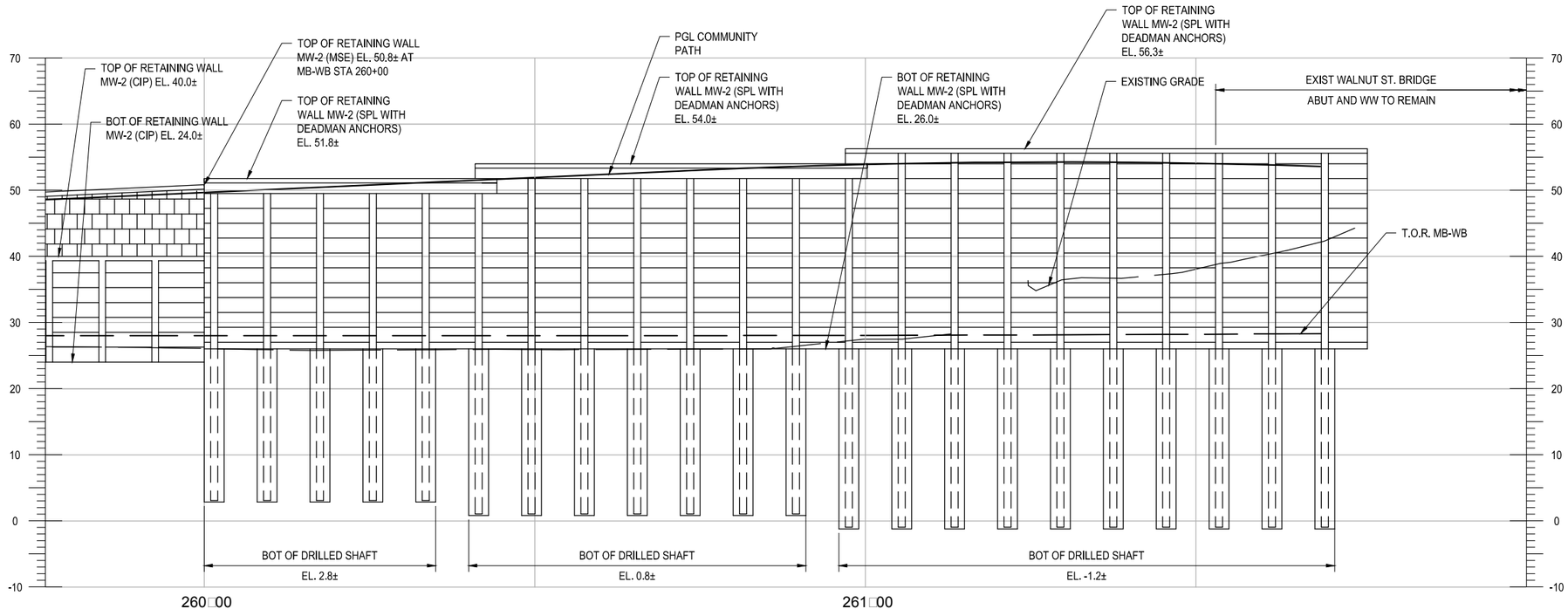


DEVELOPED WALL ELEVATION MW-2 - WEST RETAINING WALL

SCALE 1"=10'

SCALE IN FEET

0 10 20 30

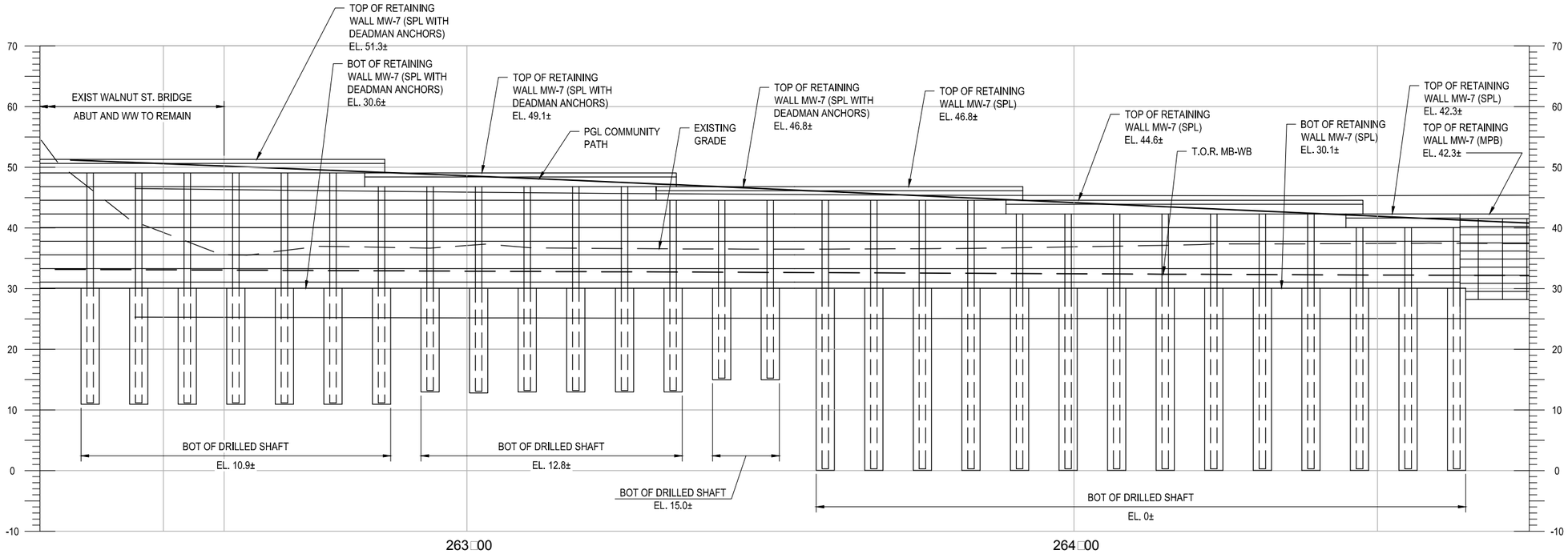
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD BRANCH
WEST CORRIDOR WALL ELEVATION
MB-WB STA 259+75 to STA 262+50

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **RWS-S-3001**



DEVELOPED WALL ELEVATION MW-7 - WEST RETAINING WALL

SCALE 1"=10'

SCALE IN FEET

0 10 20 30

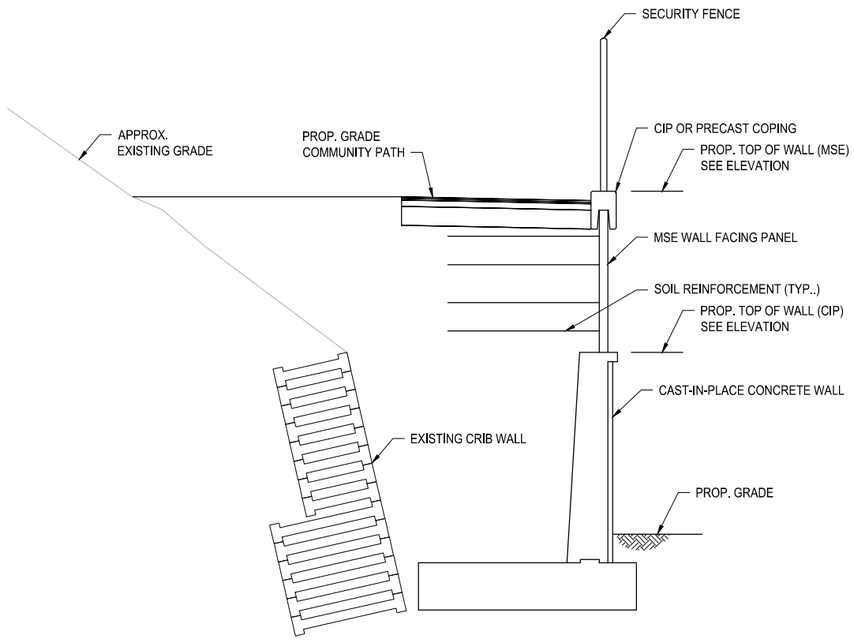
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

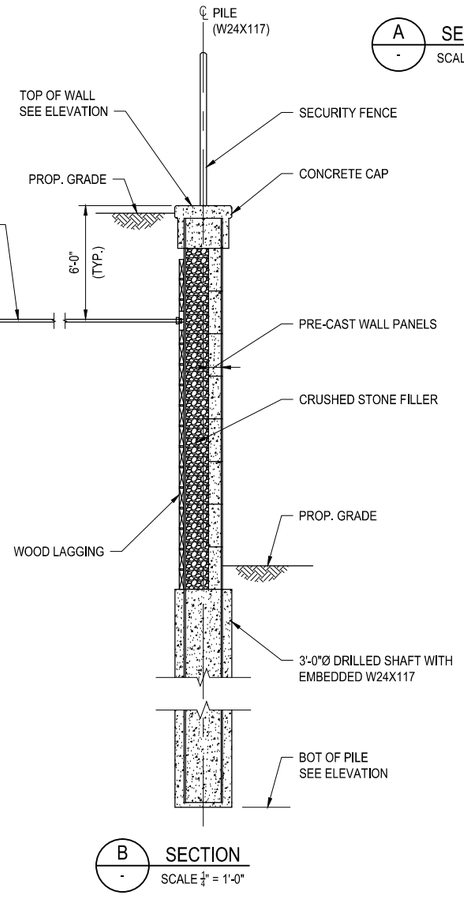
THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD BRANCH
WEST CORRIDOR WALL ELEVATION
MB-WB STA 262+25 to STA 264+75

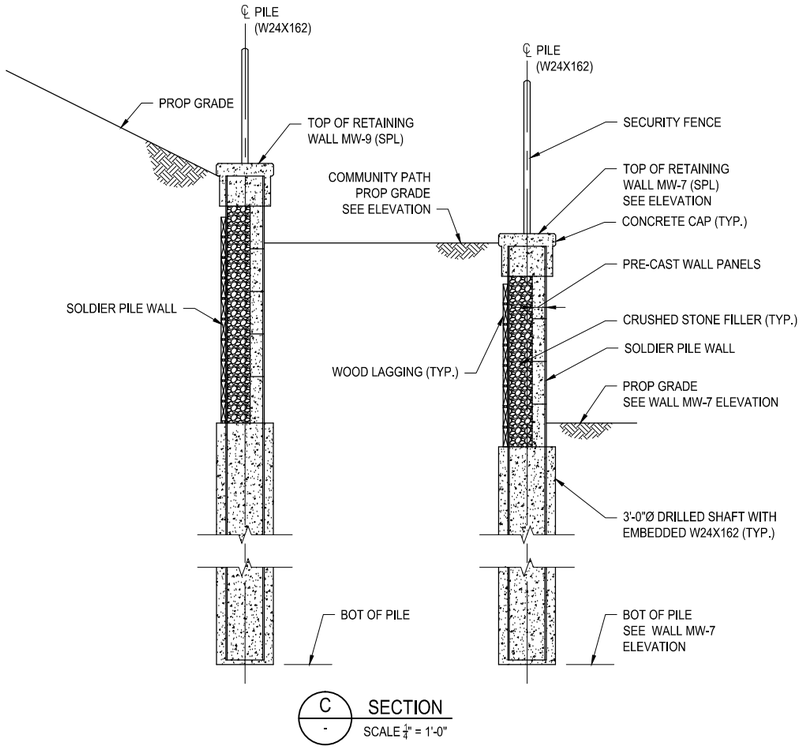
DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **RWS-S-3002**



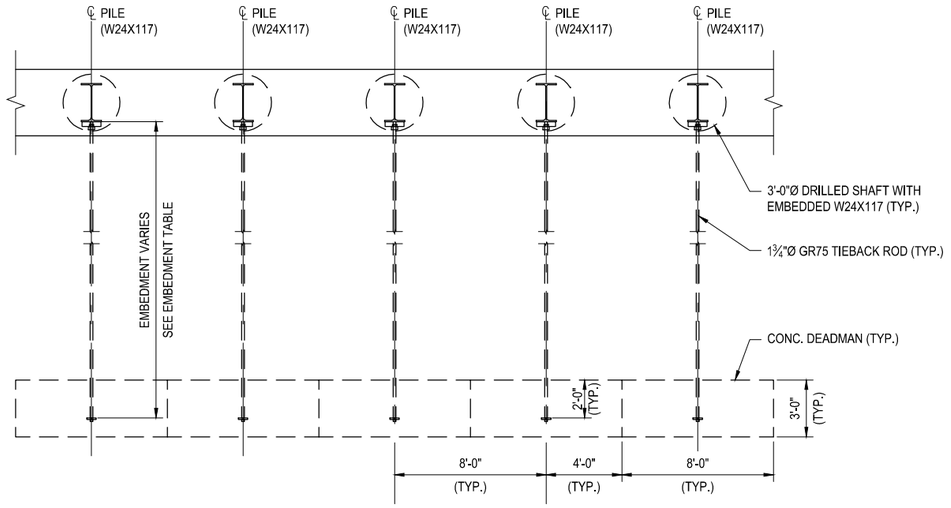
A SECTION
SCALE 1/4" = 1'-0"



B SECTION
SCALE 1/4" = 1'-0"



C SECTION
SCALE 1/4" = 1'-0"



PARTIAL WALL PLAN
SCALE 1/2" = 1'-0"

TIEROD EMBEDMENT TABLE	
STATION (MB-WB)	EMBEDMENT LENGTH
260+00 TO 260+49	23'-2"
260+49 TO 260+97	25'-2"
260+97 TO 261+76	27'-3"
262+36 TO 262+92	15'-1"
262+92 TO 263+40	17'-1"
263+40 TO 263+51	19'-1"
272+40 TO 272+80	15'-1"
272+80 TO 273+28	17'-1"
273+28 TO 273+84	19'-1"
273+84 TO 274+32	21'-2"
274+32 TO 275+37	23'-2"

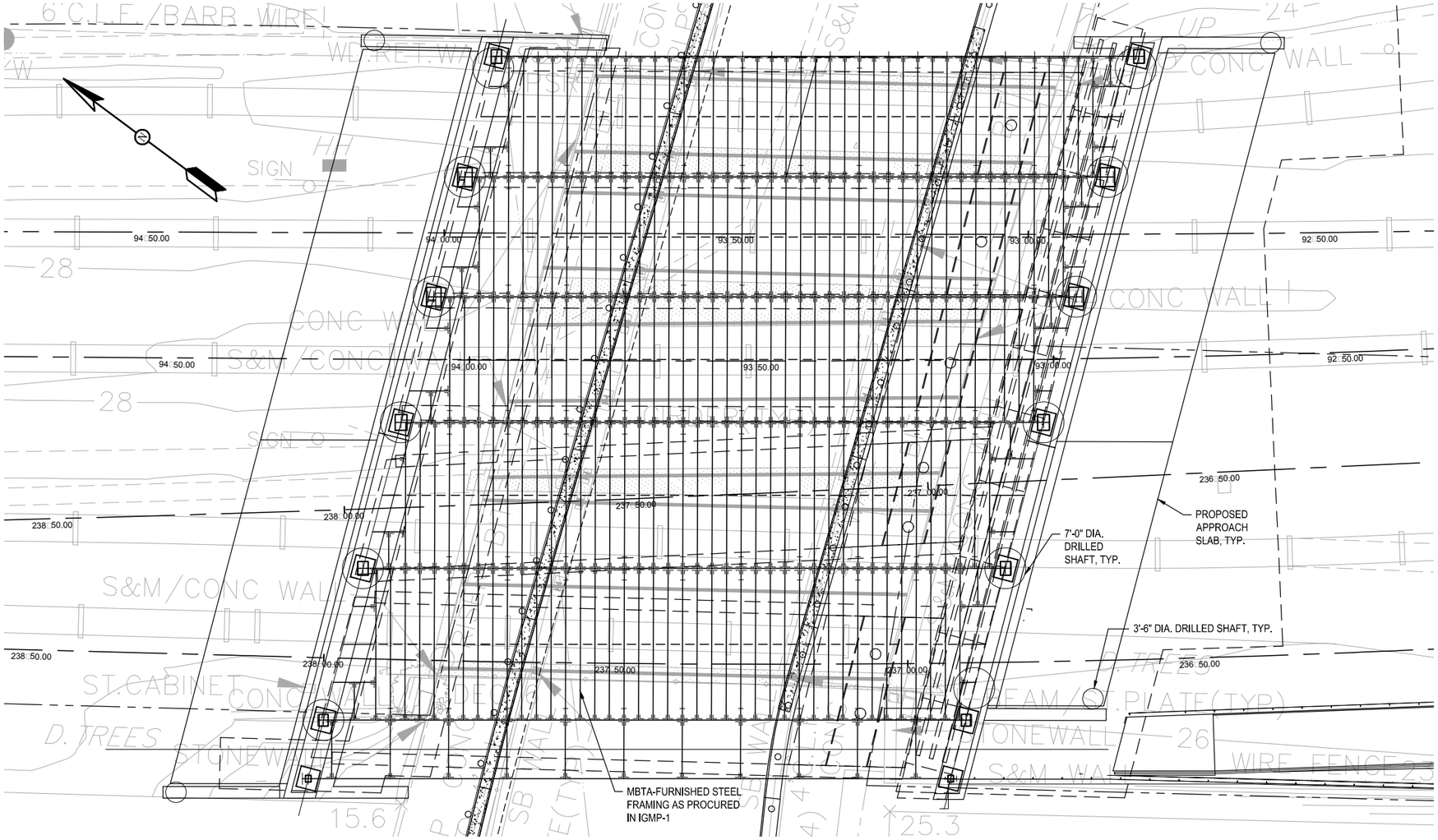
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

MEDFORD BRANCH RETAINING WALL DETAILS

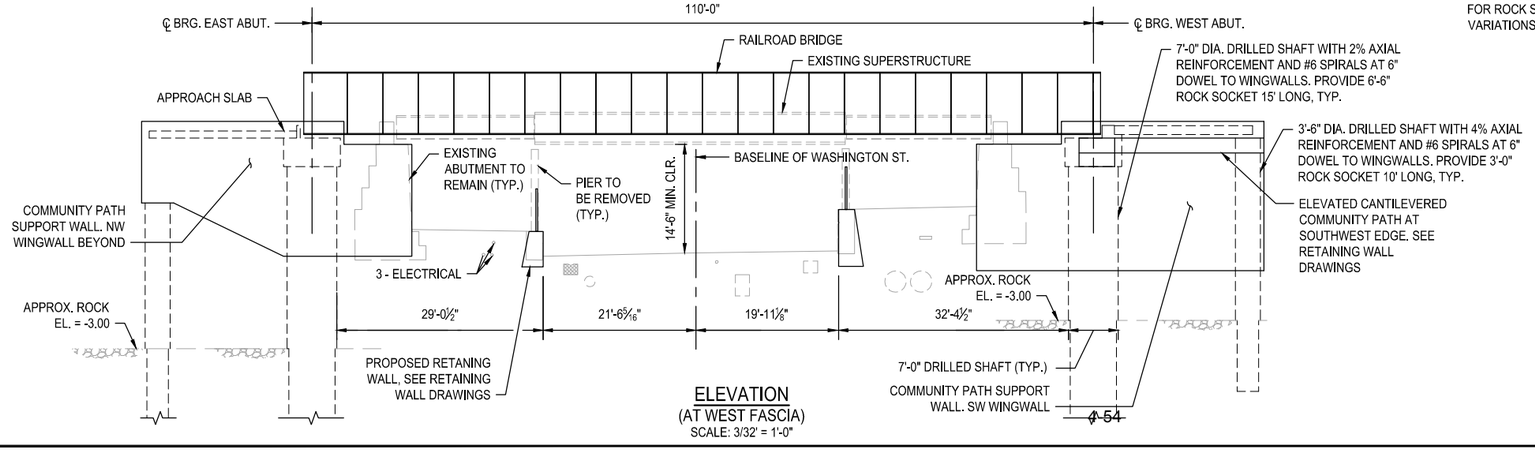
DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET RWS-S-8001



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

NOTE:

AVERAGE ROCK ELEVATIONS SHOWN, SEE BORING LOGS FOR ROCK SURFACE VARIATIONS



ELEVATION
(AT WEST FASCIA)
SCALE: 3/32" = 1'-0"

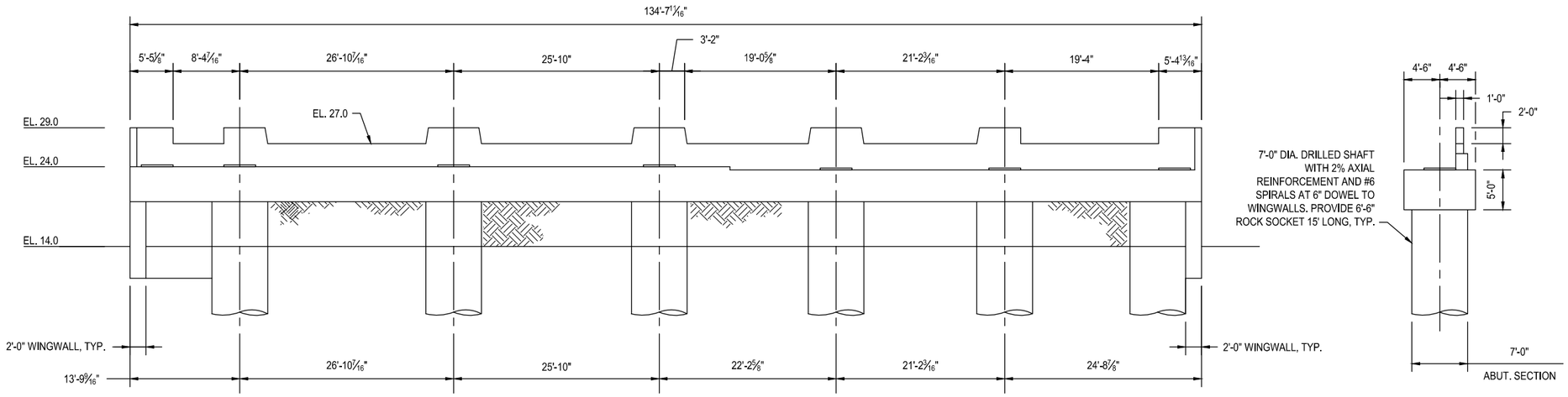
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

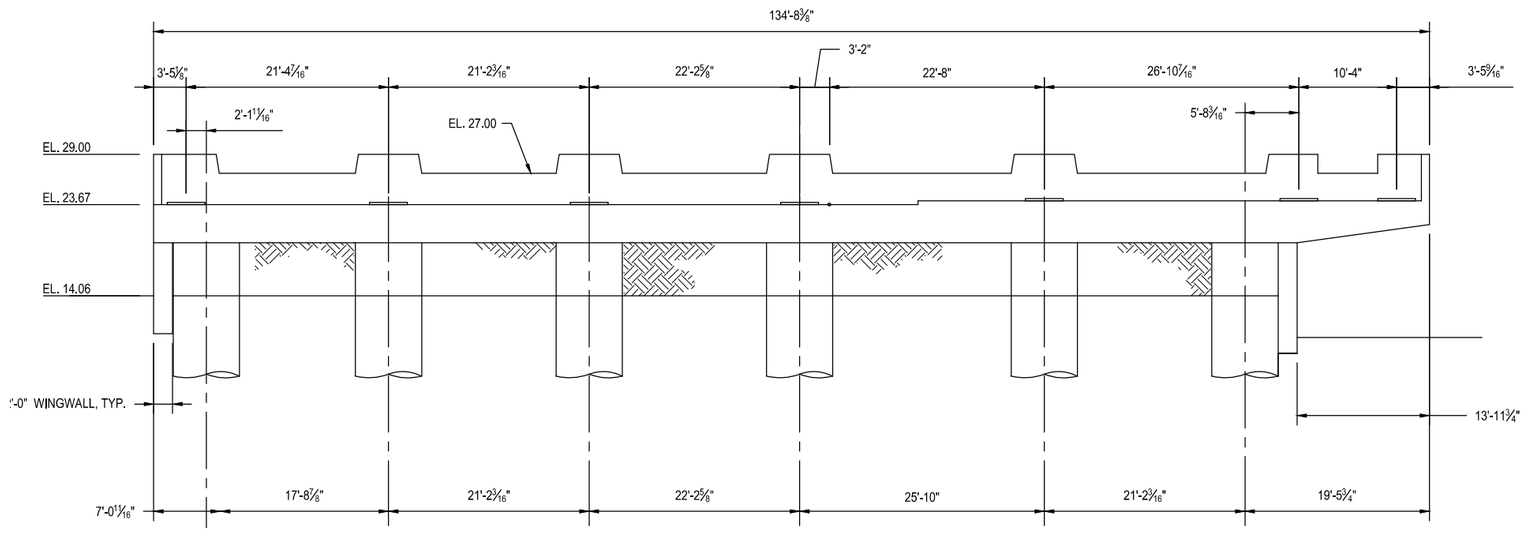
WASHINGTON STREET RAILROAD BRIDGE DECK PLAN & LONGITUDINAL SECTION

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET WSB-S-2001



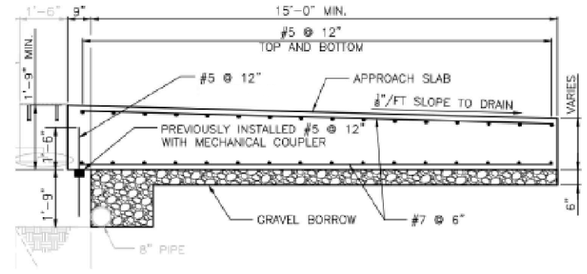
NORTH ABUTMENT ELEVATION

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



SOUTH ABUTMENT ELEVATION

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



APPROACH SLAB SECTION

NOT TO SCALE

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT

DESIGN BUILD - MBTA CONTRACT NO. E22CN07

CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

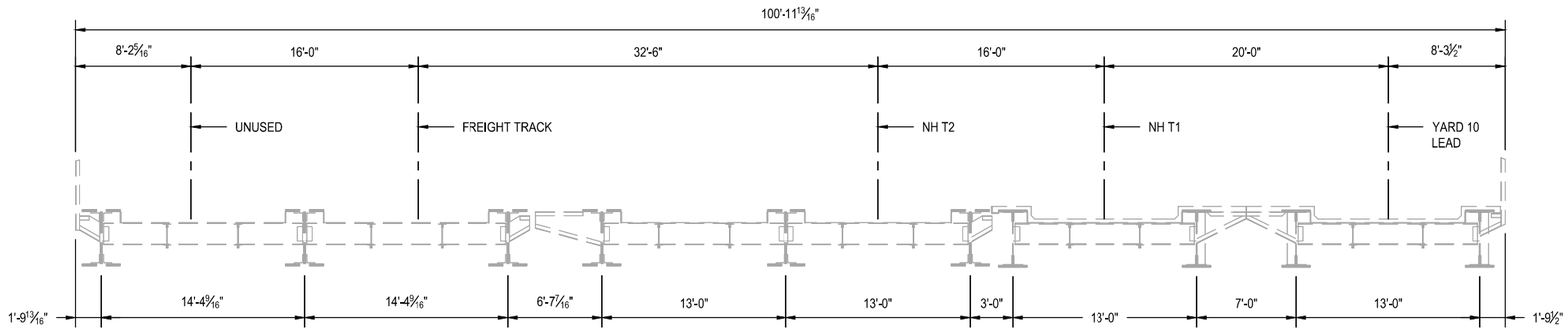
THE WALSH BARLETTA GRANITE

Joint Venture Team

WASHINGTON STREET RAILROAD BRIDGE

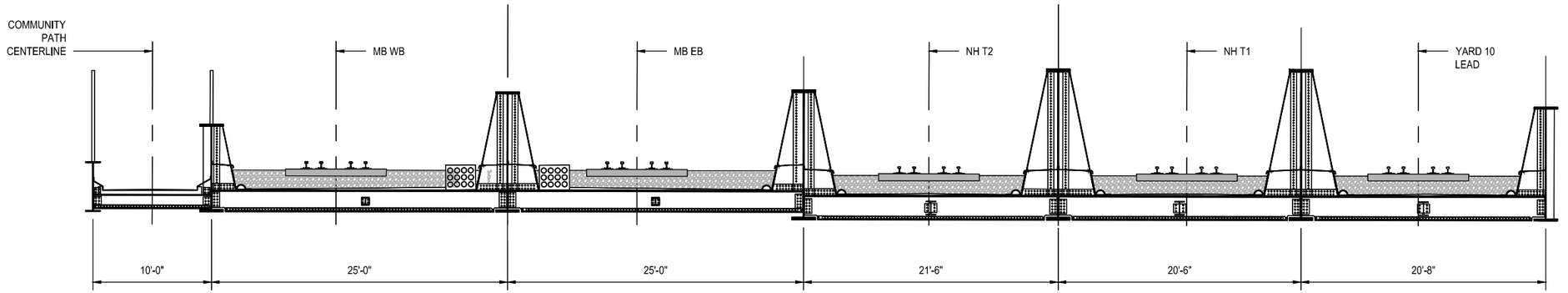
ABUTMENT ELEVATIONS

DATE: SEPT. 28, 2017	SCALE: AS NOTED	SHEET WSB-S-3001



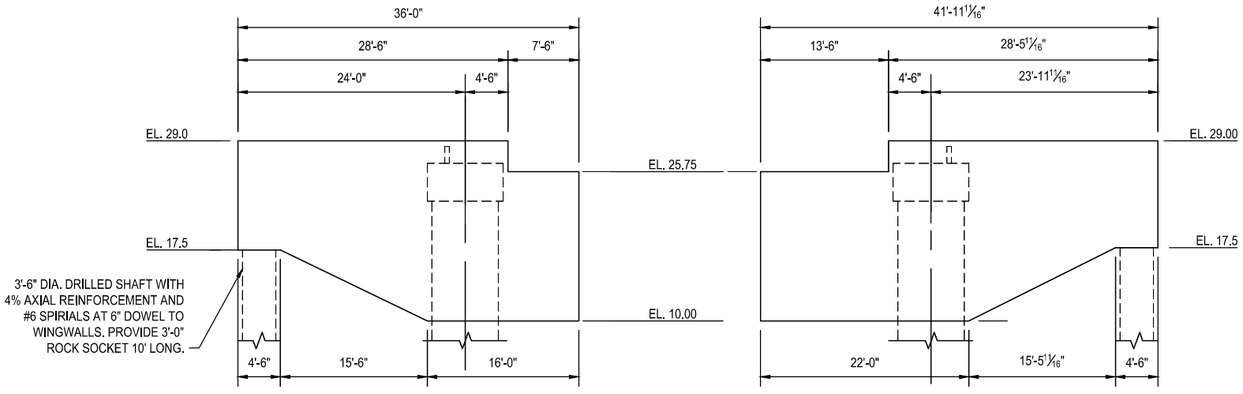
EXISTING TRANSVERSE SECTION

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



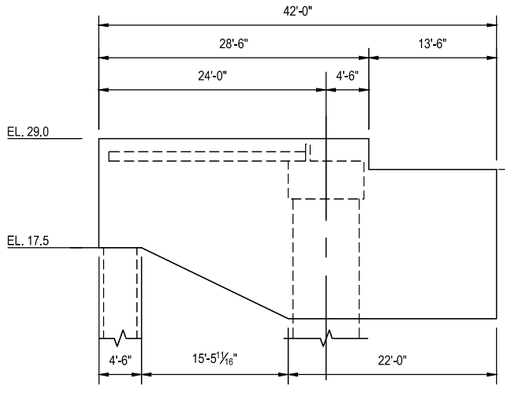
PROPOSED TRANSVERSE SECTION

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

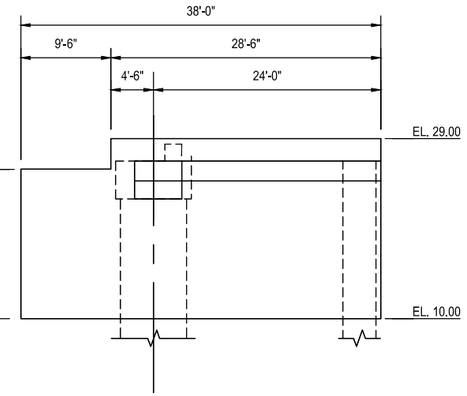


SOUTH EAST WINGWALL

NORTH EAST WINGWALL



NORTH WEST WINGWALL



SOUTH WEST WINGWALL

EAST WINGWALL ELEVATION

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

WEST WINGWALL ELEVATION

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

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT

DESIGN BUILD - MBTA CONTRACT NO. E22CN07

CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

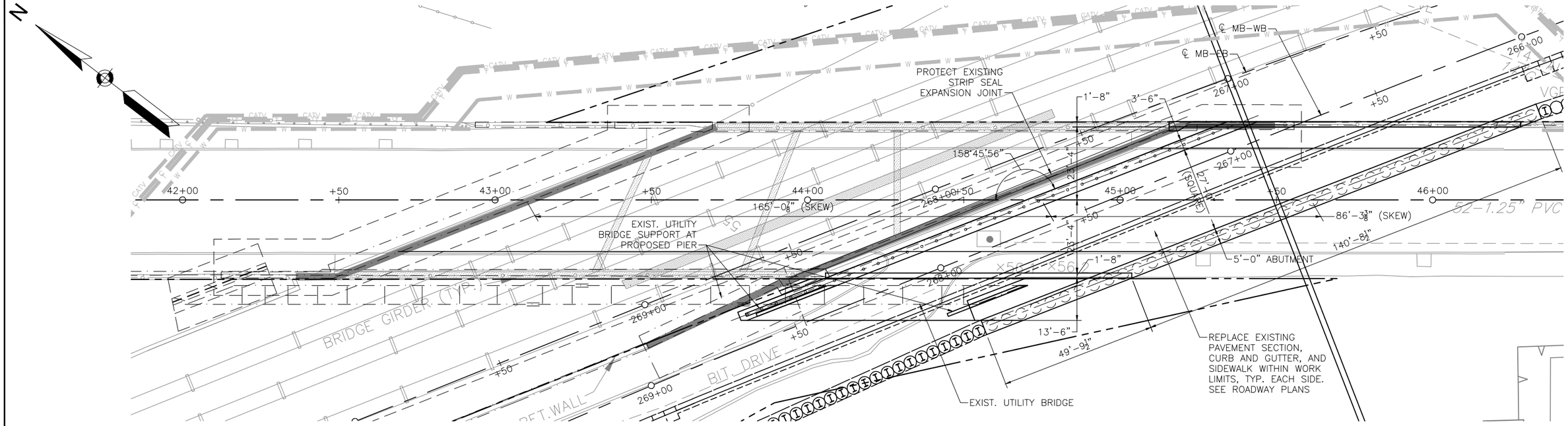
WALSH GRANITE

THE WALSH BARLETTA GRANITE

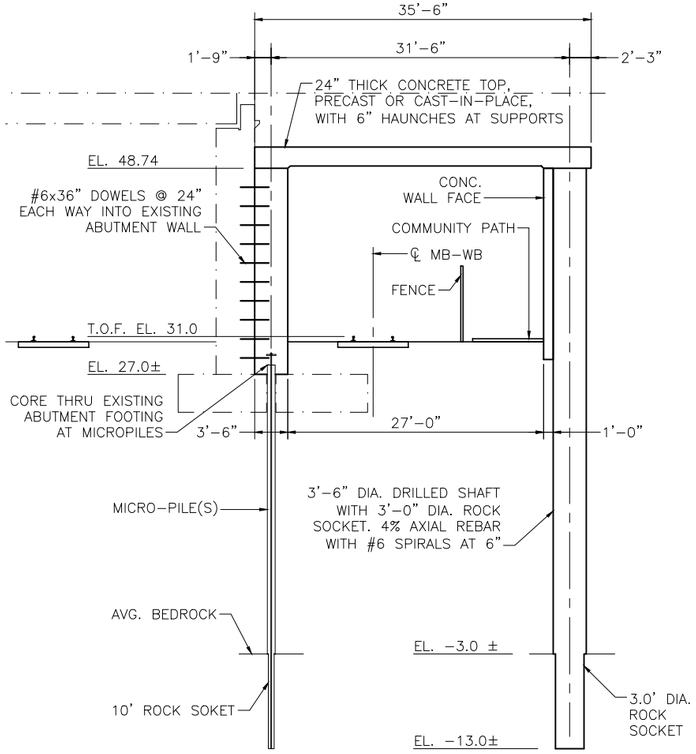
Joint Venture Team

WASHINGTON STREET RAILROAD BRIDGE TRANSVERSE SECTIONS

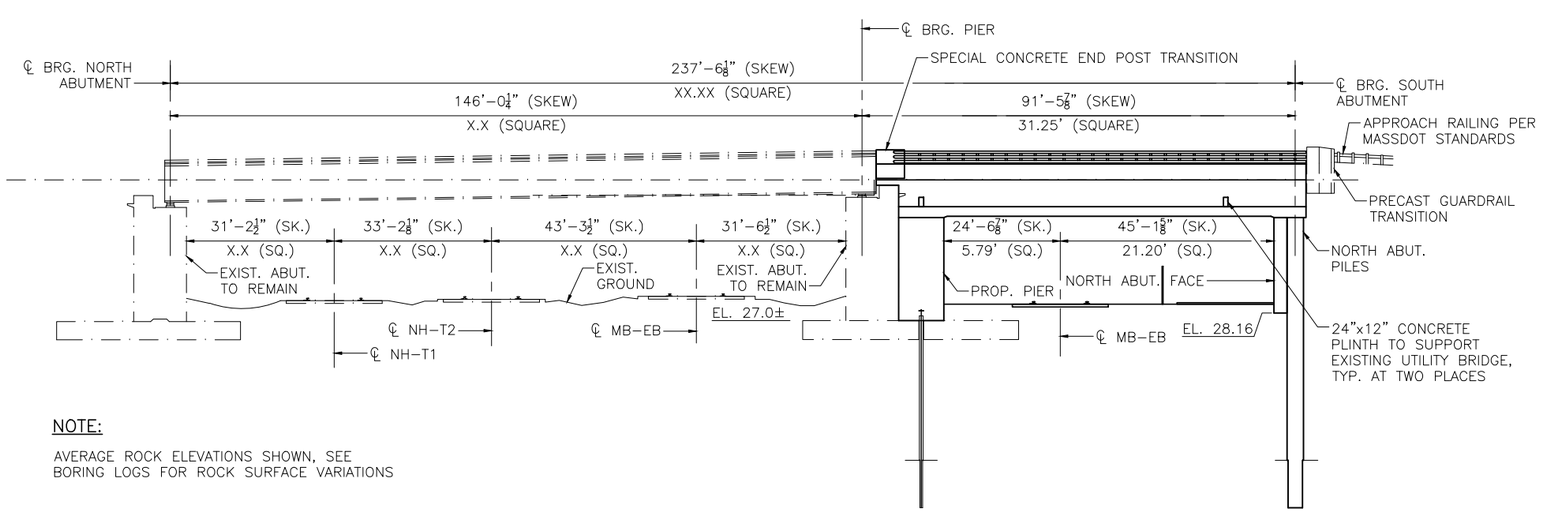
DATE: SEPT. 28, 2017	SCALE: AS NOTED	SHEET WSB-S-4001



DECK PLAN
SCALE: 1/16" = 1'–0"



PROPOSED SECTION NORMAL TO ABUTMENT BEARING
SCALE: 1/16" = 1'–0"



NOTE:

AVERAGE ROCK ELEVATIONS SHOWN, SEE BORING LOGS FOR ROCK SURFACE VARIATIONS

PROPOSED LONGITUDINAL SECTON
SCALE: 1/16" = 1'–0"

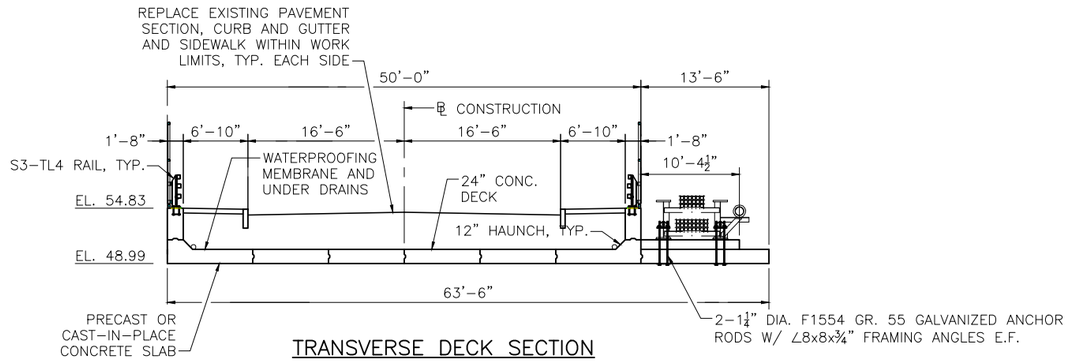
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

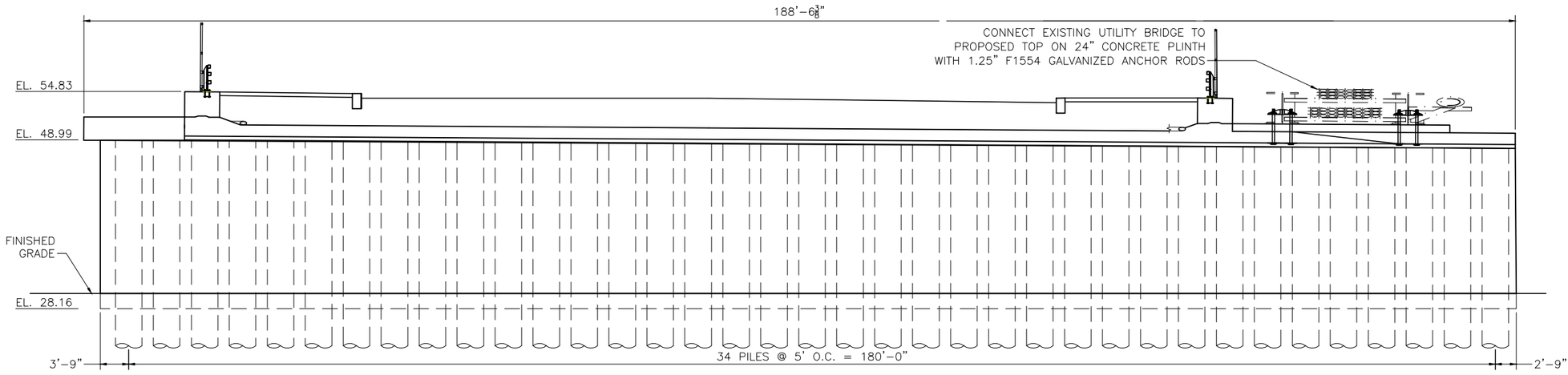
MEDFORD STREET BRIDGE
DECK PLAN & LONGITUDINAL SECTION

DATE: SEPT. 28, 2017	SCALE: AS NOTED	SHEET MEB-S-2001



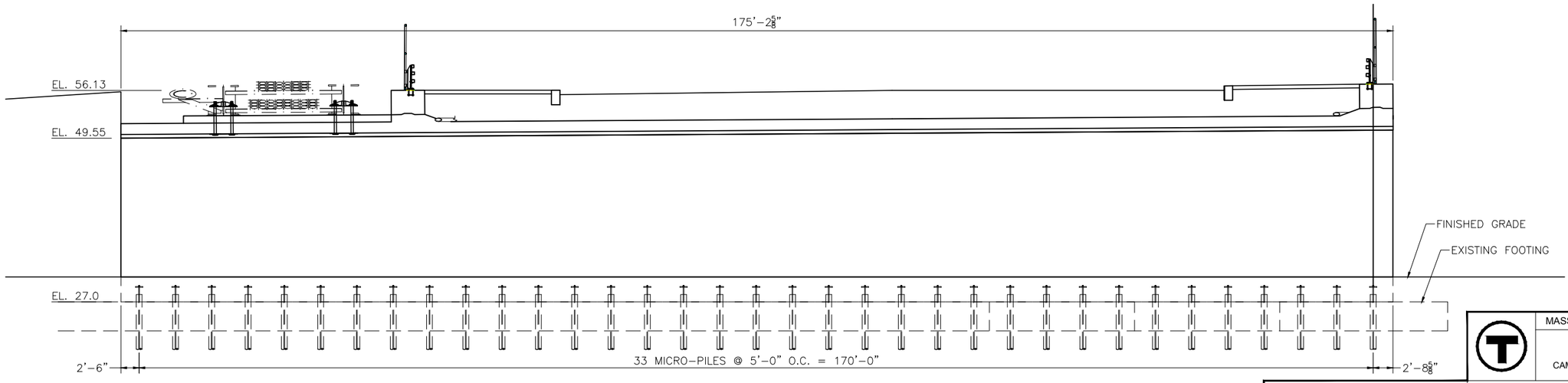
TRANSVERSE DECK SECTION

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



SOUTH ABUTMENT ELEVATION

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



PIER ELEVATION

(NOTHERN FACE)

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

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT

DESIGN BUILD - MBTA CONTRACT NO. E22CN07

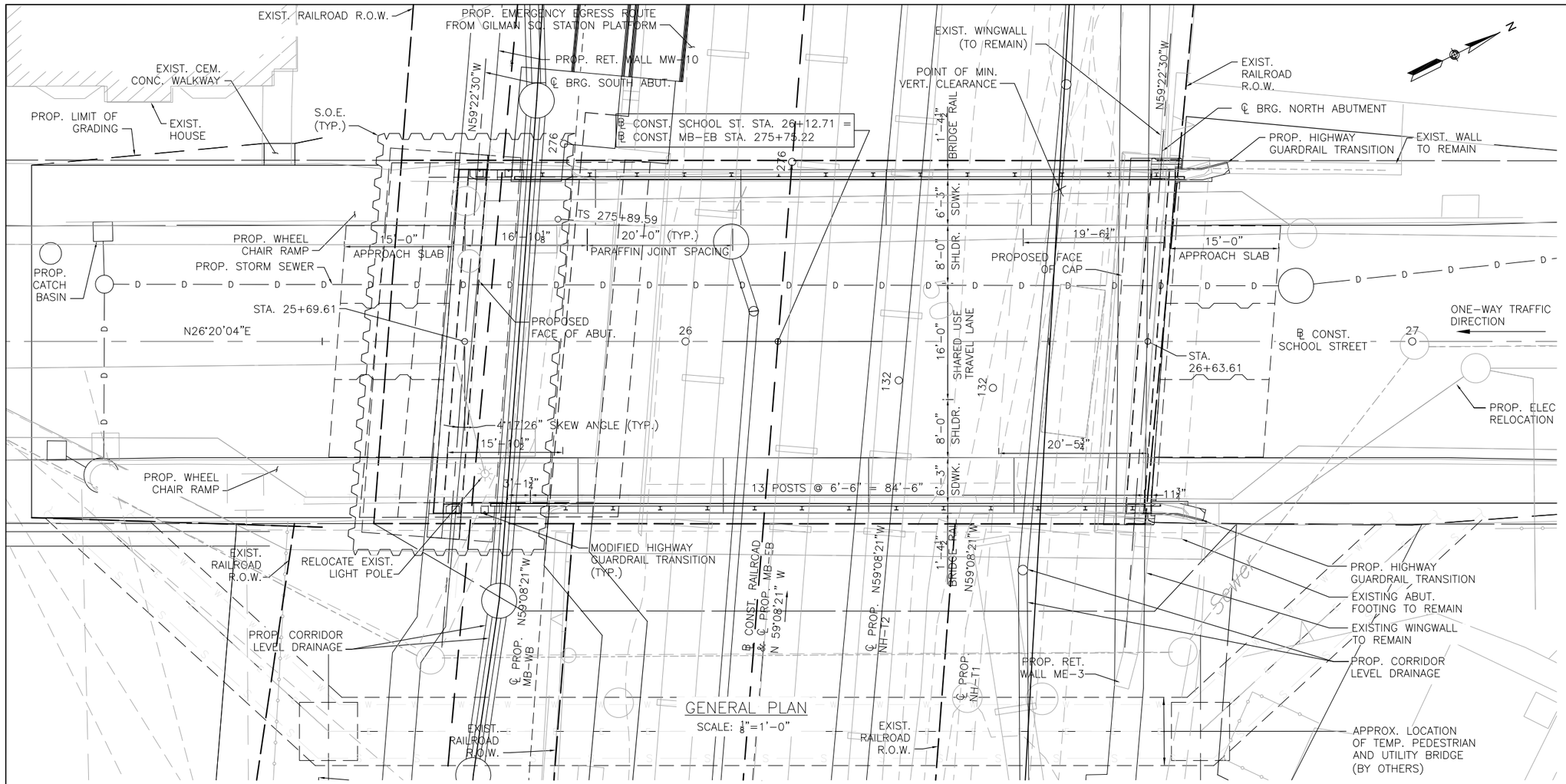
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

MEDFORD STREET BRIDGE
ABUTMENT ELEVATIONS

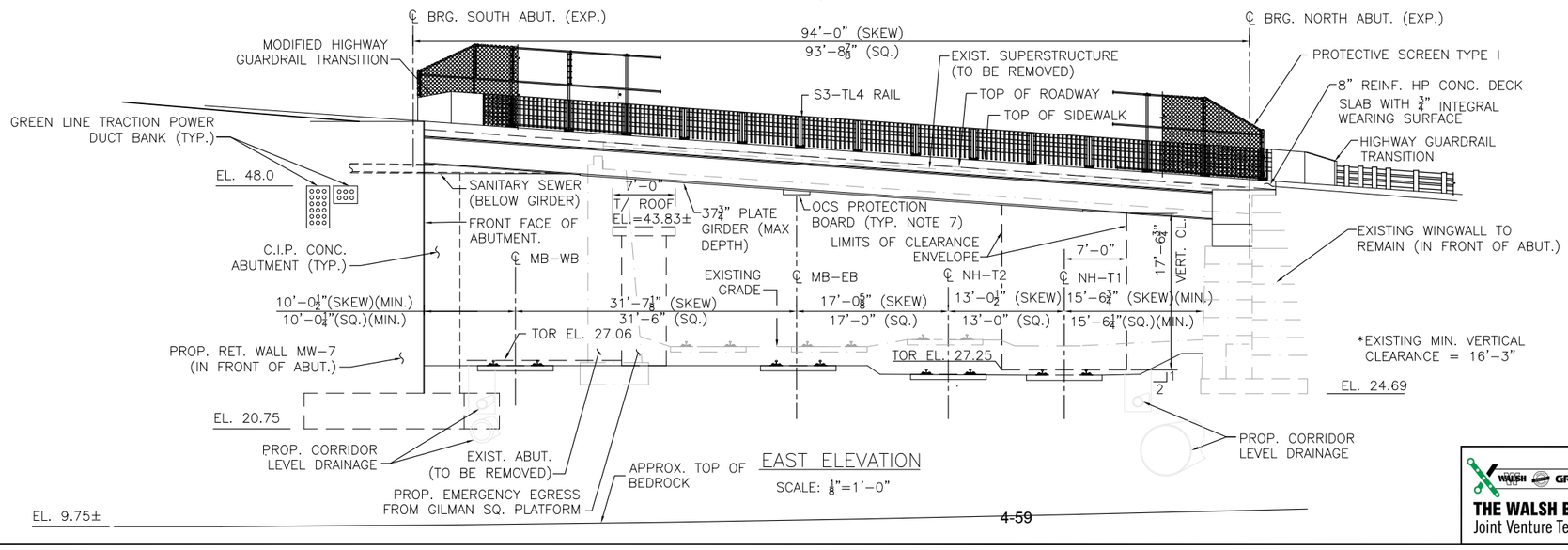
WALSH GRANITE

THE WALSH BARLETTA GRANITE
Joint Venture Team

DATE: SEPT. 28, 2017	SCALE: AS NOTED	SHEET MEB-S-3001



GENERAL PLAN
SCALE: ⅛"=1'-0"



EAST ELEVATION
SCALE: ⅛"=1'-0"

ATC 3

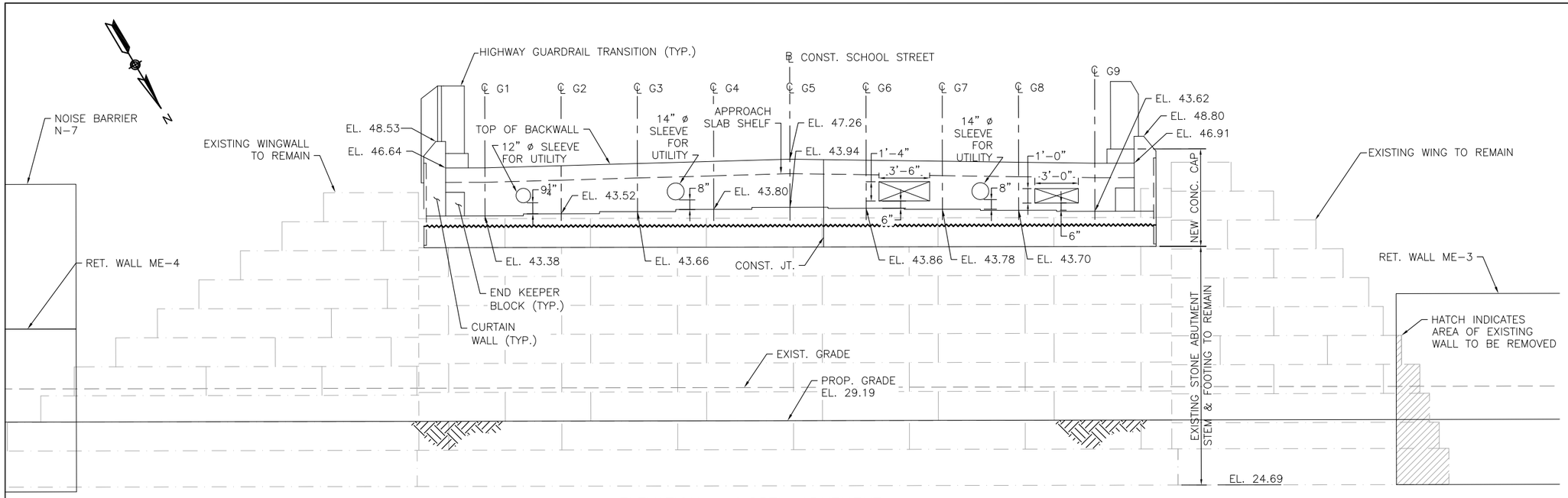
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

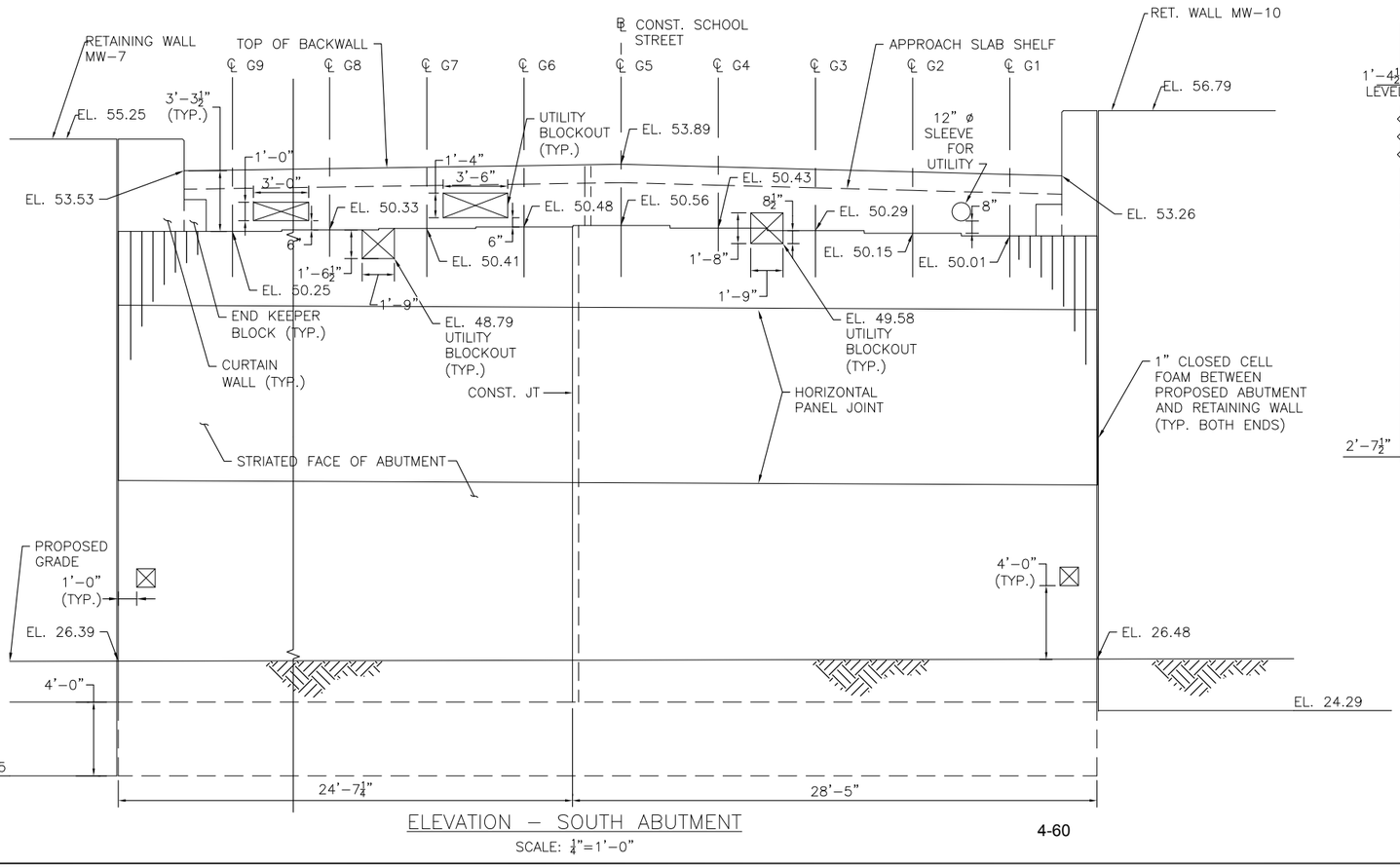
SCHOOL STREET BRIDGE GENERAL PLAN & EAST ELEVATION

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET SCB-S-2001



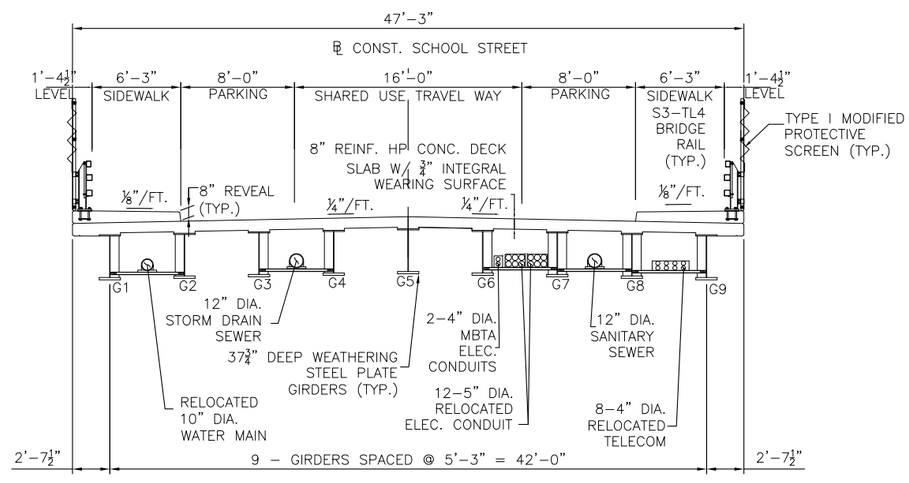
ELEVATION – NORTH ABUTMENT

SCALE: ¼"=1'-0"



ELEVATION – SOUTH ABUTMENT

SCALE: ¼"=1'-0"



TRANSVERSE SECTION – LOOKING NORTH

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

ATC 3

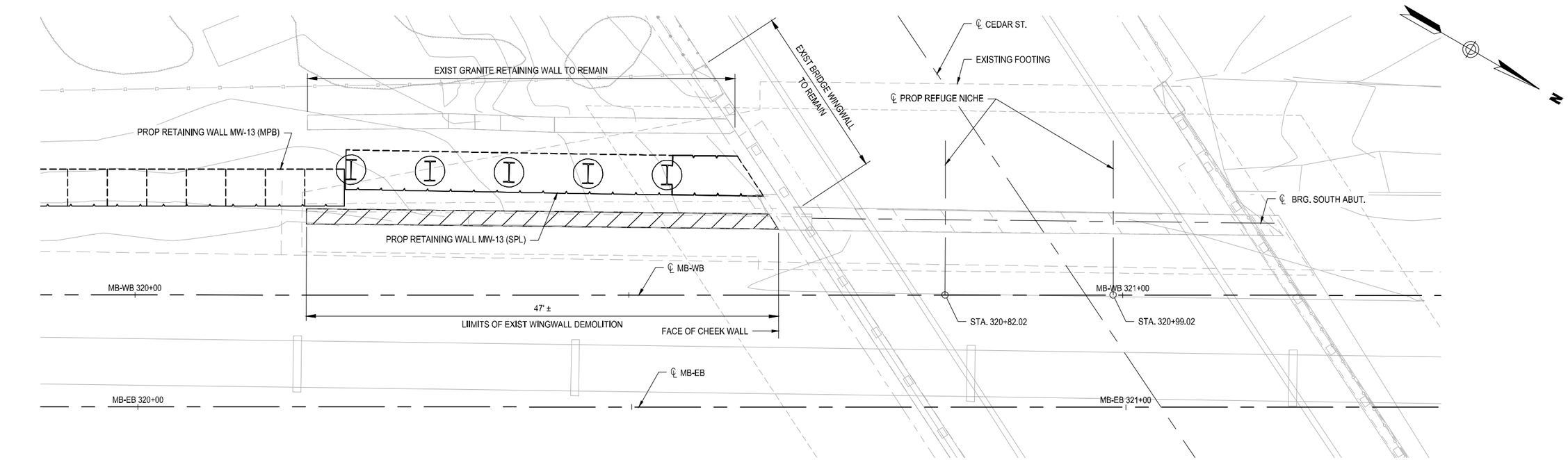
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

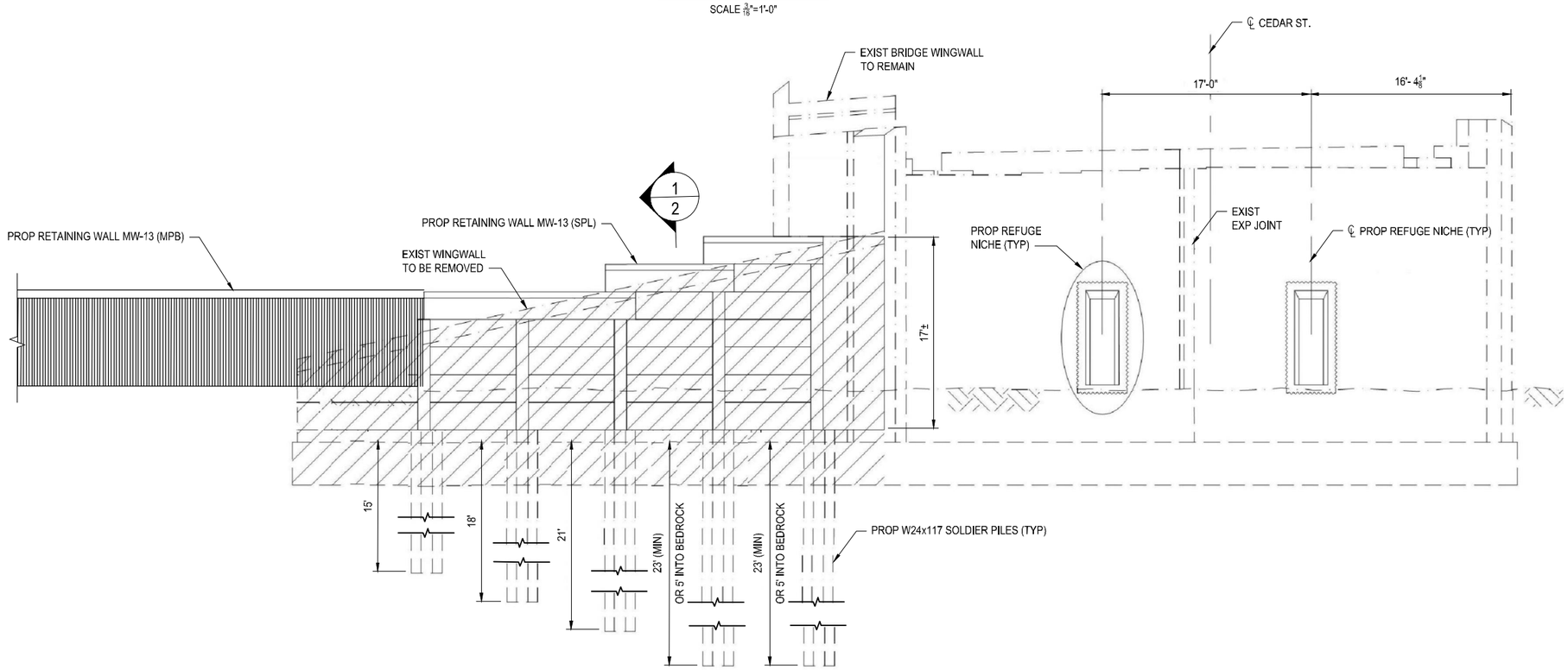
SCHOOL STREET BRIDGE
NORTH & SOUTH ABUTMENT ELEVATION AND TRANSVERSE SECTION

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET SCB-S-3001



SOUTH ABUTMENT PLAN

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



SOUTH ABUTMENT ELEVATION

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

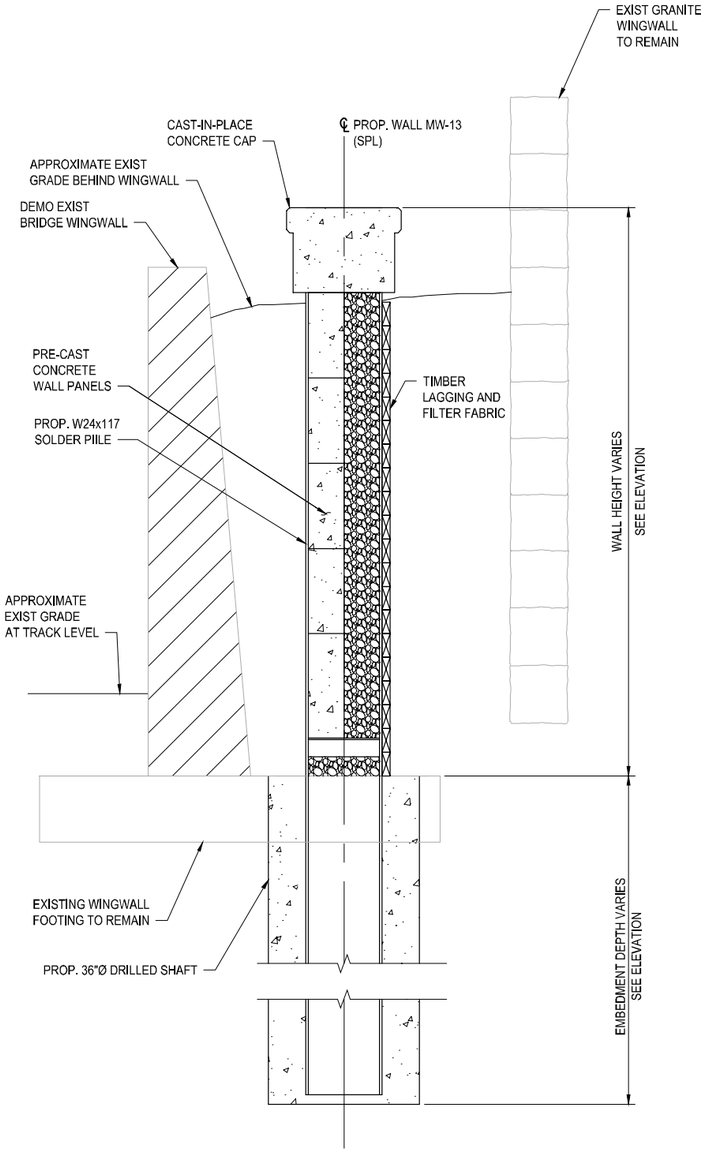
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

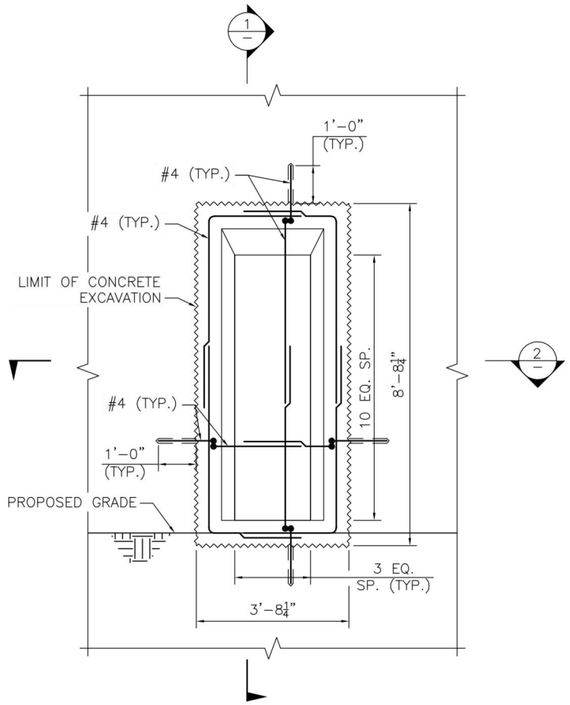
CEDAR STREET BRIDGE
SOUTH ABUTMENT
PLAN AND ELEVATION

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET CEB-S-2001



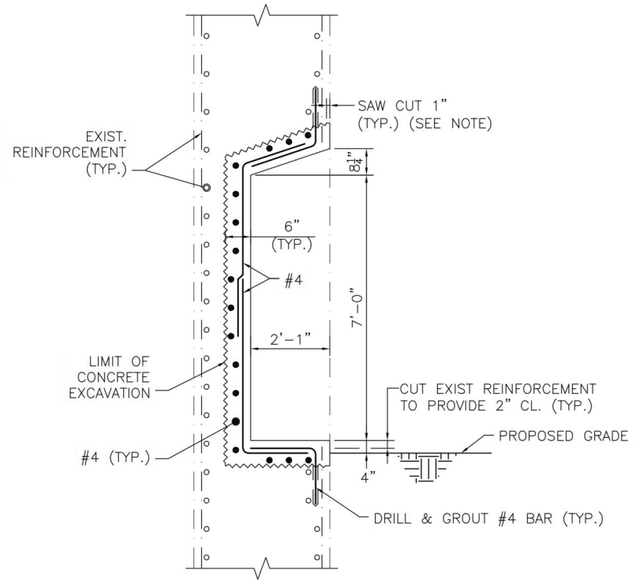
SECTION 1

SCALE $\frac{1}{2}$"=1'-0"



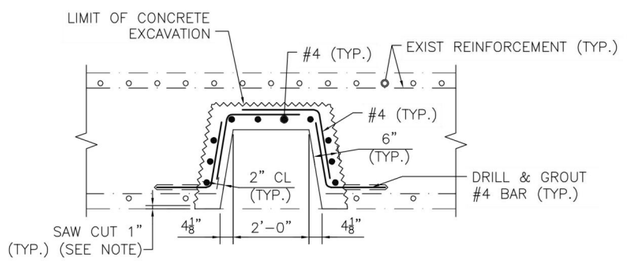
NICHE DETAIL

SCALE $\frac{1}{2}$"=1'-0"



SECTION 1

SCALE: $\frac{1}{2}$"=1'-0"



SECTION 2

SCALE: $\frac{1}{2}$"=1'-0"

NOTE:
SAWCUT OPENING 1" DEEP BEFORE CONCRETE EXCAVATION

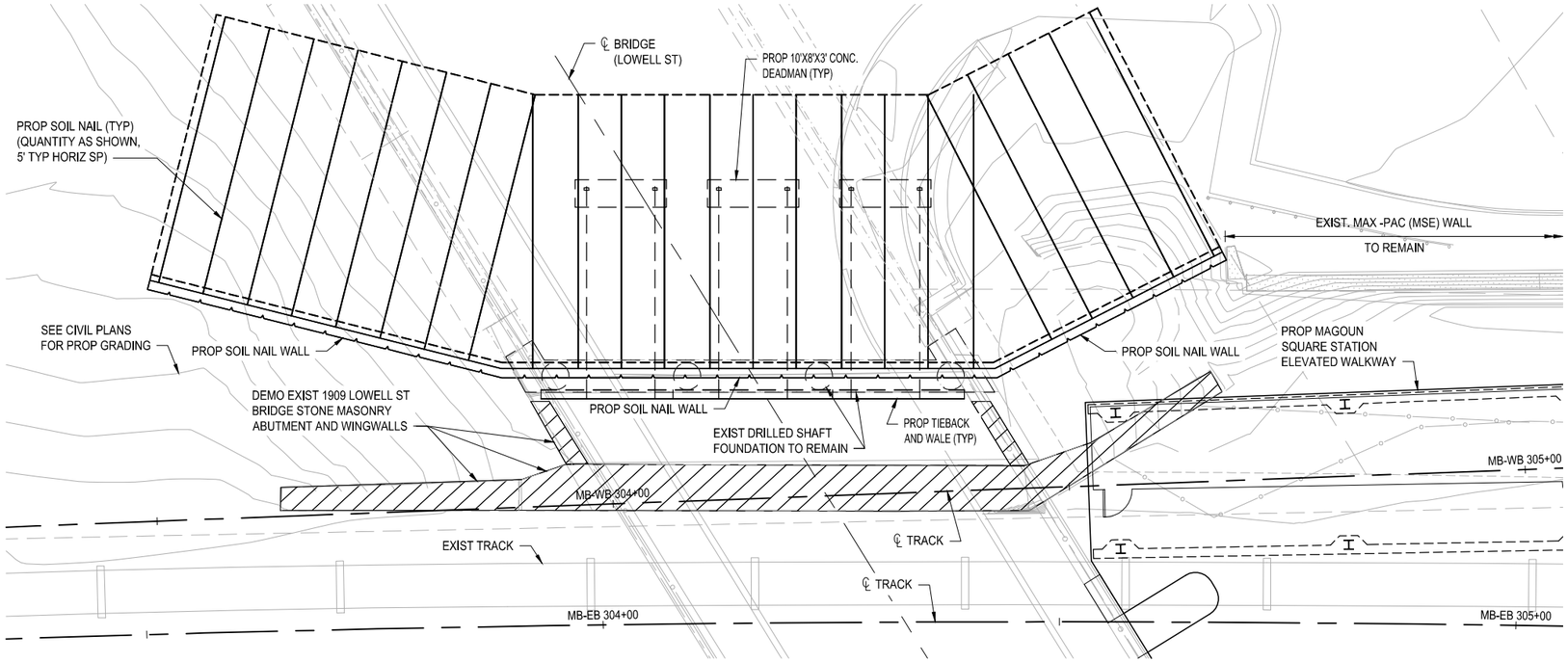
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

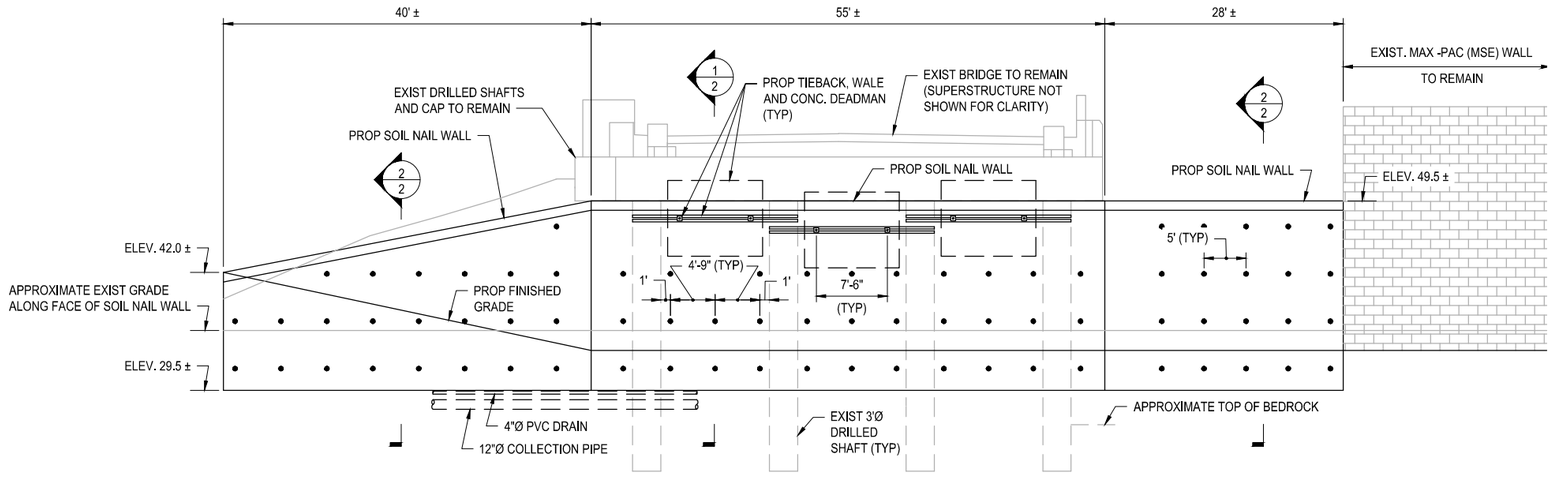
CEDAR STREET BRIDGE
SOUTH ABUTMENT
SECTION AND DETAILS

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **CEB-S-8001**



SOUTH ABUTMENT PLAN

SCALE $\frac{3}{8}$"=1'-0"



SOUTH ABUTMENT ELEVATION

SCALE $\frac{3}{8}$"=1'-0"

NOTE:
CONTRACTOR TO VERIFY THE ELEVATIONS OF EXISTING ADJACENT FOOTINGS.

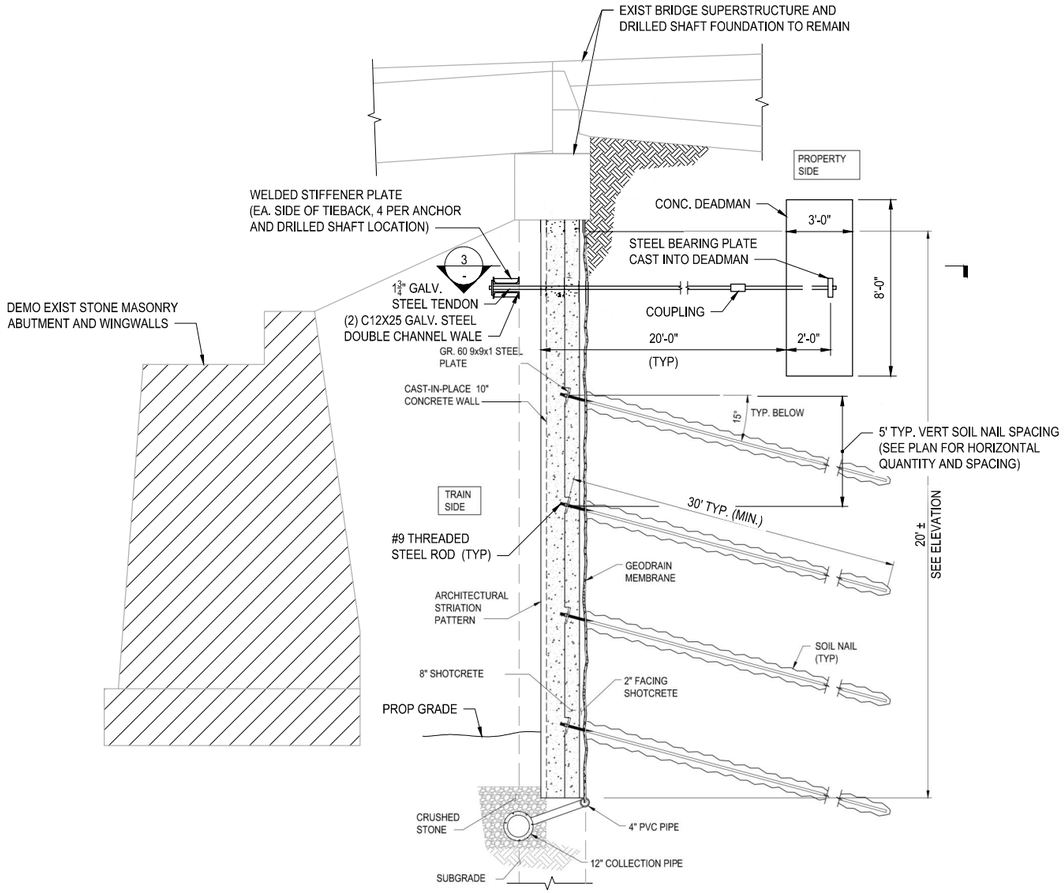
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

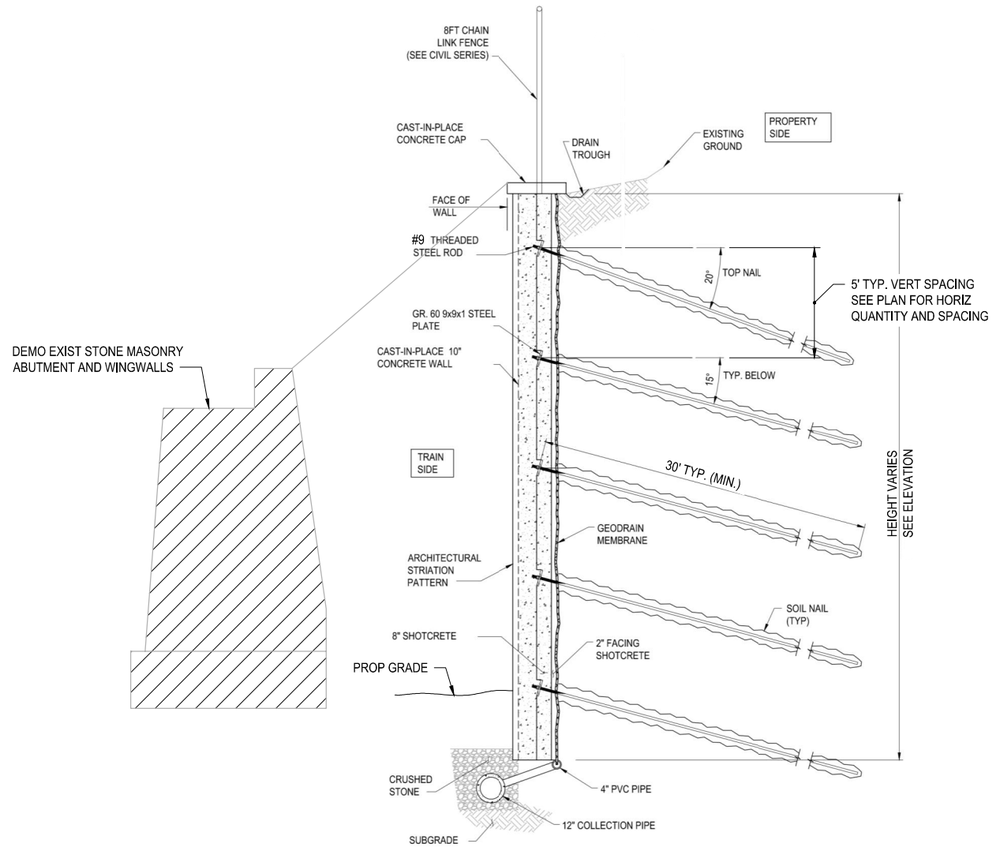
LOWELL STREET BRIDGE
SOUTH ABUTMENT
PLAN AND ELEVATION

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **LOB-S-2001**



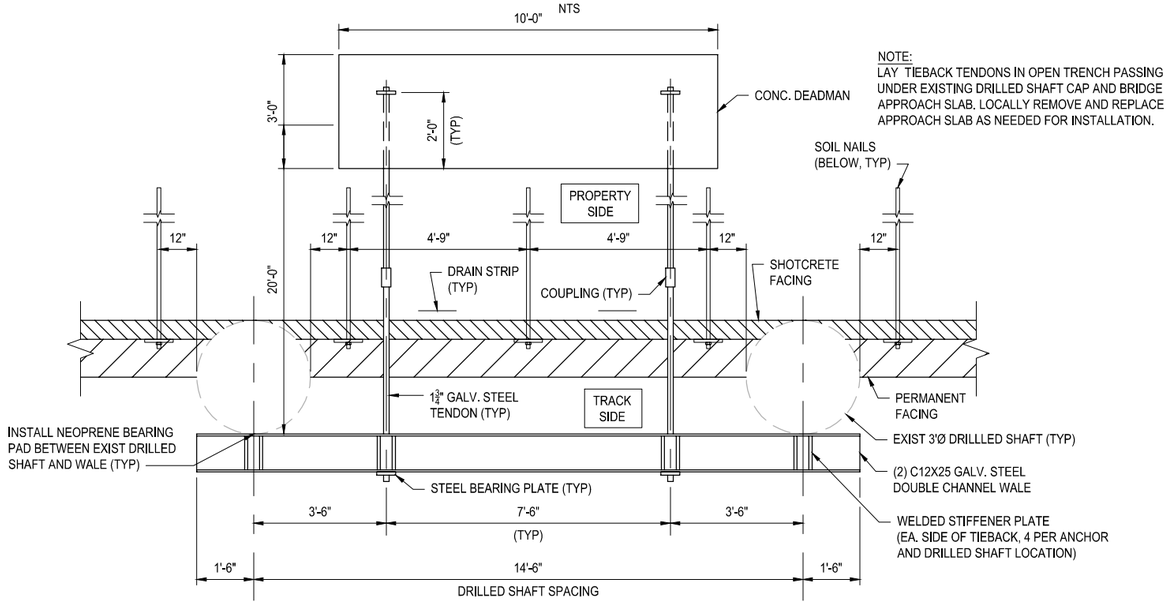
SECTION THRU ABUTMENT - SECTION 1

NTS



SECTION THRU WINGWALL - SECTION 2

NTS



HORIZONTAL SECTION THRU ABUTMENT - SECTION 3

NTS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

LOWELL STREET BRIDGE
SOUTH ABUTMENT
SOIL NAIL WALL SECTIONS

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET **LOB-S-8001**

WINGWALL

146'-4 1/8"

+04.41
CS 331+00

+80.98
SC

+20.98
TS

N

73+00 +50 74+00 +50 75+00

℄ ABUTMENT

3'-6" DIA. PILES, TYP.

℄ MB-WB

330+00

℄ PIER

3'-3" DIA. PILES

EXISTING UTILITY BRIDGE TO REMAIN. PAINT GIRDERS PER TECHNICAL PROVISIONS

52'-11" DECK

8'-8"
5'-0"
12'-0" (TRAVEL LANE)
12'-0" (TRAVEL LANE)
5'-0"
7'-6"

8'-9"

186+00

EXISTING ABUTMENT

EDGE OF DECK

℄ EAST ABUTMENT

℄ MB-EB

+02.21
℄ BS
85+00

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

℄ WEST ABUTMENT — 142'-0" — ℄ EAST ABUTMENT

53'-0" | 89'-0"

PIER

℄ MB-WB ℄ MB-EB ℄ NH-T2 ℄ NH-T1

EXISTING ABUTMENT

EST. ROCK

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

NOTE:

AVERAGE ROCK ELEVATIONS SHOWN. SEE BORING LOGS FOR ROCK SURFACE VARIATIONS

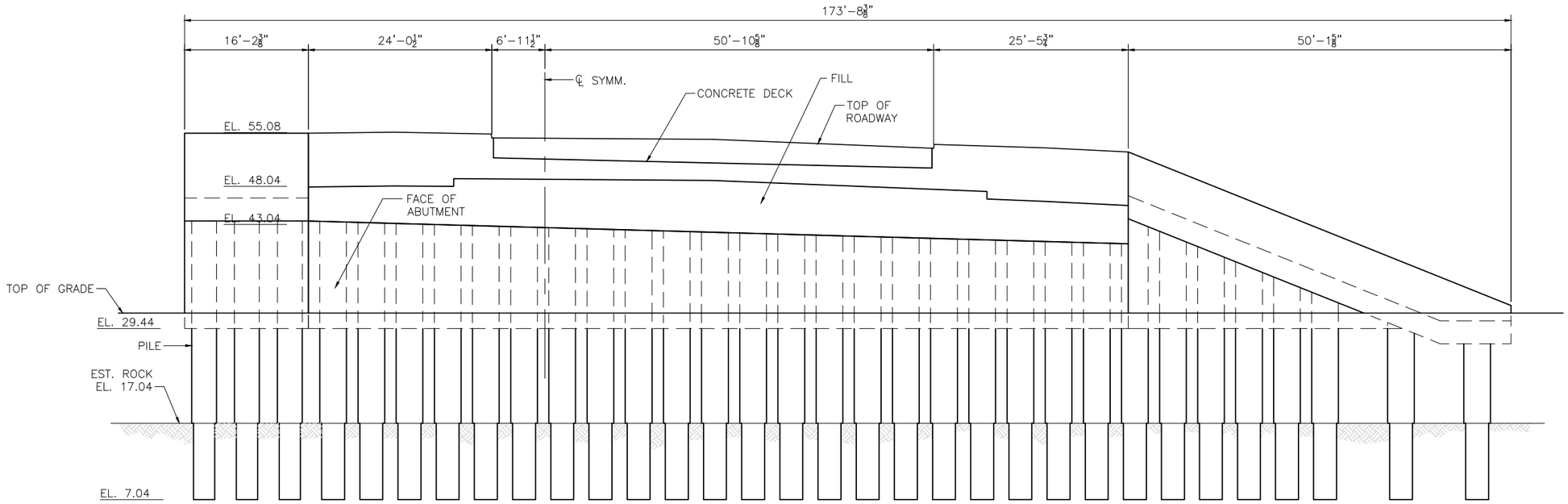
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

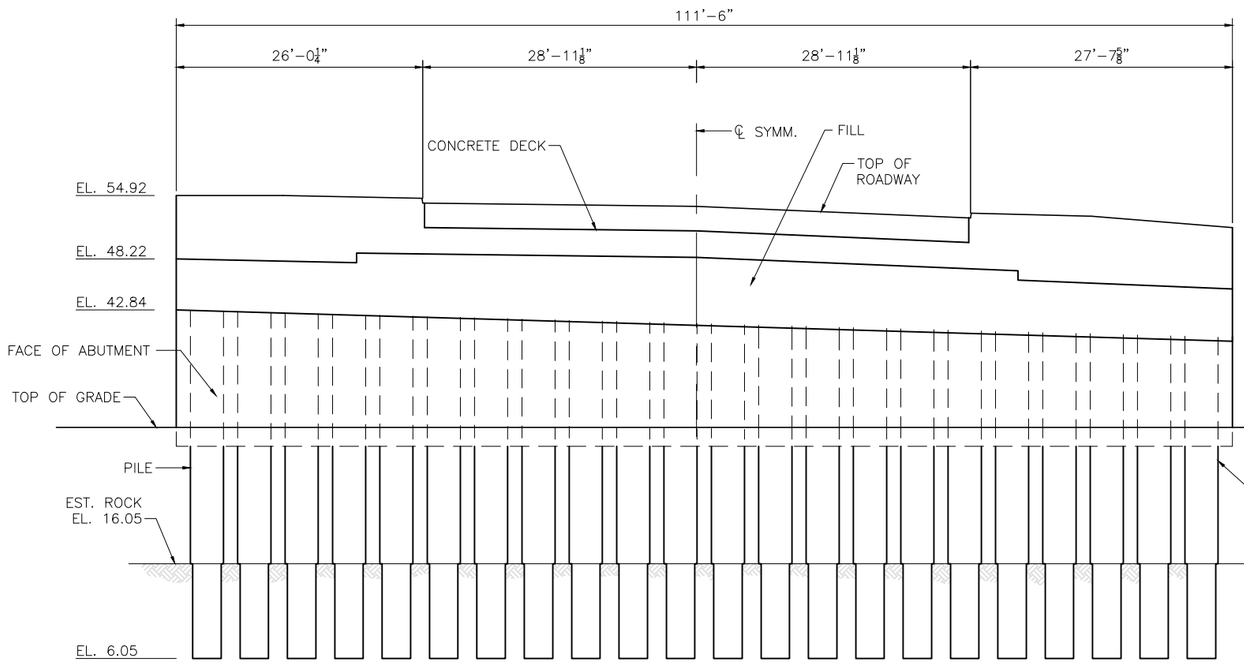
THE WALSH BARLETTA GRANITE
Joint Venture Team

BROADWAY BRIDGE
DECK PLAN & LONGITUDINAL SECTION

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET BRB-S-2001



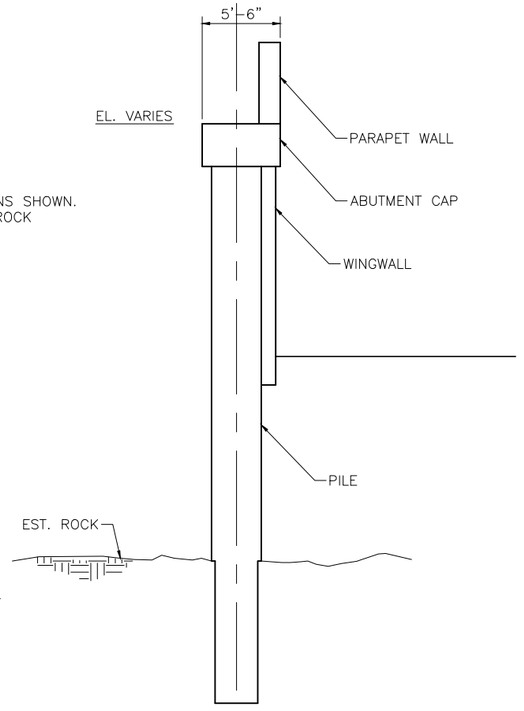
WEST ABUTMENT ELEVATION
SCALE: 1/16" = 1'–0"



EAST ABUTMENT ELEVATION
SCALE: 1/16" = 1'–0"

NOTE:

AVERAGE ROCK ELEVATIONS SHOWN. SEE BORING LOGS FOR ROCK SURFACE VARIATIONS



WINGWALL SECTION
SCALE: 3/16" = 1'–0"

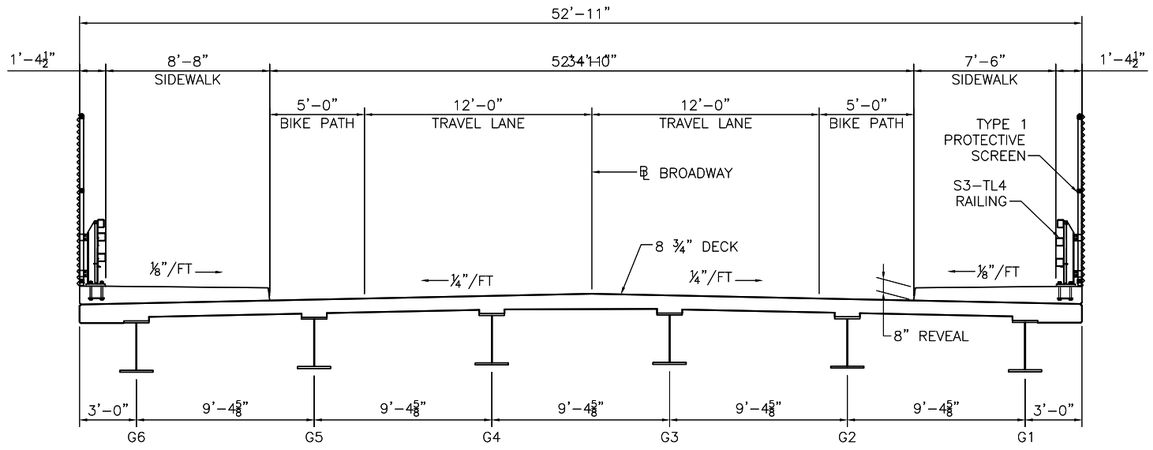
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

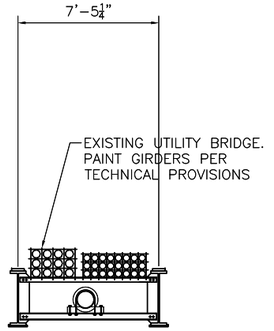
THE WALSH BARLETTA GRANITE
Joint Venture Team

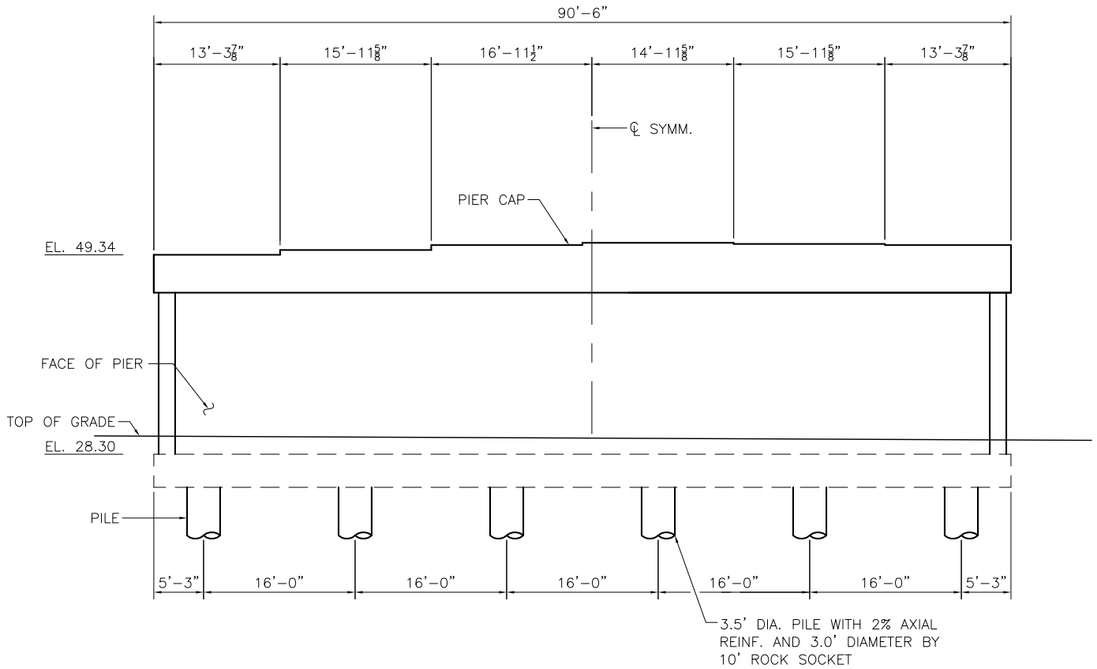
BROADWAY BRIDGE
ABUTMENT ELEVATIONS

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET BRB-S-3001



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

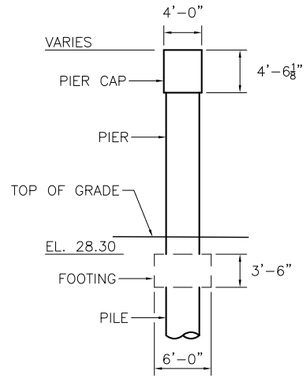




PIER ELEVATION
SCALE: 1/16" = 1'-0"

NOTE:

AVERAGE ROCK ELEVATIONS SHOWN. SEE BORING LOGS FOR ROCK SURFACE VARIATIONS



PIER SECTION
SCALE: 1/16" = 1'-0"

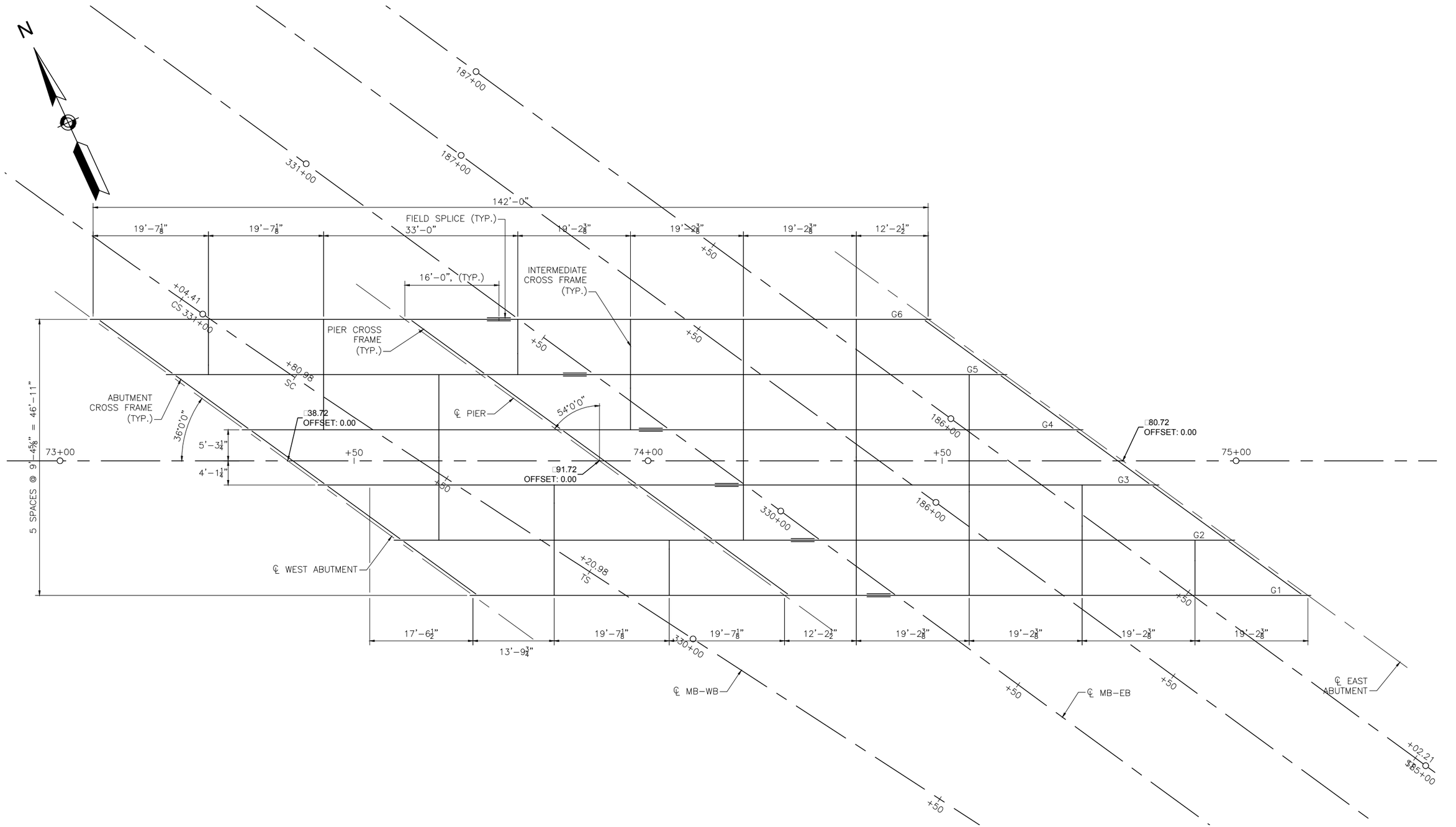
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

BROADWAY BRIDGE
TRANSVERSE SECTION AND PIER DETAILS

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET BRB-S-4001



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

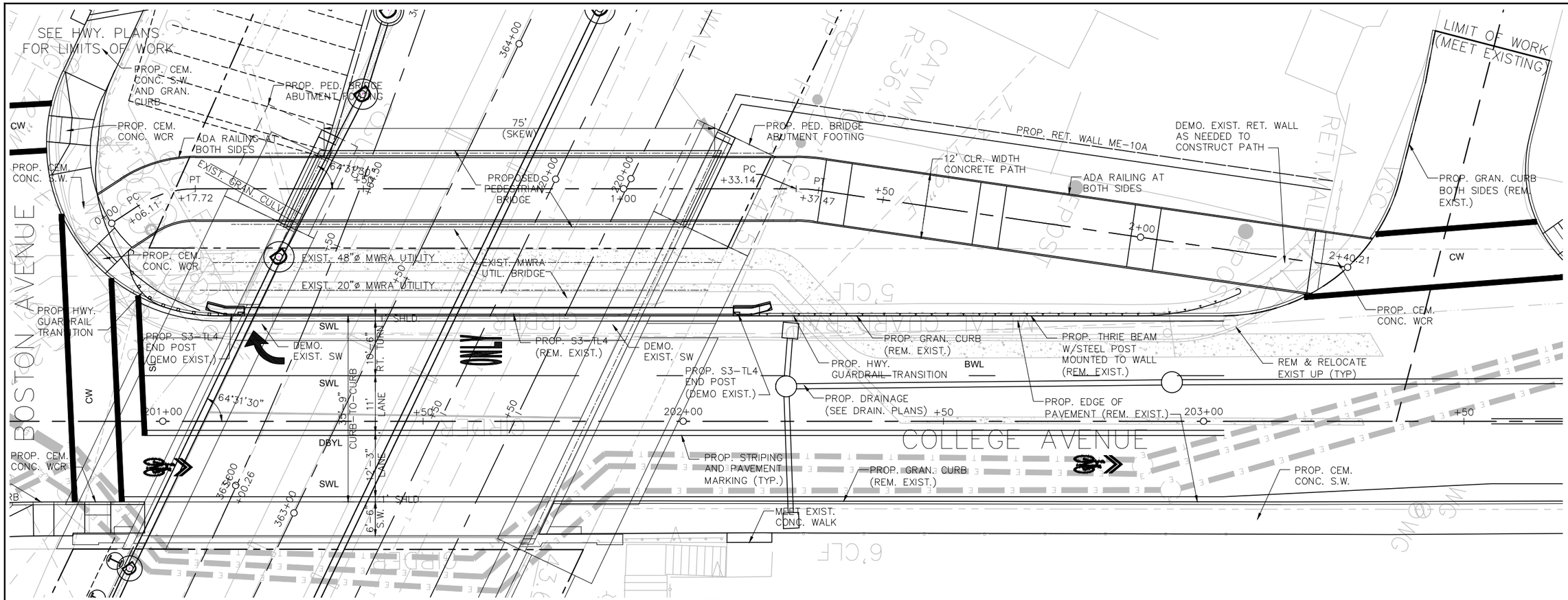
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

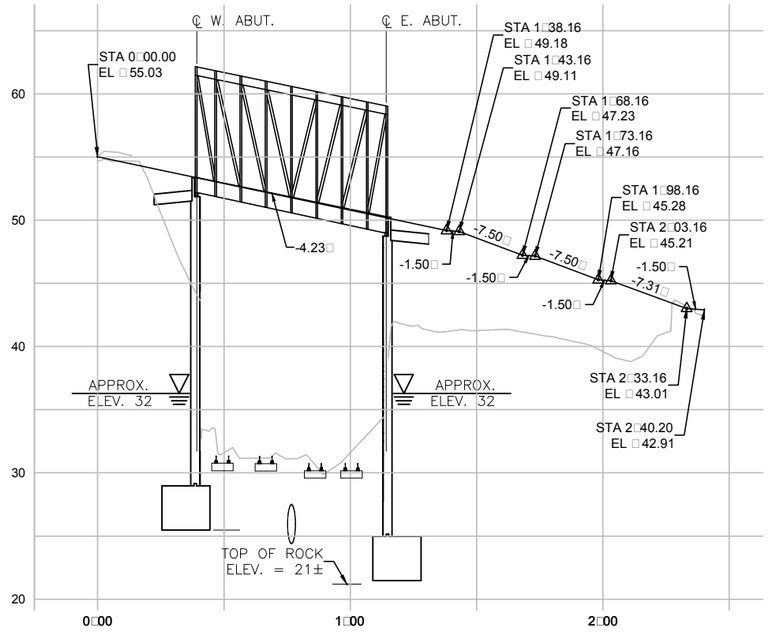
WALSH GRANITE
THE WALSH BARLETTA GRANITE
Joint Venture Team

BROADWAY BRIDGE
FRAMING PLAN

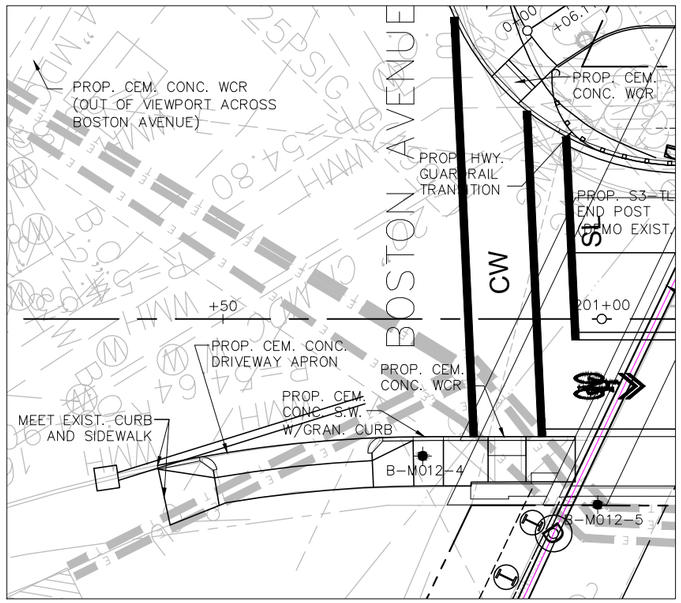
DATE: SEPT. 28, 2017	SCALE: AS NOTED	SHEET BRB-S-5001



PARTIAL PLAN 1 OF 2
COLLEGE AVENUE OVER MBTA
SCALE: 1" = 10'



COLLEGE AVENUE PROFILE – ℄ PROPOSED PEDESTRIAN BRIDGE
HORIZ.: 1'=30' VERT.: 1'=6'



PARTIAL PLAN 2 OF 2
COLLEGE AVENUE OVER MBTA
SCALE: 1" = 10'

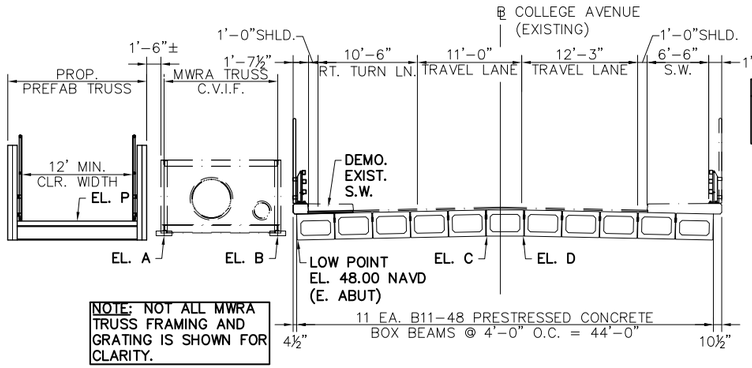
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

COLLEGE AVENUE BRIDGE
BRIDGE PLAN & PROFILE

DATE: SEPT. 28, 2017	SCALE: AS NOTED	SHEET COB-S-2001



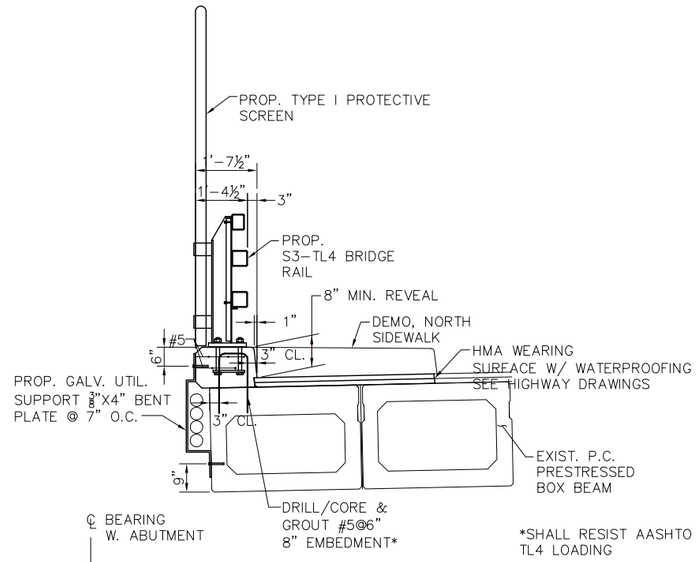
	EL. A	EL. B	EL. C	EL. D	EL. P
W. ABUT.	50.65	51.79	50.65	50.65	53.08
MID-SPAN	49.76	49.90	49.72	49.72	51.52
E. ABUT.	48.86	49.00	48.78	48.78	49.95

EXISTING ELEVATIONS (A–D) ARE PROVIDED IN N.A.V.D. 1988
TAKEN FROM REFERENCE PLANS USING N.G.V.D 1929
N.A.V.D. 1988 = N.G.V.D. 1929 – .807

NOTES:
1. PROVIDE INTEGRAL CONCRETE WEARING SURFACE
2. PROVIDE LIGHTING ALONG ENTIRE LENGTH OF APPROACH AND BRIDGE.
3. FOR LANDSCAPING SPECIFICATIONS REF. VOLUME 2 TECHNICAL PROVISIONS 7.5.3.7.
4. FOR HIGHWAY SPECIFICATIONS REF. VOLUME 2 TECHNICAL PROVISIONS 9.1.3.4.
5. PROVIDE ADA RAILINGS ALONG ENTIRE LENGTH OF APPROACHES AND ON BRIDGE.
6. BRIDGES AND APPROACHES SHALL COMPLY WITH ADA.

PROPOSED PEDESTRIAN AND COLLEGE AVENUE BRIDGE SECTION

SCALE: ¼" = 1'-0"



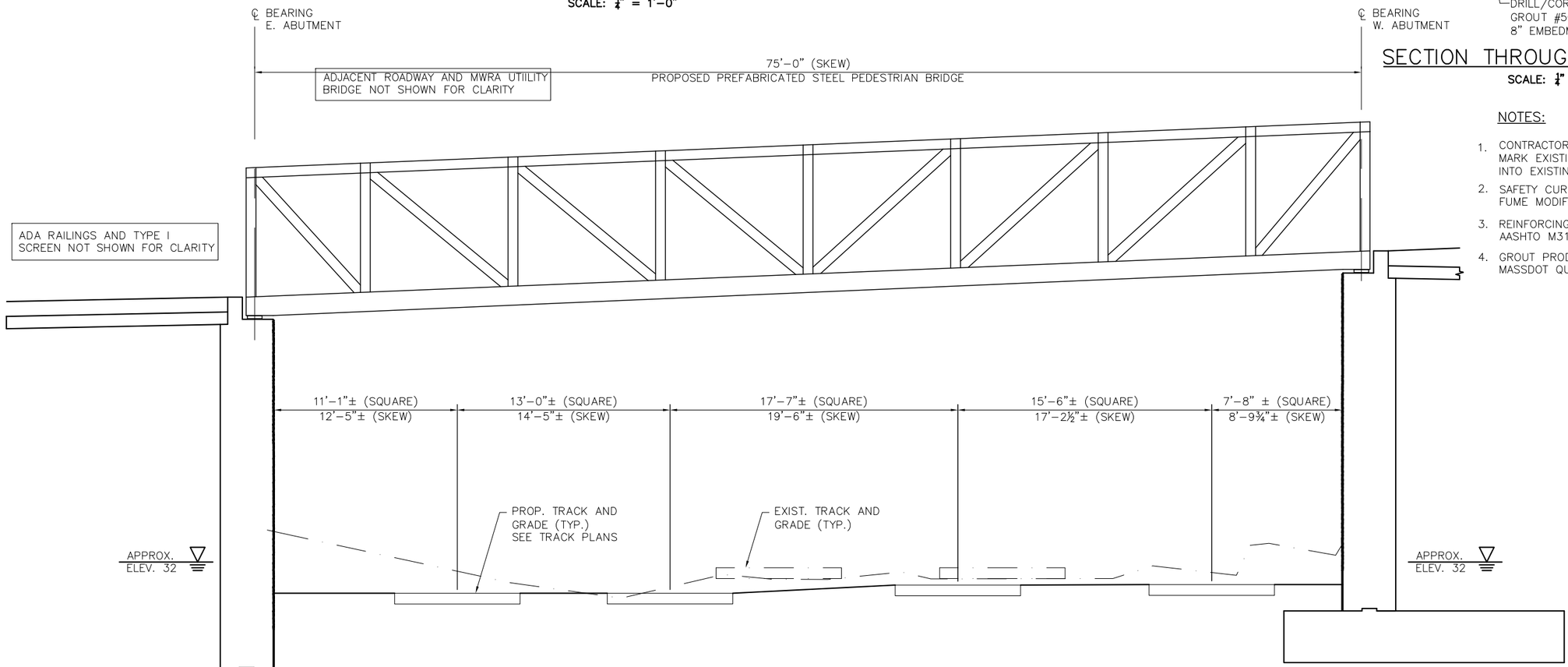
*SHALL RESIST AASHTO TL4 LOADING

SECTION THROUGH SAFETY CURB

SCALE: ¼" = 1'-0"

NOTES:

1. CONTRACTOR SHALL USE PACHOMETER TO LOCATE AND MARK EXISTING REINFORCING BEFORE DRILLING/CORING INTO EXISTING BEAMS.
2. SAFETY CURB CONCRETE SHALL BE 5000 PSI, ¾", SILICA FUME MODIFIED CEMENT CONCRETE.
3. REINFORCING SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M31 GRADE 60 AND SHALL BE EPOXY COATED.
4. GROUT PRODUCT SHALL BE LISTED ON THE CURRENT MASSDOT QUALIFIED CONSTRUCTION MATERIALS LIST.



PEDESTRIAN BRIDGE LONGITUDINAL SECTION

SCALE: ¼" = 1'-0"

4-70

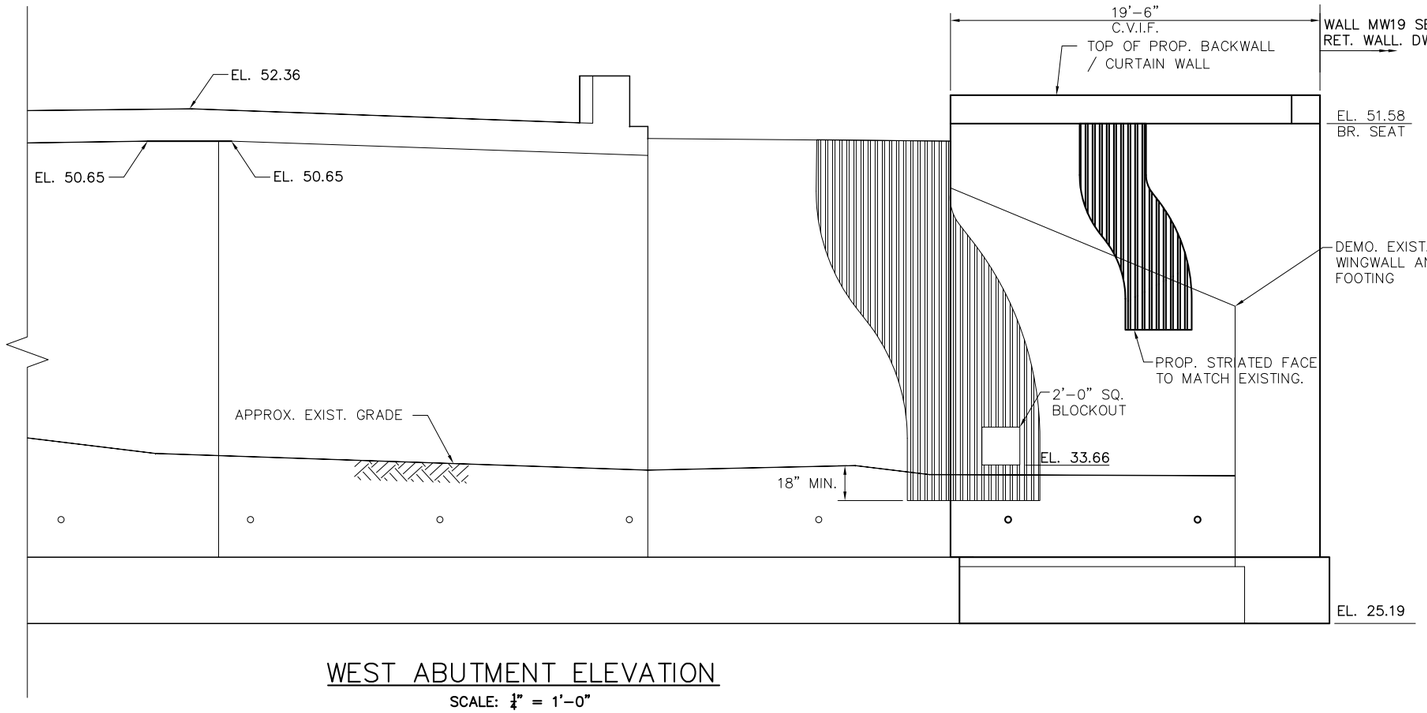
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

COLLEGE AVENUE BRIDGE
DECK PLAN & LONGITUDINAL SECTION

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET COB-S-3001

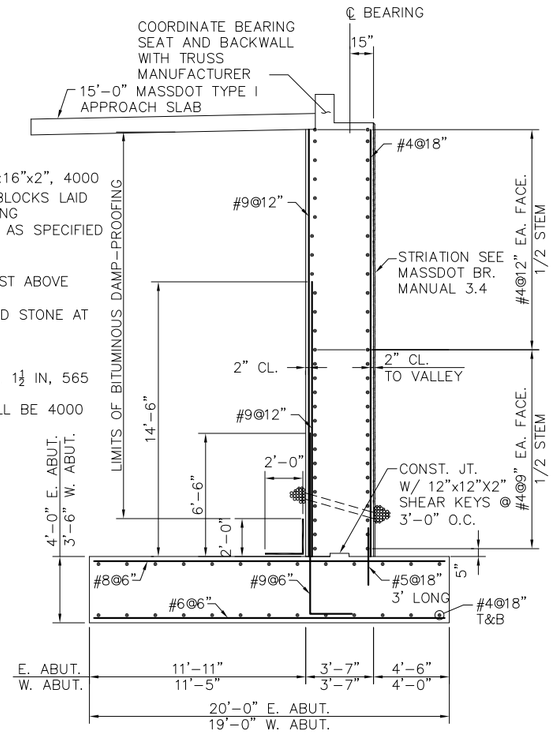


WEST ABUTMENT ELEVATION

SCALE: $\frac{1}{4}$" = 1'-0"

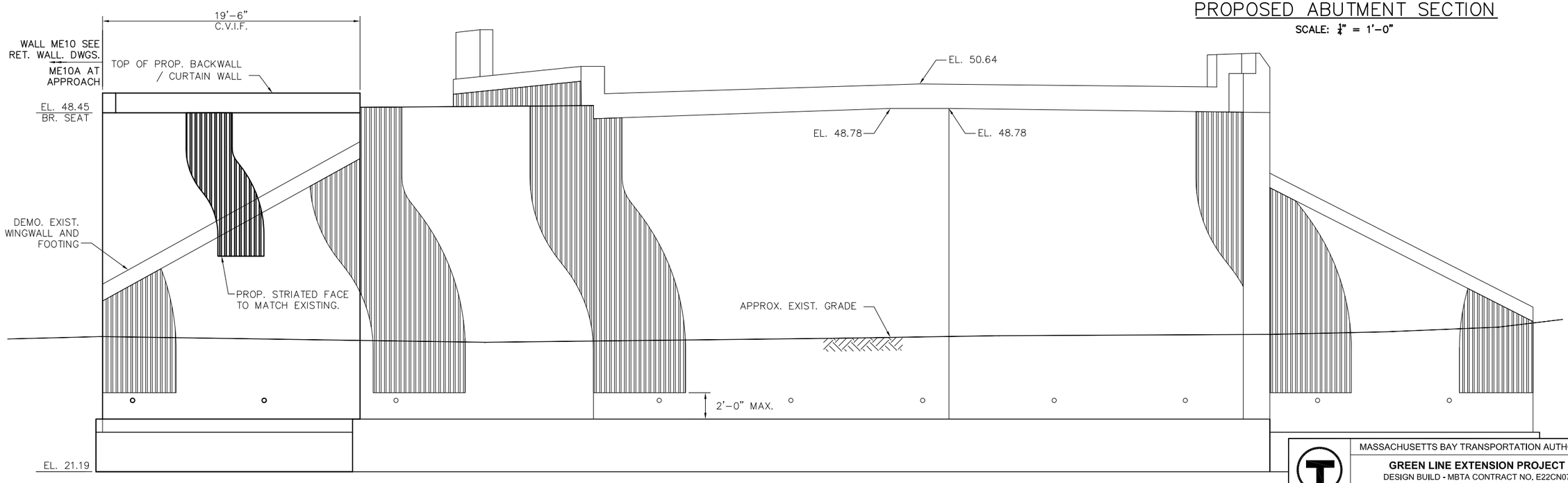
NOTES:

1. MEMBRANE WATERPROOFING AND 8"x16"x2", 4000 PSI, $\frac{3}{4}$ IN, 610 CEMENT CONCRETE BLOCKS LAID IN MORTAR OR OTHER WATERPROOFING PROTECTIVE COURSE, MIN. 2" THICK AS SPECIFIED IN MHD STANDARD SPECIFICATIONS.
2. 4" ø WEEP HOLES 10'-0" O.C. (JUST ABOVE PROTECTIVE COURSE). PROVIDE 1 CUBIC YARD OF CRUSHED STONE AT EACH END OF WEEP HOLE.
3. ALL CONCRETE SHALL BE 4000 PSI, $1\frac{1}{2}$ IN, 565 CEMENT CONCRETE EXCEPT THE BACKWALL, WHICH SHALL BE 4000 PSI, $\frac{3}{4}$ IN, 610 CEMENT CONCRETE.



PROPOSED ABUTMENT SECTION

SCALE: $\frac{1}{4}$" = 1'-0"



EAST ABUTMENT ELEVATION

SCALE: $\frac{1}{4}$" = 1'-0"

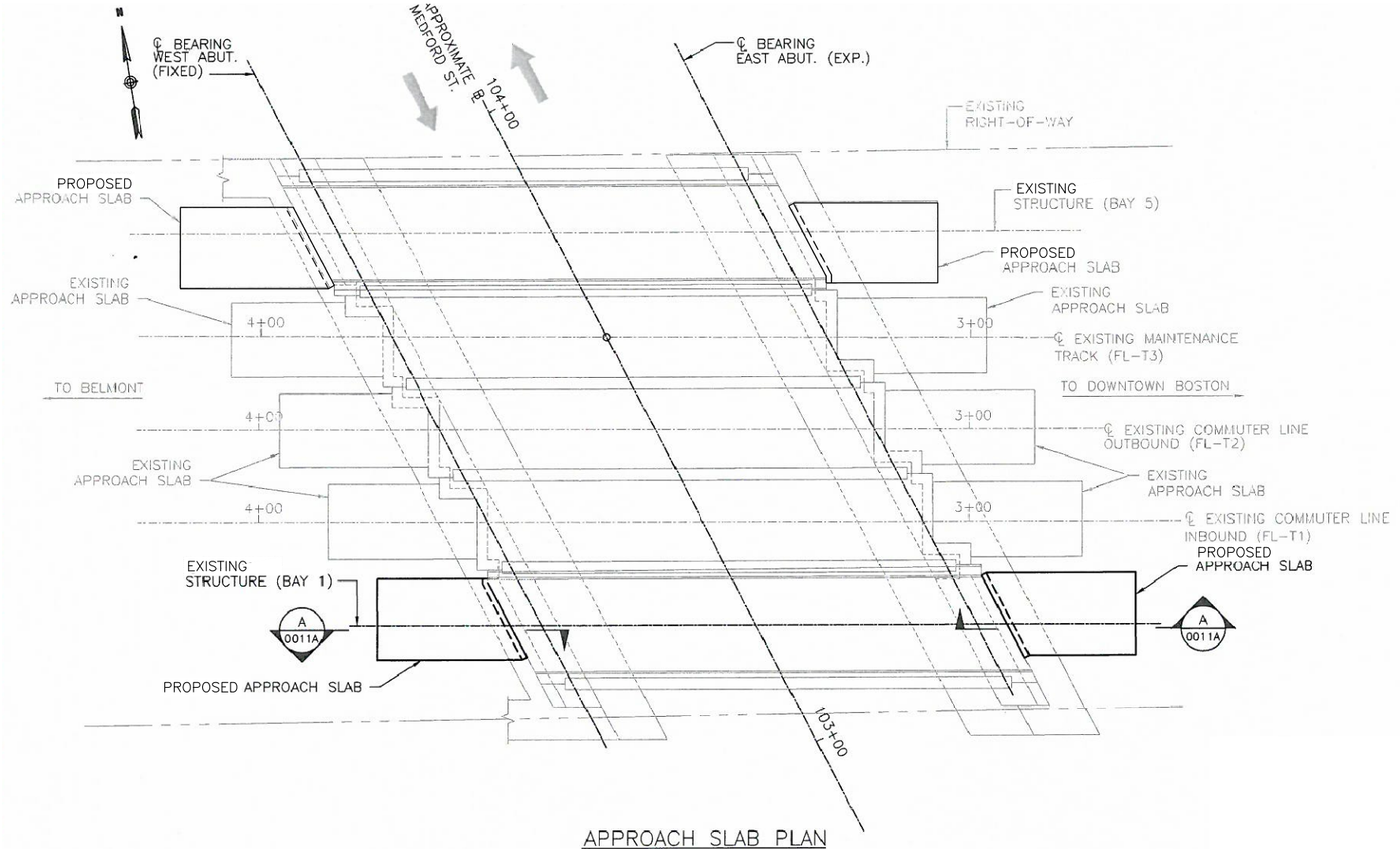
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

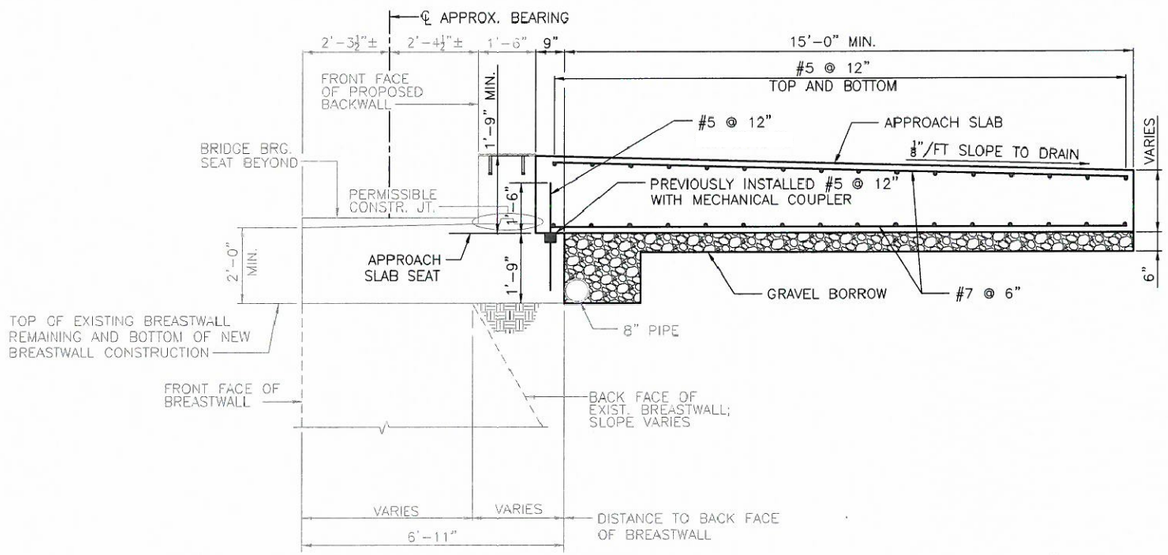
COLLEGE AVENUE BRIDGE
BRIDGE SECTIONS

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET COB-S-8001



APPROACH SLAB PLAN

SCALE: $\frac{1}{32}$" = 1'-0"



TYPICAL APPROACH SLAB DETAIL – SECTION A–A

SCALE: ½" = 1'-0"

STRUCTURAL NOTES

CAST–IN–PLACE CONCRETE

ALL CAST–IN–PLACE CONCRETE SHALL BE IN ACCORDANCE WITH THE SPECIFIED MINIMUM COMPRESSIVE STRENGTH (f'c) AND CONCRETE CLASS AT 28 DAYS:

f'c=4000 PSI, 1½" MAX. AGGREGATE FOR APPROACH SLABS.

CONCRETE MIX DESIGNS SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL.

MINIMUM CONCRETE COVER SHALL BE AS SPECIFIED IN AREMA CHAPTER 8, TABLE 2–7, UNLESS OTHERWISE NOTED.

REINFORCING STEEL

REINFORCING STEEL SHALL CONFORM TO THE REQUIREMENTS OF ASTM DESIGNATION A615, GRADE 60.

ALL SPLICES OF REINFORCEMENT SHALL BE IN ACCORDANCE WITH AREMA CHAPTER 8, SEC. 2.22, UNLESS OTHERWISE NOTED. ALL REINFORCING STEEL SHALL BE EPOXY COATED.

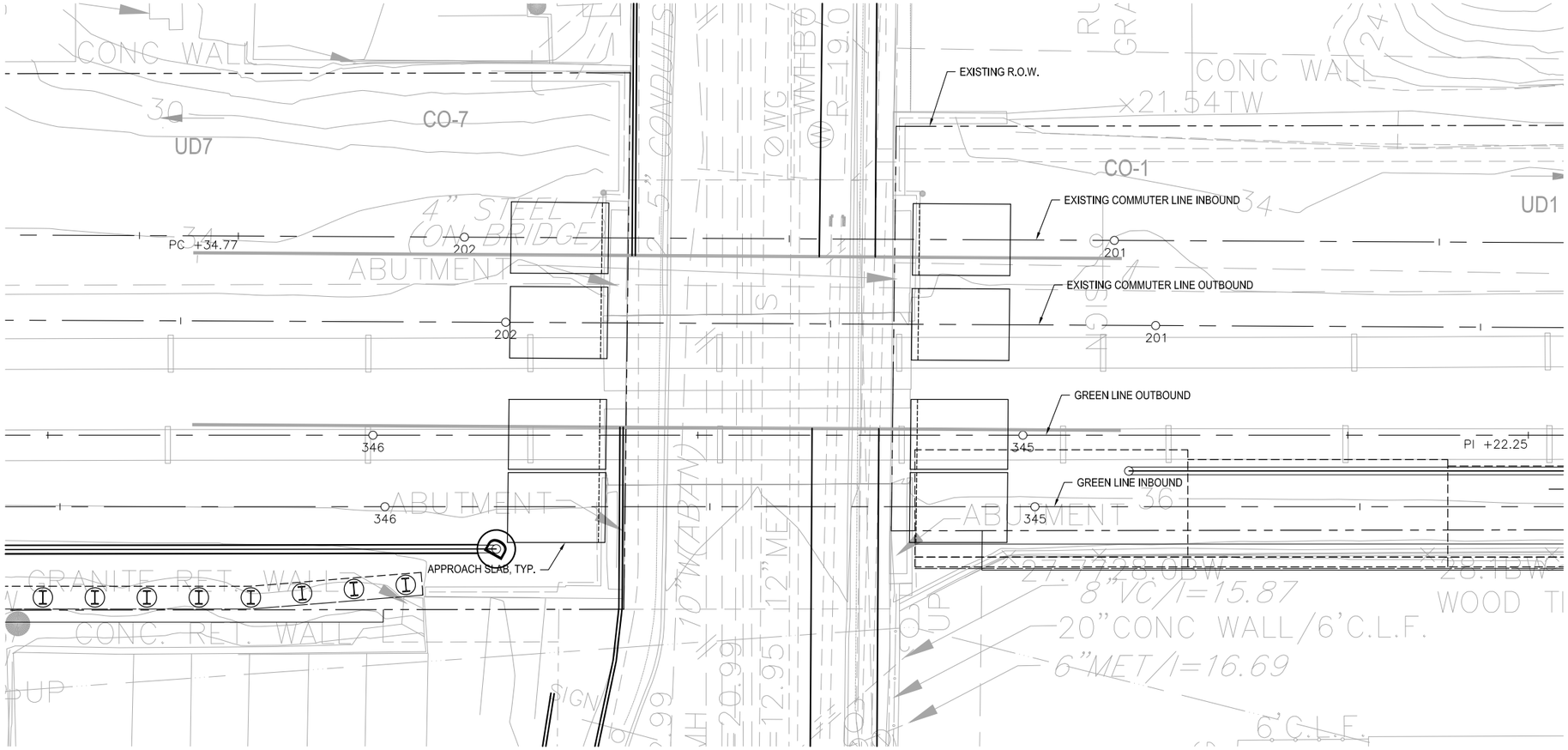
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

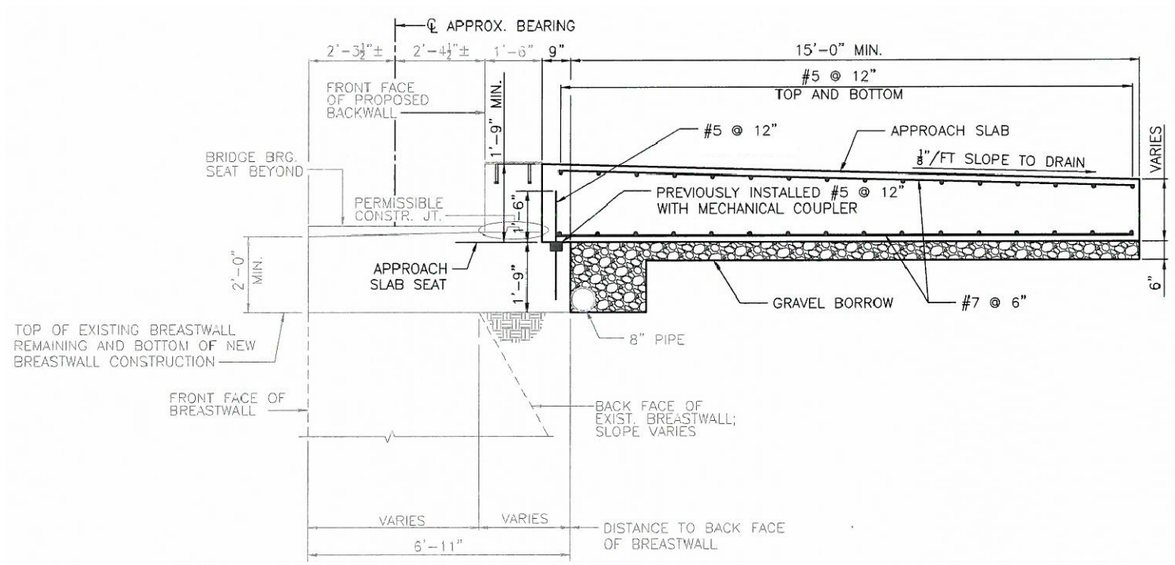
MEDFORD STREET RAILROAD BRIDGE
RAILROAD APPROACH SLAB

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET MRB-S-2001



APPROACH PLAN

SCALE: 1" = 10'



TYPICAL APPROACH SLAB DETAIL – SECTION A–A

SCALE: ½" = 1'-0"

STRUCTURAL NOTES

CAST–IN–PLACE CONCRETE

ALL CAST–IN–PLACE CONCRETE SHALL BE IN ACCORDANCE WITH THE SPECIFIED MINIMUM COMPRESSIVE STRENGTH (f'c) AND CONCRETE CLASS AT 28 DAYS:

f'c=4000 PSI, 1½" MAX. AGGREGATE FOR APPROACH SLABS.

CONCRETE MIX DESIGNS SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL.

MINIMUM CONCRETE COVER SHALL BE AS SPECIFIED IN AREMA CHAPTER 8, TABLE 2–7, UNLESS OTHERWISE NOTED.

REINFORCING STEEL

REINFORCING STEEL SHALL CONFORM TO THE REQUIREMENTS OF ASTM DESIGNATION A615, GRADE 60.

ALL SPLICES OF REINFORCEMENT SHALL BE IN ACCORDANCE WITH AREMA CHAPTER 8, SEC. 2.22, UNLESS OTHERWISE NOTED. ALL REINFORCING STEEL SHALL BE EPOXY COATED.

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GREEN LINE EXTENSION PROJECT
DESIGN BUILD - MBTA CONTRACT NO. E22CN07
CAMBRIDGE/SOMERVILLE/MEDFORD, MASSACHUSETTS

THE WALSH BARLETTA GRANITE
Joint Venture Team

HARVARD STREET RAILROAD BRIDGE
RAILROAD APPROACH SLAB

DATE: SEPT. 28, 2017 | SCALE: AS NOTED | SHEET HAB-S-2001

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STATIONS

THE WALSH BARLETTA GRANITE
Joint Venture Team

4.3 Stations

WBG member firms have considerable MBTA experience in the design and construction of transit stations, with projects such as Fairmount Corridor Improvements, Worcester Commuter Rail Extension, Yawkey Commuter Rail Station, Light Rail Accessibility projects on the Blue, Green and Red Line, and System Wide Elevator Upgrades. Drawing from this experience, all seven of the new Green Line stations will emphasize functionality, accessibility, consistency, life safety, neighborhood integration, and ease of maintenance. The stations will be designed and constructed to accommodate potential future expansion beyond the Union Square and College Avenue stations.

A. ARCHITECTURAL REQUIREMENT

The goal of WBG's station design is to create a comfortable passenger experience and efficient technical layout for the station operators. The following narrative explains these design elements.

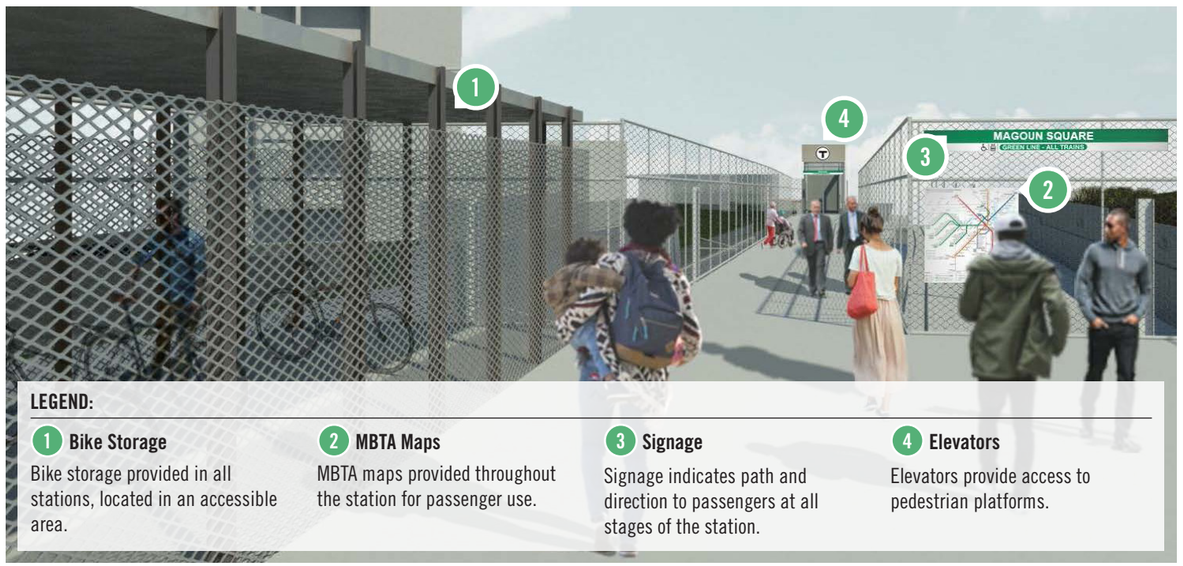
Accommodating Passenger Flows

Each station approach will be easily identifiable by using the MBTA logo "lollipop" signs. Routes to the station center platforms will be ADA accessible and will have an ADA-accessible path all along the platform and onto the train. The stations will have a clear entry, followed by an illuminated path with wayfinding signage. Signage will also be used to identify the main elements of the station such as bicycle storage, elevator, stairs, and fare vending machines.

During the design and construction process, WBG will coordinate with all relevant MBTA departments, such as Safety, Security, System-Wide Accessibility, Communications, Wayfinding, and Graphics. We will provide the Department of Public Safety construction progress updates via the MBTA. WBG will consider community feedback in the design.

Figure 4.3-1 shows the major elements that allow passengers to navigate the station with ease.

Figure 4.3-1 Passengers can easily navigate stations.



Crime Prevention Through Environmental Design

All stations are designed with the Crime Prevention Through Environmental Design (CPTED) approach in mind. Natural surveillance is a key part of the CPTED; it is created through consideration of the placement of physical features, activities, and flow of people in such a way that maximizes user visibility. This fosters positive and safe social interaction among users of all spaces within and around the stations.

The platforms at each station, with the exception of the elevated viaduct station at Lechmere, are slightly lower than the level of the surrounding streets. The difference in height creates a direct view from the streets to the platforms, allowing for natural surveillance to occur. Potential offenders feel increased scrutiny through natural surveillance, and thus perceive an increase in risk. All stations are designed to minimize the number of blind spots and potential hiding areas, and all platform shelters will be transparent. Station entries will be located in an area visible from the public way in a well-traveled area to maximize natural surveillance. The landscape design will not obstruct main user sight lines, especially at station entry and exit points. The elevators will use glass to create visibility from the interior of the elevator to the platform at all times.

The lighting design will create a uniform lighting strategy throughout the station and platform in order to avoid blind spots and potentially dark areas. The fare collection machine area and other secluded areas will be especially well lit. Lighting will be provided with enough intensity to illuminate all areas, but dim enough to prevent blinding glare and/or deep shadows that would hinder the users' view. Lighting will be provided along pathways and other pedestrian-use areas at appropriate heights to ensure that users' faces will be illuminated at all hours of the day.

In addition to the CPTED technique of natural surveillance, emergency call boxes and closed circuit television cameras will be located throughout the stations.

Full Accessibility

The station design focuses on providing a fully accessible experience for all passengers. To create this experience, station entries will be accessible from a public way with a minimum of one accessible route to the platform (Figure 4.3-2). All walkways will be at least 8 feet wide and permit the customer to navigate to and from the platform in the most direct route possible with a clear line of site to changes in vertical direction. All elevators will comply with the requirements of the Boston Center for Independent Living (BCIL).

Figure 4.3-2 Full Accessibility. Each station will have a minimum of one accessible route to the platform. Additionally, WBG will use BCIL-compliant elevators, such as the one shown below, to improve accessibility.

LECHMERE STATION
Walkways from East and North First Streets, Route 28, and bus loop; Utilizing **stairs and elevators** to elevated platform

EAST SOMERVILLE STATION
Community Path from Washington Street
Utilizing **sloped walkways** to the platform

GILMAN SQUARE STATION
Elevated entry from Medford Street
Utilizing an **elevator and stairs** to the platform

MAGOUN SQUARE STATION
Elevated entry from Lowell Street
Utilizing an **elevator and stairs** to the platform

BALL SQUARE STATION
Boston Avenue to platform
Utilizing **at-grade walkways**

COLLEGE AVENUE STATION
Elevated entrance from plaza on Boston Avenue
Utilizing an **elevator and stairs** to the platform

UNION SQUARE STATION
Bennett Court to platform
Utilizing **sloped walkways** to the platform

Yawkey Station Improvements Design-Build, Boston. Walsh led this project constructing a new headhouse to provide vertical access to the station from the street utilizing stairs and four elevators.

All stations will be compliant with ADA Standards. Compliance will be achieved through designing the platform to create accessible entry onto all MBTA trains. Platforms will be a minimum of 20 feet wide, and provide a minimum clearance of 6 feet from platform edge to any obstruction such as columns, shelters, and other amenities, as well as providing accessible fare vending machines and including yellow tactile warning panels along the edge of the platform. The stations will have the flexibility to include bilingual wayfinding in order to address Title VI of the Civil Rights Act. Platforms include two means of egress, which will include emergency egress routes that will either be fully accessible or provide an area of refuge at least 50 feet away from the platform area and enclosed with fencing. All pedestrian paths that cross the tracks will include rubber crossings.

Customer Experience

Customer experience is an important and key component of the GLX Project. The customer experience begins before a user even enters the station. All stations will be visible from the public way by utilizing MBTA logo "lollipop" signs, and will have clear signage indicating the entrance and location of the platform. Once entering the station, the path to the platform will be well lit and include proper signage to indicate the direction of exits and the platform. The platform will provide seating and shelter, in addition to proper illumination and wayfinding.

To ensure that passengers have a pleasant and successful experience, clear and consistent signage will indicate the nearest exit, train destination for each side of the platform, customer assistance area, communication devices, call boxes, variable message signs (VMS), and closed circuit television cameras.

To maintain the cleanliness of the stations, as well as the user experience over time, the stations will include vandal-proof design strategies. This includes graffiti mitigation, implementing a bird repellent system, and avoiding creating spaces that could potentially enable homeless staging. The finishes and elements of the station will be selected with durability and maintainability in mind, as well as ease of replacement. The design of the stations also will take into account the need for winter resiliency through snow removal and de-icing, the location of trash receptacles, and the ability for the platform to be vertically relocated 6 inches to accommodate level boarding into the future Type 9 vehicles.

Visual Continuity

The stations will be clearly marked at the public way to ensure it is identifiable by all users as an MBTA station. GLX will follow the MBTA Manual of Guidelines and Standards in order to ensure that all stations are clearly identifiable as part of the MBTA system. Every station will be designed to blend into the aesthetics of each neighborhood as much as possible.

Interfaces

All station entries will be situated in a clearly visible point of the public way that is accessible from a major public way of the surrounding area. Intersection improvements, such as the addition of wheelchair ramps, bicycle pavement markings, and signage, will promote a seamless interface between public areas and station entry points. At Gilman Station, the Community Path will be a key point to ensure that the Green Line is well integrated with the surrounding infrastructure and neighborhood.

Shelter Design

Materials, Finishes, Envelope, and Weather Protection

The main purpose of the shelter is to protect passengers from natural elements. The shelter will be constructed out of weather-resistant materials, such as tempered glass and galvanized aluminum.

Number and Size of Shelters

Shelters will be provided to accommodate average peak hour, per-vehicle passenger volume projected for that station. The number of shelters will account for approximately 3.5 square feet per person. There will be at least three shelters at each station, with a 6-foot by 8-foot minimum dimension, in accordance with MBTA guidelines. Shelters will accommodate two wheelchair areas, seating for at least two customers, and lighting for customer convenience and safety.

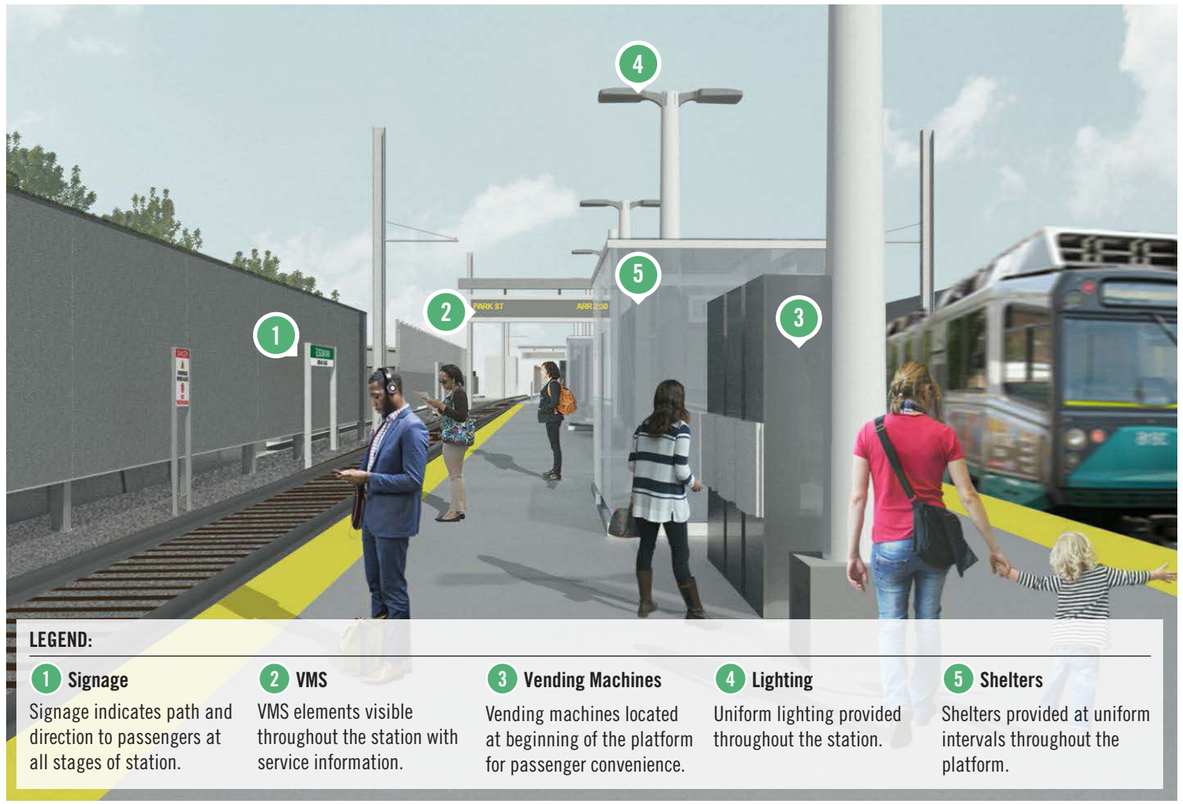
Organization of Required Platform Equipment and Elements

The stations will be organized with all passengers in mind. The signage and primary needs, such as bicycle storage, will be at the station entrance. Within the platform, equipment will be organized in order of necessity to the user. For example, the fare vending machines will be situated at the entry of the platform. Shelters and benches will be provided at a set distance no more than 200 feet from one to the other, with an emphasis on placing benches in close proximity to waiting areas. Trash receptacles will be located near station entrances and shelters and clear from the path of travel. Stations will also include passenger assistance units that will be located along the platforms, walkways, and in the Customer Assistance Area. (Figure 4.3-3).

B. ARCHITECTURAL DRAWINGS

WBG has provided site plans with information on platform equipment with the Composite Drawings. Included is a site plan for every station with 3D views and typical details for all elements present in drawings.

Figure 4.3-3 Organization of Required Platform Equipment and Elements.



LANDSCAPING AND STATION SIGNAGE DESIGN

THE WALSH BARLETTA GRANITE
Joint Venture Team

4.4 Landscaping and Station Signage Design

Communication with the MBTA's Wayfinding and Graphics departments is essential to a successful signage package. The MBTA emphasizes coordination with their departments in order to ensure system-wide consistency. WBG will pay special attention to ensure code compliant slopes, as well as positive drainage at landscaped plazas. The landscape and signage materials, chosen for their durability and performance, will be integrated into a cohesive design vision that reflects a commitment to context, quality, and longevity.

A. LANDSCAPE ARCHITECTURE

The GLX Project's landscape architectural component contributes to the public's ease of use and pleasurable experience of this transit project. Each station will be integrated into its urban context, like the Cambridge Center Plaza in Figure 4.4-1 designed by WBG's Landscape Architect, Shadley Associates, P.C. (Shadley). Shadley is a Massachusetts-based DBE firm that has significant experience designing landscapes for urban areas throughout New England.

Conformance to Landscape Requirements

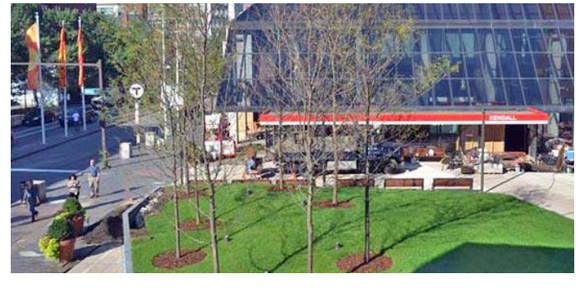
The landscape architectural components, composed of the protection of existing vegetation, creation of new planted areas for slope stabilization, visual buffers and drainage control, and new public plazas with site amenities, will integrate transit improvements into their context. We will design and construct landscape improvements that use native plants and sound planting and maintenance practices, anticipate climate change, utilize the principles of Crime Prevention through Environmental Design, and are safe and comfortable.

Site-Specific Landscaping Requirements

Stations: Each station will be designed to fit within its context. This includes clear, ADA-compliant and safe pedestrian connections; low-maintenance, attractive, and comfortable plazas where appropriate; artwork where possible; and plant material that encourages visibility and easy maintenance, and provides shade, habitat, and visual appeal based on sound horticultural practices. Landscape plans will incorporate stormwater water quality and detention goals. In addition, station design will anticipate and support adjacent private Transit-Oriented-Development, including honoring MBTA agreements with these developers. Each of the seven light-rail stations has specific landscaping goals, as described in Figure 4.4-2.

Vehicle Maintenance Facility (VMF): The landscape improvements at the VMF will include the appropriate depth of landscape medium for the proposed shade trees at 3-inch to 3.5-inch caliper, shrubs, and perennials, which will soften and buffer this facility and its parking area. Plant materials near parking areas will be selected for salt-tolerance, and snow stockpile areas will be considered as well.

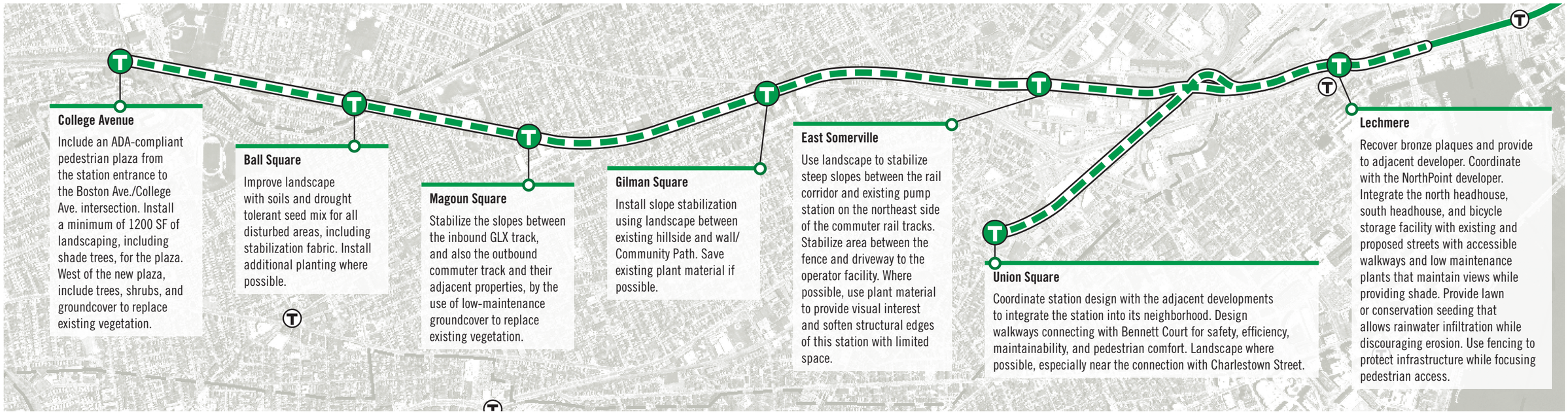
Figure 4.4-1 Cambridge Center Plaza adjacent to the MBTA's Kendall Square Light Rail Station. Trees at station entrances will be selected based on their planting environment and functional goals. (Landscaping design by Shadley)



Traction Power Substations: The landscape at the traction power substations will be designed to maximize visibility for security cameras, while also providing visual buffers where appropriate.

Transit Corridor: The landscape plans will preserve and protect existing vegetation on private abutting property, and within the transit corridor wherever possible. A tree/vegetation survey will be performed, which will be used for the tree protection and maintenance program implemented before construction begins.

Figure 4.4-2 Landscaping Goals for the Seven Light Rail Stations.



Community Path: Landscaping along the Community Path (Figure 4.4-4) will include landscaped edges to minimize erosion by installing seeding, planting, and erosion control geotextiles where appropriate. Plantings will be used to provide buffer screening, while maintaining visibility for safety, providing shade, and adding visual and seasonal interest. Benches will be added at appropriate locations to encourage community use.

Planting Criteria

WBG will prepare an overall plant list for deciduous, ornamental and evergreen trees, deciduous and evergreen shrubs, and groundcover in a matrix form with essential criteria. Criteria will include each plant's native status, drought tolerance, salt tolerance, tolerance of heat and water, USDA zones (5 is required), and mature plant characteristics such as height, width, flower, bark, fall color, and maintenance requirements. Each plant needs to thrive without irrigation and fertilizer after the establishment period. The plants for each station or location will be selected from this list, using sound design principles for specific sites such as solar orientation, wind, and slopes, as well as proximity to fences, wall, or pedestrian paths, and aesthetic goals.

During the installation and maintenance period, all landscaped areas will be monitored to prevent the establishment of invasive species. New plants will be monitored for possible weeds in their rootballs, finish grading work will include removing all weed growth, and installation of seed mixes will be monitored. During establishment, all landscape areas will be reviewed and inspected, and any invasive species will be removed.

Site Amenities and Furnishings

Site amenities, such as bike racks (shown in Figure 4.4-3), benches, and trash receptacles, plus other site elements in the public realm (including lighting, signage, security cameras and bicycle parking), will be integrated within each station's site design (Figure 4.4-5). Our general approach is to make amenities consistent throughout the entire GLX Project so that the MBTA may maintain them easily. However, there may be reasons at specific locations to differ from this approach to integrate the location with its neighborhood context. All site furnishings shall conform to MBTA Design Standards.

Third Party Agreement Requirements

Third party agreements will be cataloged, understood, and honored in the landscape plans. These agreements are critical to the success of this project, both for the MBTA and for the private parties who are anticipating the GLX Project in their developments. Examples of third party requirements that will be adhered to include tree protection and areas that must be restored to their original condition.

Landscape Drawings

Landscape drawings are included with the Composite Drawings that demonstrate the following:

- Integration of the system into the surrounding urban context
- Identification of pedestrian and cycling connections
- Consistency of a system-wide streetscape
- Accessibility

Renderings

Renderings are included with the Composite Drawings that illustrate typical grading, materials, site amenities and furnishings, including lighting, bicycle racks, signage, plant material, and other elements to demonstrate compliance with the Technical Provisions.

Figure 4.4-4 Community Path Landscaping Plan.

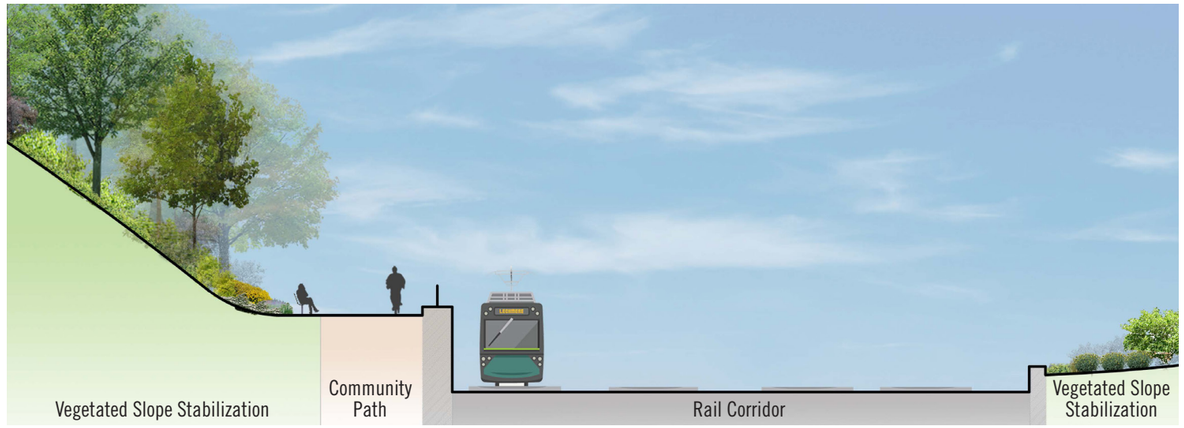


Figure 4.4-5 Landscaping along the GLX College Avenue Station. Trees, native shrubs, groundcover, and benches add a welcoming entry to the College Avenue Station.

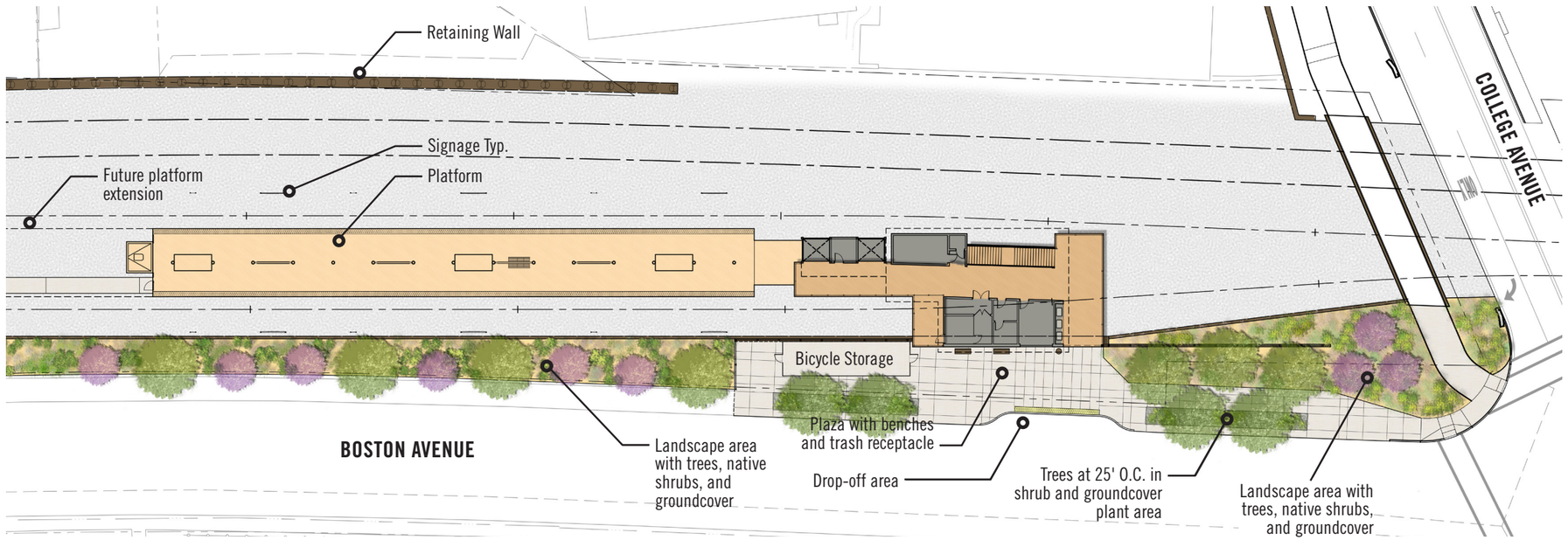


Figure 4.4-3 Station Amenities. Bicycle cage at Malden Center Station on the Orange Line, as designed by Jacobs.

B. WAYFINDING, SIGNAGE, AND VISUAL DISPLAY

Visual Elements Strategy

Signage and Common Elements

Our approach to placement and system integration of signage and common elements throughout the GLX Project relies on close coordination with the MBTA Wayfinding and Graphics departments. We will work with the MBTA to incorporate the common graphic standards and symbols used for wayfinding throughout MBTA projects. This will create continuity and easy recognition of the MBTA throughout all stations on the Green Line Extension. Signage will be placed at locations that are most visible and accessible to all riders, and will clearly direct, warn, and inform riders through common graphics.

To create further clarity, wayfinding elements will have unobstructed sight lines and be well-lit by a uniform lighting strategy (Figure 4.4-7). The lighting strategy will be visually comfortable for riders, meaning proper illumination during dark hours and no glare on signage or wayfinding elements.

Figure 4.4-7 Lighting Strategy. WBG's design will include a uniform lighting strategy that provides well-lit signage and wayfinding elements.

Government Center Green Line Station
Constructed by Barletta

Charles/MGH Red Line Station
Constructed by Barletta

Intuitive Wayfinding

To provide intuitive wayfinding, we will use clear and consistent graphics (such as colors, text, and symbols) across the seven stations and the Lechmere bus loop along the GLX corridor. Each station entry will provide wayfinding that is clearly visible in point of the public way. As a critical decision making point, station entries will provide wayfinding that clearly identifies all route options to riders. The wayfinding will direct riders throughout the station and identify accessible routes, nearest exit, and destination of the train on each side of the platform.

Wayfinding Routing

All stations will be designed with equal use and accessibility in mind for all riders. All accessible routes of travel will be integral with the primary route for the general public. There will be directly accessible pathways from public sidewalks and transit stops to the accessible entrance. The accessible routes will be clearly identified through wayfinding elements at all critical decision making points leading up to and within the stations (Figure 4.4-6).

Visual Elements Drawings

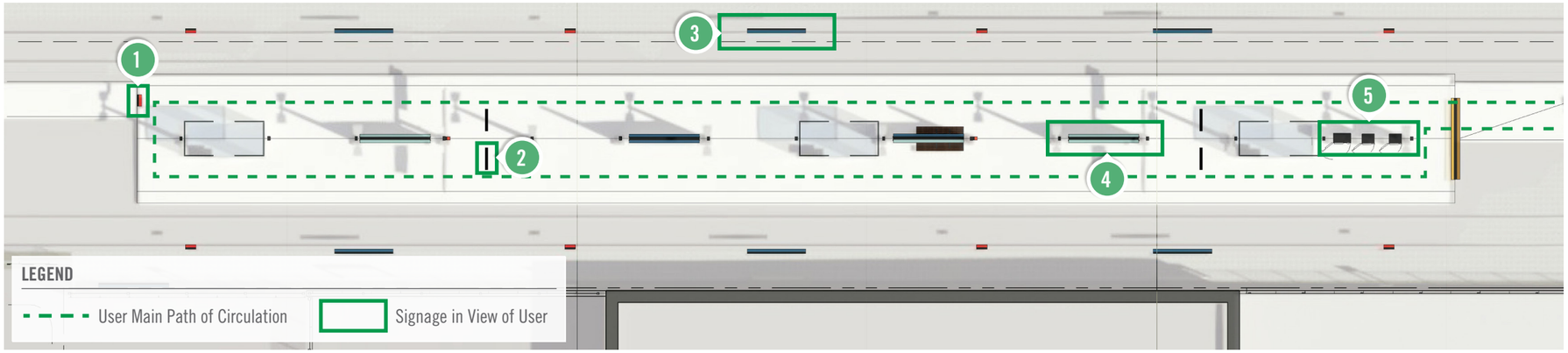
Drawings are provided with the Composite Drawings that demonstrate the following, per the Instructions to Proposers:

- Station site plans showing typical wayfinding routing with sign placement and wayfinding routes, including accessible and non-accessible routes
- Signage plans showing static and variable messaging signs, including station identification signs and markers, regulatory signs, code-required signs, informational signs, system-wide signs, and signs related to the art program, such as plaques.

Renderings

Typical renderings for key points are provided with the Composite Drawings.

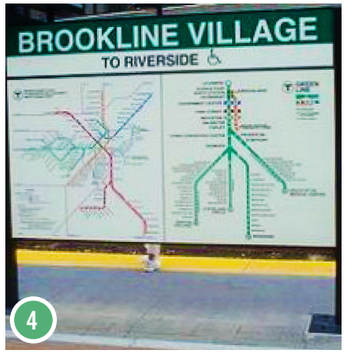
Figure 4.4-6 Typical Wayfinding Routing. Critical visual elements on a typical GLX station platform.



Regulatory/Warning Signage
Emergency Egress sign

Variable Message Sign
Schedule information

Track Signage
Station Identification and Wayfinding signs



Platform Maps
Rapid Transit Line Map and Green Line Map signs

Visual Elements
Fare Collection signs and equipment

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VEHICLE MAINTENANCE FACILITY

THE WALSH BARLETTA GRANITE
Joint Venture Team

4.5 Vehicle Maintenance Facility

Both the Vehicle Maintenance and Transportation Buildings will be designed and built to create a facility that is durable and efficient. WBG has thoroughly planned all aspects of the facility so that the MBTA will have a safe and reliable facility to store, operate, and maintain the GLX fleet. Combining our full understanding of MBTA operations with our shop and yard experience will allow WBG to deliver a compliant and functional facility.

A. ARCHITECTURAL DESIGN

Meeting Architectural Requirements

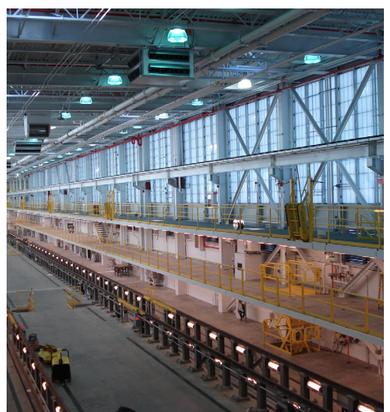
WBG conducted a thorough review of the Vehicle Maintenance Building (VMB). Our design development process has allowed us to confirm code compliance, design building systems, and minimize construction costs, all while enhancing the overall building design. Six new mechanical and electrical equipment rooms were added to the design. Several new doors were also added for emergency egress and equipment room access. These refinements will benefit MBTA personnel working in the building and demonstrate WBG's in-depth understanding of shop operations. Ample heating and ventilation have been provided in the design to ensure worker comfort, and extensive areas of translucent panels are provided on the modern building facade.

The six new rooms were added on a newly designed mezzanine (Figure 4.5-1). This addition eliminated the need to grow the building's footprint, which would have impacted the already sharp curves in the yard track alignment. These rooms are located above the office area and connected by a stairway. Although not ADA accessible, these infrequently used rooms will need to be serviced by able-bodied workers, similar to the main pit area. Removable railings will allow forklift access to this floor for transporting heavier items.

The following detailed discussion demonstrates WBG's complete understanding of Vehicle Maintenance Facility (VMF) requirements and operations.

VMF Design Expertise. WBG's Lead Designer, Jacobs, has designed eight shops for transit clients. Our designers understand how to design buildings for this challenging work environment and lay out the various systems and infrastructure in the yard that support these buildings.

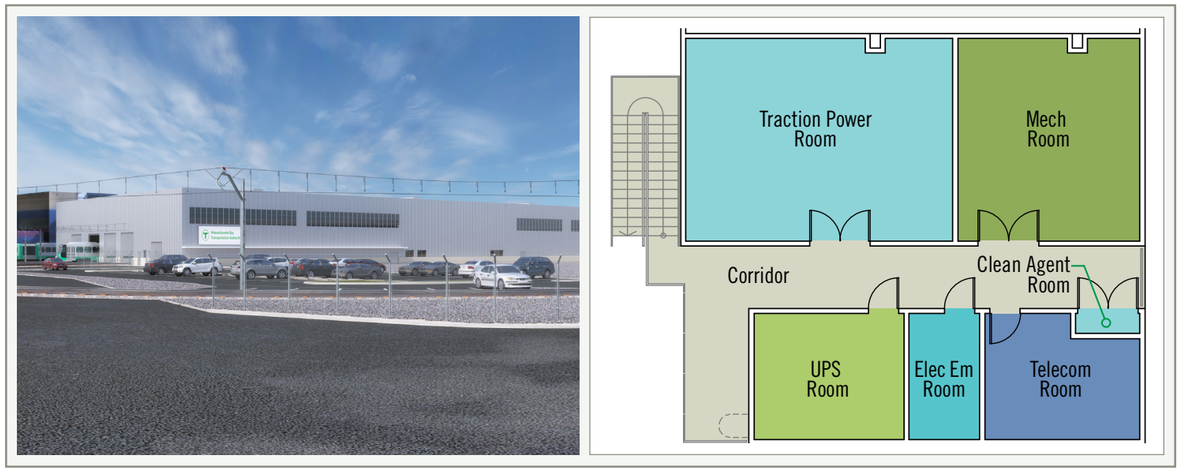
Long Island Rail Road Arch Street Shop and Yard, designed by Jacobs



Metro-North Railroad's Coach Shop, designed by Jacobs

Metro-North Railroad's Coach Shop, designed by Jacobs

Figure 4.5-1 WBG's design refinement for the Vehicle Maintenance Building. Our design includes a mezzanine for mechanical and electrical equipment. The design eliminates the need to grow the building's footprint, while maintaining worker efficiency.



Life Safety

The VMF will be designed in accordance with the following adopted codes, standards and regulations as implemented by the Massachusetts Consumer Affairs and Business Regulation:

- Massachusetts State Building Code (MSBC) 780 CMR (referencing the 2015 International Building Code)
- Massachusetts Comprehensive Fire Safety Code, 527 CMR 1.00
- Massachusetts Architectural Access Board, 521 CMR
- ADA Standards for Transportation Facilities by US DOT
- Massachusetts Electrical Code (MEC), 527 CMR 12.00
- International Mechanical Code, as amended by 780 CMR 28.00
- Uniform State Plumbing Code, 248 CMR
- International Energy Conservation Code, as amended by 780 CMR 13.00
- Massachusetts Board of Elevator Regulations, 524 CMR
- FM Global Standards
- MBTA Guidelines & Standards
- MBTA Guide to Access
- American Public Transportation Association (APTA) Guidelines
- Association of American Railroads (AAR)
- NFPA 285: Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components

A code summary sheet is provided with our Composite Drawings.

Floor Area Summary

The gross square footage of the VMB is 56,015 square feet, and the net is 53,085 square feet. Our design provides 2,000 additional square feet in the building to provide utility rooms not previously included in the RFP documents. This additional space ensures a functional building that will address MBTA needs. We included a mezzanine for the traction power, clean agent, telephone, mechanical, uninterruptible power supply (UPS), and electrical rooms. Note that the mezzanine will limit the height of the breakroom to 11.5 feet. While less than the requested 14 feet, this height is still more than the customary 9.5-foot-high ceilings provided for most rooms of this type.

Architectural Design Description

The new VMB will be located within the VMF rail yard. The facility will be built in a fairly open area of the yard. To the north of the VMF will be four new tracks and a new parking area to support the facility. To the east of the VMB are existing tracks. Four tracks will enter the VMF from the south and exit on the north side of the building. To the west is an open field that will be reserved for the future expansion of the VMB.

The VMB massing is uncomplicated. The massing is driven by the function of the facility. The one-story rectangular form lends itself to receiving rail vehicles at one end and moving them through to the other end after they have been maintained and serviced. The

rectangular massing also works well in terms of shop operations due to the large spanning structure and high bay areas that support large pieces of equipment such as bridge cranes and wheel truing equipment. The VMB massing allows the facility to blend into the surrounding site, complementing the new Transportation Building located southwest of the facility. Shrubs and smaller trees will be introduced in specific areas of the site to provide natural aesthetics in an otherwise industrial-looking setting. Figure 4.5-2 provides the general building arrangement for the VMB and Transportation Building.

Accommodating MBTA Requirements

The VMB will be designed to comply with the Technical Provisions. These requirements include floor layout, work flow, pit access, mechanical/electrical/plumbing (MEP) requirements, sustainability, safety, durability, and equipment specifications. WBG has included additional rooms to ensure full compliance with the provisions and provide sufficient space for workers and equipment.

The shop is designed for movement of trains by either the overhead contact system or stinger in the crane areas. Pit access, under-track pit lighting, storage layout, work flows, and material movement have all been reviewed and designed into the floor plan. Power to the proposed and future equipment is included, and embedded rails for the future hoist will be provided so that future slab modifications are not needed.

WBG understands and has addressed MEP requirements in the VMB to ensure shop functionality. Rooftop heating and ventilating (HV) units provide 100% outside air and include energy recovery wheels. The HV units, along with exhaust fans and the large train doors on the shop's north and south walls, provide ventilation during summer months. In colder months, the HV units provide heat and are supplemented by gas unit heaters at the shop perimeter.

All required plumbing systems will meet the Technical Provisions, including industrial waste, water, and sanitary. Water-efficient water closets and water flow restrictors will be provided on faucets for lavatories, sinks, and shower heads. Industrial waste effluent will be treated through an oil water separator. Emergency eyewash and showers will be provided in hazard areas.

Translucent panels will be used to provide a bright shop area, and wireless daylight dimming will be used for the high-bay LED lighting. Lighting control systems will be provided in all normally occupied areas, and motion detectors in utility rooms and storage rooms will turn lights on and off automatically. Variable speed systems for all fans, pumps, and motors will be provided to conserve energy.

Physical Working Environment

WBG team members have direct experience working on MBTA maintenance facilities, including work on multiple carhouses at Riverside, Wellington, and Cabot. We have used this experience to address critical factors affecting the physical working environment. One such critical factor is the integration of key systems. An inventory that documents the flow and movement of materials, equipment, and workers throughout the facility provides the basis of design for all aspects of programming.

Another critical factor to consider in design is the environmental separation between the shop spaces that support industrial activities on tracks and smaller spaces that support human comfort. The support facilities have offices, lockers, crew quarters, restrooms, and electronics rooms embedded inside a larger envelope.

Accessibility

The VMB design will provide for an ADA-compliant break room, training room, and restrooms. Since the mechanical rooms, electrical rooms, wheel truing machine area, and pit areas require able-bodied workers to perform industrial activities, such areas will not be ADA accessible. The Transportation Building design will be ADA-compliant to meet the Technical Provisions requirements.

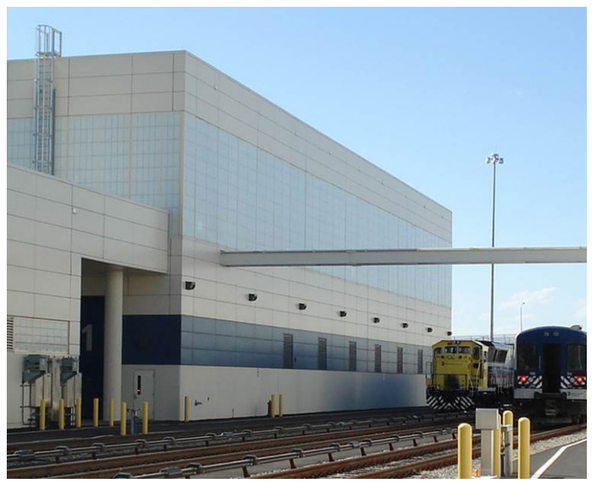
Durability

The exterior materials for the building meet the Technical Provisions requirements, as well as requirements of FM Global. The materials are durable, resilient, and low maintenance. The life span of these materials will exceed the 25-year requirement. The VMB will consist of a steel framing structure with a precast concrete base and an insulated metal wall panel system above. The building envelope will provide continuous insulating properties along the base, walls, and roof. The material and construction of the VMB will be corrosion-free and weather resistant. The Transportation Building will have a matching wall panel system.

Noise, Vibration, and Light Trespass Mitigation

The proposed VMB location was selected from several alternatives to minimize environmental and operational concerns. Previous

Similar to GLX, Jacobs designed Metro-North Railroad's locomotive shop with abundant translucent panels. The exterior's sleek, modern wall panel system uses extensive translucent panels. The interior is bright and energy efficient as a result of these panels that allow daylight harvesting.



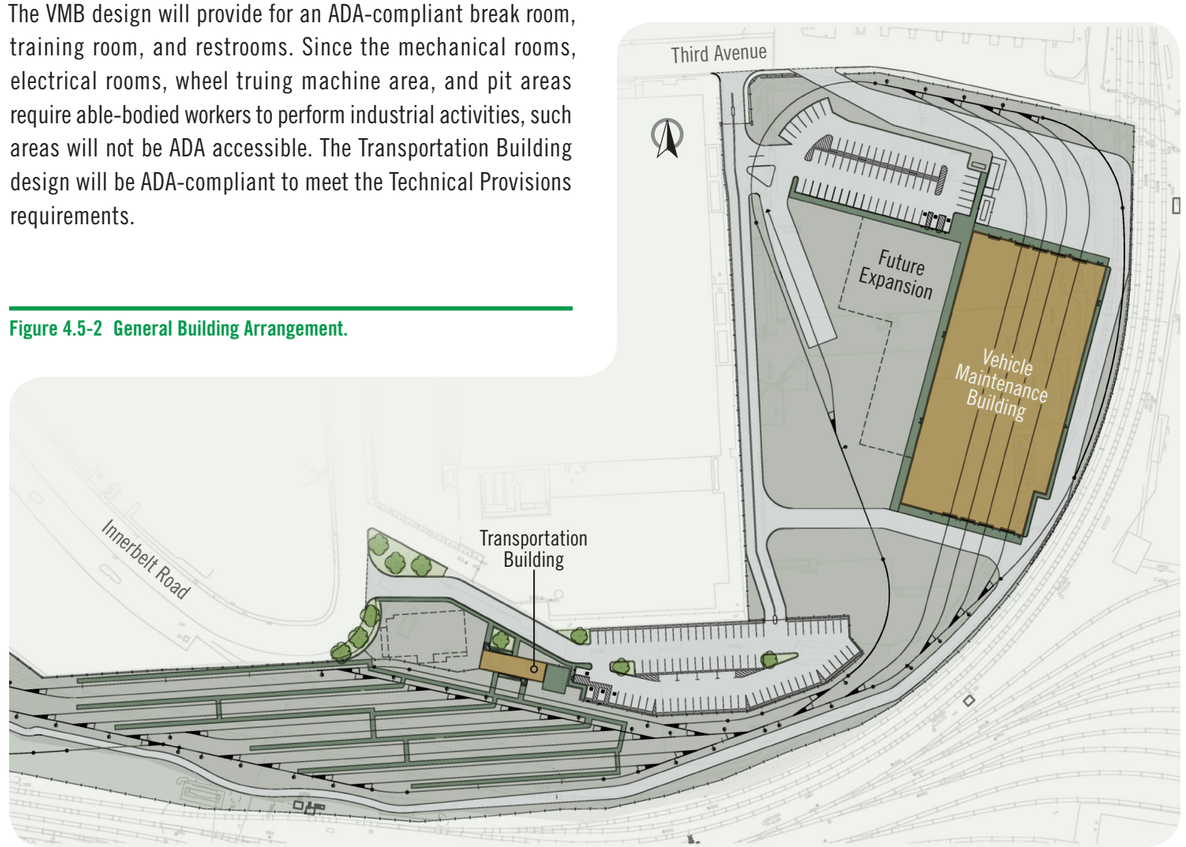


Figure 4.5-2 General Building Arrangement.

studies determined that noise or vibration-sensitive land use that could be affected by VMF operations was limited to the Brickbottom multi-family residential building near the yard leads. Detailed assessments of VMF operation noise and vibration impact will be conducted for locations near the facility based on updated design and land use information, with appropriate mitigation measures designed and implemented in accordance with FTA guidance and the MBTA noise and vibration mitigation policy.

Lighting levels and spill light will be closely reviewed to ensure proper levels for the building location. Luminaires illuminating the building facade will be shielded from view beyond the site boundary. Luminaires not illuminating the building facade with intensities greater than 10,000 candela will be shielded or rated as full cut-off per Illuminating Engineering Society of North America (IESNA) guidelines. Direct illumination onto adjacent properties will be avoided to limit spill light.

VMF Architectural Drawings

VMF architectural drawings are provided in the Composite Drawings.

B. MECHANICAL, ELECTRICAL, AND PLANT

Conformance to Electrical and Mechanical Requirements

Electrical Systems

VMF electrical systems will be designed to comply with MEC, MSBC, applicable local codes, and City of Somerville requirements. The electrical distribution design will incorporate an optimized, energy efficient, and low-maintenance electrical system.

Distribution equipment serving life safety (such as emergency lighting, optional-standby, and other MBTA-defined emergency loads) will be in the Emergency Electrical Distribution Room (EDR). All other distribution equipment will be in the Normal EDR or throughout the facility for an optimized location.

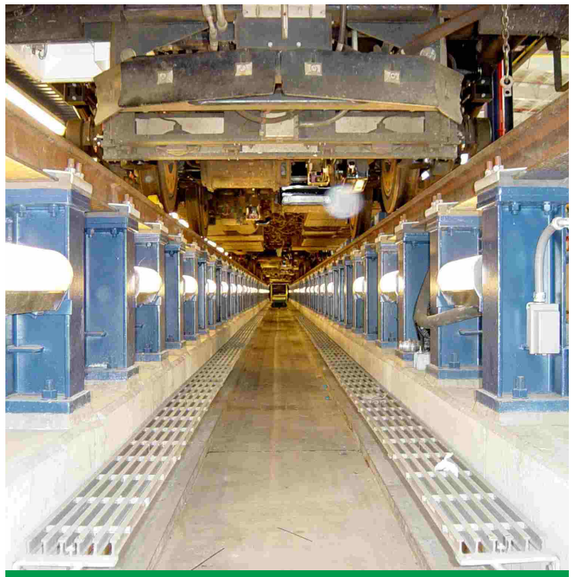
A standby permanent gas generator and multiple automatic transfer switches will be installed to provide power to emergency systems, legal standby systems, and any other loads required by MBTA. Design will adhere to all MEC, NEC, NFPA 110, Massachusetts State Building and all other required applicable codes.

Lighting will be designed using Illuminating Engineering Society's (IES) guidelines to comply with MBTA's light level requirements for indoor and outdoor applications. LED fixtures will be incorporated in the shop areas and at exterior locations, as required by Technical Provisions 13.5.

UPS will be provided as per Technical Provisions 14.5.3.6 to power all life safety loads as defined in Technical Provisions 14.5.3.5.

Where there is sufficient ingress of natural light, shop area lighting will be controlled by lighting control panels with integral programmable controller and network capability to provide daylight harvesting. Lighting controls will be designed to turn lights on or off, or be dimmed in those areas with natural light available. Any daylight dimming will be accomplished via wireless communication to allow seamless calibrations and future flexibility to redefine zones. Additional controls via photocells will be provided in areas defined by the Technical Provisions.

Specialized lighting will be provided for pedestal tracks in the pits. This lighting will be aimed to light both the underside of the cars and the shop floor in order to provide a bright, functional work environment.



For GLX, WBG will provide pit pedestal lighting similar to this Arch Street Shop project, designed by Jacobs for the Long Island Rail Road. The heavy-duty pit light provides a bright work area.

The lightning protection system will be provided by a UL-certified lightning protection installer, complying with UL 96A (Standard for Installation Requirements for Lightning Protection Systems) and NFPA 780-2014 (Standard for the Installation of Lightning Protection Systems).

The building grounding system will be designed in accordance with IEEE 142-1991 (IEEE Recommended Practice for Grounding of Industrial and Commercial Power System) and per recommendations of MBTA as listed on Technical Provisions 14.5.3.7. Final grounding wire sizes, as required by MBTA's standards, will be confirmed during final design.

PA, Fire Alarm Systems, Security, and Other System Elements

A fire alarm system will be provided as per NFPA 72 and Massachusetts Comprehensive Fire Safety Code. The main fire alarm panel will be located in the main communications room, with its remote annunciator housed in the main entrance of the building. Monitoring and control modules for interconnections with systems such as HVAC equipment, sprinkler system, public address system two-way communications, access control, fire pump, and clean agent systems (as required in Section 14.3 of the Technical Provisions) will be provided.

The automatic sprinkler protection provided within the VMB and Transportation Building will be hydraulically calculated based on the available water pressure. A hydrant flow test will be performed. An electric fire pump, jockey pump, and associated controllers are expected for the VMB to boost water pressure. The fire pump will be a vertical in-line pump, with an estimated size of 500 gpm at 65 psi. The jockey pump size is estimated to be 5 gpm at 75 psi. An automatic wet standpipe system will be installed throughout the VMB.

Clean agent protection will be provided within all communication rooms (VMB, Transportation Building, and stations). Clean agent releasing panel will monitor smoke detectors/manual activation within the communication rooms and be equipped with dedicated notification appliances, abort switches, and signage. Releasing panel will communicate with the VMB fire alarm control panel and secondary power will be via battery backup. Two, cabinet-enclosed, self-contained breathing apparatus (30-minute air supply) will be installed outside each communication room. Pre-action sprinkler protection will be provided within the VMB and Transportation Building communication rooms. All sprinkler piping will be Schedule 40. Fire extinguishers will be located throughout VMB and Transportation Building.

The VMF communications and security systems will be based on MBTA and industry standards and, to an extent, are an extension of the GLX station systems. These systems will interface to the existing communications and security systems currently in service at the MBTA, and will follow the Configuration Management Plan.

Public Address System

The VMB public address system will be local to the VMB and will not interface to the MBTA Operations Control Center (OCC). The system will consist of loudspeakers, digital signal processor, power amplifiers, mixers, and microphones. Users will access these systems via analog outputs from the Avaya telephone system.

Security

The VMF will have nodes off the wide area network (WAN) and the security wide area network (SWAN). These nodes will allow the VMF communication and security systems to be integrated into the existing physical security management system (PSIM), the Avaya Voice over IP (VoIP) telephone system, the power and communication SCADA systems, and the corporate IT systems.

The CCTV system provides remote surveillance and video recording of areas in and around the VMF for the operations and security departments and transit police. All video cameras will be incorporated into the MBTA's PSIM system.

Power over Ethernet (PoE) IP-based cameras will be placed within the VMB to view secure rooms. Exterior cameras will be located outside the VMB, within the yard and at motorized lift gates.

The Project will provide video management and storage solutions for the proposed video cameras. Video servers will be added at the MBTA's data center at the OCC to store video.

The Electronic Access Control System (EACS) will provide access through secure portals to users with authorized credentials. Card readers, door contacts, and electric locks will be provided at doors that lead to critical infrastructure, such as communications, electrical, and mechanical rooms. Double card readers and stanchions

Exterior cameras will be located outside the VMB, within the yard and storage area, and at the motorized lift gates. A dual card-reader/intercom at the motorized gate provides additional security.

will be provided at each motorized lift gate. Each card reader will interface to a local access control panel that will then interface to the PSIM via the SWAN. The PSIM will be updated to include alarm rules, such as a door propped or forced open. Some portals require only monitoring (such as roll-up doors) and will be equipped with only magnetic door contacts. WBG will follow the MBTA's Safety and Security Management Plan for the VMF through final design, construction, testing, and commissioning.

Communications

New core (10GBPS) and local area network (1GBPS) data switches will be provided at the VMF (Cisco for the WAN, Extreme for the SWAN). IP address schemes and virtual private networks (VPN) will be developed in coordination with the MBTA to integrate these new switches, and their data traffic, into the existing networks. These data switches will use the new 96-strand communications fiber optic cable extended from Lechmere and East Somerville stations.

To support data and telecommunications services, Category 6 data cable will be provided from the closest communications distribution location to jack locations, as shown on the project drawings. At locations where Ethernet limits are exceeded, communications cabinets will be installed and be connected to the core switches via fiber optic cable. The cabinets will house hardened data switches, patch panels, power supplies, and UPS units.

WBG will provide an Avaya IP telephony gateway at the VMB to provide telephone service (VoIP, digital, and analog) for the offices and support rooms. An ancillary component of the telephone system will be an audio logging recorder. This unit will be configured to record the telephones within the VMB, and to record the MBTA's two-way radio system. In addition to telephone service provided through the Avaya telephone gateway, a Verizon point-of-demarcation will be provided at the VMB to accommodate leased communications services. The proposed VoIP call boxes for the motorized lift gates will be ADA compliant and compatible with the existing AlphaCom server located at the OCC.

Remote monitoring of pumps, generator, and fire alarm panel will be accomplished through the Hub Monitoring and Control Systems (HMCS). Input and output points for the various devices will be connected to a new communications programmable logic controller (CPLC) to be located within the VMB communications room. The CPLC will interface to the servers at the OCC via the WAN.

The power SCADA that provides the remote monitoring and control of traction and unit power substations will connect to the MBTA datacenter at the OCC via the WAN. The power dispatcher graphical user interface screens will be updated to include the new VMF substations.

All of the communications and security systems require back-up power. The back-up power requirements vary among the systems. Each communications and security system will have a rack, panel, or rail-mounted UPS that will provide back-up power. In the event of a power outage, the UPS units will allow the generator to come on-line without the systems losing power.

Mechanical Systems

HVAC System

HVAC Codes: All mechanical work will be designed in conformance with the International Mechanical Code (2009), International Energy Conservation Code, IECC (2015), Massachusetts State Building Code, National Fire Codes (NFPA), and National Institute of Occupational Safety and Health (NIOSH) standards. We will use Boston weather data from the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Fundamentals Handbook, 2013.

VMB HVAC: Six rooftop HV units will provide a 100% outside air ventilation rate to the main shop and will include heat recovery using a heat recovery wheel during the winter. During the summer, the HV units will operate with the internal supply and exhaust fans in the HV units supplying 100% outside air, but will not use the heat recovery wheel.

Exhaust fans on the roof will provide summer ventilation for cooling the rail shop. The summer exhaust fans, along with the HV unit internal exhaust fans, will provide approximately six air changes per hour. The make-up air during this operation will come through the open track doors.

Gas-fired unit heaters throughout the rail repair shop will supply the exterior wall area with supplemental heat. The supplemental heat will be based on unit-mounted thermostats for the internal areas' unit heaters, and wall-mounted thermostats for all the perimeter unit heaters.

Support Spaces HVAC: A split system with an air conditioning unit (AC-1) and associated rooftop condensing unit (CU-1) will be provided to condition the support spaces for building personnel. The support space systems will be controlled by area thermostats with their associated Variable Air Volume (VAV) boxes, with electrical reheat coils, and the setpoint controlled by the Building Management System (BMS).

Exhaust fans will ventilate the storage, cleaning, fire pump/water meter, electrical, mechanical, lube oil, air compressor, toilet, and traction power rooms, and the purge fan for the communications room. In addition, a portable ducted fume hood with internal fan and filtration unit will be provided in the welding area, and an exhaust ventilation system with capture hood will be provided in the truck washing area.

Gas unit heaters mounted to columns provide perimeter heat to supplement rooftop units at Long Island Rail Road's Arch Street Shop, designed by Jacobs.

Plumbing and Drainage System

Plumbing Codes: All plumbing work will be designed in conformance with the Uniform State Plumbing Code, International Energy Conservation Code, IECC (2015), MSBC, and Massachusetts Fuel Gas Code.

Plumbing for VMB: A natural gas system will serve rooftop HV units, gas-fired unit heaters, domestic water heaters, truck washing machine, and the gas-fired air curtain for the roll-up door. The natural gas will be supplied from an existing gas main in the area and enter the north side of the building. The utility company will provide a new gas meter and regulators for the service to the building. The gas piping will be routed via a looped piping system located at the truss level throughout the building with piping to the HVAC, industrial, and plumbing equipment.

The domestic water service to the building will serve the water closets, urinal, toilet room lavatories, kitchen sinks, porter mop sinks, emergency eyewash stations (including those with showers), hose bibbs located along the building interior walls, water drops down in the pit areas, the posted rail pit areas, outside water hydrants, and the truck washing machine. Domestic hot water for the plumbing fixtures below the mezzanine will be provided by a gas-fired domestic water heater. Tepid water to the emergency eyewash stations throughout the VMB will be provided by local instantaneous electric water heaters.

Sanitary and industrial waste (IW) drainage systems will be provided in the VMB. The IW drainage system will be separate from the sanitary system in the building. IW will collect drainage from the below-floor trench drains and from catch basins, floor drains, and sump discharge from low-point sump pumps located in pits areas. The discharge from the industrial waste will then flow into an oil-water separator located outside the building. The separate sanitary line will connect to all the sanitary fixtures, including toilets and sinks, and mop sinks in the mezzanine area.

Storm drainage will be provided by roof drains connected to the site drainage system. Overflow scuppers will also be provided to drain runoff in the event a roof inlet is clogged.

A compressed air system for the VMB will provide compressed air to numerous air drops, as supplied from a looped piping system located at the truss level.

Main Mechanical Equipment Schedules

The VMB mechanical equipment schedules include the following:

- HV units, gas-fired heating
- Gas-fired unit heaters for rail shop heating
- Air curtain door heater for one door
- Exhaust fans rooftop, used for summer ventilation
- Exhaust fans for local ventilation of toilet rooms, storage rooms, cleaning room, fire/water meter room, electrical rooms, UPS, mechanical room, communications room (FM-200 purge)
- Exhaust fans serving the truck washing/ventilation hood, lube oil room, the air compressor room, and the traction power room
- Air conditioning units (AC-1, AC-2) serving non-shop personnel spaces
- Split air conditioning units (AC-3/4), ductless, serving the communications room

Building Automated Control System

The VMB will have a building management system (BMS) and automatic temperature controls system. Zone sensors and thermostats will be located in the maintenance areas to control the rooftop HV units for heating and ventilation. Area temperature sensors will be located near the doors for monitoring and freeze protection. The HV units with energy recovery will be controlled only during the heating seasons. The units do not have air conditioning, so the heat recovery will not operate. Summer exhaust fans will be controlled by outside adjustable air temperature sensors. Occupied and unoccupied scheduling for HVAC controls will be provided.

Local thermostats will be used to control areas served by AC-1, such as the breakroom, offices, training room, and parts storage area. These areas will be zoned using VAV terminal units and thermostats for zone control. Temperature setpoints will be adjustable. AC-1 will include controls for enthalpy-based economizer (free cooling).

The rail shop will consist of rooftop HV units, exhaust fans, and one roll-up door air curtain. These standalone systems will be interconnected to the BMS via a twisted cable for monitoring, alarming, and control using BACnet protocol logic controls. The BMS and its network will be interconnected to the HVAC equipment and systems and to fire alarm panels in the VMB and Transportation Building. Critical alarm points will be sent to the MBTA Operations Control Center at 45 High Street, Boston.

Unit heaters will include their own local controls and not be interconnected to the BMS. The air curtain will operate and be controlled by the door switch.

Electrical Utility Service Supply Point

The service utility pole location and its associated 15kV service isolation switches will be further coordinated with MBTA and Eversource along Third Avenue to provide accessible installation and routing. All temporary power to the existing MBTA facilities will be phased and installed with minimal service disruption. The point of service will be near the new Eversource transition vault on Third Avenue. A pad-mounted, cast coil, dry type transformer will step down the utility feed (15kV) to 480Y/277V, and then feed the main 480Y/227V switchboard to distribute power throughout the facility via multiple 480Y/277V distribution panels and 208Y/120V power panels (via 480V to 208V/120V step-down transformers).

Electrical Drawings

Electrical drawings are included in the Composite Drawings.

Mechanical Drawings

Mechanical drawings are included in the Composite Drawings.

C. INDUSTRIAL PROCESS AT VEHICLE MAINTENANCE FACILITY

Design Approach

Functional Design Concept for the VMF

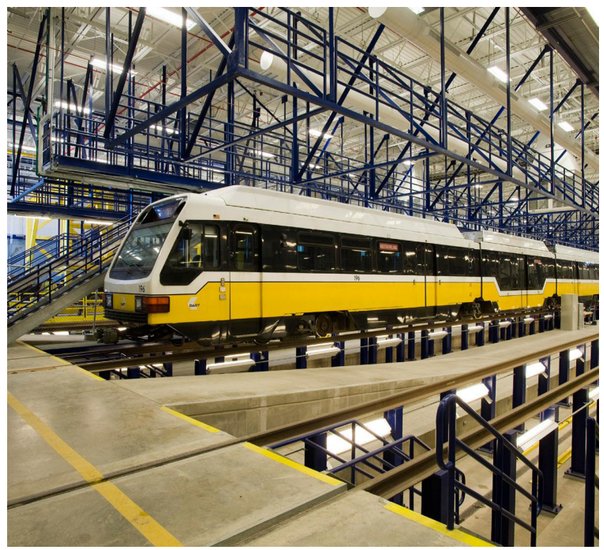
While the VMB must be a bright, safe, and durable facility, it must also be functional. Equipment and utilities need to support maintenance operations so workers can successfully accomplish their tasks. Trains need to move from the mainline to the yard to the shop efficiently, and underground utilities must be designed to avoid conflicts and comply with the Technical Provisions. WBG has the expertise and experience to properly design and build a safe and functional shop and yard.

In the main shop area of the VMB, Tracks 1 and 2 will have pedestal tracks for running repairs, inspections, and light maintenance. The posted tracks will be equipped with undertrain lighting for visual inspections of the under-carriage. They will also have portable work access platforms to provide better access to the sides of the train. The underside of the train will be accessible for changing the gear-case oils and providing brake servicing. Light welding may be performed, so welder outlets will be provided throughout the pit areas. Many other tasks may be completed, including the repair of door closers and some glass change-outs.

Access to the pit level for the pallet jacks, rolling tool boxes, oil containers, and equipment is by flat platform scissor-lifts to and from the center service floor to the pit floor. Tracks 1 and 2 will also be covered with catenary traction power and have methods to power up and to de-power for service and safety. Tracks 3 and 4 are flat tracks with no pits for inspection or work except for the wheel truing pit on Track 3, which will be designed for a wheel milling machine in the future. This pit will have posted rail and be left open so that trains can pass over the pit, with a guardrail to protect shop workers from the opening. The remaining portion of Track 3 will remain open and be left clear of obstructions for the western end of the building so that a rooftop platform can be placed by the MBTA after the completion of the shop. The floor of the building along the track will be finished flat with no rail or guidance for the roof access platform being provided.

There are no catenary wires over Tracks 3 and 4. As established in Addendum No. 6, the movement of vehicles on Tracks 3 and

VMF Construction Expertise. WBG's managing partner, Walsh, has constructed vehicle maintenance facilities similar in size and scope to GLX. DART's Northwest Operating Facility in Dallas, Texas, was part of the over $1 billion program completed as part of their Green Line Extension Project. The facility included a mezzanine similar to what we propose for the MBTA GLX Project.

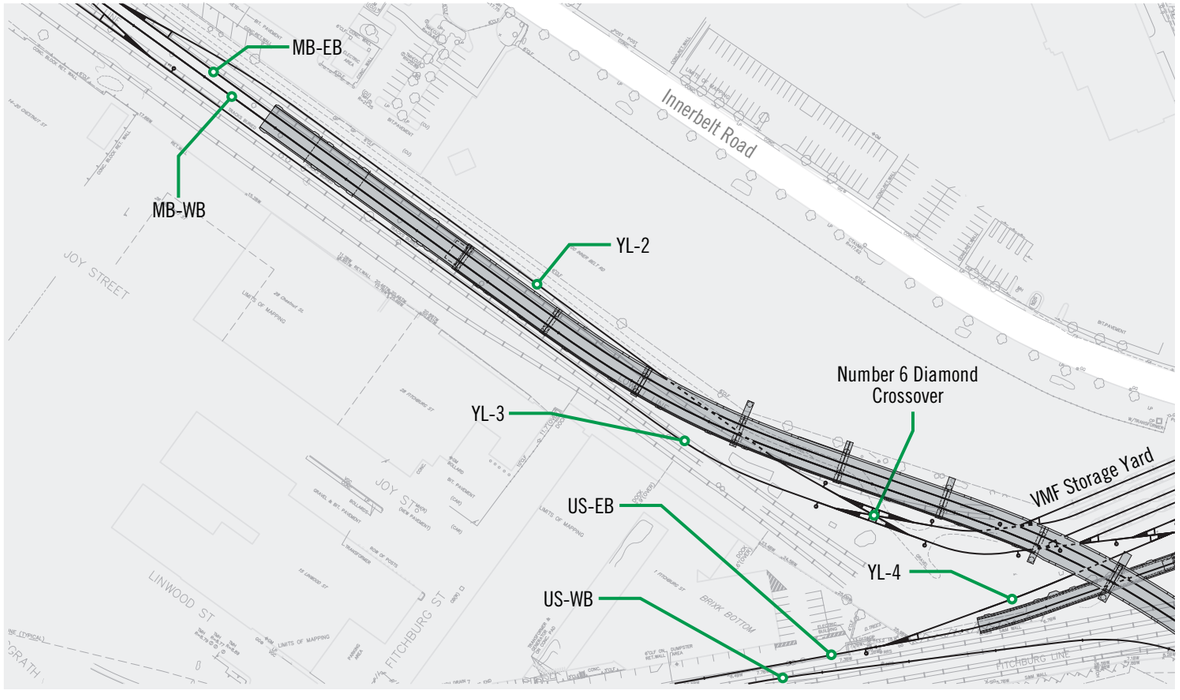


4 will be by a stinger system; therefore, no winches, catheads, or any other methods of advancers are provided. As requested, we have added steps into each end of the service floor to the bottom of the pit between the tracks. This is to allow access for inspection of the train undercarriage between the rails.

Interface with the Main Line

The VMF yard will be accessible by train from both the Medford and the Union Square Branches of GLX (Figure 4.5-3). The Medford Branch connects to the northwestern-most corner of the VMF storage yard using Yard Leads 2 and 3 (YL2 and YL3). YL2 diverges from the Medford Branch eastbound and connects to Track MAF-1 in the uppermost northwest corner of the yard. YL3 diverges from the Medford Branch westbound and connects to Track MAF-1 in the upper most northwest corner of the yard, south of the YL2 connection. West of the yard, a fully guarded #6 diamond crossover provides operational and maintenance flexibility while moving trains and equipment in and out of the yard from the Medford Branch. YL3 diverges from the Union Square Branch eastbound and connects to Track MAF-1 south of the YL2 and YL3 connections. There is only one direct lead from the Union Square Branch; however, the crossover located at approximate engineering station US-EB 20+00 on the Union Square Branch mainline may be used to cross trains from the westbound to the eastbound track and back as operationally needed.

Figure 4.5-3 Yard Interface with Main Line.



Yard Layout and Vehicle Storage

Design of a rail yard is usually more complex than first envisioned, but WBG's extensive experience will allow us to design and build a functional layout that facilitates MBTA's VMF operations. The VMF yard will be separated into two main sections connected by a minimum of two track routes and a series of redundant connection turnouts. This double-track, redundant switch configuration is designed to allow movement from one side of the yard to the other and eliminate a single point of failure location. The primary function of the east section of the yard is train maintenance and maintenance-of-way equipment storage; the west section is for the storage of existing Type 7 and Type 8 LRVs, as well as future storage for the proposed Type 9 vehicle during off-peak and non-revenue hours. The storage yard will be designed to accommodate a minimum of 43 LRVs at any one time in single, pair, and triple revenue configurations for full operational flexibility. The storage yard will consist of 11 tracks in parallel with a ladder track at each end and a run-around track on the east side for direct access to the maintenance side of the yard from either the storage area or the mainline. The revenue vehicles will be stored in a powered and ready state. Access to the stored trains will be available via asphalt walkways between every other storage track for safe and convenient access by maintenance, yard, and operations personnel.

The yard will be designed with an overhead contact system, utilities, fire hydrants, drainage, paved roadways, lighting, signing, and striping. Pressure lines will be protected by casing sleeves under the tracks. Power and truck access will be provided to the compactor and bailer. Below-surface infrastructure (the sanitary pump station and oil water separator) and above-grade facilities (the generator and transformer) will all be located in appropriate places.

Shop Equipment List

Please see drawing MAF-EQ-2101 in the Composite Drawings for a complete shop equipment list. WBG has designed facilities with wheel truing machines (Figure 4.5-4), such as will be provided for GLX. In designing these facilities, consideration must be given for the removal of waste millings, or chips, and removal of heavy machine parts for maintenance. The wheel truing machine for the VMB is not located along an exterior wall; therefore, it cannot convey chips outside. Instead, the chips must be collected in a container and hauled outside via forklift. The bridge crane could also be used to take chips to the door for loading on a truck. The 10-ton bridge crane to be furnished for GLX can easily lift out parts for maintenance.

Industrial Design

Most of the industrial operations will take place along Tracks 3 and 4 (Figure 4.5-5). Track 4 facilitates the changing of the trucks (bogies) from any A-B car set. The single hoisting unit has three pits with jacks and body stands to support the A-B train set. It allows a single truck to be lowered back to the floor level, turned 90 degrees to the main track, and rolled onto the off track. Once into the shop area, the truck may be lifted by the 7.5-ton bridge crane and transported throughout the workshop area. The truck may be placed in the wash area for clean up or on the work hoist for inspection, certain testing, or light repairs. Should the unit require transport to another facility for heavy repairs or rebuild, it would be placed in the waiting area within the shop or placed on an open bed truck for transport. The 7.5-ton crane will service the entire workshop area. The truck unloading area within the workshop is to remain open for heavy (up to 7.5-ton loads) that are to be trucked into or out of the facility. Once set on the floor by the crane, a forklift can transport and place equipment, parts, or supplies in temporary storage within the facility.

Figure 4.5-4 WBG's Past Experience with Wheel Truing Facilities. Jacobs has designed facilities with wheel truing machines, including Metro-North Railroad's wheel truing facility. This facility housed only the second tandem machine in the United States at the time of construction (2007).

A 3-ton bridge crane is used for the cutter heads and other heavy repair parts to be safely lifted out of the wheel truing machine.

This tandem axle machine allows work on four wheels at a time. Chip collection and disposal occur outside of the building.

In all cases, the train on the hoist will remain in the air until either the truck is returned with repairs, or a rebuilt unit is placed into the train. The train will then be lowered to the running rail and tested for return to service.

At the south end of Track 4, three additional pits will be constructed for the future addition of a second train hoist system. For safety and practicality, the open pits will be bridged over with steel beams and a concrete deck. Later, the deck can be removed and the machinery placed in the pits. Conduits will be provided to accommodate future wiring.

A second bridge crane over Tracks 3 and 4 will have a rating of 10 tons and the ability to cover the entire length of the tracks inside the building. This crane will be able to lift air conditioning units off the top of the cars as well as other equipment. The equipment can then be transported north-south or east-west in the air to set down on the floor beside the train units. Normally, the equipment would be placed on a wheeled cart to be rolled to the shop and again cross under Column Line 2 into the shop for testing repair, or a new or rehabilitated unit can be hoisted on top of the train to replace the removed unit.

Should the second hoisting machinery be placed on the south end of Track 4, the 10-ton crane would be more than adequate to remove and transport the truck to the north end of the shop. From there, it would be transferred to the workshop under Column Line 2 via the existing set-out tracks entering the workshop from Track 4 for repair or transport.

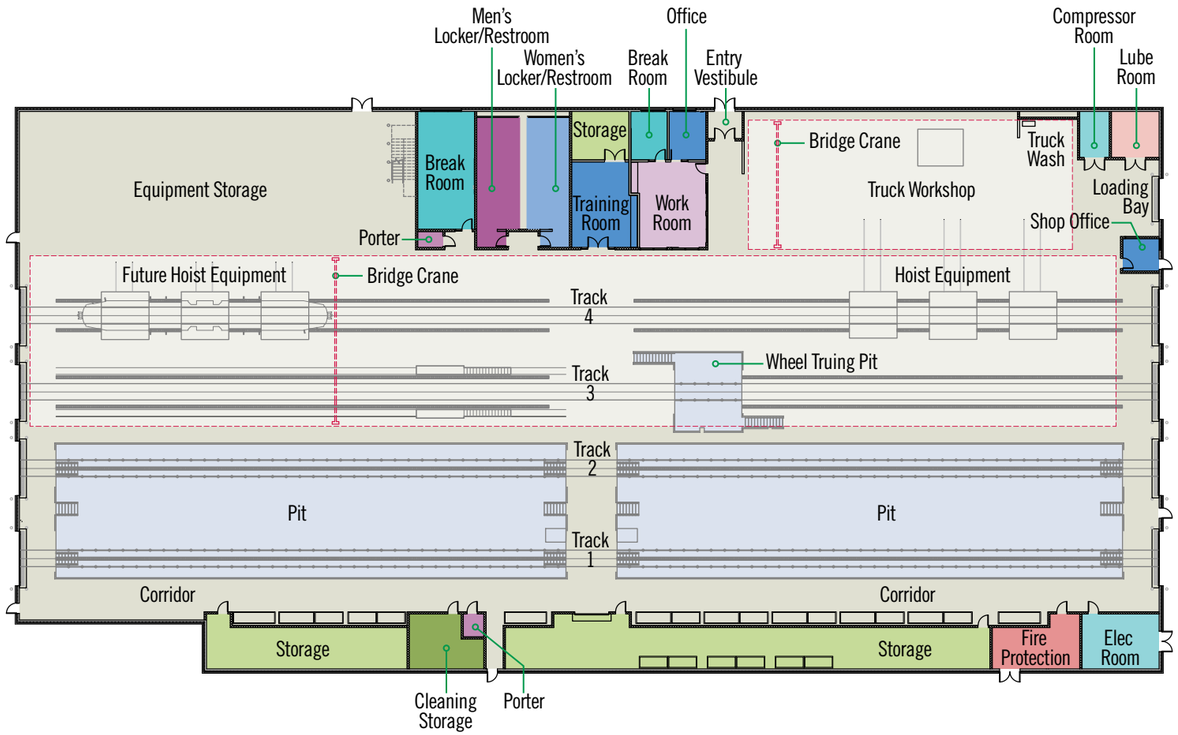
As indicated on the plans, either rails or a slot for out-take tracks on the south location toward the storage area and the slab would be made thicker at those areas to accommodate future hoist equipment. The removed trucks or other equipment would be transferred to the north end workshop and then to the set-out tracks to allow transfer to the workshop area to test or repair the removed equipment. This can be done for any equipment via rubber tired transfer vehicle under the crane beams from Tracks 3-4 and the shop/truck bay.

The rest of the operation in the VMB will be cleaning and storage, with racks for pallet storage and shelves for smaller parts and supplies. A 4,000-pound capacity forklift for very narrow aisle service will be furnished with the ability to turn and extend the forks at 90 degrees to the alignment of the mobile direction of the forklift.

Additional small equipment for the delivery and storage of oil along with compressed air and welding receptacles will be furnished for light and temporary repairs. No heavy welding is expected, planned, or requested for this shop as no special hooding and venting was requested in the RFP.

Sand can be delivered to the facility from the south end of Track 4 in small bags from outside via forklift on pallets through the south train door for storage adjacent to the south end of Track 4. It can then be hand-delivered to the vehicles in the shop. A 20 cubic yard trash compactor and a vertical bailer are located outside of the shop on the north end to allow disposables to be picked up in a safe manner.

Figure 4.5-5 The VMB floor plan showing major equipment and crane coverage.



2. VMF Drawings

Drawings showing WBG's approach demonstrating how the design for the VMF will conform to the requirements of Volume 2 Technical Provisions, Section 10.0, are provided in the Composite Drawings.

D. BUILDING STRUCTURES

VMF Structural Design Approach

WBG designed the VMB as a one-story structure with a partial mezzanine that will accommodate LRV service and maintenance, and provide associated office spaces.

Design Criteria and Standards

Figure 4.5-6 provides a summary of the codes and criteria WBG will use in the final design.

Figure 4.5-6 Design Criteria and Standards.

Codes, Standards, and Manuals

- Massachusetts State Building Code, 780 CMR
- ASCE 7, Min. Design Loads for Buildings and Other Structures
- AREMA Manual for the Railway Engineering
- AISC Steel Construction Manual
- AISC Design Guide 11: Floor Vibration Due to Human Activity
- AISC Seismic Provisions, as amended by 780 CMR
- ACI-318, Building Code Requirements for Structural Concrete
- ACI 301, Specifications for Structural Concrete
- ACI-530, Building Code Requirements for Masonry Structures
- AISI S100, Specification for the Design of Cold Formed Steel Structural Members
- AWS D1.1, Structural Welding Code - Steel
- AWS D1.3, Structural Welding Code – Sheet Steel
- AWS D1.4, Structural Welding Code – Reinforcing Steel
- MBG 531, Metal Bar Grating Manual
- AASHTO LRFD Bridge Design Specifications, as supplemented by the FHWA Drilled Shaft Manual, the latest edition
- ASME Safety Code for Elevators and Escalators A17.1
- Guide Specifications for Structural Design of Rapid Transit and Light Rail Structures
- FM Global Property Loss Prevention Data Sheets; 1-28 Design Wind Loads, 1-31 Metal Roof Systems, and 1-54 Roof Loads for New Construction
- MBTA Railroad Operations Commuter Rail Material Specifications, Commuter Rail Design Standards Manual, and Book of Standard Plans – Track and Roadway

Design Methodology

- Steel Elements - Allowable Stress Design (ASD) or Load and Resistance Factor Design (LRFD) Method
- Concrete Elements - Ultimate Strength Method
- Masonry Elements - ASD or LRFD Method

Live Loads

- Corridor - 100 PSF
- Offices - 50 PSF
- VMB main floor - 250 PSF, 3000-pound concentrated
- Mechanical rooms - 100 PSF
- Stairways - Maximum of 150 PSF or 100 PSF with concentrated forces of 300 pounds on the center of tread
- All other areas - Per Mass Building Code 780 CMR

Crane Loads

One 10-ton and one 7.5-ton top running bridge cranes. Unless the crane manufacturer's design specifies higher impact loads, the following impact will be added to increase maximum vertical wheel loads:

- **Vertical impact:** 10% of maximum vertical wheel load for pendent-operated bridge crane
- **Transverse force:** Applied to the traction surface of runway beam in either direction perpendicular to the runway beam; 20% of rated capacity plus weight of hoist and trolley
- **Longitudinal force:** Applied on crane runway beam; 10% of maximum wheel loads of the crane

Serviceability Criteria

Maximum Deflections

- Floor Framing Deflections - Live Load Deflection = L/360 Total Load Deflection = L/240
- Roof Framing Deflections - Live Load Deflection = L/240 Total Load Deflection = L/180
- Lateral System Deflections - Wind Load Deflection = L/400 and Seismic Load Deflection per ASCE 7, Section 12.12

Bridge Crane Criteria

All cranes classified as Class C, as defined in the CMAA Spec. No. 74 (2004). Building designed in accordance with the AISC Manual of Steel Construction, except as supplemented in the AISE Tech. Report No. 13. In addition to applicable codes and standards, areas with cranes designed per the following criteria:

- Building frame lateral drift at top of the crane girders to be lesser of 1/400 of the height from column base or 2 inches.
- In addition to dead and live loads, crane girders and supporting structure designed for impact, longitudinal, and lateral forces, with the most severe loading condition and crane(s) in the most critical position, in accordance with AISC/AISE.
- Adequate bracing provided to resist concentrated localized forces caused by crane operation.
- Crane girder deflection for live load without impact to be less than L/1000 vertically, and L/400 laterally; structural members supporting cranes designed to limit deflection less than 1 inch.
- Crane girder checked for the local longitudinal bending stresses in the top flange of the girder due to crane wheel passage.
- The end sections of the crane runway designed for a longitudinal force applied to the crane stops.

Structural Elements

The VMB's primary structure will consist of a steel-framed building, slab-on-grade, and foundations/piles. We will select the best option between a conventional or a pre-engineered steel building to minimize design and construction times without compromising design or quality. The building will satisfy the strength and serviceability limits per applicable codes, standards, and manuals. We will design braced or moment connected steel frame to take the lateral loads and control deflection. ATC 1 will allow us to streamline any cold weather concrete construction while still building structures that meet the technical requirements of ACI 306.1.

One cost saving measure we introduced was limiting the clear span between columns in the truck hoist area. The RFP showed a 73-foot span between Columns 20 and 2R. This long span was problematic since it carried the 10-ton bridge crane and thus resulted in very high loads at center span. By adding two columns that did not interfere with the hoist operations, we were able to significantly reduce the size, and therefore cost, of this beam by limiting the span to 26 feet.

Building columns will be supported by concrete pile foundation. Grade beams around the building perimeter will be provided to connect the pile caps and support the precast concrete perimeter wall. The first floor, including the pit floors, will be designed as reinforced concrete slab-on-grade, supported on crushed stone and compacted fill. The continuous reinforcement in the slab-on-grade, with dowels to grade beams, piers, pile caps, and footing wall, will connect all the pile caps. The mezzanine floor will be slab-on-metal deck.

Top-Down Construction Method

Since the VMF must be operational for revenue service to begin on either of the branches, its design and construction lies on or close to the critical path. WBG's experience with maintenance shops will allow us to design and sequence the work so that the facility is ready on time. Invariably, we have found that the systems and equipment require the most time to design and build. These elements are complex, require coordination from the operating groups, and entail long lead times to procure and install specialized equipment. WBG understands these shops and proposes a top-down construction approach (Figure 4.5-7) to mitigate the associated schedule risk.

Key to this approach is to allow work in the field to proceed concurrently instead of consecutively. Many contractors build from the ground up, but this requires the underground systems and floor slab to be in place before the superstructure can proceed. Expediting the design of the foundation system and superstructure allows us to build top-down, providing more time for the systems and equipment design and installation.

Our first step will be to take borings before the existing buildings on the site have been demolished. We plan to get the rigs inside the buildings and use mechanical ventilation for the exhaust. This will allow us to obtain the lab results we need for design without having to wait for building demolition work to be completed.

Using the lab results, we will release the foundation early works package and begin to install the piles in late summer of 2018, immediately after building demolition. The superstructure will be released allowing fabrication to begin in early fall. Our design facilitates this approach, as the foundation system for the columns is separate from the floor slab. This separation will allow the piles, pile caps, and superstructure to be installed without the slab in place.

Figure 4.5-7 Top-Down Construction of the VMB. This method will allow us to design and sequence the work so that the facility is ready on time. Our member firms have had success using this method to expedite schedules through concurrent work.

At the Metro-North Coach Shop, designed by Jacobs, the superstructure is up, the utilities are installed, the waterproofing is in place, and the floor slab work is following behind in the distance.

Walsh used the top-down method to accelerate construction of the VMF building shell at the Tampa Airport People Mover project in order to optimize mechanical and process systems embedded in the base slab.

Grade beams will be used for lateral support, and the piles will be able to accommodate uplift forces. The design meshes seamlessly with the construction approach.

While this field work is proceeding, the design detailing of the systems and shop interiors will continue. Proper time will be provided for coordination with the MBTA and for design development of a functional shop layout. The design will be completed toward the end of 2018. This will allow the winter of 2019 to be used to submit shop drawings and procure materials. Once the weather improves, the underground systems will be installed beneath the superstructure. This includes communications conduits, power duct banks, drainage systems, waterproofing and other buried infrastructure. Concurrently, the facade and roofing systems will begin to be installed on the in-place superstructure. And final pit elements with embedments that match the selected equipment will be installed with the pit formwork.

The key benefit of this top-down construction approach is the ability to work concurrently. Construction of the superstructure and building envelope will be well underway, as will be the work on underground systems and pits. The floor slab will follow the installation of the buried utilities. By advancing the work concurrently, we will be able to create more time for the electricians to install, test, and commission the systems in the shop (from stingers, fire alarm, and HVAC, to communications, emergency systems, and controls)—activities that take considerable time in the schedule. This top-down construction approach will greatly reduce the time needed to construct the VMB and will ensure ample time for design development and detailing.

Transportation Building

Structural framing for this one-story building will consist of a braced steel frame with steel W beams for the roof members and W or HSS square tube members for columns. Columns will be supported on reinforced concrete spread footing, and the CMU/brick perimeter wall will be supported on concrete wall footing. Roofing for this structure will consist of light-weight concrete on galvanized metal deck. The first floor slab will be a slab-on-grade supported on crushed stone and compacted fill.

Waterproofing System

WBG will provide the positive-side membrane waterproofing system on the exterior surfaces of hoist pits and the wheel truing pit, up to where the pit walls meet the first floor. A vapor barrier will be provided under all slabs.

Frost Heave

We will place building foundations four feet deep to mitigate frost heave.

Right-of-Way

The VMF will be constructed within the site limits indicated on the RFP drawings. Two retaining walls will be constructed to ensure that grading does not spill outside of the identified site limits.

2. VMF Structural Drawings

Structural drawings are provided in the Composite Drawings.

CIVIL AND GUIDEWAY

THE WALSH BARLETTA GRANITE
Joint Venture Team

4.6 Civil and Guideway

WBG's integrated track level design uses innovative structural concepts incorporated through our ATCs that provide enhanced access and safety for users of the Community Path, while optimizing track alignment and site lines. Clear access will be provided for long-term maintenance at traction power substations, and signal and communications infrastructure.

A. MEETING REQUIREMENTS

WBG's design complies with the Technical Provisions and features a number of design improvements. During preliminary design, we reviewed the track geometry for both the Green Line and commuter rail tracks to ensure that the track geometry met the required standards. We identified opportunities to adjust alignments, which has resulted in reducing some bridge spans and retaining walls. These adjustments have been built into our base design.

Following the setting of the track geometry, we then considered other elements including the revised Community Path alignment and retaining walls. We also considered structural solutions for bridges and underpasses to minimize structural elements while supporting the need for an integrated guideway corridor, Community Path, and access to stations. Constructability, construction staging, and impacts on the surrounding community were all evaluated, resulting in a compliant, constructable design that meets the needs of the MBTA and local end users.

Alignment Design Elements

The MBTA Medford Branch, Union Square Branch, Vehicle Maintenance Facility (VMF) yard and yard lead tracks will be new, ballasted wood tie construction, utilizing fully destressed continuously welded rail (CWR) 115R E running rail, 15/16-inch screw spikes, and resilient plate and fasteners in accordance with the RFP documents and the Light Rail Transit Track Maintenance and Safety Standards (LRTMSS). Based on this proven track structure design, the track will be constructed with minimal design limitations, allowing for safer, more comfortable, and faster train service for the riding public and MBTA personnel.

Available space within the right-of-way corridor allowed WBG's design team to provide a higher speed and safer design, while still providing the required clearance envelope. Our design:

- Implements longer spirals and higher speed super-elevated curves to increase the train speeds between stations and provide a safer, smoother ride
- Implements AREMA-sized, fully guarded, flange-bearing turnouts, improving the safety and efficiency of crossing trains along the GLX mainlines
- Provides increased line-of-sight distances, improving safety for the riding public at stations and crossings, as well as for maintenance personnel and LRV operators

The MBTA New Hampshire Main Line (NHML) commuter rail will be ballasted, wood tie construction using fully destressed 132#, CWR throughout the project limits. The NHML track will be designed and constructed to meet FRA Class 5 track for maximum allowable train speeds of 79 mph for passenger trains and 60 mph for freight trains. The NHML track geometry has been designed to support future passenger train speed increases to 79 mph with superelevation modifications. To control ambient train noise and vibration, mitigation in the form of ballast mat will be installed on the subgrade below the tracks in locations designated in the contract plans.

Clearances along the line will be in accordance with the contract plans, specifications, and the Commuter Rail Design Standards Manual (CRDSM) – Section 1, Chapter 6 clearance criteria. Maintenance and emergency egress walkways will be provided per the contract plans and specifications and in accordance with the National Fire Protection Association (NFPA) requirements.

Transition ties will be used as specified in MBTA Railroad Operations Book of Standard Plans– Drawing Number 1108 – Transition Ties, whenever a significant change in track modulus occurs at locations such as rail bridges, wood to concrete tie transitions, and at-grade crossings.

WBG remains aware of the unique challenges and limitations posed by the current Green Line Type 7 and Type 8 LRV fleet, and the proposed Type 9 LRV cars. We have adhered to the Technical Provisions and current track standards, from the LRTMSS as well as the Book of Standard Trackwork Plans (BSTP), to ensure that clearance criteria is met, particularly in regard to end and middle overhang adjustments related to the Green Line LRV design. In light of the low profile of these vehicles, the vertical curve tolerances and clearance envelope parameters have been strictly followed during design.

Design Speed

The horizontal track alignment, vertical track alignment, alignment through areas of special trackwork, and horizontal and vertical clearance requirements have been designed to accommodate a maximum design speed of 50 mph wherever possible, and to incorporate sufficient superelevation and spiral lengths necessary to safely and smoothly transition the LRV into and out of curves at speed. In cases where the 50 mph cannot be met due to operational, geometric, or physical limitations, the maximum speed was calculated and incorporated into the design.

Transitions Between Various Track Bedding Types

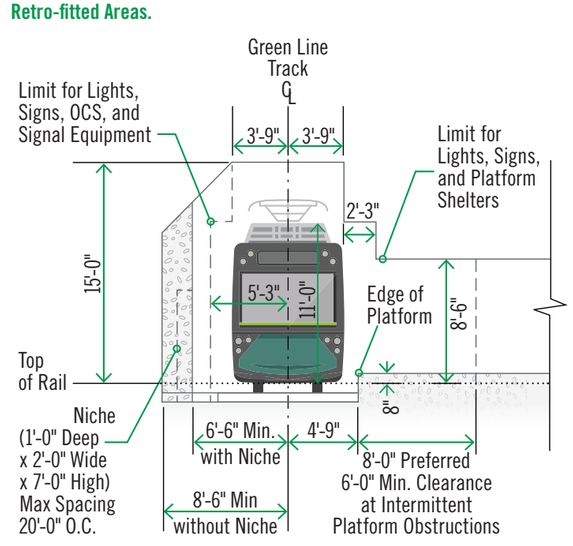
WBG will give special design consideration when transitioning the track modulus and track stiffness. Track modulus is a measure of the vertical stiffness of the rail foundation, and track stiffness is a measure of the vertical stiffness of the entire track structure. Both are related to the track system's performance, maintenance requirements, reliability, and ride quality. Typical track construction will include a layer of compacted, sloped-to-drain sub-ballast installed on top of the subgrade.

WBG will install industry-proven track modulus attenuation methods at transitions between different track bed construction types. Typical measures include the use of ballast mats, asphalt underlayment, and transition tie spacing, based on the needs and type of the transition, in order to achieve a properly maintained track surface for both the short- and long-term life cycle of the track system. Well designed and constructed track modulus and stiffness transition zones are critical to track safety, reliability, and reduced operations and maintenance costs.

Clearance Envelope

WBG developed typical clearance diagrams for both the commuter rail and Green Line corridors. Where standard clearances were not obtained, code compliant safety niches have been provided. This includes the safety niches required to be retro-fitted to the Cedar Street bridge abutment. Otherwise, a minimum standard clearance of 8-foot 6-inches on tangent track has been maintained. This horizontal offset clearance requirement increases with track curvature and other wayside factors that have been integrated into the design. Details of the clearance envelopes and egress walkways for the Green Line are shown in Figure 4.6-1.

Figure 4.6-1 Standard Clearances and Safety Niche Requirements for Retro-fitted Areas.



Notes

LRV Dynamic Envelope dimensions per MOW Standard Drawing No. 160

Dimensions shown do not consider Other Wayside Factors (OWF) and Running Clearance (RC) requirements

Line of Sight and Approaching Stations

Line of sight considerations have been reviewed at all approaches to stations and with regard to the placement of wayside objects and signage. Our approved ATC 2 at Walnut Street improves line of site. Vertical geometry has also been reviewed, paying particular attention to crest vertical curves that potentially limit operator lines of sight.

Structural Crossings

The structures have been designed to meet required clearances. At the Washington Street and Harvard Street bridges, a shared egress walkway in the center of the structure has been adopted for use by both the NHML commuter rail and the Green Line. At each of these locations, the track structure is proposed to be a ballasted deck in accordance with contract standards.

Special Track Work

The light rail mainline special trackwork includes turnouts, cross-overs, and diamond crossings designed to interconnect the rail system along the mainline from one track to another and from each branch line to another, including interconnectivity to the VMF via yard leads for equipment moves and operational flexibility. The size, location, and type of special trackwork depends on its purpose, and has been designed and located in such a way as to provide the MBTA with the means to move trains and equipment safely and efficiently, and to provide the riding public with the fastest and most reliable service possible.

Geometric Horizontal and Vertical Alignment Criteria

The horizontal and vertical track alignments for the MBTA Green Line allow for safe, economical, efficient, and comfortable transportation for passengers while maintaining adequate protection with respect to overall operation, maintenance, and vehicle stability. The criteria set forth by the MBTA, and adhered to by the WBG design team, meet or exceed LRT engineering practices and are consistent with the operational expectation of the current Green Line LRT system.

The NHML commuter rail alignments within the project limits are designed to meet the various criteria listed in Technical Provisions Section 10, and follow the MBTA's Railroad Operations Commuter Rail Design Standards Manual. The alignment design also meets applicable AREMA and FRA Class 4 criteria that allow passenger train speeds up to 79 mph. The NHML corridor alignment design accommodates regional freight rail carriers and Intercity Amtrak Downeaster service.

Two separate and distinct track construction methodologies and criteria associated with the GLX Project are described in Figure 4.6-2. In all cases, superelevation will be used for passenger comfort and to maximize running speeds where it does not interfere with stations or other operational speed requirements. Actual superelevation will be attained and removed linearly throughout the full length of the spiral transition curve by raising the outside rail while maintaining the inside rail at the rail profile grade. The vertical alignment will contain constant grade tangents connected by a parabolic curve having a constant rate of change.

Our design identified a number of areas where track geometry created tight clearances. In these areas, WBG reviewed each cross section for clearance and adjusted the track geometry to ensure standards compliance and fit within the right-of-way. These areas include both the Central Street and Walnut Street overhead bridges.

Our design also identified areas where improvements to the geometry allowed for reduced walls and bridge spans. Other improvements made to the Green Line alignment north of College Avenue maximize use of existing right-of-way, significantly reducing the size of retaining walls along the western side of the alignment. This improvement is critical for future construction at the high school to be located adjacent to the GLX track. These changes maintain the functionality of the terminal station tracks, keep the platform straight, and do not exclude a future platform extension.

Details of vertical and horizontal geometry including curve data are shown on the plan and profile drawings.

Wayside Elements

Following the review of track geometry and the re-design of the Community Path, WBG shifted focus to the addition of other elements that need accommodation within the guideway. We created CAD overlays to show security fence, intertrack fence, access roads, hi-rail access pads, signal bungalows, and the Community Path. By using overlays, we were able to confirm the placement of each item.

Figure 4.6-2 Design standards for the two distinct track construction methodologies for the GLX Project.

NHML Commuter Rail Track

Design Standards: WBG will design and install the NHML commuter rail track in accordance with the Technical Provisions and the following standards and manuals:

- ☑ Manual for Railway Engineering published by AREMA
- ☑ MBTA Railroad Operations, Commuter Rail Design Standards Manual
- ☑ MBTA Railroad Operations, Book of Standard Plans, Track and Roadway
- ☑ MBTA Railroad Operations, Track Maintenance Standards
- ☑ MBTA Railroad Operations Directorate, latest version
- ☑ MBTA MW-1: Specifications for Construction and Maintenance of Track
- ☑ MBTA Commuter Rail Material Specifications
- ☑ NFPA 130: Standard for Fixed Guideway Transit and Passenger Rail Systems

Horizontal and Vertical Alignment: The horizontal and vertical alignment of the NHML will consist of tangents joined by circular curves with spiral transition curves. The circular curves and superelevation will be related to the design speed and the acceleration and deceleration characteristics of the MBTA commuter rail equipment. The track geometrics will accommodate the maximum design speed of 79 mph for Class 5 track in accordance with the Technical Provisions and all applicable standards set forth by the MBTA.

Curvature:	Chord Definition Degree of Curve (Dc) = 2 Sin-1 (50/R)
Superelevation:	Equilibrium (Ee) = 0.0007 DV2 Unbalanced (Eu) = 1.5" preferred Actual (Ea) = Ee - Eu
Spiral:	Length of Spiral (Ls) = 83 Ea (formula is speed dependent)
Vertical:	Rate of Change (r) = 2000/V2

Green Line Track

Design Standards: WBG will design and install the Green Line track superstructure in accordance with the Technical Provisions and the following standards and manuals:

- ☑ MBTA MOW Green Line LRT Track Maintenance and Safety Standards
- ☑ MBTA, Standard Track Work Plans
- ☑ NFPA 130: Standard for Fixed Guideway Transit and Passenger Rail Systems
- ☑ MBTA Railroad Operations, Commuter Rail Design Standards Manual
- ☑ MBTA Railroad Operations, Book of Standard Plans, Track and Roadway
- ☑ MBTA Railroad Operations, Track Maintenance Standards
- ☑ Associated MBTA and AREMA standards

Horizontal and Vertical Alignment: The horizontal and vertical alignment of the Green Line will be designed to accommodate the current fleet of Type 7, Type 8, and future Type 9 LRVs. Curvature and superelevation will be related to the characteristics of the vehicle design, and the effects of acceleration, deceleration, and speed command levels of the signal system. Within the VMF, track will be designed to include operational requirements and to minimize track and vehicle wear. Track alignment criteria will be designed in accordance with the Technical Provisions and all applicable standards set forth by the MBTA.

Curvature:	Radius Definition (R) = CL Radius Min. Mainline Radius = 275' Min. Yard Radius = 120'
Superelevation:	Equilibrium (Ee) = 4.011 (V2/R) Unbalanced (Eu) = 0.5" preferred Actual (Ea) = Ee - Eu
Spiral:	Length of Spiral (Ls) = 40(Ea), SE Runoff 1" in 62' preferred
Vertical:	Length of Curve (LVC) = (Grade1- Grade2)100

We have assessed cross-sectional elements to confirm sufficient width to accommodate overhead catenary system poles, egress walkways, and conduit duct banks for communications and traction power, paying particular attention to the required clearances.

Security Fence

Security fencing surrounding the site has been designed in accordance with the Technical Provisions. The design of the fence includes all required gates and combines 8-foot-high and 6-foot-high sections of fence as required by the Technical Provisions.

Intertrack Fence

A 4-foot-high intertrack fence will separate the NHML and Green Line tracks as required by the Technical Provisions.

Access Roads

Access roads have been provided to hi-rail access pads at Tufts Interlocking, Ball Square Station, Magoun Square Station, and south of East Somerville Station at Joy Street. Access roads have also been provided to signal equipment, pump stations, and the traction power substations.

Conduits

Conduits for communications, signals, and traction power have been routed to avoid conflicts with other infrastructure elements within the guideway.

Community Path

The Community Path has been re-designed to meet the requirements of the Technical Provisions (Figure 4.6-3). The path matches into the existing Somerville Community Path near Lowell Street and heads south through Junction Park to Central Street where the path crosses the corridor to continue south on the eastern side of the railway. The path re-crosses the corridor at School Street, ultimately matching into the Washington Street bridge at the East Somerville Station.

With ATC 2, WBG has also introduced an at-grade crossing at Walnut Street to improve path access for the community. This ATC not only enhances the path by creating additional access points, it also improves visibility and safety by eliminating a pedestrian underpass.

The Friends of the Community Path created various concepts for the path. We have incorporated some of these concepts into our Community Path design, including at Walnut Street where our ATC 2 design provides an additional street-level connection. After award, WBG's final design will consider incorporation of additional concepts from this community group.

Civil Infrastructure for Signaling and Communications Equipment and Electrification

WBG's integrated design approach has coordinated the civil design requirements with the railway systems. Elements that have been considered and allowed for include:

Communications:

- **Signal and communications cable troughs:** Identified locations and included on the cross sections
- **Conduits and pull boxes:** Incorporated into the concept design and considered in the development of the cross sections
- **Wayside telephone mountings and foundations:** Identified locations and conduit needs
- **Camera pole foundations:** Identified locations for cameras required on platforms, walkways, wayside, and in the storage yard, with sufficient room for appropriate foundations
- **Variable message sign pole foundations:** Identified locations, with sufficient room for appropriate foundations
- **Communications cabinet foundations on platforms and walkways:** Identified locations with sufficient room for appropriate foundations; located "City of Somerville" standard emergency phones on the Community Path drawings, including provision for a MassDOT foundation

Road access to central instrument house/signal instrument house:

- Designed access roads to signal equipment where possible; in some cases, provided access via station platforms.

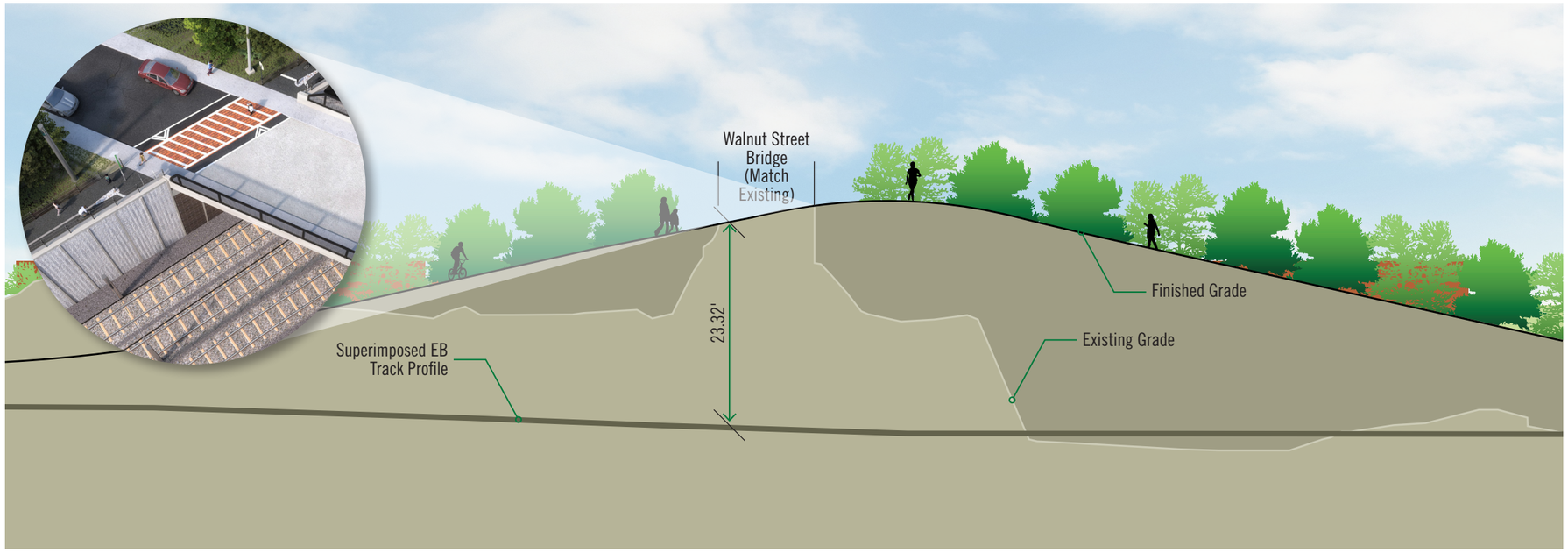
Foundations and site layouts for central instrument house:

- Located central instrument house to provide sufficient room for foundations and safe access

Traction power:

- **Traction power conduits and manholes for line feeds:** Identified locations and considered in the design
- **Traction power conduits and manholes for connection to the grid:** Identified locations and considered in the design
- **Foundations for overhead catenary system:** Identified location of overhead catenary system poles with sufficient room for appropriate foundations
- **Layout requirements:** Considered site layout requirements for the traction power substations

Figure 4.6-3 Community path redesign. WBG designed an at-grade crossing for the Community Path at Walnut Street to improve path access for the community. The design creates an additional access point, and improves visibility and safety by eliminating a pedestrian underpass.



B. CIVIL AND GUIDEWAY DRAWINGS

Continuous plan and profile alignment drawings along the GLX Project corridor are included with the Composite Drawings.

C. COMMUNITY PATH DRAWINGS

Continuous plan and profile drawings along the GLX Project corridor clearly defining the Community Path are included with the Composite Drawings.

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DRAINAGE AND STORMWATER MANAGEMENT

THE WALSH BARLETTA GRANITE
Joint Venture Team

4.7 Drainage and Stormwater Management

WBG's stormwater management system will collect runoff and groundwater flows and comply with applicable federal, state, and municipal requirements, including permits related to stormwater management. The drainage facilities will result in a significant improvement over the existing system and provide additional treatment and control of stormwater discharges. WBG's relationships with the surrounding municipalities, and familiarity with their storm drainage and combined sewer system, make us well positioned to design the MBTA drainage systems and develop an effective stormwater management plan.

A. STORMWATER MANAGEMENT REQUIREMENTS

WBG has relationships with the both the City of Cambridge and City of Somerville Department of Public Works, as well as with the NorthPoint Development owners and designers. Based on this working relationship, WBG has a detailed understanding of the drainage systems in the two municipalities and the new development. This experience will help with our modeling efforts and development of the Stormwater Management Plan.

Approach to Stormwater Management Plans

WBG's hydraulic modeling efforts for the drainage design will be coordinated with the MBTA. This iterative process identifies design refinements required for the stormwater management system to function in accordance with the project requirements. WBG will keep the MBTA apprised of potential impacts that design changes may have on the existing or new drainage systems.

WBG has reviewed the January 2015 Stormwater Drainage Report for the Final Engineering Design (2015 SWDR), backup documents, and stormwater model files included in Appendix C of the 2015 SWDR. These models use either PCSWMM 2D software (a proprietary graphical user interface compatible with the U.S. EPA's Stormwater Management Model software), or HydroCAD software (a proprietary version of the Natural Resources Conservation Service (NRCS) TR-20 and TR-55 hydrology modeling software). The models are a reasonable representation of existing and proposed conditions. For the 2015 SWDR, the GLX Project was divided into five separate drainage area models, which include:

- College Avenue Area
- Gilman-Ball-Washington Street
- Union Square
- Millers River System
- Lechmere/NorthPoint

The model areas are shown in Figure 4.7-1. The HydroCAD software was used for the Lechmere/NorthPoint model and for quantifying runoff for the Washington Street roadway. PCSWMM was used for all other areas.

WBG's approach will be to combine the Gilman-Ball-Washington Street model with the Millers River System model, since the boundary between these two models is the critical Washington Street roadway. We believe that this model enhancement will facilitate the assessment of the drainage design in this critical flood-prone area. Additionally, we will convert the Lechmere/NorthPoint model to PCSWMM so that results can be more easily reviewed and presented. The models will be updated as needed to reflect design changes.

Drainage Elements Design Standard and Criteria

Subsequent to the issuance of the January 2015 GLX Stormwater Drainage Report, the project design criteria were updated as outlined in the Technical Provisions. Below are the most critical updated criteria related to stormwater system design:

- Maintain a maximum water level below the top of tie during the 50-year design event.

Figure 4.7-1 Project Overview.

- Maintain post-development stormwater discharge peak flow rates that do not exceed pre-development stormwater discharge peak flow rates, based on the design storms required by the municipality when tying into a municipal system.
- Design the Washington Street underpass for a 100-year event with a peak water surface elevation 12 inches above the roadway surface.
- City of Somerville: "No increase in runoff volume or rate at site boundaries."
- City of Medford: "Based on the NRCS 25-year design storm, such that peak discharge under proposed or future conditions flow does not exceed the peak discharge from existing conditions flow."
- Obtain a City of Cambridge storm water control permit. Stormwater runoff conveyed to the Charles River is subject to the requirements of the EPA Charles River Total Maximum Daily Load (TMDL) for phosphorus.
- Track underdrain invert elevation to be a minimum 3.5 feet below top of rail and horizontal alignment a minimum of 6.5 feet from track centerline.
- Underdrain pipe to be a minimum of 12 inches perforated HDPE
- Minimum 2 feet of cover from top of pipe to bottom of tie at locations crossing under the railroad tracks
- Pipe loading crossing under the tracks to be Copper E80

Storm Runoff

The proposed stormwater management facilities located within the GLX Project limits are composed of railroad underdrains, manholes, clean-outs, drain piping, two large pump stations (Washington Street and Red Bridge), one small pump station (Gilman Street), subsurface storage chambers, detention basin, infiltration trenches, hydrodynamic particle separators, and water quality filter units. Facilities installed to-date include structures for the large pump stations, the detention basin, and a limited number of underdrains and storm drains; however, none of these facilities are yet in service.

Several subsurface storage chambers are required to control peak flows from the rail corridor to comply with City of Somerville and City of Medford Stormwater Management Guidelines. These underground chambers have been identified in the 2015 SWDR document and are included in the various models at the discharge point from the rail corridor to the municipal system. As the design is revised and the hydraulic model updated, WBG will review the design of these subsurface chamber structures.

To meet the requirements of the City of Cambridge and the EPA Impaired Waters Program TMDL requirements for phosphorus to the Charles River, leaching trenches will be constructed in the Lechmere corridor in parking lots to be used for the GLX Project. Where infiltration is not feasible due to groundwater conditions, hydrodynamic particle separators and/or water quality filter units are planned to treat runoff prior to discharge to the municipal system. All these systems will be designed to treat the first inch of runoff, as required in the MassDEP Stormwater Management Standards.

Additionally, storage conduits have been constructed between the partially completed Washington Street pump station and the Red Bridge pump station. This storage conduit system is intended to reduce peak flows from the Washington Street area to the Millers River. As the model is updated with design changes, WBG will evaluate the effectiveness of these storage conduits. Currently, the storage provided meets City of Cambridge peak flow requirements.

A stormwater detention basin has also been constructed downstream of the Red Bridge pump station. WBG will evaluate the operation of the detention basin and provide design updates if required. Currently, the storage meets the peak flow requirements of the City of Cambridge.

The storm drainage system is designed to convey runoff for the future station expansion. Therefore, no design changes will be required if the stations are extended to the 300-foot length.

Key Drainage Issues by Location

WBG has identified several key drainage issues at various locations. Below is our approach to addressing these issues in the design.

Proposed Stations

As part of our hydraulic modeling efforts, WBG determined elimination of underground platform stormwater storage chambers associated with the proposed stations did not have an adverse impact on the stormwater design. The storage units provided minimal storage and were modeled to reach capacity prior to the peak of the design storm. Therefore, we do not need underground platform stormwater storage.

College Avenue Area

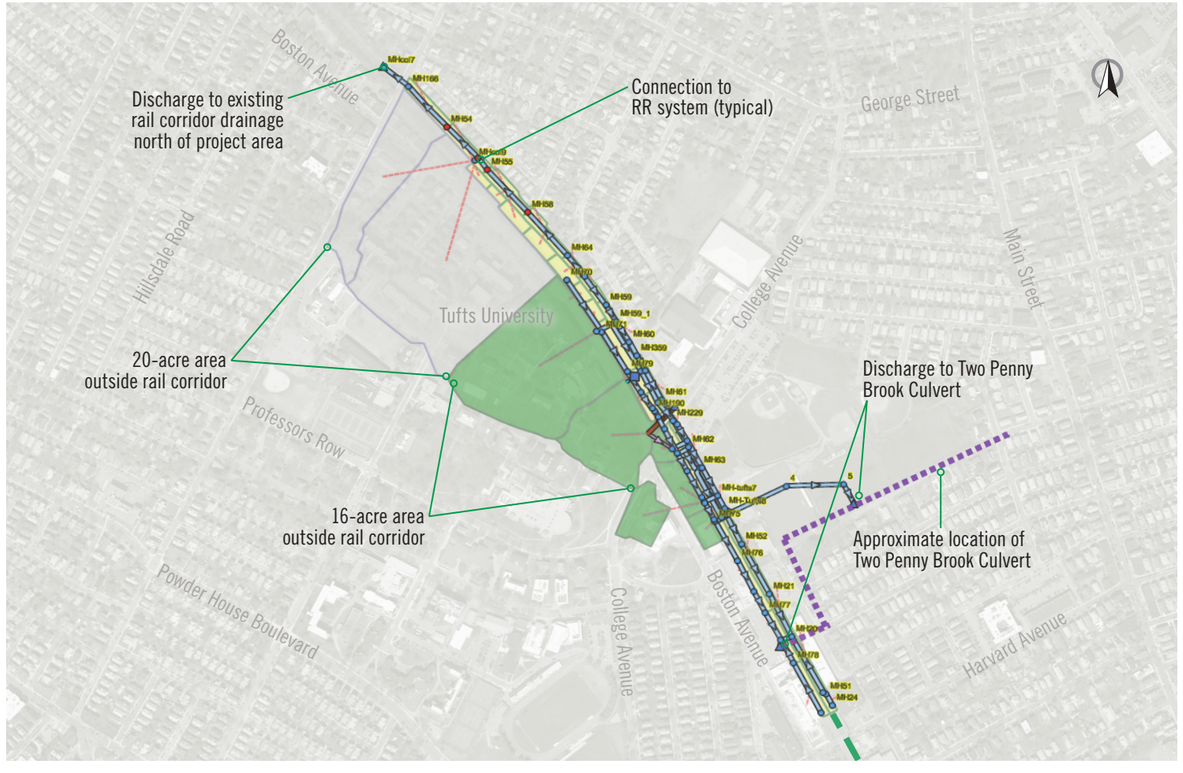
WBG understands the MBTA's long-term objective to extend Green Line service to Route 16 (Mystic Valley Parkway) in Medford. The extension from College Avenue Station to Route 16 is the subject of a Notice of Project Change filed in January 2017. MEPA review is currently in progress, and this extended section of Green Line track is under consideration. Funding and right-of-way challenges along the corridor are primary topics of discussion. The College Avenue watershed model is shown in Figure 4.7-2.

Based on our detailed review of existing RFP documents, as well as the stormwater drainage models for the project, the rail corridor west of the proposed College Avenue Station experiences major flooding due to off-site stormwater flows from upland areas of the Tufts University campus south of Boston Avenue. Stormwater flow from the campus area is diverted into the existing rail corridor and below the tracks at two specific locations.

In the first location, the model includes a 48-inch-diameter drain that the drawings indicate will be installed by Tufts University. The plans only include the portion of this drain within the rail corridor. If the downstream storm drain is not installed by Tufts, this could result in significant flooding in the rail corridor during the design storm.

At a second location, as shown in the RFP documents, upland flow from the City of Medford connects to an existing, undersized sub-drain system at the end of the project where the proposed track system meets the existing commuter rail tracks. The model, as received, includes a 13-foot-wide by 1.5-foot-deep open trench drain to convey flow north toward Winthrop Street. Currently, there are no plans to construct this trench drain. When the trench drain is removed from the model, flooding is predicted in the area between the City of Medford pipe connection and the Winthrop Street bridge above the top of tie.

Figure 4.7-2 College Avenue Watershed.



A natural breakpoint exists in this section of the proposed drain system, where stormwater flows are diverted westerly toward the Winthrop Street Bridge. WBG recommends that the ultimate solution to this flooding issue is included in the design for the Green Line Extension to Route 16 (Mystic Valley Parkway), when the commuter rail corridor is expanded to allow for a 4-track system. Constructing an open trench or subsurface detention boxes in this area is not practical, since the amount of off-site stormwater flow will greatly exceed the capacity of any proposed mitigation measures to eliminate or reduce flooding above the top of tie during the design storm event. Severe right-of-way constraints also contribute to the inability to provide effective stormwater treatment measures.

Model-predicted flooding locations are shown for College Avenue in Figure 4.7-3.

Union Square Area

The existing underdrain serving the commuter rail between Stations 103+00 to 105+50 (west end of watershed) is predicted to flood during a 50-year design storm. Flooding is a result of relatively low ground surfaces and high tailwater conditions in the downstream Somerville combined sewer system. The total volume of flooding is predicted to be approximately 0.5 acre-feet, which would result in an average depth of 6 inches over the estimated flooding area. The Union Square watershed model is shown in Figure 4.7-4.

The proposed underdrain between FLT1 98+00+ to FLT1 104+10+ should be modified to reduce the depth and duration of flooding in the existing underdrain. We recommend evaluating alternative alignments during final design. The underdrain should potentially be installed from proposed MH302_1 to existing USMH1 or USMH2. This re-routing of the proposed underdrain for the Green Line tracks will reduce the flow in the existing underdrain serving the commuter rail, which is predicted to flood during the design storm.

Gilman-Ball-Washington

The 2015 SWDR stated that the low-pressure storage conduit near Gilman Station would only be dewatered for maintenance and inspection. However, we believe that the storage conduit should be dewatered between storms to provide in-system storage. This final recommended size of the storage conduit is 60-inch FRP. The current proposed design meets the requirement of no flooding above the top of tie during a 50-year storm. The Gilman-Ball-Washington watershed model is shown in Figure 4.7-5 on page 4-93.

Millers River

The current proposed design meets the requirement of no flooding above the top of tie during a 50-year storm. However, further investigation of the drainage system for the Vehicle Maintenance Facility is required as the final design for this facility has not yet been incorporated into the model. The Millers River watershed model is shown in Figure 4.7-6 on page 4-93.

Lechmere

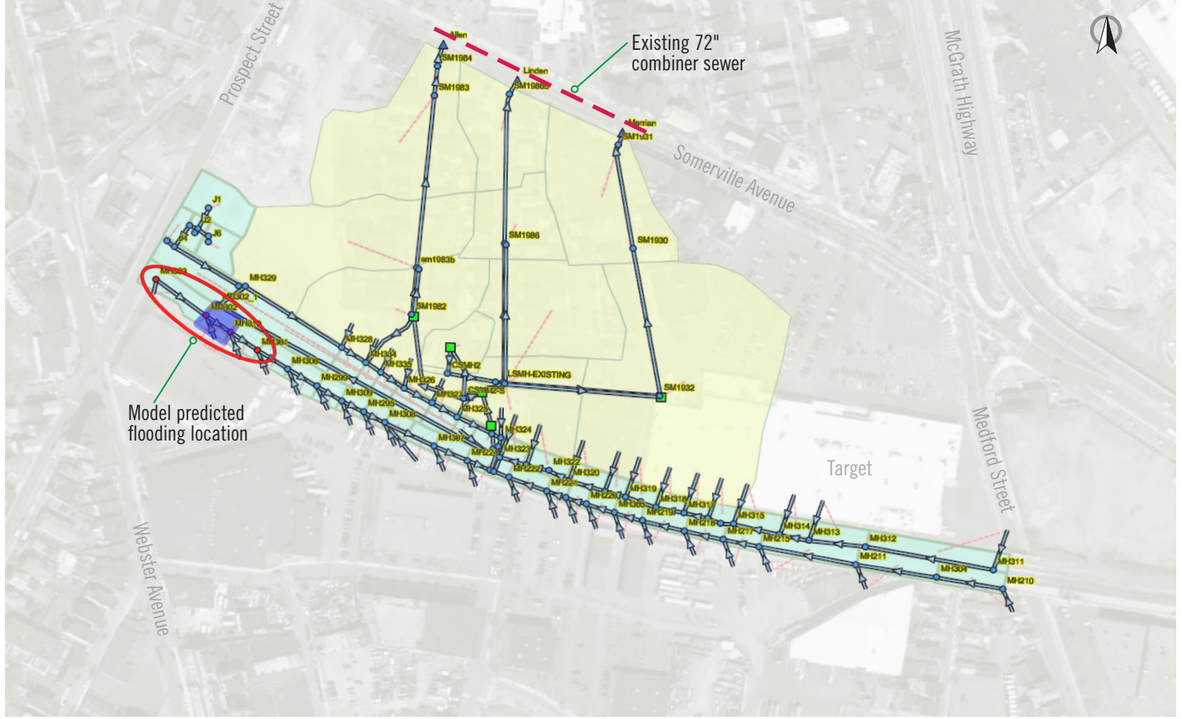
The current proposed design meets the City of Cambridge requirements for 18 inches of freeboard during the 25-year NRCS design storm. Flooding of the tracks during the 50-year storm is not an issue with the elevated viaduct in this watershed.

Millers River Drainage Outfall

The GLX Project requirements include the cleaning of three existing 48-inch RCP drain pipes and an existing 72-inch RCP drain pipe that eventually convey stormwater flow into the Millers River as shown in Volume 2 – Civil of the RFP documents. Drawings 000-C-0019 and 000-C-0020 of the Union Square Branch Drainage Layout provide the extent of the work. Roadway Discipline Design

Figure 4.7-3 College Avenue Flooding.

Figure 4.7-4 Union Square Watershed Model.



Lead Rick Azzalina is familiar with these pipes and the effort required to inspect and clean them, based on his prior Central Artery experience as an authorized representative for the area north of Causeway Street. Rick led the joint venture design team for the Charles River Crossing and Leverett Connector B and later served in the resident engineer's field office during construction. He understands the area's challenges and the solutions that proved to be successful, and will be a knowledgeable resource for WBG's drainage team.

The water level in the lower Charles River and in the Millers River, once tidal, is controlled by the Charles River Dam downstream of the outfalls. For years, outfall pipes into the Millers River have been subjected to submerged conditions (such as pipe inverts significantly lower than the Charles River Basin water level) and a constant buildup of sediment with little to no flushing action typically associated with tidal fluctuations. As a result, inspection and cleaning any existing lengths of drain pipe to remain in the Millers River Watershed Area is imperative, particularly those that are major components of the overall system.

The work will entail construction of a temporary bulkhead in the Millers River and a series of temporary bypass pumping installations to adequately inspect and clean the pipes. A specialized subcontracting firm, experienced in this type of work, will oversee the video inspection and cleaning of all existing drain pipes to remain. This same approach was successfully used for the inspection and cleaning of the main drain which currently serves the double-decked, elevated section of I-93, the Leverett Connector, and the MBTA Orange Line Rail Corridor.

Drainage System and Appurtenances

The pressure drain will convey flow from two large storm drains north of the Gilman Station approximately 2,200 feet to the Gilman Station area. A small pump station is required to dewater this pipe between storms, which will provide some in-line storage in this system. The drain was originally designed because the track in the area was lowered, requiring the replacement of existing storm drain with a deeper conduit that could not drain by gravity (requiring the pump station). The final recommended size of the storage conduit is 60-inch FRP. WBG's current proposed design meets the requirements of no flooding above the top of tie during a 50-year storm.

The previously constructed detention basin located near the Red Bridge traction power substation will store peak flows pumped into it from the Red Bridge pump station. The outlet control structure will slowly release stored flows back into the drainage system tributary to the Millers River. Preliminary modeling suggests that this detention basin is adequately sized for the 50-year design storm.

The Washington Street pump station will pump all its flow into an in-line storage system. The purpose of this in-line storage is to attenuate the peaks from the Washington Street pump station, and avoid overwhelming the downstream system. Previously, the flow from Washington Street was conveyed to the Millers River system. These pipes have all been partially constructed and preliminary modeling suggests that they are adequately sized to convey the 50-year design storm.

The Washington Street and Red Bridge pump station structures have both been installed. Pumps and appurtenances associated with Red Bridge have all been purchased and are on-site. Preliminary modeling suggests that these two pump stations are adequately sized to convey the 50-year storm event.

B. STORMWATER MANAGEMENT DRAWINGS

Stormwater management drawings are provided with the Composite Drawings.

Figure 4.7-5 Gilman-Ball-Washington Watershed Model.

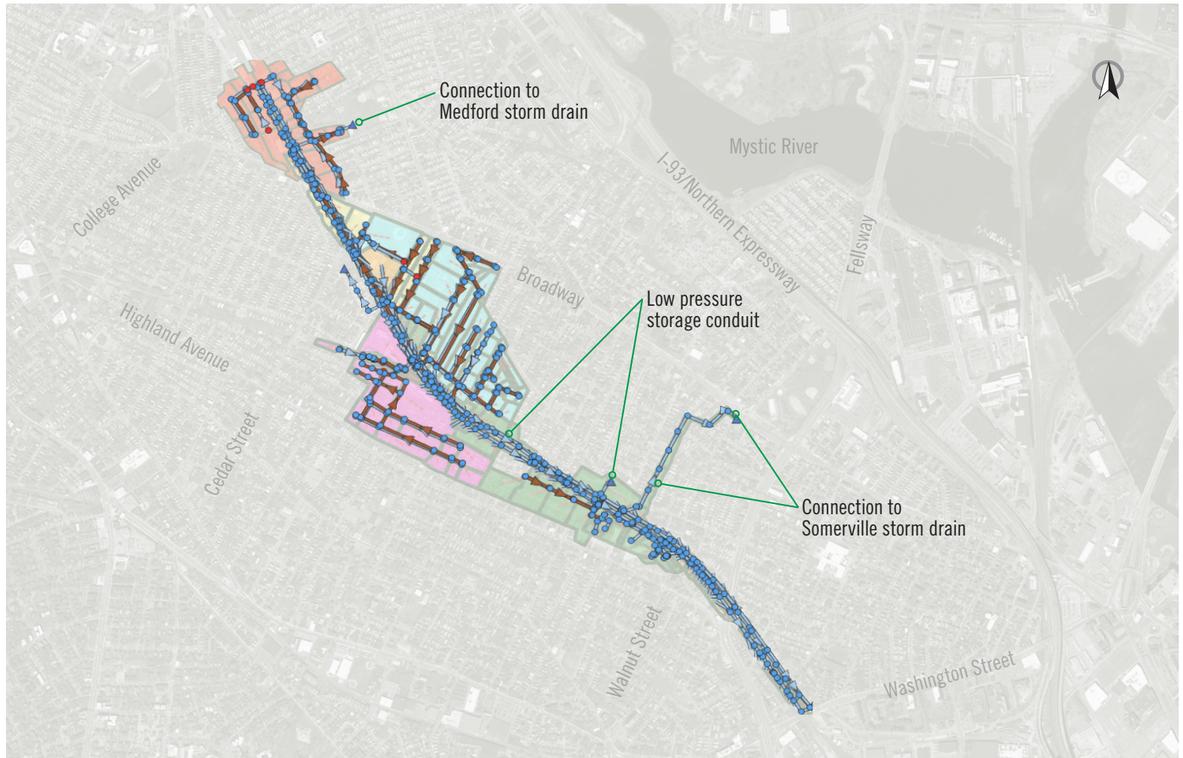
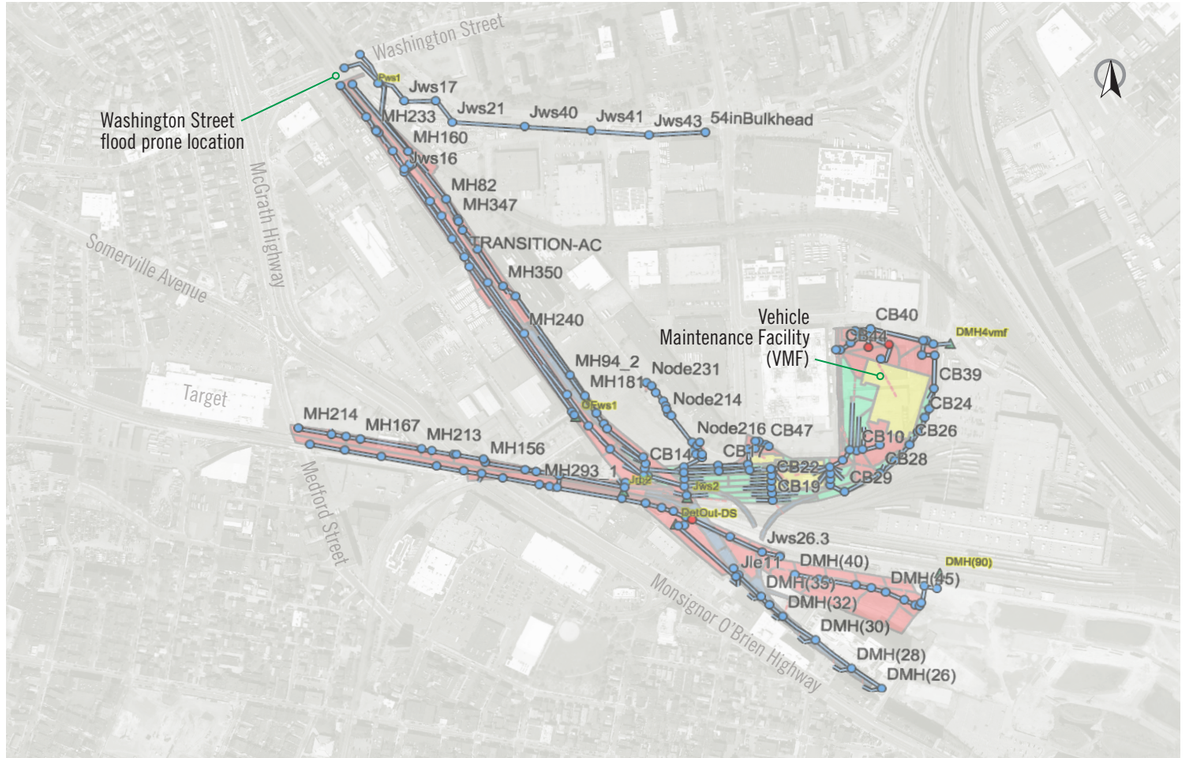
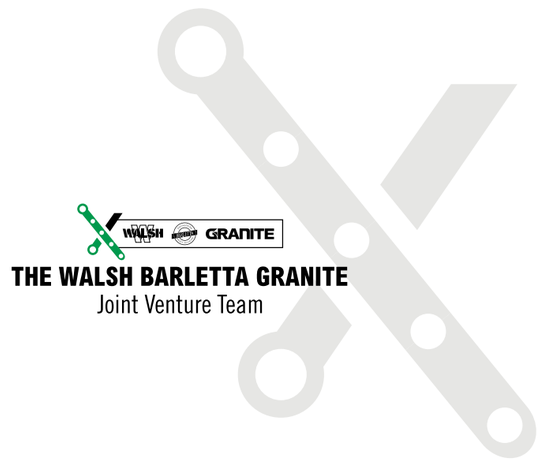


Figure 4.7-6 Millers River Watershed Model.



ENVIRONMENTAL MANAGEMENT STRATEGY



THE WALSH BARLETTA GRANITE
Joint Venture Team

4.8 Environmental Management Strategy

WBG understands that the MBTA's environmental concerns focus on the proper treatment and disposal of contaminated water and soils. Of equal importance is a comprehensive and transparent environmental program led by WBG that ensures abutters and community residents consider the GLX to be a "good neighbor." Through face-to-face communication with local residents, we will implement strategies that achieve this vision.

A. ENVIRONMENTAL TEAM

WBG will assign a full time Environmental Compliance Manager (ECM), Patrick Cornell, who will work closely with both design and construction personnel. The ECM will report directly to the Executive Committee to ensure independent reporting of all environmental-related issues. He will maintain daily communication with the Project Manager and Construction Manager, as shown in Figure 4.8-1.

For design, our ECM will have a direct contact at Jacobs who will review all design elements for potential environmental impacts and ensure full compliance with the commitments made in both the MEPA Draft 61 and the FONSI. For field operations, the ECM will have direct reporting from the personnel assigned to the day-to-day management of operations associated with landscape tracking, noise and vibration monitoring, asbestos and lead abatement, and salvage and recycling efforts. The ECM will be supported by the Licensed Site Professional (LSP), Joseph Salvetti of Stantec. Joe will be available for the Project from design through final completion.

For short-term work items, such as those associated with demolition, WBG will assign a licensed lead inspector and/or asbestos abatement inspectors, both of whom will be provided by our fully licensed specialty subcontractor(s). For long-term tasks associated with waste management, including excavated soil management, the handling and disposal of contaminated materials and waters, recycling of landscaping waste, mitigating airborne particulate matter, monitoring noise and vibration, and implementing the comprehensive plans required for this project, Patrick will be assisted by Joe and independent environmental engineers that will monitor our construction operation compliance with environmental commitments.

The asbestos abatement inspector and/or lead abatement inspector responsibilities will include:

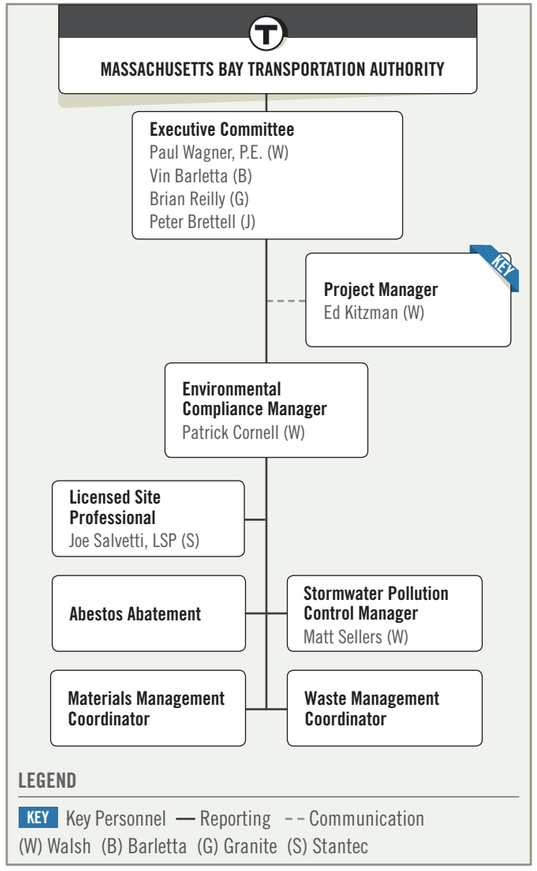
- Quantify the materials to be encountered
- Formulate and receive approval for mitigation plan
- Ensure the training, qualifications, and protocols are in place and strictly complied with by the individuals performing the work
- Maintain all necessary documentation as to the proper classification and final disposal of hazardous materials

The environmental engineers and environmental monitoring inspectors responsibilities will include the following:

- Assist with the development of the Comprehensive Environmental Protection Program (CEPP) and the associated environmental mitigation monitoring plan
- Establish and implement a comprehensive program with our excavation team to do in-situ testing and pre-classification of the soils to be excavated on the Project
- Provide training to WBG field staff on all aspects of awareness and monitoring requirements for noise, vibration, and contamination
- Monitor and provide weekly and monthly environmental monitoring reports, including monitoring methodology and reporting from WBG site forces on construction and demolition waste management plan, landscaping tracking plan, and noise and vibration monitoring plans

In addition, WBG's environmental team will include a Materials Management Coordinator, a Waste Management Coordinator, and a Storm Water Pollution Manager who report to the ECM. Their responsibilities are described later in this section.

Figure 4.8-1 GLX environmental team organization chart.



Licensed Site Professional
Joe Salvetti

Joe currently serves as LSP to the Patrick/HMM Red Line Orange Line infrastructure improvements team, providing oversight of soil management and Massachussetts Contingency Plan (MCP) regulatory compliance. He will assist ECM Patrick Cornell in daily monitoring and remediation of environmental issues throughout the GLX site.

B. ENVIRONMENTAL PROTECTION PLANS AND CONTINGENCY PLANS

WBG will develop the necessary environmental protection plans and associated contingency plans to fully comply with the MBTA's Project environmental commitments, as identified in the MEPA Draft Section 61 Finding and the Federal Transit Administration's FONSI.

Our CEPP is the overarching plan we will use to ensure that commitments made during the environmental approval and permitting process, and other environmental requirements, are reflected in the design and implemented throughout all Project phases.

The CEPP will include eleven individual environmental plans:

1. Environmental Mitigation and Monitoring Plan (EMP)
2. Environmental Protection Training Plan
3. Construction Noise Mitigation Plan
4. Storm Water Pollution Prevention Plan
5. Construction and Demolition Waste Management Plan (CDWMP)
6. Excavated Materials Management Plan (EMMP)
7. Noise and Vibration Mitigation Plan (NVMP)
8. Hazardous Waste Management Plan
9. Landscape Tracking Plan
10. Construction Indoor Air Quality Management Plan
11. Integrated Pest Management Plan

These plans outline environmental issues and detail how we will ensure that our workforce is aware of, and trained in, Project commitments to ensure that all our work occurs in a manner that is considerate to the environment while simultaneously minimizing impacts to the area surrounding our construction activities.

Within the CEPP, WBG will detail our goals and procedures for mitigating environmental impacts, while also providing details of our planned tracking methodology and reporting structures. WBG will also include information on violation reporting and issue response plans. In addition to the CEPP, WBG will provide the MBTA with required and requested plans for other specific topics to ensure WBG mitigates environmental impacts to the highest extent possible.

Through a variety of procedures, WBG will have in place comprehensive plans that ensure the most appropriate, efficient, and sustainable methods and equipment necessary are used. In addition, WBG will be able to track and receive documentary evidence of off-site recycling of Project-generated materials.

C. ENVIRONMENTAL COMMITMENTS AND AGREEMENTS

WBG is keenly aware of the MBTA's environmental commitments and agreements reached after thorough evaluation of the right-of-way and analysis of Project impacts on the surrounding community. WBG will assess all the requirements of the MEPA Draft Section 61 findings and the FONSI during both design and construction to ensure that all commitments are in full compliance. A summary of WBG's environmental strategy is shown in Figure 4.8-2.

During the early design phase, WBG evaluated processes and procedures that allow completion of all required non-exclusive deliverables within the timeframes required under Volume 2, Section 3.4. To complete these deliverables within the timeframes, WBG will assign qualified resources from design, construction management, and field supervision. They will ensure the deliverables fulfill all commitments and are tailored to our work plans.

For the environmental commitments regarding revenue service impacts from the Project, our approach will be two-fold. First, the design team will review all accumulated analysis data that the MBTA has generated and incorporate it into our designs as necessary. Second, we will supplement that information with field data where design revisions or time-sensitive data require. This approach is relevant to noise barrier designs, as changes in this portion of the work have occurred due to minor grade and alignment revisions.

WBG's work plans will include environmental mitigation. As detailed further in this section, we developed a logical and sequential approach to handling environmental commitments associated with soils, water, and landscaping debris. We will accomplish this using proper tools, equipment, and planning that minimizes, dust, noise, and vibration impacts to the community. We will also prosecute the work in a sequence that allows us to complete geographical areas and reduce our overall construction footprint as rapidly as possible, restoring the areas to the community.

To demonstrate our commitment to environmental management, WBG will prioritize training our project personnel. Training will include environmental tools and procedures to deepen our commitment to sustainability.

D. ENVIRONMENTAL MONITORING, INSPECTION, AND REPORTING

The WBG team will include independent environmental monitoring inspectors with the qualifications and training to ensure compliance with environmental approvals and hazardous materials management. They will perform site monitoring inspections, including random field verification testing, such as noise and dust monitoring, review all Project-generated environmental reports to ensure accurate and timely reporting, and assist the ECM in training and issue resolution. Joe will oversee compliance associated with soil and groundwater management within MCP disposal sites. A soil and groundwater pre-characterization plan will include soil and groundwater analytical testing. Licensed inspectors will be responsible for implementing and documenting lead and asbestos abatement.

Figure 4.8-2 WBG's environmental management strategy.

Field staff trained in the use of portable instrumentation and media sampling will be on-site during compliance monitoring activities. This includes sample collection for appropriate laboratory analysis during soil excavation and groundwater dewatering at contaminated sites. Dust monitoring will be performed during excavation and soil stockpiling activities. Appropriate quality assurance and quality control will be documented in monitoring reports.

E. MANAGEMENT AND HANDLING OF CONTAMINATED MATERIALS

Joe will oversee the management of materials encountered at any of the MCP sites. Soil will either be reused on-site or transported to a licensed disposal facility. Contaminated groundwater will be treated and discharged according to RFP requirements. A soil and groundwater pre-characterization plan will be used to identify areas where special handling of soils and groundwater may be required due to the presence of contaminants not associated with existing MCP sites. Specific soil management plans will be developed for 21 and 22 Water Street, Washington Street utilities, Ball Square Station, Union Square Station, the VMF, Gilman Square, and 137 Washington Street in Somerville.

WBG is fully aware of the MBTA's efforts to analyze the Project site and provide soil classification information in the reports provided in Section 16 – Environmental of the RIDs. WBG will work in a fashion similar to Kleinfelder to ensure all soils along the alignment are subjected to in-situ testing and classification. The soil classification matrix and project mapping will be an invaluable tool to identify the materials and determine proper handling and disposal processes.

If impacted soil/groundwater is identified outside of the known site boundaries, Joe will apply current MCP guidance and regulations to manage these materials.

F. EXCAVATED SOIL MANAGEMENT

WBG will prepare a comprehensive EMMP, overseen by the Materials Management Coordinator, describing our approach to handling excavated materials and review the site information provided in the RFP documents with specific emphasis on known areas of concern, namely the key MCP sites and the related release tracking numbers (RTNs) that identify areas of hazardous materials, groundwater contamination, and heightened concerns.

The EMMP will include a graphical representation of the entire Project with each excavation and stockpile area identified. Additionally, individual zone handling maps will identify the zone's excavation, assigned haul route, and material stockpile area or direct disposal location. This will be accompanied by a single-page oversight excavation-to-disposal site tabulation for easy field reference. The EMMP will detail daily excavation records, stock pile receipt logs, and off-site final disposal records, along with in-office detailed reports of daily and cumulative excavation/reuse and disposal tracking data.

The EMMP will define the means and methods for quantifying and identifying the material excavated daily, from point of excavation to the assigned stockpile or disposal location, for tracking purposes. Logs for all excavation work will be turned in separately from the excavation and receiving location. All input records will be cross-checked the next business day to ensure accurate inventories are in place. All data will be maintained in a database to provide monthly update reports for submission to the MBTA.

The EMMP will be updated to identify the current and available source of material via "Backfill Zone" maps. For all backfilling operations on the Project, the tracking system will remain the same as for excavation operations, wherein both source and receiver will track each movement of material and the data and documentation will be reviewed daily for accuracy and verification.

Since the MBTA is using the e-Builder system for this Project, we envision that they will have full electronic access to items such as daily records, transport logs, and current stockpiled inventory.

G. MINIMIZING NOISE AND VIBRATION IMPACTS

WBG recognizes the Project's proximity to densely populated residential areas and several schools. This requires sensitivity to noise and vibration impacts from construction. We will prepare a comprehensive NVMP tailored to WBG's equipment and methods of construction.

In developing our final design, work sequencing, and the methods to perform work, WBG will include updated, non-disruptive practices. The NVMP will address specific equipment and methods of construction. Key focus points are:

- » Move stationary construction equipment to where noise levels will have the least impact or use noise reducing enclosures
- » Minimize nighttime construction operations
- » Analyze work operations for noise impacts prior to commencement and monitor operations to ensure noise impacts are minimized

To achieve these goals, WBG will identify the means and methods to be employed, including mandatory noise equipment certification testing, specially quieted equipment with fully enclosed engines or high-performance mufflers, strictly enforcing a "no idling" policy, installing temporary noise barriers or acoustic panels for noise intensive work operations, and developing truck routes that minimize exposure to the surrounding residential areas.

The NVMP will detail protocols to report noise monitoring results, noise reduction measures, and responses to community questions through the Project hotline. The ECM will implement these protocols and be responsible for ensuring noise levels are monitored regularly throughout the Project. Corrective actions will be implemented if any exceedances are observed, and all community noise or vibration complaints will be formally documented to the MBTA within seven days of occurrence. Weekly reports will be compiled into monthly and cumulative Project records for all NVMP requirements.

KEY ITEMS TO MINIMIZE NOISE AND VIBRATION IMPACTS

NO IDLING POLICY
Implement strict no idling policy to reduce noise pollution, reduce air pollution, and promote energy conservation

MINIMIZE NIGHTTIME CONSTRUCTION
Minimize nighttime construction operations between the hours of 10 PM and 7 AM to adhere to Noise Control Plan

NOISE REDUCING MATERIALS
Use noise deadening materials on chutes and bins

ACOUSTIC SHIELDS
Use acoustic shield for noise intensive work operations to reduce noise through sound barrier and noise absorption

COMPRESSOR INTAKE AND PNEUMATIC EXHAUST SILENCERS
Use equipment furnished with compressor intake silencers and pneumatic exhaust silencers to reduce mechanical noise and increase equipment efficiency

H. AIRBORNE PARTICULATE MATTER

WBG will minimize and mitigate dust generation throughout the Project. This includes strict management of soil stockpiles and excavation. WBG will ensure that run-off from wet down operations at stockpiles are properly contained through sloping, perimeter erosion control measures, and maintenance of settlement ponds. Traffic along roadways will also be monitored to mitigate dust generation through water misting or use of calcium chloride, as determined by weather conditions. WBG will use street sweepers and washers to aid in dust mitigation. Vehicle wash-down pads and equipment decontamination pads will be used to limit the off-site spread of impacted soils near vicinity roadways and neighborhoods. The EMP will detail the measures to be taken to construct and manage the vehicle washing areas.

I. SALVAGE/RECYCLING

WBG will develop and implement a CDWMP and a Landscaping Tracking Plan, which will detail the team's commitments and detailed procedures for on-site salvage/recycling measures to meet the Project goals of salvage/recycling at least 90% by weight of total nonhazardous solid construction and demolition waste and at least 80% of all hazardous or contaminated waste material that can be recycled. For example, we are planning to reuse physical track and railroad ties whenever the condition of the materials warrant.

The CDWMP goals will be prominently included in solicitations and in final agreements with subcontractors and suppliers and will include mandatory training for all on-site employees. Project personnel training will discuss our commitment to salvage and recycling and implementation of our sustainability program.

Noise Mitigation Measures. While working in downtown New Orleans on the Loyola Streetcar Project, WBG partner Walsh used sound shields to avoid noise disruptions next to businesses.

For on-site excavation operations, WBG will work in compliance with our Project-specific EMP and a Hazardous Waste Management Plan to maximize material reuse on-site and reincorporate hazardous soils/ballast materials into the Project works. These plans will work in unison to track all areas of material excavation, stockpiling, and backfill. On a continuing basis, the data will be evaluated for effectiveness, methods for future improvements, such as ensuring maximum material use occurs on-site with the least amount of rehandling. WBG will comply with the Historic Properties requirements to preserve a dedicated portion of the Lechmere viaduct for historical restoration and reincorporation into the work. Through these efforts, WBG will ensure that direct recycling of material will be promptly completed and verifiable.

J. LANDSCAPING WASTE

WBG will assign a landscape management coordinator to develop and implement a Landscape Tracking Plan focused on sustainability. Our goal is to divert as much material from landscape waste away from landfills or incineration into reuse/composting with a target of at least 90% for landscape waste and 50% for landscape soils as reuse within the Project limits or off-site. WBG's clearing and grubbing subcontractor will take this material off-site and deliver it to an industrial composting site. Topsoil will be reused on-site.

Clearing and grubbing operations will be performed on a schedule that places removals just in advance of major earthwork along the alignment, and uses on-site mulching and composting. We will use materials that are appropriate for the season on final landscaping/grading operations.

K. TRAINING ON WASTE MANAGEMENT PROCEDURES

The CDWMP's goal is to maximize the amount of recycled materials from demolition and construction. To educate our crews, subcontractors, and suppliers on WBG's waste management goals, we will take the following steps during procurement.

1. Comprehensive pre-employment training that includes a stand-alone segment on the CDWMP to identify the plan's goals and the methods to reach them. This training will include the Waste Management Coordinator's contact information should further information be required or to report abuses of the policy. Continuing education on this topic will occur as work progresses.
2. Include requirements for suppliers that clearly delineate our waste management approach. We will require them to affirmatively respond with all necessary information to:
   - Use maximum recyclable packaging content for the components provided to the Project
   - Reclaim and reuse packaging in its entirety
   - Follow specific recycling methods for non-standard packaging
3. Include subcontractor requirements that clearly define our waste management approach and on-site mandatory recycling procedures. In addition, subcontract agreements will require that specialized contractors with unique waste generation commit to establishing a specific recycling plan for their materials with a 90% recycled waste goal.

L. CONSTRUCTION INDOOR AIR QUALITY

WBG will develop a Construction Indoor Air Quality Management Plan, in accordance with the technical provisions and with the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings Under Construction ANSI/SMACNA 008-2008 (Chapter 3) standards.

Provisions will include the use of handheld monitoring devices to ensure indoor air quality during construction and demolition.

M. INDOOR AIR QUALITY IN NEW BUILDINGS

In accordance with the International Energy Conservation Code (IECC), and the International Mechanical Code IMC), we will provide the following Indoor Air Quality (IAQ) elements:

- » Meet minimum outdoor air ventilation rates for people and air change requirements
- » Filter air supply into buildings
- » Pressurize occupied spaces in a building to improve air quality using additional air pumped into buildings to minimize the infiltration of unconditioned outdoor air

Indoor air quality standards for new buildings will be applied to the following locations: Vehicle Maintenance Building, Transportation Building, traction power substations, pump stations, and any applicable enclosed rooms at the new stations.

N. PRE-PURCHASED EQUIPMENT AND MATERIALS

WBG understands the investment the MBTA has made in raw and manufactured components for the Project. To maximize their use, WBG is committed to maintaining the structural steel investments made for the viaduct and the Washington Street bridge, and will refine the existing designs after ensuring full compliance with all applicable standards and contract requirements.

We will evaluate equipment that the MBTA has in storage to ensure it meets all requirements of the contract for operational readiness and warranty requirements. Should we determine that manufacturer recertification or recalibration is necessary and economically appropriate, WBG do so to minimize cost while providing a fully functional end use installation.

O. BUILDING COMMISSIONING FOR LIGHTING, HVAC, HOT WATER, AND RENEWABLE ENERGY

Section C408 of the IECC requires building electrical power and lighting systems and commissioning mechanical and plumbing systems. This includes air and water balancing to meet design and operational requirements and functional and performance testing of equipment and fixtures. HVAC and service water heating control systems will be tested to document that control devices, components, equipment, and systems are calibrated and adjusted to operate in accordance with plans and specifications. Sequenced HVAC system operation and equipment will be functionally tested for compliance.

P. STORING COMPONENTS

Within the CEPP, there will be a section detailing WBG's approach to storing components for the work (Figure 4.8-3).

All subcontractors and suppliers will be required, by the terms of their agreements, to assign one of the designated storage requirements to all their component parts. Quality personnel will perform material receipt inspections of on-site Project materials and will include information on material storage on daily inspection forms.

Designated material storage locations will be thoroughly inspected on a weekly basis and any variations from the recommended storage methods will be immediately rectified. Actions taken will be described in the QC inspector's daily inspection form. Proper material storage and handling will be included in employee orientation training.

Q. LANDSCAPING SPECIES

WBG will prepare an overall plant matrix including deciduous, ornamental and evergreen trees, deciduous and evergreen shrubs, and ground cover. Criteria will include each plant's native status, drought-tolerance, salt-tolerance, tolerance of heat and water, non-invasive status, USDA zones, and mature plant characteristics such as height, width, flower, bark, fall color, and maintenance issues. Each plant needs to thrive without irrigation and fertilizer after the establishment period. The plants for each station or location will be selected from this matrix, using sound design principles for specific sites such as solar orientation, wind, slopes, proximity to fences, walls or pedestrians, and aesthetic goals. The availability of the selected plant species will be assessed during the design phase. This region is experiencing a shortage of high quality, large-sized trees and shrubs and WBG will seek them early in the Project to secure the appropriate plant stock.

R. WILDLIFE HABITAT

WBG expects minimal wildlife habitat along the GLX corridor. To mitigate the level of disruption to wildlife, WBG will ensure clearing operations in the Project Schedule occur near active construction operations along each area of the Project.

To minimize the overall impact to the natural wildlife habitat, WBG plans to perform restoration and landscaping work immediately following the completion of major operations within each area, provided weather and physical conditions allow. By planting appropriate trees, shrubs, groundcover, and wildflowers as soon as practical, WBG will restore the natural habitat that will attract birds, bees, and butterflies. WBG will ensure that the landscaping type will allow for nesting areas, along with food and water accessibility throughout the Project, without creating any water ponding or maintenance areas.

S. PEST SUPPRESSION AND PREVENTION

Pest deterrence is not isolated to construction and will be addressed in final design. The design will detail appropriate measures to mitigate pest roosting such as angling abutting walls, grading pitches to drainage points, bird control spikes, bird prevention screening, and eliminating overhangs/sheltered voids.

Before work begins, a pest control specialist will perform a site reconnaissance and evaluation of the potential effects of pest displacement and migration. From this evaluation, we will develop and layout in detail the types and locations of pest habitats and the likely points of migration. With this information in hand, we will develop and implement a treatment monitoring plan that identifies specific proposed locations for baiting and trapping, the minimum pest monitoring radius, and the proximity of significant facilities such as schools, daycares, hospitals, and fast-food restaurants.

WBG will seek local municipality input on known hot spots and pest control complaint areas and share our approach with these officials. Pest complaints will be addressed through the Project hotline.

WBG will submit an Integrated Pest Management Plan within 10 working days of receipt of NTP. The plan will detail our best management practices and the appropriate balance between utilization of advanced technology and proven practices.

During construction, our workforce will be proactive in maintaining a clean work environment to minimize potential new nesting locations. Standard measures employed include spring loaded covers on refuse containers, daily policing of work areas for trash, prompt disposal of construction debris, proper stacking and spacing of stored materials, and frequent weeding/vegetation control.

T. OUTDOOR LIGHTING

Lighting controls for all exterior site areas will be installed as described in the first paragraph of Technical Provision 13.5.3. Outdoor lighting will be controlled by lighting control panels with integral programmable controllers and interface with photocells to turn lights on/off and dim up to 80% at night to reduce energy use.

Figure 4.8-3 GLX Material Storage Classifications

STORAGE LEVEL	THE WBG STORAGE APPROACH
A	» Seek indoor, secure, and well-ventilated building or equivalent enclosure (including storage trailers) » Ensure paved or well-drained floor to eliminate flooding » Ensure uniform heating and temperature control, minimum 50°F and maximum 90°F » Maintain relative humidity below 60% and never to exceed 90% in isolated intermittent circumstances » Minimize airborne contamination
B	» Seek indoor, secure, and well-ventilated building or equivalent enclosure (including storage trailers) » Ensure paved or well-drained floor to eliminate flooding » Ensure uniform heating and temperature control (minimum 50°F and maximum 90°F) » Maintain an environment that prevents accumulation of condensation and corrosion » Maintain minimum temperature of 40°F and maximum of 110°F » Minimize airborne contamination
C	» Seek outdoor storage area designated and marked for storage » Ensure area is well-drained (preferably graveled) and removed from actual construction area and traffic » Use appropriate coverage by means of a tarp or plastic to protect from weather elements
D	» Seek area outdoors designated and marked for storage » Ensure area is well-drained (preferably graveled) and removed from actual construction area and traffic
E	» Special storage required – refer to detailed storage instructions provided by vendor at time of purchase, and again accompanying delivery

NOTE: All materials shall always be kept from direct ground contact. All loose materials, shall, at a minimum, be placed on dunnage.

U. ENERGY EFFICIENT LAMPS

LED fixtures will be incorporated in locations required by Technical Provisions 13.5. This will apply to the VMF buildings and stations.

V. WATER EFFICIENT EQUIPMENT AND FIXTURES

Section C404 of the IECC requires gas-fired domestic water heaters with tanks less than 75,000 BTUS/HR input to have efficiency ratings of not less than 67%. Hot water piping insulation thicknesses shall be in accordance with Section C404.4, and Table C403.2.10 in the following buildings: Vehicle Maintenance Building, Transportation Building, Lechmere Station, College Avenue Station, Gilman Square traction power substation, Red Bridge traction power substation, and Ball Square traction power substation.