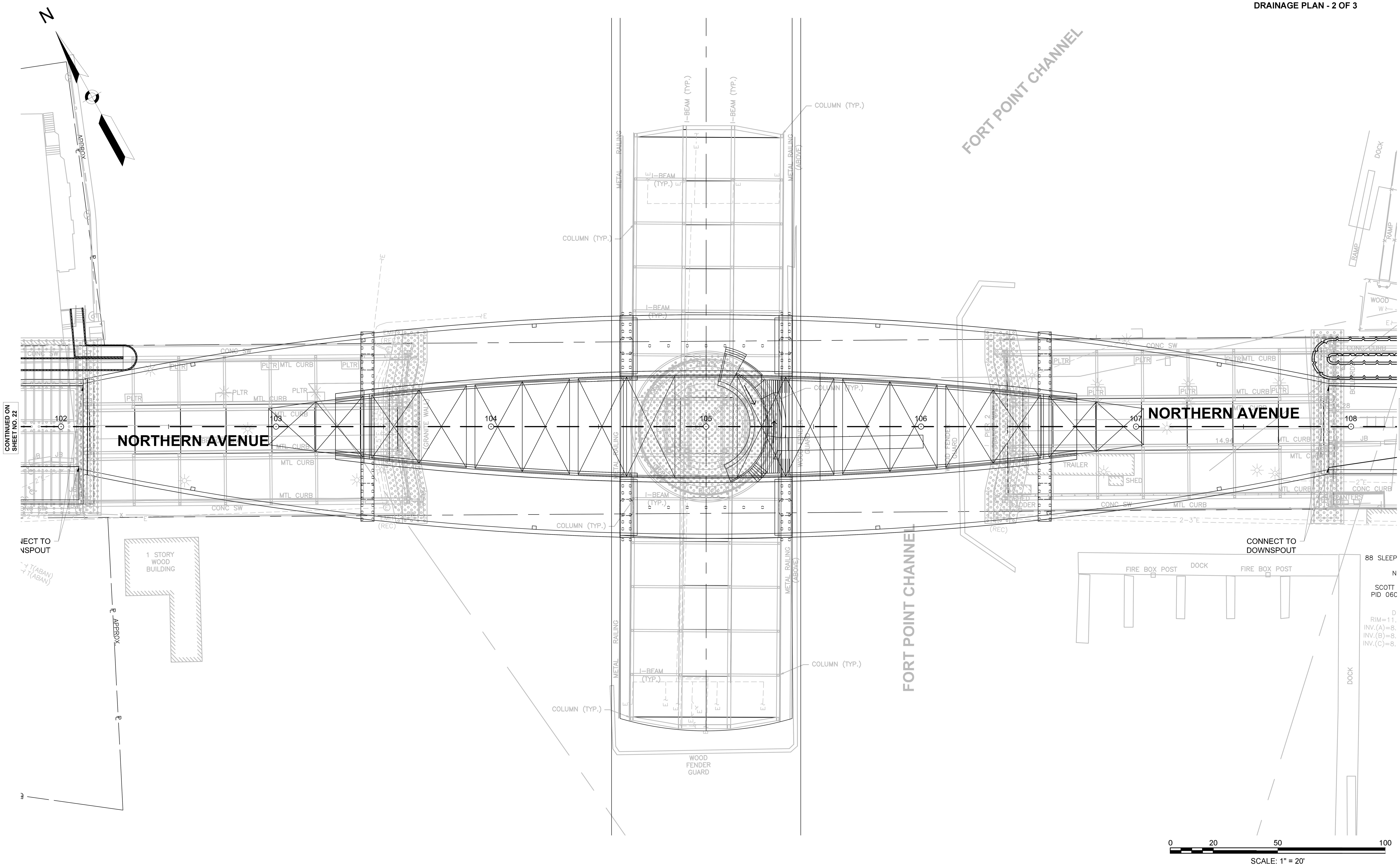
DRAINAGE PLAN - 1 OF 3

60560339_HD(DRAINAGE).DWG Plotted on 21-Apr-2020 9:30 AM

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	23	48
PROJECT FILE NO.	60560339		

DRAINAGE PLAN - 2 OF 3



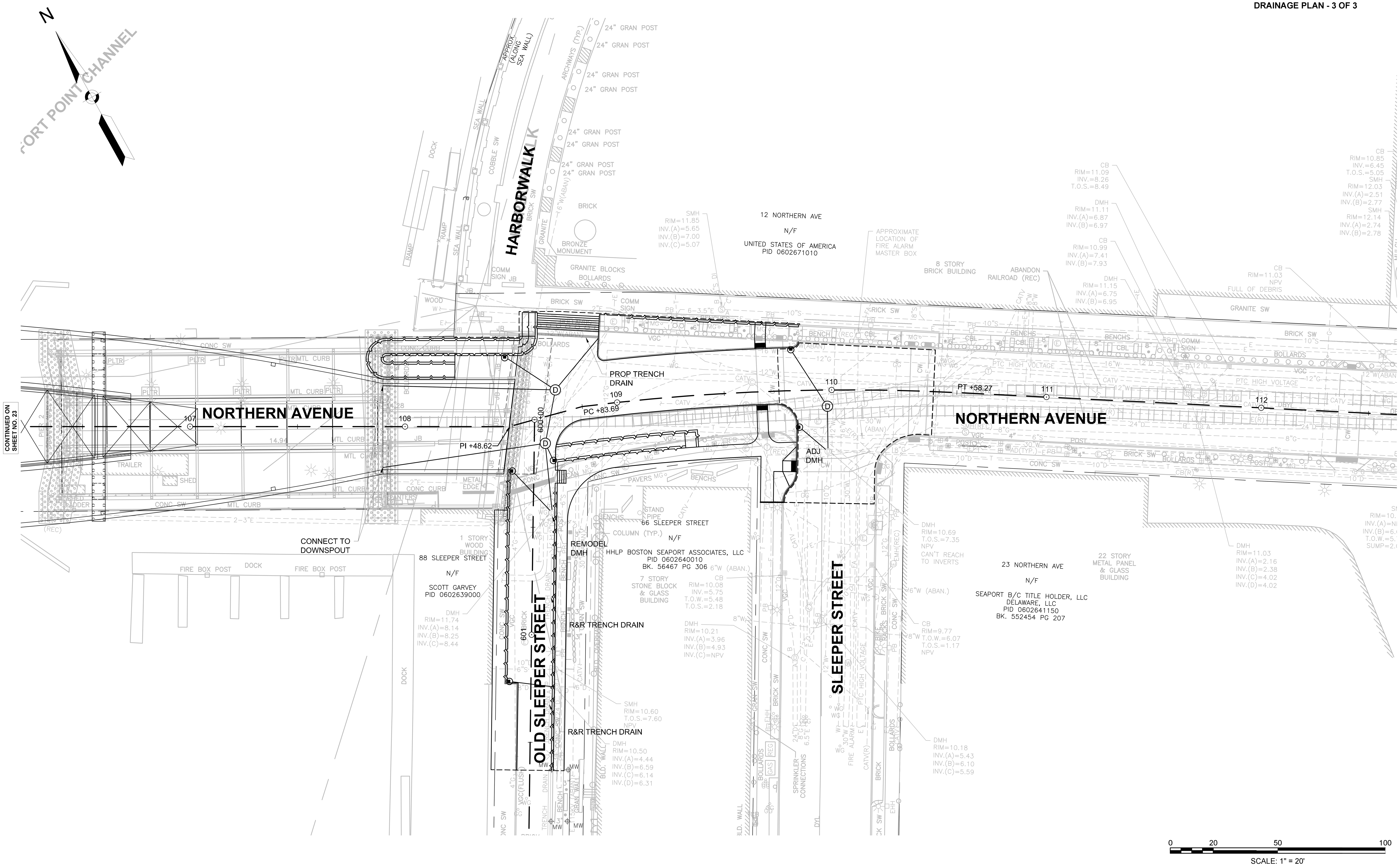
0 20 50 100
SCALE: 1" = 20'

Plotted on 21-Apr-2020 9:30 AM
60560339_HD(DRAINAGE).DWG

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	24	48
	PROJECT FILE NO.	60560339	

DRAINAGE PLAN - 3 OF 3



SCALE: 1" = 20'

60560339_HD(DRAINAGE).DWG

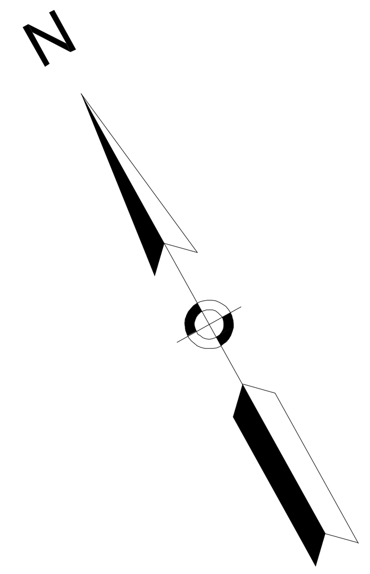
Plotted on 21-Apr-2020 9:30 AM

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	25	48
PROJECT FILE NO.	60560339		

UTILITY PLAN - 1 OF 3

60560339_EP 25%_04.19.2020.DWG Plotted on 21-Apr-2020 9:23 AM

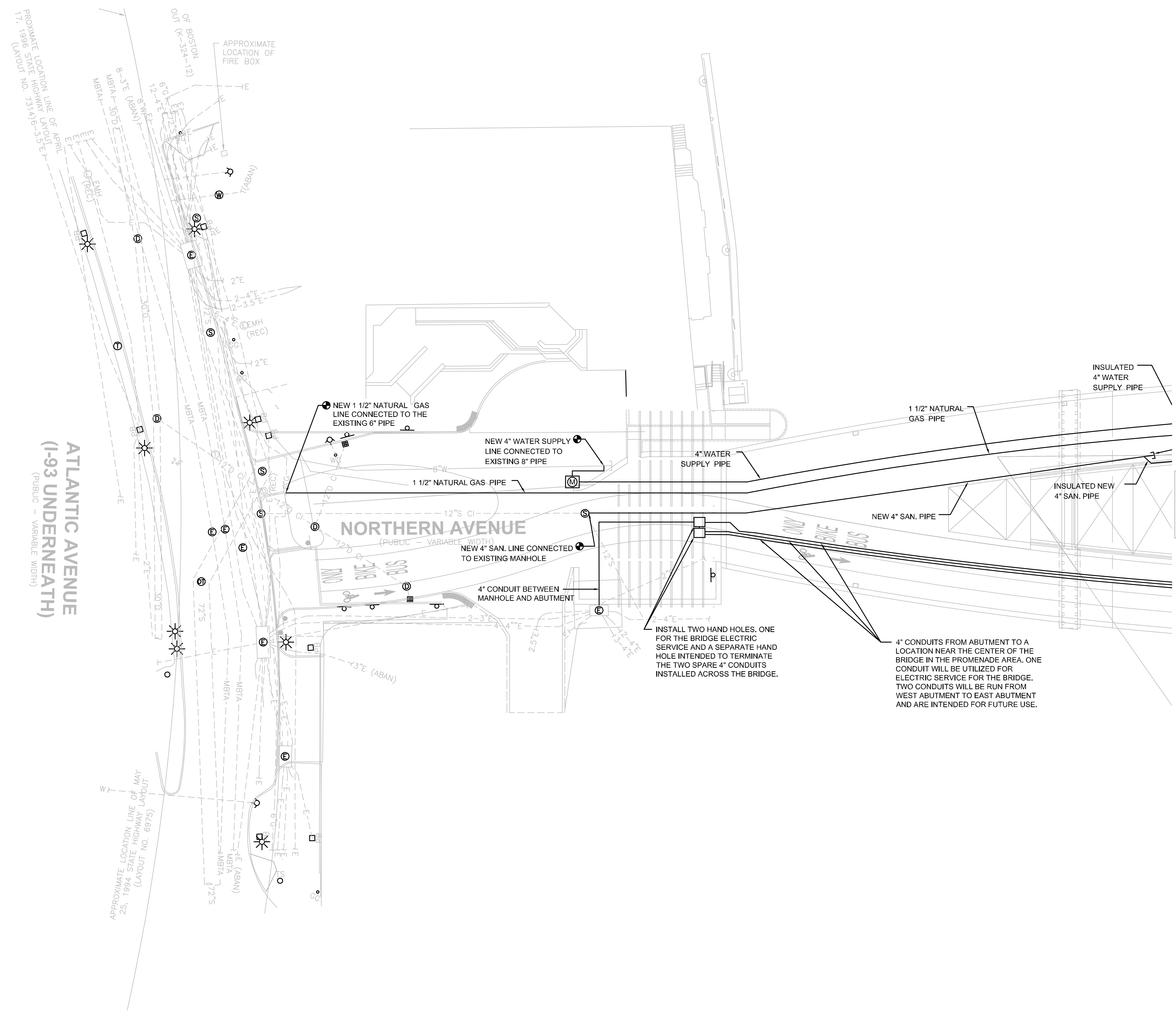


ELECTRICAL SCOPE NOTES:

1. A NEW ELECTRICAL SERVICE WILL ORIGINATE FROM THE WEST SIDE OF THE BRIDGE AND BE BROUGHT TO THE PROMENADE AREA. THE EXACT LOCATION AND SIZE OF THE NEW SERVICE EQUIPMENT AT THE PROMENADE WILL BE DETERMINED AS DESIGN PROGRESSES.
2. AS PART OF THE ELECTRICAL DESIGN AECOM WILL PROVIDE TWO NEW 4" CONDUITS FROM THE EAST BRIDGE ABUTMENT TO THE WEST BRIDGE ABUTMENT. THESE CONDUITS CAN BE UTILIZED IN THE FUTURE SHOULD THERE BE A NEED FOR ANY COMMUNICATION ENTITIES IN THE AREA TO BRING CABLES ACROSS THE BRIDGE.
3. ALL ELECTRICAL CONDUITS WILL BE INSTALLED BETWEEN BRIDGE GIRDERS IN AN EFFORT TO HIDE THEM FROM PUBLIC VIEW.
4. SHOULD TELEPHONE SERVICE BE REQUIRED TO THE PLAZA AREA, WE WILL PROVIDE A SEPARATE CONDUIT FROM EITHER THE WEST SIDE OR EAST SIDE TO THE PROMENADE.

PLUMBING SCOPE NOTES:

1. A NEW 4" SANITARY GRAVITY LINE WILL BE TIED TO SANITARY MANHOLE THAT SERVES 12" CI LINE AT THE WESTERN SIDE OF THE BRIDGE. THIS 4" LINE WILL BE EXTENDED BETWEEN BRIDGE GIRDERS TO PROMENADE. A SUMP PUMP WILL BE PROVIDED AT PROMENADE LEVEL. A FORCED LINE FROM THIS PUMP WILL BE CONNECTED TO 4" SANITARY LINE AT BRIDGE GIRDERS' LEVEL. ALL EXPOSED SANITARY LINES WILL BE INSULATED.
2. A NEW 4" WATER SUPPLY LINE WILL SERVE THE BRIDGE AND PROMENADE AREA. THIS LINE WILL BE CONNECTED TO THE EXISTING 8" CAPPED WATER LINE THAT IS LOCATED TO THE WESTERN SIDE OF THE BRIDGE AND WILL SERVE DOMESTIC WATER NEED AND POTENTIAL FIRE PROTECTION SYSTEM. A NEW WATER METER AND FLUSH VALVE WILL BE INSTALLED. LOCATION OF METER PIT TO BE COORDINATED WITH THE OTHER DISCIPLINES. FLUSH VALVE WILL BE USED TO DRAIN DEAD WATER LEG. ALL EXPOSED PIPING TO BE INSULATED.
3. A NEW 1 ½" NATURAL GAS LINE WILL BE EXTENDED TO PROMENADE AREA AND TIED TO EXISTING 6" LINE TOWARDS ATLANTIC AVENUE. A NEW GAS METER WITH ASSOCIATED ACCESSORIES WILL BE INSTALLED AT PROMENADE LEVEL. LOCATION OF GAS METER ASSEMBLY TO BE COORDINATED WITH THE OTHER DISCIPLINES.



CONTINUED ON SHEET NO. 26

PARTIAL UTILITY PLAN - WEST

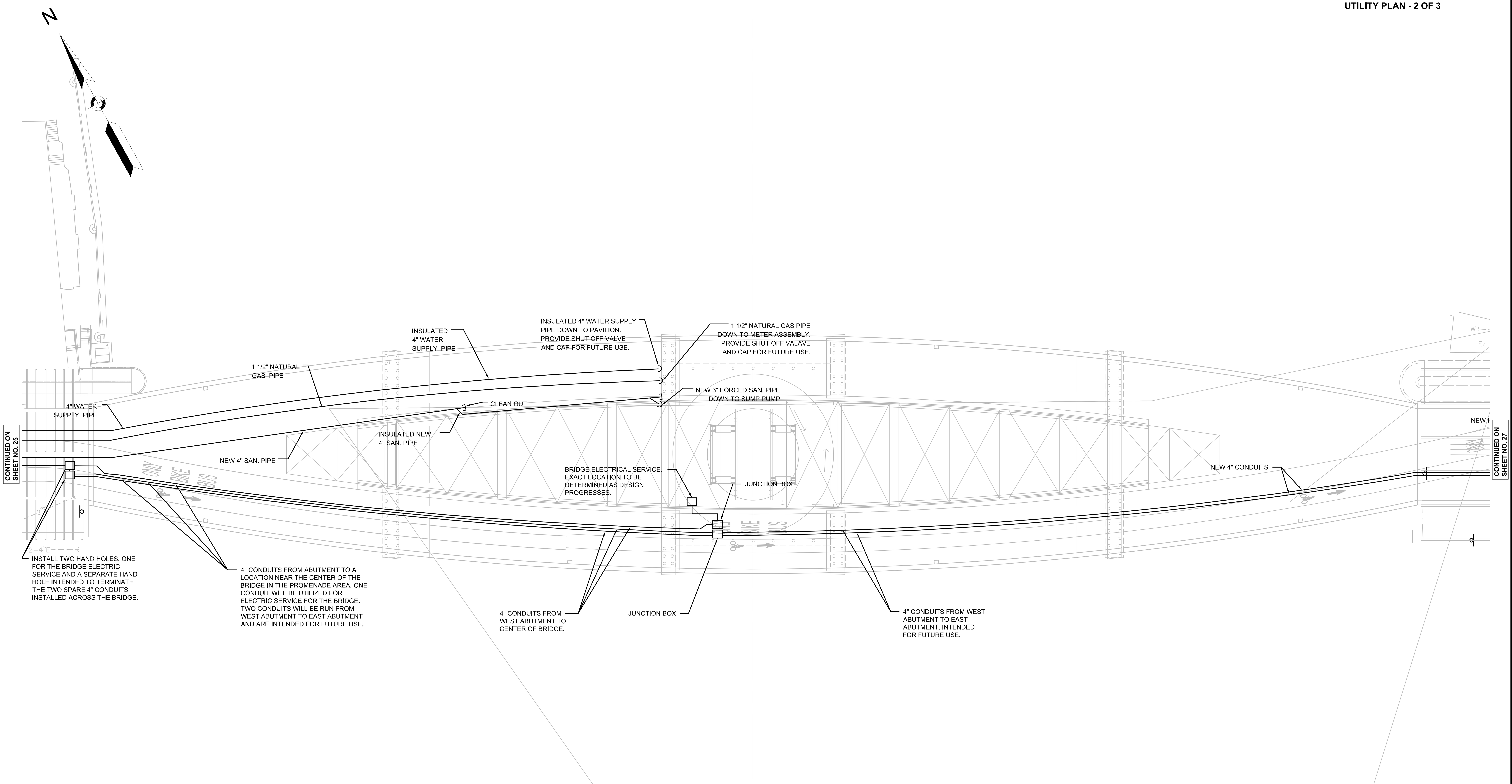
0 20 50 100

SCALE: 1" = 20'

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	26	48
PROJECT FILE NO.	60560339		

UTILITY PLAN - 2 OF 3



ELECTRICAL/PLUMBING SCOPE NOTES:

1. REFER TO PARTIAL UTILITY PLAN-WEST (SHEET NO. EP-01) FOR NOTES.

PARTIAL UTILITY PLAN - CENTER

0 20 50 100

SCALE: 1" = 20'

60560339_EP 25%_04.19.2020.DWG Plotted on 21-Apr-2020 9:25 AM

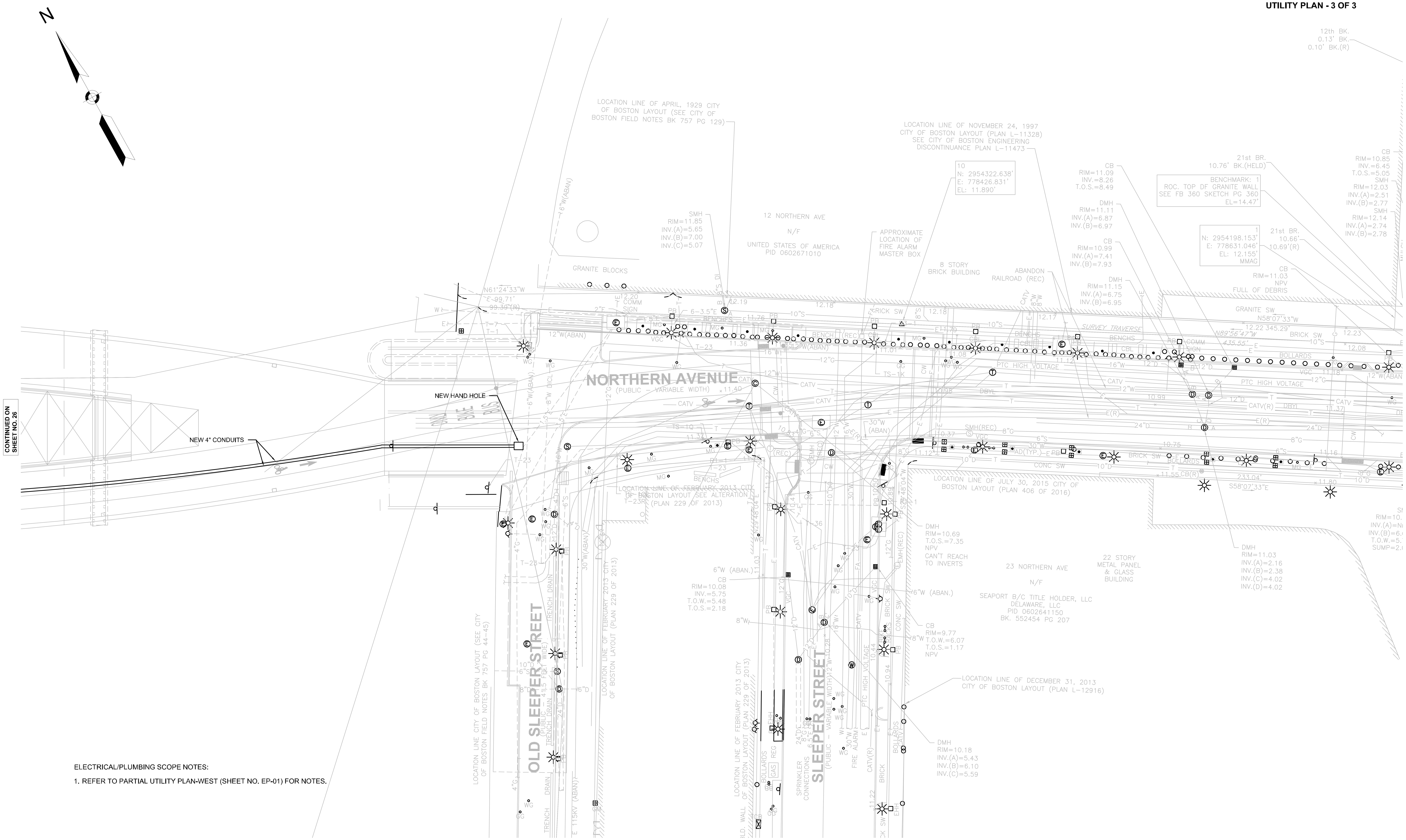
CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	27	48
PROJECT FILE NO.	60560339		

UTILITY PLAN - 3 OF 3

Plotted on 21-Apr-2020 9:26 AM

60560339_EP 25%_04.19.2020.DWG



ELECTRICAL/PLUMBING SCOPE NOTES:

1. REFER TO PARTIAL UTILITY PLAN-WEST (SHEET NO. EP-01) FOR NOTES.

PARTIAL UTILITY PLAN - EAST

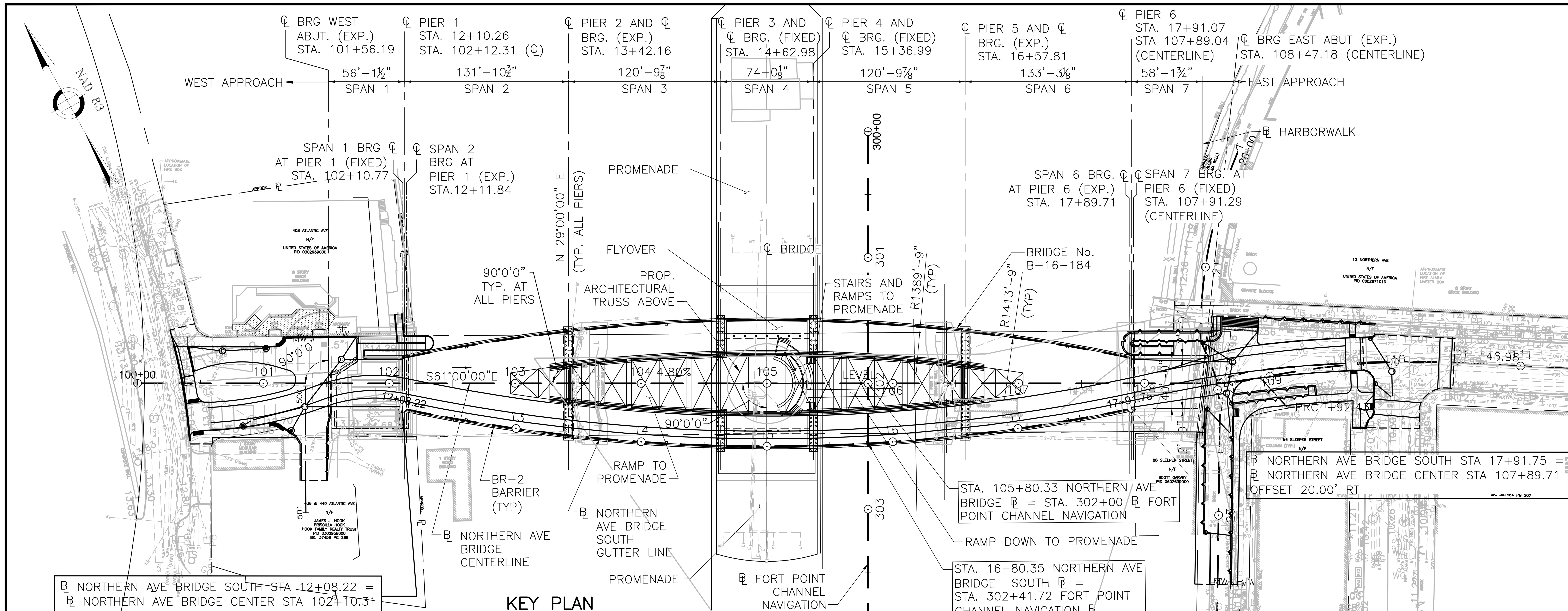
0 20 50 100

SCALE: 1" = 20'

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	28	48
PROJECT FILE NO. 60560339			

KEY PLAN, LOCUS AND PROFILE

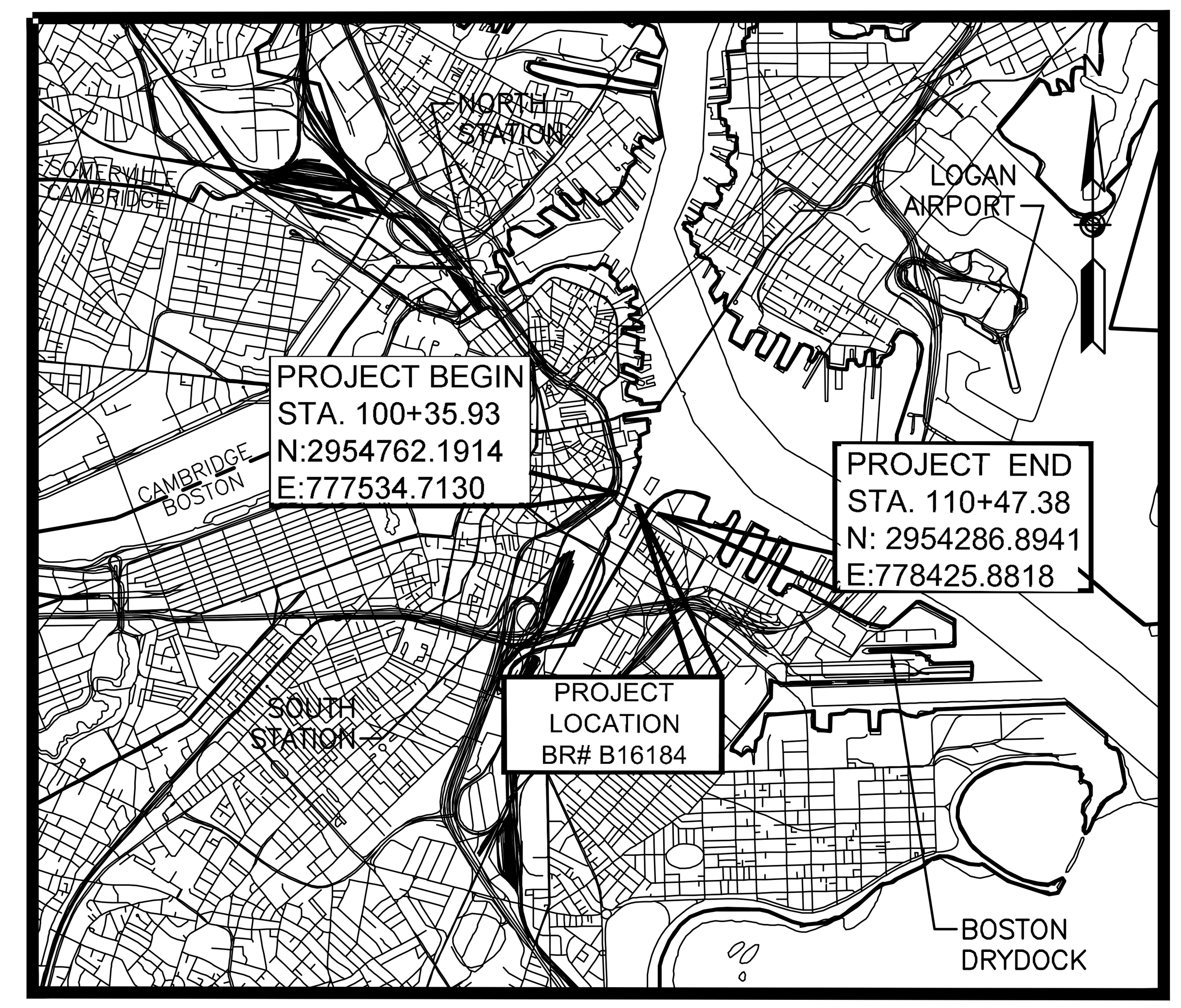


KEY PLAN
SCALE: 1" = 50'–0"

GENERAL NOTES	
PROJECT FILE NO.: XXXXXX	
PROJECT DESCRIPTION:NORTHERN AVENUE BRIDGE	
BRIDGE DESIGN LOADING: HL–93, PEDESTRIAN	
SURVEY: SURVEY INFO	
ELEVATION REFERENCE: NAVD OF 1988	

TRAFFIC DATA	ROADWAY OVER	ROADWAY UNDER
DESIGN YEAR	N/A	2035
AVERAGE DAILY TRAFFIC – PRESENT	N/A	0 (CLOSED)
AVERAGE DAILY TRAFFIC – DESIGN YEAR	N/A	110
DESIGN HOURLY VOLUME	N/A	10
DIRECTIONAL DISTRIBUTION	N/A	100% WB
TRUCK PERCENTAGE – AVERAGE DAY	N/A	0%
TRUCK PERCENTAGE – PEAK HOUR	N/A	0%
DESIGN SPEED	N/A	25 MPH
DIRECTIONAL DESIGN HOURLY VOLUME	N/A	10

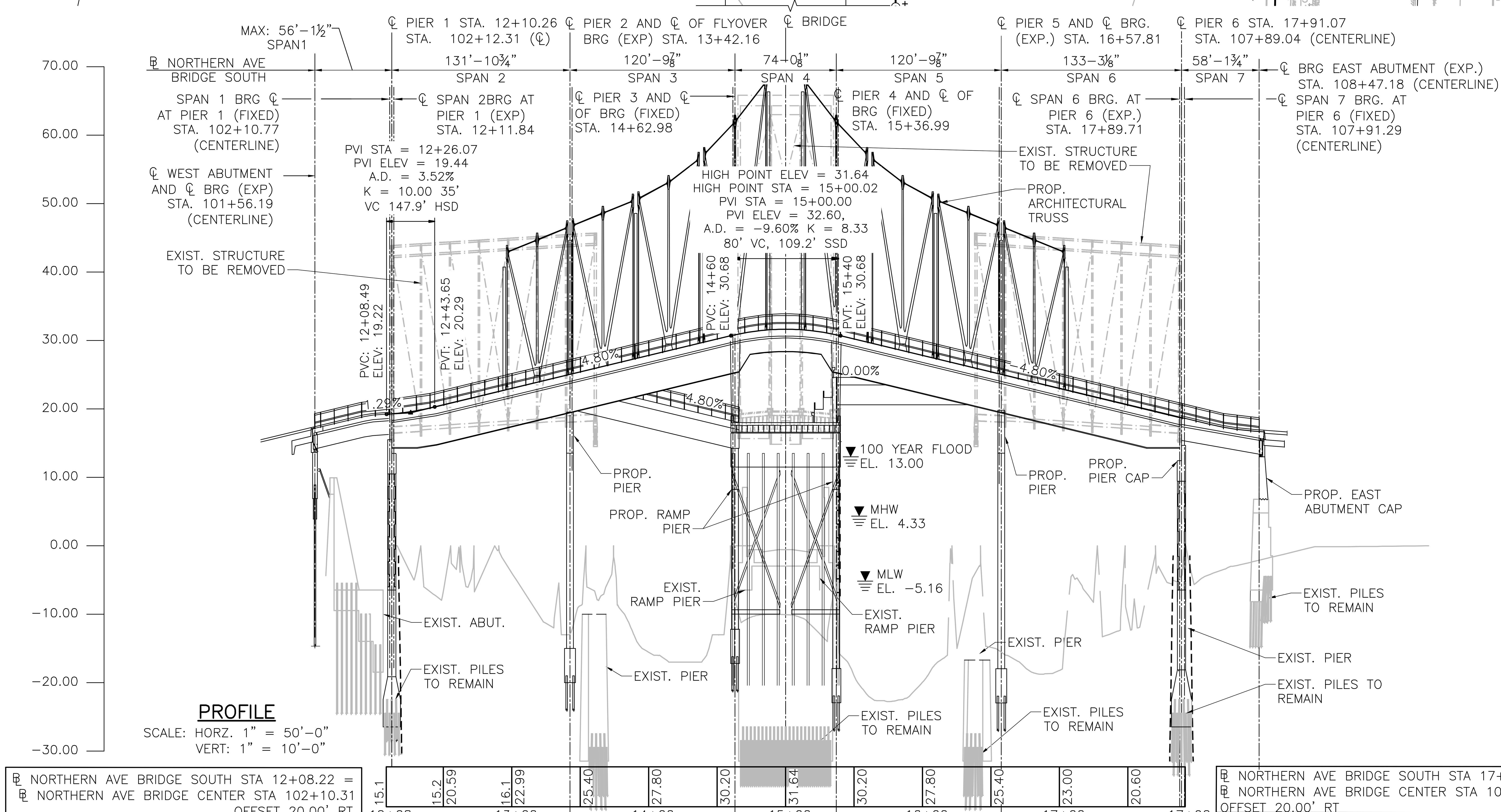
BENCH MARK: (DESCRIPTION, LOCATION AND ELEVATION)



LOCUS
SCALE: 1"=1000"

NOTES:

1. FOR GENERAL NOTES SEE SHEET 2.
2. FOR FORT POINT CHANNEL PROFILE SEE SHEET 2.

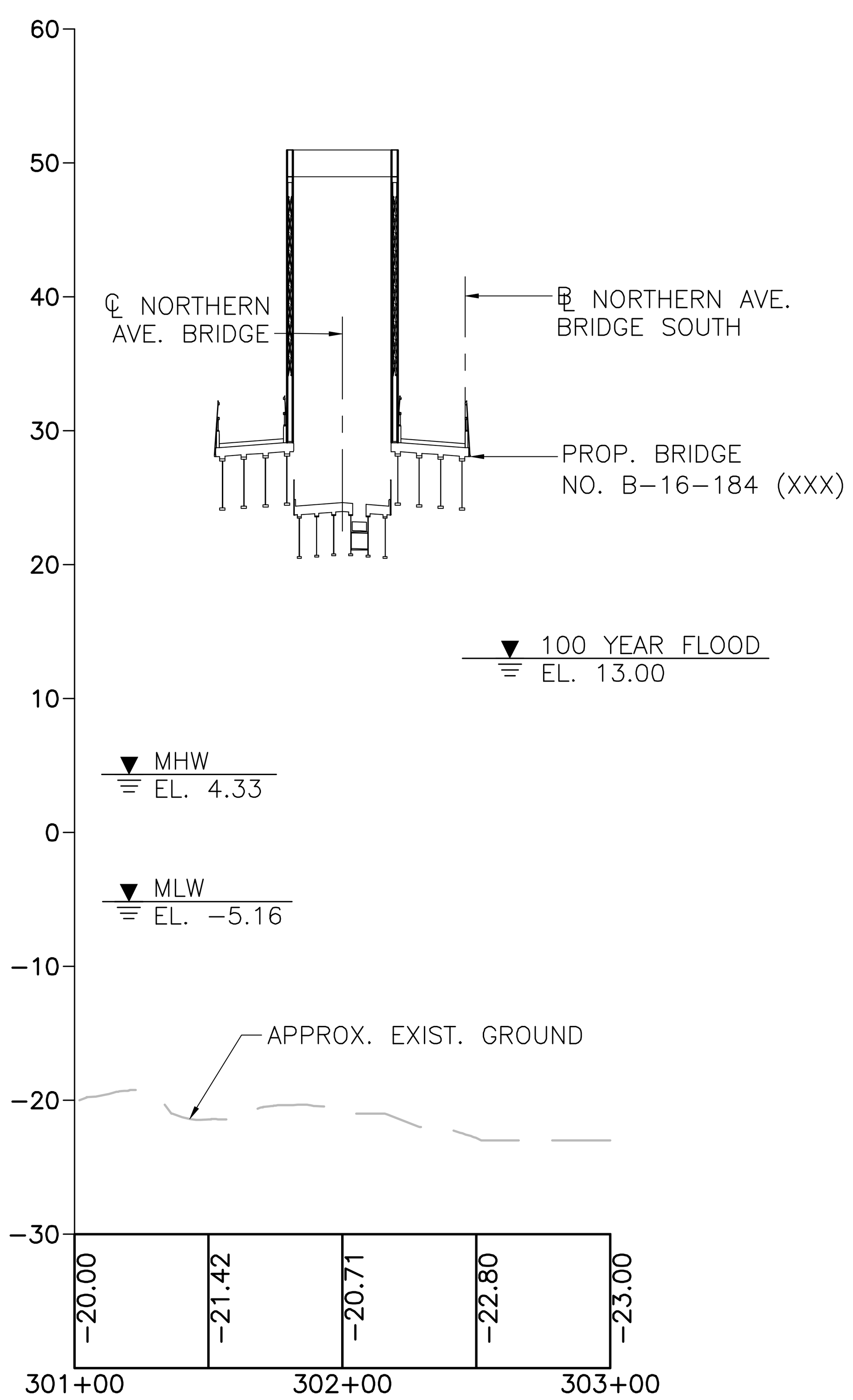


PROFILE
SCALE: HORZ. 1" = 50'–0"
VERT: 1" = 10'–0"

60560339_BR1(B16184).DWG Plotted on 21-Apr-2020 2:56 PM
60560339 Sketch Plans Submittal (SP1) 21-April-2020

INDEX TO DRAWINGS

BORINGS HAVE NOT BEEN COMPLETED AT THIS TIME AND WILL BE INCLUDED IN FUTURE SUBMITTALS.



PROFILE – ALONG ℄ FORT POINT CHANNEL NAVAGATIONAL CHANNEL

HOR. SCALE IN FEET: 50 0 50 100

VER. SCALE IN FEET: 10 0 10 20

GENERAL NOTES

DESIGN:

IN ACCORDANCE WITH 8TH EDITION, 2017 SPECIFICATIONS OF THE AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO) FOR PEDESTRIAN AND HL−93 LOADING AS WELL AS THE 2009 AASHTO LRFD GUIDE SPECIFICATION FOR THE DESIGN OF PEDESTRIAN BRIDGES. RAMPS WILL BE DESIGNED FOR PEDESTRIAN AND H−10 LOADING ONLY.

NOTES:

1. APPROVAL DOES NOT INCLUDE THE PROFILE GRADES WHICH ARE PRELIMINARY ONLY.
2. APPROVAL DOES NOT INCLUDE STRUCTURAL ANALYSIS.
3. DIMENSIONS OF STRUCTURAL MEMBERS ARE APPROXIMATE AND WILL BE FINALIZED DURING THE FINAL DESIGN PHASE.
4. SEE GEOTECHNICAL MEMO, DATED APRIL 2020.
5. SEISMIC DESIGN CRITERIA:

   DESIGN RETURN PERIOD: xxxx YEARS

   DESIGN SPECTRA: A_S = 0.xxx, S_{DS} = 0.xxx, S_{D1} = 0.xxx

   SITE CLASS = E

   SEISMIC DESIGN CATEGORY (SDC) = TO BE CONFIRMED ONCE BORINGS ARE PERFORMED
6. SEE HYDRAULIC REPORT, DATED xx/xx/xxxx.
7. NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988 IS USED THROUGHOUT.

HYDRAULIC DATA

DRAINAGE AREA: 4.5 SQUARE MILES

REFERENCE: PRELIMINARY HYDROLOGIC CALCULATION (AECOM 2020); RIVERINE FLOOD, MLLW CONDITION

DESIGN FLOOD DISCHARGE: 4,518 CUBIC FT PER SECOND
DESIGN FLOOD FREQUENCY: 10 YEARS
DESIGN FLOOD VELOCITY: 4.09 FEET PER SECOND
DESIGN FLOOD ELEVATION: 10.54 FEET NAVD

REFERENCE: STARR REPORT (2012), FEMA BASE FLOOD ELEVATION WITH WAVE CALCULATION (FEMA 2016), PRELIMINARY ESTIMATES BY AECOM 2020

BASE (100 YEAR) FLOOD DATA

BASE FLOOD DISHCHARGE: 8,161 CUBIC FT PER SECOND
BASE FLOOD ELEVATION: 13.00 FEET

REFERENCE: FEMA BASE FLOOD ELEVATION WITH WAVE ACTION, ZONE VE, FIRM: 25025C0081J (2016)

REFERENCE: PRELIMINARY HYDROLOGIC CALCULATION (AECOM 2020); RIVERINE FLOOD

DESIGN AND CHECK SCOUR DATA

DESIGN SCOUR FLOOD EVENT RETURN FREQUENCY: 25 YEARS
CHECK SCOUR FLOOD EVENT RETURN FREQUENCY: 50 YEARS

FLOOD OF RECORD

DISCHARGE: NOT AVAILABLE
FREQUENCY (ESTIMATED): 50 YEARS
MAXIMUM ELEVATION: 9.52 FEET NAVD
DATE: JANUARY 2018

REFERENCE: NOAA STATION 8443970, BOSTON, MA (2020), LOCATED IN ZONE AE

HISTORY OF ICE FLOES: NOT AVAILABLE

EVIDENCE OF SCOUR OR EROSION: PIER AND ABUTMENT SCOUR

REFERENCE: MASSDOT UNDERWATER INSPECTION REPORT (2014)

EXISTING CONDITIONS:

1. EXISTING INFORMATION AND LOCATIONS ARE BASED OFF OF THE EXISTING BRIDGE PLANS.
2. THE CONTRACTOR SHALL DETERMINE AND VERIFY ALL PERTINENT DIMENSIONS AND DETAILS NECESSARY FOR COMPLETION OF ALL WORK BY FIELD MEASUREMENT AND SURVEY. THE CONTRACTORS SHALL BE RESPONSIBLE FOR THE ADEQUACY AND ACCURACY THEREOF AND SHALL NOT ORDER ANY MATERIAL OR COMMENCE ANY FABRICATION UNTIL THE REQUIRED MEASUREMENTS HAVE BEEN MADE, AND THE EXTENT OF THE PROPOSED WORK HAS BEEN APPROVED BY THE ENGINEER.

STRUCTURAL STEEL:

1. ALL STRUCTURAL STEEL SHALL BE ASTM GRADE 50 AND SHALL BE METALIZED AND PAINTED UNLESS OTHERWISE NOTED.
2. WELDING FABRICATION SHALL BE IN ACCORDANCE WITH THE BRIDGE WELDING CODE, ANSI/AASHTO/AWS D1.5 AND ALL INTERIM REVISIONS PUBLISHED BY AASHTO AS OF THE BID OPENING DATE.
3. ALL BOLTED CONNECTIONS SHALL BE MADE WITH ⅞" DIA. HIGH STRENGTH (H.S.) BOLTS IN 15⁄16" DIAMETER HOLES UNLESS OTHERWISE NOTED.
4. ALL BOLTS, NUTS, AND WASHERS SHALL BE ASTM A325 OR A490 AS REQUIRED, UNLESS OTHERWISE NOTED.
5. ALL ANCHOR BOLTS SHALL BE ASTM F1554 GRADE 36, 55, OR 105 AS REQUIRED.

REINFORCED CONCRETE:

1. THE FOLLOWING CONCRETE MIXES SHALL BE USED WHERE NOTED:

   4500 PSI CONCRETE WITH 1.5" AGGREGATE
   - FOOTINGS
   - STEM WALLS 15" AND THICKER

   4500 PSI CONCRETE WITH 0.75" AGGREGATE
   - BACKWALLS
   - CURBS
   - SLABS

UNSUITABLE MATERIAL:

1. ALL UNSUITABLE MATERIAL SHALL BE REMOVED WITHIN THE LIMITS OF THE FOUNDATIONS OF THE STRUCTURE, AS DIRECTED BY THE ENGINEER.

DATUM:

NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988 IS USED THROUGHOUT.

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

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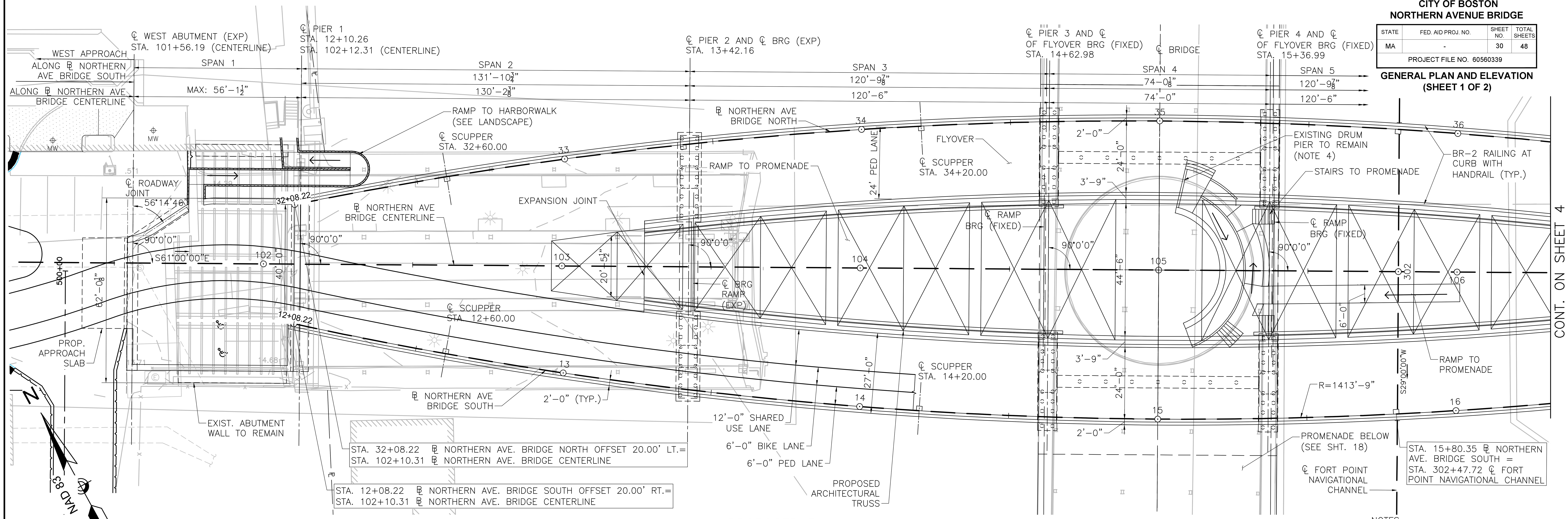
GENERAL NOTES AND CHANNEL PROFILE

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	30	48
PROJECT FILE NO. 60560339			

GENERAL PLAN AND ELEVATION
(SHEET 1 OF 2)



PROPOSED PLAN
SCALE: 1/16" = 1'-0"

NOTES:
1. ALL STATIONS ARE TAKEN ALONG THE NORTHERN AVE BRIDGE SOUTH BASELINE UNLESS OTHERWISE NOTED.
2. ALL SCUPPER STATIONS ARE TAKEN ALONG THE BASELINE ADJACENT TO THEM.
3. MINIMUM VERTICAL CLEARANCE IN SPAN 4 OF 10'-0" IS FOR 40' HORIZONTAL (20' ON EITHER SIDE OF CENTERLINE OF BRIDGE).
4. FOR WIDTH OF NAVIGATION CHANNEL, ALL STRUCTURE MUST BE ABOVE ELEVATION 20.3.
5. DRUM PIER TO BE REPAIRED AND REMAIN IN PLACE.

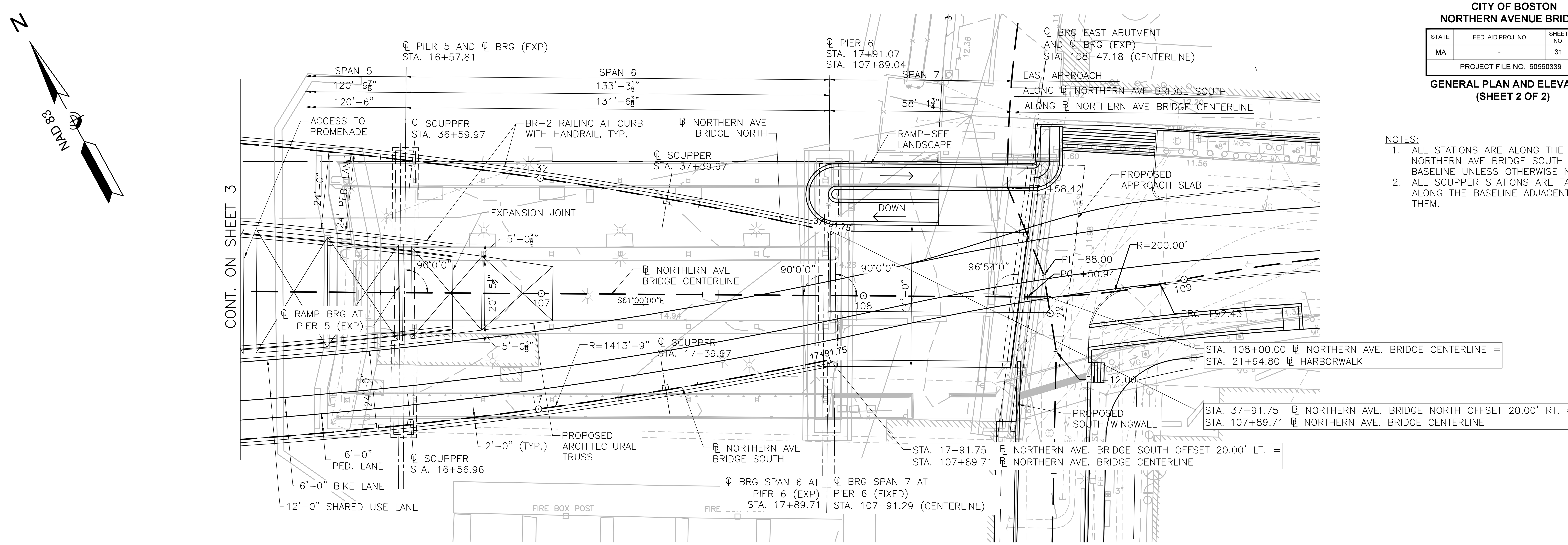
PROPOSED ELEVATION
SCALE: ¾" = 1'-0"

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	31	48
PROJECT FILE NO. 60560339			

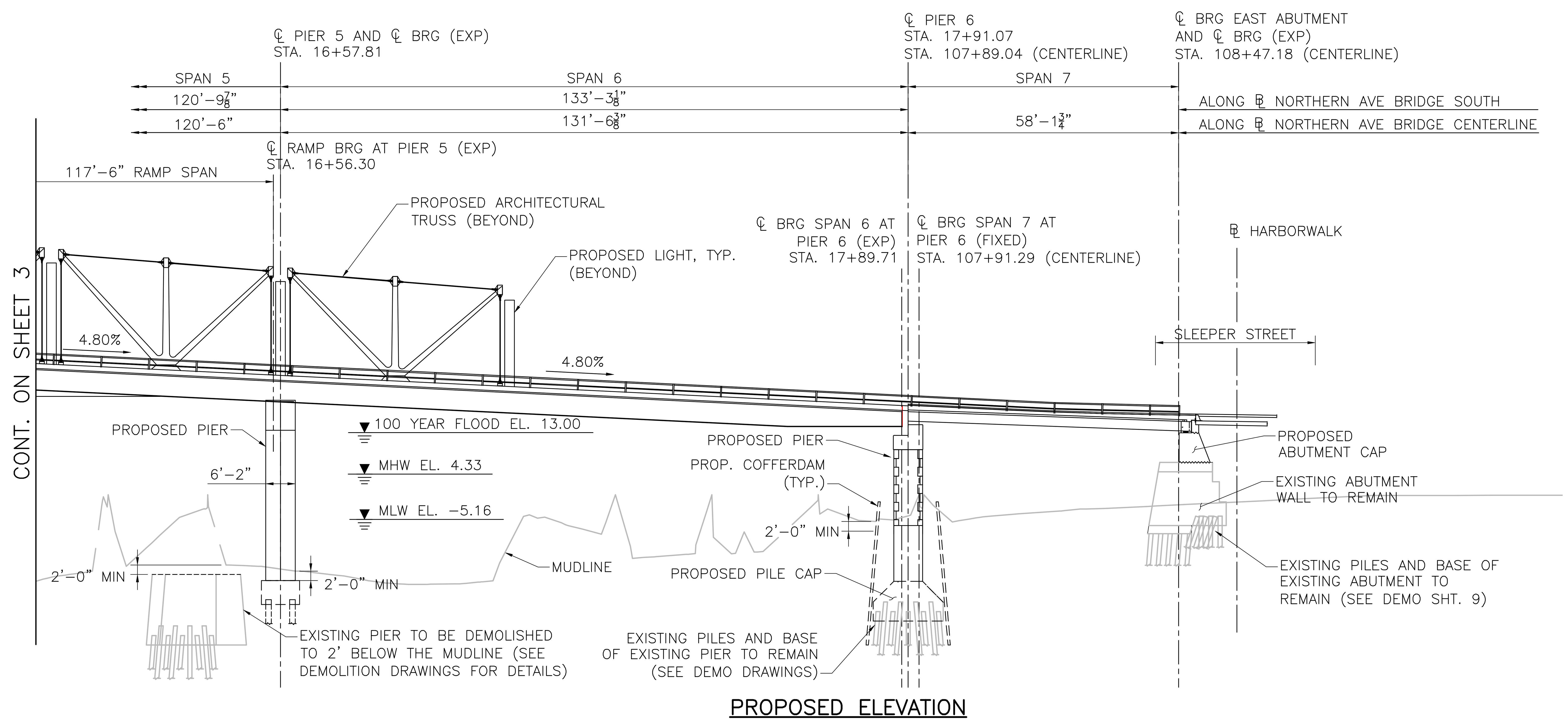
GENERAL PLAN AND ELEVATION (SHEET 2 OF 2)

NOTES:
1. ALL STATIONS ARE ALONG THE NORTHERN AVE BRIDGE SOUTH BASELINE UNLESS OTHERWISE NOTED.
2. ALL SCUPPER STATIONS ARE TAKEN ALONG THE BASELINE ADJACENT TO THEM.



PROPOSED PLAN

SCALE: ¾" = 1'-0"



PROPOSED ELEVATION

SCALE: ¾" = 1'-0"

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60560339_BR4(B16184).DWG
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CITY OF BOSTON
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STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	32	48
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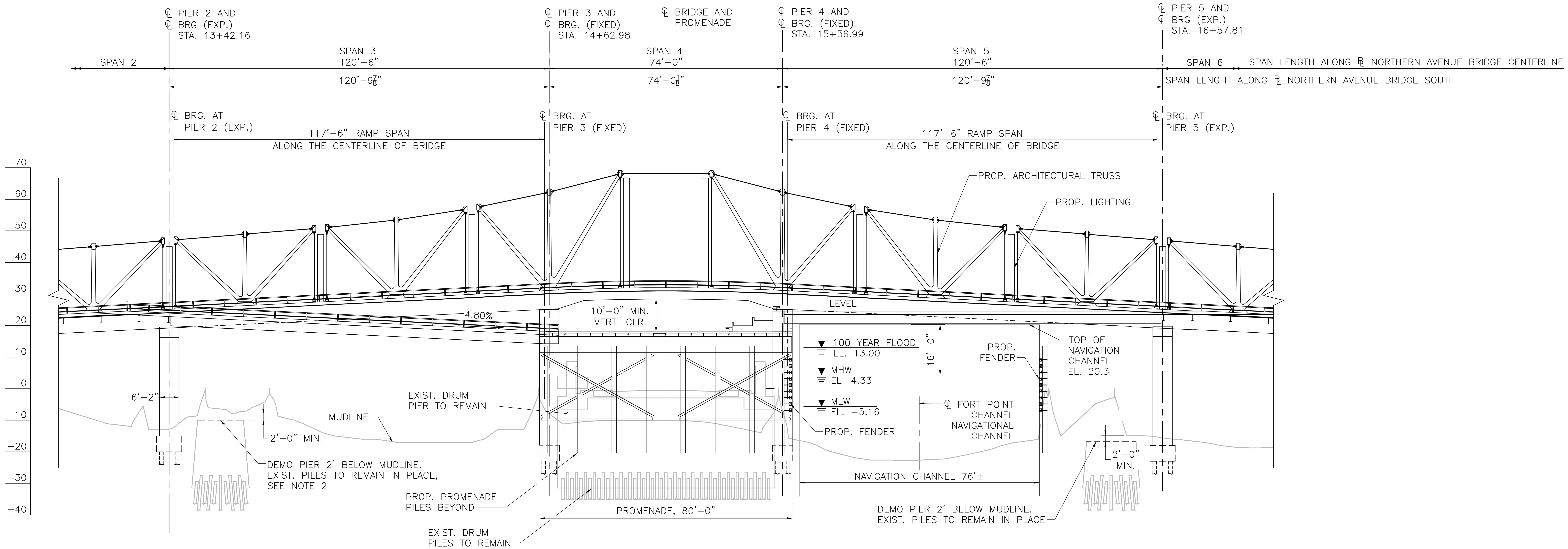
PARTIAL LONGITUDINAL SECTION



LONGITUDINAL SECTION AT BRIDGE CENTERLINE

SCALE: ¾" = 1'-0"

NOTES:

1. STATIONING GIVEN ALONG NORTHERN AVENUE SOUTH BASELINE.
2. SEE DEMOLITION DRAWINGS FOR ADDITIONAL INFORMATION ON LIMITS OF DEMOLITION.

60560339_BR5(B16184).DWG Plotted on 21-Apr-2020 2:20 PM

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DEMOLITION NOTES

1. CONTRACTOR TO OBTAIN ALL PERMITS PRIOR TO COMMENCEMENT OF DEMOLITION ACTIVITIES.
2. DIMENSIONS ARE BASED ON ORIGINAL DESIGN DRAWINGS AND ARE FOR INFORMATION ONLY. CONTRACTOR TO VERIFY ALL DIMENSIONS IN THE FIELD PRIOR TO THE COMMENCEMENT OF DEMOLITION ACTIIVITES.
3. CONTRACTOR TO SUBMIT DEMOLITION PLAN AND METHODOLOGY, DEMOLITION SEQUENCING, LIFTING, RIGGING, AND BRACING PLANS FOR ACCEPTANCE BY THE ENGINEER.
4. DRY DOCK 4 IS AVAILABLE TO THE CONTRACTOR FOR LAYDOWN, STAGING, AND DEMOLITION ACTIVITIES. DRY DOCK 4 IS LOCATED AT 290 R NORTHERN AVENUE. THERE IS APPROXIMATELY 170,000 SQUARE FEET OF EARTH SURROUNDING THE GRAVING DOCK AND THE GRAVING DOCK IS APPROXIMATELY 50,000 SQUARE FEET.
5. CONTRACTOR SHALL PROTECT IN PLACE ALL ADJACENT EXISTING STRUCTURES DURING DEMOLITION AND CONSTRUCTION. ANY DAMAGE CAUSED BY DEMOLITION IS TO BE REPAIRED BY THE CONTRACTOR TO THE SATISFACTION OF THE ENGINEER AT NO COST TO THE CITY OF BOSTON.
6. THE CONTRACTOR IS RESPONSIBLE FOR MAINTAINING THE STABILITY AND STRUCTURAL INTEGRITY OF THE STRUCTURE DURING DEMOLITION ACTIVITIES.
7. THE LIMITS OF CONCRETE DEMOLITION ARE INTENDED FOR THE CONTRACTOR'S GUIDANCE ONLY. CONTRACTOR MAY BE DIRECTED BY THE ENGINEER TO REMOVE ADDITIONAL CONCRETE IF THE CONCRETE IS NOT SOUND. MINOR DEVIATIONS ALONG THE LIMITS OF DEMOLITION ARE EXPECTED AND WILL NOT BE INCLUDED AS AN ADDITIONAL PAY ITEM. CONTRACTOR SHALL USE NEAT LINES FOR DEMOLITION QUANTITIES.
8. REMAINING CONCRETE ALONG THE LIMITS OF DEMOLITION, WHERE NEW CONCRETE IS TO BE REPLACED, SHALL BE ROUGHENED TO $\frac{1}{4}$" AMPLITUDE.
9. CONTRACTOR TO INSTALL TEMPORARY SHIELDING AND PLATFORMS AS NEEDED FOR DEMOLITION ACTIVITIES.
10. CONTRACTOR SHALL PROVIDE PROPER PROTECTION OF ALL STRUCTURAL COMPONENTS AND EQUIPMENT TO BE REUSED OR REHABILITATED.

SUGGESTED DEMOLITION SEQUENCING

THE FOLLOWING SUGGESTED DEMOLITION SEQUENCING IS SUMMARIZED AND NOT ALL ENCOMPASSING. SEE THE SUBSEQUENT DEMOLITION SHEETS FOR ADDITIONAL DETAILS.

1. OBTAIN ALL NECESSARY PERMITTING FOR IN WATER WORK, LAND SIDE WORK, AND DISPOSAL OF MATERIALS PRIOR TO COMMENCEMENT OF THE WORK.
2. PROVIDE RINGER CRANE, TENDER CRANE, AND ASSOCIATED BARGES.
3. PRIOR TO REMOVAL OF ANY BRIDGE SUPERSTRUCTURE, REMOVE UTILITIES, APPURTENANCES, AND OTHER TOPSIDE FEATURES. REMOVE BRIDGE DECK AND RAILING AS NECESSARY.
4. INSTALL ALL TEMPORARY BRACING AS NEEDED FOR SAFE REMOVAL AND TRANSPORTATION OF THE BRIDGE STRUCTURES TO DRY DOCK 4 IN SOUTH BOSTON.
5. DEMOLISH FENDER SYSTEM AND ASSOCIATED PILES AS NEEDED FOR REMOVAL OF BRIDGE STRUCTURES. PILES TO BE CUT 2 FEET BELOW THE MUDLINE WITH THE TOP PORTION REMOVED AND THE LOWER PORTION ABANDONED IN PLACE.
6. REMOVE SPAN 1 (BOSTON APPROACH) AND TRANSPORT TO DRY DOCK 4.
7. REMOVE SPAN 2 (SOUTH BOSTON APPROACH) AND TRANSPORT TO DRY DOCK 4.
8. REMOVE DRAW SPAN AND TRANSPORT TO DRY DOCK 4.
9. PERFORM SELECTIVE DEMOLITION OF TRUSS MEMBERS FROM SPANS 1, 2, AND DRAW SPAN. SELECT TRUSS MEMBERS ARE TO BE REUSED IN THE PROPOSED STRUCTURE.
10. REMOVE SPAN 3 SUPERSTRUCTURE AND DECK, TRANSPORT TO DRY DOCK 4, AND DEMOLISH.
11. DEMOLISH REMAINING FENDER SYSTEM AND ASSOCIATED PILES. PILES TO BE CUT 2 FEET BELOW THE MUDLINE WITH THE TOP PORTION REMOVED AND THE LOWER PORTION ABANDONED IN PLACE.
12. DEMOLISH DRAW PIER PILE FIELD. PILES TO BE CUT 2 FEET BELOW THE MUDLINE WITH THE TOP PORTION REMOVED AND THE LOWER PORTION ABANDONED IN PLACE. IN THE AREA OF THE PROPOSED PROMENADE, CONTRACTOR MAY ELECT TO INSTALL PROPOSED PILES PRIOR TO DEMOLITION OF THE EXISTING.
13. PRE–TRENCH ALONG THE LINES OF COFFERDAM INSTALLATION.
14. INSTALL COFFERDAMS AT PIER 1, 2, 3, DRAW PIER, AND EACH ABUTMENT.
15. DEMOLISH PIERS 1, 2, AND 3 TO THE LIMITS INDICATED WITHIN THE DEMOLITION SHEETS.
16. REMOVE DRUM GIRDER ASSEMBLY TO DRY DOCK 4 FOR RECONDITIONING. REMOVE EXISTING MACHINERY AND TRANSPORT TO DRY DOCK 4.
17. PERFORM SELECTIVE DEMOLITION OF DRAW PIER AS NEEDED FOR RECONDITIONING AND WATERPROOFING.
18. DEMOLISH EACH ABUTMENT, INCLUDING THE BOSTON SIDE VAULT TO THE LIMITS INDICATED WITHIN THE DEMOLITION SHEETS.
19. PROVIDE ASBESTOS AND LEAD PAINT MITIGATION FOR THE TENDER HOUSE. REMOVE HISTORIC MACHINERY AND TRANSPORT TO DRY DOCK 4. DEMOLISH THE TENDER HOUSE AND PILES. PILES TO BE CUT 2 FEET BELOW THE MUDLINE WITH THE TOP PORTION REMOVED AND THE LOWER PORTION ABANDONED IN PLACE.

60560339_BR6(B16184).DWG Plotted on 21-Apr-2020 2:20 PM
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NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	34	48
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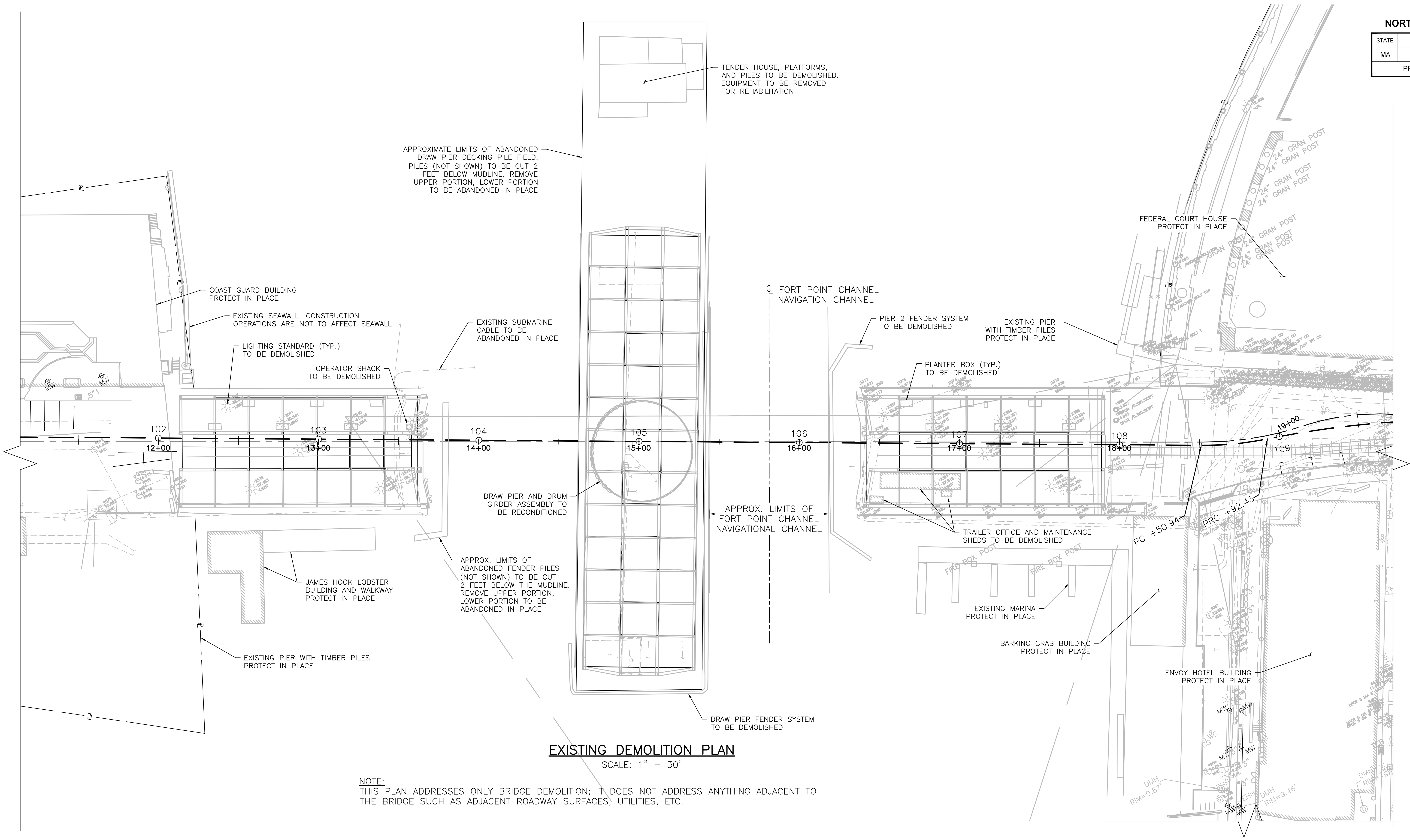
DEMOLITION PLAN



EXISTING DEMOLITION PLAN

SCALE: 1" = 30'

NOTE:
THIS PLAN ADDRESSES ONLY BRIDGE DEMOLITION; IT DOES NOT ADDRESS ANYTHING ADJACENT TO THE BRIDGE SUCH AS ADJACENT ROADWAY SURFACES, UTILITIES, ETC.

TENDER HOUSE DEMOLITION NOTES

1. CONTRACTOR TO REFERENCE EXISTING PLANS FOR DIMENSIONS AND ELEVATIONS.
2. TESTING PERFORMED IN 2016 HAS INDICATED THE PRESENCE OF ASBESTOS AND LEAD PAINT. ASBESTOS IS PRESENT WITHIN FLANGE GASKETS AND VALVE PACKINGS ASSOCIATED WITH THE MECHANICAL EQUIPMENT, ASSOCIATED PIPING SYSTEMS, AND ELECTRICAL EQUIPMENT COMPONENTS. LEAD PAINT IS PRESENT ALONG THE INTERIOR AND EXTERIOR OF THE TENDER HOUSE.
3. CONTRACTOR TO SUBMIT ASBESTOS ABATEMENT AND LEAD PAINT ABATEMENT WORK PLANS/SPECIFICATIONS PRIOR TO COMMENCING DEMOLITION ACTIVITIES.
4. THE EXISTING MECHANICAL MACHINERY (COMPRESSED AIR SYSTEM) WITHIN THE TENDER HOUSE IS HISTORIC AND WILL BE RECONDITIONED. THE CONTRACTOR SHALL SALVAGE THE MACHINERY AND STORE AT DRY DOCK 4 FOR POTENTIAL FUTURE REUSE.
5. THE TENDER HOUSE AND ALL CONTAINED MATERIALS (EXCEPT HISTORIC MACHINERY) SHALL BE DISPOSED OF LEGALLY AND IN COMPLIANCE WITH ALL LOCAL, STATE, AND FEDERAL REGULATIONS.
6. THE PILES SUPPORTING THE TENDER HOUSE ARE TO BE CUT AT 2 FEET THE MUDLINE. THE LENGTH OF PILE BELOW THIS LINE IS TO BE ABANDONED IN PLACE.

TOPSIDE DEMOLITION NOTES

1. THE FOLLOWING ITEMS IN SPANS 1 AND 2 ARE TO BE REMOVED AND/OR DEMOLISHED WHILE THE EXISTING BRIDGE IS IN PLACE: TOPSIDE LIGHTING STANDARDS, L.E.D. GROUND LIGHTS, PLANTER BOXES, TRAFFIC GATES, OPERATOR SHACK, TRAILER OFFICE, MAINTENANCE SHEDS, TIMBER WALKWAY IN THE SWING SPAN, DEBRIS, AND OTHER LOOSE MATERIALS NOT SPECIFICALLY NAMED. CONTRACTOR MAY BE DIRECTED TO REMOVE/DEMOLISH ADDITIONAL TOPSIDE ITEMS AT THE DIRECTION OF THE ENGINEER.
2. CONTRACTOR MAY ELECT TO DEMOLISH THE BRIDGE DECK IN PLACE OR IN DRY DOCK ONCE THE SUPERSTRUCTURE IS REMOVED AND RELOCATED. IF THE DECK IS LEFT IN PLACE UNTIL THE SUPERSTRUCTURE IS RELOCATED, CONTRACTOR SHALL ENSURE THAT ALL EXISTING BRIDGE RAILINGS, UTILITIES, AND OTHER REMAINING TOPSIDE ITEMS ARE SECURE AND STABLE FOR TRANSPORT.

FENDER SYSTEM AND ABANDONED DRAW PIER DECKING PILE DEMOLITION NOTES

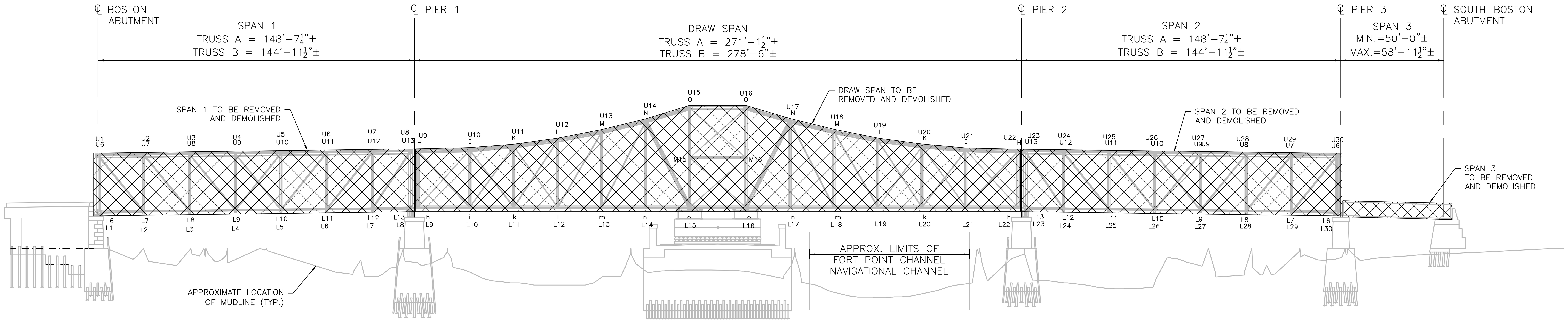
1. CONTRACTOR SHALL REFERENCE EXISTING PLANS FOR DIMENSIONS AND ELEVATIONS.
2. THE ENTIRETY OF THE DRAW PIER AND PIER 2 FENDER SYSTEMS ARE TO BE DEMOLISHED. THE FENDER SYSTEM PILES ARE TO BE CUT AT 2 FEET BELOW THE MUDLINE. THE LENGTH OF PILE BELOW THIS LINE IS TO BE ABANDONED IN PLACE. DEMOLITION OF THE FENDER SYSTEM INCLUDES NAVIGATION LIGHTING AND ASSOCIATED COMPONENTS.
3. THE ABANDONED PILES FOR THE ABANDONED DRAW PIER DECKING (MOSTLY LOCATED BELOW THE SWING SPAN OPEN POSITION) ARE TO BE CUT 2 FEET BELOW THE MUDLINE AND REMOVED. CONTRACTOR MAY ELECT TO INSTALL PROPOSED PILES PRIOR TO DEMOLITION OF THE EXISTING PILES.
4. THE ABANDONED PILES FOR THE OLD PIER 1 FENDER ARE TO BE CUT 2 FEET BELOW THE MUDLINE AND REMOVED.

60560339_BR7(B16184).DWG Plotted on 21-Apr-2020 2:21 PM
60560339 Sketch Plans Submittal (SP1) 21-April-2020

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	35	48
PROJECT FILE NO. 60560339			

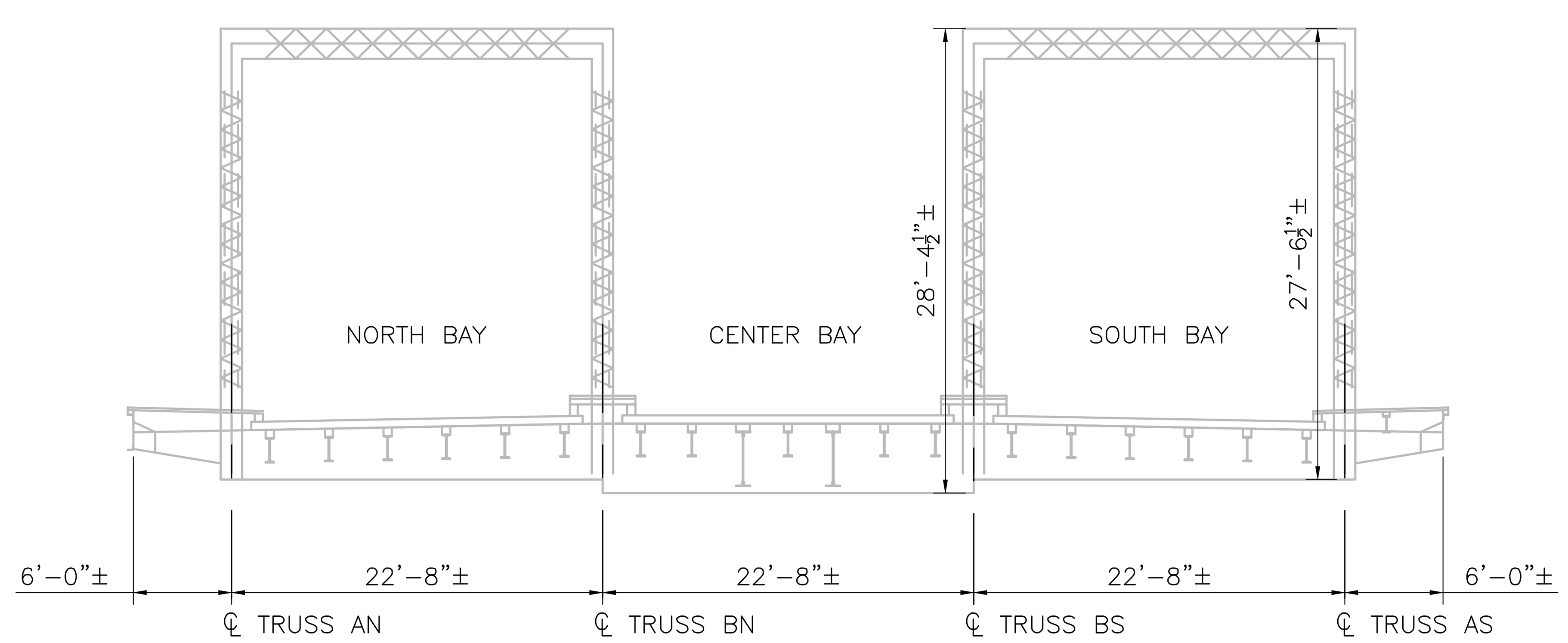
DEMOLITION ELEVATION



TRUSS B ELEVATION (LOOKING NORTH)

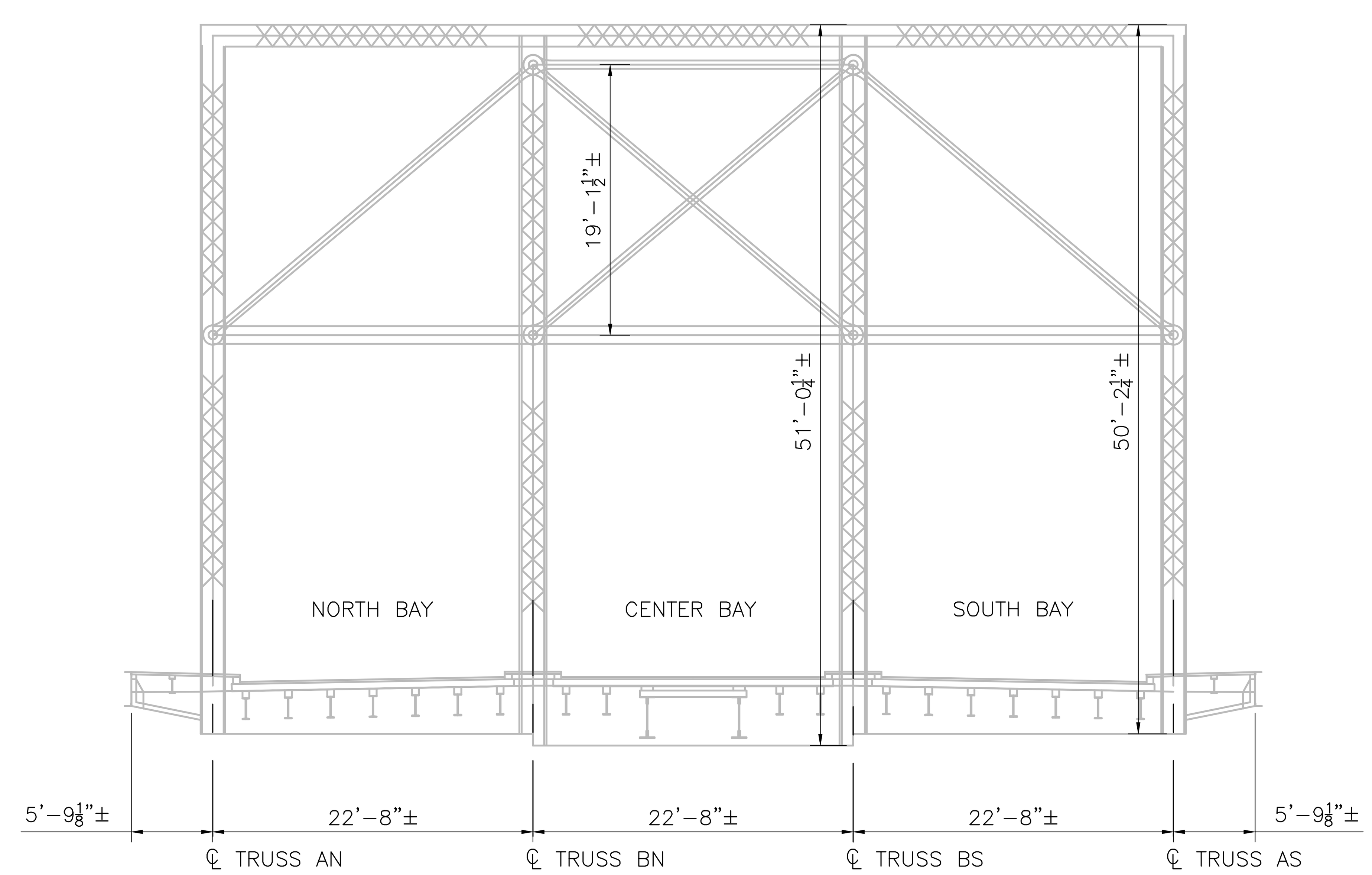
SCALE: 1" = 300'

NOTE:
DRAW SPAN SHOWN IN CLOSED POSITION, HOWEVER, DRAW SPAN IS CURRENTLY IN THE OPEN POSITION AND WILL BE REMOVED FROM THAT POSITION



TYPICAL CROSS SECTION (SPANS 1 AND 2) (VIEW LOOKING EAST)

SCALE: ⅛" = 1'−0"



DRAW SPAN CROSS SECTION AT MIDSPAN

SCALE: ⅛" = 1'−0"

NOTE:
DRAW SPAN SECTION IS LOOKING EAST WHEN BRIDGE IS IN THE CLOSED POSITION AND LOOKING NORTH WHEN BRIDGE IS IN THE OPEN POSITION.

DECK AND SUPERSTRUCTURE DEMOLITION NOTES

1. CONTRACTOR SHALL REFERENCE EXISTING PLANS FOR DIMENSIONS AND ELEVATIONS OF THE STRUCTURE. SPAN DIMENSIONS SHOWN ABOVE INDICATE CENTERLINE TO CENTERLINE OF BEARINGS BASED ON THE ORIGINAL CONSTRUCTION DRAWINGS.
2. EXISTING BRIDGE SUPERSTRUCTURE AND DECK IS TO BE PICKED, LOWERED ONTO BARGES, AND TRANSPORTED TO DRY DOCK FOR DISASSEMBLY AND/OR DEMOLITION. THE CONTRACTOR SHALL SUBMIT DEMOLITION AND SEQUENCING, LIFTING, BRACING, AND RIGGING PLANS FOR ACCEPTANCE BY THE ENGINEER PRIOR TO COMMENCING DEMOLITION. CONTRACTOR TO INCLUDE MEANS AND METHODS AS WELL AS ALL ALL PIECES OF EQUIPMENT FOR USE IN THE DEMOLITION PROCESS.
3. THE EXISTING PROTECTIVE COATING CONSISTS OF LEAD PAINT. CONTRACTOR TO FOLLOW ALL APPLICABLE SAFETY REGULATIONS AND ESTABLISH CONTAINMENT AS NEEDED.
4. CONTRACTOR TO DISCONNECT ALL UTILITIES IN COORDINATION WITH THE UTILITY OWNER AND THE CITY OF BOSTON. UTILITIES, CONDUITS, AND JUNCTION BOXES THAT ARE TO BE DEMOLISHED MAY BE LEFT IN PLACE TO BE DEMOLISHED IN DRY DOCK UNLESS OTHERWISE DIRECTED BY THE ENGINEER.
5. SWING SPAN MACHINERY SHALL BE DISCONNECTED AND REMOVED PRIOR TO REMOVAL OF THE SWING SPAN.
6. EXISTING CATWALKS AND ACCESS LADDERS AT PIERS 1 AND 2 ARE TO BE REMOVED AND DEMOLISHED WHILE THE SUPERSTRUCTURE IS IN PLACE.
7. THE DECK IN SPANS 1, 2, AND 3 CONSISTS OF TIMBER, GRANITE BLOCKS, AND BITUMINOUS CONCRETE. THE DRAW SPAN DECK CONSISTS OF STEEL GRID DECK WITH A SECTION OF CONCRETE FILL ABOVE THE DRAW PIER.
8. CONTRACTOR IS TO SALVAGE TRUSS MEMBERS AS DESIGNATED IN THE FINAL DESIGN PLANS FOR FUTURE REUSE.

CITY OF BOSTON NORTHERN AVENUE BRIDGE			
STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	36	48
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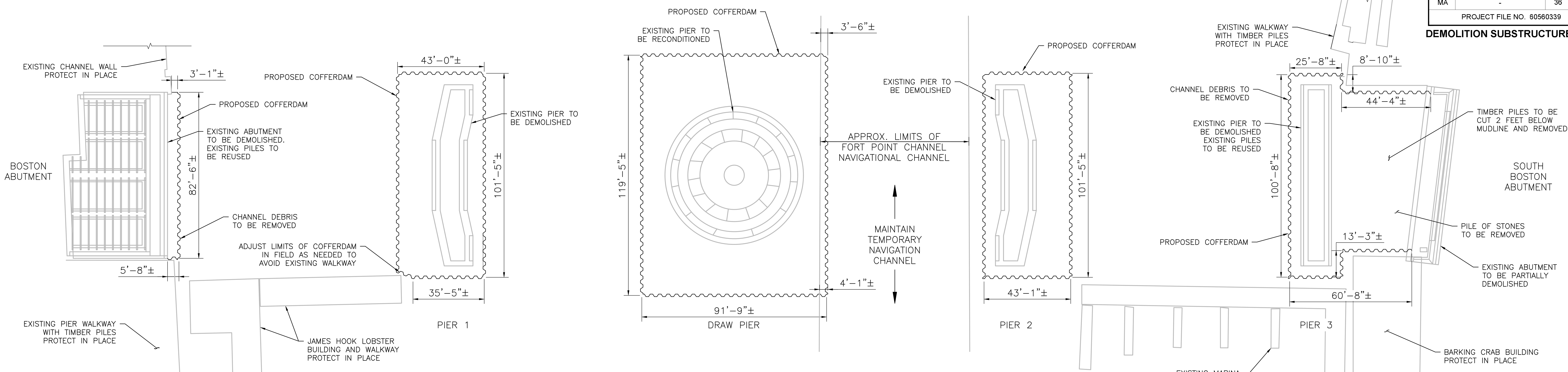
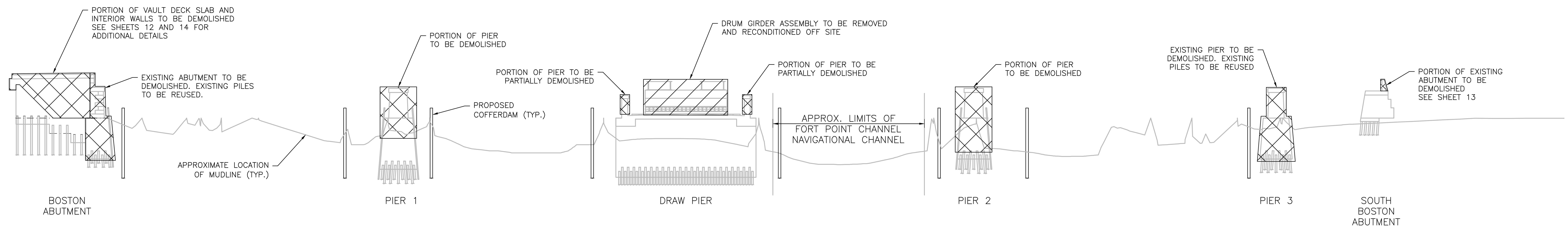
DEMOLITION SUBSTRUCTURE PLAN



SUBSTRUCTURE DEMOLITION PLAN

SCALE: 1" = 300'



SUBSTRUCTURE DEMOLITION ELEVATION

SCALE: 1" = 300'

SUBSTRUCTURE DEMOLITION NOTES:

1. DIMENSIONS AND ELEVATIONS SHOWN ARE INTENDED TO BE SCHEMATIC. CONTRACTOR IS TO VERIFY ALL DIMENSIONS AND ELEVATIONS IN THE FIELD PRIOR TO BEGINNING DEMOLITION.
2. THE LOCATION OF ADJACENT EXISTING STRUCTURES IS APPROXIMATE. CONTRACTOR TO VERIFY LOCATIONS PRIOR TO BEGINNING DEMOLITION.
3. PRIOR TO DRIVING SHEETING FOR COFFERDAMS, CONTRACTOR TO REMOVE AND DISPOSE OF CHANNEL DEBRIS IN THE COFFERDAM FOOTPRINT AFTER REMOVING SUPERSTRUCTURE. APPROXIMATE AREAS OF KNOWN DEBRIS ARE INDICATED ON THE SUBSTRUCTURE PLAN. ADDITIONAL AREAS OF DEBRIS THAT REQUIRE REMOVAL MAY BE PRESENT. COFFERDAMS SHOWN ABOVE ARE INTENDED TO BE SCHEMATIC. CONTRACTOR TO VERIFY THAT SHEETING IS NOT OBSTRUCTED BY CHANNEL DEBRIS OR EXISTING PILES PRIOR TO INSTALLING. CONTRACTOR TO INSTALL COFFERDAMS TO MINIMIZE ENCROACHMENT INTO THE NAVIGATION CHANNEL.
4. CONTRACTOR SHALL COORDINATE IN WATER DEBRIS REMOVAL WITH COFFERDAM INSTALLATION.
5. EXISTING STRUCTURES ON THE SOUTH SIDE OF THE BOSTON ABUTMENT AND ON BOTH SIDES OF THE SOUTH BOSTON ABUTMENT LIMIT THE PLACEMENT OF COFFERDAMS. CONTRACTOR TO TAKE CARE NOT TO DAMAGE EXISTING STRUCTURES OR UTILITIES TO REMAIN DURING INSTALLATION. ANY DAMAGE TO THE EXISTING STRUCTURES OR UTILITIES TO REMAIN SHALL BE REPAIRED BY THE CONTRACTOR TO THE SATISFACTION OF THE ENGINEER AT NO COST TO THE CITY.
6. THE DRUM GIRDER ASSEMBLY WHICH INCLUDES THE DRUM GIRDER, DISTRIBUTION GIRDER, AND LOADING BEAM, IS TO BE REMOVED AND RECONDITIONED AT DRY DOCK 4 FOR FUTURE REUSE.
7. DRAW PIER MACHINERY WHICH INCLUDES THE DRUM GIRDER WHEELS AND TRACK, MOTORS, AND PINION ARE TO BE REMOVED AND RECONDITIONED AT DRY DOCK FOR FUTURE REUSE.
8. EXISTING PILES ARE TO BE REUSED AT THE BOSTON ABUTMENT AND PIER 3. CONTRACTOR TO TAKE SPECIAL CARE TO ENSURE THAT PILES ARE NOT DAMAGED DURING DEMOLITION.
9. THE ANTICIPATED DEMOLITION OF EACH EXISTING SUBSTRUCTURE UNIT FOLLOWS:
   - 9.1. BOSTON ABUTMENT VAULT: DEMOLITION OF THE VAULT DECK SLAB AND TOP PORTION OF THE INTERIOR WALLS. REMAINING PORTION TO BE ABANDONED IN PLACE.
   - 9.2. BOSTON ABUTMENT: DEMOLITION OF THE ENTIRETY OF THE ABUTMENT. EXISTING PILES TO BE REUSED FOR NEW BRIDGE.
   - 9.3. PIERS 1 AND 2: DEMOLITION OF THE PIER EXTENDING TO 2 FEET BELOW THE MUDLINE. THE REMAINING PORTION OF THE PIER BEYOND THIS LIMIT IS TO BE ABANDONED IN PLACE.
   - 9.4. DRAW PIER: PARTIAL DEMOLITION OF THE PIER IN ORDER TO FACILITATE RECONDITIONING AND WATERPROOFING ACTIVITIES.
   - 9.5. PIER 3: DEMOLITION OF THE ENTIRETY OF THE PIER. EXISTING PILES TO BE REUSED FOR NEW BRIDGE.
   - 9.6. SOUTH BOSTON ABUTMENT: DEMOLITION OF THE BACKWALL. REMAINING PORTION TO BE REUSED FOR NEW BRIDGE.

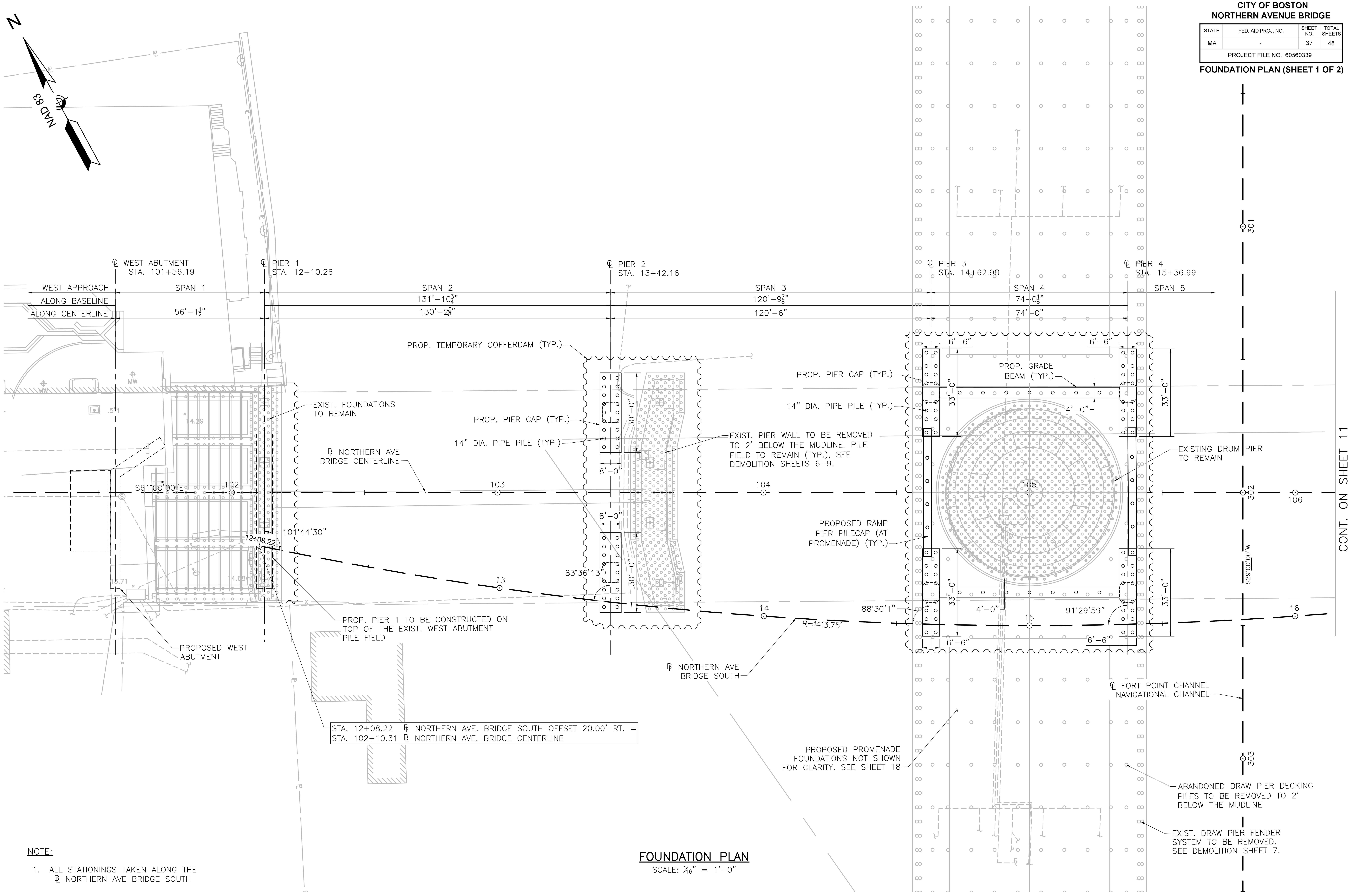
60560339_BR9(B16184).DWG Plotted on 21-Apr-2020 2:21 PM
60560339 Sketch Plans Submittal (SP1) 21-April-2020

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	37	48

PROJECT FILE NO. 60560339

FOUNDATION PLAN (SHEET 1 OF 2)



FOUNDATION PLAN
SCALE: 1/16" = 1'-0"

NOTE:

1. ALL STATIONINGS TAKEN ALONG THE ℞ NORTHERN AVE BRIDGE SOUTH

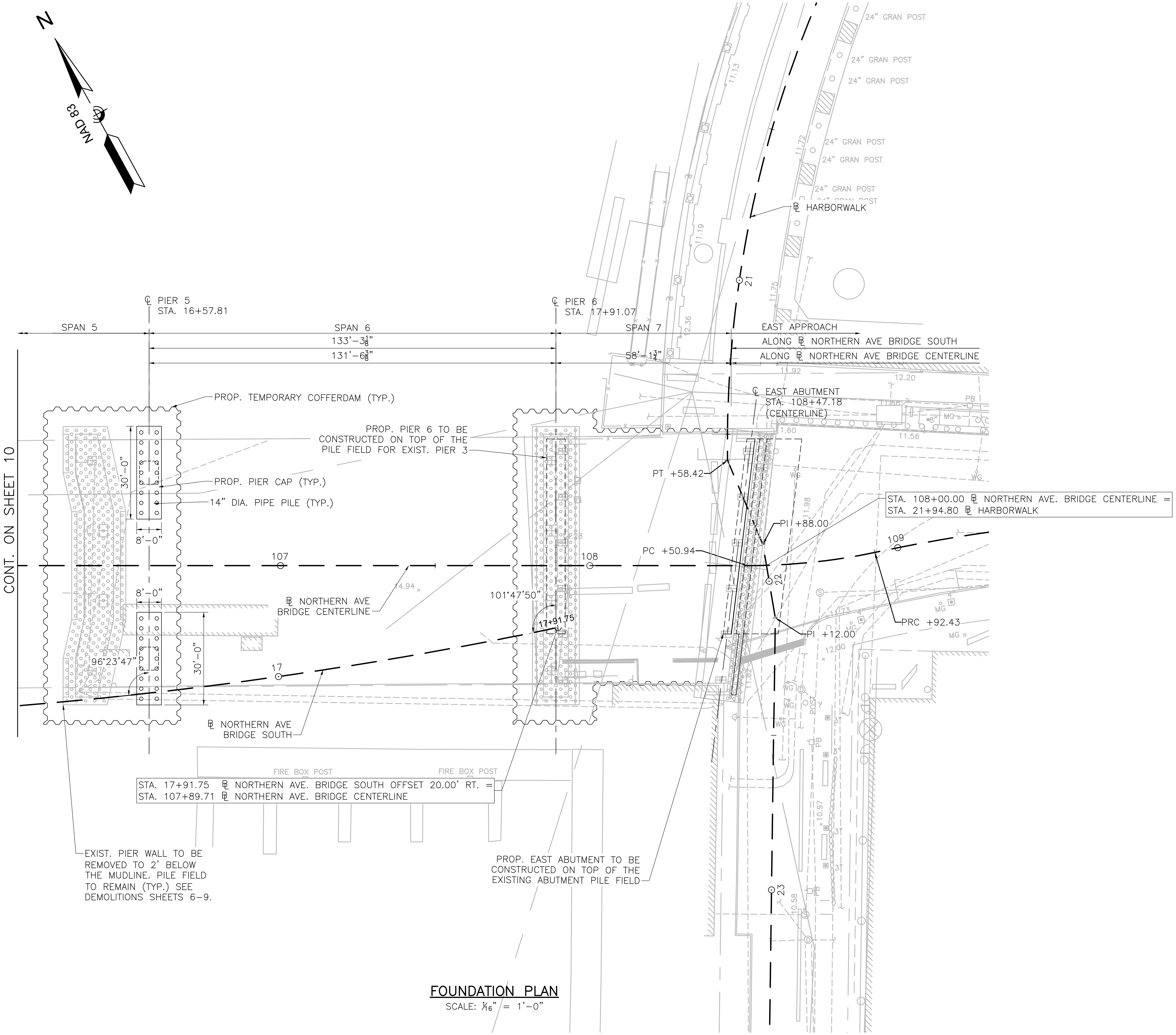
60560339_BR10(B16184).DWG Plotted on 21-Apr-2020 2:22 PM
60560339 Sketch Plans Submittal (SP1) 21-April-2020

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	38	48
PROJECT FILE NO. 60560339			

FOUNDATION PLAN (SHEET 2 OF 2)

NOTES:
1. ALL STATIONS ARE TKAEN ALONG THE NORTHERN AVE BRIDGE SOUTH BASELINE UNLESS OTHERWISE NOTED.



FOUNDATION PLAN
SCALE: 1/16" = 1'-0"

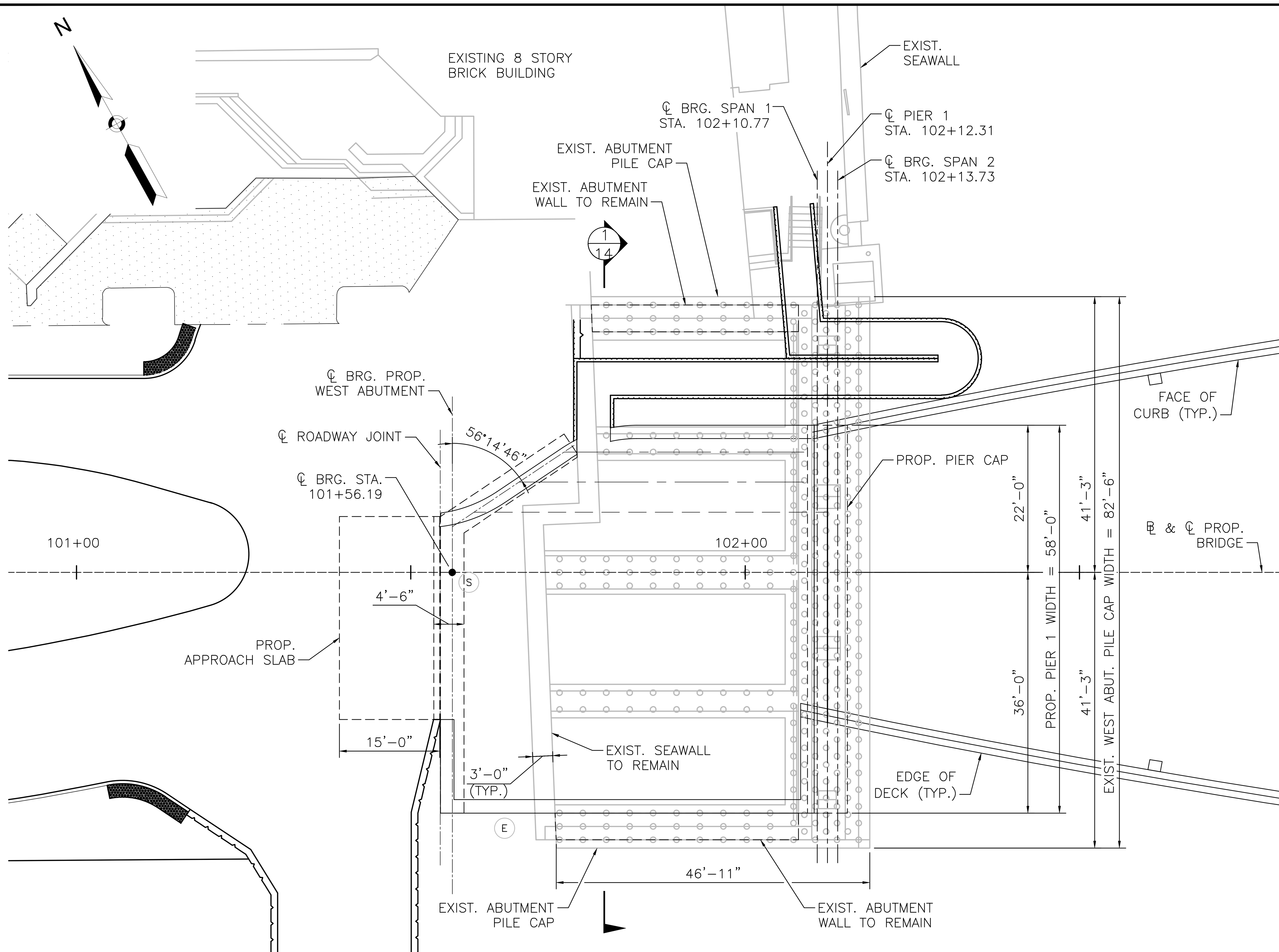
Plotted on 21-Apr-2020 2:22 PM 60560339_BR11(B16184).DWG

60560339 Sketch Plans Submittal (SP1) 21-April-2020

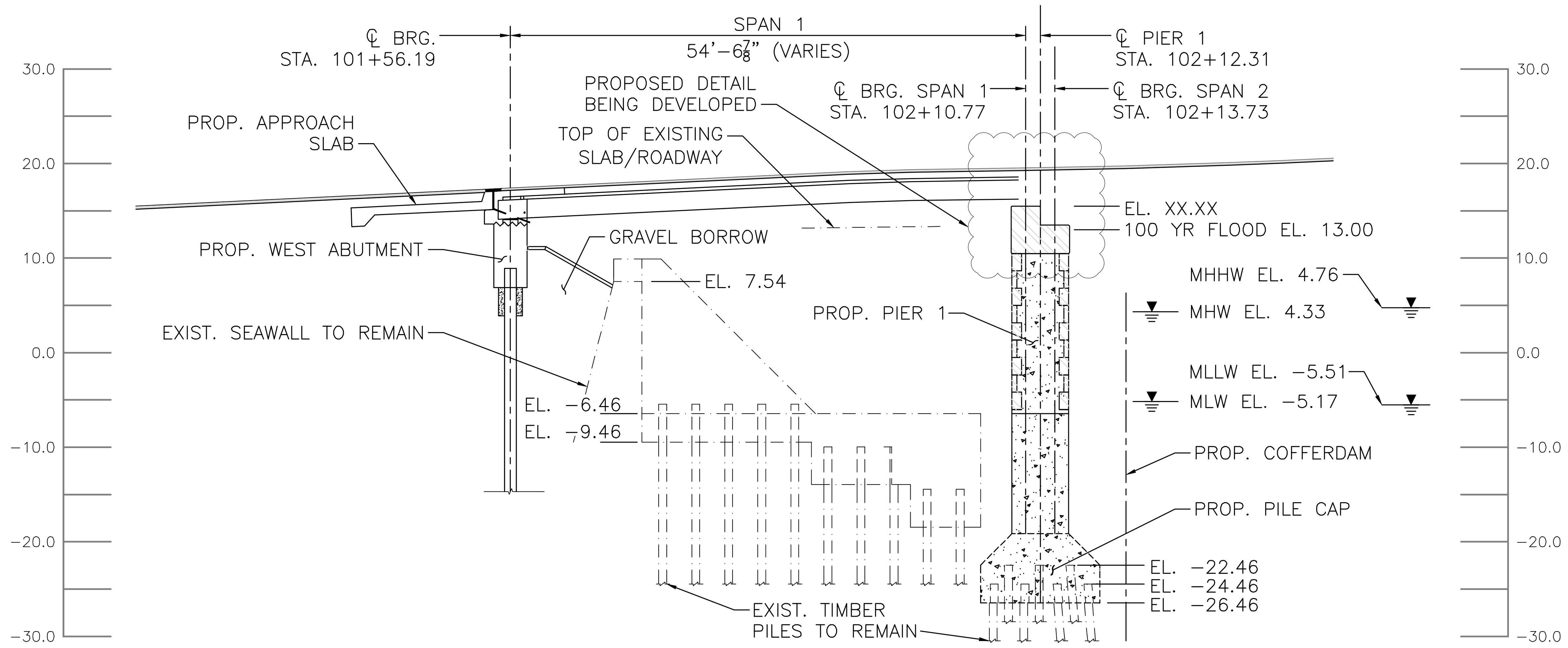
CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	39	48
PROJECT FILE NO. 60560339			

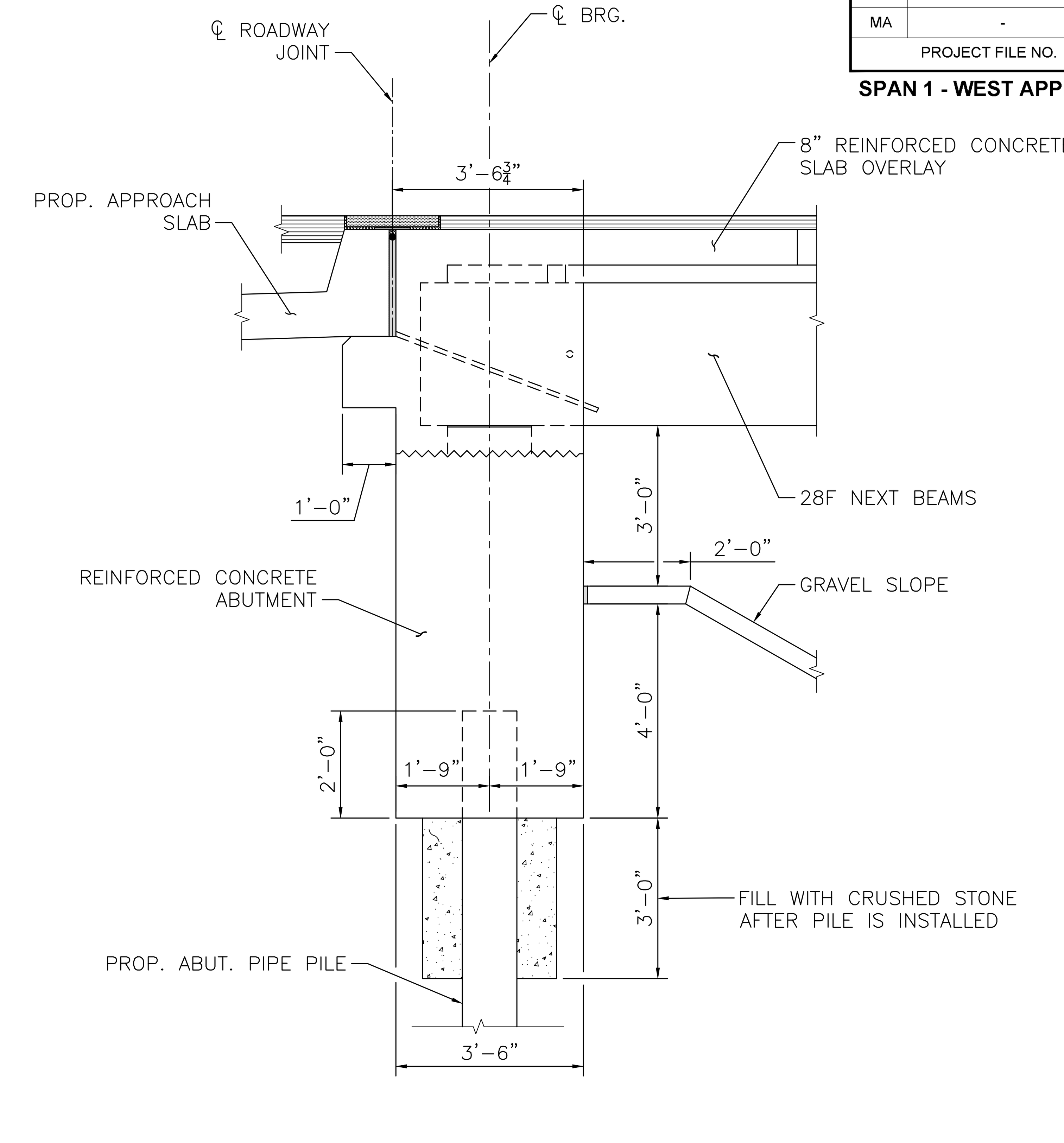
SPAN 1 - WEST APPROACH SPAN



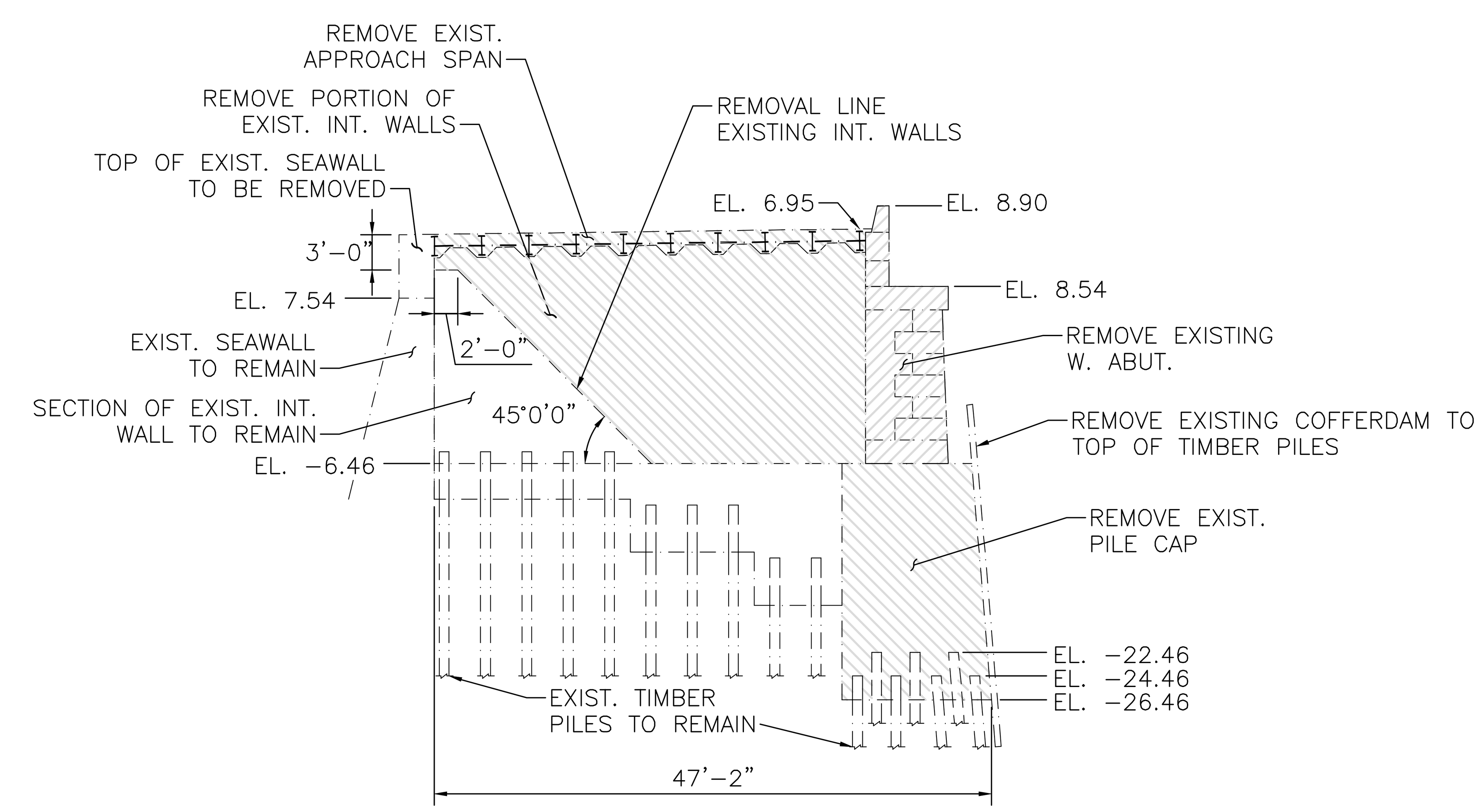
PROPOSED SPAN 1 – WEST APPROACH PLAN
SCALE: 3/32" = 1'-0"



SPAN 1 – LONGITUDINAL SECTION
SCALE: 3/32" = 1'-0"



WEST ABUTMENT DETAIL
SCALE: 1/2" = 1'-0"



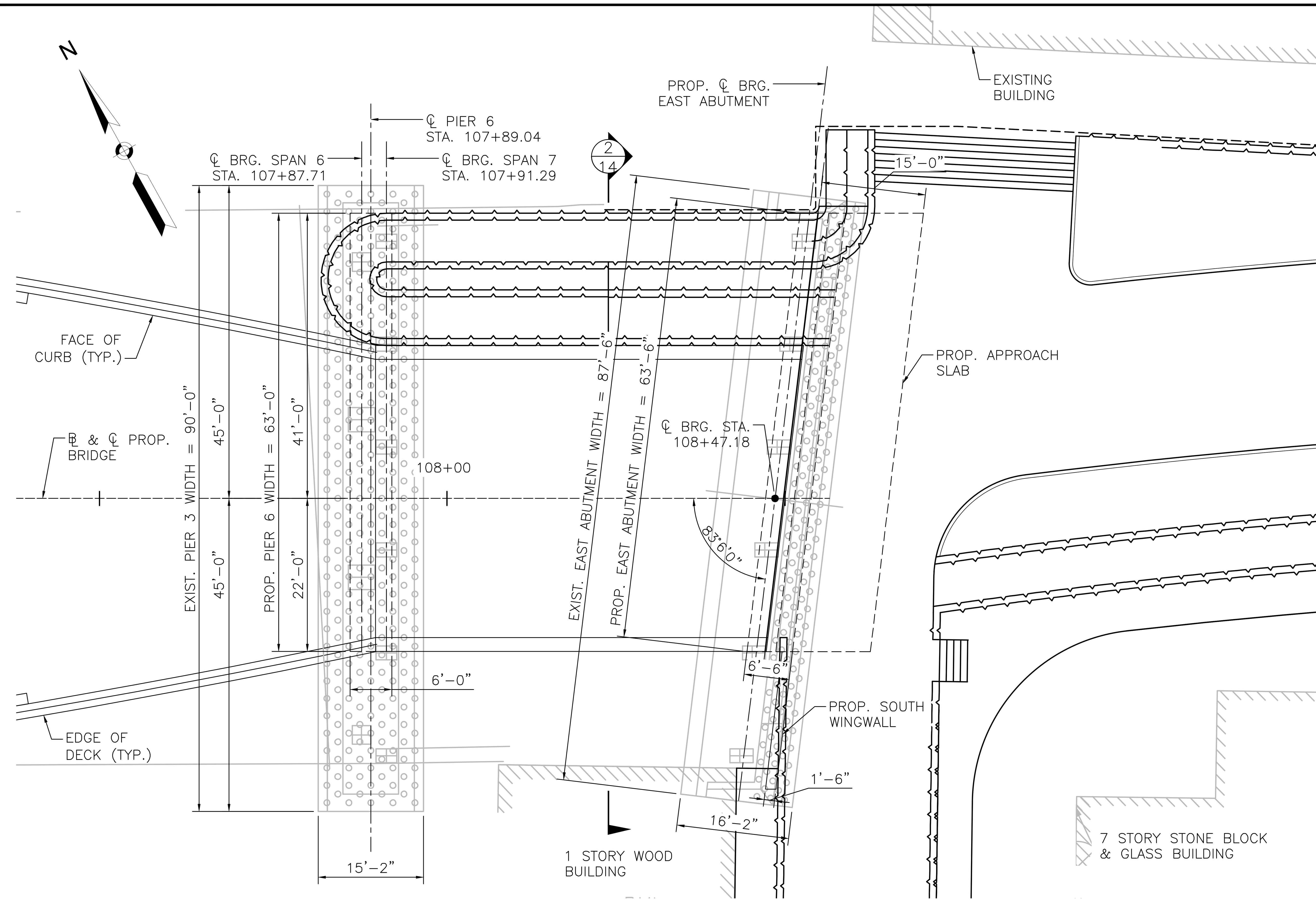
WEST ABUTMENT: CONSTRUCTION DEMO
SCALE: 3/32" = 1'-0"

60560339_BR12(B16184).DWG Plotted on 21-Apr-2020 2:23 PM
60560339 Sketch Plans Submittal (SP1) 21-April-2020

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

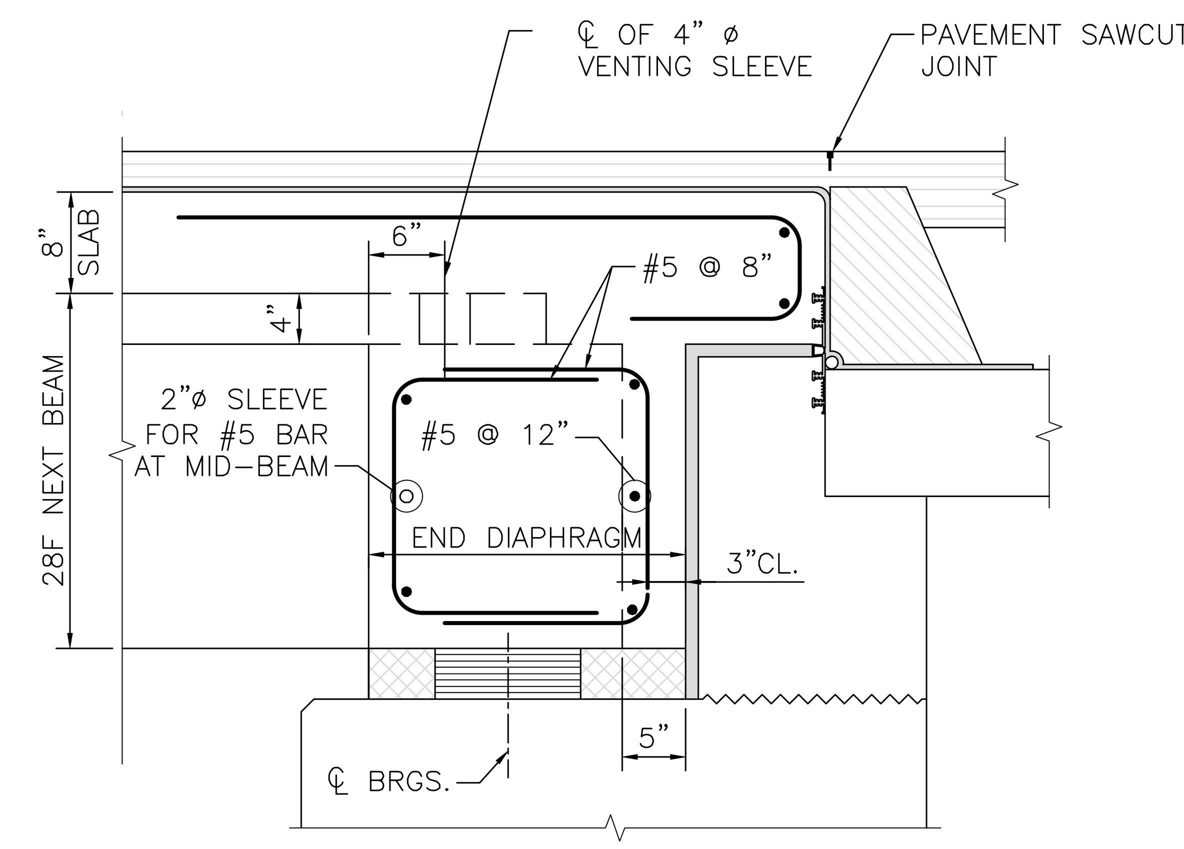
STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	40	48
PROJECT FILE NO. 60560339			

SPAN 7 - EAST APPROACH SPAN



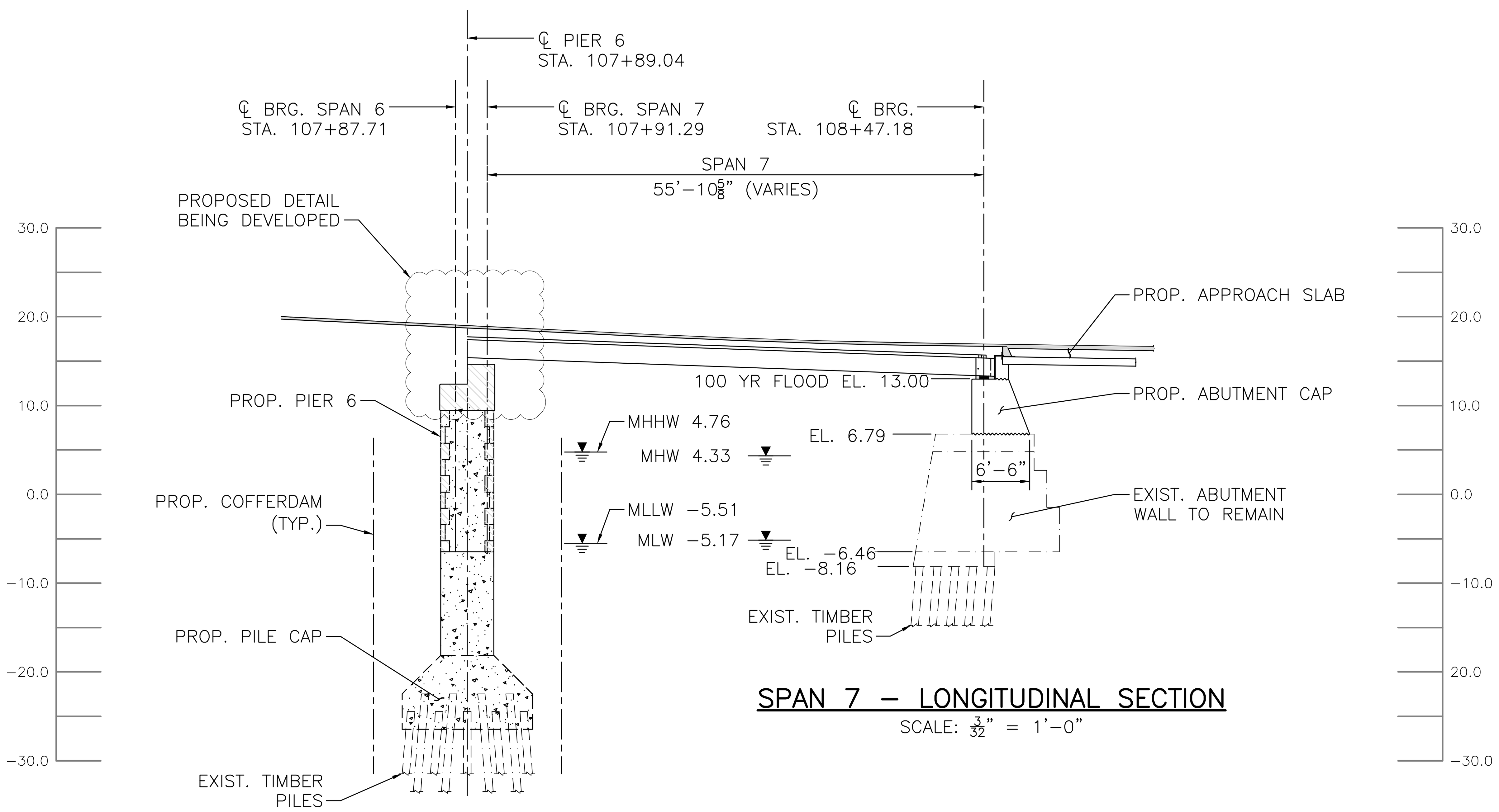
PROPOSED SPAN 7 – EAST APPROACH PLAN

SCALE: 3/32" = 1'-0"



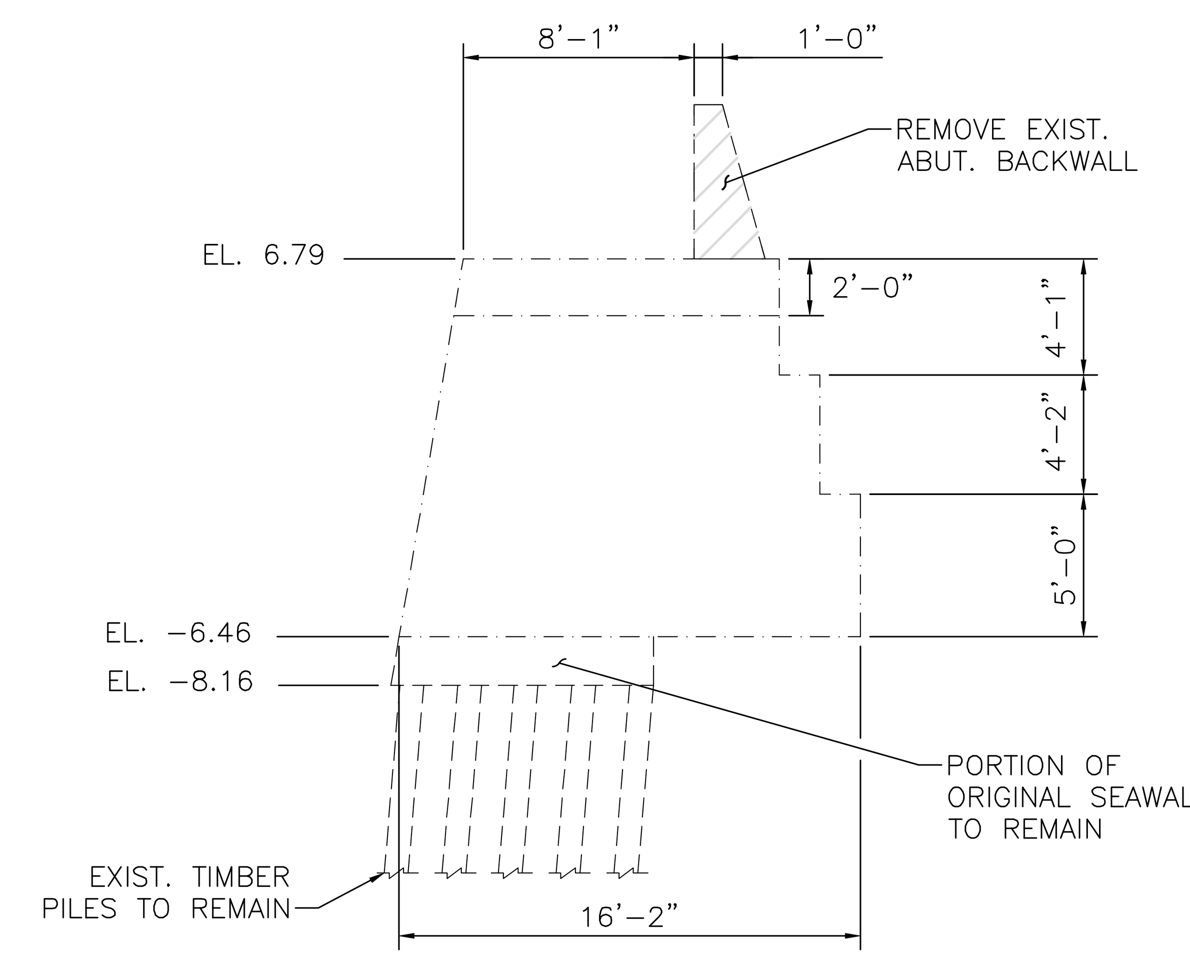
EAST ABUTMENT DETAIL

SCALE: 1" = 1'-0"



SPAN 7 – LONGITUDINAL SECTION

SCALE: 3/32" = 1'-0"



EAST ABUTMENT: CONSTRUCTION DEMO

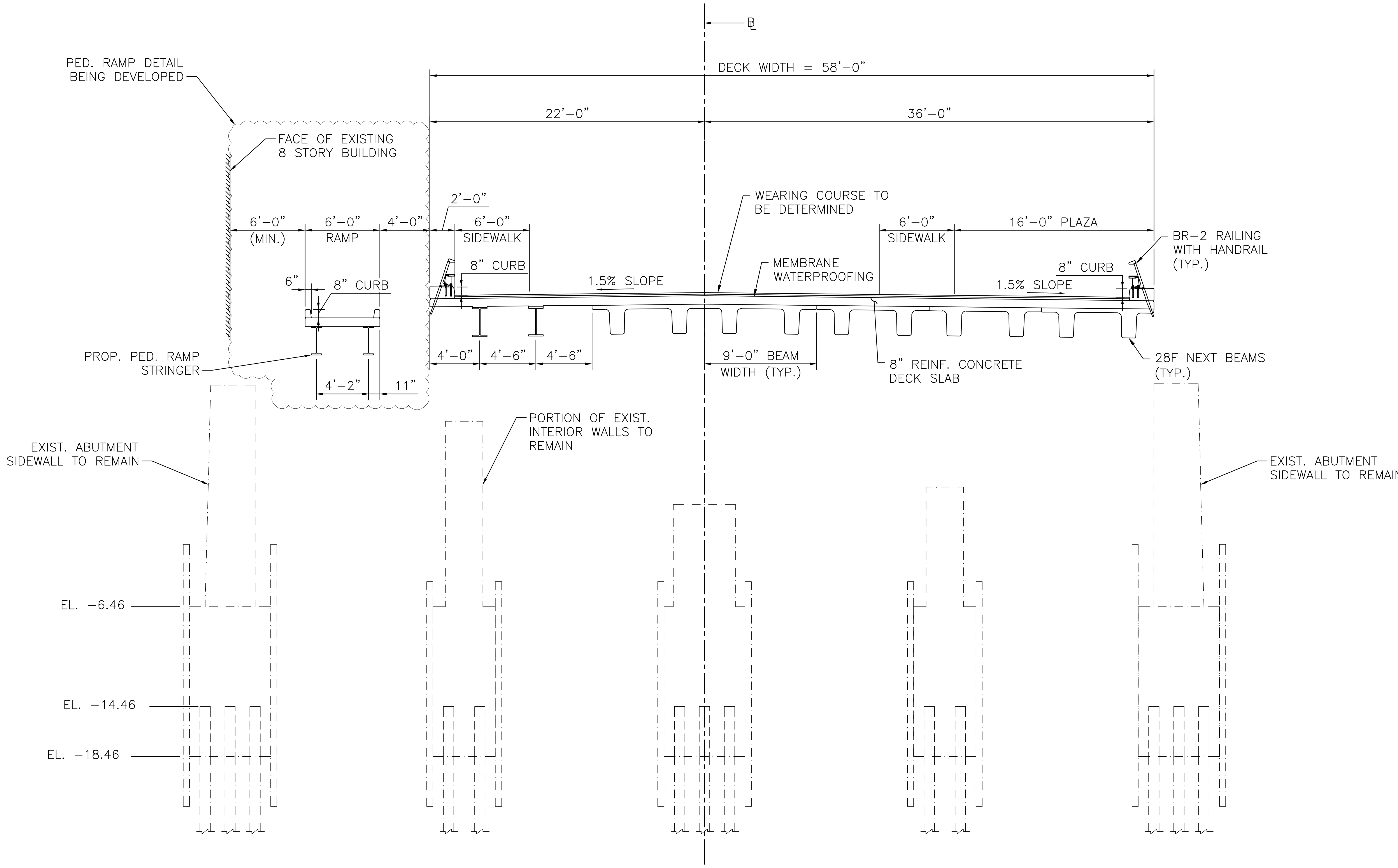
SCALE: 3/16" = 1'-0"

Plotted on 21-Apr-2020 2:24 PM
60560339_BR13(B16184).DWG
60560339 Sketch Plans Submittal (SP1) 21-April-2020

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

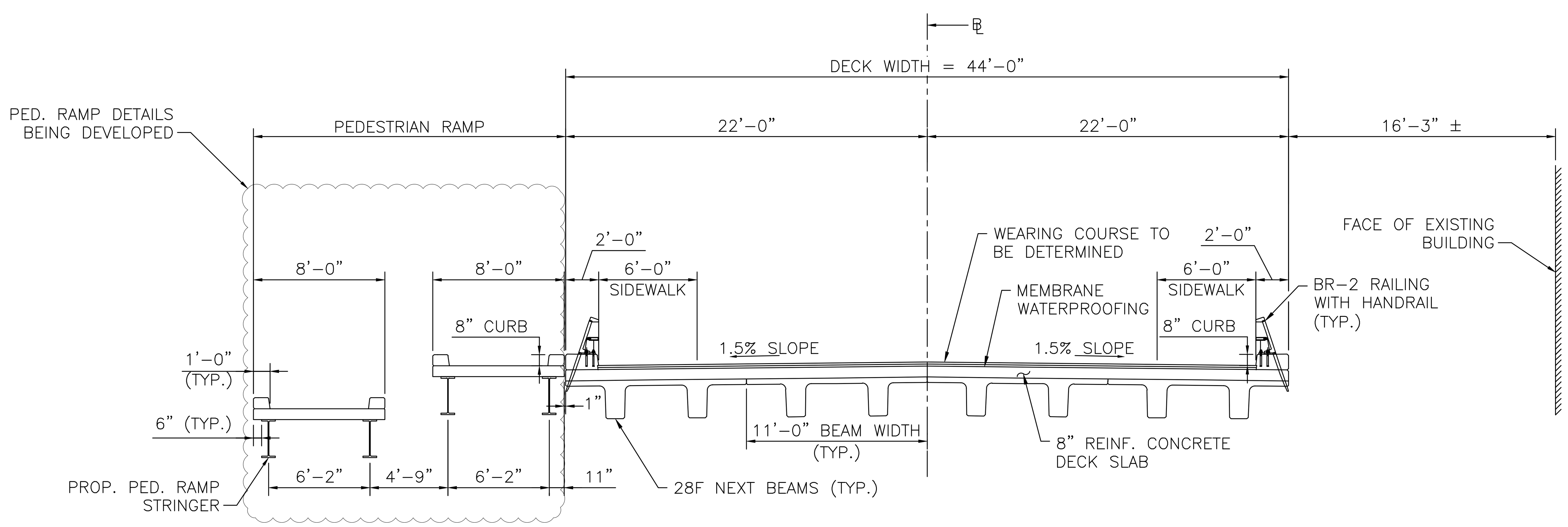
STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	41	48
PROJECT FILE NO. 60560339			

SPAN NOS. 1 AND 7 SECTIONS



SECTION 1: SPAN 1 (LOOKING EAST)

SCALE: $\frac{3}{16}$" = 1'-0"



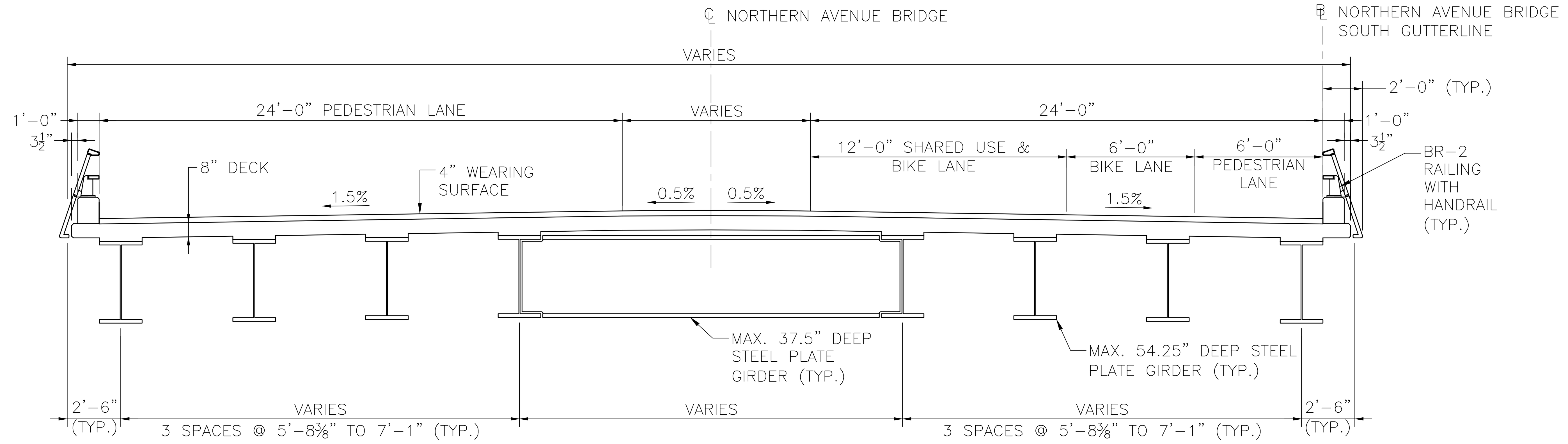
SECTION 2: SPAN 7 (LOOKING EAST)

SCALE: $\frac{3}{16}$" = 1'-0"

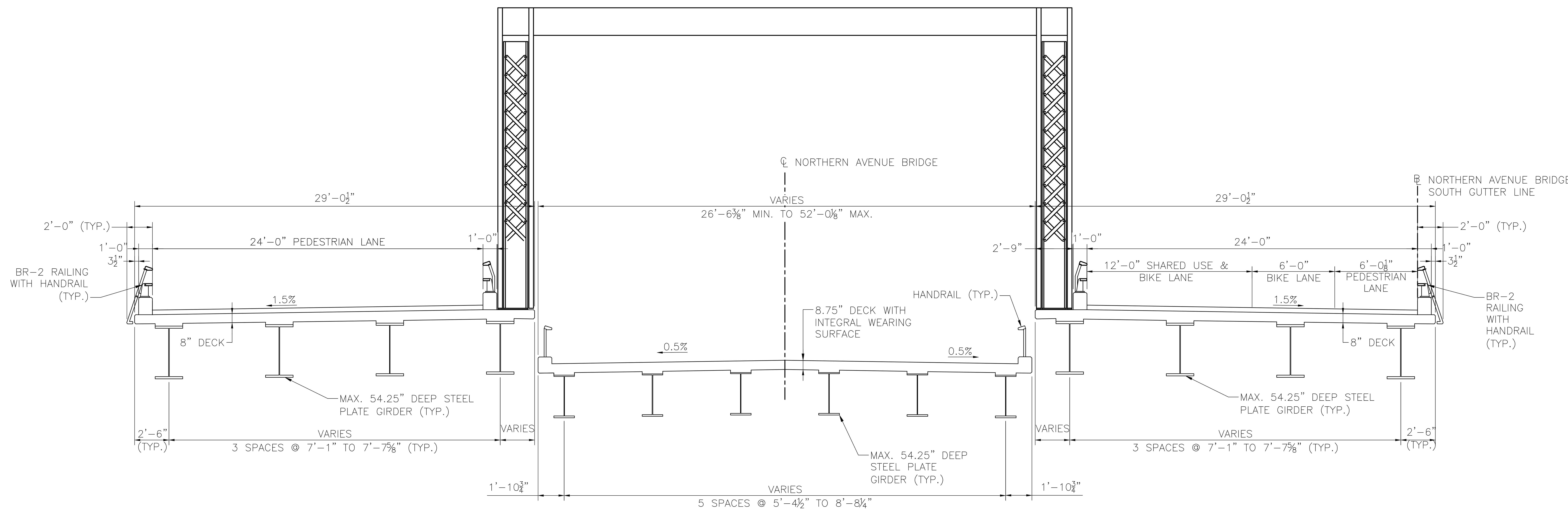
CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	42	48
PROJECT FILE NO. 60560339			

TYPICAL SECTIONS (SHEET 1 OF 2)



SECTION AT SPANS NO. 2 & 6
STA. 12+12.95 TO STA. 13+27.63
(STA. 102+14.95 TO STA. 103+28.08 ALONG ℔)
SCALE: ¼" = 1'-0"



SECTION AT RAMP
STA. 13+27.63 TO STA. 14+62.89
(STA. 103+28.08 TO STA. 104+62.92 ALONG ℔)
SCALE: ¼" = 1'-0"

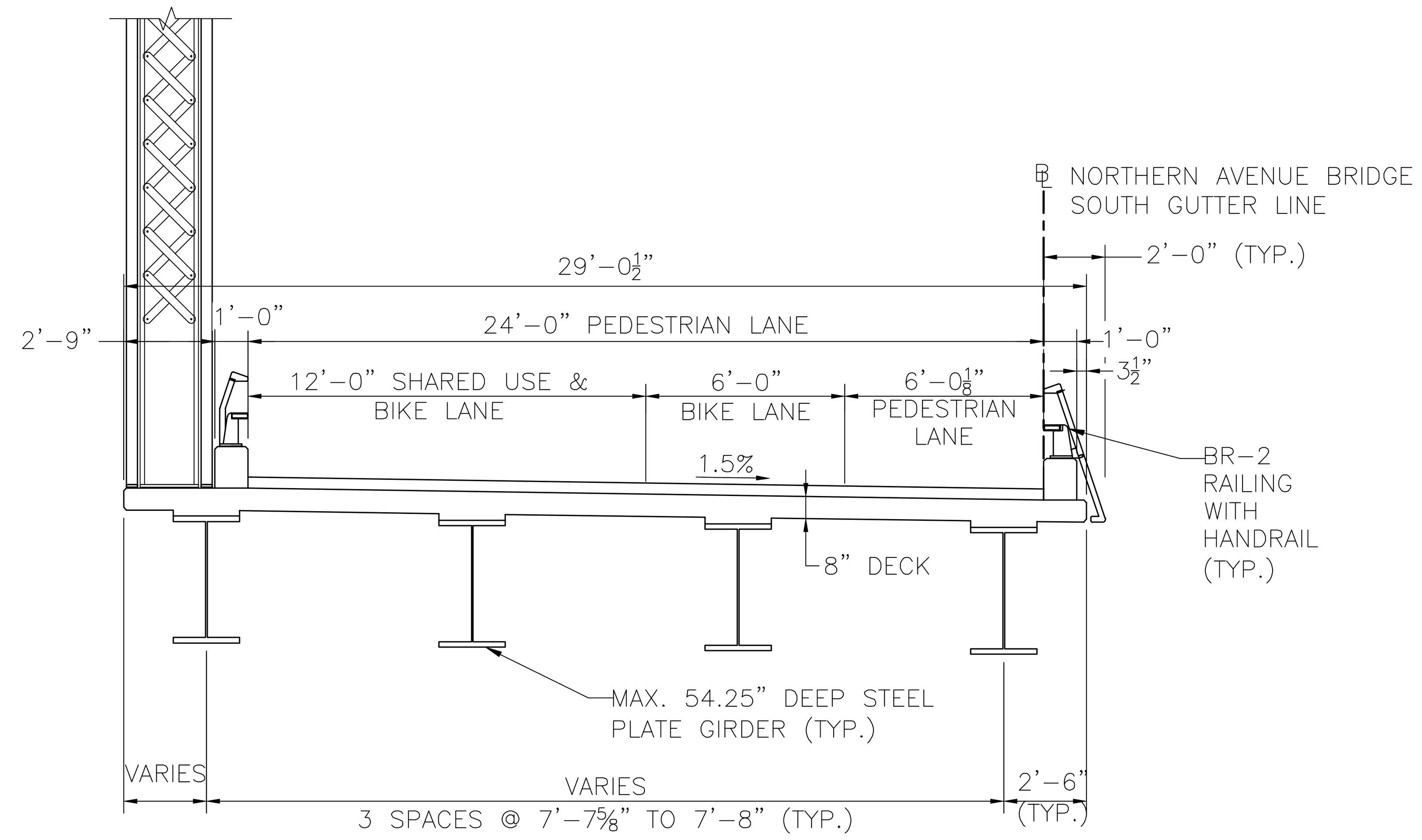
60560339_BR15(B16184).DWG Plotted on 21-Apr-2020 2:25 PM
60560339 Sketch Plans Submittal (SP1) 21-April-2020

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

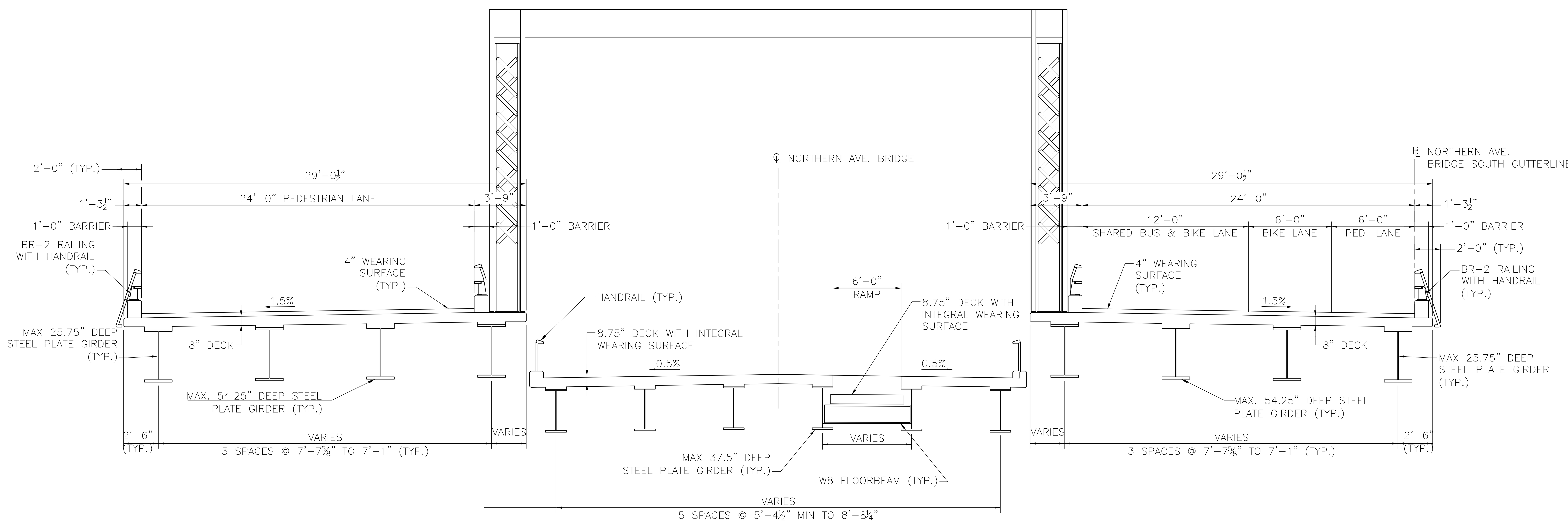
STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	43	48
PROJECT FILE NO. 60560339			

TYPICAL SECTIONS (SHEET 2 OF 2)

60560339_BR16(B16184).DWG Plotted on 21-Apr-2020 2:25 PM



SECTION – AT LOCATION OF DECK OPENING
STA. 14+62.89 TO STA. 15+37.14
(SOUTH SIDE SHOWN, NORTH SIDE OPPOSITE HAND AND FULL WIDTH PEDESTRIAN LANE)
SCALE: ¼" = 1'-0"



SECTION AT LEVEL SURFACE
STA. 15+37.14 TO STA. 16+72.43
SCALE: ¼" = 1'-0"

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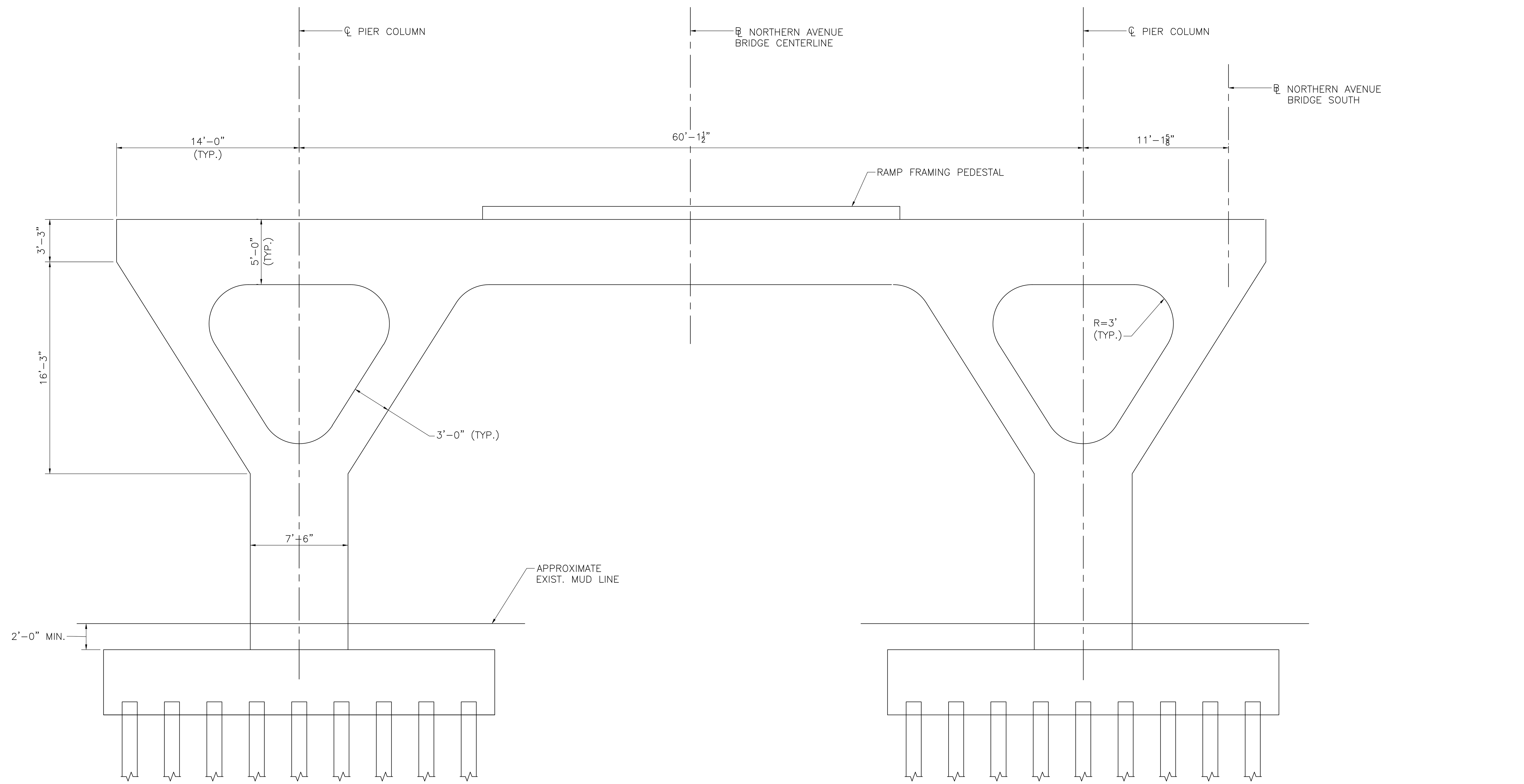
CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	44	48
PROJECT FILE NO. 60560339			

PIER ELEVATION



TYPICAL FLANKING PIER ELEVATION
(PIER 2 SHOWN, PIER 5 SIMILAR)
SCALE: ¼" = 1'–0"

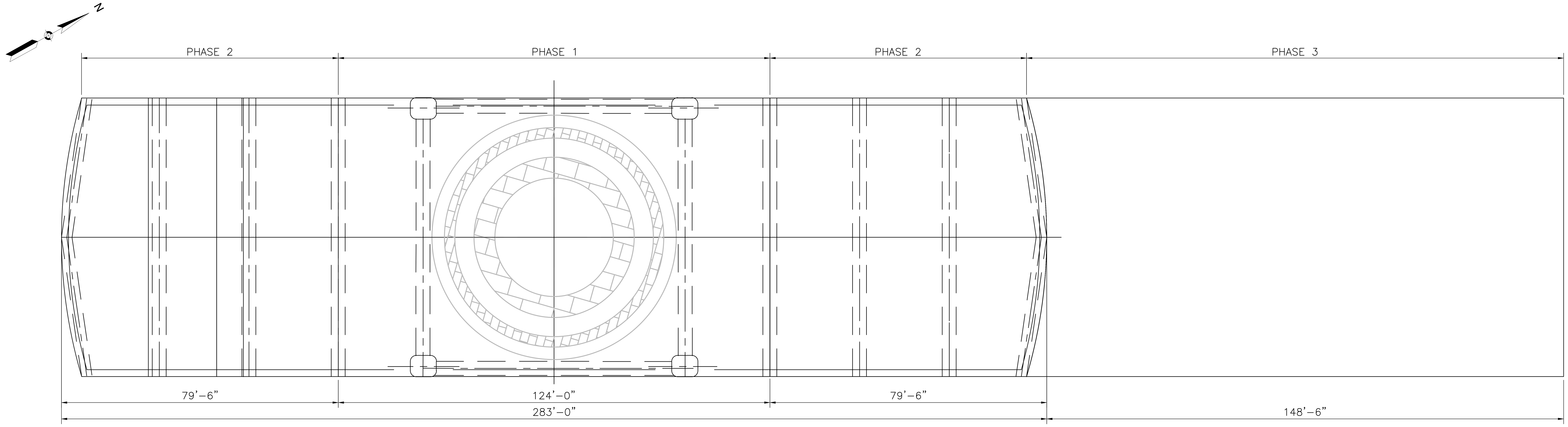
60560339_BR17(B16184).DWG Plotted on 21-Apr-2020 2:26 PM

60560339 Sketch Plans Submittal (SP1) 21-April-2020

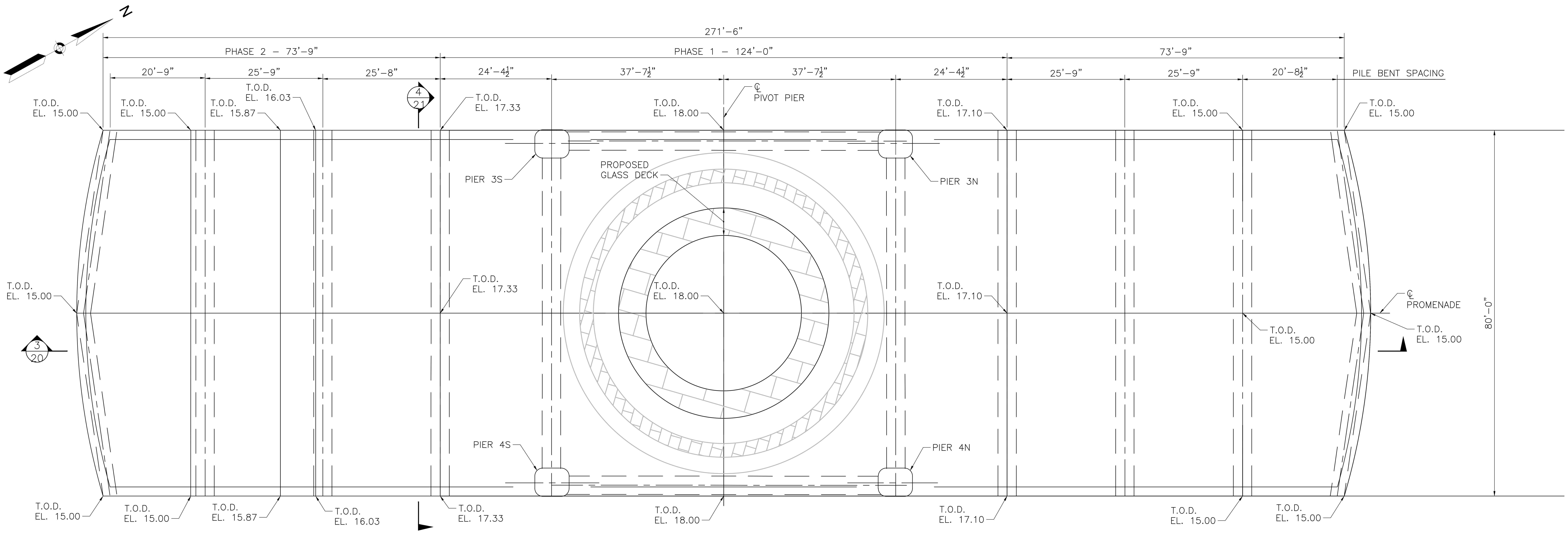
CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	45	48
PROJECT FILE NO. 60560339			

PROMENADE PLAN



PROMENADE CONSTRUCTION PHASING LAYOUT
SCALE 1/8" = 1'-0"



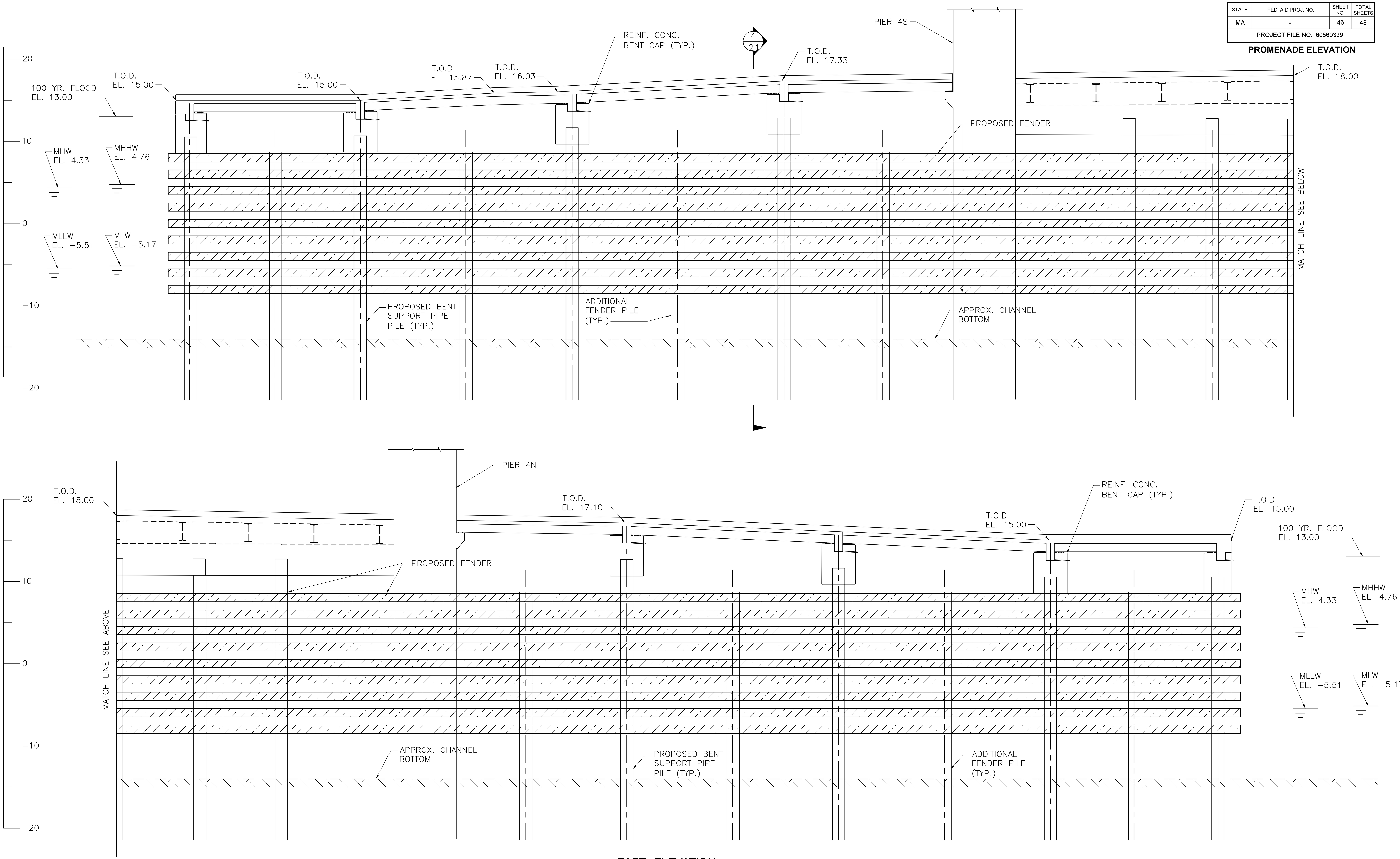
PROMENADE DECK PLAN VIEW
SCALE 3/32" = 1'-0"

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	46	48

PROJECT FILE NO. 60560339

PROMENADE ELEVATION



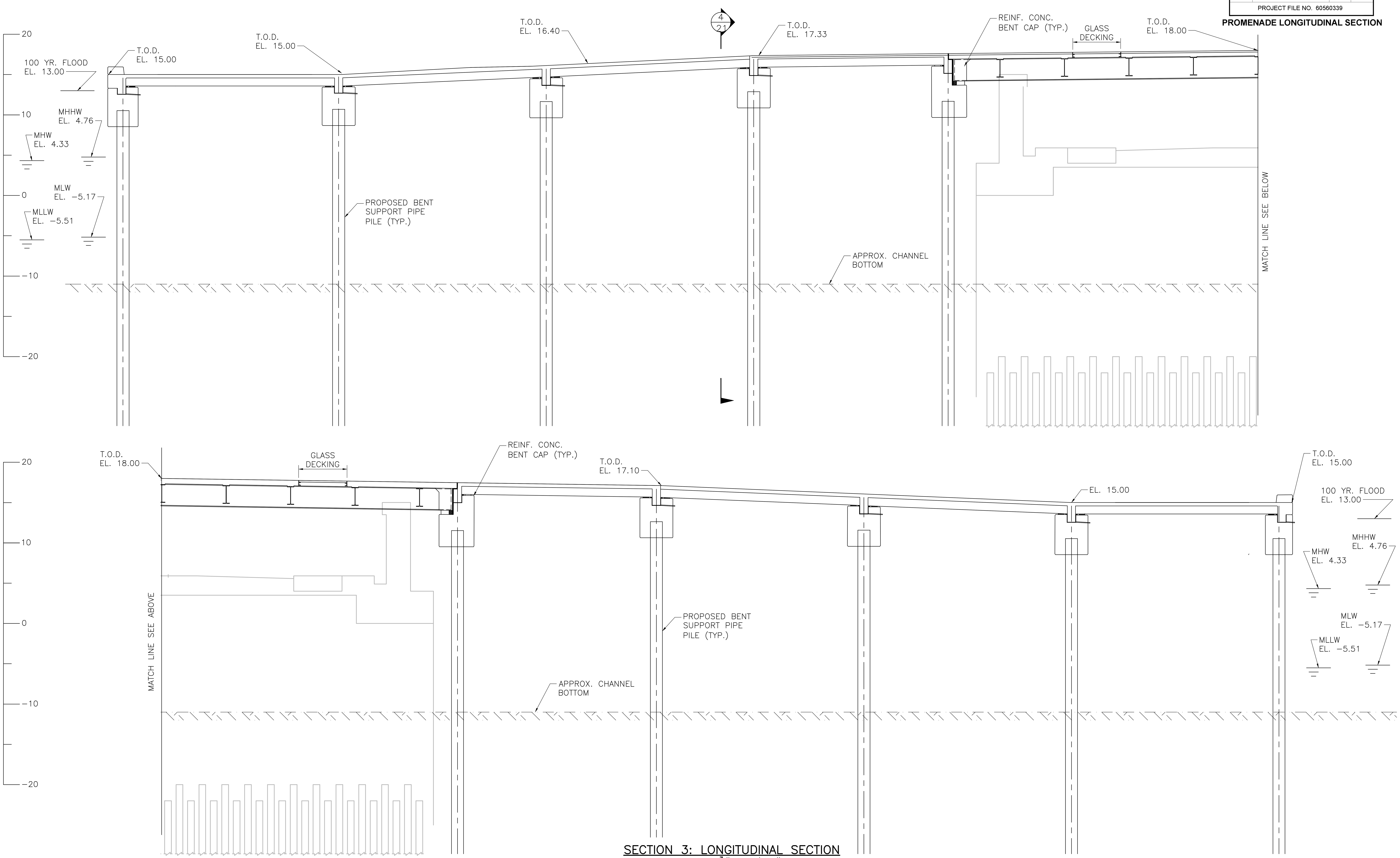
EAST ELEVATION
SCALE $\frac{3}{16}$" = 1'-0"

60560339_BR19(B16184).DWG Plotted on 21-Apr-2020 2:26 PM
60560339 Sketch Plans Submittal (SP1) 21-April-2020

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	47	48
PROJECT FILE NO. 60560339			

PROMENADE LONGITUDINAL SECTION



SECTION 3: LONGITUDINAL SECTION
SCALE $\frac{3}{16}$" = 1'−0"

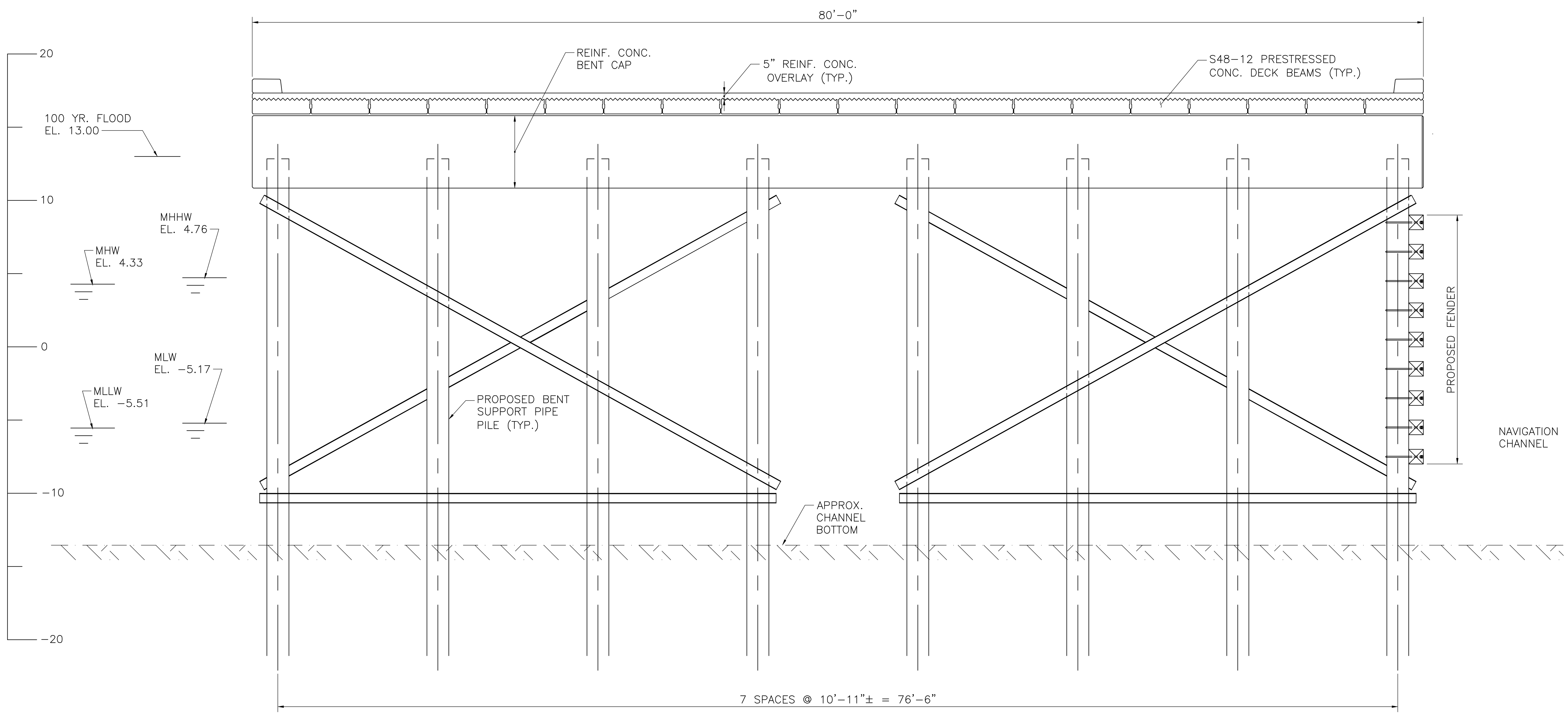
SHEET 20 OF 21 SHEETS BRIDGE NO. B−16−184 (XXX)

60560339_BR20(B16184).DWG Plotted on 21-Apr-2020 2:27 PM
60560339 Sketch Plans Submittal (SP1) 21-April-2020

CITY OF BOSTON
NORTHERN AVENUE BRIDGE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	48	48
PROJECT FILE NO. 60560339			

PROMENADE TRANSVERSE SECTION



<u>SECTION 4: TRANSVERSE SECTION</u>
SCALE $\frac{1}{4}$" = 1'–0"

60560339_BR21(B16184).DWG Plotted on 21-Apr-2020 2:27 PM

60560339 Sketch Plans Submittal (SP1) 21-April-2020

Attachment 3

ENF Distribution List

ENF Distribution List

Department of Environmental Protection Boston Office	MassDEP Commissioner's Office One Winter Street Boston, MA 02108 Email: helena.boccadoro@mass.gov
Department of Environmental Protection, Appropriate Regional Office and to each program from which a permit will be sought	MassDEP Northeast Regional Office Attn: MEPA Coordinator 205B Lowell Street Wilmington, MA 01887 Email: john.d.viola@mass.gov
	MassDEP Water Quality Certification Program One Winter Street Boston, MA 01208 Email: David.W.Wong@mass.gov
	MassDEP Chapter 91 Program One Winter Street Boston, MA 01208 Email: DEP.Waterways@mass.gov
Massachusetts Department of Transportation (MassDOT)	MassDOT Public/Private Development Unit 10 Park Plaza, Suite 4150 Boston, MA 02116 Email: lionel.lucien@dot.state.ma.us
Applicable MassDOT District Office	MassDOT District #6 Attn: MEPA Coordinator 185 Kneeland Street Boston, MA 02111 Email: amitai.lipton@dot.state.ma.us
Massachusetts Historical Commission	Massachusetts Historical Commission The MA Archives Building 220 Morrissey Boulevard Boston, MA 02125 Email: mhc@sec.state.ma.us Brona.Simon@state.ma.us
Applicable Regional Planning Agency	Metropolitan Area Planning Council 60 Temple Place/6th floor Boston, MA 02111 Email: mdraisen@mapc.org rdavis@mapc.org
City of Boston	Boston City Council Frank Baker 1 City Hall Square Room 550 Boston, MA 02201 Email: frank.baker@boston.gov
	Boston Planning and Development Agency Richard McGuinness 1 City Hall Square

City of Boston (continued)	9th Floor Boston, MA 02201 Email: Richard.mcguinness@boston.gov
	Conservation Commission C/O Environment Department Amelia Croteau 1 City Hall Square Room 709 Boston, MA 02201 Email: amelia.croteau@boston.gov
	Boston Public Health Commission Monica Valdes Lupi 1010 Massachusetts Avenue 2nd Floor Boston, MA 02118 Email: info@bphc.org
	Landmarks Commission 1 City Hall Square Room 709 Boston, MA 02201 Email: BLC@BOSTON.GOV
	Boston Public Library 700 Boylston Street Boston, MA 02116 Email: ask@bpl.org pcarver@bpl.org
If the Project is in a Coastal Zone Community	Coastal Zone Management Attn: Project Review Coordinator 251 Causeway Street, Suite 800 Boston, MA 02114 Email: robert.boeri@mass.gov patrice.bordonaro@mass.gov
	Division of Marine Fisheries Division of Marine Fisheries (North Shore) Attn: Environmental Reviewer 30 Emerson Avenue Gloucester, MA 01930 Email: DMF.EnvReview-North@state.ma.us
If the Project affects DCR roadways, watersheds or other properties	DCR Attn: MEPA Coordinator 251 Causeway St. Suite 600 Boston MA 02114 Email: nathaniel.tipton@mass.gov
If the Project implicates public health impacts	Department of Public Health (DPH) Director of Environmental Health 250 Washington Street Boston, MA 02115 Email: DPHToxicology@State.MA.US
If the Project is in a municipality served by the Massachusetts Water Resources Authority (MWRA)	Massachusetts Water Resource Authority Attn: MEPA Coordinator 100 First Avenue Charlestown Navy Yard Boston, MA 02129 Email: katherine.ronan@mwra.com

Attachment 4

Permit List
(Federal and Municipal Permits)

List of Municipal and Federal Permits Required by the Project

Municipal Permits	Order of Conditions – Boston Conservation Commission
Federal Permits	USACE Rivers and Harbors Act Section 10 & Section 408 Permitting/NEPA Compliance US Coast Guard Bridge Permit Section 106 Review/Memorandum of Agreement under the National Historic Preservation Act

Attachment 5

Correspondence with
Massachusetts Historical Commission
(Project Notification Form)

AECOM Imagine it. Delivered.

Project Notification Form

Northern Avenue Bridge Project

City of Boston Public Works Department

July 25, 2019

Prepared for:

Office of the City Engineer
Boston Public Works Department

Prepared by:

Melissa L. Ryan
Planner

AECOM
One Federal Street
Boston, MA 02110
aecom.com

Table of Contents

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Tables

1. Project Notification Form

APPENDIX A
MASSACHUSETTS HISTORICAL COMMISSION
220 MORRISSEY BOULEVARD
BOSTON, MASS. 02125
617-727-8470, FAX: 617-727-5128

PROJECT NOTIFICATION FORM

Project Name: Northern Avenue Bridge

Location / Address: Northern Avenue / Fort Point Channel

City / Town: Boston, Massachusetts

Project Proponent

Name: City of Boston Public Works Department, Para Jayasinghe, PE - City Engineer

Address: One City Hall Plaza, Room 710

City/Town/Zip/Telephone: Boston, MA 02110 617-635-4968

Agency license or funding for the project (list all licenses, permits, approvals, grants or other entitlements being sought from state and federal agencies).

Agency Name	Type of License or funding (specify)

Funding - see attached summary listing available funding identified to date
Permits - see attached summary listing possible permits

Project Description (narrative):

See attached project description

Does the project include demolition? If so, specify nature of demolition and describe the building(s) which are proposed for demolition.

The project is in the conceptual phase and the extent of demolition has not been determined.

Does the project include rehabilitation of any existing buildings? If so, specify nature of rehabilitation and describe the building(s) which are proposed for rehabilitation.

The project is in the conceptual phase and the options for rehabilitation are being considered and are presented in detail in the attached project description.

Does the project include new construction? If so, describe (attach plans and elevations if necessary).

The project is in the conceptual phase and the options for new construction are being considered and are presented in detail in the attached project description.

APPENDIX A (continued)

To the best of your knowledge, are any historic or archaeological properties known to exist within the project's area of potential impact? If so, specify.

Yes - the Northern Avenue Bridge is eligible for listing on the National Register of Historic Places and is a contributing resource to the NHRP-listed Fort Point Channel Historic District.

What is the total acreage of the project area?

Woodland	N/A	acres	Productive Resources:		
Wetland	N/A	acres	Agriculture	N/A	acres
Floodplain	N/A	acres	Forestry	N/A	acres
Open space	N/A	acres	Mining/Extraction	N/A	acres
Developed	~ 2	acres	Total Project Acreage	~ 2	acres

What is the acreage of the proposed new construction? ~ 2 acres

What is the present land use of the project area?

The project area is currently a bridge (transportation use), however it is not currently in service.

Please attach a copy of the section of the USGS quadrangle map which clearly marks the project location.

This Project Notification Form has been submitted to the MHC in compliance with 950 CMR 71.00.

Signature of Person submitting this form: [signature] Date: July 25, 2019

Name: Para Jayasinghe, PE - City Engineer

Address: One City Hall Plaza, Room 710

City/Town/Zip: Boston, MA 02110

Telephone: 617-635-4968

REGULATORY AUTHORITY

950 CMR 71.00: M.G.L. c. 9, §§ 26-27C as amended by St. 1988, c. 254.

2. Project Description

The City of Boston Public Works Department (PWD) proposes to rebuild the Northern Avenue Bridge. See Figure 1 for the USGS Locus Map. PWD has initiated a process in which the work that has been completed in the recent past will inform a design to provide a bridge for the future while encapsulating its history, serving the mobility needs of its surrounding area, being resilient to climate change, and making the bridge a destination with a sense of place. To date, PWD has engaged AECOM to develop conceptual ideas of what the bridge could be. Over the last year PWD has solicited input from the Mayoral Advisory Task Force appointed for this project and has also engaged the public to provide input on those concepts. As a result, PWD has conceptual designs to present to the Massachusetts Historical Commission (MHC's) and other consulting parties to initiate the Section 106 consultation process for opening of the Northern Avenue Bridge.

2.1 Historical Context

The Northern Avenue Bridge (BOS.9000) and its Tender's House (BOS.15356) are considered eligible for listing on the National Register of Historic Places (NRHP) and are contributing resources to the NRHP-listed Fort Point Channel Historic District (BOS.WZ). See Figure 2 for a map of Historic Resources.

The Northern Avenue Bridge was constructed in 1905-1908 by the City of Boston's Engineering Department and designed by William Jackson, City Engineer. It occupies a prominent site at the juncture of the Fort Point Channel and Boston Harbor. The bridge was built "as part of a general upgrading of vehicular, railroad and pedestrian service to the South Boston wharfs and warehouses which were expanded at a rapid rate." (Historic Engineering Record Documentation (HAER) No. MA-37, 1989, McGinley Hart & Associates, Inc.).

The bridge and Tender's House are significant for its period engineering and architecture in addition to the transportation uses that it has served. In MHC's response to a previous proposed project (MHC # RC.2913, response letter dated March 7, 2016), MHC previously identified the following components of the bridge as its most significant features:

- The three barrel, four truss design and the design of the trusses themselves
- The horizontal members between the trusses which are not only important structurally but create the essence of the "through truss" bridge.
- The riveted, lattice box-beam structural elements
- The original rack and pinion compressed air drive system contained within the Tender's House.
- The granite piers, including the cylindrical swing pier and side span piers.
- The turning mechanism
- The draw fender pier on which the swing span rests when open.

The Fort Point Channel (FPC) Historic District is significant for its architecture, engineering, community planning, commerce, transportation, industry and maritime history that is represented by its contributing resources.

Figure 1. USGS LOCUS MAP

Portion of Boston South USGS Quadrangle 1987
Source: MassGIS.

July 2019

M:\work\NorthernAveBridge\Locus.mxd 7/17/2019 3:49:19 PM

0 500 1,000 2,000 Feet

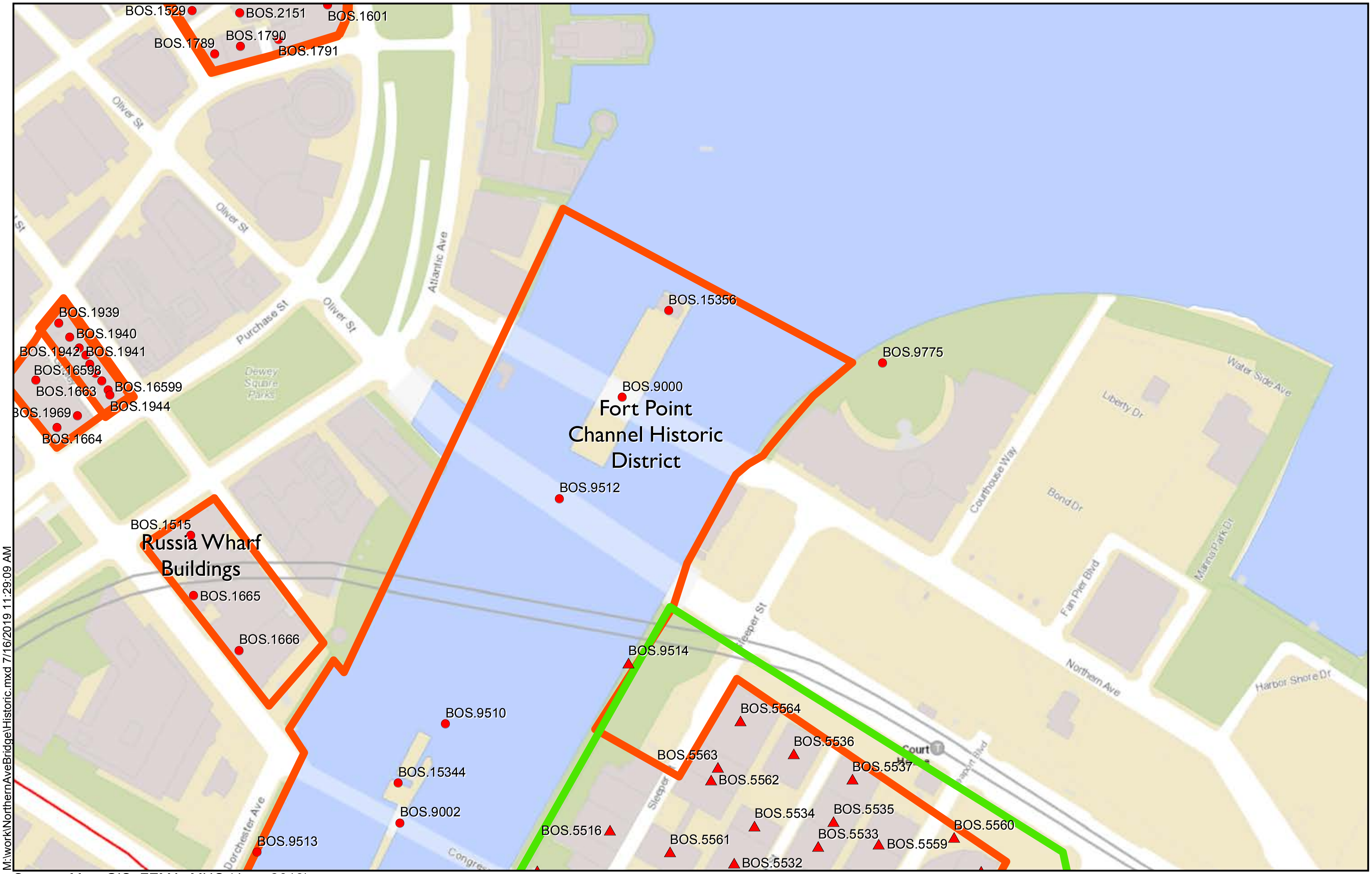
Figure 1

Locus Map

Northern Avenue Bridge
Replacement
Boston

AECOM Imagine it. Delivered.

Figure 2. HISTORIC RESOURCES MAP



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Source: MassGIS, FEMA, MHC (June 2019)

● Nat'l Register of Historic Places

▲ NRHP and LHD

Nat'l Register of Historic Places (orange outline)

Local Historic District (green outline)

0 150 300 600 Feet

Historic Resources

Northern Avenue Bridge

AECOM

2.2 Existing Conditions

Despite completing multiple repairs and rehabilitation efforts due to the severity of past and ongoing deterioration, the bridge was closed to vehicular traffic in 1997 and closed to pedestrian traffic in 2014. The 2014 closure was prompted by a new revelation that several floor beams supporting the pedestrian walkway had a calculated live load rating capacity of zero tons. This finding was the result of an inspection and rating effort provided by TranSystems in 2013. Since then, the bridge has been out of service and left in the swung open position.

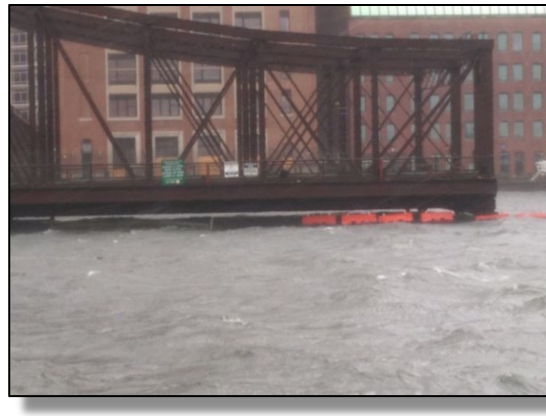
In 2017 AECOM performed a hands-on structural inspection of the bridge and provided an Existing Conditions Report to PWD. The purpose of this inspection was twofold: compare the existing conditions found in the 2013 Routine & Special Members Inspection Report prepared by TranSystems and evaluate the potential steps necessary to rehabilitate or reuse existing structural members.

Based on the condition inspection results from 2013 and 2017, the following has been concluded. The deck and floor system, including all deck and structural framing elements as well as the sidewalk cantilevers and lower lateral bracing, are not structurally adequate to support design loads due to widespread deterioration. Approximately 75% of the primary truss members in both the swing span and the approach spans are severely corroded and deteriorated.

Combining the results of the condition inspection and structural analysis, the following has been concluded. As previously discussed, the floor system is beyond repair and would require replacement in any proposed concept. For the primary truss elements, based on existing conditions and structural analysis, 75% of the exterior and interior swing span trusses, 90% of the exterior approach span trusses and 75% of the interior approach span trusses primary members would require some level of repair and/or do not meet load capacity requirements based on current code-mandated loading for public occupancy. Secondary truss lattice elements (such as sway bracing) make up about 15% of the overall truss elements. Of these secondary lattice members, approximately 25% of the upper sway bracing on the approach spans and nearly 20% of the upper sway bracing on the swing span require repair and/or strengthening.

The Tender's House was not inspected as part of AECOM's 2017 inspection. During the site visit, however, AECOM inspectors noticed significant deterioration to its exterior. The timber walkways had areas of sagging and a section of railing partially disconnected and hanging. The roof had several patch repairs and holes.

Currently, the bridge underside is submerged in water during storm events. This direct exposure to salt water worsens the severe condition of the floor system and the lower portions of the truss. Below are photos from recent 2018 winter storms when Boston Harbor reached the underside of the bridge.



A more detailed analysis of the bridge's existing condition in included as Appendix A.

2.3 Concepts

PWD has set four guiding principles as the framework of the conceptual development. The concepts should improve mobility, honor history, strengthen resiliency and create a destination. In addition to the framework, the concepts developed have taken into consideration style, size, uses and cost and have been grouped into the following style options: *Restore, Reinterpret, Contextual and Basic*.

Given that sea levels are expected to rise over the next 80 years, and with the resiliency goal of the project in mind, the intent of the project is to raise the bridge to improve its resiliency during future storm events. All concepts will allow for the bridge to be raised for resiliency both in the center and at the approaches and the design is to be in coordination with Boston Planning and Development Agency's climate resiliency design checklist.

Given its proximity in the Fort Point Channel, which is a navigable channel, the future position of the Northern Avenue Bridge cannot block navigation through the channel. Since the ends of the bridge are to be raised for resiliency reasons, it is logical to raise it slightly more at the navigable channel to match the navigable clearance of the adjacent Seaport Boulevard Bridge (Moakley Bridge) of 16 feet above Mean High Water, allowing the bridge to remain stationary.

As described above, all concepts are proposed to be fixed spans. Lastly, all concepts shall be designed to withstand a 75-year design life.

Bridge concepts have been developed through the public planning process by evaluating specific bridge styles that would also accommodate realistic uses. Potential uses of the bridge are related to the size (width) of the bridge. Order of magnitude costs have been evaluated for the style and size combinations. A brief summary of the styles, sizes and costs are described in the following sections.

2.3.1 Styles

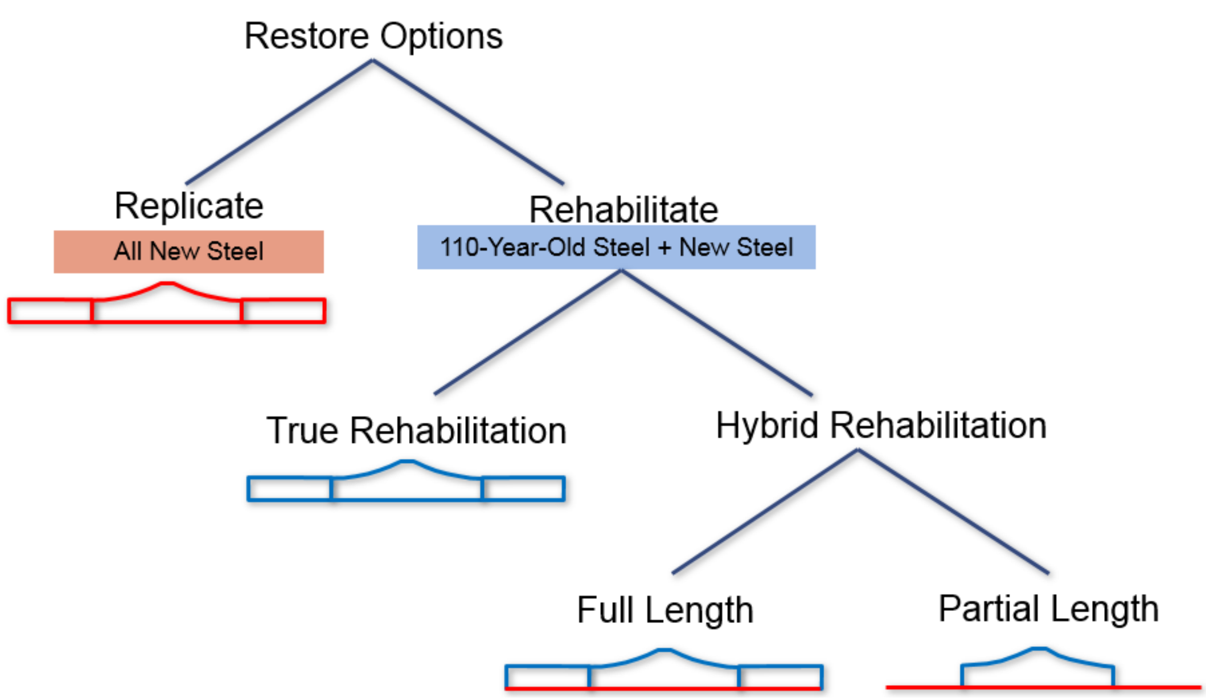
All styles considered have degrees of reflection to the history of the existing bridge or the historical context of the project location including the maritime history of the Fort Point Channel and surrounding area.

Restore

The Restore concept was developed to evoke the spirit of the existing bridge using the same design and a combination of new and old materials. PWD has investigated multiple options which are summarized as follows:

- *Replication* - building a truss bridge with all new steel following the same design as the existing bridge. This assumes the truss is replicated and is functional to support the current required loads but is a fixed bridge;
- *Rehabilitation* – replacement of the steel members and portions of members that are deteriorated and/or do not meet the load carrying capacity and re-using certain parts of the truss that meet load criteria. Rehabilitation would include splicing new steel to the existing steel members and reconstruction of the pin jointed connections. Certain load carrying members of the existing truss (for example tension only members) will require replacement due to fatigue life considerations.
  - This concept can be divided into further hybrid rehabilitation options which include rehabilitating the full length of the bridge (all trusses) or only a partial length (center truss). These hybrid options allow the trusses to be rehabilitated with deteriorated members being replaced and spliced to the old steel. This provides a feeling of the old truss without the truss supporting live loads. The truss would be providing no structural support and be set on top of a new, basic bridge.

The Restore concepts are summarized graphically below.



Reinterpret

This concept reinterprets the former Northern Avenue Bridge through the use of a modern truss structure, reflecting the scale, profile, and silhouette of the old bridge; merging a modern structural design with the historical spirit of the old bridge. It is designed to be in scale with the surrounding bridges at the Fort Point Channel.

Contextual

This concept draws inspiration from the location of Fort Point Channel as a focal point of the Boston Harbor. Historical and current maritime elements are incorporated into the design, evoking sails and movements. This bridge is intended to be seen as an iconic beacon at the beginning of the channel representing the history of the Fort Point Channel. It is designed to be bold and unique, representing the future of the City.

Basic

The Basic concept was developed to provide the minimum design of a structurally sound crossing of the Fort Point Channel. This bridge meets resiliency challenges and navigational clearance for the future. This structure is designed to be understated, creating a ribbon that cuts across the horizon and evokes the undulating patterns of the waves beyond relating it to the FPC and Boston Harbor beyond in an uncluttered and simple way.

2.3.2 Sizes (Bridge Widths)

After development of the four styles described above, PWD considered various bridge widths that would allow for multi-modal transportation uses, in addition to emergency access and evacuation and placemaking. Shown below in Table 1 is a summary of the results from the size and use evaluation. The existing bridge has a usable (or "clear") width of 64 feet between the trusses. This width was only considered for the evaluation of the Restore style. The Reinterpret, Contextual and Basic styles were evaluated using the range of widths shown in the table.

POTENTIAL USE	WIDTH					
	12 FT	24 FT	30 FT	42 FT	56 FT	64 FT
1. Pedestrian & Bike Bridge	✔ (red)	✔	✔	✔	✔	✔
2. Emergency Access		✔ (red)	✔	✔	✔	✔ (red)
3. Emergency Evacuation			✔ (red)	✔	✔	✔
4. Placemaking on the Bridge				✔ (red) or	✔ and/or	✔ and/or
5. Vehicular Lane				✔ (red)	✔	✔

✔ = Meets Potential Use

✔ (red) = Can Accommodate Potential Use, But not Ideal

Table 1 – Size and Use Evaluation Summary

2.3.3 Costs

Order of magnitude costs for the combination of style and size options were then developed for comparison of the options. The values are shown in Table 2 on the next page. These amounts represent "average" order of magnitude cost values for the various options and an order of magnitude *Restore* cost of $150 Million encompasses a range of $145 Million to $160 Million which includes the hybrid options discussed above, in Section 2.3.1.

Next, PWD looked at order of magnitude lifecycle costs of maintaining a functioning bridge into the future based on the analysis completed for the proposed concepts. The lifecycle costs and construction costs are summarized in Table 3 on the next page which represent the present value of a proposed bridge.

	STYLE			
SIZE	Basic	Reinterpret	Contextual	Restore
64 FT	-	-	-	$150
56 FT	$ 65	$ 100	$ 110	-
42 FT	$ 56	$ 86	$ 100	-
30 FT	$ 49	$ 73	$ 88	-
24 FT	$ 46	$ 68	$ 83	-
12 FT	$ 40	$ 57	$ 73	-

1. Costs in $ Millions
2. "Sunk Costs" are included in each option for demolition, substructure and approaches (varies $34M to $60M)

Table 2 – Construction Costs

COSTS	RESTORE	BASIC	REINTERPRET	CONTEXTUAL
Present Value: Initial Construction Costs	$150	$60	$95	$105
Present Value: Life Cycle Costs	$58	$20	$32	$35
Total Present Value (June 2019)	**$208**	**$80**	**$125**	**$140**

1. Costs in $ Millions
2. "Sunk Costs" are included in each option for demolition, substructure and approaches (varies $34M to $60M)

Table 3 – Construction and Lifecycle Costs

2.4 Summary

PWD has initiated a conceptual planning process to develop potential options for opening the Northern Avenue Bridge. Building on the work completed for this bridge in the past, PWD set the framework for the project to improve mobility, honor history, strengthen resiliency and create a destination. The concepts developed allow for each of these objectives while being sensitive to the potential uses and costs. PWD has compiled an extensive amount of conceptual details during this planning process. Recognizing that the Northern Avenue Bridge is eligible for listing on the NRHP and a contributing resource to the NRHP-listed Fort Point Channel Historic District, PWD presents these concepts, briefly described herein, as a basis for initiating Section 106 consultation with MHC and other consulting parties before proceeding to the next phase of the project.

Appendix A - Existing Northern Avenue Bridge Evaluation Memo

EXISTING NORTHERN AVENUE BRIDGE EVALUATION MEMO

PROJECT BACKGROUND

The Northern Avenue Bridge over the Fort Point Channel in Boston MA was originally constructed between 1905 and 1908 and has been repaired / rehabilitated numerous times throughout the years. Due to severe deterioration, the bridge was closed to vehicular traffic in 1997 and closed to pedestrian traffic in 2014. The 2014 closure was prompted by a new revelation that several floor beams supporting the pedestrian walkway had a calculated live load rating capacity of zero tons. This finding was the result of an inspection and rating effort provided by TranSystems. Since then, the bridge has been out of use and left in the swung open positon.

Through the 2017 consultant selection process, AECOM was selected by the City of Boston as the Consultant for the project. As the first step of the Contract, AECOM performed another iteration of the bridge inspection as an independent effort to compare with the results of the 2013 inspection performed by TranSystems. Based on the inspection and structural analysis, AECOM has further evaluated the feasibility of rehabilitating or preserving the bridge.

CONDITION INSPECTION SUMMARY

In 2017 AECOM performed a hands-on structural inspection of the Northern Avenue Bridge and submitted an Existing Conditions Report to the City of Boston on March 30, 2018. The purpose of this inspection was twofold: compare the existing conditions found in the 2013 Routine & Special Members Inspection Report prepared by TranSystems, and evaluate the potential steps necessary to rehabilitate or reuse existing structural members.

Floor System Condition

The deck and floor system, including all deck and structural framing elements as well as the sidewalk cantilevers and lower lateral bracing, were inspected in 2013. These members were not re-inspected in 2017 based on the severity of the condition noted during the previous inspection. The deck and floor system were found to be in critical condition due to widespread deterioration, and a portion of the sidewalk cantilevers were noted as a risk for imminent failure at the time of the 2013 report. Refer to Images 1 and 2 below, showing sample floor beam and stringer conditions.

Image 1: 100% Section Loss in a Swing Span Floorbeam

Image 2: 100% Section Loss in an Approach Span Stringer

Truss Elements Condition

The truss members themselves varied in condition based on their location along the bridge and by element. The lower chord members exhibit moderate-to-severe corrosion and deterioration (up to 100% section loss) concentrated around the ends of the members near the pin assemblies (See Image 3). The upper chord members are observed to be in generally satisfactory condition, with a few scattered deficiencies and corrosion with no significant visible deterioration (See Image 4).

The condition of the vertical truss members vary along their length, with the areas below the deck possessing moderate-to-advanced corrosion and the areas above the deck in generally satisfactory condition with minor deficiencies and scattered corrosion. In general, the portions of the verticals which extend below the deck and pin joint are severely deteriorated, as seen in Image 5.

Similar to the verticals, the diagonal truss members generally show moderate-to-advanced corrosion below the deck level, especially concentrated around the pin joint areas. An example of section loss of the diagonals at the lower pin joint can be seen in Image 6.

The upper lateral bracing members are generally in satisfactory condition with isolated locations of moderate to advanced deterioration concentrated mainly at the ends of the members. The upper sway bracing on the swing span is generally in satisfactory condition with a few scattered deficiencies.

Image 3: Severe Deterioration and 100% Loss of Lattice Bracing in the Swing Span Lower Chord

Image 4: Typical Top Chord Member in the Approach Spans

Image 5: Severe Deterioration of the Verticals Below the Deck and Pin

Image 6: 100% Section Loss of Eye Bars Diagonals in the Swing Span

Based on the existing conditions found during the inspection, not considering structural analysis, approximately 75% of the primary truss members in both the swing span and the approach spans are severely corroded and deteriorated, and/or would require significant repairs.

STRUCTURAL ANALYSIS SUMMARY

A structural analysis was performed to determine if there are members which, even in good condition, would not be suitable for reuse in the trusses due to their structural capacity. The primary and secondary truss members were analyzed for their combined axial and flexural capacity, based on anticipated loading conditions. The analysis treated the swing span as fixed in the closed position and supported at the approach piers and center drum pier. Due to the severally deteriorated condition of the floor system, it was assumed that in any rehabilitation scenario the floor system would need to be completely replaced and thus the stringers and floor beams were not analyzed at this time.

Loading scenarios were based on the proposed future programing of the bridge, which considers the potential for vehicular traffic (HL-93 Truck), pedestrian traffic and lateral wind loading on the superstructure. Current specifications for vehicular, pedestrian and wind loading conditions vary from the original forces the bridge was designed for in the early 1900's. Due to the location of the structure and the possibility for large gatherings on the bridge, such as when there are fireworks in the harbor or when the tall ships come to town, the pedestrian load is treated as an assembly load of 100 pounds per square foot (psf), per the Building Code, rather than 75 psf per AASHTO design requirements.

Based on the loading and conditions described above, in all spans, the interior trusses performed better than the exterior trusses. This is likely due to the fact that the interior barrel was initially designed for railroad loading. The swing span has a greater percentage of members meeting capacity, as compared to the approach spans. This is likely due to the fact that the swing span had to be constructed with heavier members to withstand loads in the open cantilevered position in addition to loads in the closed position.

COMBINED CONDITION AND ANALYSIS SUMMARY

Combining the results of the condition inspection and structural analysis, the elements of the bridge which may be potentially re-used in a rehabilitated structure have been evaluated. As previously discussed, the floor system is beyond repair and would require replacement in any rehabilitation scenario. Figure 1 below graphically shows the summary of the results of the combined capacity and condition analysis for the primary truss elements. The elements depicted in red indicate members which would need significant repair and/or do not meet current load capacity requirements. Members depicted in green would meet current load capacity requirements but may also require minor repairs. The diagram is shown for a typical truss in the structure; there is some minor variation among the spans and trusses. Overall, based on existing conditions and structural analysis, 75% of the exterior and interior swing span trusses, 90% of the exterior approach span trusses and 75% of the interior approach span trusses primary members would require significant repair and/or do not meet load capacity requirements. For the secondary truss elements approximately 25% of the upper sway bracing on the approach spans and less than 20% of the upper sway bracing on the swing span would require significant repair and/or do not meet load capacity requirements.

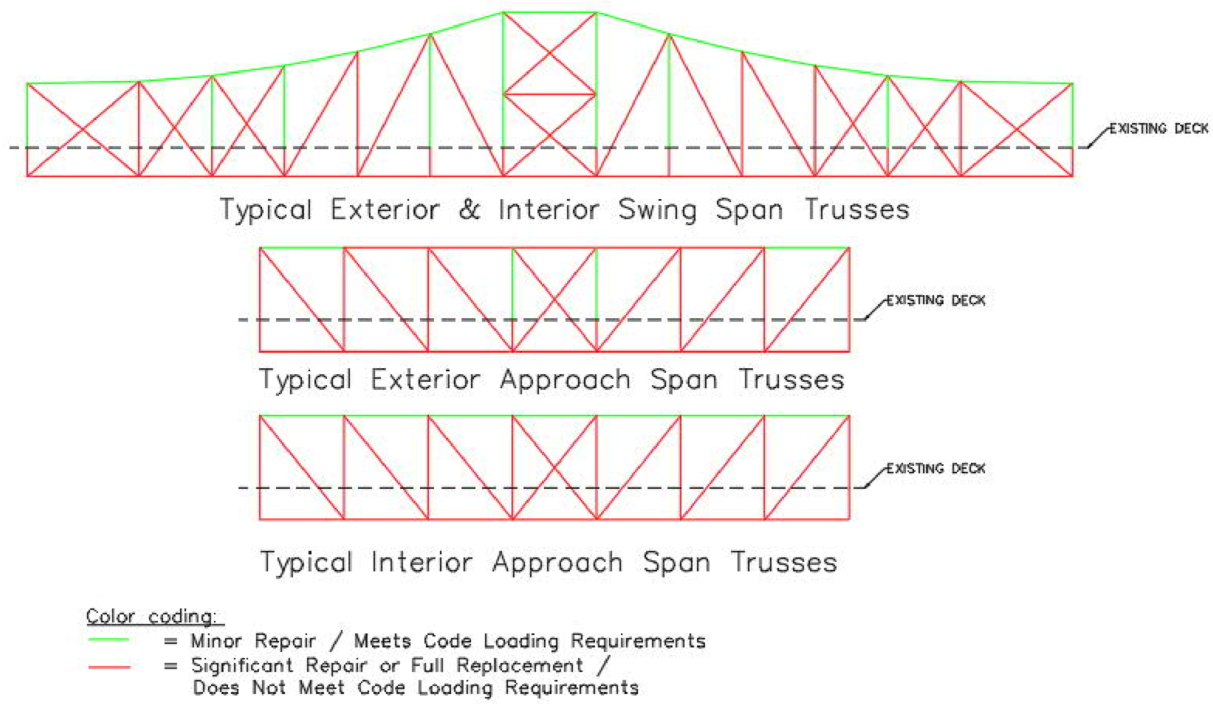


Figure 1: Truss Based on Combined Condition and Capacity

There may be rehabilitation strategies to reduce the amount of rehabilitated or replaced elements and these are discussed in the following section.

REHABILITATION CONSIDERATIONS AND STRATEGIES TO REDUCE THE PERCENTAGE OF NON-USEABLE MEMBERS

Based on the above discussion, approximately 10% to 25% of the primary truss members have the potential to be reused in the new structure after minor repairs are addressed and the members are cleaned and re-coated. The remaining primary truss members will require significant repairs or full replacement in order to satisfy safety and service requirements of the new structure. To rehabilitate the individual members, the trusses have to be carefully disassembled and reassembled. This work entails moving the existing bridge offsite to a controlled environment.

Fabrication and Rehabilitation Considerations

The majority of the truss members are comprised of unique, built-up shapes with intricate connection details and numerous blind spots. The majority of the repairs undertaken would be fabricated on a case-by-case basis, with limited typical repair details. For these types of rehabilitations, standard repair designs require supplemental work to account for restrictions due to the distinct member cross sections and connections.

As is commonly associated with rehabilitation of this type of structure, there are uncertainties as to the full extent of deficiencies which cannot be confirmed until the bridge is disassembled. While visible surface defects were recorded during the inspection, until the members are deconstructed and observed more closely, the full extent of these defects is uncertain. This is particularly true at the pinned connections, where numerous members are stacked together, blocking the full view of all members. It is probable that hidden deficiencies will be uncovered at these locations during deconstruction. Thus, the potential for greater loss than previously observed is high. This may lead to additional repairs, design or analysis being needed and more members which will be deemed unsuitable for reuse or rehabilitation in order to safely complete the restoration. For example, on the recent Longfellow Bridge rehabilitation project, the original intent had been to retain and repair all of the columns on three of the eleven arch spans and all of the columns on the outside fascia for all of the other spans. Once this was attempted, it became obvious that it was not going to be feasible. The necessary repairs were too extensive and obtrusive, negating the historic aspect as well as not providing a 75-year useful life. The decision was made to replace them all as replica columns. As a result, the only original steel remaining is in the arches, which is only possible because they were over designed originally.

It can be challenging to fit the components back together when they are reassembled. For example, the swing span has been in the swung open position since 2014; however, in the 2013 inspection it was noted that the live load shoes for the swing span were missing. This means that since some unknown time before the 2013 inspection, the swing span has been resting solely on the drum pier in a cantilever condition. The original bridge was only designed to be cantilevered for short periods, during which times there was no live load on the bridge. Due to these conditions, during the time between when the live load shoes were removed and the pedestrians were allowed on the bridge, the load path in the truss was altered from its original design, and truss members that were designed to only carry dead load were now subjected to pedestrian live loads. Since the structure was not designed to be cantilevered for long periods of time, the swing span as a whole has experienced significant sagging. Photo 7 below shows the difference in vertical alignment between the approach span and the swing span one of the last times the bridge was closed. In fact, the alignment was so far off that timber walkways had to be constructed along the north bay to provide an even walkway for pedestrians when the bridge was still in use. Thus, work will need to be performed to ensure that once repaired and swung closed, the swing span will line up with the approach spans and that the required bridge geometry is attained.

Image 7: Vertical Alignment Differential between the Swing and Approach Span

More localized examples include elongation of individual members, which may be a hindrance when reassembling the truss, as they will not line up as intended. This is particularly challenging since all of the 248 pinned connections would need to be disassembled and reassembled. These joints are complex in the sense that there are many connecting elements and plates at the joint, as seen in Images 8 & 9. The possibility that all of the pieces will not fit back together properly after repairs are made is highly probable. Given the historical cyclic loading of the bridge, it is also possible that the holes in the members that encase the pin have experienced "egging" and are no longer uniform circles, and thus do not provide the same constraints as when they were originally designed. Examples of deformation in the pin and the surrounding members are observed in Images 10 & 11 below. In addition to repairing deterioration in the member cross sections, distortion of the pin holes would also need to be addressed and corrected in order to restore the structural integrity of the pinned connections. Such repairs could potentially be achieved via cover plates, splices, or full member replacements, all of which have the potential to further complicate the joint, particularly in regard to geometric constraints.


Image 8: Typical Lower Chord Pinned Connection


Image 9: Model of a Disassembled Pin Connection


Image 10: Deterioration of the Pin


Image 11: Egging around the Pin Hole

<u>Materials and Fatigue Considerations</u>

The material properties of the existing steel are an important consideration when evaluating rehabilitation options. There are at least two types of steel on the existing bridge: steel from the original construction between 1905 and 1908, and steel from the reconstruction of the swing span between 1934 and 1936. Given that both types of steel are over 80 years old, there are uncertainties as to whether or not the existing members will provide the proposed 75-year service life. In conjunction with the uncertainties relating to the as-built materials, there are also unknowns about the fatigue life of the as-inspected materials. Fatigue is the weakening of a material due to repeated cyclic loading and unloading, such as vehicular traffic or bridge openings. Damage due to fatigue is cumulative and permanent; it cannot be reversed with reduced loading. Fatigue failures are generally localized, and they typically occur suddenly at stress levels lower than the actual yield stress of the material.

Steel has an approximate fatigue limit, which refers to the number of stress cycles it can withstand before failure. It is difficult to estimate the amount of remaining fatigue life for a structure of this age, due to a lack of accurate traffic information since the bridge was constructed, and due to historical bridge opening logs being unavailable. The uncertainties associated with the fatigue evaluation are particularly concerning for the members which see tensile stresses due to live load, such as the diagonals, as fatigue is most often observed in tension members. Given that the remaining fatigue life of the steel cannot be accurately determined, it cannot be confirmed with certainty that if the existing steel in these components was reused or rehabilitated that it would last for the remaining service life of the structure. For these reasons, tension only members should not be rehabilitated or repaired and instead should be replaced.

Preservation Strategies

A strategy to increase the percentage of usable members may include splicing new sections onto the existing steel components. Details of this nature would potentially allow for more of the existing steel to be reused, by splicing new and old steel sections together. Splices on the lower chord are not practical given existing condition as well as fatigue considerations, and splices on the diagonals are not acceptable as described above; thus, this strategy could potentially be applied to verticals and selected secondary members.

Welded Splice

A welded splice may be desirable from a visual point of view, since, if done using full penetration welds, with the welds ground smooth, the splice would be nearly undetectable. Welding to tension members is not recommended on bridges due to the potential for fatigue cracking from added stress concentrations and failure at welded locations. Welding may be considered for non-tension elements, such as the majority of the truss verticals; however, there are challenges associated with welding to the existing steel.

The American Welding Society (AWS) first issued its Standard Specifications for Welded Highway and Railway Bridges in 1941. Bridge steels of the early 1900's era had little in their specifications in regards to chemical composition to control weld cracking other than limits on impurities (Phosphorous & Sulphur) related to the steel manufacturing processes typically employed. Therefore, there is uncertainty with the weldability of the existing steel and, as a result, laboratory testing, development of specific weld procedures, qualification of those procedures and non-destructive testing (NDT) would be necessary to ensure weld integrity.

When evaluating the feasibility of welded splices the differing physical shape of the members must be considered. Members of the bridge are built up from rolled steel shapes available at the time of construction. For many of these shapes, there is no modern equivalent shape, so creating an exact match for a welded splice is problematic. The built up shapes (i.e., multiple plates and rolled shapes combined) require prep work for creating acceptable weld joint details and weld sequencing to avoid member distortion (see following discussion regarding geometry control). This work requires specialized welding techniques akin to ornamental ironwork with unique set ups and control of operations. If the anticipated welding is not done properly and carefully, it will likely lead to weld defects or cracking and the associated re-welding to address these imperfections may create delays and added cost.

Bolted Splice

A bolted splice is a feasible alternative to a welded splice. Due to the intricate lattice work on the verticals, not only would a splice of the verticals need to be sized for capacity, but it would also need to be designed around the existing lattice pattern. Due to the combined axial and flexural effects on the verticals and the geometric limits based on lattice location, larger splice plates are required. The approximate location of the splice on the vertical truss members would be just above the deck level. A preliminary splice detail for a sample vertical is presented in Figure 2 below.

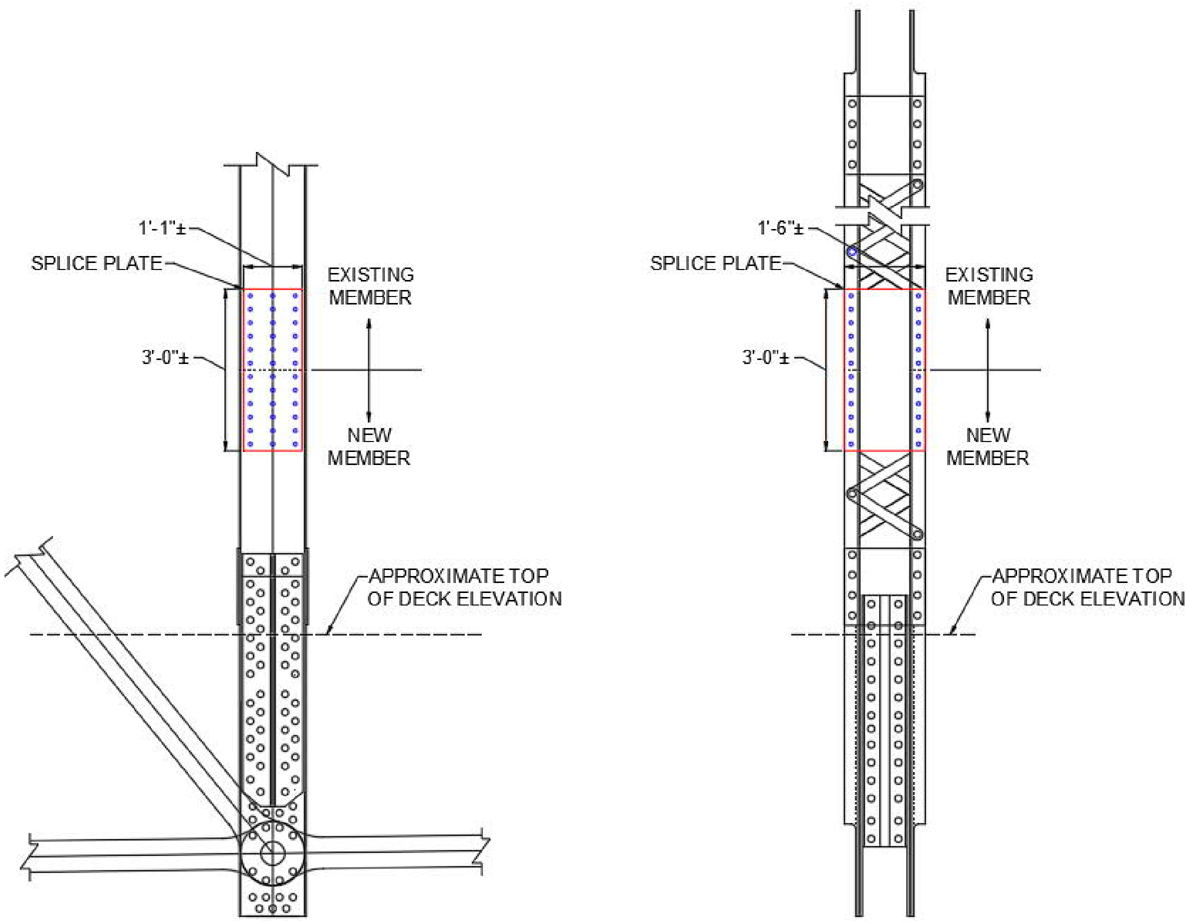


Figure 2: Approximate Splice Detail

Regardless if the splice is bolted or welded, there are challenges related to geometry control. It is critical on a truss bridge structure that the geometry is carefully controlled so the bridge profile is correct once dead loads are applied. This geometry is controlled by precisely setting the layout of the pin connected joints, which accounts for the elongation or shortening of the members under dead load. With a pin-connected truss, the holes for the pins are reamed in a shop environment in order to precisely control the pin hole locations and geometry. As a result, after splicing onto the existing member, additional operations to drill or straighten the members to these tolerances would be required.

It should also be noted that if the splice option is pursued, additional repairs would still be necessary. Since the truss members are primarily axial force members, they do not function like a typical beam where repairs can be focused in high-stress regions. Instead, the axial force travels through the entire member, and thus the cross section at every location along its length would need to possess adequate capacity. This means that a spliced member may still require additional strengthening outside of the splice region; this is particularly true at the pin locations. The inspection report indicated the majority of member deterioration was concentrated around the pins, and thus the majority of the members at these locations would need to be rehabilitated in order to restore the integrity of the pinned connection.

Coating System

When evaluating rehabilitation of the truss elements, the coating system required to provide a structure with a 75-year design life also needs to be considered. New construction of bridges over waterways in Massachusetts uses hot dip galvanizing in order to protect the structural steel and to provide the desired design life. For the rehabilitation of the truss elements, galvanizing is not an option, especially if using riveted connections in the rehabilitation. Thus, the steel would need to be protected via a coating system. A coating system for this structure, when exposed to the elements, would require additional maintenance and re-coating efforts in frequent intervals throughout its life.

Rehabilitation of the Trusses as Non-Structural Elements

An alternative to the rehabilitation of the trusses to be re-used as originally intended, with the trusses acting as the primary structural elements, is restoration of the trusses for non-structural use. In this scenario, the truss would act as an ornamental or architectural feature designed to withstand its own self-weight and lateral wind loads but it would not be subjected to live loads nor contribute to the structural capacity of the bridge span. As part of this option, a new girder bridge, designed for live load and, potentially, the additional weight of the architectural truss, would be designed and constructed.

This option eliminates many of the concerns discussed above regarding fatigue life and structural capacity of the truss members. The reduced loading of the non-structural truss will improve performance of the members; however, approximately 75% of the bridge will still require repairs to some degree based on condition alone to meet service and safety requirements. The challenges associated with member deformation, hidden deterioration, service life and coatings previously discussed would still apply.

A new girder bridge, either between the existing trusses or supporting the rehabilitated trusses, would have a deeper section below the deck. This increased structure depth would increase the overall profile, creating more impacts on the approaches in order to meet slope requirements.

Resiliency

Resiliency is one of the overall conceptual foundations of the Northern Avenue Bridge Project. One of the goals of this project is to be among the first structures in the area to follow the Climate Ready Boston guidelines for a sustainable future. Currently, the bridge underside is submerged in water during storm surges. This direct exposure to salt water only worsens the already declining condition of the floor system and the lower portions of the truss. Given that sea levels are expected to rise over the desired 75 year life of the structure raising the bridge to improve resiliency is essential. Regardless of whether the bridge is rehabilitated or replaced, the final structure will need to be raised in order to achieve resiliency and to meet the Climate Ready Boston guidelines.

COST CONSIDERATIONS

Order of magnitude costs have been developed to help evaluate the feasibility of rehabilitation. These were developed in a "bottoms up" fashion based on means and methods a contractor would need to use. This includes first removing the existing structure from the site, disassembling the truss elements, evaluating the pieces, replacing and/or repairing the elements as required, reassembling the trusses, transporting the trusses back to the site and re-erecting the trusses. The reconstruction work would also entail work to rehabilitate the existing foundations as well as work on the approaches to the bridge to transition the new profile to the existing grade.

The range of cost for the superstructure work alone (not including the substructure and approaches) is on the order of $100,000,000 to $105,000,000. These costs are escalated to future dollars assuming a start date of construction of spring of 2021. This considers the time, skills and precision associated with strategically disassembling and reassembling the truss. Extreme care needs to be taken to preserve as many members as possible, and the complexity of details to match existing elements would add to the overall cost. Given the high probability of finding further deterioration once the bridge is disassembled, additional costs to account for unforeseen repairs are probable and contractors will account for these risks with higher bid costs. This factor has been considered in the cost evaluation.

The non-structural rehabilitation option is comprised of two major stages, first constructing a new girder bridge and also rehabilitating the truss elements. Due to the added cost of a new structure to support bridge loadings, plus the aforementioned cost of truss restoration, the costs for this option are significantly higher – on the order of $110,000,000 to $115,000,000, not including foundation work and approach work.

PROS AND CONS OF REHABILITATION

The previous discussion has described the inspection and analysis conducted to date as well as a discussion of the technical challenges associated with rehabilitating a truss structure of this age and condition. To help the City of Boston evaluate whether rehabilitation is feasible, Table 1 below summarizes the pros and cons associated with rehabilitation of the truss structure.

Table 1: Pros and Cons of Truss Rehabilitation

Pros	Cons
Bridge's character-defining features remain in place, including its triple barrel design, truss approach profile, and truss side profile	Cannot be galvanized which is the preferred coating method for the site to provide a 75 year design life
Maintaining the original designs, materials and workmanship allows users to experience the historic associations and feelings of the original bridge.	Difficult and lengthy process of removal and disassembly to evaluate components
	Associated risks in terms of cost and schedule regarding unknown and hidden conditions
	Large percentage of primary truss elements require significant repairs or replacement due to condition and/or capacity
	Given the mixture of new and existing steel the desired design life of 75 years is questionable and the bridge would require a vigorous maintenance schedule and additional costs.
	Raised profile will detract from the historical significance of maintaining the original truss shape
	Splices on the lower chord are not practical given existing condition as well as fatigue considerations, and splices on the diagonals are not acceptable as described above; thus, splicing would primarily be possible for the verticals and other secondary members

CONCLUSIONS & RECOMMENDATIONS

Based on our evaluation and analysis presented in this report, it is not recommended that the City of Boston pursue rehabilitation of the original truss structure. This recommendation is based on the condition of the bridge elements and structural analysis, as well as evaluation of the risks associated with rehabilitating the steel in terms of schedule, cost and design life considerations.

As options are further evaluated to meet the needs of the project, the costs and risks associated with rehabilitation will be compared to replacement options. Replacement options may range from reinterpretations of the crossing with a similar scale and profile of the existing truss to completely new and "bold" options. In the event that rehabilitation is not pursued and a new bridge is constructed there still may be options to salvage portions of the bridge for historic purposes such as displays or other acceptable preservations means. Regardless of the option selected, there is also an opportunity to conduct a 3-D laser survey of the bridge with the goal of providing a virtual reality tour of the original bridge, either on site or at a nearby museum. All replacement options will be evaluated in terms of how they may honor the history of the original bridge as well as the history surrounding the Fort Point Channel and the City of Boston.

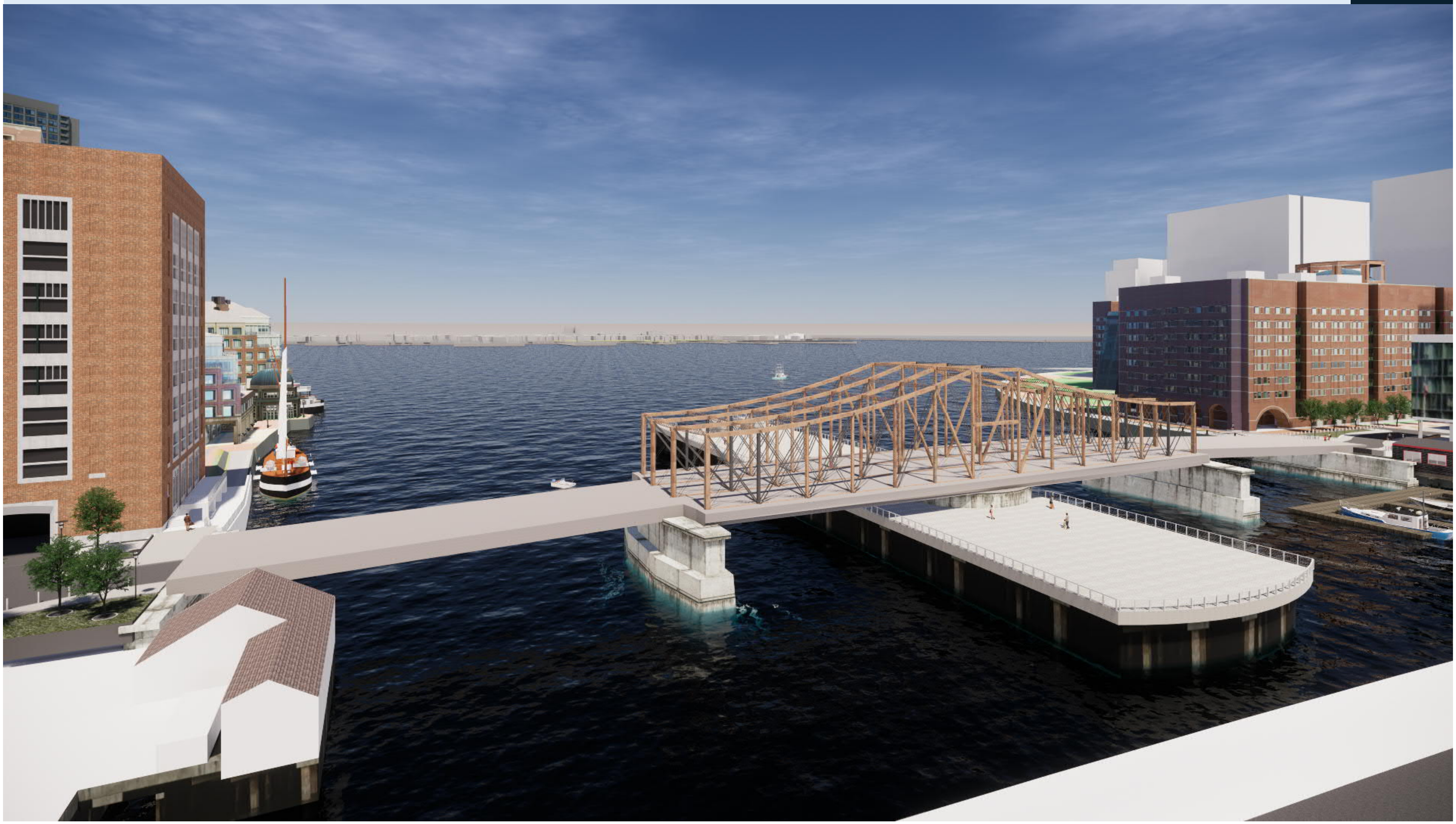
Appendix B – Concept Renderings

NORTHERN AVENUE BRIDGE

RESTORE

NORTHERN AVENUE BRIDGE

REHAB – HYBRID - PARTIAL LENGTH OPTION

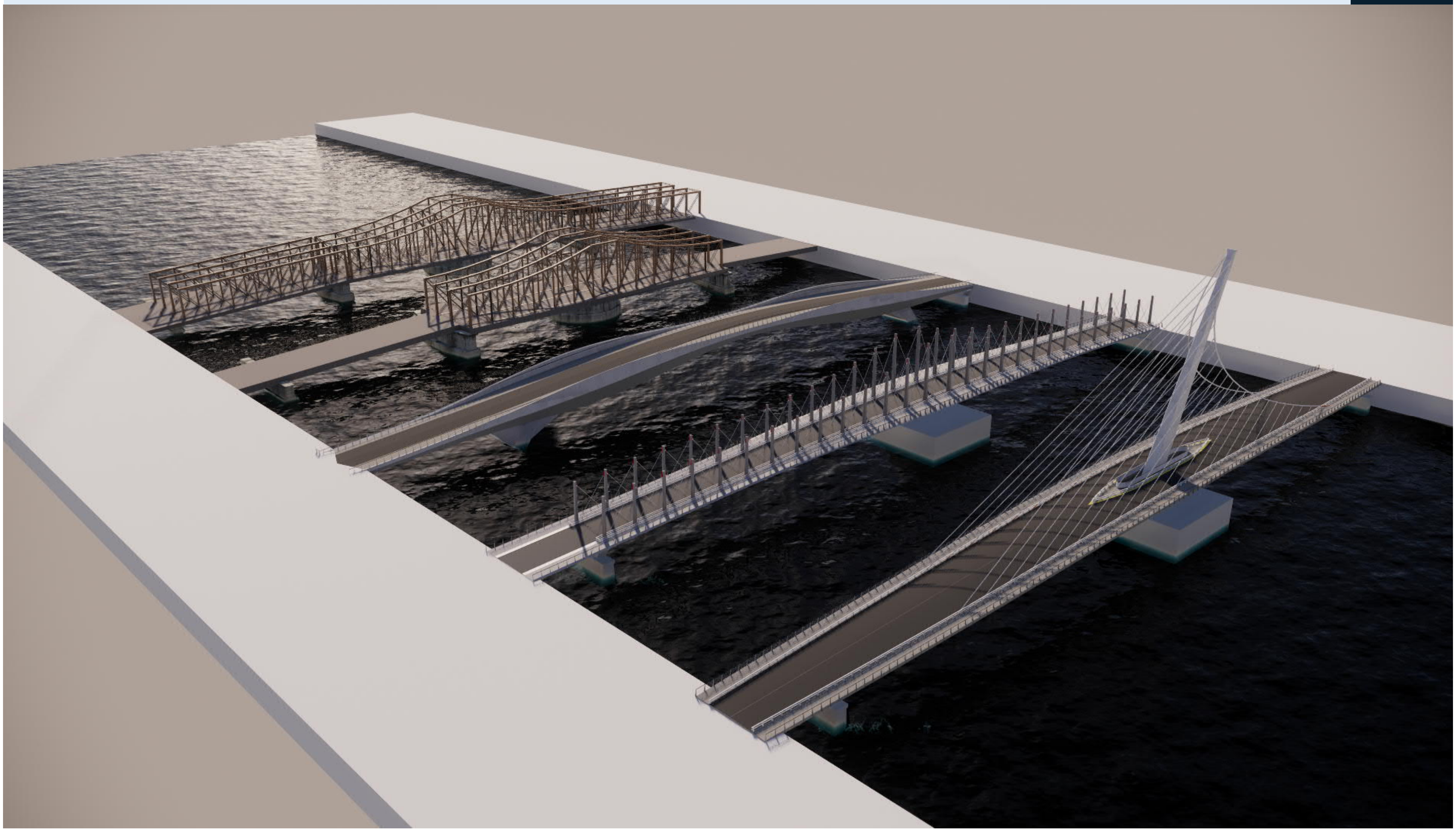


REINTERPRET

CONTEXTUAL

BASIC

COMPARISON OF STYLES



Appendix C – Funding Summary

NORTHERN AVENUE BRIDGE

FUNDING SUMMARY

City Funding	
• General Obligation Bonds	$ 31 M
• Parking Meter Fund	$ 15 M
	$ 46 M
Federal Funding	
• 2005 SAFTEA-LU Earmark #1	$ 2 M
• 2005 SAFTEA-LU Earmark #2	$ 6 M
• 2008 Appropriations Earmark	$ 1 M
• 2010 Appropriations Earmark	$ 1 M
	$10 M
Private Funding	
• WS Seaport	$ 2 M
	$ 2 M
TOTAL ALLOCATED FUNDING	**$58 M**

Appendix D – Permit List

Anticipated Environmental Permitting Matrix
Northern Avenue Bridge - Boston, MA

Authority (Statutes, Regulations & Programs)	Agency	Jurisdictional Resource Area or Threshold	Filing
State Permits			
Massachusetts Environmental Policy Act (MEPA) and MEPA Regulations at 301 CMR 11.00	Execution Office of Energy and Environmental Affair's - MEPA Office	Wetlands, Waterways, Tidelands; Transportation; Historic & Archeologic Resources	ENF
Massachusetts Public Waterfront Act - Chapter 91 and Waterways Regulations at 310 CMR 9.00	Mass DEP Waterways Regulation Program	Any project proposed in, under, or over flowed or filled tidelands	Chapter 91 License
Section 401 of the Clean Water Act and Water Quality Certification Regulations at 314 CMR 9.00	Mass DEP	Dredge and/or fill projects in waters and wetlands subject to state and federal jurisdiction if a federal permit is required for the project	Water Quality Certification Application
Massachusetts Wetland Protection Act (WPA) and WPA Regulations at 310 CMR 10.00	Mass DEP and local Conservation Commission	Coastal Resource Areas - LUW Land Subject to Coastal Storm Flowage	NOI
Massachusetts State Register of Historic Places Review pursuant to MGL Chapter 9, Sections 26-27C as amended by Chapter 254 of the Acts of 1988 and 950 CMR 71.00	Massachusetts Historical Commission	State Action	PNF - submitted and reviewed concurrently with Section 106
Federal Permits			
US Coast Guard Bridge Permit Regulations 33 CFR Parts 114-118	US Coast Guard	Construction of a bridge over a navigable waterway	Bridge Permit Application
National Environmental Policy Act (NEPA) of 1969	US Coast Guard	Federal Action/Permit (USCG Bridge Permit and/or Section 106 Review)	Categorical Exclusion

Authority (Statutes, Regulations & Programs)	Agency	Jurisdictional Resource Area or Threshold	Filing
Federal Historic Review under Section 106 of the National Historic Preservation Act	Massachusetts Historical Commission	Federal Action/Permit (USCG Bridge Permit) and NAB is a contributing resource to Fort Point Channel National Register Historic District	Project Notification Form
Section 10 of the Rivers and Harbors Act of 1899 33 CFR 323	ACOE	Construction of any structure in, over or under any navigable water of the United States	Self Verification Form - General Permit 6
Section 404 of the Clean Water Act	ACOE	The discharge of dredged or fill material and discharges associated with excavation into waters of the U.S.	Self Verification Form - General Permit 6
Federal Consistency Review under Federal Coastal Zone Management Act of 1972	Mass CZM Office	Within the Coastal Zone Management Area and subject of a Federal Permit	Pre-application consultation and/or Application
US Endangered Species Act	US Fish and Wildlife Service	Endangered Species located within Project Limits (Roseate Tern) Federal Permit	Section 7 Consultation
Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Avt of 1996	National Marine Fisheries Service	Federal action that may adversely affect EFH	Essential Fish Habitat Assessment

Attachment 6

Substructure Inspection Report

Northern Avenue Bridge

Boston, MA

Substructure Inspection Report

April 2018

Submitted to:

AECOM

1 Federal Street, 8th Floor

Boston, MA 02110

Submitted by:

Childs Engineering Corporation

34 William Way

Bellingham, MA 02019

TABLE OF CONTENTS

Northern Avenue Bridge

Boston, MA

Substructure Inspection Report

Submitted by:

Childs Engineering Corporation

34 William Way

Bellingham, MA 02019

508-966-9092

www.childseng.com

CEC Project: 2753-17.00

Date of Inspection: April 23 24 & 26, 2018

1.0 Executive Summary

Childs Engineering Corporation conducted a structural inspection of the Northern Avenue Bridge substructures located on the Fort Point Channel in Boston, MA on April 23 24 & 26, 2018. The inspection was conducted by a 4 person team of our engineer divers, and included an underwater and above water inspection of bridge substructures: Boston Abutment, Pier 1, Draw Pier, West Fender System, East Fender System, Pier 2, Pier 3, and South Boston Abutment. The inspection was conducted from the top course of granite block down to the mudline; and did not include the steel bridge superstructure, turning mechanisms, or piles below the mudline. The inspection was intended to assess the general condition of the concrete footings, steel sheet pile encasements, granite blocks, and timber fender components. Information for the bridge structures was obtained from a previous inspection reports performed by Childs Engineering Corporation, which referred to the original City of Boston Northern Avenue Bridge design drawings and from field measurements obtained by the inspection crew.

The inspection found that overall the bridge substructures are in **fair to poor** condition. The Boston and South Boston Abutments are in **fair** condition typically showing loss of mortar in the block joints, vertical cracks through the granite blocks, and deterioration of the concrete footing. Piers 1, 2, and 3 are in **fair to poor** condition typically showing loss of mortar in the block joints, vertical cracks through the granite blocks, deterioration of the concrete footings, and isolated displaced granite blocks. The Draw Pier is in **poor** condition typically showing loss of mortar in the block joints, vertical cracks through the granite blocks, and deterioration of the concrete footings. The Fender System is in **satisfactory** condition typically showing marine borer damage, missing timber wales members, and missing connection bolts for the timber wales.

The bridge substructure and fender system requires maintenance to prevent the structural integrity and functionality from being compromised further. While the bridge no longer sees the original design loads, repair work may be necessary if future development or repurpose use is anticipated. Otherwise, the bridge substructure components and fender system will continue to deteriorate, requiring extensive rehabilitation in the future if no maintenance work is performed. We recommend that the defects be repaired, and in a manner that aligns with the intended future use of the structure.

At this time, the conditions found are not significant enough to suggest immediate failure. However, we recommend further engineering studies and the repairs mentioned in this report be considered in order to maintain the structure so that more costly work may be avoided in the future. We also recommend that the bridge substructure be re-inspected within 3 to 5 years, to ensure that conditions have not worsened unexpectedly.

2.0 General Structural Description

The following is a brief description of the structures inspected. For more information on layout and orientation of the bridge substructures, please refer to Appendix B.

The Northern Avenue Bridge was built in 1908 spanning the Fort Point Channel. It was closed in 1999 to vehicle traffic, and operated as a pedestrian bridge until 2014. Thereafter it was closed to pedestrians, being deemed unsafe and hazardous for vessel traffic below, and left in the open position. The bridge is now abandoned in place, waiting for redevelopment or removal.

The Boston Abutment, located on the West side of the bridge structure, consists of an east face and a south face. The east face is approximately 80 feet long and is constructed of 11 courses of mortared granite blocks that form a fascia for a mass concrete backing (See Photo 1). The granite and concrete stem bears on a timber pile supported, 20 feet high, concrete footing. Five timber pile supported concrete counterforts extend approximately 42 feet inshore from the stem, the timber piles are below the mudline. The south counterfort forms the abutment south face with 12 courses of mortared granite blocks that form a fascia. Each granite block course is approximately 2 feet in height, except the top four courses on the south face which are approximately 18 inches in height each. The top 4 feet of the concrete footing is exposed on the east face and the majority of the footing is buried below the mudline on the south face.

The South Boston Abutment, located on the East side of the bridge structure, is approximately 88 feet long and is integral with the granite block seawall on the east side of the Fort Point Channel (See Photo 2). The abutment is constructed of 7 courses of mortared granite blocks that form a fascia for a mass concrete backing. The abutment is supported by a timber stone deck. Only the top 6 courses are accessible. The 7th granite block course and the supporting deck structure are below the mudline.

Piers 1, 2 and 3 are generally rectangular and are approximately 78 feet long and 8 feet wide. The piers are constructed of 7 courses of mortared granite blocks with concrete infill in the pier interior (See Photos 3 to 5). Each course of granite block is approximately 2 feet in height. The granite and concrete stems bear on timber pile supported, 20 feet or 25 feet high, concrete footings. These timber piles are typically not exposed. The exposed height of the top of the concrete footings varies from 3 feet to 8 feet above the mudline. Steel sheet piling was driven to create an approximately 20 feet by 20 feet caisson at each pier end and was filled with concrete to encase the pier ends. The concrete starts at the bottom of course 5 (course 1 is the top course) and extends to the mudline. The concrete typically encases the end 3 or 4 granite blocks in courses 6 and 7, and the concrete footing below course 7 at each end of the pier.

The Draw Pier supports the main swing span of the Northern Avenue Bridge. The pier is constructed of a timber pile supported, 25 feet high, 68’-8” diameter concrete footing that supports a 63 feet diameter, granite and concrete circular wall. The wall is constructed of 7 courses of granite blocks with a concrete backing (See Photo 6). The wall thickness is approximately 4 feet. Each granite block course is 20 inches high, except the top course which is 18 inches high. The circular wall provides an approximately 11 feet deep dry well for the machinery that rotates the bridge main span. The exposed height of the concrete footing varies from 8 feet to 12 feet above the mudline.

The East and West Fender Systems are located on the sides of the navigation channel between the Draw Pier and Pier 2 and protect the piers from vessel impact (See Photos 7 and 8). The West Fender System is constructed of approximately 61 pile bents. Each bent consists of a vertical timber pile with a timber batter pile bolted to it, each spaced approximately 6 feet on center. Seven, horizontal, 8 inch by x 12 inch timber wales, spaced 2 feet on center, are bolted to the vertical timber piles. The East Fender System construction is identical except there are approximately 34 pile bents. The west system is 360 feet in length and the east system is 172 feet in length. Both fender systems have a narrow timber deck walkway on top of the piles. On the west system, this timber walkway widens under the bridge.

3.0 Terminology

The following list are commonly used terms in this report:

Abutment – A substructure composed of stone, concrete, brick, or timber supporting the end of a single span or the extreme end of a multi-span superstructure and, in general, retaining or supporting the approach embankment placed in contact therewith.

Aggregate – The sand, gravel, broken stone, or combinations thereof with which the cementing material is mixed to form a mortar or concrete.

Disintegration – A condition where the concrete cement/paste breaks down and erodes, exposing the aggregate within the concrete.

Footing – The enlarged, or spread-out lower portion of a substructure, which distributes the structure load either to the earth or to supporting piles. The most common footing is the concrete slab, although stone piers also utilize footings.

Marine Borer – The most commonly encountered crustacean borer is the limnoria, or wood louse. It bores into the surface of the wood to a shallow depth. Wave action or floating debris breaks down the thin shell of timber outside the borers' burrows, causing the limnoria to burrow deeper. The continuous burrowing results in a progressive deterioration of the timber cross section between the tide levels.

Mortar – The enduring jointing material filling the interstices between and holding in place the quarried stones or other solid materials of masonry construction.

4.0 Assessment Ratings

Each structure is assessed based on our inspection findings and is given a condition assessment rating of satisfactory, fair, poor, or serious. A description of the condition assessment ratings for the structures used in this report are as follows:

Satisfactory Rating – Limited minor to moderate defects or deterioration observed, but no overstressing observed.

Fair Rating – All primary structural elements are sound, but minor to moderate defects or deterioration observed. Localized areas of moderate to advanced deterioration may be present, but do not significantly reduce the load bearing capacity of the structure.

Poor Rating – Advanced deterioration or overstressing observed on widespread portions of the structure, but does not significantly reduce the load bearing capacity of the structure.

Serious Rating – Advanced deterioration, overstressing or breakage may have significantly affected the load bearing capacity of the primary structural components. Local failures are possible and load restrictions may be necessary.

5.0 Inspection Findings

5.1 <u>Summary of Findings</u>

The following is a summary of the conditions observed. For more information on layout and orientation of deficiencies noted, please refer to Appendix B.

The inspection found that overall the bridge substructure is in **fair to poor** condition. The Boston and South Boston Abutments are in **fair** condition typically showing loss of mortar in the block joints, vertical cracks through the granite blocks, and deterioration of the concrete footing. Piers 1, 2, and 3 are in **fair to poor** condition typically showing loss of mortar in the block joints, vertical cracks through the granite blocks, deterioration of the concrete footings, and isolated granite blocks exhibiting displacement. The Draw Pier is in **poor** condition typically showing loss of mortar in the block joints, vertical cracks through the granite blocks, and deterioration of the concrete footings. The Fender System is in **satisfactory** condition typically showing marine borer damage, missing timber wales members, and missing connection bolts for the timber wales.

It is apparent that all of the pier's concrete footings, joint mortar for granite blocks, and low water timber wale connections for the fender system are compromised. This deterioration will reduce of the stability of the abutments and piers; and weaken the structural integrity significantly with time. The timber fender system will continue to deteriorate and eventually affect its functionality.

5.2 Abutments

The Boston and South Boston Abutments are in **fair** condition. Defects include loss of mortar in the block joints, vertical cracks through the granite blocks, and deterioration of the concrete footing.

The Boston Abutment has a loss of mortar in the block joints on approximately 15% of the joints, and South Boston Abutment has a loss of mortar in the block joints on approximately 65% of the joints. Mortar loss depths range from 1 inch to less than 24 inches, but are typically 12 inches deep. Typical granite block joint widths are 1 to 2 inches. Several granite blocks are noted with 1/8 inch to 1/2 inch wide vertical cracks through the blocks, indicating overstressing at these areas (See Photo 9). No displacement of granite blocks were noted.

The Boston Abutment concrete footing has general surface deterioration along the footing corner and vertical face with concrete section loss of up to 12 inches deep. The concrete footing deterioration extends to the granite block face over 10 linear feet at approximately mid abutment. The tops of three timber piles are exposed due to concrete section loss and the piles have severe section loss from marine borer damage. The bottom course of the South Boston Abutment was covered by the mudline and not accessible during the inspection.

5.3 Pier 1, 2, & 3

Piers 1, 2, and 3 are in **fair to poor** condition. Defects include loss of mortar in the block joints, vertical cracks through the granite blocks, deterioration of the concrete footings, and isolated granite blocks exhibiting displacement.

The Piers have a loss of mortar in the block joints on approximately 80% of the joints. Mortar loss depths generally range from 1 inch to greater than 24 inches, but are typically 12 inches deep. There are several localized areas of block joints with shotcrete repairs over the joints that may conceal voids in the joints behind the repairs. Typically, the granite block joint widths for the piers are 1 to 2 inches (See Photo 10).

There is a steel wale and tie rod system installed on the south end of Pier 1 centered on the horizontal joint between courses 1 and 2 over the first 5 to 6 blocks on the east and west pier faces. Tie rod system is uncoated, and has heavy surface corrosion and scale on all the steel surfaces. There is a 6 inch diameter steel electrical conduit fastened to the granite blocks on the east face at mid pier. The conduit extends vertically down the pier face into the mudline and travels over to the Draw Pier. Several stainless steel dowels were observed between the granite blocks at the horizontal joints for Pier 1 and 2 (See Photo 11). Dowels appear to be in satisfactory condition.

Numerous granite blocks have a vertical cracks, typically 1/8 to 1/2 inch wide, which are the full height of the blocks. A majority of these blocks are located below the bridge beam bearing plates, indicating overstressing at these areas. There are a few isolated granite blocks that are displaced (See Photo 12). In addition, several granite blocks have cleaved corners (See Photo 13).

The concrete footings for the piers have general surface deterioration and voids along the footing corner and vertical face with concrete section loss typically a 12 inches deep, but in some instances up to several feet deep, no reinforcing steel was observed. Pier 1 has the tops of several timber piles exposed due to concrete section loss and the piles have section loss from marine borer damage. The steel sheet pile formwork for the concrete encasements at the pier ends typically have no coating or sacrificial anodes (See Photo 14). The average steel thickness for the sheet piles, measured near the mudline, is 0.283 inches for the webs and 0.282 inches for the flanges. The steel sheet piles have a band of thin steel at MLW with numerous corrosion holes (See Photo 15). The prevailing concrete within the encasements seemed sound when struck with rock hammers by divers.

5.4 Draw Pier

The Draw Pier is in **poor** condition. Defects include loss of mortar in the block joints, vertical cracks through the granite blocks, and deterioration of the concrete footings.

The Draw Pier has a loss of mortar in the block joints on approximately 90% of the joints. Mortar loss depths range from 1 inch to greater than 24 inches, but are typically 12 inches deep. The greatest mortar loss depth occurs on the top 6 courses with typical losses of 12 inches to greater than 24 inches. The bottom course generally has mortar loss depths of less than 12 inches. Typical granite block joint widths for the pier are 1 to 3 inches. The block joints in course 1 have mortar and epoxy sealant repairs over the joints that may conceal voids in the joints behind the repairs. Several granite blocks are noted with 1/8 to 1 inch wide vertical cracks.

Overall the concrete footing is in **serious** condition and has general advanced surface deterioration with large areas of section loss, exposed aggregate and an irregular surface (See Photos 16 to 18). The concrete typically is 1/4” soft; no reinforcing steel was observed. The footing top corner is rounded due to a loss of concrete of up to 1 foot depth at the corner. The footing vertical face at roughly mid height has a 1 to 3 feet high layer of very soft concrete around the entire circumference of the pier (see Photos 19 and 20). The soft concrete was easily chipped away by divers using rock hammers. There are sporadic voids in the soft concrete layer up to 3 feet deep. Over approximately 50 linear feet on the footing north side, there is a 3 feet deep by 2 feet high continuous void in the soft concrete layer on the footing vertical face.

There is a 6 inch diameter steel electrical conduit fastened to the granite blocks on the west side of the pier. The conduit extends vertically down the pier face into the mudline and extends over from Pier 1. This is most likely the power feed for the machinery that rotates the bridge main span.

5.5 Fender System

The Fender System is in **satisfactory** condition. Defects include marine borer damage, missing timber wales members, and missing connection bolts for the timber wales.

The Fender System has marine borer damage to the timber wales, isolated missing lower timber wale sections, missing connection bolts for the timber wales, and corrosion of connection hardware. No sealant material was noted on any of the countersunk bolt holes in the wales. No significant defects were noted on the timber piles (See Photo 21).

The lower connection hardware below low water was observed to have minor surface corrosion of the connection hardware (See Photo 22). The tops of the timber batter piles typically have marine borer damaged and showed 20% section loss that extends down approximately 1 foot. Marine borer damage was typically found at saw cut joints and counter sunk bolt holes that compromised the timber treatment and did not receive addition field applied protection. Moderate marine borer damage was noted at the countersunk bolt holes for the bottom 4 wales typically (See Photo 23). Damaged areas usually are a void in the wale interior around the bolt head approximately 12 inch long, 3 inch wide, and 3 inch deep (see Photo 24). Isolated missing lower corner timber wale sections, and connection bolts for the timber wales were noted on the West Fender System (See Photo 25). The lower wale connection hardware typically have moderate corrosion and showed 20 to 40% section loss (See Photo 26). Approximately 80 linear feet of timber wale has severe marine borer damage and detached from the fender structure (See Photo 27).

6.0 Recommendations

6.1 Summary of Recommendations

The repair recommendations for the piers and abutments are based on our presumption that the Northern Avenue Bridge will be removed for rehabilitation or replacement. Our recommended repairs will require the construction of a steel sheet pile cofferdam around each pier and abutment so that the work can be performed in dry conditions. The bridge structure will have to be removed to drive steel sheet piling to construct the cofferdams. The bridge substructure and fender system requires maintenance to prevent the structural integrity and functionality from being compromised further. While the bridge no longer sees the original design loads, repair work may be necessary if future development or repurpose use is anticipated. Otherwise, the bridge substructure components and fender system will continue to deteriorate, requiring extensive rehabilitation in the future if no maintenance work is performed. We recommend that the defects be repaired, and in a manner that aligns with the intended future use of the structure.

6.2 Abutments & Piers

It is recommended that the joints between granite blocks be repaired. The joints noted with mortar loss and with mortar intact shall be repaired. Existing joint patchwork repairs may only be surface deep, and may hide deeper joint voids. Repairs would entail cleaning marine growth and debris by low pressure water blasting. If deteriorated mortar is encountered, it must be removed to sound mortar. All exposed sound mortar must have a clean, square cut surface. Repoint the cleaned joints with grout using hand tools. If existing mortar is removed to a depth of 12” or greater, the joint shall be repaired by grout injection to achieve bearing between granite blocks.

It is recommended that all displaced granite blocks noted on Piers 1, 2, and 3 be removed and reset. The granite blocks shall be adjusted to match the existing horizontal joint lines and the plane of the granite surface. Non- metallic spacers shall be used to maintain proper joint widths. Existing, deteriorated mortar shall be removed by mechanical chipping or hydro-blasting when the block is removed. New joint grout shall be placed by hand tools or pressure injection as described above when the block is reset.

It is recommended that all cracked granite blocks noted be repaired by low pressure crack injection methods. The granite blocks shall be cleaned of marine growth and debris by low pressure water blasting. Blocks noted with 1/8 to 1/2 inch wide cracks shall be repaired with epoxy crack injection. Granite blocks noted with greater than 1/2 inch wide cracks shall be treated as a block joint and repaired with grout injection.

Given the widespread nature of defects on the concrete footings and sheet pile encasements, a possible fix is to install new sheet pile encasements around Pier 1, 2, 3, and the Boston Abutment. The repairs would entail chipping deteriorated concrete back to sound concrete, removing the existing sheet piles, driving new steel sheet piles around entire footing, and pouring 4000 psi concrete with proper reinforcing steel. If reinforcing steel is exposed, it shall be cleaned and epoxy coated or replaced if there is greater than 25% bar section loss. The mudline shall be excavated several feet to determine if the deteriorated concrete surface extends below the mudline. Any deteriorated concrete surfaces uncovered shall be repaired. Excavations shall be backfilled to the original mudline elevation. Any weep pipes encountered in the footings shall be kept unobstructed and the pipe interiors shall be cleaned of marine growth and debris. Exposed timber piles shall be cut flush to the sound concrete.

It is recommended that the concrete footing for the Draw Pier be replaced with a new reinforced concrete footing. The repairs would entail chipping deteriorated concrete back to sound concrete, driving steel sheet piles, and pouring 4000 psi concrete with proper reinforcing steel. However, before a repair is designed, we recommend that concrete core samples be extracted from the existing Draw Pier concrete footing. The purpose is to determine the extent of the soft concrete layer noted on the footing sides and the concrete condition. This information will aid in formulating a repair method and determining repair quantities. The cores shall be sent to a testing lab for concrete strength and condition analysis.

In addition, demolition of some old and unused timber piles, located in the adjacent pile fields, may be required in order to position a barge close enough to the Draw Pier to perform work.

6.3 Fender System

It is recommended that all the recesses for the countersunk bolt holes in the timber wales for both fender systems be cleaned and sealed. The wale recesses in the tidal zone shall be sealed to prevent marine borer attack. The wale recesses above the tidal zone shall be sealed to prevent fungal attack. This repair will prevent further damage from occurring at countersunk recesses noted with marine borer damage. The timber batter pile tops with marine borer damage should also be cleaned and sealed for the same reasons mentioned.

It is recommended that all the missing wale connection bolts be replaced with galvanized bolts, nuts and washers in kind.

It is recommended that the missing lower corner timber wales, and the 80 linear feet of timber wale noted with severe marine borer damage and detached on the West Fender System be replaced in kind. The new wale sections shall be spliced to the existing wales with timber splice blocks secured with two galvanized bolts.

7.0 Summary

The Northern Avenue Bridge foundation is in **poor to serious** condition overall. Defects were found to be consistent with the previous inspection, but generally more widespread indicating a normal rate of deterioration with age. Generally, minor to advance deterioration was observed throughout. However at this time, the conditions found do not suggest immediate failure. That being said, extensive repairs are required if the bridge substructure is to remain in service or be reused. We also recommend that the bridge substructure be re-inspected within 3 to 5 years, to ensure that conditions have not worsened unexpectedly.

Childs Engineering Corporation appreciates the opportunity to present our findings and recommendations from our recent investigation. If you have any questions or comments on this report, please don't hesitate to contact the undersigned.

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APPENDIX A
Photographs

Photo 1 – Overall view of the Boston Abutment, looking northwest.

Photo 2 – Overall view of the South Boston Abutment, looking south.

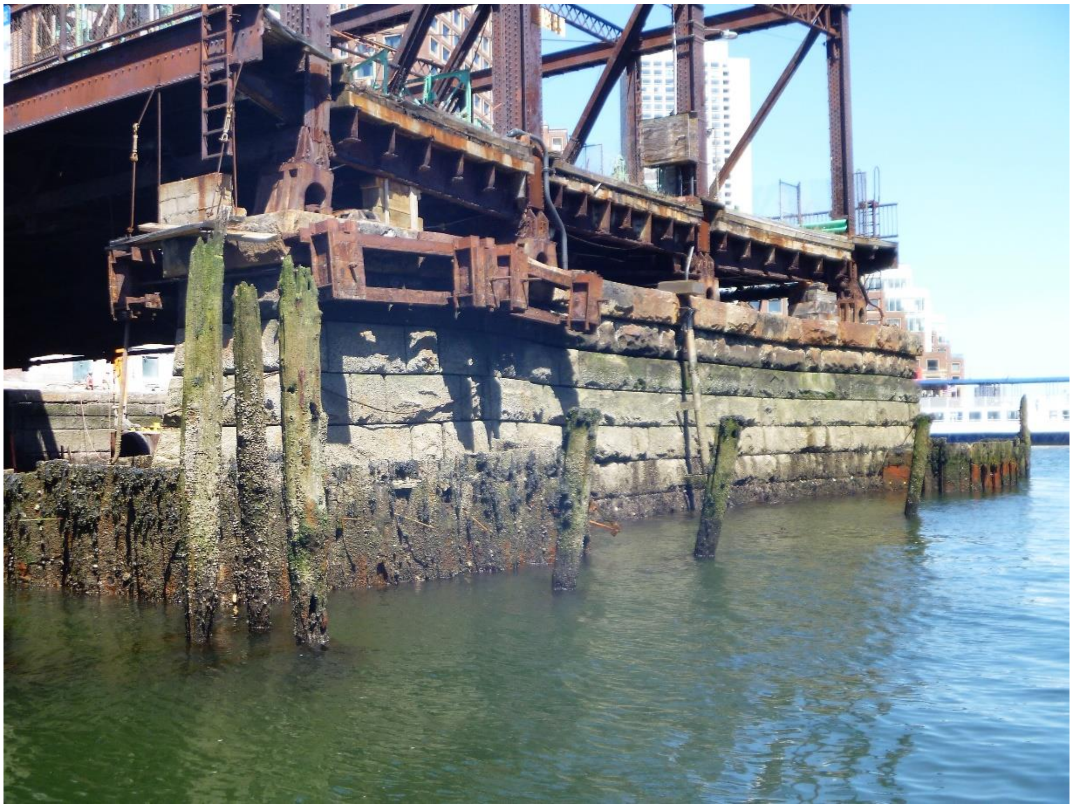


Photo 3 – Overall view of Pier 1, looking north.

Photo 4 – Overall view of Pier 2, looking west.

Photo 5 – Overall view of Pier 3, looking east.

Photo 6 – View of the northeast quadrant of the Draw Pier, looking southwest.

Photo 7 – View of the southwest end of the East Fender System, looking east.

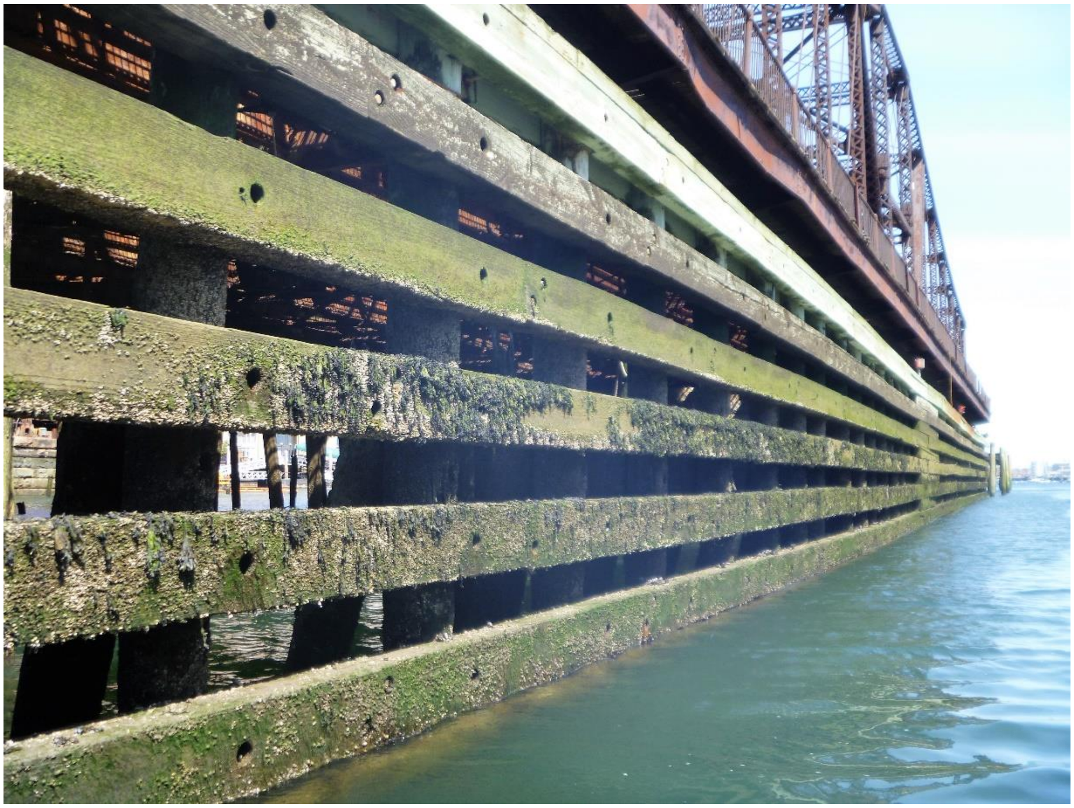


Photo 8 – Overall view of the West Fender System, looking north.

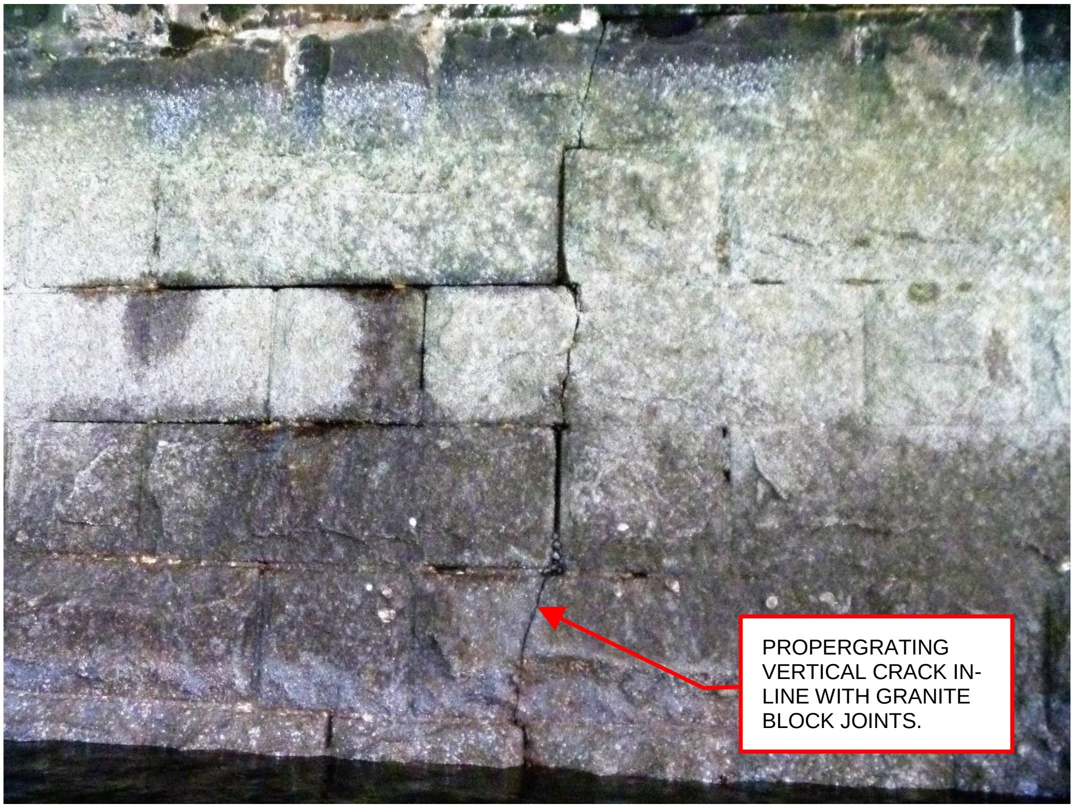


Photo 9 – Vertical crack in granite blocks in the Boston Abutment.

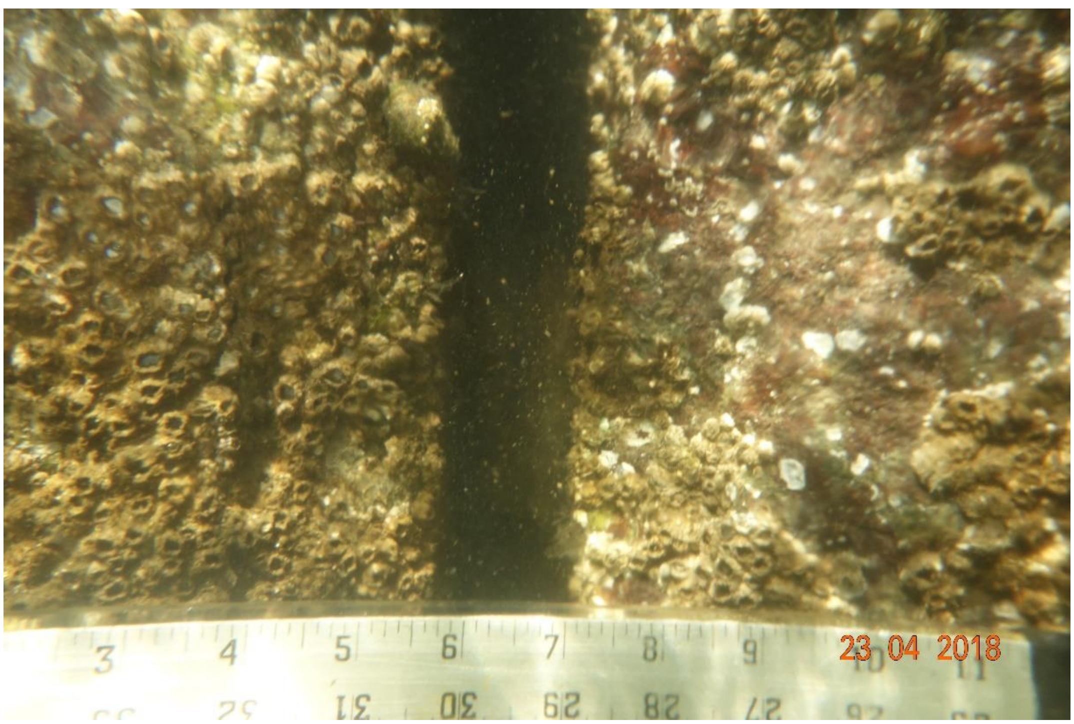


Photo 10 – Typical gaps, with mortar loss, in granite blocks below water.

Photo 11 – Exposed stainless steel tie rod in granite block of Pier 2's East face.

Photo 12 – Vertical crack in granite block, and displaced granite block.

Photo 13 – Cleaved corner of granite block in Pier lower course.

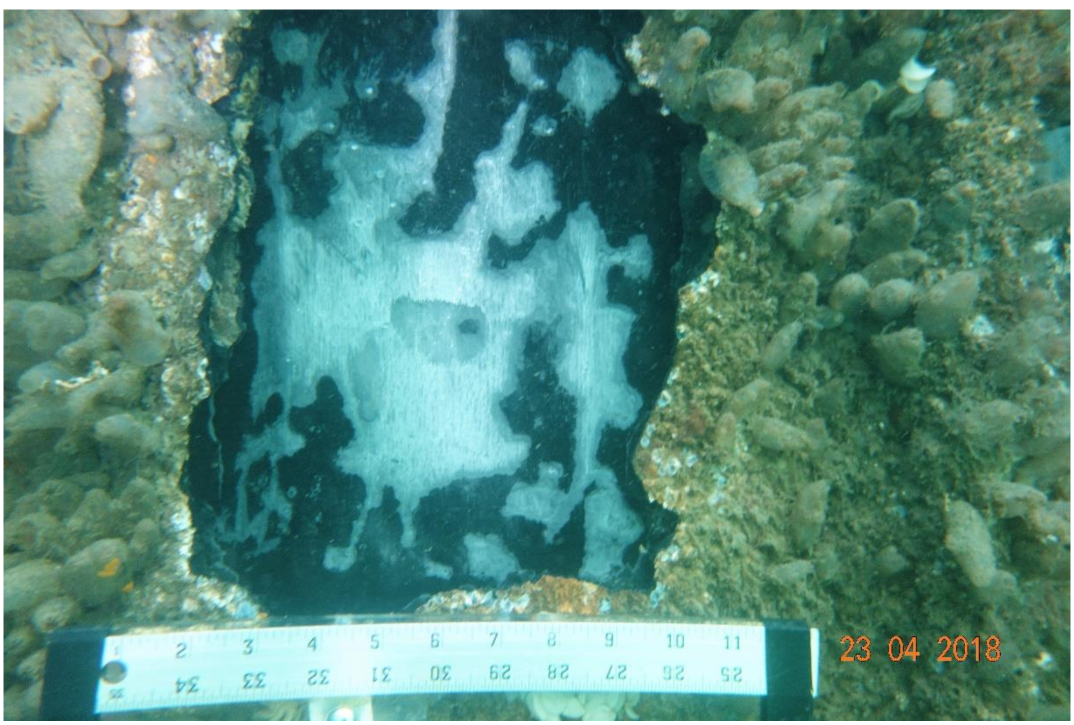


Photo 14 – Sheet pile with bare steel exposed for concrete encasement below water.

Photo 15 – Corrosion holes in steel sheet pile for concrete encasements.

Photo 16 – Top of concrete footing near southwest quadrant of the Draw Pier.

Photo 17 – Top of concrete footing near northeast quadrant of the Draw Pier.

Photo 18 – Typical top of concrete footing for Draw Pier.

Photo 19 – Concrete footing for Draw Pier below water.

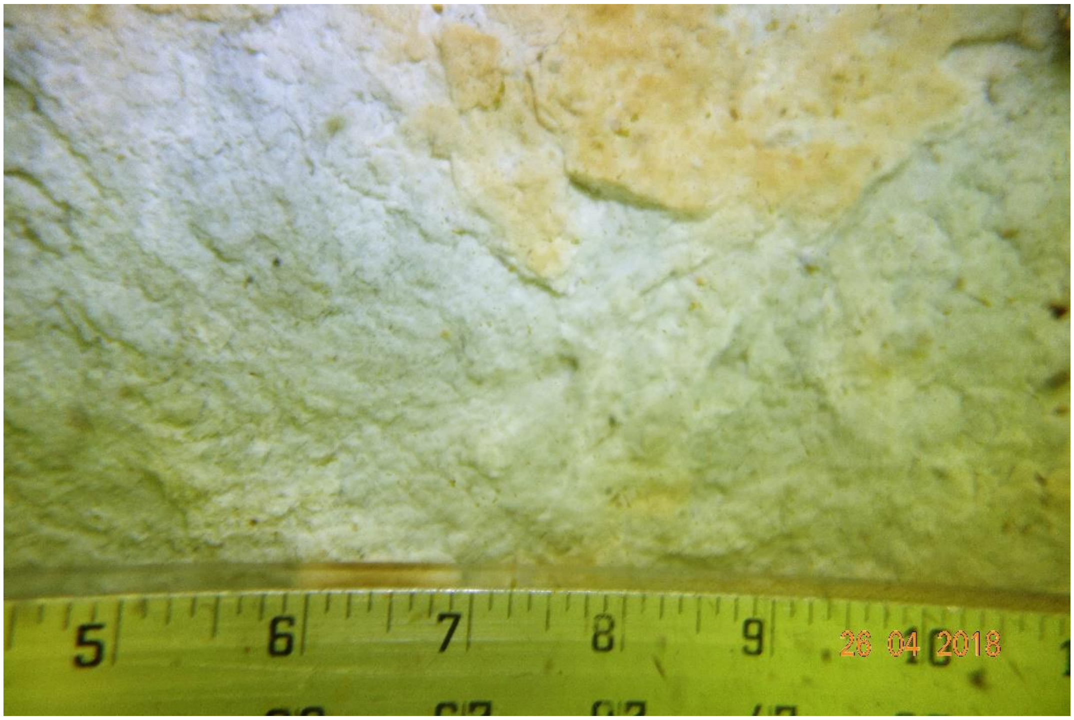


Photo 20 – Layer of soft concrete for the footing of Draw Pier below water.

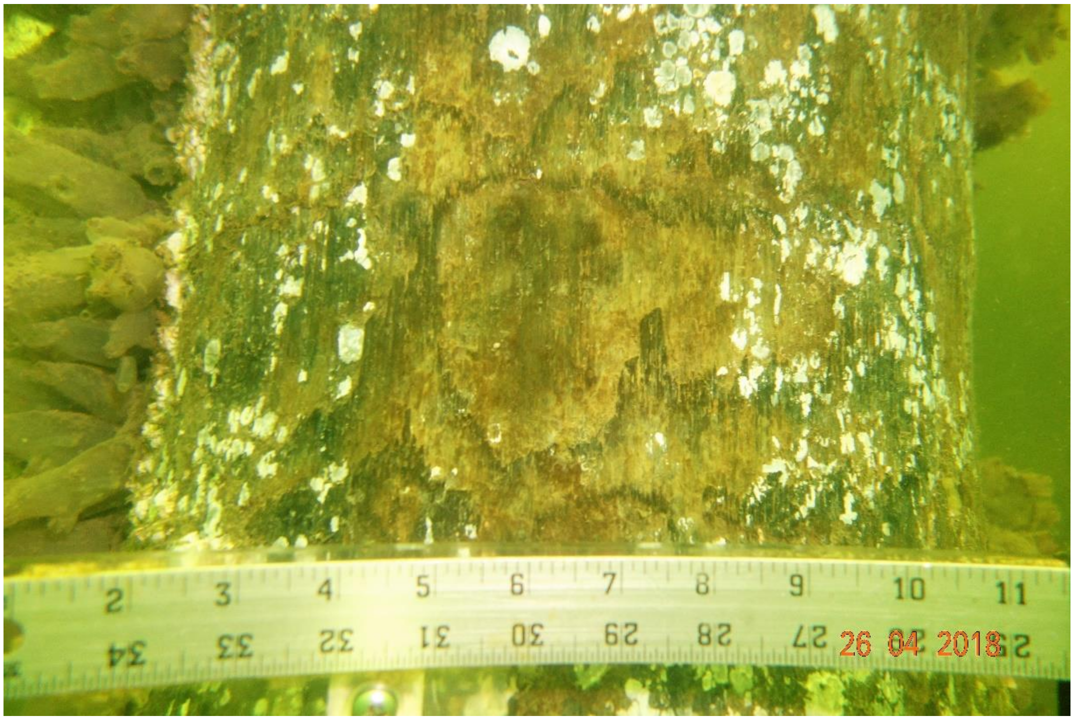


Photo 21 – Typical timber vertical pile for fender system below water.

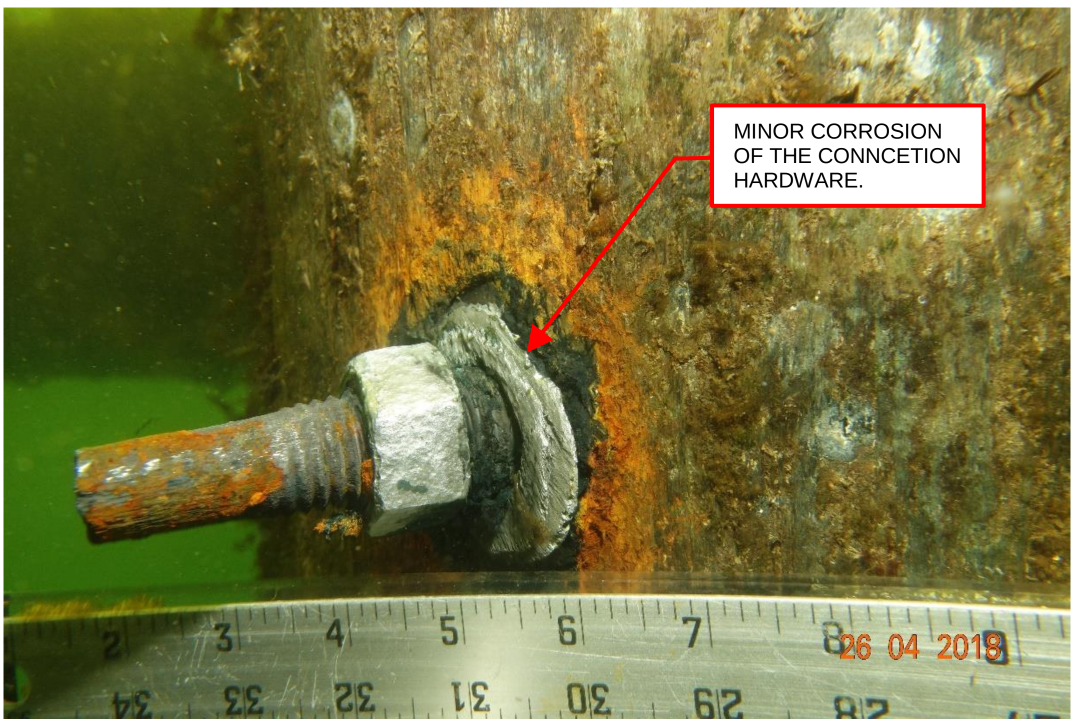


Photo 22 – Top of timber batter pile connection below water.

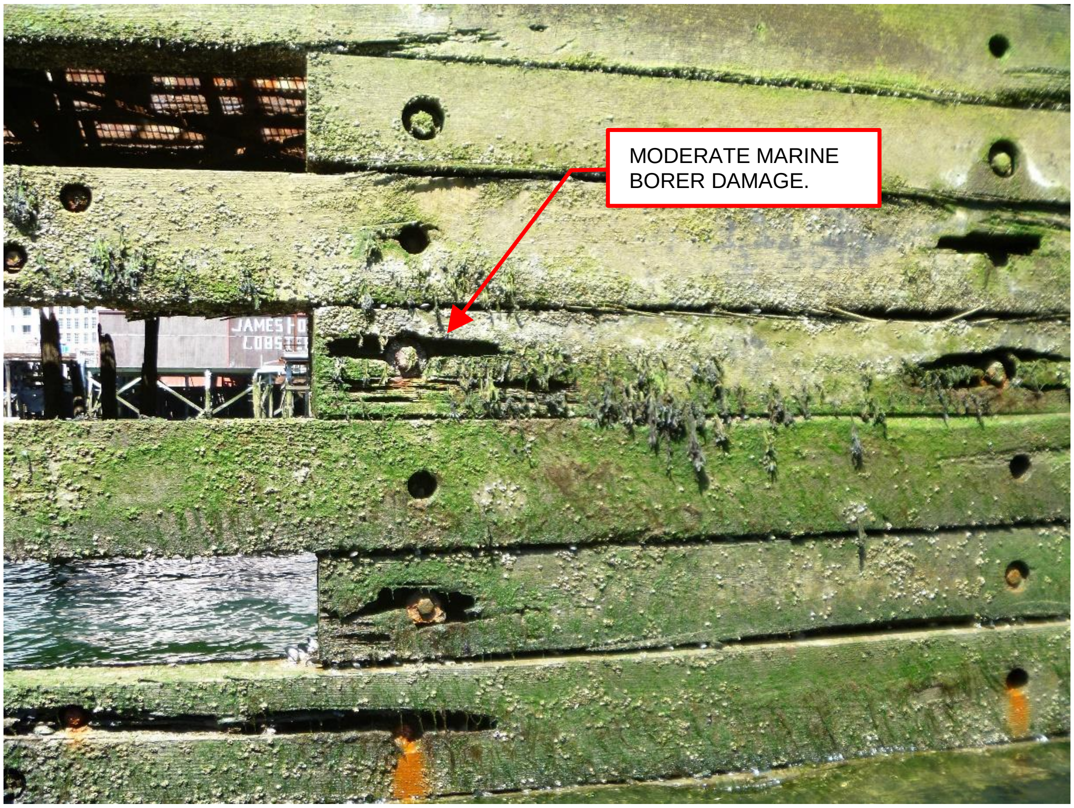


Photo 23 – Typical bottom 4 timber wales for the Fender System.

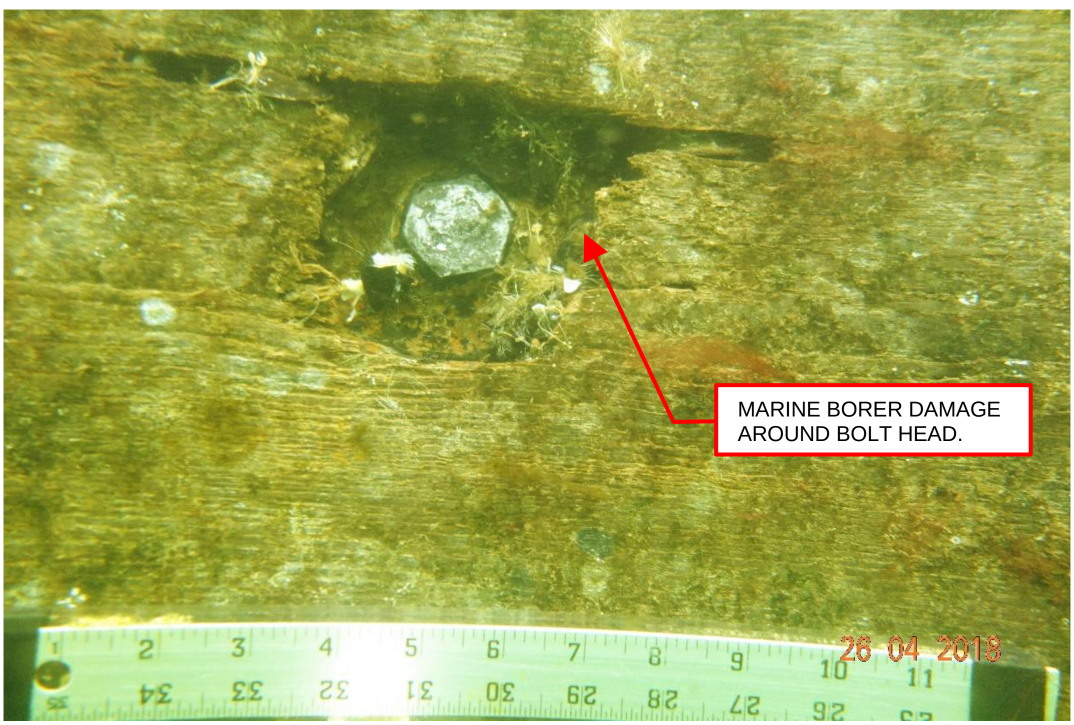


Photo 24 – Typical timber wale connection below water.

Photo 25 – Missing timber wale section at south corner of West Fender System.

Photo 26 – Typical lower timber wale connection.

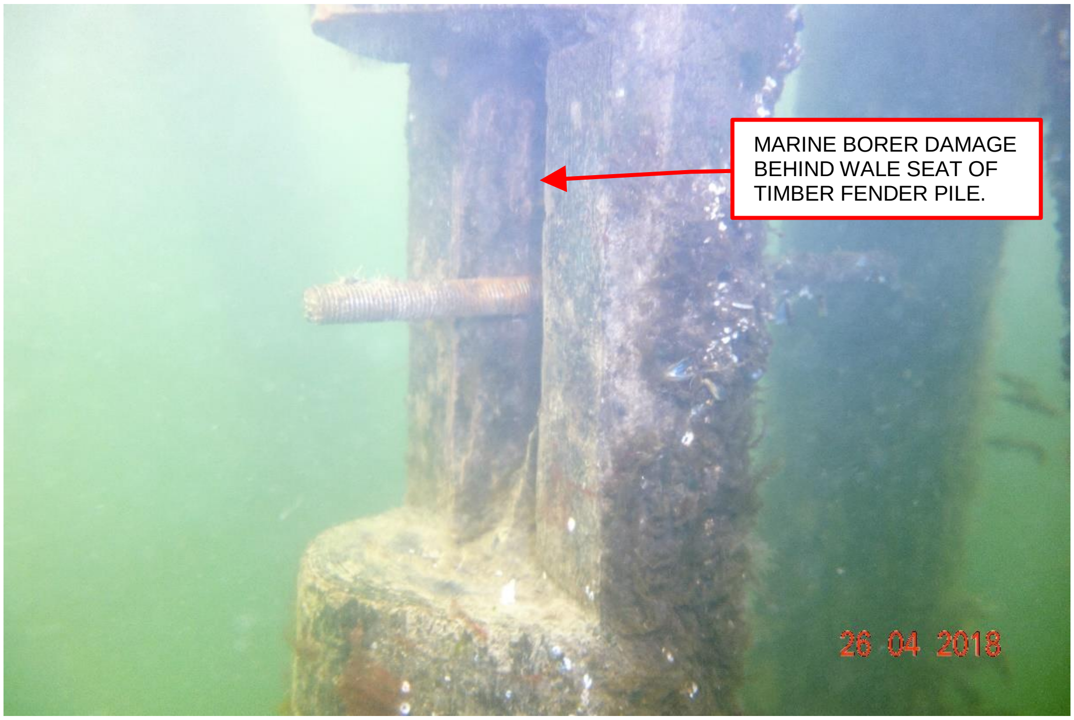
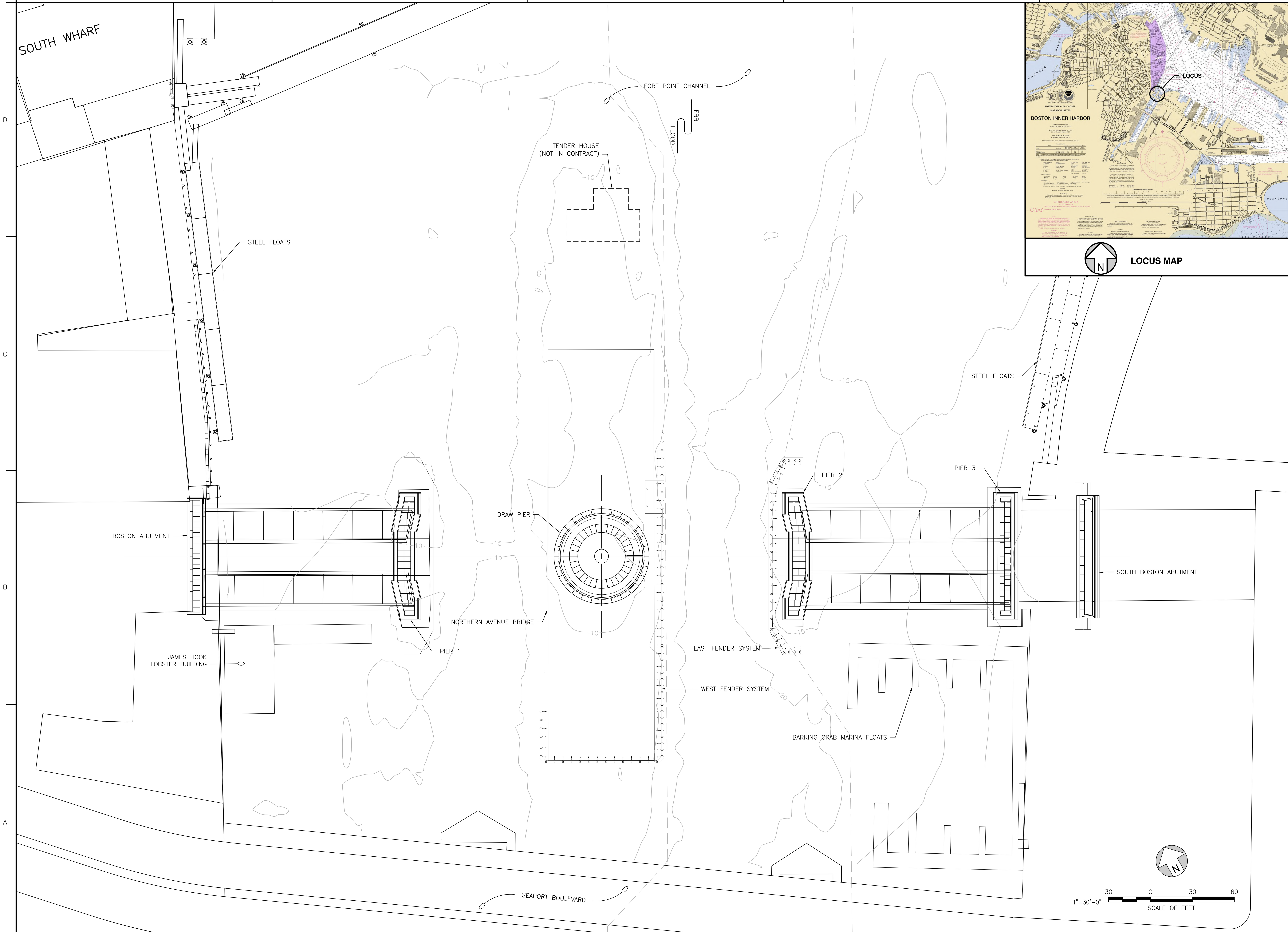


Photo 27 – Separated section of timber wale for the Fender System.

APPENDIX B
Drawings



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Mark	Description	Date	Appr.

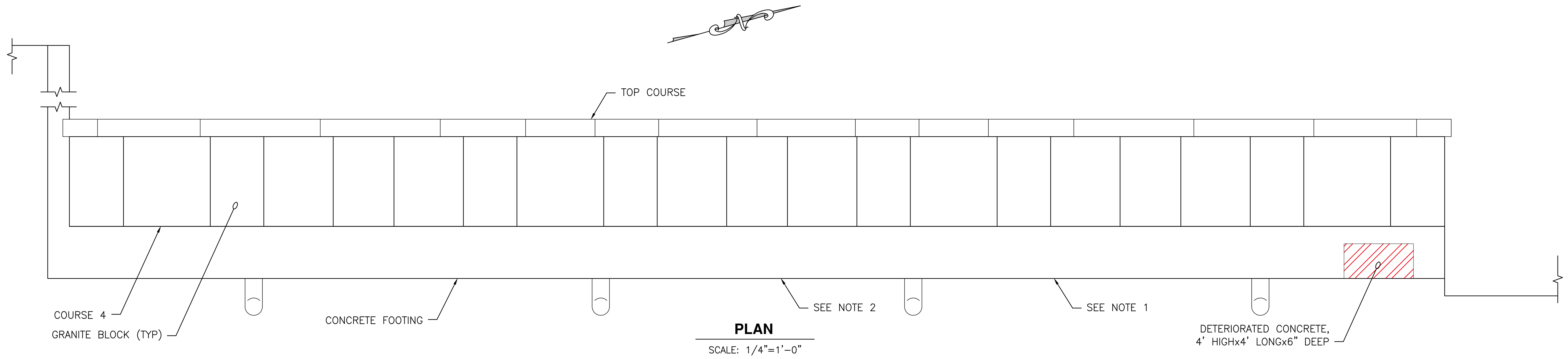
Designed by: CIC	Date: 5/16/18
Dwn by: TEQ / Ckd by: CIC	Design file no. 275317 X-01
Reviewed by: ARN	Scale: 1"=30'-0"

NORTHERN AVENUE BRIDGE
AECOM
BOSTON, MA

SITE PLAN

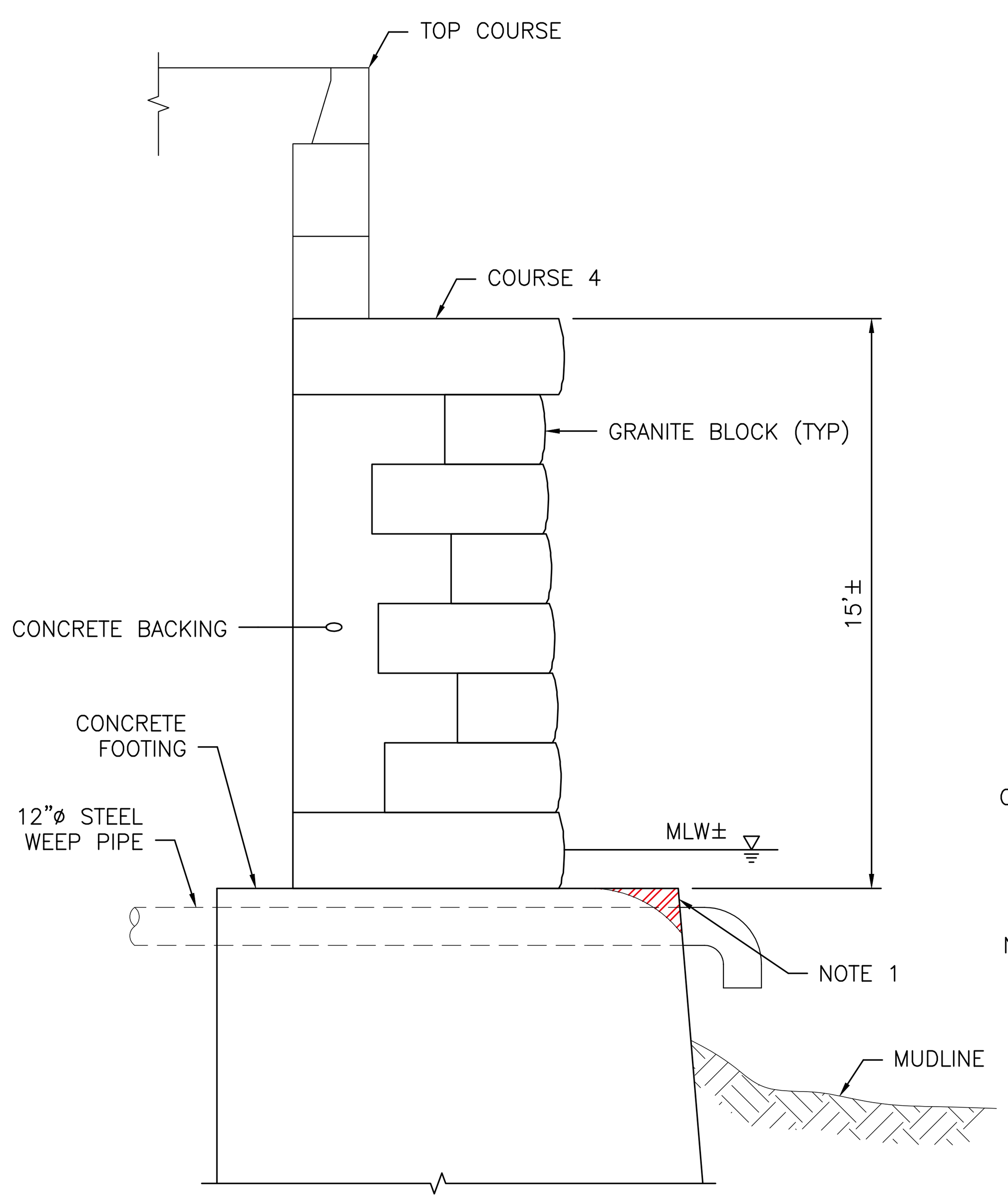
Sheet reference number: X-01
Sheet 1 of 11

TOM QUINN K:\2753-17.00 NORTHERN AVE BRIDGE - AECOM\CADD\CURRENT WORKING DWGS\275317.00 X-01 SITE PLAN.DWG May 16, 2018 - 3:51pm



PLAN

SCALE: 1/4"=1'-0"



SECTION A-A

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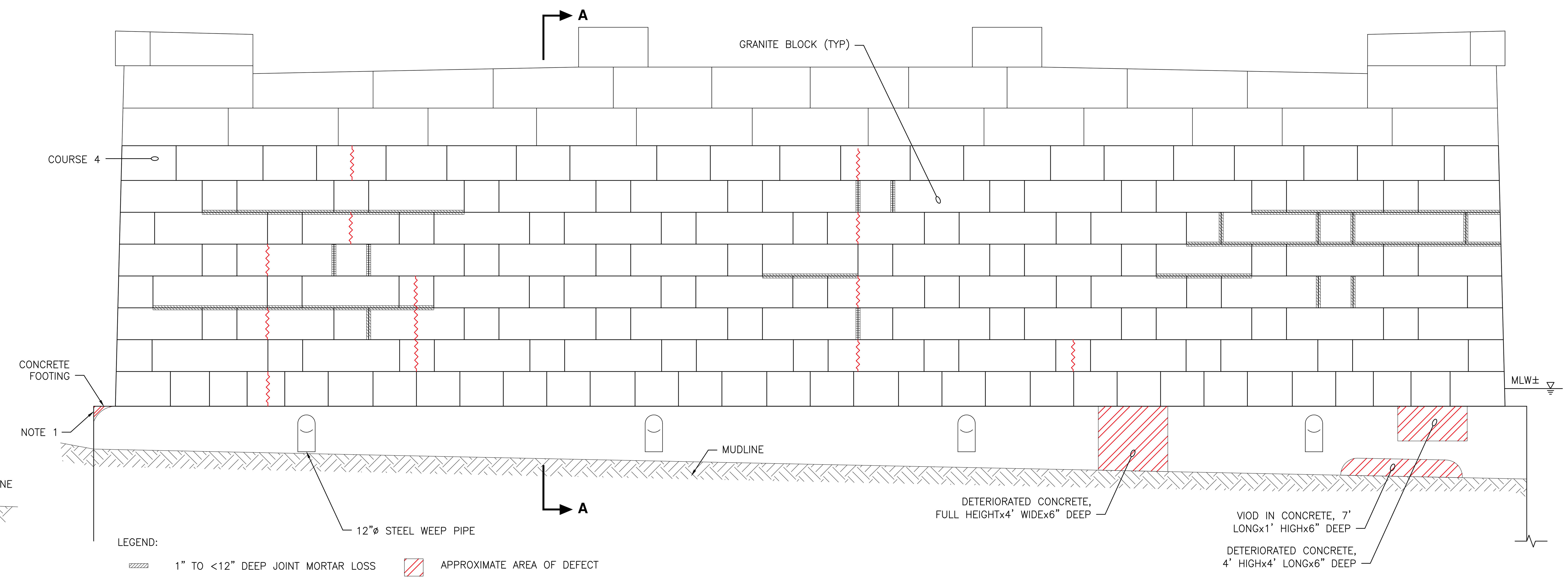


LEGEND:

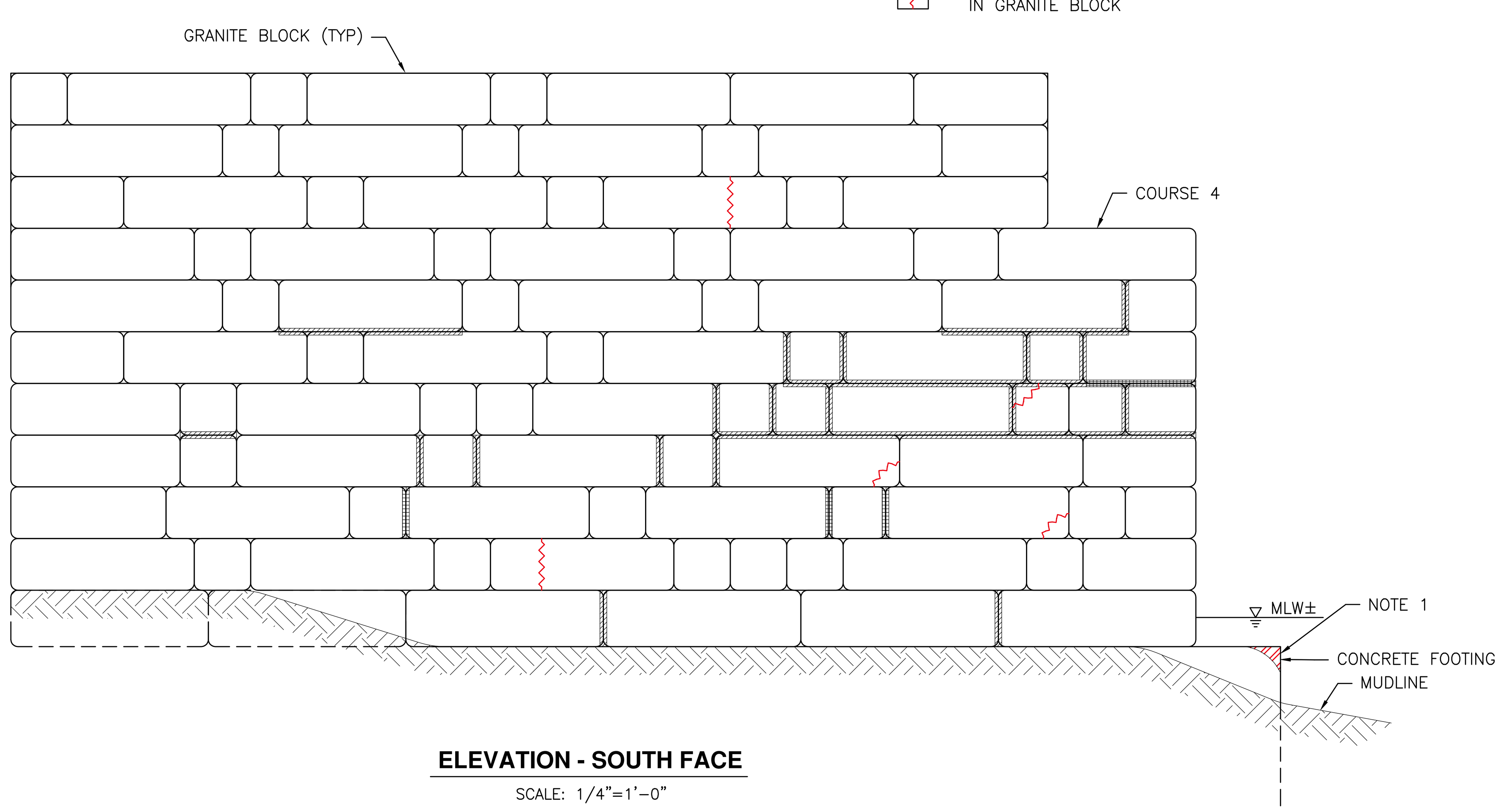
- 1" TO <12" DEEP JOINT MORTAR LOSS
- 12" TO <24" DEEP JOINT MORTAR LOSS
- 1/8" WIDE TO 1/2" WIDE VERTICAL CRACK IN GRANITE BLOCK
- APPROXIMATE AREA OF DEFECT

ELEVATION - EAST FACE

SCALE: 1/4"=1'-0"

BOSTON ABUTMENT CONDITION NOTES:

1. THE CONCRETE FOOTING HAS GENERAL SURFACE DETERIORATION ALONG THE FOOTING CORNER AND VERTICAL FACE WITH POCKETS UP TO 12" DEEP IN THE CONCRETE. THE FOOTING TOP CORNER IS ROUNDED DUE TO A LOSS OF CONCRETE OF UP TO 1' DEPTH AT THE CORNER.
2. THE CONCRETE FOOTING DETERIORATION EXTENDS TO THE GRANITE BLOCK FACE OVER 10 LF AT APPROXIMATELY MID ABUTMENT. THE TOPS OF 3 TIMBER PILES ARE EXPOSED IN THIS AREA. THE PILES HAVE SEVERE SECTION LOSS FROM MARINE BORER DAMAGE.



ELEVATION - SOUTH FACE

SCALE: 1/4"=1'-0"

1/4"=1'-0" 4 0 4 8 SCALE OF FEET

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Designed by: CIC | Date: 4/26/18
Dwn by: APL | Ckd by: CIC | Design file no. 275317 X-02
Reviewed by: ARN | Scale: 1/4"=1'-0"

NORTHERN AVENUE BRIDGE
AECOM
BOSTON, MA

BOSTON ABUTMENT
CONDITION PLAN

Sheet reference number: X-02

Sheet 2 of 11

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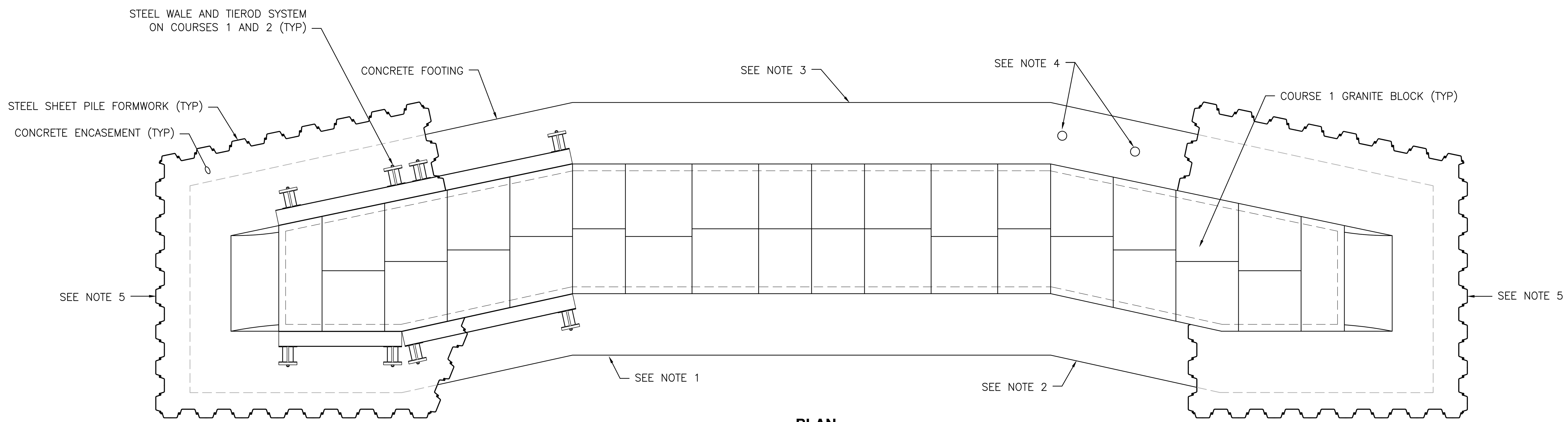
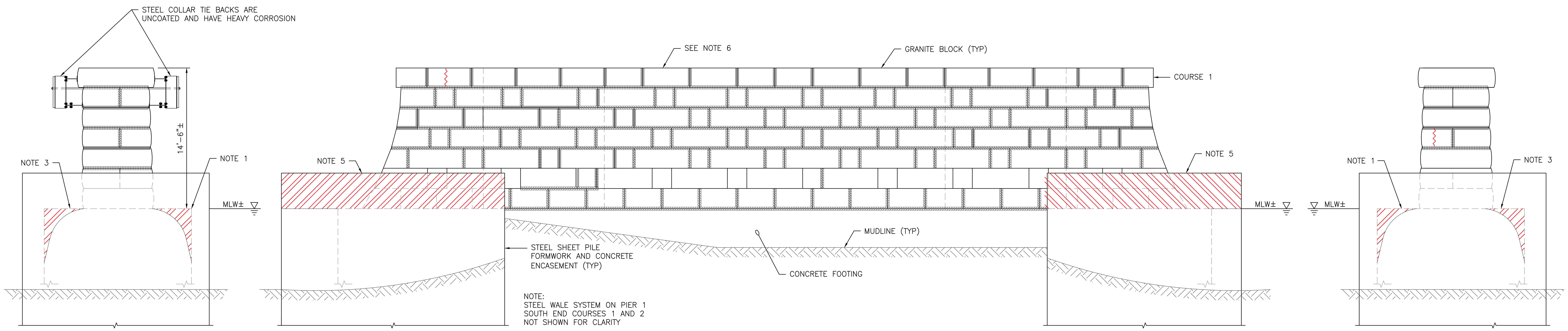


PLAN



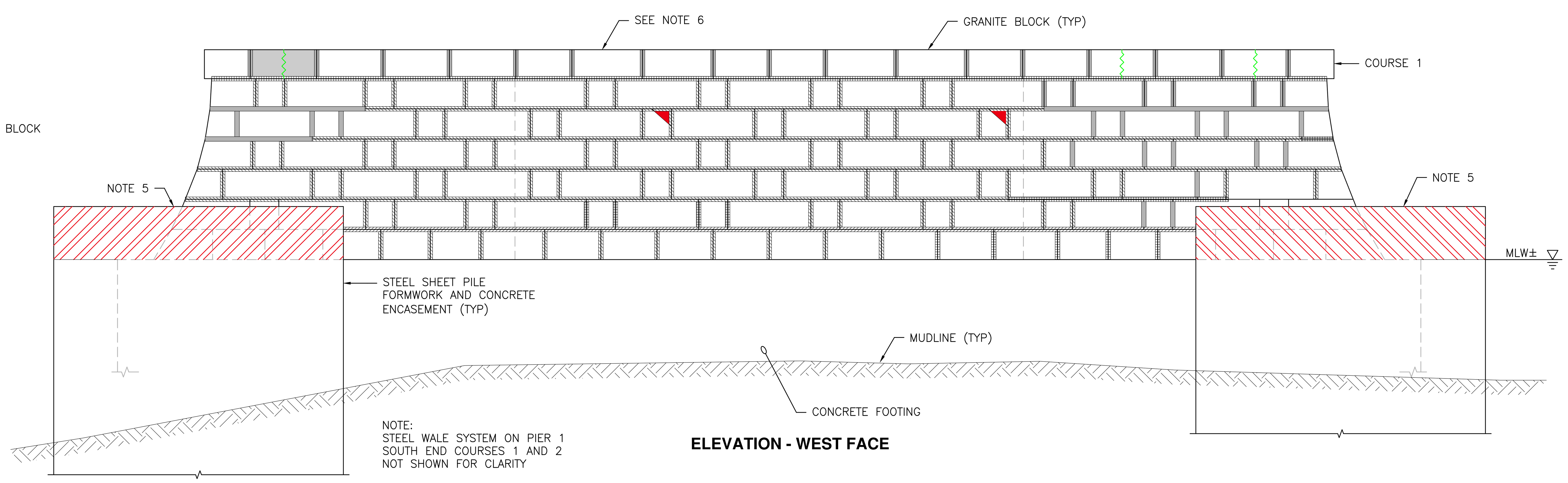
ELEVATION - SOUTH FACE

ELEVATION - EAST FACE

ELEVATION - NORTH FACE

LEGEND:

- 1" TO <12" DEEP JOINT MORTAR LOSS
- 12" TO <24" DEEP JOINT MORTAR LOSS
- ≥24" DEEP JOINT MORTAR LOSS
- 1/8" TO 1/2" WIDE VERTICAL CRACK IN GRANITE BLOCK
- >1/2" TO 1" WIDE VERTICAL CRACK IN GRANITE BLOCK
- DISPLACED GRANITE BLOCK
- CORNER CLEAVE OF GRANITE BLOCK
- APPROXIMATE AREA OF DEFECT



ELEVATION - WEST FACE

PIER 1 CONDITION NOTES:

1. THE CONCRETE FOOTING HAS GENERAL SURFACE DETERIORATION WITH A ROUNDED TOP CORNER DUE TO A LOSS OF CONCRETE UP TO A DEPTH OF 1 TO 2 FEET. THE FOOTING CORNER IS SQUARE AT THE NORTH END WITH INCREASING CORNER DETERIORATION TOWARDS THE SOUTH END. AT MID PIER THE CONCRETE IS DETERIORATED TO WITHIN 2 1/2 FEET OF THE GRANITE BLOCK FACE. AT THE SOUTH END, THE CONCRETE IS DETERIORATED BACK TO THE GRANITE BLOCK FACE.
2. THE CONCRETE FOOTING VERTICAL FACE HAS A 7' LONG x 1' HIGH x 3' DEEP VOID. THE VOID HAS EXPOSED THE TOP 6" OF A TIMBER PILE. THE TIMBER PILE HAS MARINE BORER DAMAGE WITH 7" DIAMETER REMAINING.
3. THE CONCRETE FOOTING HAS GENERAL SURFACE DETERIORATION WITH ROUNDED TOP CORNER DUE TO A LOSS OF CONCRETE UP TO A DEPTH OF 3'. THE VERTICAL FACE HAS VOIDS UP TO 2 FEET DEEP.THE CONCRETE DETERIORATION IS WITHIN 1' OF THE GRANITE BLOCK FACE IN SOME LOCATIONS.
4. TWO TIMBER PILES ARE PROTRUDING APPROXIMATELY 2' ABOVE THE TOP FACE OF THE CONCRETE FOOTING.
5. THE STEEL SHEET PILE FORMWORK HAS A BAND OF THIN STEEL AT MLW WITH NUMEROUS CORROSION HOLES.
6. THE COURSE 1 GRANITE BLOCK HORIZONTAL JOINTS HAVE SHOTCRETE REPAIRS THAT HAVE MULTIPLE 6" TO 24" DEEP JOINT VOIDS BEHIND THE REPAIR.

PIER 1 CONDITIONS

SCALE: 3/16"=1'-0"

3/16"=1'-0" 4 0 4 8 12 SCALE OF FEET

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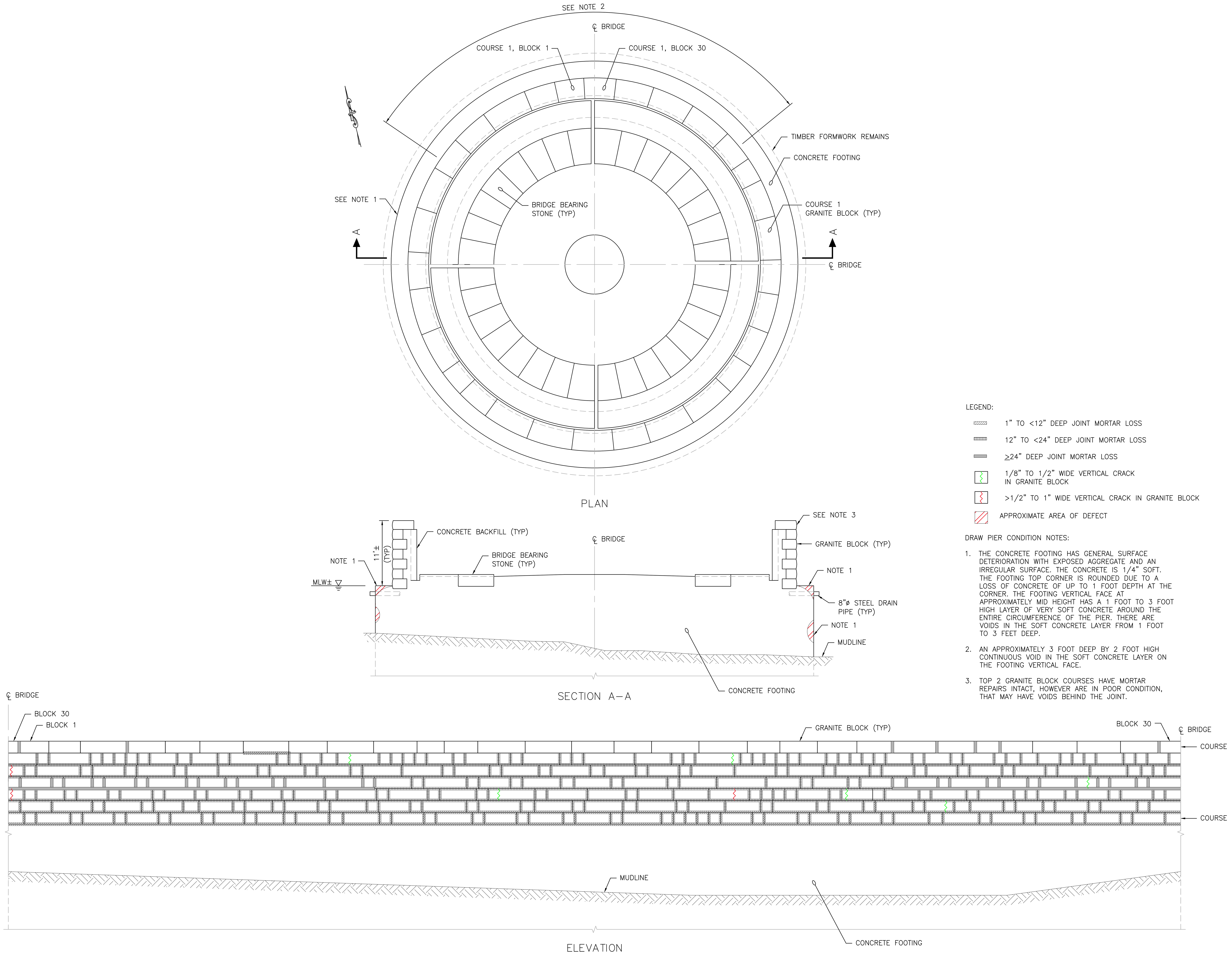
Reviewed by: ARN | Scale: 3/16"=1'-0"

NORTHERN AVENUE BRIDGE
AECOM
BOSTON, MA

PIER No.1
CONDITION PLAN

Sheet reference number: X-03
Sheet 3 of 11



DRAW PIER CONDITIONS

SCALE: 1/8"=1'-0"

LEGEND:

- 1" TO <12" DEEP JOINT MORTAR LOSS
- 12" TO <24" DEEP JOINT MORTAR LOSS
- ≥24" DEEP JOINT MORTAR LOSS
- 1/8" TO 1/2" WIDE VERTICAL CRACK IN GRANITE BLOCK
- >1/2" TO 1" WIDE VERTICAL CRACK IN GRANITE BLOCK
- APPROXIMATE AREA OF DEFECT

DRAW PIER CONDITION NOTES:

1. THE CONCRETE FOOTING HAS GENERAL SURFACE DETERIORATION WITH EXPOSED AGGREGATE AND AN IRREGULAR SURFACE. THE CONCRETE IS 1/4" SOFT. THE FOOTING TOP CORNER IS ROUNDED DUE TO A LOSS OF CONCRETE OF UP TO 1 FOOT DEPTH AT THE CORNER. THE FOOTING VERTICAL FACE AT APPROXIMATELY MID HEIGHT HAS A 1 FOOT TO 3 FOOT HIGH LAYER OF VERY SOFT CONCRETE AROUND THE ENTIRE CIRCUMFERENCE OF THE PIER. THERE ARE VOIDS IN THE SOFT CONCRETE LAYER FROM 1 FOOT TO 3 FEET DEEP.
2. AN APPROXIMATELY 3 FOOT DEEP BY 2 FOOT HIGH CONTINUOUS VOID IN THE SOFT CONCRETE LAYER ON THE FOOTING VERTICAL FACE.
3. TOP 2 GRANITE BLOCK COURSES HAVE MORTAR REPAIRS INTACT, HOWEVER ARE IN POOR CONDITION, THAT MAY HAVE VOIDS BEHIND THE JOINT.

3/16"=1'-0" 4 0 4 8 12 SCALE OF FEET

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Drwn by:	APL
Date:	4/26/18
Ckd by:	CIC
Design file no.:	275617 X-04
Reviewed by:	ARN
Scale:	3/16"=1'-0"

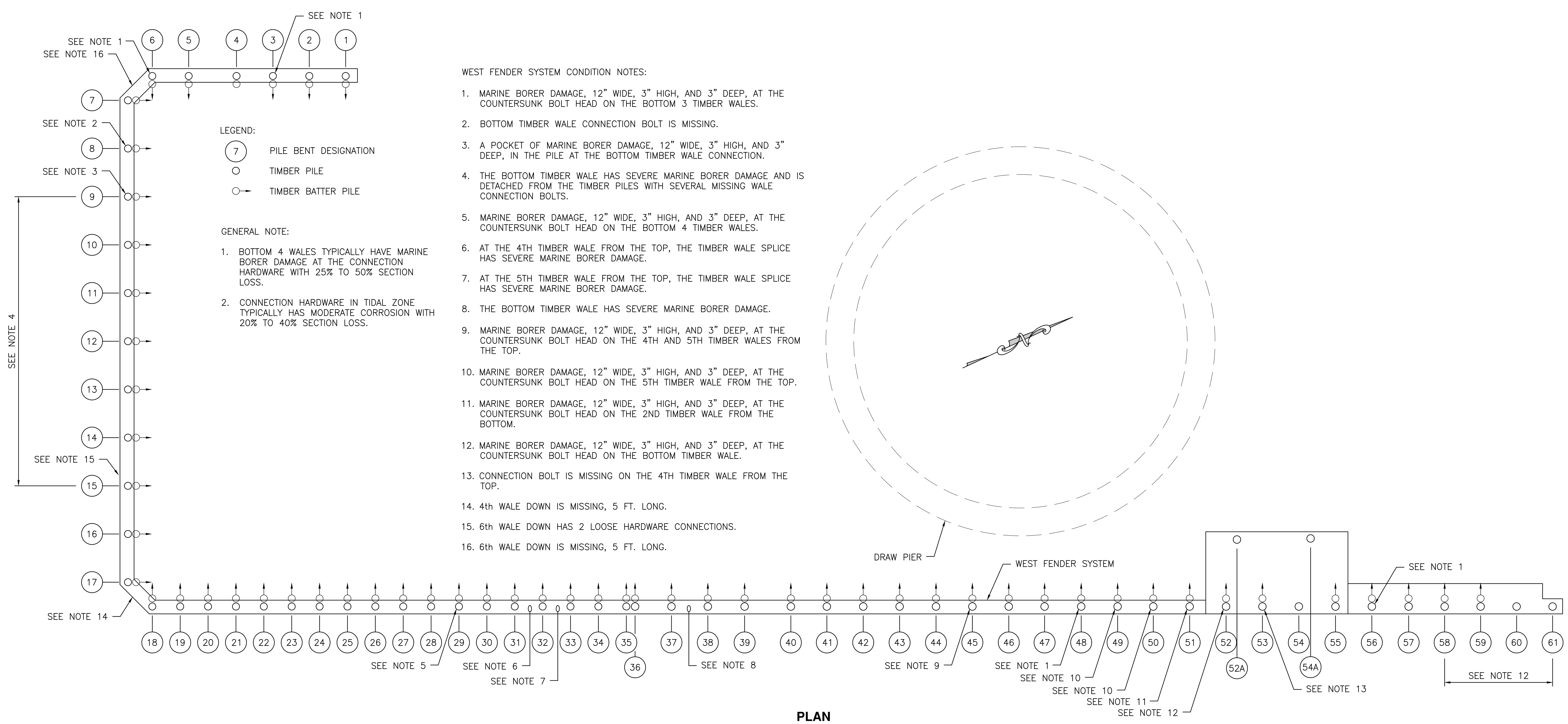
NORTHERN AVENUE BRIDGE
AECOM
BOSTON, MA

DRAW PIER CONDITION PLAN

Sheet reference number: X–04

Sheet 4 of 11

COREY K:\2753-17.00 NORTHERN AVE BRIDGE – AECOM\CADD\CURRENT WORKING DWGS\275317.00 X-04 DRAW PIER CONDITION PLAN.DWG May 11, 2018 – 1:39pm



WEST FENDER SYSTEM CONDITION NOTES:

1. MARINE BORER DAMAGE, 12" WIDE, 3" HIGH, AND 3" DEEP, AT THE COUNTERSUNK BOLT HEAD ON THE BOTTOM 3 TIMBER WALES.
2. BOTTOM TIMBER WALE CONNECTION BOLT IS MISSING.
3. A POCKET OF MARINE BORER DAMAGE, 12" WIDE, 3" HIGH, AND 3" DEEP, IN THE PILE AT THE BOTTOM TIMBER WALE CONNECTION.
4. THE BOTTOM TIMBER WALE HAS SEVERE MARINE BORER DAMAGE AND IS DETACHED FROM THE TIMBER PILES WITH SEVERAL MISSING WALE CONNECTION BOLTS.
5. MARINE BORER DAMAGE, 12" WIDE, 3" HIGH, AND 3" DEEP, AT THE COUNTERSUNK BOLT HEAD ON THE BOTTOM 4 TIMBER WALES.
6. AT THE 4TH TIMBER WALE FROM THE TOP, THE TIMBER WALE SPLICE HAS SEVERE MARINE BORER DAMAGE.
7. AT THE 5TH TIMBER WALE FROM THE TOP, THE TIMBER WALE SPLICE HAS SEVERE MARINE BORER DAMAGE.
8. THE BOTTOM TIMBER WALE HAS SEVERE MARINE BORER DAMAGE.
9. MARINE BORER DAMAGE, 12" WIDE, 3" HIGH, AND 3" DEEP, AT THE COUNTERSUNK BOLT HEAD ON THE 4TH AND 5TH TIMBER WALES FROM THE TOP.
10. MARINE BORER DAMAGE, 12" WIDE, 3" HIGH, AND 3" DEEP, AT THE COUNTERSUNK BOLT HEAD ON THE 5TH TIMBER WALE FROM THE TOP.
11. MARINE BORER DAMAGE, 12" WIDE, 3" HIGH, AND 3" DEEP, AT THE COUNTERSUNK BOLT HEAD ON THE 2ND TIMBER WALE FROM THE BOTTOM.
12. MARINE BORER DAMAGE, 12" WIDE, 3" HIGH, AND 3" DEEP, AT THE COUNTERSUNK BOLT HEAD ON THE BOTTOM TIMBER WALE.
13. CONNECTION BOLT IS MISSING ON THE 4TH TIMBER WALE FROM THE TOP.
14. 4th WALE DOWN IS MISSING, 5 FT. LONG.
15. 6th WALE DOWN HAS 2 LOOSE HARDWARE CONNECTIONS.
16. 6th WALE DOWN IS MISSING, 5 FT. LONG.

LEGEND:

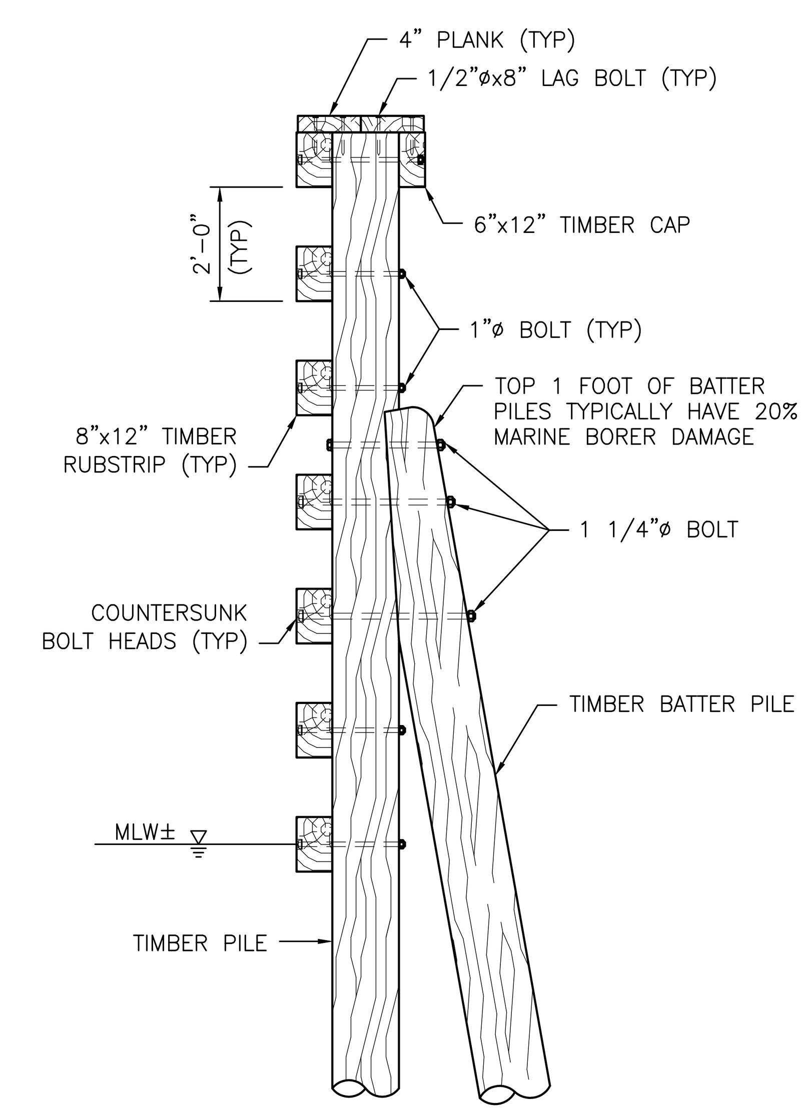
- (7) PILE BENT DESIGNATION
- ○ TIMBER PILE
- ○→ TIMBER BATTER PILE

GENERAL NOTE:

1. BOTTOM 4 WALES TYPICALLY HAVE MARINE BORER DAMAGE AT THE CONNECTION HARDWARE WITH 25% TO 50% SECTION LOSS.
2. CONNECTION HARDWARE IN TIDAL ZONE TYPICALLY HAS MODERATE CORROSION WITH 20% TO 40% SECTION LOSS.

PLAN

SCALE: 1"=10'-0"



TYPICAL FENDER SYSTEM SECTION

SCALE: 3/8"=1'-0"

3/8"=1'-0" — 2 0 2 4 6 SCALE OF FEET

1"=10'-0" — 10 0 10 20 SCALE OF FEET

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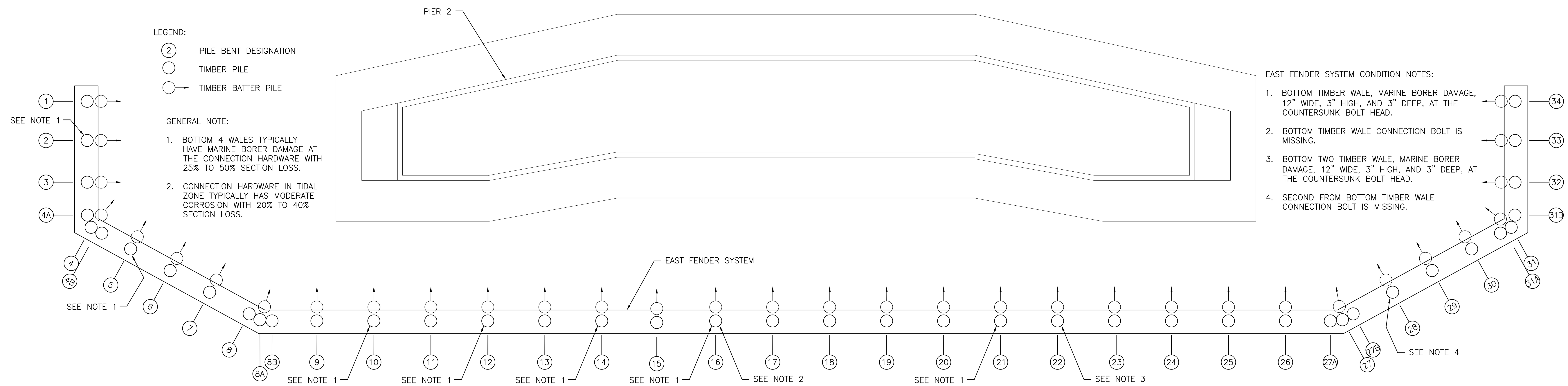
Mark	Description	Date	Appr.

Designed by:	Drn by:	Ckd by:	Reviewed by:	Date:	Design file no.:	Scale:
CIC	APL	CIC	ARN	4/26/18	275317 X-05	3/16"=1'-0"

NORTHERN AVENUE BRIDGE
AECOM
BOSTON, MA

WEST FENDER SYSTEM CONDITION PLAN

Sheet reference number: X-05



LEGEND:

- (2) PILE BENT DESIGNATION
- TIMBER PILE
- TIMBER BATTER PILE

GENERAL NOTE:

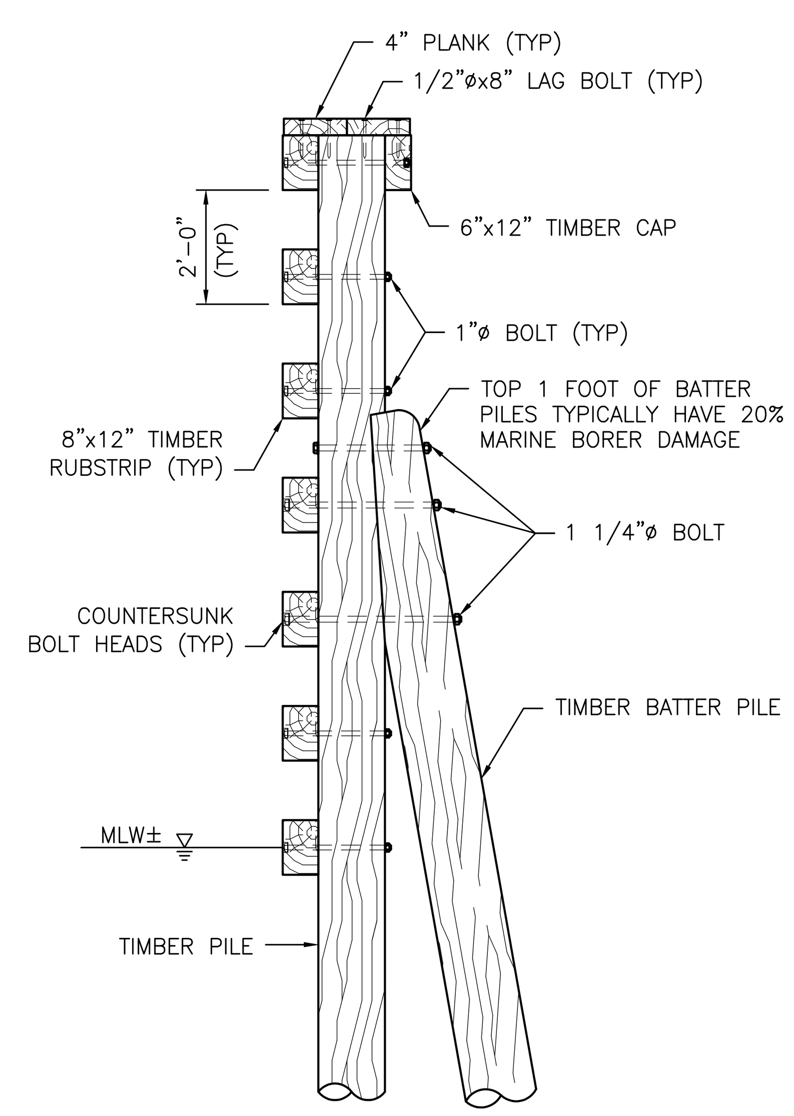
1. BOTTOM 4 WALES TYPICALLY HAVE MARINE BORER DAMAGE AT THE CONNECTION HARDWARE WITH 25% TO 50% SECTION LOSS.
2. CONNECTION HARDWARE IN TIDAL ZONE TYPICALLY HAS MODERATE CORROSION WITH 20% TO 40% SECTION LOSS.

EAST FENDER SYSTEM CONDITION NOTES:

1. BOTTOM TIMBER WALE, MARINE BORER DAMAGE, 12" WIDE, 3" HIGH, AND 3" DEEP, AT THE COUNTERSUNK BOLT HEAD.
2. BOTTOM TIMBER WALE CONNECTION BOLT IS MISSING.
3. BOTTOM TWO TIMBER WALE, MARINE BORER DAMAGE, 12" WIDE, 3" HIGH, AND 3" DEEP, AT THE COUNTERSUNK BOLT HEAD.
4. SECOND FROM BOTTOM TIMBER WALE CONNECTION BOLT IS MISSING.

PLAN

SCALE: 3/16"=1'-0"



TYPICAL FENDER SYSTEM SECTION

SCALE: 3/8"=1'-0"

3/8"=1'-0" 2 0 2 4 6 SCALE OF FEET

3/16"=1'-0" 4 0 4 8 12 SCALE OF FEET

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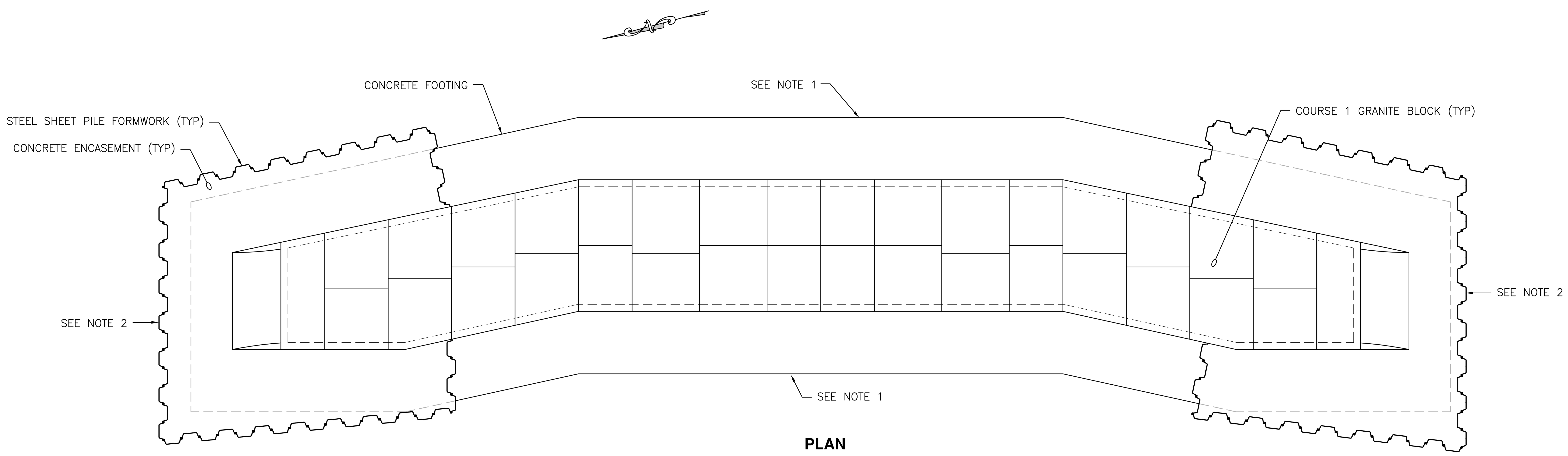
Mark	Description	Date	Appr.

Designed by: CIC | Date: 4/26/18
Drn by: APL | Ckd by: CIC | Design file no.: 275317 X-06
Reviewed by: ARN | Scale: 3/16"=1'-0"

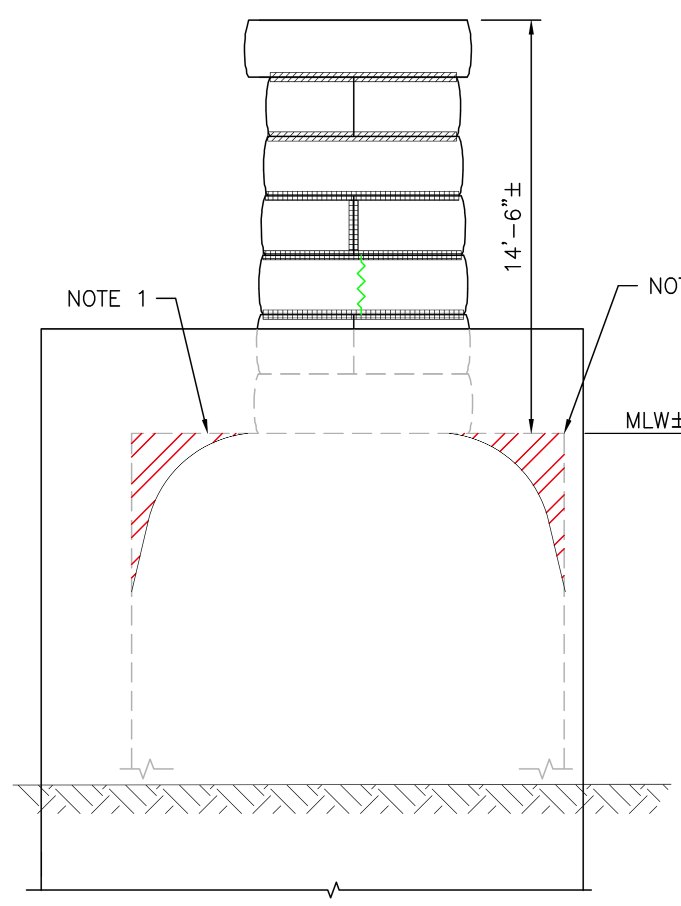
NORTHERN AVENUE BRIDGE
AECOM
BOSTON, MA

EAST FENDER SYSTEM CONDITION PLAN

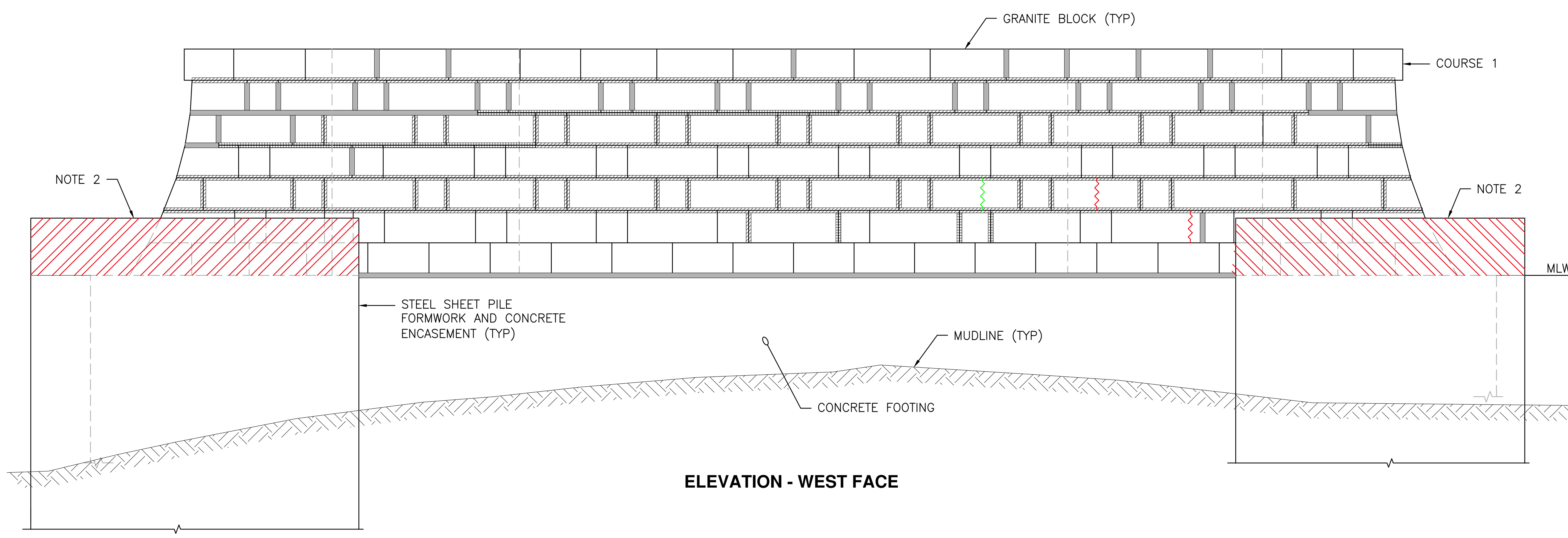
Sheet reference number: X-06
Sheet 6 of 11



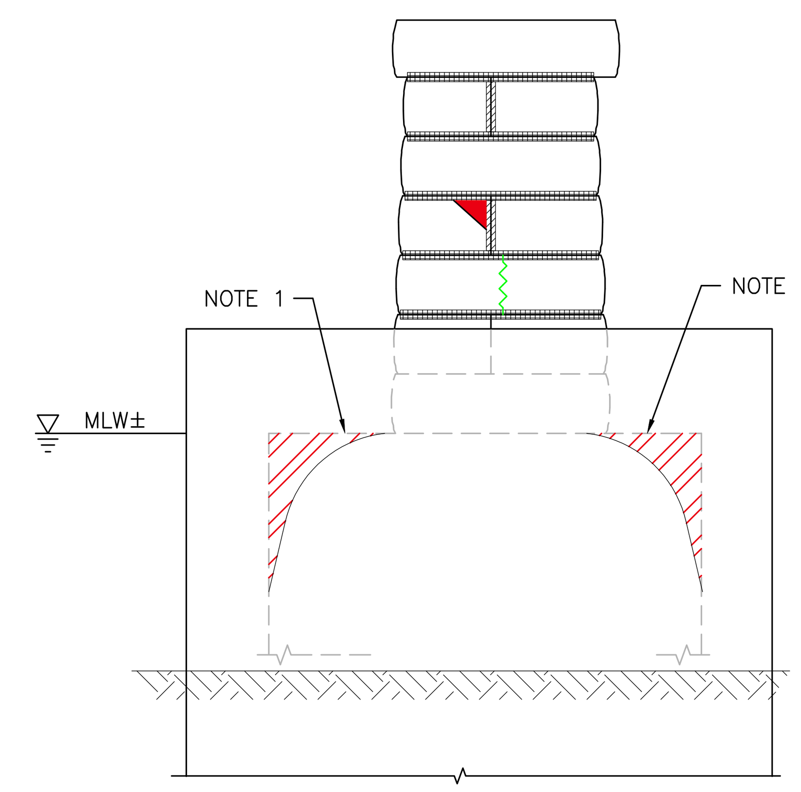
PLAN



ELEVATION - NORTH FACE



ELEVATION - WEST FACE



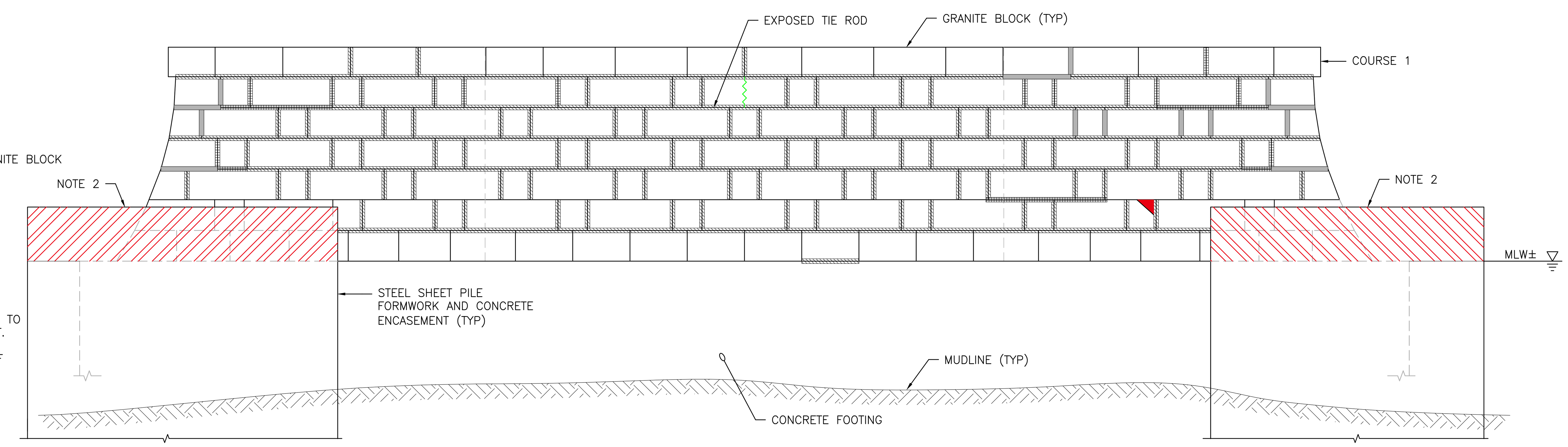
ELEVATION - SOUTH FACE

LEGEND:

- 1" TO <12" DEEP JOINT MORTAR LOSS
- 12" TO <24" DEEP JOINT MORTAR LOSS
- ≥24" DEEP JOINT MORTAR LOSS
- 1/8" WIDE TO 1/2" WIDE VERTICAL CRACK IN GRANITE BLOCK
- >1/2" TO 1" WIDE VERTICAL CRACK IN GRANITE BLOCK
- DISPLACED GRANITE BLOCK
- CORNER CLEAVE OF GRANITE BLOCK
- APPROXIMATE AREA OF DEFECT

PIER 2 CONDITION NOTES:

1. THE CONCRETE FOOTING HAS GENERAL SURFACE DETERIORATION WITH A ROUNDED TOP CORNER DUE TO A LOSS OF CONCRETE UP TO A DEPTH OF 1 FOOT.
2. THE STEEL SHEET PILE FORMWORK HAS A BAND OF THIN STEEL AT MLW WITH NUMEROUS CORROSION HOLES.



ELEVATION - EAST FACE

PIER 2 CONDITIONS

SCALE: 3/16"=1'-0"

3/16"=1'-0" SCALE OF FEET

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Mark	Description
Date	Appr.

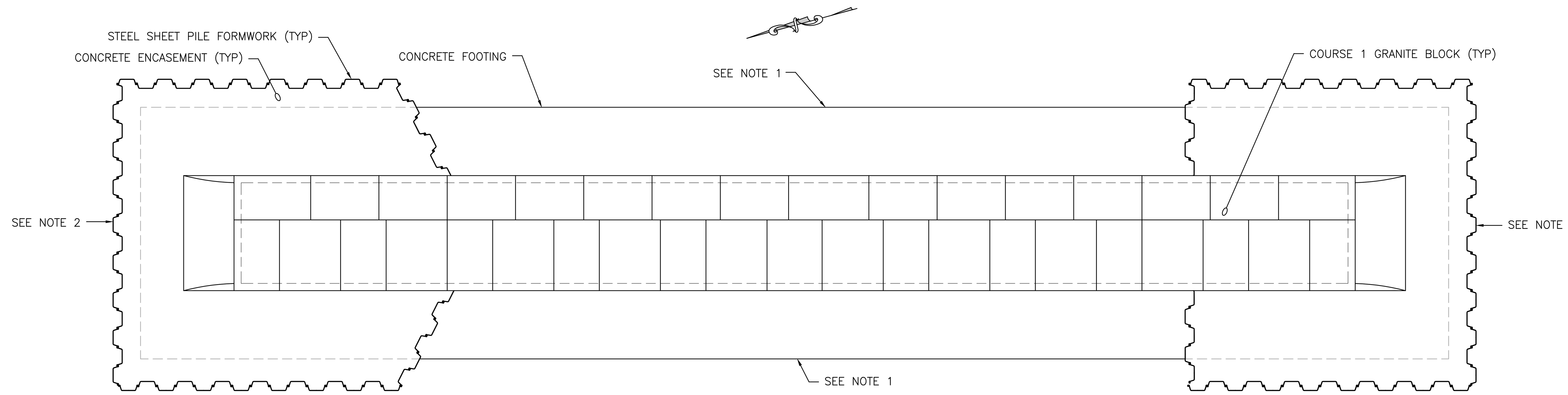
Date: 4/26/18
Design file no. 275317 X-07
Scale: 3/16"=1'-0"
Designed by: CIC
Ckd by: CIC
Drn by: APL
Reviewed by: ARN

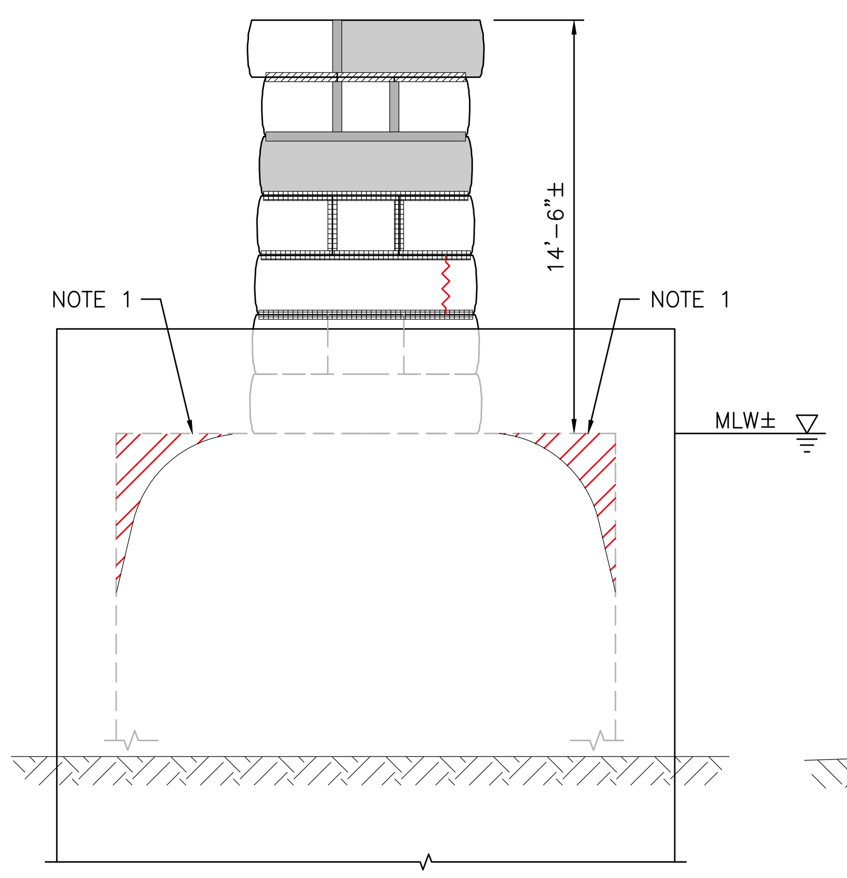
NORTHERN AVENUE BRIDGE
AECOM
BOSTON, MA

PIER No.2
CONDITION PLAN

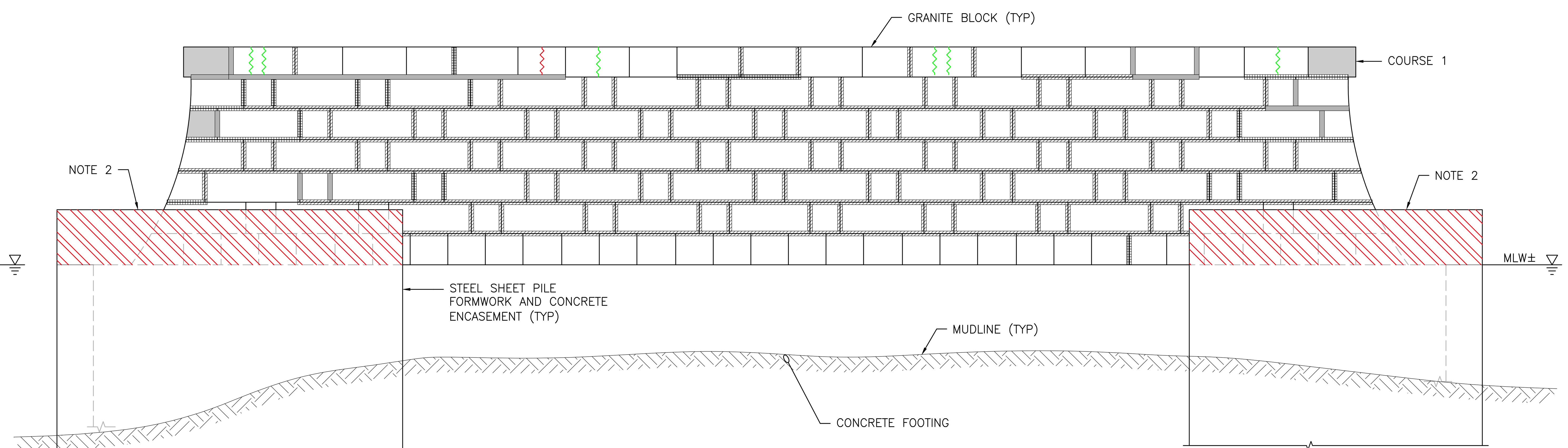
Sheet reference number: X-07
Sheet 7 of 11

AL LEDUC K:\2753-17.00 NORTHERN AVE BRIDGE - AECOM\CADD\CURRENT WORKING DWGS\275317.00 X-07 PIER 2 CONDITION PLAN.DWG May 10, 2018 - 4:05pm

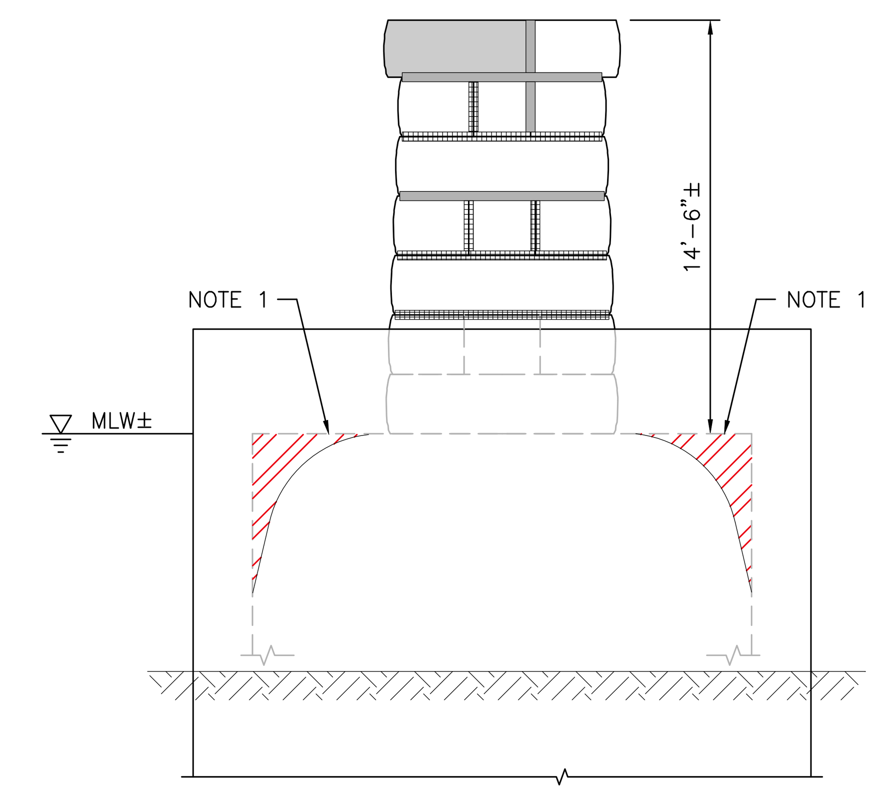




ELEVATION - NORTH FACE



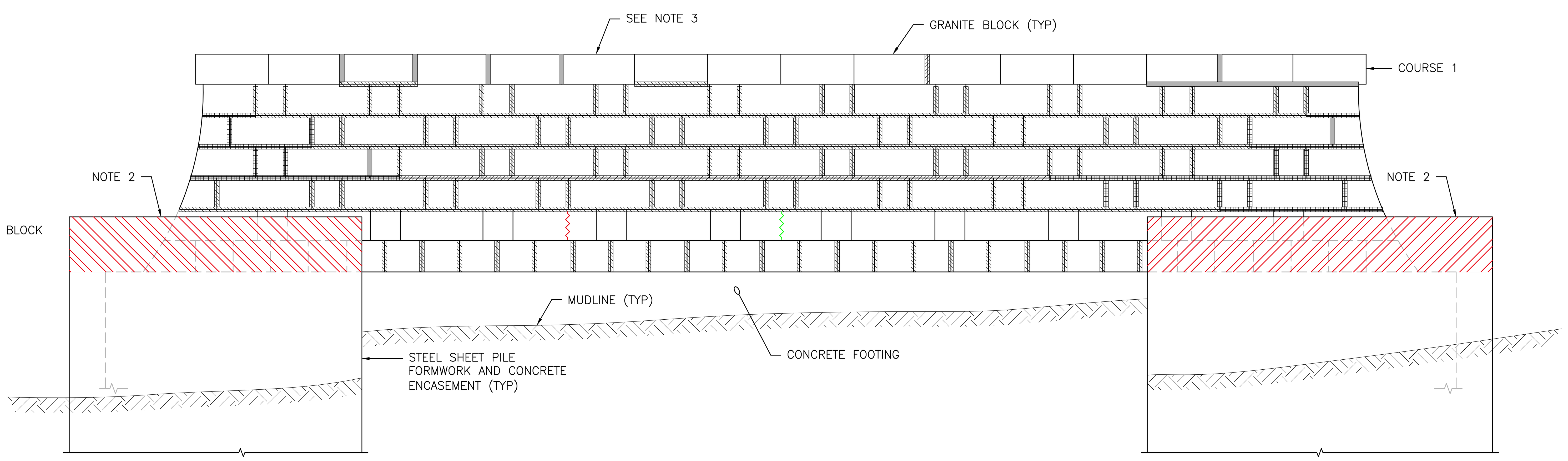
ELEVATION - WEST FACE



ELEVATION - SOUTH FACE

LEGEND:

- 1" TO <12" DEEP JOINT MORTAR LOSS
- 12" TO <24" DEEP JOINT MORTAR LOSS
- ≥24" DEEP JOINT MORTAR LOSS
- 1/8" WIDE TO 1/2" WIDE VERTICAL CRACK IN GRANITE BLOCK
- >1/2" TO 1" WIDE VERTICAL CRACK IN GRANITE BLOCK
- DISPLACED GRANITE BLOCK
- CORNER CLEAVE OF GRANITE BLOCK
- APPROXIMATE AREA OF DEFECT



ELEVATION - EAST FACE

PIER 3 CONDITION NOTES:

1. THE CONCRETE FOOTING HAS GENERAL SURFACE DETERIORATION ALONG THE FOOTING CORNER AND VERTICAL FACE WITH POCKETS UP TO 12" DEEP IN THE CONCRETE. THE FOOTING TOP CORNERS ARE ERODED DUE TO A LOSS OF CONCRETE OF UP TO 2 FEET DEPTH AT THE CORNER.
2. THE STEEL SHEET PILE FORMWORK HAS A BAND OF THIN STEEL AT MLW WITH NUMEROUS CORROSION HOLES.
3. COURSE 1 GRANITE BLOCK JOINTS HAVE SHOTCRETE REPAIRS THAT MAY HAVE VOIDS BEHIND THE JOINT.

GENERAL NOTE:

WEST FACE BLOCKS BENEATH BEARING MEMBERS ARE TYPICALLY CRACKED

PIER 3 CONDITIONS

SCALE: 3/16"=1'-0"

3/16"=1'-0" 4 0 4 8 12 SCALE OF FEET

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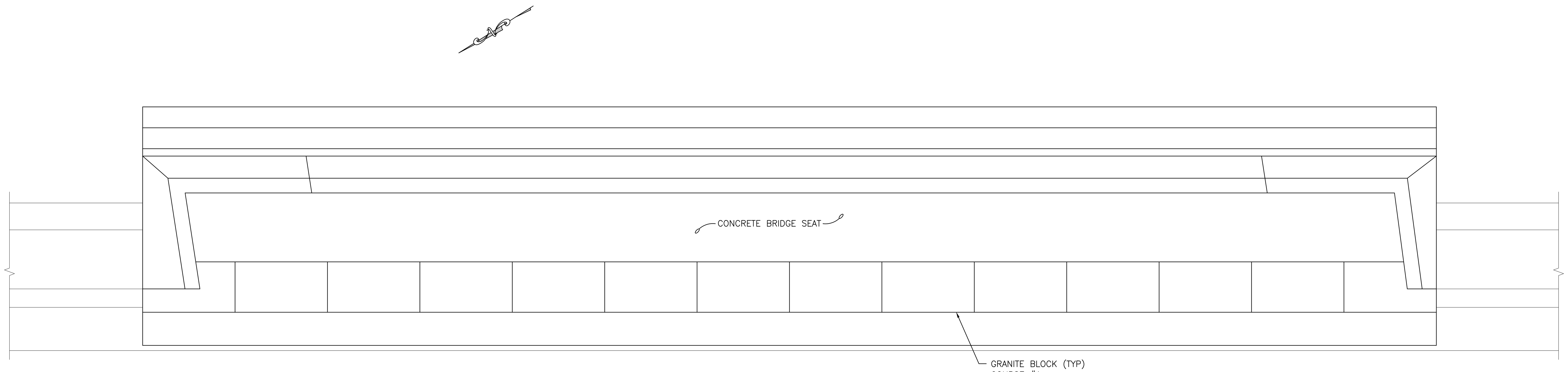
Mark	Description	Date	Appr.

Date: 4/26/118
Design file no.: 275317 X-08
Scale: 3/16"=1'-0"
Designed by: CIC
Ckd by: CIC
Dwn by: APL
Reviewed by: ARN

NORTHERN AVENUE BRIDGE
AECOM
BOSTON, MA

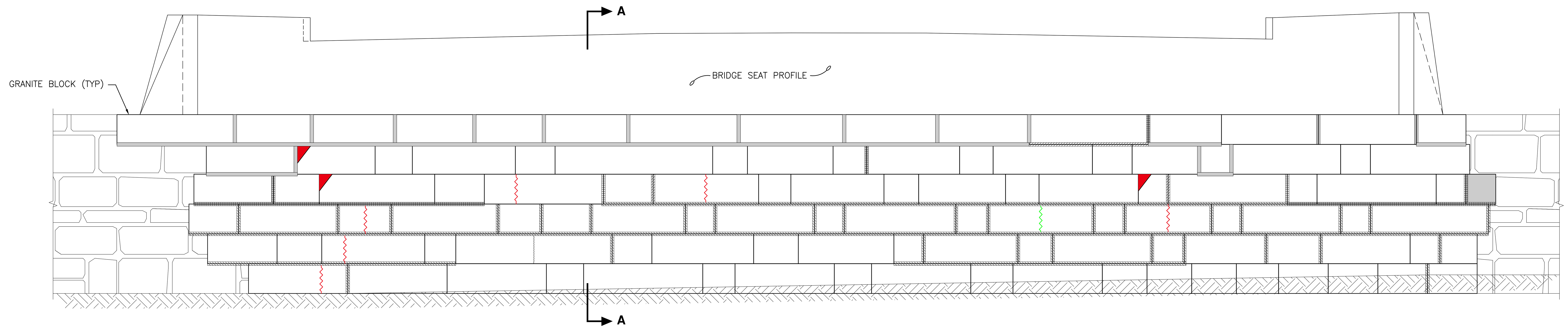
PIER No.3
CONDITION PLAN

Sheet reference number: X-08
Sheet 8 of 11



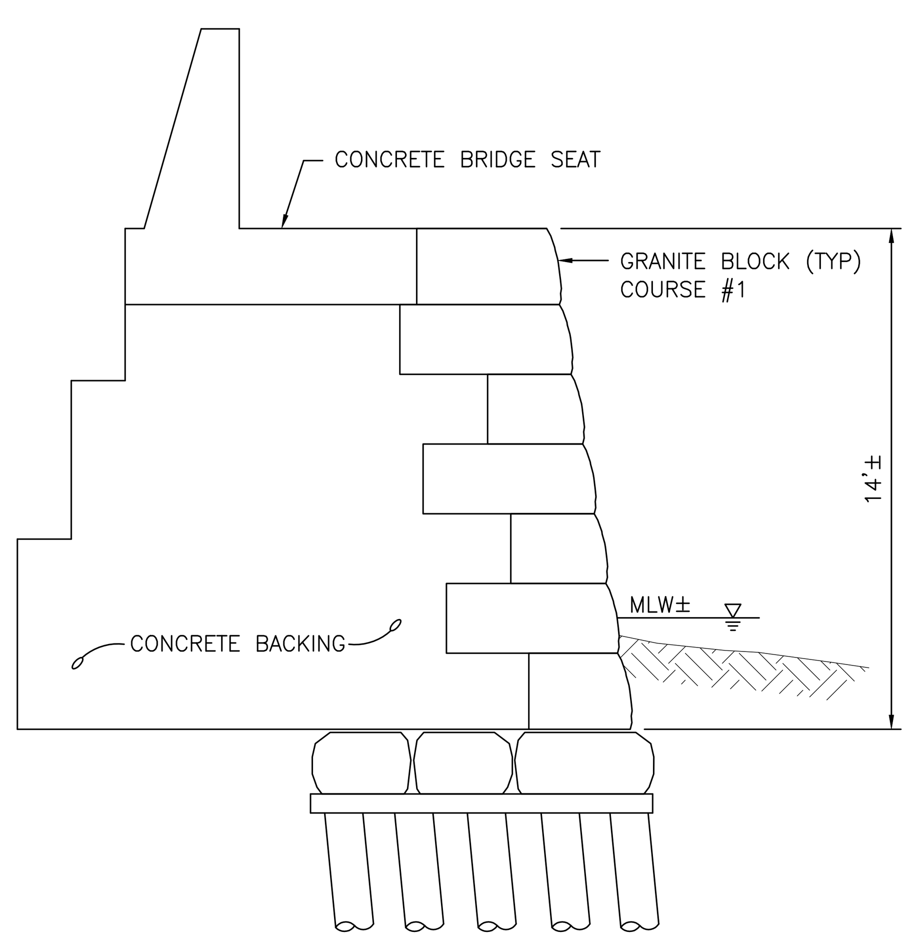
PLAN

SCALE: 1/4"=1'-0"



ELEVATION

SCALE: 1/4"=1'-0"



SECTION A-A

SCALE: 1/4"=1'-0"

LEGEND:

- 1" TO <12" DEEP JOINT MORTAR LOSS
- 12" TO <24" DEEP JOINT MORTAR LOSS
- ≥24" DEEP JOINT MORTAR LOSS
- 1/8" WIDE TO 1/2" WIDE VERTICAL CRACK IN GRANITE BLOCK
- >1/2" TO 1" WIDE VERTICAL CRACK IN GRANITE BLOCK
- DISPLACED GRANITE BLOCK
- CORNER CLEAVE OF GRANITE BLOCK

1/4"=1'-0" 4 0 4 8 SCALE OF FEET

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Mark	Description	Date	Appr.

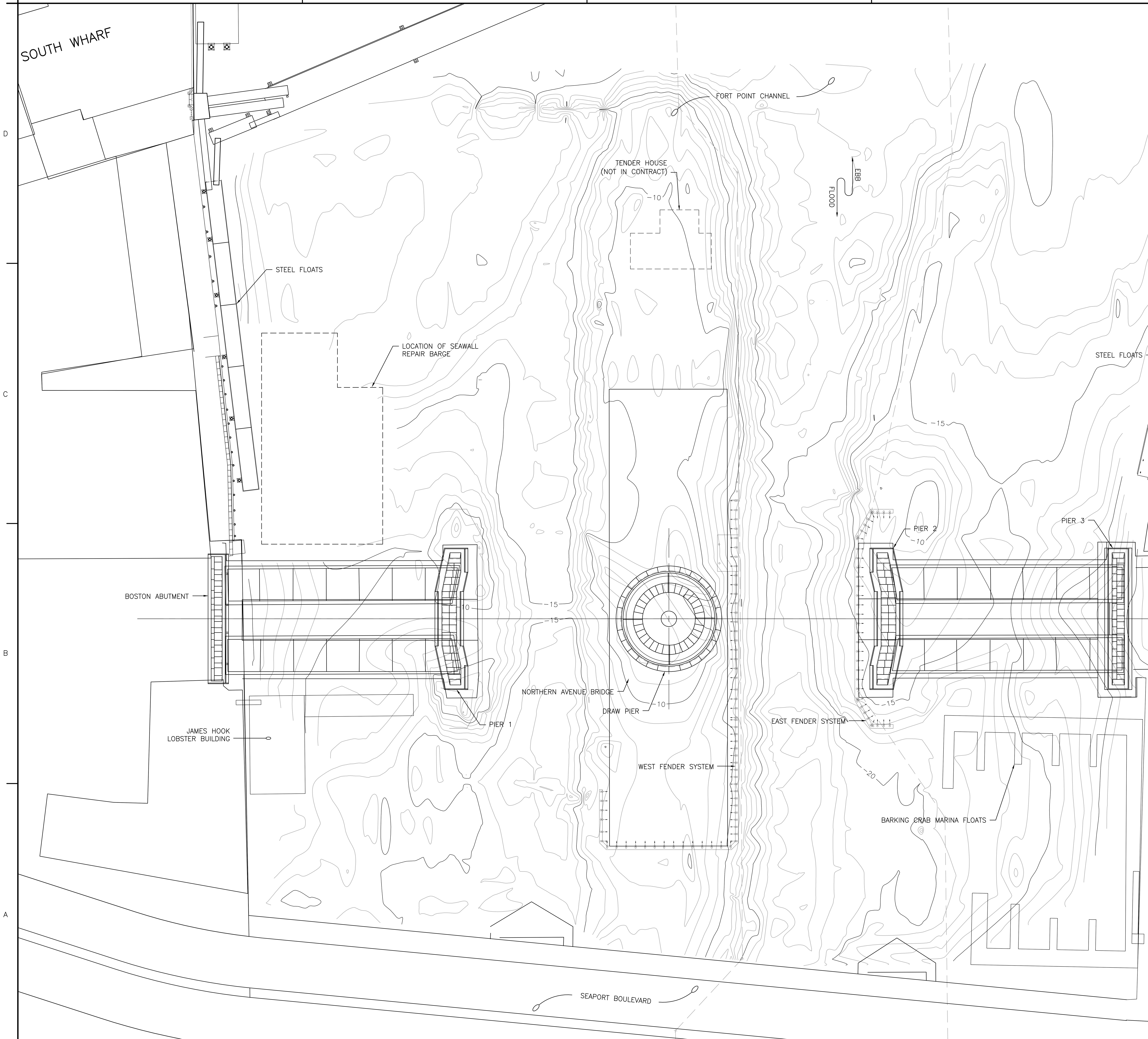
Date: 4/26/18
Design file no: 2753170 X-09
Scale: 1/4"=1'-0"
Designed by: CIC
Cad by: CIC
Drn by: APL
Reviewed by: ARN

NORTHERN AVENUE BRIDGE
AECOM
BOSTON, MA

SOUTH BOSTON ABUTMENT CONDITION PLAN

Sheet reference number: X-09
Sheet 9 of 11

AL LEDUC K:\2753-17.00 NORTHERN AVE BRIDGE - AECOM\CADD\CURRENT WORKING DWGS\275317.00 X-09 SOUTH BOSTON ABUTMENT CONDITION PLAN.DWG May 11, 2018 - 9:01am



NOTES:

1. HYDROGRAPHIC DATA SHOWN WAS COLLECTED ON APRIL 27, 2018 BY CHILDS ENGINEERING CORPORATION AND CAN ONLY REFLECT CONDITIONS AS THEY EXISTED DURING THE TIME OF THE SURVEY.
2. COORDINATES ARE BASED ON THE MASSACHUSETTS MAINLAND STATE PLANE COORDINATE SYSTEM NAD 1983 AND ARE EXPRESSED IN FEET.
3. SOUNDINGS AND ELEVATIONS ARE SHOWN IN FEET AND TENTHS BASED ON THE MEAN LOWER LOW WATER LINE (MLLW). POSITIVE VALUES REPRESENT AN ELEVATION BELOW THAT SAME PLANE.
4. BRIDGES, SEAWALLS AND BUILDINGS ARE SHOWN FOR REFERENCE ONLY.
5. SINGLE BEAM BATHYMETRIC DATA WAS COLLECTED USING ODOM ECHOTRAK 200 KHZ, TRIMBLE R8S AND HYPACK 2018 FOR DATA ACQUISITION AND PROCESSING.

TIDAL DATUM
NOT TO SCALE
NOAA TIDE STATION 8443970

MHHW = 10.28'
MHW = 9.84'
NAVD88 = 5.51'
MLW = 0.35'
MLLW = 0.00'

N

30 0 30 60
1"=30'-0" SCALE OF FEET

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Mark	Description	Date	Appr

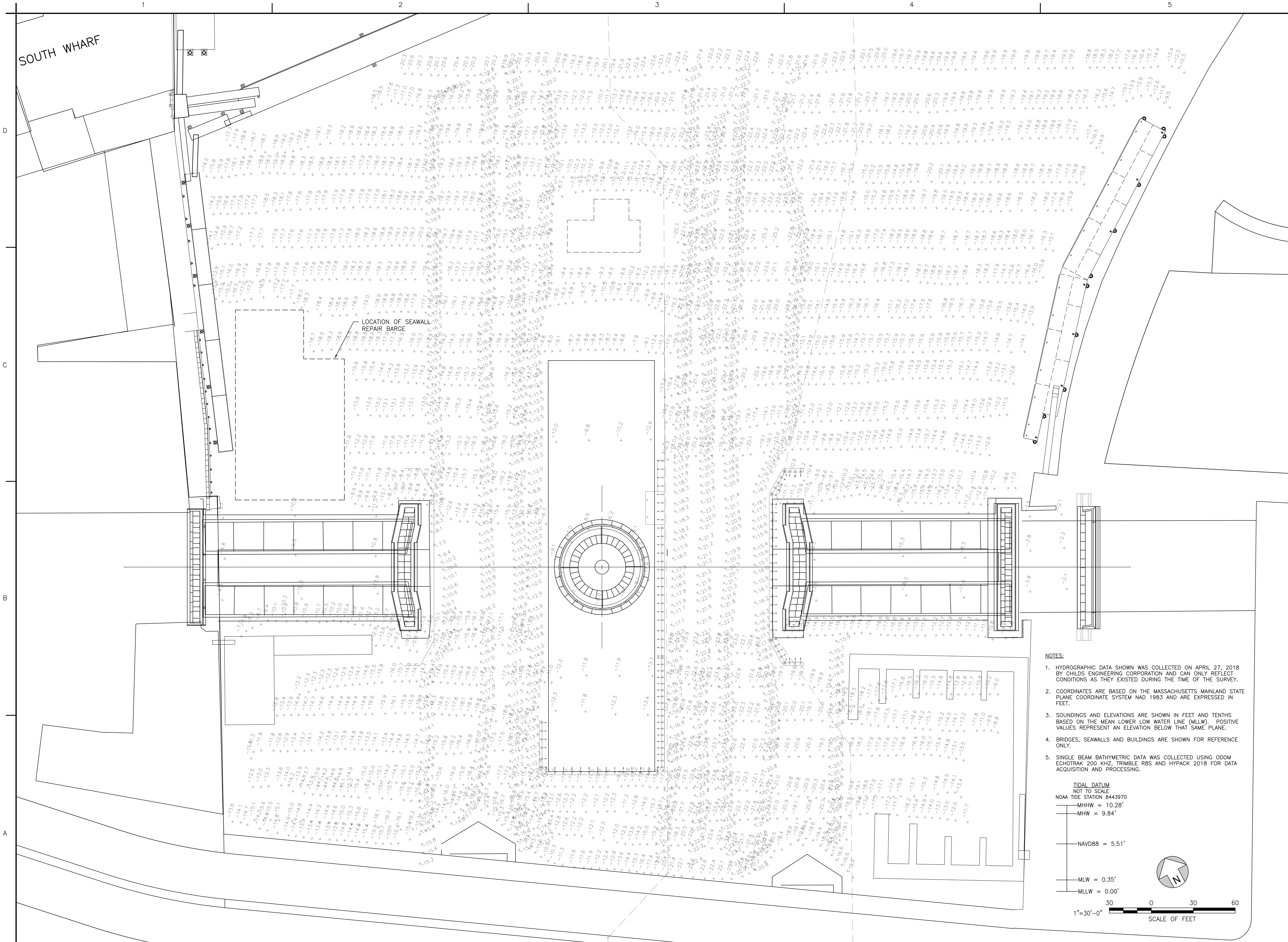
Designed by: CIC	Date: 5/16/18
Dwn by: APL / Ckd by: CIC	Design file no. 275317 X-10
Reviewed by: ARN	Scale: 1"=30'-0"

NORTHERN AVENUE BRIDGE
AECOM
BOSTON, MA

HYDROGRAPHIC SURVEY
CONTOUR PLAN

Sheet reference number:
X-10
Sheet 10 of 11

DREW K:\2753-17.00 NORTHERN AVE BRIDGE - AECOM\CADD\CURRENT WORKING DWGS\275317.00 X-10_11 HYDRO.DWG May 18, 2018 - 1:22pm



NOTES:

1. HYDROGRAPHIC DATA SHOWN WAS COLLECTED ON APRIL 27, 2018 BY CHILDS ENGINEERING CORPORATION AND CAN ONLY REFLECT CONDITIONS AS THEY EXISTED DURING THE TIME OF THE SURVEY.
2. COORDINATES ARE BASED ON THE MASSACHUSETTS MAINLAND STATE PLANE COORDINATE SYSTEM NAD 1983 AND ARE EXPRESSED IN FEET.
3. SOUNDINGS AND ELEVATIONS ARE SHOWN IN FEET AND TENTHS BASED ON THE MEAN LOWER LOW WATER LINE (MLLW). POSITIVE VALUES REPRESENT AN ELEVATION BELOW THAT SAME PLANE.
4. BRIDGES, SEAWALLS AND BUILDINGS ARE SHOWN FOR REFERENCE ONLY.
5. SINGLE BEAM BATHYMETRIC DATA WAS COLLECTED USING ODOM ECHOTRAK 200 KHZ, TRIMBLE R8S AND HYPACK 2018 FOR DATA ACQUISITION AND PROCESSING.

TIDAL DATUM
NOT TO SCALE
NOAA TIDE STATION 8443970

MHHW = 10.28'
MHW = 9.84'
NAVD88 = 5.51'
MLW = 0.35'
MLLW = 0.00'

1"=30'-0" 30 0 30 60
SCALE OF FEET

CHILDS ENGINEERING CORPORATION
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Mark	Description	Date	Appr.

Designed by:	Date:
CIC	5/16/18
Drawn by: APL	Chk'd by: CIC
Design file no.	275317 X-11
Reviewed by: ARN	Scale: 1"=30'-0"

NORTHERN AVENUE BRIDGE
AECOM
BOSTON, MA

HYDROGRAPHIC SURVEY
SURVEY POINTS PLAN

Sheet reference number:
X-11
Sheet 11 of 11

Attachment 7

Existing Condition Report

EXISTING CONDITION REPORT

Prepared For:

City of Boston
Department of Public Works

Northern Avenue Bridge
Over
Fort Point Channel

Bridge No: B-16-184 (38K)

Prepared by:

AECOM

AECOM
One Federal Street, 8th Floor
Boston, MA 02110

In Association with:

Hardesty & Hanover

March 30, 2018

Table of Contents

Files included electronically only
2017 Inspection Field Notes
2017 Inspection Photo Logs
2018 CSi Model for Northern Avenue Bridge

Additional reference documents not included within this report
Existing Bridge Plans
2015 Floorbeam Structural Ratings by TranSystems
2013 Structural Calculations by TranSystems
2013 Routine & Special Member Inspection Report by TranSystems
2014 Routine Underwater Inspection Report by MassDOT

1. Executive Summary

The Northern Avenue Bridge (Structure B-16-184, BIN 38K) has been closed to traffic since 1997 and pedestrians since December 2014. AECOM was hired by the City of Boston to develop project options for the existing site as well as perform a structural assessment of the existing structure in order to evaluate the feasibility of restoring the existing bridge. This existing condition report is intended to provide the City of Boston with an overview of the condition and capacity of the Northern Avenue Bridge.

AECOM performed a limited scope hands-on structural inspection of the bridge in the month of December 2017. The purpose of the inspection was to assess the condition of bridge components which have the potential to either be rehabilitated or reused for future project options. AECOM also developed 3d models of the bridge using CSiBridge software based on the existing design plans and as-inspected conditions of the bridge. The models were analyzed for several cases of live load which include pedestrian load only, H20 Vehicle, HS20 Vehicle, and HL-93 Truck.

Based on the inspection condition and load rating analysis, the level of effort required to restore the bridge to working order was determined. This report includes general strategies for restoration as well as a preliminary cost estimate. Based on this initial assessment, the order of magnitude cost for restoring the bridge to usable condition is approximately $83,500,000.

The report does not evaluate the various design options for the final solution but is simply an assessment of what elements of the bridge may be rehabilitated vs. replaced and the effort associated with doing so.

2. Summary of Recommendations

This report provides an evaluation of the current condition of the bridge and provides preliminary recommendations for a structural and mechanical/electrical rehabilitation in order to restore the existing bridge to a functional condition. Also included is an order of magnitude engineer's estimate for the cost of the recommended repairs. This evaluation and recommendations are based on field inspection findings and load rating analysis as described in detail in this report. The level of effort is limited to general strategies for restoration. The specific details of repairs and replacement of members are not included within the scope of this existing condition report. This report does not evaluate various use options and development.

The preliminary levels of effort to restore the bridge to functional condition are as follows:

- Complete replacement of the floor system for all truss spans, which includes the stringers, floorbeams, purlins, sidewalk cantilever brackets, and sidewalk support beams.
- Complete replacement of the deck and associated top of deck elements.
- Complete replacement of the Span 3 superstructure which includes stringers, floorbeams, girders, and the bearings.
- Rehabilitation of the trusses, which includes full replacement of selected truss members.
- Reconstruction of the piers, which includes replacement of the concrete core. The existing piles and pile caps are assumed to remain in place. The swing pier exterior wall should be extended vertically, as much as allowed by the trusses and floor system, to reduce flooding of the machinery pit.
- Repairs to the abutments, which includes repointing and concrete backwall repairs.
- Replacement of all mechanical and electrical components that comprise the swing machinery including, but not limited to, the live load shoes, span lock, pinion bearings, track castings, and tread plates.
- Replacement of all mechanical and electrical components that comprise the traffic gates and signals for vehicular control and safety.
- Installation of a permanent sump pump system within the machinery pit.
- A new tender's house, whose location should be determined based upon the future project options.

It should be noted that:

- The layout of the lower chords, diagonal web members, vertical web members, and upper chords make it difficult to measure and precisely quantify section loss due to space restrictions caused by the tight packing of the truss members. The complete extent of the deterioration in these areas will not be known until the areas are deconstructed and hidden deficiencies are uncovered. The potential for greater loss than previously observed is high and may lead to additional repairs, design, or analysis being needed in order to safely complete the rehabilitation.
- The Boston abutment vault which is located behind the abutment on the Boston side of the bridge (a coursed rubble filled chamber according to the design plans) is inaccessible and unable to be inspected. According to the design plans, the interior of the abutment consists of concrete encased 20" I-beams supported by concrete walls founded on concrete footings with timber piles. The condition of the interior of the vault is unknown. This existing condition report does not include an evaluation of this vault area.
- The condition of the timber friction piles supporting the abutments and piers is unknown. According to the Routine Underwater Inspection Report dated 11/25/14, the piles are

hidden and not visible for inspection. This existing condition report assumes that the pile condition and capacity is adequate for restoring the existing structure.

- The tender house was not inspected as part of the scope of this inspection. AECOM inspectors noticed significant deterioration to the exterior of the tender house. The timber walkways had areas that are sagging and a section of railing that is partially disconnected and hanging. The roof had several patch repairs and a few holes. If the tender house is to remain in place, it will require a follow-up inspection to develop rehabilitation plans.
- The existing fender system was constructed in 1996 and is generally in good condition based on previous inspection reports. Unless rehabilitation efforts require the removal of the fender system to perform construction, the fender system may be able to remain in place. Minor repairs would include replacing a few missing wales and replacing several missing bolts/nuts/washers at the pile-wale connection. If the fender system is to remain in place, it will require a follow up inspection to develop repair plans.
- The grade of steel used within the existing structure is unknown. The existing structure has two types of steel, one from the original construction in 1908 and the other from the reconstruction of the swing span from 1934 to 1936 which utilized the existing steel members as well as new steelwork fabricated by the Lehigh Structural Steel Company of Allentown, PA.
- Fatigue evaluation of the existing steel is unable to be performed since accurate traffic volume information as well as historical bridge opening logs are unavailable.
- This evaluation for restoration of the existing structure does not include consideration for raising the bridge for future sea level rise. For the purpose of this report, the existing elevation of the bridge is assumed to remain the same.

AECOM

3. Project Background

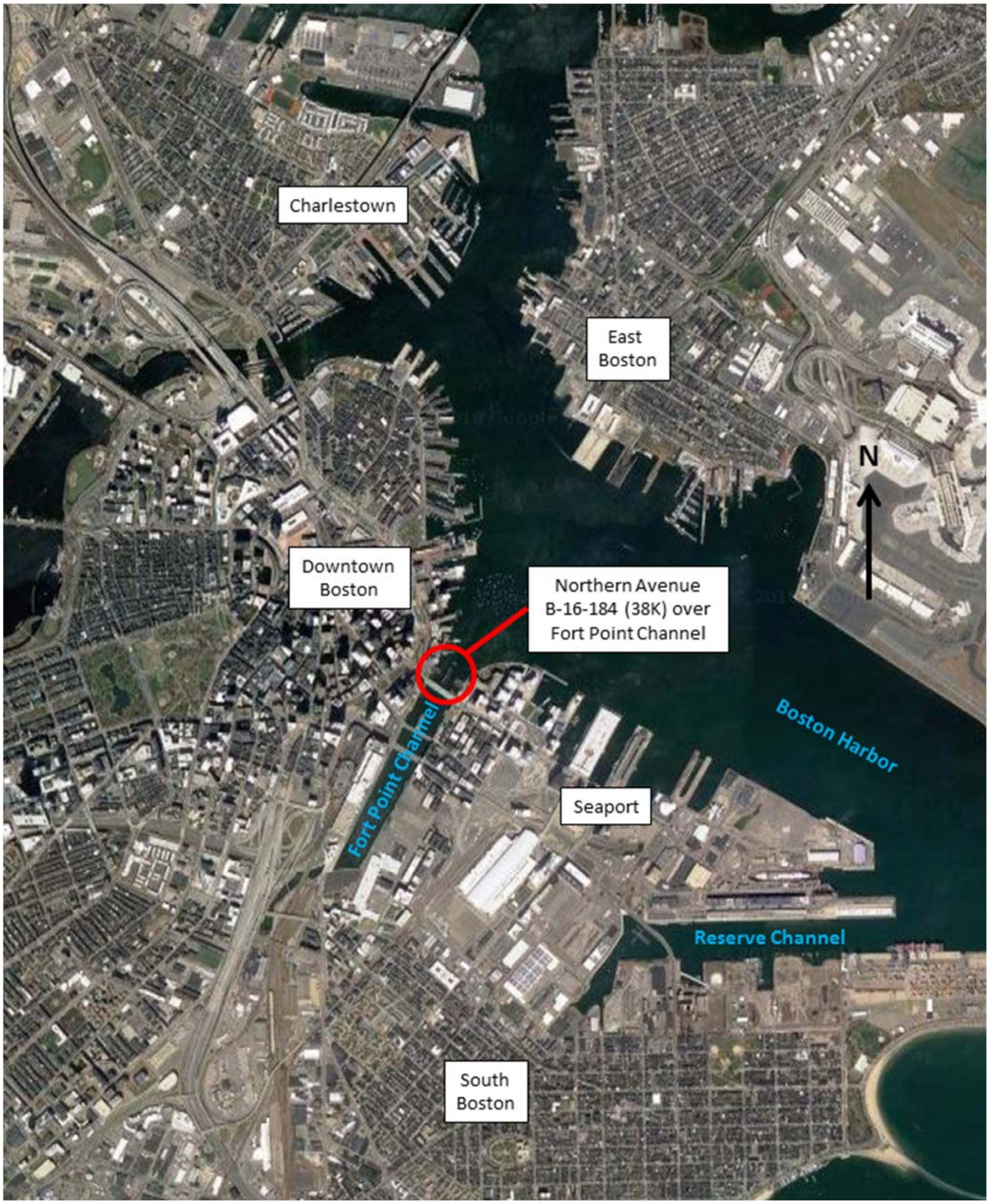
The Northern Avenue Bridge was constructed between 1905 and 1908 by the City of Boston's Engineering Department. The Northern Avenue Bridge is a four-span, 643-foot long, triple-barreled swing bridge with two Pratt-type pin-connected truss spans, a pin-connected truss swing span,and a steel multi-girder and floorbeam approach span on the east side. The bridge rests on granite block piers and abutments which are supported by concrete foundations and friction piles. The center swing pier, approximately 69-feet in diameter, is a massive concrete and granite structure which supports the swing span operating equipment set in a three-foot thick concrete turntable pit. For additional information regarding the bridge, **refer to Section 5: Description of Existing Structure**.

In 1997, the Northern Avenue Bridge was closed due severe deterioration and vehicular traffic was diverted to the newly constructed Evelyn F. Moakley Bridge. The bridge was then repurposed to serve as a pedestrian and cycle bridge as part of the Boston Harbor Walk with pedestrian traffic using the north bay. The bridge served in this role until December 17, 2014 when the bridge was closed to pedestrian and cyclist traffic following a load rating analysis in which 11 floorbeams that carried the pedestrian walkway were found to have a capacity of 0 tons.

Since then, the swing span has been kept in the open position allowing the navigable waterway to remain clear for marine traffic. Since the complete closure of the bridge, there have been concerns regarding the severe deterioration of the Northern Avenue Bridge and its structural stability.

4. Project Location

Image 1: Location Map



Not to Scale

5. Description of Existing Structure

5.1 Description of Bridge and Inspection & Rating Nomenclature

Bridge B-16-184 (38K) is a four span structure that carries Northern Avenue over the Fort Point Channel in the City of Boston.

This structure consists of a movable steel through-truss with a rim-bearing swing span, a fixed steel through Pratt truss approach span to the west and both a steel through Pratt truss and a steel multi-girder span as approach spans to the east. The swing span through-truss is comprised of riveted built-up steel upper chords, lower chords, end posts, verticals and diagonals, and steel eyebar diagonals with pinned connections. Riveted built-up steel floorbeams support rolled steel stringers and purlins which support an open steel grid deck, concrete filled over the machinery areas. The swing span is supported by riveted built-up steel distribution girders on a riveted built-up steel drum girder.

The through Pratt truss approach spans are comprised of riveted built-up steel upper chords, lower chords, end posts, verticals, and steel eyebar lower chords and diagonals with pinned connections. Riveted built-up steel floorbeams support rolled steel stringers which support a timber deck. The multi-girder approach span consists of riveted built-up steel girders and floorbeams with rolled steel stringers which support a reinforced concrete deck.

The approach spans are labeled from west to east with the west (Boston) approach span labeled span 1 and the east approach (South Boston) spans labeled spans 2 and 3. The swing span between spans 1 and 2 is referred to as "the swing span". The swing span is center-supported over a swing pier.

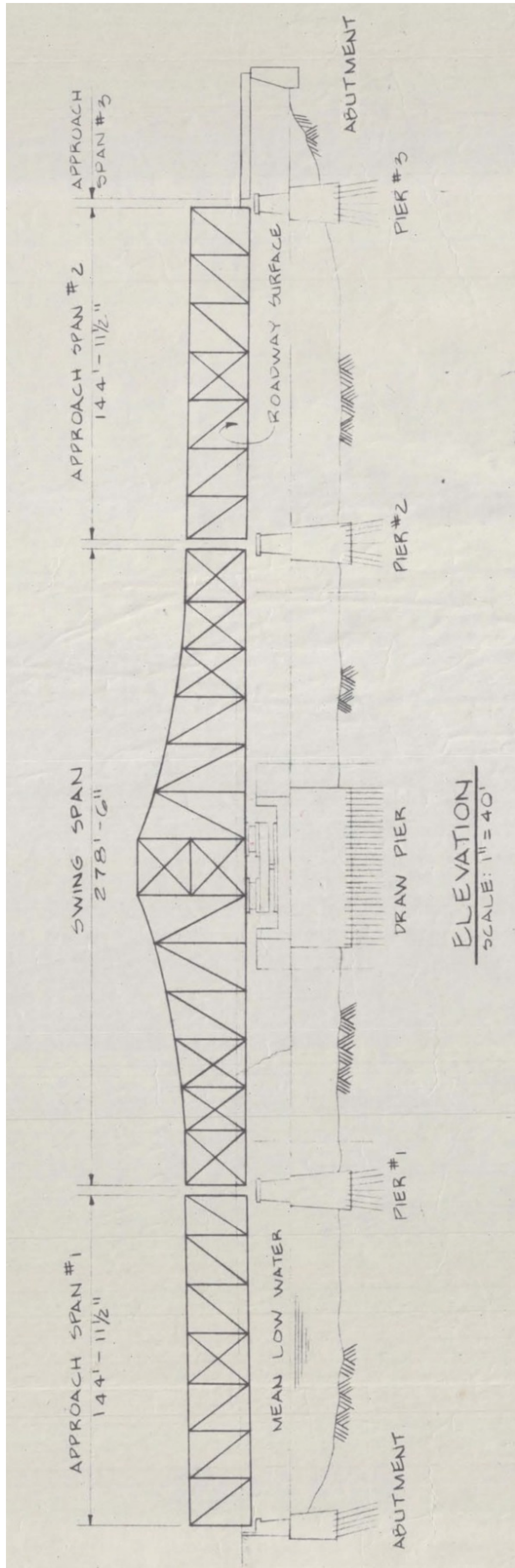
Each truss span has four trusses which divide the spans longitudinally into three bays and two sidewalks designated as the south sidewalk, south bay, center bay, north bay, and north sidewalk. The trusses in the swing span are designated A1S, B1S, B1N, and A1N from south to north. The four trusses in each truss approach span (spans 1 and 2) are designated A2S, B2S, B2N and A2N from south to north. The truss joints and floorbeams are labeled 1 through 30 starting with 1 at the west abutment in span 1, continuing sequentially through the swing span, and ending with 30 at pier 3 in span 2. Stringers are labeled from south to north within each bay and are designated by bay or sidewalk.

The girder span (span 3) has six girders which divide the span longitudinally into five bays and two sidewalks designated as the south sidewalk, bays 1 through 5 and the north sidewalk. The girders are labeled K through P from south to north. Floorbeams are labeled FB1 through FB6 from west to east. Stringers are labeled from south to north within each bay and are designated by bay or sidewalk. Span 3 is not included as part of the scope of this existing condition report and was not inspected or rated.

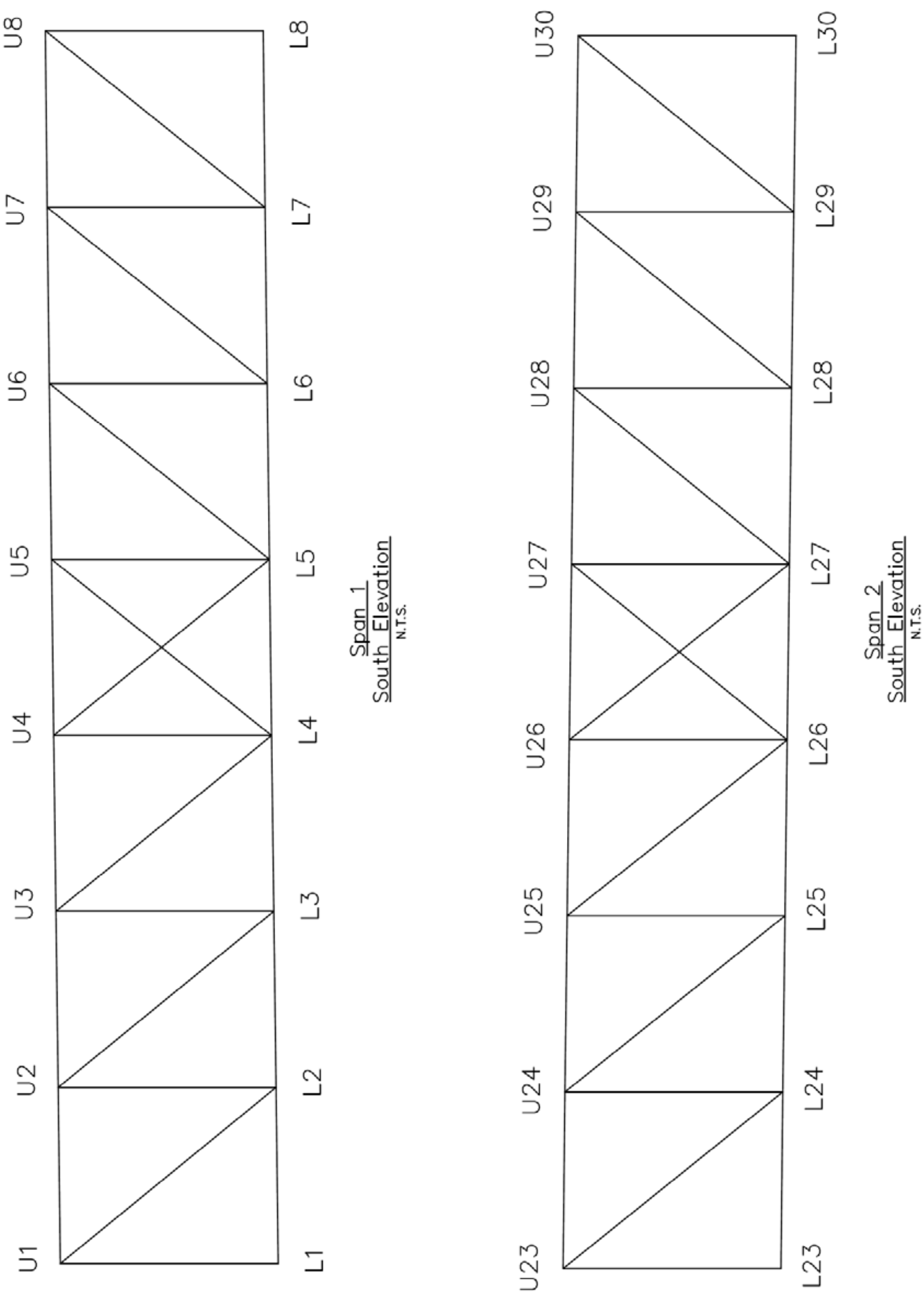
The substructure consists of two granite masonry abutments (east and west abutments), three granite masonry piers and a circular granite masonry swing pier. The substructure is designated from west to east as west abutment, pier 1, swing pier, pier 2, pier 3 and east abutment.

For general orientation, **refer to Sketches 1 through 5**.

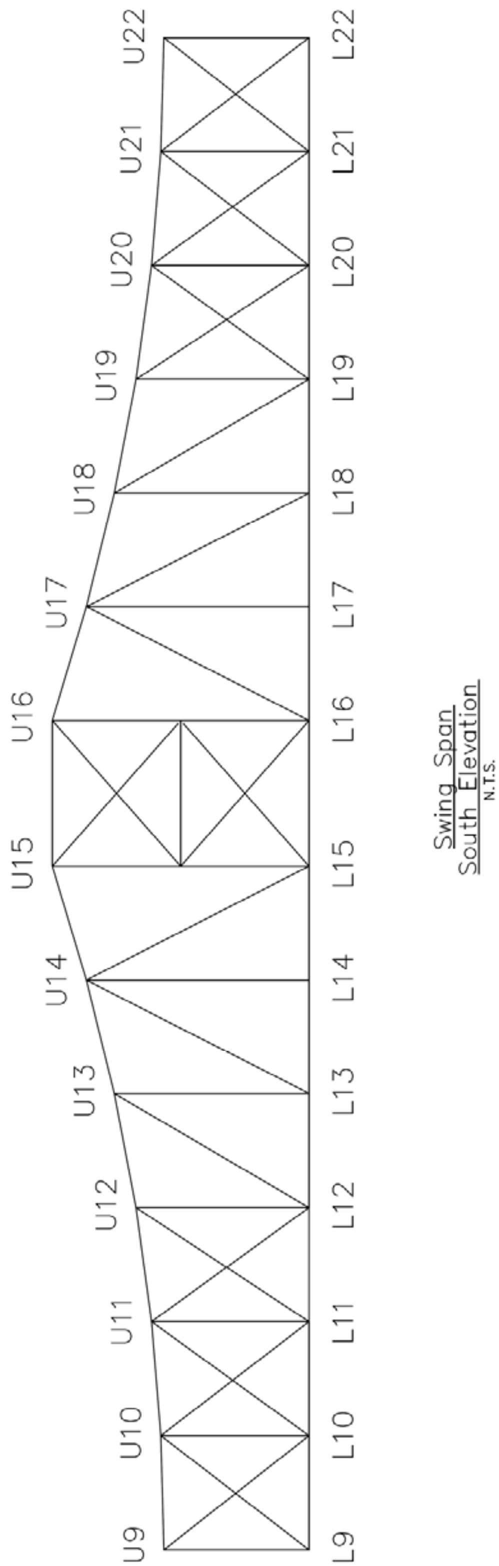
Sketch 1: Northern Avenue Bridge South Elevation



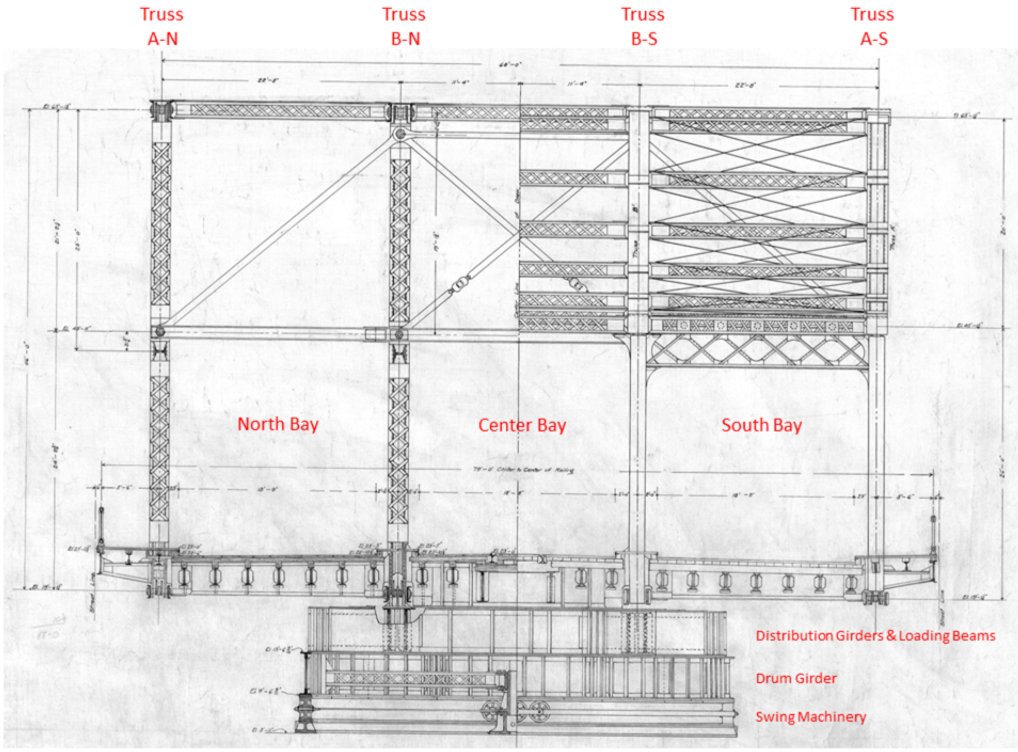
Sketch 2: Approach Span Truss Elevations



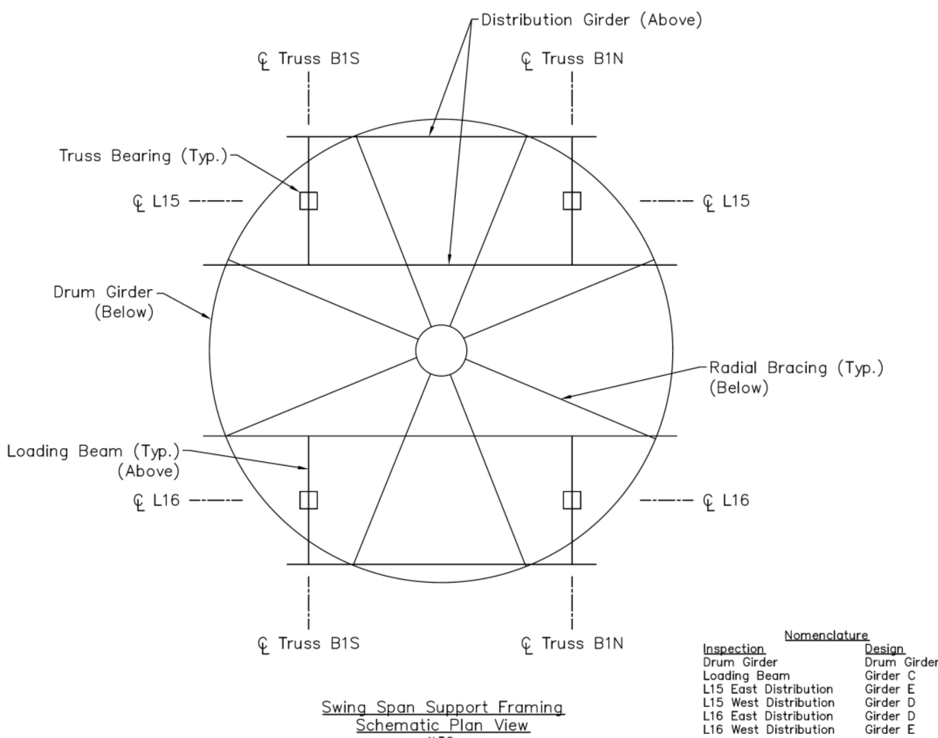
Sketch 3: Swing Span Truss Elevation



Sketch 4: Swing Span Cross Section (Looking East at Swing Pier Shown)



Sketch 5: Swing Span Support Framing Schematic Plan View



5.2 Design Plan versus Inspection Nomenclature Differences

This inspection followed the nomenclature used within the 2013 Routine and Special Member Inspection. This nomenclature differs from the design plans as follows:

Inspection Nomenclature	Design Plan Nomenclature
Truss panel points are numbered 1 through 30 from west to east through all spans	Swing span panel points are identified by letter; truss approach spans are identified by number
Stringers are numbered from south to north within each bay and designated by bay or sidewalk	Stringers are identified by size/type
Floorbeams are identified by truss panel point (1 through 30 from west to east through all spans)	Floorbeams are identified by size, type, and bay
Distribution Girders	Turntable Girders D & E
Loading Beam	Turntable Girder C
West Abutment	Boston Abutment
Swing Pier	Draw Pier
East Abutment	South Boston Abutment

6. Existing Conditions

6.1 Inspection Approach and Methodology

6.1.1 Structural Inspection

AECOM performed a limited scope hands-on structural inspection of the Northern Avenue Bridge (Bridge No. B-16-184, BIN 38K) in December 2017. The intent of the inspection was to assess condition of elements that could be reused after rehabilitation and to compare condition vs. the previous inspection. AECOM reviewed the Routine & Special Member Inspection Report dated July 9, 2013 (and associated field notes) and evaluated which elements had deteriorated to the degree that they cannot be reused or would require removal in order to facilitate rehabilitation.

The elements not inspected as part of this inspection on the basis that deterioration of a member or the general system with which it is associated prohibits reuse or rehabilitation are as follows:

- Deck and associated deck elements including the wearing surface, stay-in-place forms, curbs, median, sidewalks, guardrails, pedestrian railing, lighting standards, utilities, and deck joints
- Approach truss span floor system (stringers and floorbeams)
- Swing span floor system (stringers, floorbeams, and purlins)
- Truss span floor system bracing and lower lateral bracing
- Sidewalk cantilever brackets and sidewalk stringers (all spans)
- Span 3 in its entirety including the stringers, floorbeams, girders, and bearings
- Fender system

The conditions of the above elements are herein summarized as per the 2013 inspection report and the associated field notes.

AECOM identified all structural elements other than those listed above as requiring an in-depth inspection in order to adequately perform analysis and develop repair plans for project options involving rehabilitation of the existing structure or selective reuse of any members. The AECOM inspection verified and updated the 2013 Routine and Special Member Inspection Report field notes. The inspected elements follow:

- The existing substructure including the abutments and piers above the waterline
- All trusses in their entirety along with all secondary and bracing members and associated connections
- Truss bearings / live load shoes
- Swing span support members including the drum girder, distribution girders, and loading beams (access to these members was limited, as the machinery pit was flooded)

6.1.2 Mechanical & Electrical Inspection

The inspection of the mechanical and electrical components and their functionality has not been performed at the time of this existing condition report. The swing pier machinery pit was flooded at the time of inspection preventing access to the mechanical and electrical machinery.

6.1.3 Underwater Inspection

An underwater dive inspection has not been performed at the time of this existing condition report. The substructure was inspected from a skiff at low tide as part of the structural inspection.

6.2 Inspection Access Methods

The inspection was performed using several methods of access. The portions of the trusses below the deck and the substructure were inspected using a skiff with scaffolding. The upper portions of the exterior trusses were inspected using a Harcon bucket boat. The upper portions of the interior trusses were inspected using ladders and protected climbing techniques. At the time of the inspection, the swing span was in the open position and required the use of the bucket boat to gain access. The swing span support members are accessible within the machinery pit. The machinery pit access opening and ladder are located adjacent to the tender shack at the center of the swing span.

At the time of inspection, the bottom level of the machinery pit was flooded with water, limiting access to some of the swing span support members. The water submerged the drum girder and turning mechanismsand also limited access to portions of the distribution girders.

6.3 Inspection Team and Dates

This structural inspection was performed by R. Brockman (Team Leader), K. Ahearn, R. Matson, G. Mirliss, J. Jermyn, C. Yee, and T. Dunfey. The structural inspection was performed on 12/13/17, 12/14/17, 12/15/17, 12/18/17, and 12/19/17.

6.4 Inspection Findings Requiring Emergency Repair

While numerous structural members of the Northern Avenue Bridge have advanced deterioration, no emergency repair work was identified as necessary to maintain the bridge in its present condition.

6.5 Summary of Conditions of Structural Elements

This section summarizes the general conditions of the bridge elements. These comments are intended to describe the general conditions of the bridge. Any deficiencies beyond typical that require attention are also identified. The conditions are summarized based upon the 2017 AECOM inspection and the 2013 Routine & Special Member Inspection Report and associated field notes.

For specific deficiencies related to the 2017 AECOM inspection, **refer to Appendix A: 2017 Inspection Findings and Appendix B: Inspection Summary Photos.**

For specific deficiencies related to the 2013 inspection, refer to the 2013 Routine and Special Member Inspection Report and associated field notes.

6.5.1 Substructure

The substructure is designated from west to east as west (Boston) abutment, Pier 1, swing (draw) pier, Pier 2, Pier 3, and east (South Boston) abutment.

The west (Boston) abutment consists of a granite backwall, granite bridge seat, granite faced concrete breastwall, granite face concrete wingwalls, and concrete footings founded on piles. The bridge seat supports four truss bearings. The breastwall facing consists of 8 courses of granite stone. According to the design plans, the interior of the abutment consists of concrete encased 20” I-beams supported by concrete walls founded on concrete footings with timber piles. The interior of the abutment is inaccessible.

Specific deficiencies to the exterior of the west abutment follow:

- The breastwall is missing mortar for approximately 25% of the area.
- The breastwall has nine stones that have cracks up to 1/4” wide.
- The wingwalls are missing mortar for approximately 50% of the area.
- The bridge seat has debris and missing pointing.

The east (South Boston) abutment consists of a concrete backwall, concrete bridge seat, and granite faced concrete breastwall founded on the previously existing channel wall and its pile cap?and piles installed during the bridge construction. The breastwall facing consists of 7 courses of granite stone with only 6 courses visible above the mudline. The bridge seat has bearing stones partially embedded in the bridge seat to support six girder bearings. The channel walls adjacent to the abutment consist of granite blocks with chinking stones.

Specific deficiencies to the east abutment follow:

- The breastwall is missing mortar throughout.
- The breastwall has three stones with spalls up to 15” high x 15” wide by 10” deep.
- The breastwall has four stones with cracks up to 1/4” wide.
- The bridge seat has debris.
- The backwall has a vertical crack up to 1” wide, a 3’-0” by 3’-0” by 1” deep spall, and a 3’-0” length that is spalled through/failed with soil coming through.

The swing (draw) pier consists of granite faced concrete walls, a concrete floor, and a concrete footing supported by timber piles. The top of the wall has timber blocking with steel trim on top of the granite stones. The swing pier has seven courses of granite above the exposed footing.

Specific deficiencies to the swing pier follow:

- The swing pier is missing mortar throughout.
- The swing pier has six stones with cracks.
- The swing pier has four stones that have dropped onto the course below.
- The swing pier is full of standing water.
- The footing has scaling throughout.

The piers consist of granite faced concrete pierwalls supported by a concrete footing founded on timber piles. The top course of granite is considered the pier cap. The north and south ends of the piers have concrete aprons surrounded by sheet piling.

Specific deficiencies to Pier 1 follow:

- There is differential settlement at the south end of Pier 1. Due to the settlement, the southernmost 25'-0" of the pier is shifted up to 2" to the south, has complete mortar loss, and has daylight visible through the pierwall. The settlement has caused the Truss A2S bearing to lean towards the north. There is steel lagging in place which was installed as part of the repair plans dated 12/07/93 by Anderson-Nichols.
- The pierwall has mortar loss throughout.
- The pier has 6 stones with vertical cracks.
- The pierwall has 1 stone with a spall measuring 2'-0" high by 1'-0" wide.
- The pierwall has 1 stone that has shifted and is sitting on top of another block.
- The cap has debris and remnants of the live load shoes.

Specific deficiencies to Pier 2 follow:

- The pierwall has mortar loss throughout.
- The pierwall has two lengths, measuring 20'-0" and 5'-0", where there is a gap between courses and the stones are heaved upward approximately 1".
- The cap has four locations where the stones have shifted with gaps up to 5" between the adjacent stones. One of these locations has a stone overhanging the west edge of the cap by 2".
- The cap has debris and remnants of the live load shoes.

Specific deficiencies to Pier 3 follow:

- The pierwall has mortar loss throughout.
- The pierwall, at the north end, has approximately an 11'-6" wide gap between the cap and 2nd course from the top with stones heaved up to 2" on the east and west faces of the pier.
- The pier has 7 stones that have cracks up to 1/2" wide.
- The pierwall, at the north and south ends, has a location where daylight is visible between adjacent stones.
- The cap, at the north and south ends, has a stone that is shifted up to 1 1/2" towards the fascia of the bridge.

6.5.2 Trusses

The truss members were found to be varying in condition based upon their location along the bridge. The truss members located above the roadway are generally in satisfactory condition, with only a few areas of advanced deterioration. The truss members below the roadway generally have moderate deterioration, with several areas of advanced deterioration. The deterioration below the deck is typically located at the lower chord truss pins. The 2013 Routine and Special Member inspection rated Truss Elements (Item 59.5) as critical (condition rating = 2) due to this deterioration below the deck. The truss elements are summarized below:

Upper Chords:
The upper chords are generally in satisfactory condition (Condition rating = 6) and have a few scattered locations with minor section loss, rusted through/broken lacing bars, minor dents to flanges, or pack rust up to 1/4” thick between flanges and cover/splice plates. No significant deterioration was noted along the upper chords.

Additionally, at the upper chord splices, the bottom flange angles have butt welds between the adjacent angles (the webs and flanges have riveted splice plates). Within the swing span, some of these welds are cracked up to the full width of the weld however do not extend into the base metal.

Lower Chords:
The lower chords in the approach spans consist of riveted built-up box shaped end struts at the end posts and multiple eyebars throughout the interior panels. The riveted built-up end struts have severe losses with one instance of the member having failed and fallen into Fort Point Channel. These end struts were originally designed as zero force members and were not to carry live load.

The approach truss span lower chord eyebars have numerous areas of advanced deterioration, typically limited to the end 1’-0” of the eyebars at the truss pins. There are a few locations with previous repairs; however, the repairs also have advanced deterioration.

The lower chords in the swing span consist of riveted built-up members. The lower chords have areas of moderate deterioration with isolated locations with advanced deterioration, typically limited to the end 2’-0” of the members at the truss pins. A few of the lower chord members have rusted through/failed batten plates and lacing bars.

Vertical Members:
The truss verticals are riveted built-up members in all spans. Just above the top of the deck, the vertical members have moderate deterioration with isolated locations of advanced deterioration. Just below the deck level, the vertical members generally have moderate deterioration with isolated locations of advanced deterioration. The portion of the verticals which extends below the truss pins are typically severely deteriorated and deformed due to pack rust. Above the deck, a few of the verticals have minor to moderate deterioration along the edges of lacing bars or other attachments.

The verticals have welds along the flanges for the guardrail posts, welded plates along the flanges at the deck penetrations, and a few scattered welded attachments. Generally, no weld issues were noted; however, a few of the welded plates at the deck penetrations had cracked through welds which do not extend into the base metal. An isolated vertical member has moderate collision damage with a dented flange.

Diagonal Members:
The truss diagonals consist of eyebar members with the exception of the diagonals over the swing pier, which are riveted built-up members. The built-up swing pier diagonals have minor section loss below the deck level. Above the deck, the built-up swing pier diagonals are in good condition.

The eyebar members generally have advanced deterioration in the vicinity of the lower truss pins. Generally, the eyebar members are in satisfactory to good condition above the deck; however, there are a few isolated locations with minor deterioration at the upper chord pins. The eyebar members have a few areas of repairs, which consist of steel cables, looped wire rope with welded rods, or welded plates. The eyebar members have welded abrasion plates at the deck penetrations; one isolated location has a cracked weld. There are a few isolated welded attachments, with one isolated location with cracked welds which do not extend into the base metal.

Lower Lateral Bracing / Truss Span Floor System Bracing:
The center bay of the approach truss spans and swing span have angle or structural T bracing with riveted/bolted connections. The north and south bays of the swing span have a mix of round and square bar bracing with pin and clevis connections. The north and south bays of the approach truss spans have floor system bracing in lieu of lower lateral bracing which consists of a mix of round and square bar bracing with pin and clevis connections. The lower lateral bracing has areas of advanced deterioration with numerous connections that have rusted through completely.

Upper Lateral Bracing:
The upper lateral bracing consists of square bar bracing with forged loop ends and pinned connections. Several of the bracing bars have minor bends to the bars, likely resulting from construction. Several of the bracing bars have minor losses to the forged loop ends, with isolated areas with moderate to advance deterioration. Several of the bracing bar connection angles in the approach truss spans have rust holes along the edges of the angles and/or pack rust up to 1/2” thick between the forged loop ends and angles. Other than at the connections, the lateral bracing bars are generally in satisfactory condition.

Sway Bracing:
The sway bracing consists of built-up riveted angles, plates, and lacing bars. The approach truss spans have no sway bracing between the interior trusses (B2N & B2S). Generally, the sway bracing is in satisfactory condition. The sway bracing has a few scattered minor dents to the flanges. There are a few areas of rusted through/broken lacing bars, minor section loss, and isolated locations of small rust holes to the bottom flange angles.

Truss Pins:
The upper chord truss pins are generally in good condition. The upper chord truss pins have a few scattered areas of gaps between the pin nut and upper chord. There is an isolated pin nut with 3/8” negative thread. No losses to the upper chord pins were noted.

The lower chord truss pins have isolated areas of moderate deterioration to the pin, a few areas of moderate to heavy deterioration to pin nuts, several areas with gaps between the pin nuts and lower chords, and isolated pin nuts with negative threads up to 5/8”.

Notable deficiencies to the truss pins follow:

- 11 locations with losses to the pin nuts
- 16 locations with losses to the pin
- 15 locations with backed off pin nuts; 5 of 15 with negative thread

6.5.3 Truss Bearings & Live Load Shoes

The truss roller bearings (at the West Abutment and Pier 3) have heavy rust with losses ranging from 1/8” to 1/4” to all surfaces with rust holes to the pin plate stiffeners. The rollers have heavy rust bloom and are frozen. The fixed truss bearings (at Piers 1 and 2) have heavy rust with losses typically 1/8” deep to all surfaces with isolated locations up to 1/4” deep. Some of the bearing pin plates have small rust holes.

The live load shoes and some of the associated mechanical components for the swing span have been removed. Many of the end lift base castings are abandoned on the top of the piers; however, some of the bearing components been removed or are missing. A full inventory of the components was not performed.

At Pier 1, the Truss A2S bearing is misaligned and leaning due to the settlement of the pier. The south side of the bearing is 1 1/4” higher than the north side of the bearing. A concrete pad has been poured to provide full and even bearing of the leaning steel pedestal.

6.5.4 Swing Span Support Framing

The swing span support framing consists of a drum girder, distribution girders (Girders D and E per design plans) and loading beams (Girder C per design plans).

The drum girder is a circular built-up riveted girder which rests on 56 chamfered rollers that are placed around the circumferential length of the girder to provide almost continuous bearing. The drum girder is braced by radial struts and the rollers are braced by steel rods, both of which extend to the center pivot casting. Two sets of two distribution girders are supported by the drum girder with two sets of short loading beams that span between the distribution girders. The loading beams are twin built-up riveted girders that are in line with the centerlines of the B1N and B1S trusses. The L15 and L16 bearings for these trusses are located on top of the loading beams.

Due to the standing water within the machinery pit, the inspection of these members was limited at this time. This section is based on the 2013 Routine and Special Member Inspection. An additional follow up inspection of these members will be performed when the machinery pit has been drained.

The 2013 inspection indicates that the drum girder had heavy corrosion with areas of 1/8”section loss to the web, localized areas of up to 100% loss across the full width of the top flange angles, and additional areas of advanced deterioration to the outstanding legs of the web stiffeners. The drum girder radial bracing members have scattered locations with advanced deterioration to the angle legs and lacing members. Three of the original radial bracing members have advanced deterioration with 100% section loss to the angle legs and lacing bars. Four of the radial members were replaced in 2003.

The 2013 inspection indicates that the distribution girders had heavy corrosion with scattered areas of 1/4” inch section loss over the full height of the web adjacent to the stiffeners and sections along the bottom flange angles. There are also isolated small corrosion holes that have developed in the webs, and the outstanding legs of the web stiffeners have areas of advanced section loss and deterioration.

The 2013 inspection indicates that the loading beams had heavy corrosion with areas of 1/8” to 3/16” section loss and corrosion holes through the web. There were also localized areas of 100%

loss by up to the full width of the top flange angle outstanding legs, and areas of advanced deterioration along the outstanding legs of the web stiffeners.

6.5.5 Tender House

While not included as part of the scope of this inspection, AECOM inspectors noticed significant deterioration of the tender house. The timber walkways had areas that are sagging and a section of railing that is partially disconnected and hanging. The roof had several patch repairs and a few holes.

6.5.6 Deck and Associated Deck Elements

The deck and associated deck elements were not included as part of the 2017 inspection scope. The comments within this section are based on the 2013 Routine and Special Member Inspection Report and associated field notes.

The deck consists of timber planks in the approach spans and an open steel grid deck in the swing span. The timber planks have areas of minor rot. The open steel grid deck has areas of severe deterioration with disconnected and missing bars.

The associated top of deck elements were rated in 2013 as follows:

- Wearing Surface: Fair condition (5)
- Deck Condition: Poor condition (4)
- Stay-in-place forms: Fair condition (5)
- Curbs: Poor condition (4)
- Sidewalks: Imminent failure (1)
- Railing: Poor condition (4)
- Lighting Standards: Fair condition (5)
- Utilities: Poor condition (4)
- Deck Joints: Serious condition (3)

The sidewalk is rated as “imminent” failure (1) because a section of sidewalk is caving in due to severely deteriorated sidewalk stringers, sidewalk cantilever brackets, and sidewalk planks.

The remaining top of deck elements are anticipated to be removed and fully replaced in order to facilitate rehabilitation of the bridge.

6.5.7 Approach Truss Span Floor System (Stringers and Floorbeams)

The approach truss span floor system (stringers and floorbeams) was not included as part of the 2017 inspection scope. The comments within this section are based on the 2013 Routine and Special Member Inspection Report and associated field notes.

The stringers and floorbeams are both considered to be in critical condition (Condition Rating = 2). Numerous stringers have extensive areas of advanced deterioration including full height rust holes in the web and areas of 100% loss by up to full width of the flanges. Some stringers have detached bottom flanges due to corrosion holes in the webs.

Within the approach truss spans, the floorbeams vary in condition from fair (Condition Rating = 5) to critical (Condition Rating = 2). The floorbeam webs have losses up 1/4” deep while a few floorbeams have web rust holes. The floorbeam top and bottom flanges have losses ranging from minor to advanced with a few areas with rust holes.

6.5.8 Swing Span Span Floor System (Stringers, Floorbeams, and Purlins)

The swing span truss span floor system (stringers, floorbeams, and purlins) was not included as part of the 2017 inspection scope. The comments within this section are based on the 2013 Routine and Special Member Inspection Report and associated field notes.

The swing span stringers, floorbeams, and purlins were not inspected as part of this scope. The stringers and floorbeams are both considered to be in "critical" condition (Condition Rating = 2). The purlins are considered to be in "poor" condition (Condition Rating = 4).

Nearly all of the stringers have extensive areas of advanced deterioration including full height rust holes in the web and areas of 100% loss by up to full width of the flanges. Some stringers have detached bottom flanges due to corrosion holes in the webs.

Nearly all of the floorbeams have extensive areas of advanced deterioration including full height rust holes in the web and areas of 100% loss by full width of the flanges and flange cover plates.

The purlins are only located within the swing span. The purlins are in poor condition (Condition Rating = 4). There are localized purlins with advanced deterioration with full height rust holes to the web.

6.5.9 Sidewalk Cantilever Brackets and Sidewalk Stringers

The sidewalk cantilever brackets and sidewalk stringers were not included as part of the 2017 inspection scope. The comments within this section are based on the 2013 Routine and Special Member Inspection Report and associated field notes

The sidewalk cantilever brackets have small rust holes to the webs, areas of 100% loss by up to full width of the flanges, and deteriorated top flange tie plates. The sidewalk stringers have areas of moderate to severe loss.

6.5.10 Span 3 in its Entirety (Stringers, Floorbeams, Girders, Bracing, Bearings)

Span 3 was not included as part of the 2017 inspection scope. The comments within this section are based on the 2013 Routine and Special Member Inspection Report and associated field notes

The stringers, floorbeams, and girders within Span 3 have areas of moderate to severe deterioration. The stringers have severe deterioration with rust holes up to the full height of the web near Pier 3. The end floorbeams have severe loss with large rust holes to the web and areas of 100% loss by full width of the top and bottom flanges. The girders have 1/8" loss to the bottom flange cover plates, pack rust between bottom flange cover plates, and advanced deterioration to the lower portion of the web towards the east end of the span. The floor system bracing has areas of advanced deterioration to the bracing members and connections with areas of 100% loss and hanging bracing.

6.5.11 Fender System

The fender system was not included as part of the 2017 inspection scope. The comments within this section are based on the 2013 Routine and Special Member Inspection Report and associated field notes and the 2014 Routine Underwater Inspection Report.

The fender system was noted to be in good condition (2014 Underwater Report) and satisfactory condition (2013 Routine & Special Member Report). The fender system has two sections of missing wales (40'-0" long and 15'-0" long). The angle points have a few missing corner blocks. The pile-to-wale connections have a few areas where the bolts, nuts, and washers are missing.

6.6 Overview, Condition, and Rehabilitation of Mechanical & Electrical Elements

6.6.1 Overview of Electric Motors Installed in 1999

The existing bridge electrical control and drive system was installed in 1999. Originally the bridge was scheduled to be demolished in 2001 and as such the electrical control and drive system was designed for a two year service life. The prime movers are installed on small frames attached to the concrete filled steel grid deck over the machinery pit. The motor shafts are connected to the original gearing through a series of vertical gear couplings at the location of the original stub shafts used for operating the bridge manually via "T" wrenches.

The original operating system was compressed air and some of the original equipment, although not in service, still occupies the site. Some of the equipment, such as the electrical collector, several of the pneumatic end lift jacks, and various valves and levers that controlled the bridges operation have been lost over time.

The current prime movers are 15 HP 230/460 volt three phase totally enclosed fan cooled motors equipped with condensate drains and internal space heaters. They are currently operated by a three phase 208 VAC that is available at the site via a submarine cable originating from a terminal box located below the North Abutment.

The motors are attached to flange mounted reversible vertical gearmotors. They are of the multiple reduction type with a gear ratio of 64.3 to 1.

The brakes are direct acting, spring set, electromagnetically released, and are attached to the top of the prime movers. They are set for 50-foot pounds of torque. The brakes have been modified in the field by the removal of one (each) friction disc to provide a longer reaction time to reduce shock loads in the event of a power failure during operations for navigation.

Motor control is provided by a 30 Horsepower NEMA4 Invertor located in a NEMA4 enclosure equipped with a 200-watt space heater, cooling fan, and lineside terminal block. Current limiting transducers are provided on the load side of the invertor to prevent damage to the bridge operating machinery in the event of excessive operating friction/resistance loads.

Operation of the span is controlled via key switches located on the exterior wall of the invertor enclosure. The first key switch energizes the invertor and a second key switch controls rotation (open/close). A "jog mode" feature is also available to align the span with the approaches when "fully closed." A shielded foot switch is provided for machinery control and "dead man" safety. The brakes are released when power is applied to the gearmotor.

In the event of a power failure, the span can be operated by pulling a detent pin located on top off each motor brake to manually release the brake. Removal of a small plug, also on the top of each motor, exposes a shaft for the attachment of a ratchet, T wrench, or high torque low speed electric drill.

Swing span rotational speed and position control is provided by a series of 6 foundry grade limit switches located on a control arm bracket attached to the Boston side bull gear, pinion shaft and main pinion frame assembly located in the machinery pit. These limit switches control slow speed bridge opening and closing, bridge open and closed stops, and open and closed over travel stops. A series of curvilinear strike plates are attached to the inside of the concrete wall of the machinery pit to activate bridge control functions.

Currently, the machinery pit is underwater and prohibits a complete machinery and electrical inspection. The condition of the racks, wheels, tread plates, spider ring, reduction gearing, machinery support framing and associated shaft bearings are deteriorated from being submerged. The structural framing including the drum girder etc. are also assumed to have additional deterioration from seawater.

In general, the position and operating control limit switches and curvilinear strike plates are inoperable and/or damaged beyond reuse or repair. It is assumed that all above grade electrical equipment is functional and/or repairable. All electrical equipment, at the time of installation in 1999, including panel boards, enclosures, service disconnects at each motor, and terminations of the submarine cable at the bridge etc. were compliant with the Massachusetts Electric code.

There are few if any additional systems to be evaluated at this time. The existing swing span is not equipped with end locks and/or end lifts and it floats above the retracted live load bearings. Flashing red semaphore lights, located on the overhead portals of the approach span, were activated to announce operations for navigation. In addition, traffic barrier gates, located at the approaches to the swing span, were closed and opened manually by guards during operations for navigation. An alarm was also available. Street lights above the pedestrian way and a chain link fence along the interior truss line of the pedestrian way were used for public safety to control pedestrian traffic during operations for navigation.

6.6.2 Overview of Original Operating System Gearing, End Locks, and Gates

The existing machinery pit is flooded below the motor deck. The motor deck, which is wood frame construction, allowed access to the compressed air powered donkey engines and the compressed air connections to the various deck level operating valves and levers. The donkey engines have been disconnected from the drive train to reduce operating loads on the vertical gearmotors (back driving). The valves and levers were removed to allow structural repairs to the east side lower chord strut that restrains the loads from the cantilever trusses while the swing span is open to permit navigation.

The vertical motors are connected to the same shafts as the donkey engines and comprise the secondary gear set. The secondary gear set drives the tertiary gear set consisting of the bull gear and main pinion. There are two sets of “turning mechanisms”, both located along the centerlines of the interior “B” trusses. The main pinion interface has a curvilinear rack with a 21’-4-1/2” radius pitch line. The bull gear is connected to top of a 5-3/4” diameter vertical main pinion shaft connected to the main pinion that interfaces with the curvilinear rack. The pinion shaft is supported by two main bearings mounted to a steel frame connected to the drum girder. The pinion shaft, main bearings, and the main pinion were replaced in 2003. The original rack installation consisted of 32 sections attached to track castings on the floor of the machinery pit. The swing span is limited to a 90-degree rotation in the counterclockwise direction for opening due to the lack of useable rack sections. Eight (8) sections are required for the 90-degree movement. Two additional sections, one at each end of the eight required, are attached to the adjacent track castings to prevent translation of the rack during operations for navigation.

The swing span is a rim bearing design with a radius of 20’-0” to the centerline of the beveled tread plates. Between the upper and lower tread plates are 56 steel wheels with a mean diameter of 24 inches. The wheels maintain their radius via 1-3/8” diameter replacement tie rods attached to a replacement spider ring supported by a pivot casting located in the center of the turntable assembly. Interior and exterior steel spacing rings maintain circumferential spacing of the wheels and are from the original construction.

The lower beveled tread plate is attached to the track castings. Additional 1-1/8” square tie roads were added between the pivot casting and the tread plate casting in 1909. The presence of these tie rods has not been verified due to the amount of compacted debris on the floor of the machinery pit. The upper tread plate is attached to the lower flange of the circular drum girder. The alignment and position of the drum girder is maintained by eight (8) radial struts, including four (4) replacements attached to the drum girder and a center casting that rotates on the top of the pivot casting. The drum girder supports the distribution girders and the loading bears which in turn support the trusses.

In 1999, as part of the work to activate the bridge to permit navigation, the live load sliding shoes were disengaged. The live load sliding blocks were withdrawn into their nesting position, which is located below and within the adjacent approach truss span bearings, causing the ends of the swing span to float. The pneumatic end lifts, located at the South Boston end of each truss line of the swing span were disconnected from the below deck lifting arms/levers, and the pneumatic pistons were removed from the span. At the South Boston end of the swing span at least one of the bearing castings attached to the top of the rest pier was removed to prevent interference from thermal deflection of the trusses.

The roadway gates are original and operated manually, in pairs, via quarter moon gear segments located at the top and bottom attachments to the approach span end posts. The gates are held in the open position with hooks attached to “bunter” posts and are restrained in the closed position by chains. The gates are constructed of lightweight steel Tees and angle sections. Steel mesh was mechanically attached to the steel frame for security and a diagonal tie rod was added from the top corner at the end of the gate to a pivot connection about 4 feet above the top fence connection on the end post.

6.6.3 Rehabilitation of Mechanical & Electrical Systems

The mechanical and electrical inspection of the Northern Avenue Bridge has not been performed at the time of this existing condition report due to the standing water within the machinery pit. However, based on previous inspection reports, first-hand knowledge from previous inspections, and previous repairs, the following descriptions of the various critical components and anticipated repairs are reasonably valid for the purposes of this existing condition report.

The Northern Avenue Bridge requires, at a minimum, the following description of mechanical and electrical improvements and upgrades to restore serviceability.

Traffic gates and barrier gates on the approach spans will be required as part of the restoration for vehicular control and safety. Pedestrian gates will also be required. Electric power is available at each abutment. Depending on the location of the Bridge Tender's shelter, a wireless control system may be considered to reduce the need for new submarine cables.

The swing span will need a center lock, to maintain the alignment of the swing span and the approach spans. Four new live load shoes at each rest pier are required, and four end lifts at each truss termination will also be required. Depending on the end lift location, wireless or hardwired controls are both suitable.

As part of the rehabilitation process, the existing pneumatic end lifts, lifting arms/levers, and associated equipment on the downtown side of the navigation span, should be removed ***and it is suggested that they be saved for future display.*** Likewise, the lifting arms/levers and associated equipment, on the South Boston side of the navigation span should be removed. Any remaining air supply piping and appurtenances may be removed during the repairs to the purlins, stringers and floor beams.

The center traffic lane, formerly used to accommodate the Union Freight Railroad and a reversing vehicular traffic flow, is now occupied by the vertical gear motors, service disconnects and control center for operating the swing span for navigation. Access to the machinery pit is located on the north center truss line, near this equipment. Most of this equipment will not be suitable for reuse and will need to be removed New prime movers and enclosed speed reducers will need to be installed on the motor deck and integrated with the existing secondary gear set via the beveled gear set (disconnected as previously described) or a vertical right-angle drive. Swing span rotational speed and position control will be regulated by rotary cam switches connected to one of the speed reducers via a second output shaft. The donkey engines should be carefully removed ***and it is suggested that they be saved for future display.***

Relocation of the control center will require some study and be based upon the project options. Three possible locations to be considered include overhead, above the center span and supported by the truss framing, above a sidewalk and attached to the truss framing, and cantilevered outside a sidewalk (poor visibility) and restrained by the truss framing.

Operating the swing span for navigation, in its existing condition, and with the machinery pit dry, would require all bearings to be disassembled, cleaned and lubricated. These components include the center casting, spider ring, all wheel axles and all shaft bearings. Additionally, all exposed gear teeth need to be cleaned and lubricated including the secondary gear set, bull gear, main pinion, and all rack sections. The wheels and upper and lower tread plates will require scraping and wire brushing prior to operation and again after initial rotation. If the machinery and support system has not changed condition, the navigation span could be operated manually by a qualified operator, noting the fact that the speed and position controls are not operational.

A permanent sump pump system should be installed to assist in keeping the machinery pit dry. The floor of the machinery pit floor is equipped with a launder and collection pits for this purpose. At the present time, there are several inches of compacted debris that includes rust, scale and old lubricants that needs to be removed and legally disposed of, to facilitate future storm water and seawater removal.

The concrete ring wall surrounding the machinery pit should be extended vertically to reduce flooding. The elevation will be limited by interference points of the swing span roadway deck framing. The existing timber stop logs, installed in 2003 as a stop gap measure, should be removed, repaired and/or extended as required depending on the permanent design.

The main pinions and upper and lower main pinion bearings were replaced in 2003. The 2003 repair plans do not reflect this. The new main pinions (2) were plasma cut from A788 Pressure Vessel Steel and finished in a machine shop. These "new" components may be serviceable if refurbished. However, it shall be noted that the substrate drum girder had suffered severe section loss prior to this repair, making replacement of the main pinion frames, attached to and cantilevered off the drum girder, difficult. The installation of the main pinion frames to the substrate drum girder was completed in a step by step sequence of individual structural elements, under the supervision of a structural engineer, prior to attaching the new main pinion bearings and related components. Additionally, as part of the 2003 repair, the exterior spacing ring was to be replaced with a bronze thrust washer placed between the wheel hub and the spacing ring. This work was not performed, as a cost saving measure, due to the extra work of replacing the main bearings and pinion support frames. The existing/original exterior spacing ring is well worn at the wheel locations due to the axial thrust generated by the beveled wheels. The exterior spacing ring requires replacement with thrust washers.

Electric power to the swing span requires a complete inspection by qualified personnel. The junction box on top of the stop logs and on top of the pivot casting should be opened and inspected and refurbished as required. The power cable between the two boxes is installed in the old air pipe. This pipe may be flooded, thus the cable may be compromised. The cable should be megger tested prior to operating any electric system on the swing span.

The track castings, rack segments and lower tread plates are all in poor condition and are likely to be unserviceable and require replacement. As previously discussed, rack segments have been relocated along the pier and there may not be any more serviceable segments to use. The track castings have brackets that are used to attach the rack sections, but the holes have elongated and enlarged over time from wear from rack slip and corrosion. Rack movement can generate severe shock loads to the machinery. Additionally, about ten (10) years ago, the lower tread plates started to shift, indicating the connections to the track casting were failing. Clips were bolted to the sides of several tread plates to maintain alignment.

7. Preliminary Analysis and Comparison to Previous Floor System Rating Reports

7.1. Overview

A detailed review of Transystem's 2015 Load Rating Report for the floor system of Northern Avenue Bridge was performed by AECOM and it was determined that the findings in this report were accurate at the time of the previous inspection and that an additional load rating analysis was not necessary at this time. Based on the results of the previous load rating and the anticipated future usage of the bridge, it is recommended that the entire floor system, in the approach truss spans, the swing span, and Span 3, be replaced.

7.2. Background

The previous load rating analyzed the floor beams in the north barrel of the swing and approach spans of Northern Avenue Bridge according to the allowable stress method at the operating level with a pedestrian load of 65 psf. Pedestrian loading was applied within a 12' wide lane in the north barrel of the swing span and within the 18.75' wide lane in the north barrel of the approach spans.

The stringers in each span were presumed to exhibit similar or worse conditions than the floor beams and thus were not rated. The south barrel of each span utilizes the same design as the north barrel, the only difference being the as-inspected conditions. It was assumed that if rated, the south barrel would yield similar results to the north barrel and thus it was not rated separately in 2015. In addition, at the time, only the north and south barrels were anticipated to carry traffic and as such the center barrel floor beams were not rated.

7.3. Review

The applied deck dead load calculations utilized by Transystems were checked and determined to be an accurate representation of the as-built deck assembly. The associated load distributions and resulting member responses were checked and deemed to be accurate. The previous inspection report was reviewed. It has been determined that the bridge conditions have not improved, nor significantly declined, since the previous load rating. Member capacities were based off of the as-inspected member conditions found in the 2013 inspection report; the adjusted sectional property calculations were checked and deemed to be accurate.

7.4. Results

The 2015 load rating analysis of the Northern Avenue Bridge revealed that 1 out of 8 floor beams in the north barrel of Span 1 and Span 2 did not have sufficient capacity for the anticipated loads and that 11 out of the 14 floor beams in the north barrel of the swing span also did not have sufficient capacity for the anticipated loads. The tables below present a summary of Transystem's findings based on the as-inspected conditions with an anticipated pedestrian load of 65 psf.

Table 1: Approach Spans 1 & 2	
Member	**Operating Rating Factor**
FB 1 & 30	3.7
FB 2-6 & FB 25-29	3.05
FB 7 & 24	4.92
FB 8 & FB 23	0

Table 2: Swing Span	
Member	**Operating Rating Factor**
FB 9 – 14, FB 17, & FB19-22	0
FB15	4.24
FB16	2.15
FB18	5.71

7.5. Recommendations

Based on the anticipated usage of Northern Avenue Bridge it is recommended that the floor system be completely replaced instead of rehabilitated. The proposed usage of the bridge includes vehicular traffic as well as an increased pedestrian load of 75 psf. Given that the 2015 rating, which considered comparatively reduced live load cases, found that a significant number of the floor beams had zero live load capacity, it has been determined that the existing floor system is insufficient for any proposed usage of the bridge. The increased loading scenarios will yield decreased rating results and given the vast number of members that do not rate as is, rehabilitation of the floor system going forward is impractical. Thus a complete replacement of the floor system on each span is recommended.

8. Preliminary Analysis and Comparison to Previous Truss System Rating Reports

8.1. Summary

The primary members of the trusses on the approach and swing spans of the Northern Avenue Bridge were rated using the allowable stress method based on their existing conditions and the anticipated usage of the bridge in order to determine which members could be rehabilitated and which ones needed to be replaced. It should be noted that these recommendations are based on the as-inspected conditions. It is possible that when actual rehabilitation of the trusses commences, additional deficiencies may be discovered.

The results of our analysis were compared to results from the load rating performed by TransSystems dated 2013. Overall we found good correlation with the previous rating in terms of which members control the load rating, although there were numerical differences.

Our results show that the swing span truss yielded fewer members with insufficient load carrying capacities than the approach span trusses. Likewise, the interior trusses yielded fewer members with insufficient capacitates than the exterior trusses in both the approach and swing spans. Of the members that did not rate, the majority were lower chord and diagonal members. Approximately 52% of the approach span members did not rate for their controlling load case under the inventory condition as-inspected. Similarly, approximately 13% of the swing span truss members did not rate for their controlling load case under the inventory condition as-inspected.

8.2. Background

Each span of the Northern Avenue Bridge was analyzed and rated based on the assumptions and modeling conditions stated in Section 8.5: Computer Modeling. The models were created based on the as-built geometry and member sizes found in the existing plans. The effects of the as-inspected conditions were applied and checked in post-processing by adjusting the sectional properties and associated capacities of the members as needed.

For the purposes of this analysis, the anticipated usage of the Northern Avenue Bridge includes full vehicular and mixed vehicular/pedestrian options. The bridge was rated for the extreme anticipated conditions and the results are presented in this report.

8.3. Design Criteria

The following codes were referenced for modeling and analysis purposes;

- AASHTO LRFD Bridge Design Specifications, 7th Edition
- AASHTO Standard Specifications for Highway Bridges, 17th Edition
- AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges, 2009
- AASHTO LRFD Movable Highway Bridge Design Specifications, 2nd Edition
- MassDOT LRFD Bridge Manual, 2013 Edition

8.4 Design Assumptions

The following general design assumptions were made during the modeling process. More detailed information on the modeling assumptions and implementation are contained in Appendix C:

1. Based on the previous load rating and inspected condition, it is assumed that the entire floor system will be replaced. Thus, this load rating is based on the notion that the floor has been replaced in kind. The deck is also assumed to be replaced in kind for the purposes of this analysis.
2. The pinned connections on the truss and between the truss and the floor system enable each span, and each bay within each span, to function as an individual simply supported structure. The tension plates used to transfer load between the truss verticals and the sidewalk overhangs shall be analyzed at a later time.
3. The gusset plates in the floor system were not explicitly modeled however the weight of the gusset plates were applied as gravity loads at the base of the truss verticals where they framed into.
4. The railing and barrier between the main travel lanes and the sidewalk overhangs is assumed to be replaced with a type S3-TL4 safety rail and barrier that qualifies the sidewalk as non-mountable in terms of vehicular loading.
5. The substructure is not including in this rating analysis.

8.5 Computer Modeling

The bridge was modeled using CSiBridge software. The as-inspected load rating was determined based on the results from six models. Two models for the approach spans, two for the swing span in the closed position and two for the swing span in the open position were analyzed. The truss diagonals were varied in each model to ensure that the eye-bars were only subjected to tensile forces.

As described below, the models were analyzed for four cases of live loads; 75 psf of Pedestrian Load, H20 Vehicle, HS20 Vehicle and an HL-93 Truck. The locations of these loads were adjusted to yield the maximum responses in the truss members.

Each approach span was modeled as a simply supported structure. The swing span was modeled with pinned supports at either end and at the center pier for the closed position and with pinned supports at the center pier for the open position. Based on as-built connection details, the model was formed such that the stringers were pinned to the floor beams and the floor beams were pinned to the truss verticals. A pin connection was utilized at the deck to truss connection in order to limit the shears, moments and torsions in the deck transferring into the truss. All truss members were idealized as pin connections.

The material properties, section properties and loading conditions used to develop the model are discussed in the preceeding sections of this report. For further information on the model refer to *Appendix C.*

8.6 Geometry

The geometry of the model is based off of the as-built bridge plans. The total usable sidewalk width is 6.89 feet and the total usable lane width is 18 feet. There is 1 stringer in the sidewalk overhang on the approach spans and 2 in the swing span. The approach span exterior roadway lanes are supported by 6 stringers and the interior lanes are supported by 5 stringers and 2 track stringers. The swing span exterior roadway lanes are supported by 7 stringers and the interior lanes are supported by 4 stringers and 2 track stringers.

8.7 Materials

Material properties were based off of historical data from the date the bridge was constructed and matched those used in the previous load rating. *Tables 3 and 4* below summarize the material utilized.

Table 3: Unit Weights of Materials

Material	Weight	Units
Steel	490	pcf
Normal Weight Concrete	150	pcf
Light Weight Concrete	115	pcf
Paving Sand	120	pcf
Granite	170	pcf
Timber	50	pcf

Table 4: Strength of Materials

Property	Value	Units
Steel Yield Stress (F_y)	30	ksi
Steel Tensile Strength (F_u)	60	ksi

8.8 Members

The as-built section properties were based off of the bridge plans and the as-inspected bridge properties were based off of the 2012 existing condition report. It is assumed that the member conditions have not improved, nor significantly deteriorated, since the inspection. However it shall be noted that the as-inspected results included in this report are not definite and may not represent the exact condition of the bridge at the time of this report. For example, during the 2017 inspection select members were noted as exhibiting area losses greater than those used in the 2013 report. It was noted that a majority of the area losses utilized in the previous rating were taken at locations below the deck but that some members exhibited greater losses at locations above the deck. All conditions will be verified in the field during construction.

Each model was run utilizing the as-built conditions and as-inspected conditions were incorporated in post-processing. Area losses were calculated based on the inspection report and utilized to obtain an updated member capacity and associated load rating based on the existing conditions of the bridge. Refer to *Appendix D* for a summary of the section properties used in this load rating for each member.

8.9 Loading Conditions

8.9.1. Overview

Loads were applied in order to yield the extreme response on a typical interior and exterior truss line. Given the symmetry of the bridge it was assumed that if the opposite lanes were loaded that similar results would be observed. As such, only truss A1S, B1S, A2S, and B2S were analyzed and the results from these were applied to truss lines A1N, B1N, A2N, and B2N. The only difference between the north and south trusses within a given span are the as-inspected conditions and these were accounted for in post-processing. A total of 14 load cases were checked based on the potential usage of the bridge.

8.9.2. Dead Loads

Member self-weights and their associated responses were calculated in CSi based on sectional properties. Deck dead loads were calculated based on the as-built plans and were compared and verified with the previous rating results. Additional dead loads for connections and miscellaneous steel were added as line loads to each applicable member.

Equal dead load distribution was assumed rather than the pile cap analogy as proposed in the MassDOT Bridge Manual. The pile cap analogy determines the worst case scenario for the member being loaded and as a result, the sum of the force applied to all individual members being loaded is greater than the actual total load applied. Since the rating is concerned with the truss, which is loaded through the floor system, it is undesirable to have excesses loading transferring into the truss. Thus the deck dead loads were distributed based on equal distribution to all stringers in a given bay.

The applied dead loads include the weight of the slab, timber planking, safety railings, curbs, medians, nailers and other contributors. A breakdown of these loads can be found in *Appendix D.* In addition to the as-built loads a MassDOT Type S3-TL4 railing/barrier was added to either side of each roadway lane, resulting in a total of 6 barriers in each span. Barriers were added to replace the existing guardrail. The new system protects pedestrians and well as the truss members above the deck from vehicular impact. *Table 5* below summaries the final load applied to each stringer to account for the weight of the deck and its components.

Table 5: Load Distributions to Stringers

Stringer Location	Applied Load	
	Quantity	Units
Sidewalk - Approach Spans	0.61	klf
Sidewalk - Swing Span	0.08	klf
Exterior Lane - Approach Spans - All Bays	0.61	klf
Exterior Lane - Swing Spans - Typical Bays	0.1	klf
Exterior Lane - Swing Spans - Bays 14 to 16	0.16	klf
Interior Lane - Approach Spans - All Bays	0.57	klf
Interior Lane - Swing Spans - Typical Bays	0.12	klf
Interior Lane - Swing Spans - Bays 14 to 16	0.2	klf

Additional weight of connections, plates, and miscellaneous steel were calculated by hand based on the as-built drawings. The total weights per member were converted to equivalent line loads and compared to the pounds per linear foot of the given member's self-weight. A weight modification factor was determined based on the relationship between the self-weight and additional steel, these values can be found in *Appendix D*. The gusset plates attached to the floor system in the swing and approach spans were not converted to equivalent line loads. Instead, the weight of each plate was calculated and added as a gravity point load at the locations of the truss where they were connected. *Table 6* below summarizes these loads.

Table 6 Gusset Plate Loads

Spans	Area (ft)	Volume (ft^3)	Weight (kips)	Locations	
				Panel Points	Applicable Trusses
Approach	3.716	0.116	0.057	PP8, 23	1 on B1N and 1 on B1S
	5.948	0.186	0.091	PP7, 24	1 on B1N and 1 on B1S
	6.082	0.190	0.093	PP3, 4, 5, 6, 25,26,27,28	1 on B1N and 1 on B1S
	6.623	0.207	0.101	PP2, 29	1 on B1N and 1 on B1S
	3.902	0.122	0.060	PP1, 30	1 on B1N and 1 on B1S
Swing	3.487	0.109	0.053	PP9, 22	1 on B1N and 1 on B1S
	7.031	0.220	0.108	PP10, 21	1 on B1N and 1 on B1S
	6.623	0.207	0.101	PP11, 12, 13, 18, 19, 20	1 on B1N and 1 on B1S
	10.862	0.339	0.166	PP14, 17	1 on B1N and 1 on B1S
	10.424	0.326	0.160	PP15, 16	1 on B1N and 1 on B1S

8.9.3. Live Loads

A pedestrian load of 75 psf was distributed evenly amongst all stringers in a given span and applied as line loads where applicable, a summary of these loads can be found in *Table 7*. The pedestrian loading was considered across the 6.89' wide sidewalk and the 18' wide lane. Refer to *Appendix D* for more information.

Table 7: Pedestrian Load Distributions

Span	Stringer Location	Number of Stringers	Distributed Load per Stringer (klf)
Approach	Sidewalk	1	0.517
	Exterior Barrel	6	0.234
	Interior Barrel	7	0.201
Swing	Sidewalk	2	0.258
	Exterior Barrel	7	0.201
	Interior Barrel	6	0.234

Three vehicular load cases were considered; H20 Vehicle, HS20 Vehicle and an HL-93 Truck. The H20 load was considered so that the results could be compared with the previous rating results. The HL-93 truck functions as the benchmark for the worst possible vehicular loading condition. Given that a fair number of the truss members did not previously rate for H20 loading, it was anticipated that the HL-93 loading may cause a majority of the members to not rate and, as such, the HS20 vehicle was checked as a middle ground between the H20 and the HL-93 loading conditions.

In total, 14 load combinations were considered and a summary of these can be found in *Table 8* below. The maximum conditions for each member in an exterior and an interior truss were considered. Given the symmetry of the bridge, it was assumed that if the loading presented in Table 8 were reversed, for example if load combination 1 were applied to the north and center lanes instead, then it would yield identical results on the north exterior and interior trusses. *Images 2 through 7* depict the various conditions considered. Refer to *Appendix D* for more information.

Table 8: Live Load Combinations

Combination	Applicable Truss	South Sidewalk	South Lane	Center Lane	North Lane	North Sidewalk
1	Exterior Truss Line	-	H20 Truck	-	-	-
2		-	HS20 Truck	-	-	-
3		-	HL-93 Truck	-	-	-
4		Pedestrian	H20 Truck	-	-	-
5		Pedestrian	HS20 Truck	-	-	-
6		Pedestrian	HL-93 Truck	-	-	-
7		Pedestrian	Pedestrian	-	-	-
8	Interior Truss Line	-	H20 Truck	H20 Truck	-	-
9		-	HS20 Truck	HS20 Truck	-	-
10		-	HL-93 Truck	HL-93 Truck	-	-
11		-	Pedestrian	Pedestrian		
12		-	Pedestrian	H20 Truck	-	-
13		-	Pedestrian	HS20 Truck	-	-
14		-	Pedestrian	HL-93 Truck	-	-

Image 2: Vehicles in the Exterior Barrels
(Load Combinations 1-3)

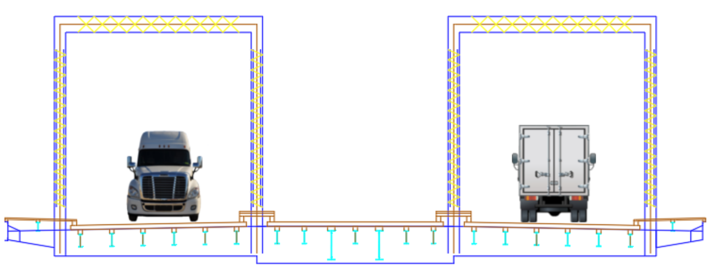


Image 3: Vehicles in the Exterior Barrels with Pedestrians in the Sidewalk (Load Combinations 4-6)

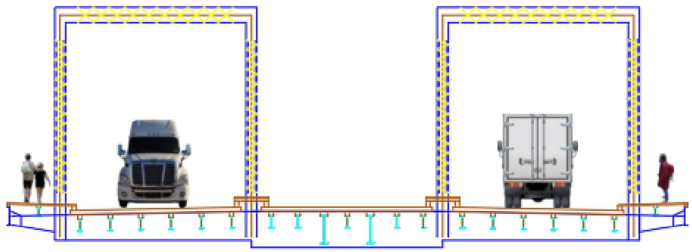


Image 4: Pedestrians in the Exterior Barrels with Pedestrians in the Sidewalk (Load Combination 7)

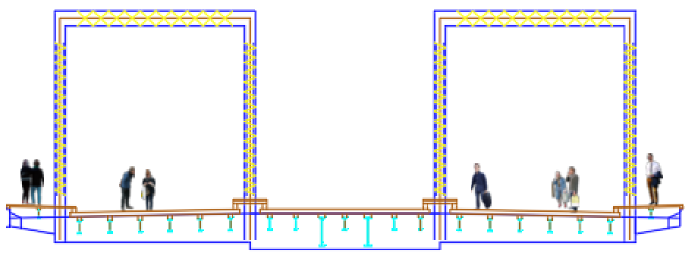


Image 5: Vehicles in all Three Barrels (Load Combinations 8-10)

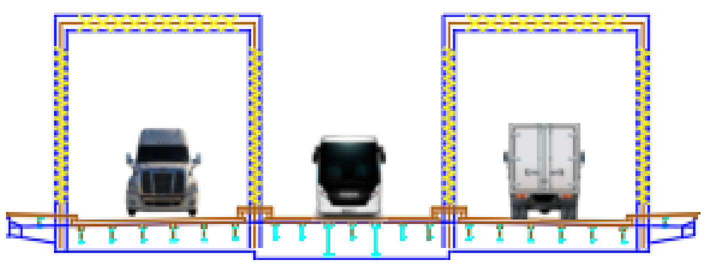


Image 6: Pedestrians in all Three Barrels (Load Combination 11)

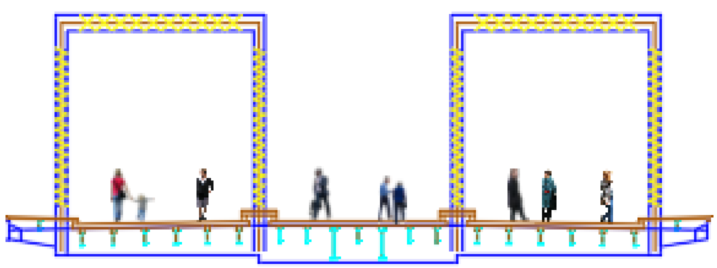
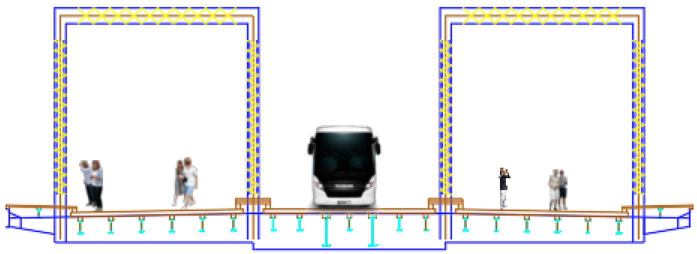


Image 7: Pedestrians in the Exterior Barrels and Vehicles in the Interior Barrel (Load Combinations 12-14)



8.10 Load Rating Inputs

8.10.1 Stresses

The stresses implemented to obtain the member capacities were based off of the equations in the Manual for Bridge Evaluation. Values varied based on tension and compression as well as inventory and operating load rating levels. *Table 9* below summarizes these values, for complete lists of the stresses utilized refer to *Appendix D.*

Table 9: Stresses

Stresses				
Stress	**Cases**	**Quantity[1]**	**Units**	**Reference**
F_{y_axial}	Inventory - Tension	16	ksi	MBE Table 6B.5.2.1-1
F_{y_axial}	Inventory - Compression	VARIES[2]	ksi	MBE Table 6B.5.2.1-1
F_{y_axial}	Operating - Tension	22.5	ksi	MBE Table 6B.5.2.1-2
F_{y_axial}	Operating - Compression	VARIES[2]	ksi	MBE Table 6B.5.2.1-2

(1) Values approximated based on historical data from the year the bridge was built
(2) Values vary based on the slenderness ratio of the member. Refer to Appendix D Section 6.5 for a complete list of the stresses utilized.

It shall be noted that the compressive stress for the as-inspected conditions were calculated using the same radius of gyration as the as-built sections. The radius of gyration will change based on the location of the defect on the member and will vary along the length of the member with each recorded defect. Since the area loss was taken as the extreme section loss along the length of the member updated radius of gyration was not calculated. Consequently, the compressive stresses utilized for the as-inspected members may not represent the actual stress in the field.

8.10.2. Capacities

Member capacities were based off of the sectional properties and anticipated stresses under the as-built and as-inspected conditions for each member. The inspection reports were utilized to determine the worst case of area loss for each member and these values were utilized to adjust the member capacities based on existing conditions. The reduced capacities for the as-inspected conditions are based on the extreme area losses recorded in the 2013 inspection report. As previously noted this does not necessarily represent the greatest area loss along the length of the member and thus all values shall be verified in the field. A summary of the results is presented in *Appendix D*. It shall be noted that if deteriorated members were replaced in kind, the increase strength of modern steel as compared to the steel used when the bridge was constructed would yield improved load carrying capacities of the members. However, the updated capacities of members with new steel were not checked at this time.

8.11 Load Rating Results

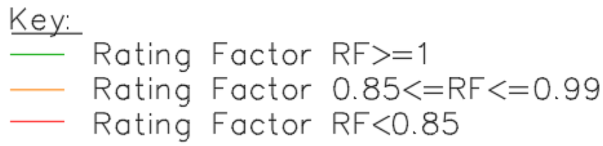
Axial loads were obtained for every primary truss member for each loading condition. Primary truss members include the lower chord, upper chord, verticals and diagonals. A complete list of the resulting axial load in each member can be found in *Appendix D*.

Rating factors were obtained for each member based on the 14 live loading scenarios described above. In general, the exterior trusses on both the approach and swing spans were controlled by the HL-93 Truck and sidewalk loading condition and the interior trusses were controlled by the two lanes of HL-93 Trucks. A complete list of the load rating for inventory and operating levels for each member for each load case can be found in *Appendix D.*

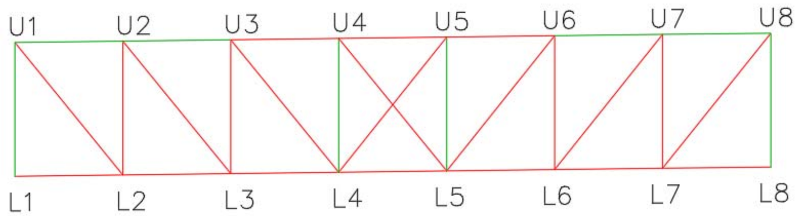
In general, the as-inspected interior truss performed better than the exterior truss. In most cases, the exterior trusses had nearly twice as many members categorized as having insufficient capacity for the anticipated loads as the interior trusses. This is likely due to the fact that the interior barrel was initially designed for increased railroad loading. The approach spans have nearly twice as many members noted as not having sufficient load carrying capacity as the swing span. This is likely due to the fact that the swing span members are built up for when it is cantilevered in the open, closed for traffic, position. Out of the four types of truss members considered, overall the upper chord had the fewest number of insufficient members and the lower chord and diagonals had the largest number of insufficient members for the anticipated loads.

A summary of the controlling rating factor results for the as-inspected inventory rating can be found in *Sketches 7 through 18.* A rating factor greater than 1 indicates the capacity of the given member is equal or greater than the loading. Refer to Appendix D for the complete load rating results.

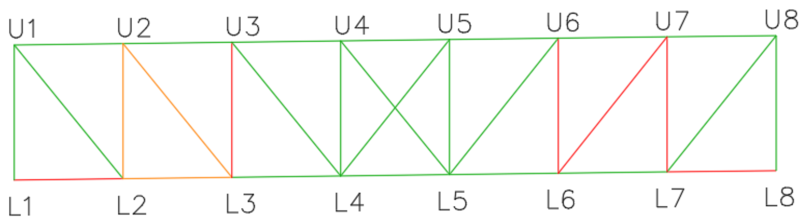
Sketch 6: Key for Sketch 7 through 18



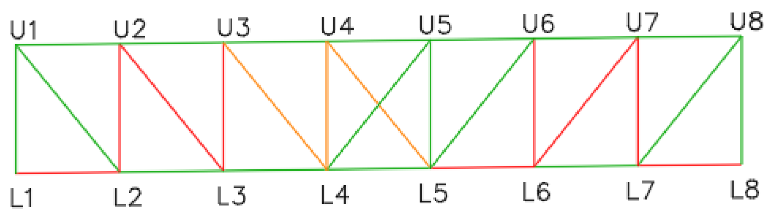
Sketch 7: Approach Span 1 Truss A2N



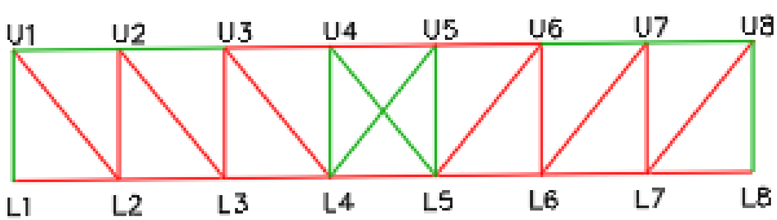
Sketch 8: Approach Span 1 Truss B2N



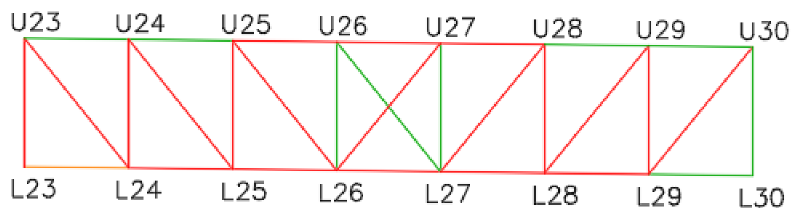
Sketch 9: Approach Span 1 Truss B2S



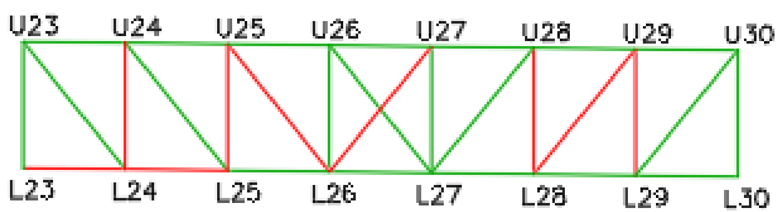
Sketch 10: Approach Span 1 Truss A2S



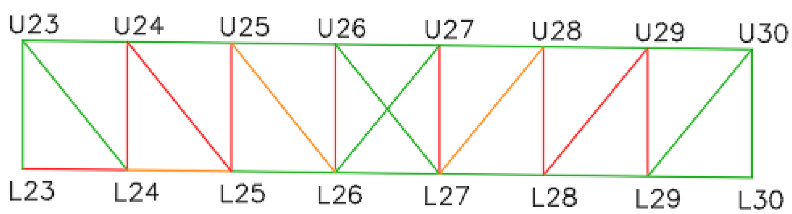
Sketch 11: Approach Span 2 Truss A2N



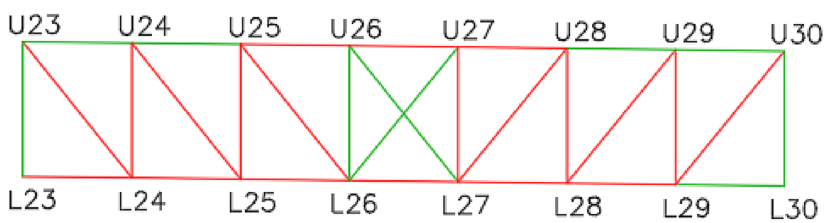
Sketch 12: Approach Span 2 Truss B2N



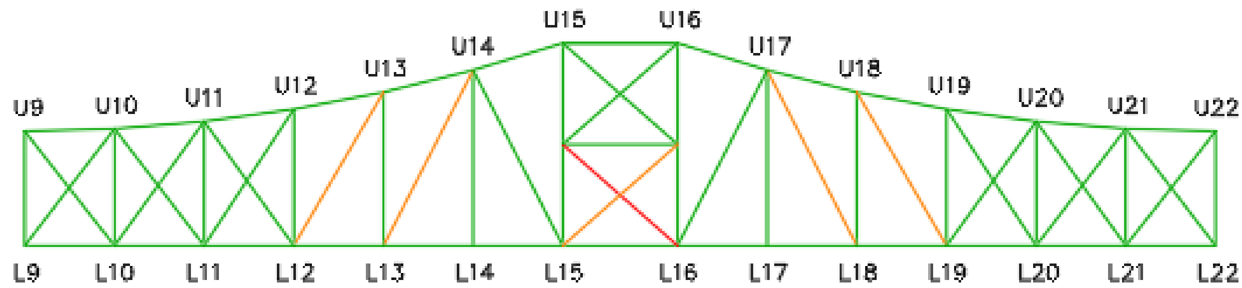
Sketch 13: Approach Span 2 Truss B2S



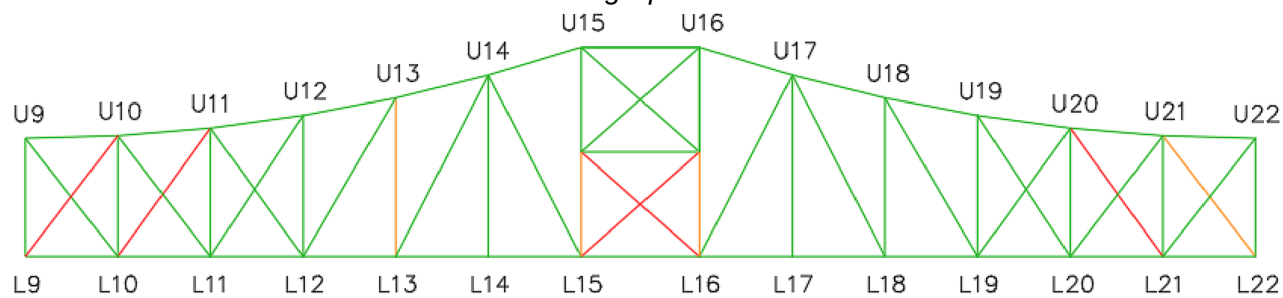
Sketch 14: Approach Span 2 Truss A2S



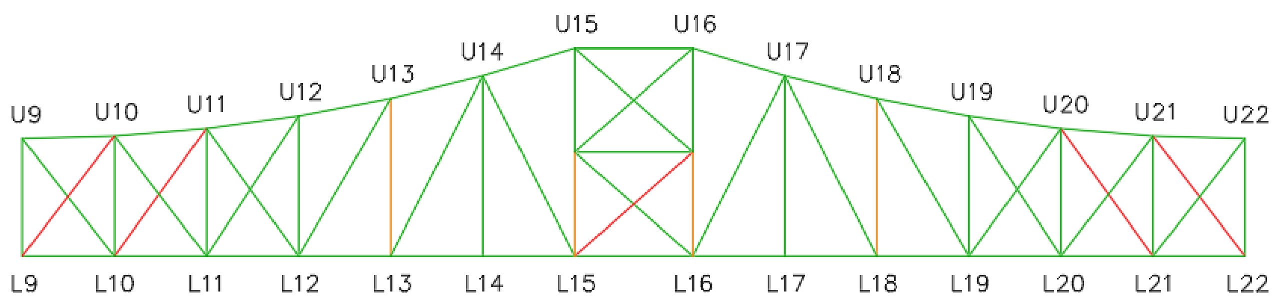
Sketch 15: Swing Span Truss A2N



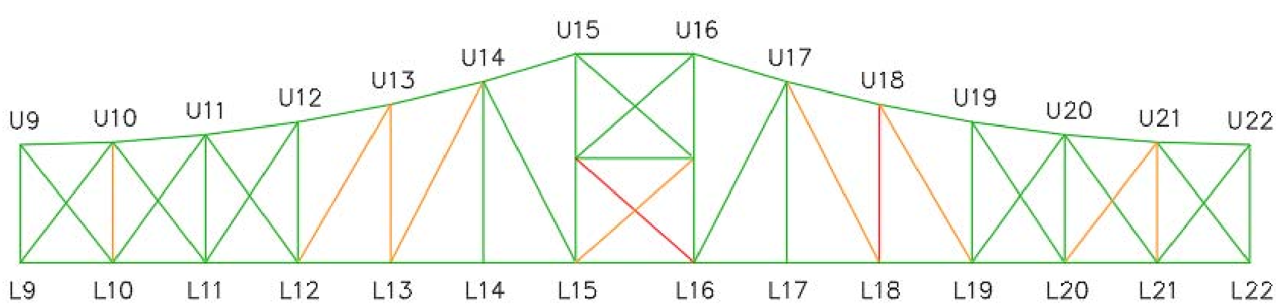
Sketch 16: Swing Span Truss B2N



Sketch 17: Swing Span Truss B2S



Sketch 18: Swing Span Truss A2S



Select members did not rate for the as-built loading conditions. For the inventory rating condition on the swing span a total of eight diagonals, 4 in the north interior truss and 4 in the south interior truss did not possess sufficient load carrying capacity for all 14 load cases considered as-built. Under the operating condition two members in the exterior truss of the approach span did not rate for the HL-93 Truck loading. The inventory condition resulted in a range of members yielding insufficient capacities depending on the loading condition. These members were primarily located in the exterior trusses. The HL-93 Truck was the main contributor to these conditions, however in select cases, members possessed insufficient capacities for other vehicles as well. Out of the members that did not rate under the as-built inventory conditions, the majority were verticals and diagonals. A full description of these members can be found in *Appendix D*.

If these members were replaced in kind they may rate and have sufficient load carrying capacity. The original steel has a significantly reduced strength compared to today's steel, thus if these same member sizes were re-created with stronger steel it is possible that they would have sufficient capacity for the anticipated loads. However, this will need to be verified during design if the rehabilitation is progressed. Should the members continue to yield insufficient load carrying capacities, even with the stronger materials, then larger cross sections will need to be used.

8.12 Recommendations

The members that will need to be repaired versus replaced are dependent on the final live loading scenario selected for the bridge as well as the field conditions at the time of rehabilitation. As noted earlier in the inspection portion of this report, certain members will need to be replaced based on their condition alone. The maximum vehicular load allowed on the bridge as well as the lane loading conditions selected will dictate the final rating results. These results shall be used in conjunction with the actual condition of the bridge at the time of repair to determine which members may be salvaged and repaired and which will need to be replaced, either in kind or with a larger section. Once final recommendations on the use of the bridge in terms of vehicle loading and pedestrians are developed, the complete extent of member repair and replacement can be refined.

9. Preliminary Analysis of Swing Pier Support Framing

The swing pier support framing consists of four loading beams which support the truss bearings and frame into the distribution girders. The distribution girders are supported on the drum girder at eight equidistant points, which is an arrangement that provides approximately even bearing to the drum girder rollers. The existing plans do not indicate the type of steel that was used in construction for these members. Therefore, these members were assumed to have a yield stress of 30 ksi.

At the time of this existing condition report, the machinery pit was flooded and an updated condition of these members could not be determined. As a result, the section losses documented in the 2013 inspection were used as the basis of this preliminary analysis with an additional 5% overall loss to account for any new losses over the last five years.

The preliminary analysis looked at the capacities of the loading beams and distribution girders to support the maximum vertical dead and live load truss reactions of the span in the closed position. This preliminary analysis did not include stresses from transverse or longitudinal loads. The transverse or longitudinal loads are a lower magnitude compared to the vertical dead and live load reaction, but will have some effect on the member capacities. However, this initial preliminary analysis was performed to determine if these members could support the major dead and live load vertical reaction, with remaining capacity for transverse and longitudinal load stresses that may affect the members. The maximum swing span truss reaction loads that were calculated as part of the preliminary truss analysis were used for the analysis of the swing pier support framing.

It was determined that:

- The live load beam reactions at the interior distribution girders cause a moment that is approximately 30% over capacity at the load beam connections. Additionally, the midspan moments due to the vertical dead and live load reactions calculated for the interior distribution girders were about equal to capacity. Additional stresses due to transverse and longitudinal loads would overstress this location.
- The exterior distribution girders and the loading beams were determined to have adequate reserve capacity to include stresses due to transverse and longitudinal loads.

The results of this analysis indicate that for the load beams and distribution girders to adequately support the main span, rehabilitation and strengthening of these members, as well as, the drum girder would have to be performed.

10. Basis for Preliminary Rehabilitation Cost Estimate

Planning level costs for the rehabilitation of the existing structure have been developed as part of this existing condition report. These costs are order of magnitude and are based on the currently available limited information and would need to be further refined at a later phase of this project.

The estimated cost for rehabilitation of the existing structure is $ 83,570,000 including contingencies, as the scope of this existing condition report is limited in terms of broad level rehabilitation. This estimate should be used to give an overall sense of the level of effort required to bring the structure back to working order. This cost does not include refinements in the use, approach work, resiliency and other factors which may be included in a final design solution for the site. The cost estimate is limited to construction costs and does not include soft costs such as design fees, construction management, or permitting.

The cost estimate is divided into 8 sections, each section dealing with a specific component of the bridge rehabilitation, *refer to Table 10*.

Table 10: Preliminary Rehabilitation Cost Estimate

Item	Description	Cost
997.01	Rehabilitation of Approach Truss Span 1 Superstructure	$8,460,000
997.02	Rehabilitation of Approach Truss Span 2 Superstructure	$8,460,000
997.03	Rehabilitation of Swing Span Superstructure	$25,910,000
997.04	Span 3 – Demolition & Superstructure Replacement	$1,350,000
997.05	Deck and Associated Deck Elements (all 4 spans)	$3,210,000
997.06	Abutment Rehabilitation (West and East)	$740,000
997.07	Pier Reconstruction (1, Swing/Draw, 2, 3)	$3,240,000
997.08	Waterway Construction Activities	$12,910,000
	Subtotal	$64,280,000
	30% Contingency	$19,284,000
	Total	$83,564,000
	CALL	**$83,570,000**

The preliminary rehabilitation cost estimate is based upon the structural rehabilitation evaluation included as Section 2 of this report. The basis for this cost estimate is limited to general strategies for restoration. The specific repairs and replacement of members are not included within the scope of this existing condition report. Repair details will need to be prepared as part of a later phase of this project.

The cost estimate was completed based upon the following overall assumptions:

<u>Approach Truss Spans:</u>

- The approach truss spans will be disassembled and rehabilitated off-site using cranes and barges to pick the spans.
- The truss rehabilitation includes the full replacement of the lower chords and diagonal web members, and the replacement of the bottom 8’-0” of each vertical web member. An additional 25% was added to cover other steel repair costs. Span 1 and 2 were assumed to have identical repairs.
- The existing floor system would be demolished and replaced in kind.
- The existing deck would be demolished and replaced with a reinforced concrete deck.

Swing Span:

- The swing span will be disassembled and rehabilitated off-site using cranes and barges to pick the spans.
- The truss rehabilitation includes the full replacement of the diagonal web members and replacement of the bottom 8'-0" of each web member. The lower chords were assumed to require replacement for 50% of the members. An additional 25% was added to cover other steel repair costs.
- The existing floor system would be demolished and replaced in kind.
- The existing deck would be demolished and replaced in kind.
- The existing swing pier support framing would be removed and replaced in kind.
- The swing machinery and other mechanical/electrical equipment would be removed and replaced with a new system.

Span 3:

- Span 3 would be demolished in place with adequate shielding and water protection.
- The new Span would not be replaced in kind. It was assumed that the span would consist of 8 girders with an assumed size of W33 x 141.
- The new superstructure would be assembled off site and picked into position with cranes and barges.
- The new deck would consist of reinforced concrete.

Substructure:

- The substructure rehabilitation will require the use of cofferdams.
- The existing piers would be demolished down to the top of the pile cap and then replaced in kind (granite with concrete core). The existing piles and pile caps are assumed to remain in place.
- The existing abutments would be repaired or rehabilitated which includes repointing and concrete backwall repairs.

Waterway:

- The waterway within the footprint of the bridge would be cleared of debris and abandoned piles. This would include dredging of the channel for the barges during span lifts. Hazardous material disposal costs are included for assumed values.
- The existing fender system would be removed due to interference with the cofferdams.
- The Barking Crab and James Hook would require costs to protect the buildings, dock, and pier.
- The existing tender house was assumed to be rehabilitated and would require asbestos abatement for the machinery.
- A new fender system would be constructed along Piers 1 and 2 and completely surround tender house and swing span in the open position. The estimate does NOT include a deck for the swing pier fender.