

Riverside Neighborhood Drainage Improvements Hydrology and Hydraulic Report

City of Revere

Revere, Massachusetts

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1 Background

Fuss & O'Neill contracted with the City of Revere at the beginning of 2025 to provide professional engineering services regarding the study and possible implementation of drainage improvements within the Riverside Neighborhood in Revere, Massachusetts. The purpose of this project is to study and evaluate flooding conditions within the Riverside Neighborhood which includes Mills Avenue and 11 short residential streets that connect Mills Avenue and Route 1A. The neighborhood is located adjacent to the Rumney Marsh and Pines River and experiences flooding during high intensity storms, astronomical high tides, and storm surges. The neighborhood will become more vulnerable to severe flooding impacts due to anticipated climate change impacts including higher rainfall intensities, increased storm surge and sea level rise.

Proposed solutions to protect this neighborhood were included as part of the Gibson Park project that is currently under construction. The Gibson Park project originally included the construction of a berm along the western side of Mills Avenue that faces the Pines River. After extensive permitting efforts and significant filings with the Executive Office of Energy and Environmental Affairs under the Massachusetts Environmental Policy Act, the construction of the berm was removed from the Gibson Park project due to pressure from the neighborhood residents and considerable design requests from regulatory agencies concerning the design of the berm.

This project, which has been funded through a Housing Choice Community Development Block Grant, includes a study of the existing drainage system in the Riverside Neighborhood and design and modelling of a proposed drainage system to help alleviate flooding concerns within the neighborhood. The original scope of work, which was approved in early 2025, includes seven phases. These phases included the following: Task 1 – Existing Conditions Assessment; Task 2 – H&H Modelling; Task 3 – Permit Scoping; Task 4 – Design Alternative Concepts; Task 5 – 75% Design; Task 6 – Community Engagement; and Task 7 – Permitting. During the course of the project, the original scope of work has been altered, consistent with requests and discussion with City of Revere staff. These scope changes are as follows:

1. The existing conditions task (Task 1) was altered to remove the closed-circuit television filming and cleaning of the drainage system. It was determined early in the project that drainage improvements throughout the neighborhood would include a completely new drainage system. The existing outfalls are too small to accommodate discharge from a larger storm drain system and need to be abandoned and removed to accommodate a new drain system. Therefore, we did not perform the closed-circuit television filming. The project team directed its focus to the alternatives analysis to identify the best and most feasible alternatives.
2. Task 7 – Permitting was started but the project team quickly realized that there was not enough time to complete this task so it was put on hold. Due to the complexity of the design, modeling, and extensive permitting that would be required for the project, the project team, led by the City of Revere, decided not to pursue project permitting at this time. The project team determined that because the berm along Mills Avenue had been part of the original Gibson Park project, any permitting associated with stormwater improvements in the Mills Avenue neighborhood would likely require a Notice of Project Change to the Gibson Park project. That project filed an Expanded Environmental Notification Form, Draft Environmental Impact Report, Supplemental Draft Environmental Impact Report, and Final Environmental Impact Report. The complexity of the permitting as well as the time associated with this permitting could not be accomplished within the grant's timeframe.



Figure 1. Project Area

1.1 Existing Flooding

Flooding has been previously reported by City officials and local residents throughout the Riverside neighborhood, with points of emphasis along Mills Avenue, River Avenue, and Thayer Avenue which have a lower elevation in comparison to the remainder of the neighborhood. As seen in Figure 2, significant roadway flooding has been observed, inundating Mills Avenue between Archer Ave and North Shore Rd (Route 1A).

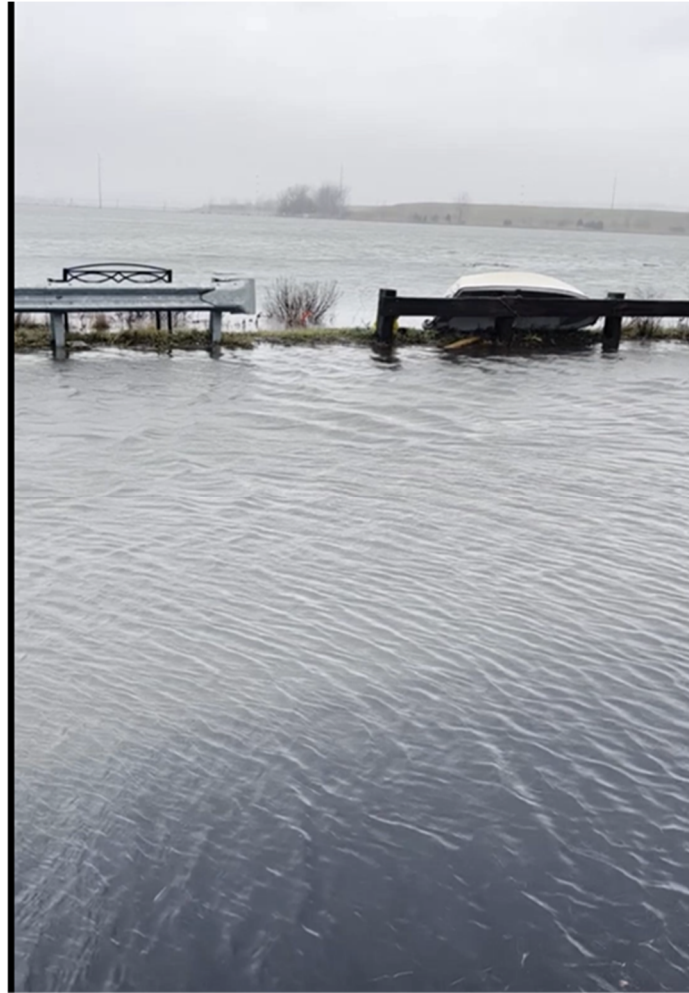


Figure 2. Roadway Flooding on Mills Ave (December 2022)

2 Existing Conditions Assessment and Basemapping

The Existing Conditions Survey was performed by Hancock Associates. Hancock Associates had been involved with the previously performed existing conditions survey, design and permitting for the Gibson Park Project which included a berm along Mills Avenue to protect the Riverside Neighborhood. However, the level of detail associated with the Gibson Park survey for the Riverside Neighborhood was not adequate for the design of stormwater improvements. More detailed field survey and site investigation were required to develop an existing conditions plan that was suitable to perform civil engineering design. In addition to performing additional topographic field survey, extensive utility research was performed at the City of Revere as well as local utility providers to determine the size, location and material for existing subsurface utilities. Tie cards for water and sewer connections were requested and provided by the City of Revere. However, the records for this information were extremely dated, consistent with the age of the neighborhood, and were not complete. Therefore, the existing conditions survey prepared by Hancock Associates includes the best information available, including information pertaining to non-gravity utilities such as water and gas. The subsurface utilities shown on this plan cannot be considered 100% accurate due to possible erroneous record information. In the event the stormwater management system described in this report is constructed, the site contractor will need to include significant

subsurface exploration to confirm utility locations and depths for non-gravity utilities. All elevations shown on the existing conditions plan are on the North American Vertical Datum of 1988 (NAVD88).

Following receipt of the existing conditions survey, multiple site investigations were performed to assess local conditions and understand the condition of infrastructure within the Riverside Neighborhood. Discussions were held with City staff and previously prepared permitting documents for the Gibson Park Resiliency project were reviewed. Review of this information yielded the following observations:

1. The existing storm drain system appears to have been constructed in stages and has not been constructed consistent with current stormwater design and construction standards. New drainage systems typically include catch basins with sumps and hoods, catch basins to drain manhole connections, and minimum pipe sizes of 12 inches. The existing drainage system includes 8" ductile iron pipes, 6" PVC pipes, 10" cast iron pipes, and multiple catch basin to catch basin connections. The catch basins do not include sumps. All the piping, including the discharge points into the Pine River, are undersized. In some instances, the discharge pipes are smaller than piping upstream that contributes to the discharges.
2. Discharge elevations from the drainage system into the Pines River vary greatly. Some of the discharge piping was unable to be located and is likely buried under the Pines River. The discharge from the large 24" pipe that runs through John Avenue has a discharge elevation of -.1 NAVD.
3. The drainage system that exists within the Riverside Neighborhood is insufficient. Catch basins do not exist at all low spots. When catch basins are not located at low spots, isolated ponding occurs. Catch basins are not located at all intersections. There are some streets, including Blanchard Avenue, Tobin Avenue, and John Avenue, that do not include any catch basins. Thayer Avenue contains one catch basin.
4. Inconsistent pavement conditions exist throughout the neighborhood. In some areas, pavement is in good condition. In other areas, the pavement has settled and become uneven. The uneven pavement creates areas for water to collect.
5. The neighborhood includes eleven separate discharge points into the Pines River. These discharge points include the following
 - a. 6-inch PVC discharge from two catch basins located at the end of River Avenue.
 - b. 24-inch cast iron discharge at the end of John Avenue. This discharge point collects stormwater generated from North Shore Road (Route 1A) but does not include any stormwater generated by John Avenue.
 - c. An 8-inch cast iron pipe located at the end of Beckert Avenue that discharges water collected by two catch basins.
 - d. An 8-inch discharge pipe located at the end of Frank Avenue that discharges flow generated by four catch basins.
 - e. A discharge pipe at the end of Gilbert Avenue that discharges water collected by two catch basins.
 - f. A 10-inch cast iron discharge pipe near the end of Blanchard Avenue that collects stormwater from one catch basin.
 - g. A discharge pipe at the end of Wadleigh Avenue that discharges water collected by two catch basins. No size information for this pipe was available.
 - h. A 10-inch PVC pipe located north of Lawson Avenue that discharges water collected by one catch basin.
 - i. An 8-inch clay pipe at the end of Lawson Avenue that discharges water collected by two catch basins.

- j. An 8-inch PVC pipe at the end of Archer Avenue that discharges water collected by two catch basins.
 - k. A 12-inch cast iron pipe located between the intersection of Mills Avenue and Archer Avenue that discharges water collected by one catch basin.
- 6. Existing road slopes are less than 1% throughout the neighborhood. Fuss & O'Neill performed a comprehensive study and analysis of street slopes which verified the slope of the roads and the inconsistent location of low spots. Flat roads do not facilitate efficient flow of water and draining of streets. This situation contributes to flooding within the neighborhood.
- 7. We understand that check valves have been installed within some of the discharge pipes. Comments from residents indicate that some of these check valves are not working properly and water continues to enter the neighborhood's drainage system from the Pines River. These comments are consistent with observations of flooding conditions within the neighborhood. During high tides, this water surcharges the existing drainage system resulting in flooding throughout the neighborhood.
- 8. Discussions with residents indicate that when coastal flooding occurs, water either overtops Mills Avenue or surcharges out of the catch basin rims during high tides. When the high tides subside, water flows down the side streets to Mills Avenue and ultimately to the Pines River. As water subsides and water in the drainage system flows towards the Pines River, some of the water that has ponded in the neighborhood flows out through the drainage system.
- 9. Mean High Water elevation is elevation 4.3 NAVD88. Most of the discharge elevations from the drainage systems located in the Riverside Neighborhood are below this elevation. This creates a surcharge condition within the neighborhood's drainage system, which reduces system capacity and prevents water from discharging to the Pines River. This water is not treated prior to discharge to the Pines River.
- 10. Mills Avenue pitches from the east side of the road to the west side towards the Pines River. There is no curbing or berm on the west side of Mills Avenue to collect water. Therefore, any water that flows to the west from the neighborhood that is not collected by the neighborhood's closed drainage system flows over the western edge of Mills Avenue into the Pines River.
- 11. Elevations along Mills Avenue vary but are generally between elevation 7 and 8 on the western edge of the Mills Avenue.
- 12. The neighborhood is located near and/or in substantial environmentally regulated areas. Portions of Mills Avenue and Thayer Avenue are located within the Rumney Marsh Area of Critical Environmental Concern (ACEC). The Boatworks property, located to the north of Thayer Avenue, is also located with the Rumney Marsh ACEC. The neighborhood is located in a FEMA Coastal Zone AE with a base flood elevation of 10 feet according to the FEMA Flood Insurance Rate Map 25025C0028J dated March 16, 2016. All of the streets within the Mills Avenue neighborhood are below elevation 10 and the majority of Mills Avenue and the side streets are between elevation 7 and 8. The site discharges to a conditionally restricted shellfish growing area. Portion of the neighborhood are located within Chapter 91 Flowed and Filled Tidelands jurisdiction. The site is also located within a Riverfront Area to the Pines River. Other wetlands resources within or in proximity to the neighborhood include Land Under Ocean, Coastal Dune, Barrier Beach, Land Containing Shellfish, Fish Runs, Salt March, and Land Subject to Coastal Storm Flowage.
- 13. We understand contaminated materials exist within the Boatworks Property. Therefore, any excavation or subsurface excavation on this property will be subject to the Massachusetts Contingency Plan requirements.
- 14. The existing gravity sanitary sewer system in the neighborhood flows from west to east. A sanitary sewer line connects to the sanitary lines located in the side streets. This line runs from south to north. This configuration results in a situation where sanitary sewer connections are higher on the western ends of

the side streets than the eastern side. The sanitary line that runs from south to north becomes deeper as it runs to the north.

15. There are significant utilities located in all side streets including existing drain, sanitary sewer, water, and gas utilities. The existence of these utilities within the side streets requires the relocation of some of these existing utilities in order to construct a larger drainage system with more capacity.

The existing conditions survey can be found in Attachment A.

3 Permitting Scope Task

Our contract included a small permitting evaluation task to evaluate permitting options and pathways for the project. It is clear after reviewing the extensive Massachusetts Environmental Policy Act filings for Gibson Park, including the Expanded Environmental Notification Form, the Draft Environmental Impact Report, the Supplemental Draft Environmental Impact Report, and the Final Environmental Impact Report that permitting efforts will be extensive. Since the berm along Mills Avenue was part of the initial Gibson Park filing under the Massachusetts Environmental Policy Act (EEA File 16711), we expect any work associated with the drainage improvements within the Riverside Neighborhood or the construction of a berm would require a Notice of Project Change to the Gibson Park Project be filed with MEPA in order to obtain an updated MEPA certificate. The comments that were received from both the regulatory community regarding the size, location, material, and height of any berm proposed along Mills Avenue will likely need to be addressed before any additional certificates are issued by MEPA. A significant concern for Riverside neighborhood residents was pulling the berm away from the Pines River into Mills Avenue, effectively reducing the width of Mills Avenue. Also, the concerns raised by the neighbors, including those expressed in the petition signed by 177 residents in opposition to the berm, will need to be addressed within any MEPA filings. The neighborhood opposition to the berm, which was also expressed during the public outreach meetings conducted as part of this project, remains a substantial obstacle to constructing the berm.

In the unlikely event the MEPA office determines the stormwater improvements project does not require a Notice of Project Change to the Gibson Park MEPA certificate, we expect MEPA will require a new filing for this specific project. The project will likely trigger the thresholds described in 301 CMR 11.03(3)(b)(1)(a) regarding alteration of coastal dune, barrier beach, or coastal bank as well as 301 CMR 11.03(11)(b) which requires any project ½ acre or more within a designated ACEC to file an ENF. Since the project is located within an Environmental Justice Community, an Environmental Impact Report will also be required. Given the complexity of the project, as well as its location in an Environmental Justice community, we expect the project will require both a Single EIR and a Final EIR.

In addition to a MEPA certificate, we expect the additional permitting efforts to be required to construct the stormwater improvements including the following:

- A Chapter 91 license from the Massachusetts Department of Environmental Protection for work within Flowed and Filled Tidelands
- An Order of Conditions will be required from the Revere Conservation Commission for work within jurisdictional areas under the Massachusetts Wetlands Protection Act including Riverfront Area and Land Subject to Coastal Storm Flowage.
- Possible Water Quality Certificate for discharge of fill into waters subject to regulation under the clean Water Act.

- Section 404 Permit from the United States Army Corps of Engineers for discharging of fill into waters of the United States.
- Possible Site Plan Review/coordination with the City of Revere.
- A Public Benefits Determination from the Secretary of the Executive Office of Energy and Environmental Affairs.
- A Pre-Construction Notification (PCN) to the United States Army Corps of Engineers.
- Possible Consistency Review by the Massachusetts Office of Coastal Zone Management.
- A Construction General Permit from the United States Environmental Policy Act under the National Pollutant Discharge Elimination System.

4 Design Alternative Concepts

The scope of work included the development of two concept plans. The project team developed six concept plans of various levels of detail including the following:

1. Initial Draft Storage Vault Concept
2. Concept 1 – Gravity only, seven discharge points
3. Concept 2 – Gravity system with pump near Frank Avenue
4. Concept 3 – Gravity system with pump near Boatworks Property
5. Concept 4 – Gravity system with pumps near Boatworks Property and southern side of Mills Avenue
6. Concept 5 – Gravity system with discharge only near Boatworks Property

Below is a brief description of each of the alternatives:

1. Initial Draft Storage Vault Concept

This concept was initially developed to examine options for creating more storage within the neighborhoods stormwater management system. As described above, the existing piping system includes undersized pipes and pipe sizes that are substandard when compared with today's standard engineering practice. This concept included the construction of large concrete storage vaults located beneath Mills Avenue to collect and store stormwater generated by the neighborhood during high tide. These storage vaults would hold water until tides subsided and then discharge the retained water to the Pines River during low tide. This alternative was developed as a sketch only before it was presented as a concept to the City of Revere. City of Revere staff discounted this option due to the significant amount of disruption that would occur in Mills Avenue as a result of the excavation within Mills Avenue. Effectively all of Mills Avenue would need to be closed for a considerable amount of time in order to install the vaults and relocate existing utilities within Mills Avenue. The City was also concerned about the amount of maintenance required to clean and maintain the vaults. This option was dismissed quickly by City of Revere staff and never advanced.

2. Concept 1 – Gravity only, seven discharge points

This concept included the development of a new closed drainage system with the neighborhood. The new system reduces and consolidates the number of outfalls into the Pines River from eleven to seven. It also increases the number of catch basins from 41 to 61 and upsizes the piping within the neighborhood to a minimum pipe size of 12 inches and increases truck lines to 24 inches. This concept adds catch basins and manholes on all streets within the neighborhood. This concept adds capacity within the drainage system. This system would provide an increase in pipe sizing allowing the storage of more

stormwater than currently exists. One factor that was discussed amongst the project team was to develop a system that could be adapted and integrated into a pump system in the future. This alternative lacks the ability to be converted to a pump system.

3. Concept 2 - Gravity system with pump near Frank Avenue

This concept includes a similar piping system to the system shown in Concept 1 above. However, it includes a 36" gravity trunk line that is designed at a .5% slope in Mills Avenue to a general pump station location near the intersection of Frank Avenue and Mills Avenue. This pump station location was explored because it is half-way between the northern end and southern end of the neighborhood. There is no available land at this location for a pump station and would require taking a property to install and construct the pump station. Due to length of the project area, utilizing a pipe slope of .5% results in an invert depth of roughly -4 feet, which is effectively twelve feet below existing grade in Mills Avenue. This option has significant challenges including finding available land for the pump station near the Frank Avenue and Mills Avenue intersection as well as a deep excavation to install the pump station. The sketch of this concept indicates a pump but does not provide a location due to the lack of available real estate to accommodate a pump system.

4. Concept 3 – Gravity system with pump near Boatworks Property

Concept 3 is similar to Concept 2 described above except it conveys all drainage to a pump station located conceptually on the Boatworks property. The catch basin and drain manhole layout in the side streets is similar to the layout described in Concept 1 and Concept 2 above. This option includes a 36" trunk line in Mills Avenue designed to convey water from the south side of the project to the Boatworks property. This option includes a .5% slope on the trunkline in Mills Avenue, which results in an invert elevation of -9 at the Thayer Avenue and Mills Avenue intersection. This option has significant challenges including a significantly deep excavation along Mills Avenue, especially at the northern end of the project and within the Boatworks property. When presented to the City of Revere, the City was concerned about the depth of the excavation and the cost that would be associated with this excavation within Mills Avenue as well as on the Boatworks property.

5. Concept 4 – Gravity system with pumps near Boatworks Property and southern side of Mills Avenue

Concept 4 is similar to both Concept 2 and 3. The catch basin layout remains the same on the side streets as described above. However, this concept includes a pump station on the north side and the south side of the neighborhood. The pump on the north side would likely be located on the Boatworks property. The pump on the south side would likely require obtaining a property to locate the pump station. Stormwater generated by the neighborhood would flow to either of these two pump stations. Stormwater collected on Beckert Avenue and all side streets north of Beckert would flow north to the pump station on the Boatworks property via a 36" drain line set flat. Stormwater collected on Frank Avenue and all side streets located south of Frank Avenue would flow to the pump station located on the southern end of Mills Avenue via a 36" drain line set flat. The pump station on the North side would have a higher invert than shown in Concept 3 above due to the installation of the flat trunk line. The invert at the Thayer-Mills Avenue would be approximately 1.4. The invert on the south side of Mills Avenue would be set at approximately 1.9. This option has a shallower depth of construction than options 2 and 3 above. However, it requires two pump stations. There is no land available on the south side of Mills Avenue so this option would require a taking of land to build the southern pump station. Two pump

stations would require twice as much maintenance as one pump station. Therefore, this option was not selected for further study.

6. Concept 5 – Gravity system with discharge only near Boatworks Property

This concept includes the same catch basin, drain manhole, and piping layout in the side streets described in Concepts 2, 3, and 4. All drainage systems in the side streets connect to a 36" trunk line in Mills Avenue set flat. Due to the size of the piping and the size of the drainage system, pressure head will push water through the system to the discharge location. This trunk line will discharge via gravity to the Pines River. The invert at the discharge point would be set at approximately elevation 1. Setting the trunk line flat minimizes the depth of excavation in Mills Avenue to a more reasonable depth. This option also results in reducing the number of discharges into the Pines River from 11 to one. Lastly, this option allows for the addition of a pump station at the Boatworks property sometime in the future.

All options were reviewed and discussed with City of Revere staff. The Project Team had significant discussions regarding the installation of a gravity system compared with a pump system. The analysis in Section 5 & 6 describes the modelling efforts which include both current and future rainfall intensity and high tide elevations. Although Mean High Water elevation is currently elevation 4.3, which is below the level of Mills Avenue, in the future Mean High water is anticipated to rise significantly. Based on Resilient Mass Action Team (RMAT) projections, Mean High Water elevation in 2050 is projected to be 7.3, which is effectively the elevation of Mills Avenue. In 2070, the elevation of Mean High Water is projected to be 9.2, which is approximately 2 feet above the Mills Avenue elevation and higher than all street elevations within the Riverside Neighborhood. Since these Mean High Water elevations are anticipated to rise so significantly, the project team determined that a pump system without a berm to protect the neighborhood will not be effective in the future. During high tidal events, the pump will effectively run continuously with little impact on flooding conditions throughout the neighborhood. Given the significant resistance to constructing the berm from both the regulatory agencies and the neighborhood, the project team decided to advance Concept 5 for additional modelling and 75% design. Fuss & O'Neill prepared a preliminary cost estimate to construct the design presented as Concept 5 including a substantial 25% contingency. The estimated price based on the preliminary plan was \$6.3 million not including additional engineering or permitting. See below for a more detailed discussion of the modelling results.

Fuss & O'Neill staff had weekly scheduled calls throughout the project to discuss project and vet the different Design Alternative concepts. The input from City staff, including the Planning Department and the City's Engineering Department was invaluable as different development options were developed and subsequently advanced. This interactive and iterative process resulted in Concept 5 being selected for advancement and modelling.

Concept Plans are included in Appendix B.

5 Stormwater Drainage System Existing Conditions Analysis

The existing stormwater drainage system was analyzed using the CHI PCSWMM© software (Version 7.7.3920, Professional 2D), which integrates two-dimensional modeling of surface flooding with the EPA Stormwater Management Model (SWMM) for conveyance of flow through subsurface structures.

5.1 Precipitation & Tidal Data

Analyses of the existing conditions and proposed alternatives were completed for the 1-, 2-, 10-, and 25-year, 24-hour rainfall recurrence intervals, concurrent with mean low, mean high, and future tidal elevations due to sea level rise. Recurrence interval (also called return period) describes the probability that a specific rainfall amount over a 24-hour period will be equaled or exceeded in any given year. For example, for a 2-year return period or 2-year storm, there is a 1 in 2 (i.e., 50%) chance in any given year that at least 3.19 inches of rain will fall on the Riverside neighborhood in 24 hours (NOAA Atlas 14).

The distribution of rainfall over time (hyetographs) was based on NOAA Atlas 14 precipitation depths using the Natural Resources Conservation Services (NRCS) Type N10_D Regional Synthetic Rainfall Distribution. The tidal information for the mean low water (MLW) and mean high water (MHW) were obtained from NOAA's Boston, MA Tidal Station (ID: 8443970). The tidal elevation (either MLW or MHW) was assigned as a constant downstream tailwater elevation at the outfalls for the duration of the 24-hour storm event as a simplifying assumption to produce the most conservative result.

The present-day design precipitation depths and tidal elevations are summarized in Table 1. The determination of future precipitation and tidal elevations are discussed in Section 5.3 of this report.

Table 1. Revere MA Present Day Storm Events

Storm Event	Tidal Condition & Elevation (ft) NAD83	Total Rainfall Depth (in)	Duration (hr)
1-year	MLW (-5.17)	2.57	24
2-year	MLW (-5.17)	3.19	24
10-year	MLW (-5.17)	5.04	24
25-year	MLW (-5.17)	6.20	24
1-year	MHW (4.32)	2.57	24
2-year	MHW (4.32)	3.19	24
10-year	MHW (4.32)	5.04	24
25-year	MHW (4.32)	6.20	24

5.2 Hydrologic & Hydraulic Modeling Data

The hydrologic properties of the subcatchments within the modeled drainage basin were determined from available topographic, land use, soils, and hydrography data. Rainfall infiltration rates were calculated using the Modified Green-Ampt Method. Soil data from the National Cooperative Soil Survey - Web Soil Survey was used to assign infiltration parameters to the soils throughout the watershed. Land use data was obtained from the MA Office of Geographic Information (MassGIS).

A two-dimensional (2-D) surface was created within PCSWMM to model surface flooding caused by surcharging within the stormwater system. Elevation data for the 2-D surface was obtained from a 0.5-meter digital elevation model (DEM) originating from the 2021 Central-Eastern Massachusetts LiDAR dataset. One-dimensional (1-D) elements, including catch basins, manholes, outfalls, and pipes, were provided as part of the City of Revere's ArcGIS storm drainage data layer and supplemented with data collected by the Hancock Associates during the site survey. Anecdotal evidence gathered from City staff regarding frequently inundated catch basins as well as flooding observations by City staff and residents were used as reference points during model development.

5.3 Future Climate Data (Precipitation & Sea Level Rise)

The existing conditions and proposed alternatives were evaluated under 2050 and 2070 future climate conditions to understand the operational efficiency of the stormwater infrastructure within a changing climate where precipitation depths are predicted to increase and mean sea level is predicted to rise.

Future climate precipitation projections were extracted from the Resilient Massachusetts Action Team (RMAT) Climate Change Project Dashboard. The Intensity-Duration-Frequency (IDF) Site located nearest to the project area was selected (IDF Site 2876), and the 50% exceedance interval precipitation depths for the corresponding return interval design storm event were utilized within future climate conditions models. Future tidal elevations were extracted from Mass Coast Flood Risk Model (MC-FRM) level-2 data which includes future tidal benchmarks for 2050 and 2070. The estimated future precipitation depths and future tidal elevations are presented in Tables 2 & 3.

Table 2. Revere MA Projected Future Climate Precipitation Depths

Rainfall (in)	Future Climate Conditions			
24-hour Duration	Return Period (years)			
	1-Year	2-Year	10-Year	25-Year
Current Climate	2.57	3.19	5.04	6.20
Year - 2050	3.1	3.9	6.2	7.6
Year - 2070	3.5	4.3	6.8	8.4

Table 3. Revere MA Projected Future Climate Tidal Benchmarks

Elev. NAVD88	Future Climate	
	Tidal Benchmark (ft)	
	MLW	MHW
Current Climate	-5.17	4.33
Year - 2050	-2.3	7.3
Year - 2070	-0.7	9.2

5.4 Stormwater System Existing Conditions, Present-Day Precipitation Analysis Results

The PCSWMM model of the Riverside Neighborhood was used to analyze flooding issues caused by potential deficiencies within the existing stormwater infrastructure system. The results of the existing conditions model identified and confirmed key areas of expected flooding and was used as a baseline for assessing the effectiveness of the proposed alternatives.

The results are summarized below; the extents of surface flooding are shown graphically on the Figures provided in Appendix C. It should be noted that surface flooding less than 0.5 inches in depth is not shown in the figures. Additionally, the figures show surface flooding related to stormwater surcharging from catch basins and manholes (i.e. surface flooding due the capacity of the stormwater system be exceeded) or from storm surge overtopping the residential roadways. The concentration and conveyance of stormwater runoff prior to entering model elements (i.e. catch basins, surface channels, etc.) is not shown on the figures. Three reference locations were selected throughout the Riverside neighborhood to evaluate the simulated maximum depth and durations of flooding for the existing conditions mode, as well as for comparison against the alternate scenario models. The model reference locations were placed in areas of frequent flooding on Mills Ave, Gilbert Ave, and River Ave. The tabulations of the maximum flood depths and flood durations for existing conditions modeled storm events included in Table 4 and Appendix C.

Model simulation results revealed that the existing system is undersized, experiences a reduction in performance during higher tidal scenarios, and does not capture runoff from all the roadways within the Riverside neighborhood.

In general, the results of the existing conditions model showed surface flooding at the following locations for the 1-year, and 2-year storm mean low and mean high water events:

- Minor flooding resulting from surcharging infrastructure on Mills Ave, Gilbert Ave, and River Ave.
- Minor flooding resulting from limited stormwater infrastructure coverage on Mills Ave, and Thayer Ave.

For the 10- and 25-year storm events, the results of the existing conditions model showed surface flooding significantly worsening at the following locations:

- Flooding resulting from surcharging infrastructure on Mills Ave, Gilbert Ave, and River Ave.
- Flooding resulting from limited stormwater infrastructure coverage on Mills Ave, and Thayer Ave.

Additional new areas of surface flooding were simulated on:

- Archer Ave, Lawson Ave, Wadleigh Ave, Franklin Ave, Beckert Ave, and John Ave

Table 4. Existing Conditions Maximum Flood Depths and Durations Current Climate

Reference Point CB1219 (Gilbert Ave)								
	Existing Conditions MHW				Existing Conditions MLW			
Storm Event	1	2	10	25	1	2	10	25
Peak Flooding Depth (ft)	0.61	0.80	1.06	1.19	0.31	0.68	1.01	1.14
Flood Duration (hr)	0.26	0.43	1.07	1.63	0.12	0.24	0.73	1.05
Flood Duration (min)	15.37	25.64	64.38	97.74	7.43	14.33	44.02	62.88
Reference Point CB3566 (Mills Ave)								
	Existing Conditions MHW				Existing Conditions MLW			
Storm Event	1	2	10	25	1	2	10	25
Peak Flooding Depth (ft)	-0.97	-0.54	0.44	0.65	-0.97	-0.54	0.44	0.65
Flood Duration (hr)	0.00	0.00	0.18	0.23	0.00	0.00	0.18	0.23
Flood Duration (min)	0.00	0.00	11.05	13.57	0.00	0.00	11.05	13.57
Reference Point CB4723 (Mills Ave)								
	Existing Conditions MHW				Existing Conditions MLW			
Storm Event	1	2	10	25	1	2	10	25
Peak Flooding Depth (ft)	0.60	0.73	0.78	0.81	0.36	0.71	0.78	0.80
Flood Duration (hr)	0.16	0.21	0.39	0.48	0.07	0.14	0.28	0.35
Flood Duration (min)	9.70	12.30	23.34	28.50	3.93	8.21	16.63	21.28

5.4.1 Existing Conditions Model Validation Event

A model validation process was completed to assess PCSWMM model's simulated flood depths and extents in comparison to observed extreme flood events. A video depicting significant flooding on Mills Ave following an extreme event that caused the ocean to overtop the road and flood the neighborhood occurring on December 23rd, 2022, was utilized as reference material. Maximum water surface elevations (~8.47 ft NAVD88) measured at the nearby Boston Tide gage (ID: 8443970) were input as model downstream boundary conditions at the outfalls and at the downstream end of the 2-D mesh neighboring the ocean. This was set up to simulate the heightened water surface elevations and subsequent overtopping of the roadway occurring during this extreme event. Additionally, the model was run with no input precipitation, as the video was captured following the precipitation event when the ocean elevation was elevated, rather than during the event. The model simulated results revealed similar flood depths and extents as depicted in the video (~1 ft deep at southern end of Mills Ave) suggesting that the model's surface terrain performance was accurate.

5.5 Stormwater System Existing Conditions, Projected (2070) Precipitation Analysis Results

The existing conditions were evaluated under 2050 and 2070 future climate conditions to understand the operational efficiency of the stormwater infrastructure within a changing climate. The projected future precipitation depths were applied to the subcatchments, and the future tidal elevations were applied to the outfalls and downstream end of the 2D mesh within the existing conditions model to achieve the future conditions assessment.

5.5.1 Future Climate Modeling Results

The results are summarized below; the extents of surface flooding are shown graphically on the Figures provided in Appendix D. The tabulations of the maximum depths and durations for all modeled storm events included in Table 5.

The results of the future climate models identified areas of flooding that are expected to worsen with projected increased future precipitation depths and sea level rise. The increased tidal water surface elevation associated with the projected 2050 MHW (7.3ft NAVD88) overtop the roadway edge of Mills Avenue (~7.2ft NAVD88), and inundates the flat, low-lying coastal areas of the Riverside neighborhood. This heightened tailwater also influences the outfalls and prevents the interior stormwater infrastructure from being able to drain any flooded roadways within the neighborhood. Given this coastal vulnerability, the influence from future sea level rise is much greater than the influence from the increases in future precipitation. This becomes more pronounced with the projected 2070 MHW tidal conditions (9.2ft NAVD88) as the water significantly overtop Mills Avenue and flood the entire neighborhood up to North Shore Road.

These future existing conditions model were utilized to design resilient proposed alternatives.

Table 5. Existing Conditions Maximum Flood Depths and Durations 2050 Climate

Reference Point CB1219 (Gilbert Ave)				
	Existing Conditions 2050 MHW			
Storm Event	1	2	10	25
Peak Flooding Depth (ft)	0.97	1.07	1.29	1.34
Flood Duration (hr)	23.80	23.80	23.80	23.80
Flood Duration (min)	1428	1428	1428	1428
Reference Point CB3566 (Mills Ave)				
	Existing Conditions 2050 MHW			
Storm Event	1	2	10	25
Peak Flooding Depth (ft)	0.80	0.83	0.88	0.90
Flood Duration (hr)	23.80	23.80	23.80	23.80
Flood Duration (min)	1428	1428	1428	1428

Reference Point CB4723 (Mills Ave)				
	Existing Conditions 2050 MHW			
Storm Event	1	2	10	25
Peak Flooding Depth (ft)	1.41	1.42	1.44	1.45
Flood Duration (hr)	23.80	23.80	23.80	23.80
Flood Duration (min)	1428	1428	1428	1428

Table 6. Existing Conditions Maximum Flood Depths and Durations 2070 Climate

Reference Point CB1219 (Gilbert Ave)				
	Existing Conditions 2070 MHW			
Storm Event	1	2	10	25
Peak Flooding Depth (ft)	2.35	2.36	2.40	2.41
Flood Duration (hr)	23.80	23.80	23.80	23.80
Flood Duration (min)	1428	1428	1428	1428
Reference Point CB3566 (Mills Ave)				
	Existing Conditions 2070 MHW			
Storm Event	1	2	10	25
Peak Flooding Depth (ft)	2.67	2.69	2.73	2.74
Flood Duration (hr)	23.80	23.80	23.80	23.80
Flood Duration (min)	1428	1428	1428	1428
Reference Point CB4723 (Mills Ave)				
	Existing Conditions 2070 MHW			
Storm Event	1	2	10	25
Peak Flooding Depth (ft)	3.33	3.34	3.38	3.38
Flood Duration (hr)	23.80	23.80	23.80	23.80
Flood Duration (min)	1428	1428	1428	1428

6 Proposed Stormwater Drainage Improvement Alternatives

The assessment of proposed improvements, which is discussed below, investigates two stormwater infrastructure alternatives for the Riverside neighborhood. The first modeled alternative is the gravity-only stormwater infrastructure improvement plan described as Concept 5 above with one additional stormwater outfall on Gilbert Ave. The second modeled alternative is the same drainage improvements described in Concept 5, with one additional stormwater outfall on Gilbert Ave, the addition of a coastal berm, and stormwater pumping station near the Boatworks Property. The two alternatives were analyzed under current and future climate conditions with 1-, 2-, 10-, and 25-year design storm events to be compared against the existing conditions model.

6.1 Gravity-Only Drainage Improvement Alternative

A conceptual gravity-only drainage infrastructure improvement plan was developed to address the inadequacies of the existing systems. The intention of this conceptual plan was to install new catch basins to capture the runoff on all the side streets within the Riverside neighborhood, route that stormwater to an enlarged truck line conduit that runs along Mill's Avenue, before it outlets to Pines River/Broad Sound via a new outfall at the northern end of Mills Ave.

The Gravity-Only drainage improvement alternative includes the infrastructure improvements described as Concept 5 with an additional stormwater outfall on Gilbert Ave. Early in the model iteration process it was revealed that additional outfall on Gilbert Avenue was necessary. The linear conduit distance between the southernmost infrastructure on Mills Ave and the single outfall near the Boatworks Property was approximately 2,300 feet. Without the additional outfall at Gilbert Ave, the gravity-only stormwater improvements were worsening conditions by increasing simulated flood depths and durations in the furthest areas of the neighborhood as the conduit travel distance was too far through the flat truck line on Mills Ave without the assistance of a stormwater pump. Therefore, the modeled results presented within this report include the additional outfall at Gilbert Avenue. The complete detailed drainage improvements are depicted on the Stormwater improvement plan included in Appendix G.

6.1.1 Gravity Only Present-Day Modeling Results

The results are summarized below; the extents of surface flooding for the gravity-only proposed improvements are shown graphically on the Figures provided in Appendix D. It should be noted that surface flooding less than 0.5 inches in depth is not shown in the figures. Additionally, the figures show surface flooding related to stormwater surcharging from catch basins and manholes (i.e. surface flooding due the capacity of the stormwater system be exceeded) or from storm surge overtopping the residential roadways. The concentration and conveyance of stormwater runoff prior to entering model elements (i.e. catch basins, surface channels, etc.) is not shown on the figures. The tabulations of the maximum flood depths and flood durations for gravity-only modeled storm events included in Table 7.

The Gravity-Only alternative model simulation results revealed significant improvements to experienced maximum flood depths and flood durations when compared to the undersized existing conditions. Additionally, the expanded infrastructure system captures runoff from all the roadways within the Riverside neighborhood.

In general, the results of the Gravity-Only alternative conditions model showed no surface flooding anywhere in the neighborhood for the 1-year or 2-year storm mean low and mean high water events:

For the 10- and 25-year storm events, the results of the Gravity-Only alternative conditions model showed minor surface flooding at the following locations:

- Minor flooding from surcharging infrastructure on Mills Ave, Frank Ave, and Beckert.
- Minor flooding from surcharge MASSDOT infrastructure on Thayer Avenue.

The minor flooding occurring during these larger storm events are short, as the increased size of the Mills Ave truck line provides increased conveyance capacity leading to significantly reduced flood durations.

Table 7. Gravity-Only Alternative Maximum Flood Depths and Durations Current Climate

Reference Point CB1219 (Gilbert Ave)								
	Prop Gravity MHW				Prop Gravity MLW			
Storm Event	1	2	10	25	1	2	10	25
Peak Flooding Depth (ft)	-0.93	-0.81	-0.40	-0.06	-0.93	-0.81	-0.40	-0.06
Flood Duration (hr)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Flood Duration (min)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Reference Point CB3566 (Mills Ave)								
	Prop Gravity MHW				Prop Gravity MLW			
Storm Event	1	2	10	25	1	2	10	25
Peak Flooding Depth (ft)	-1.77	-1.56	-0.33	0.53	-2.53	-2.40	-1.63	-0.35
Flood Duration (hr)	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00
Flood Duration (min)	0.00	0.00	0.00	3.28	0.00	0.00	0.00	0.00
Reference Point CB4723 (Mills Ave)								
	Prop Gravity MHW				Prop Gravity MLW			
Storm Event	1	2	10	25	1	2	10	25
Peak Flooding Depth (ft)	-1.36	-0.78	-0.18	-0.03	-2.75	-2.39	-0.59	-0.44
Flood Duration (hr)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Flood Duration (min)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

6.1.2 Gravity Only Projected 2070 Modeling Results

The results are summarized below; the extents of surface flooding are shown graphically on the Figures provided in Appendix D. The tabulations of the maximum depths and durations for all modeled storm events included in Appendix F.

The gravity-only improvement alternative does not include the storm surge protection provided by a potential coastal berm. Therefore, similar to the existing conditions future climate conditions, the increased tidal water surface elevation associated with the projected 2050 MHW (7.3ft NAVD88) overtop the roadway edge of Mills Avenue (~7.2ft NAVD88), and inundates the flat, low-lying coastal areas of the Riverside neighborhood. Even with the enlarged truck line, this heightened tailwater prevents the interior stormwater outfalls from being able to drain flooded roadways within the neighborhood. Given this coastal vulnerability is unchanged within the gravity-only improvement alternative, the influence from future sea level rise is much greater than the influence from the increases in future precipitation. This becomes more pronounced with the projected 2070 MHW tidal conditions (9.2ft NAVD88) as the water significantly overtop Mills Ave. and floods the entire neighborhood up to North Shore Road.

Table 8. Gravity-Only Alternative Maximum Flood Depths and Durations 2050 Climate

Reference Point CB1219 (Gilbert Ave)				
	Prop Gravity 2050 MHW			
Storm Event	1	2	10	25
Peak Flooding Depth (ft)	0.61	0.84	1.90	2.17
Flood Duration (hr)	22.96	22.96	22.96	22.96
Flood Duration (min)	1377	1377	1377	1377
Reference Point CB3566 (Mills Ave)				
	Prop Gravity 2050 MHW			
Storm Event	1	2	10	25
Peak Flooding Depth (ft)	1.06	1.10	1.16	1.18
Flood Duration (hr)	23.26	23.26	23.26	23.26
Flood Duration (min)	1395	1395	1395	1395
Reference Point CB4723 (Mills Ave)				
	Prop Gravity 2050 MHW			
Storm Event	1	2	10	25
Peak Flooding Depth (ft)	1.12	1.13	1.14	1.15
Flood Duration (hr)	23.37	23.37	23.37	23.37
Flood Duration (min)	1402	1402	1402	1402

Table 9. Gravity-Only Alternative Maximum Flood Depths and Durations 2070 Climate

Reference Point CB1219 (Gilbert Ave)				
	Prop Gravity 2070 MHW			
Storm Event	1	2	10	25
Peak Flooding Depth (ft)	2.33	2.34	2.37	2.37
Flood Duration (hr)	23.16	23.16	23.16	23.16
Flood Duration (min)	1389	1389	1389	1389
Reference Point CB3566 (Mills Ave)				
	Prop Gravity 2070 MHW			
Storm Event	1	2	10	25
Peak Flooding Depth (ft)	2.90	2.91	2.96	2.96
Flood Duration (hr)	23.22	23.22	23.22	23.22
Flood Duration (min)	1393	1393	1393	1393
Reference Point CB4723 (Mills Ave)				
	Prop Gravity 2070 MHW			
Storm Event	1	2	10	25
Peak Flooding Depth (ft)	3.00	3.00	3.02	3.03
Flood Duration (hr)	23.45	23.45	23.45	23.45
Flood Duration (min)	1407	1407	1407	1407

6.2 Coastal Berm and Pumping Station Alternative

The conceptual drainage infrastructure improvement model was modified to include a coastal berm and a pumping station at the Boatworks Property to address the potential future inadequacies of the gravity-only alternative. The intention of this conceptual plan was to build a coastal berm that would protect up to elevations 10.3 ft NAVD88 in order prevent the overtopping of Mills Avenue during the future 2070 MHW storm event, as well as to build a pumping station to assist with conveyance of stormwater during these heightened tailwater conditions. A group of three centrifugal 60 hp pumps were conceptually designed to be placed within an approximately 1900 cubic feet concrete pump chamber. Each pump was configured to turn on at different water surface elevations within the pump chamber to potential pump cycling and to assist with drainage as tidal elevations increase or storms become more intense.

6.2.1 Coastal Berm and Pumping Station Present-Day Modeling Results

The model results including a coastal berm and pump station are summarized below; the extents of surface flooding are shown graphically on the Figures provided in Appendix E. The tabulations of the maximum depths and durations for all modeled storm events included in Appendix F.

The Pump/Berm alternative model simulation results revealed significant improvements to experienced maximum flood depths and flood durations when compared to the undersized existing conditions. These improvements are virtually identical to the improvements provided by the Gravity-Only Alternative.

In general, the results of the Pump/Berm alternative conditions model showed no surface anywhere in the neighborhood for the 1-year or 2-year storm mean low and mean high water events:

For the 10- and 25-year storm events, the results of the Pump/Berm alternative conditions model showed minor surface flooding at the following locations:

- Minor flooding from surcharging infrastructure on Mills Ave, Frank Ave, and Beckert.
- Minor flooding from surcharge MASSDOT infrastructure on Thayer Avenue.

The minor flooding occurring during these larger storm events are short, as the increased size of the Mills Ave truck line and the addition of the pumping station both provide increased conveyance capacity leading to significantly reduced flood durations.

It is important to note the model was run to include tidal inundation of the Riverside Neighborhood from the Pines River only. This project did not investigate or account for any possible tidal inundation from the east (Route 1A). Analyzing the impacts of tidal inundation from the east is beyond the scope of this study.

Table 10. Pump/Berm Alternative Maximum Flood Depths and Durations Current Climate

Reference Point CB1219 (Gilbert Ave)								
	Prop Pump/Berm MHW				Prop Pump/Berm MLW			
Storm Event	1	2	10	25	1	2	10	25
Peak Flooding Depth (ft)	-0.93	-0.81	-0.40	-0.06	-0.93	-0.81	-0.40	-0.06
Flood Duration (hr)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Flood Duration (min)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Reference Point CB3566 (Mills Ave)								
	Prop Pump/Berm MHW				Prop Pump/Berm MLW			
Storm Event	1	2	10	25	1	2	10	25
Peak Flooding Depth (ft)	-1.94	-1.81	-0.08	0.71	-2.53	-2.40	-1.51	0.18
Flood Duration (hr)	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.02
Flood Duration (min)	0.00	0.00	0.00	4.42	0.00	0.00	0.00	1.12
Reference Point CB4723 (Mills Ave)								
	Prop Pump/Berm MHW				Prop Pump/Berm MLW			
Storm Event	1	2	10	25	1	2	10	25
Peak Flooding Depth (ft)	-2.69	-2.58	-1.84	-1.34	-3.19	-2.97	-2.26	-1.78
Flood Duration (hr)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Flood Duration (min)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

6.2.2 Coastal Berm and Pumping Station Projected 2070 Modeling Results

The results are summarized below; the extents of surface flooding are shown graphically on the Figures provided in Appendix E. The tabulations of the maximum depths and durations for all modeled storm events included in Appendix E.

The Pump/Berm alternative model simulation results revealed significant improvements to experienced maximum flood depths and flood durations when existing future conditions or gravity-only alternative future conditions. The Pump/Berm improvement alternative includes storm surge protection provided by a potential coastal berm. This inclusion prevents the storm surge from intruding into the neighborhood by overtopping Mills Avenue during 2050 and 2070 future MHW tidal conditions. Given this remedy to the coastal vulnerability within the Pump/Berm improvement alternative, the influence from future precipitation becomes greater than the influence from the increases in future tidal elevation.

In general, the results of the Pump/Berm alternative conditions model showed surface flooding limited to the areas of the neighborhood furthest from the pumping station in the neighborhood for the future 1-year or future 2-year 2050 and 2070 mean high water storm events. While the proposed stormwater infrastructure system momentarily surcharges, the increased conveyance capacity provided by the increased truck line and pumping station help to drain the flooding areas within a maximum of ~16 mins. This flooding occurs primarily on the

southern end of Mills Ave, while the other side streets like Frank and Blanchard Ave also experience minor flooding.

For the future 10- and future 25-year 2050 and 2070 mean high water storm events, the results of the Pump/Berm alternative conditions model showed more significant surface flooding throughout the neighborhood, with the most significant flooding occurring on the southern end of Mills Avenue, Gilbert Avenue, and Beckert Avenue. The drainage improvements included in this alternative help to drain the affected areas in approximately 30-60 mins, depending on the location.

Table 11. Pump/Berm Alternative Maximum Flood Depths and Durations 2050 Climate

Reference Point CB1219 (Gilbert Ave)				
	Prop Pump/Berm 2050 MHW			
Storm Event	1	2	10	25
Peak Flooding Depth (ft)	-0.82	-0.21	2.02	2.18
Flood Duration (hr)	0.00	0.00	0.28	0.32
Flood Duration (min)	0.00	0.00	16.67	19.45
Reference Point CB3566 (Mills Ave)				
	Prop Pump/Berm 2050 MHW			
Storm Event	1	2	10	25
Peak Flooding Depth (ft)	-1.11	0.90	1.40	1.58
Flood Duration (hr)	0.00	0.11	0.41	0.51
Flood Duration (min)	0.00	6.32	24.38	30.81
Reference Point CB4723 (Mills Ave)				
	Prop Pump/Berm 2050 MHW			
Storm Event	1	2	10	25
Peak Flooding Depth (ft)	-2.32	-1.85	-0.75	-0.63
Flood Duration (hr)	0.00	0.00	0.00	0.00
Flood Duration (min)	0.00	0.00	0.00	0.00

Table 12. Pump/Berm Alternative Maximum Flood Depths and Durations 2070 Climate

Reference Point CB1219 (Gilbert Ave)				
	Prop Pump/Berm 2070 MHW			
Storm Event	1	2	10	25
Peak Flooding Depth (ft)	-0.74	1.76	2.20	2.21
Flood Duration (hr)	0.00	0.20	0.44	0.63
Flood Duration (min)	0.00	11.96	26.33	37.69
Reference Point CB3566 (Mills Ave)				
	Prop Pump/Berm 2070 MHW			
Storm Event	1	2	10	25
Peak Flooding Depth (ft)	-0.18	1.28	1.79	1.87
Flood Duration (hr)	0.00	0.27	0.70	0.87
Flood Duration (min)	0.00	15.95	42.28	52.03
Reference Point CB4723 (Mills Ave)				
	Prop Pump/Berm 2070 MHW			
Storm Event	1	2	10	25
Peak Flooding Depth (ft)	-2.00	-1.04	-0.42	0.49
Flood Duration (hr)	0.00	0.00	0.00	0.09
Flood Duration (min)	0.00	0.00	0.00	5.47

7 75% Design

As described in Section 6.1 above, during the H&H modelling process we discovered a change to Concept 5 was necessary. Having one single outfall located at the northern end of the project area was not creating significant improvements in areas of the project that were most distant from the discharge point located near the intersection of Thayer Avenue and Mills Avenue. Specifically, the modelling showed the southern portion of Mills Avenue was experiencing flooding conditions that were worse than current conditions due to its location approximately 2300 feet from the discharge outfall location. The project team agreed that we could not propose a solution that will worsen flooding in some areas of the neighborhood. In reaction to this modelling result, Concept 5 was altered to include a second outfall at the end of Gilbert Avenue. Adding this second outfall provided an additional point of discharge which alleviated the portions of the drainage system that were surcharging under existing conditions.

Although the revised design includes a second outfall, this design can be adapted to accommodate a pump in the event a berm and pump system is eventually approved and accepted. The 36-inch pipe between manhole 54 and manhole 55 can be installed now and bricked off to allow stormwater to flow to the intended outfalls. In the event the pump is installed, the bricked openings between manhole 54 and 55 can be opened. The discharge piping leading from manhole 54 to the Pines River would be mortared and closed. This would allow flow from the southern portion of the new system to flow to any new pump station that is installed in or near the Boatworks property.

The 75% design documents include substantially more detail than the concept plans produced during the concept phase. Plan and profile sheets for Mills Avenue and all side streets were prepared as part of the 75% design plans. The most significant adjustment to these plans includes utility adjustments and relocations necessary to allow for the increase in the amount and size of drainage infrastructure proposed throughout the neighborhood. One unique feature of the utility design within this neighborhood is the location of stormwater infrastructure compared with the location of sanitary sewer infrastructure. As described in the existing conditions section of this report, the existing drainage system is undersized and flows from east to west toward the Pines River. The gravity sanitary sewer system runs from west to east and ties into a sewer main that runs from south to north along the east side of the neighborhood. These alignments have created conflicts between the existing sewer lines and proposed drains due to the upsizing of drain lines and an increase in the number of sewer lines. These conflicts have been resolved in a number of ways. Proposed drainage lines were elevated to have minimal cover on the western sides of Archer, Lawson, and Wadleigh Avenue. Additional sewer lines have been proposed to provide sewer connections on either side of the new drainage lines.

We have identified possible new conflicts with existing non-gravity utilities based on the information that was compiled in the existing conditions plans. The locations of non-gravity utilities will need to be confirmed in the field by the contractor. Since non-gravity utility locations are never perfect, any contractor selected to build the improvements will need to verify their locations. We cannot guarantee all conflicts will be identified in the plans.

Based on the revisions described above, we have revised our cost estimate for the gravity alternative only. The new cost estimate for the proposed project is \$7,047,000.

Plans, specifications, and cost estimate are located in Appendixes G, H, and I.

Conceptual design of a pump station was developed to run the H&H model as described in the previous sections. The plans described in this section include a conceptual pump station layout and detailed information on pump numbers and sizes. Additional H&H modelling and site design are necessary to advance the pump alternative.

8 Community Engagement

Two public meetings were held. The public engagement meetings were scheduled and run by the City of Revere. The first meeting was held on April 15, 2026. During the meeting we presented the project including results of the hydrologic modelling for the existing and proposed conditions. The results of the modeling, as described above, show both the existing and proposed stormwater management system under existing, 2050, and 2070 conditions. Attendees at the meetings, including residents of the Riverside neighborhood, were able to see the results of the modelling under future conditions. This modelling indicates significant flooding throughout the neighborhood during the 2050 and 2070 anticipated events with the existing drainage system and the proposed drainage system. The second presentation showed results of the modeling with a berm and pump system and the improved flood conditions resulting from the berm and pump system.

Residents continued to express their dissatisfaction with any solution that includes the berm.

9 Permitting

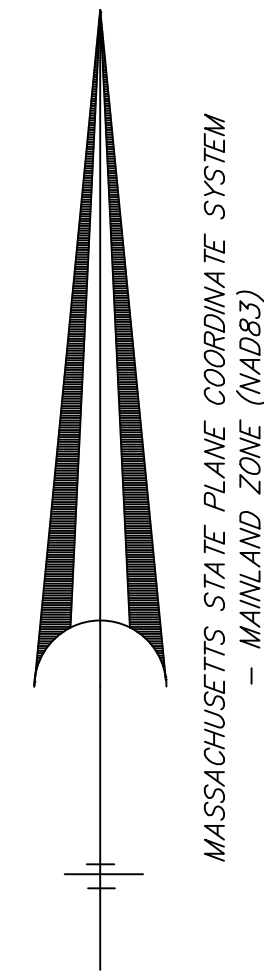
As discussed above, permitting scope was started but not advanced in this study due to the complexity of issues associated with this project as well as the anticipated length of time that will likely be required to obtain all permits. The results of the H&H modeling and development of the revised preferred concepts do not change the initial

permitting analysis. Permitting the project will require substantial effort and time due to the complexity of the project and significant environmental resources that exist within and near the Riverside Neighborhood.

10 Conclusions

As described throughout this report, the project has examined, studied and modelled the performance of the existing stormwater management system located within the Riverside Neighborhood. Currently, the neighborhood experiences periodically significant flooding due to tidal events, stormwater flooding, and intense rainfall events. This is caused by a combination of the neighborhood's location in floodplain, proximity to tidally influenced waterbodies, and undersized existing stormwater infrastructure. The project studied numerous alternatives to help alleviate these conditions now and in the future. The results of these studies resulted in the further development of an option that will improve flooding conditions immediately under existing rainfall and tidal conditions. However, as rainfall intensities and high tide elevations increase, the Riverside Neighborhood will increasingly be at risk for severe flooding over the next 40 years. Additional interventions include the installation of berms and pumps were also studied to assess their effectiveness during anticipated future rainfall and tidal conditions. The results of these models indicate the installation of berms and pumps would improve flooding conditions in the future. Those options have significant cost implications as well as regulatory hurdles and opposition from residents. Additional modeling and design efforts would be necessary to finalize the pump and berm specification if granted regulatory and community approval. Given the projects location in and near significant environmental resources, permitting of any solutions will require considerable time to obtain all state, local, and federal permits."

Appendix A – Existing Conditions Survey



SHEET #2

NOTES:

1) THE HORIZONTAL DATUM FOR THIS SURVEY IS THE MASSACHUSETTS COORDINATE SYSTEM, NAD 1983, MAINLAND ZONE. THE VERTICAL DATUM FOR THIS SURVEY IS THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88). SAID DATUMS WERE ESTABLISHED VIA GPS OBSERVATIONS UTILIZING REALIZATION NAD83(2011) AND GEOID 12A.

2) UNDERGROUND UTILITIES SHOWN HEREON ARE COMPILED FROM FIELD LOCATIONS OF STRUCTURES AND FROM AVAILABLE RECORD INFORMATION ON FILE AT THE CITY ENGINEERING OFFICES, CITY D.P.W., MASS HIGHWAY DEPT. AND UTILITY COMPANIES. OTHER UNDERGROUND UTILITIES MAY EXIST. IT SHALL BE THE RESPONSIBILITY OF THE DESIGN ENGINEER AND THE CONTRACTOR TO VERIFY THE LOCATION, SIZE & ELEVATION OF ALL UTILITIES WITHIN THE AREA OF PROPOSED WORK AND TO CONTACT "DIG-SAFE" AT 811 AT LEAST 72 HOURS PRIOR TO ANY EXCAVATION, DEMOLITION OR CONSTRUCTION.

3) PORTIONS OF THE PROPERTY SHOWN HEREON ARE LOCATED IN THE FEMA FLOOD ZONE "AE" WITH A BASE FLOOD ELEVATION OF 10 FEET. FLOOD ZONE INFORMATION WAS COMPILED FROM THE FEMA MAP OF COMMUNITY NO. 25025C0028J AS REVISED TO MARCH 16, 2016.

4) MEAN HIGH WATER ELEVATION (4.33 NAVD88) WAS OBTAINED FROM THE NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION WEBSITE, TIDAL STATION #8443970, BOSTON, MA.

5) LIMITS OF COASTAL BANK DETERMINED FROM A PDF ENTITLED "WETLAND DELINEATION SKETCH MILLS AVENUE, REVERE, MASSACHUSETTS" DELINEATED BY LEC ENVIRONMENTAL CONSULTANTS, INC ON AUGUST 31, 2022.

6) EVIDENCE OF UNDERGROUND WATER LINES EXIST ON SITE. A PORTION OF THE INFORMATION REGARDING SAID LINES WAS UNAVAILABLE AT THE TIME OF THIS SURVEY. (SEE NOTE 2)

7) EVIDENCE OF UNDERGROUND ELECTRIC LINES EXIST AT UTILITY POLES AND ELECTRIC HANDHOLES. NO INFORMATION REGARDING THE LOCATION OF SAID LINES WAS AVAILABLE AT THE TIME OF THE SURVEY.

MILLS AVENUE

Revere, Massachusetts 02151

PREPARED FOR:

FUSS & O'NEILL, INC

108 Myrtle Street, Suite 502
Quincy, Massachusetts 02171

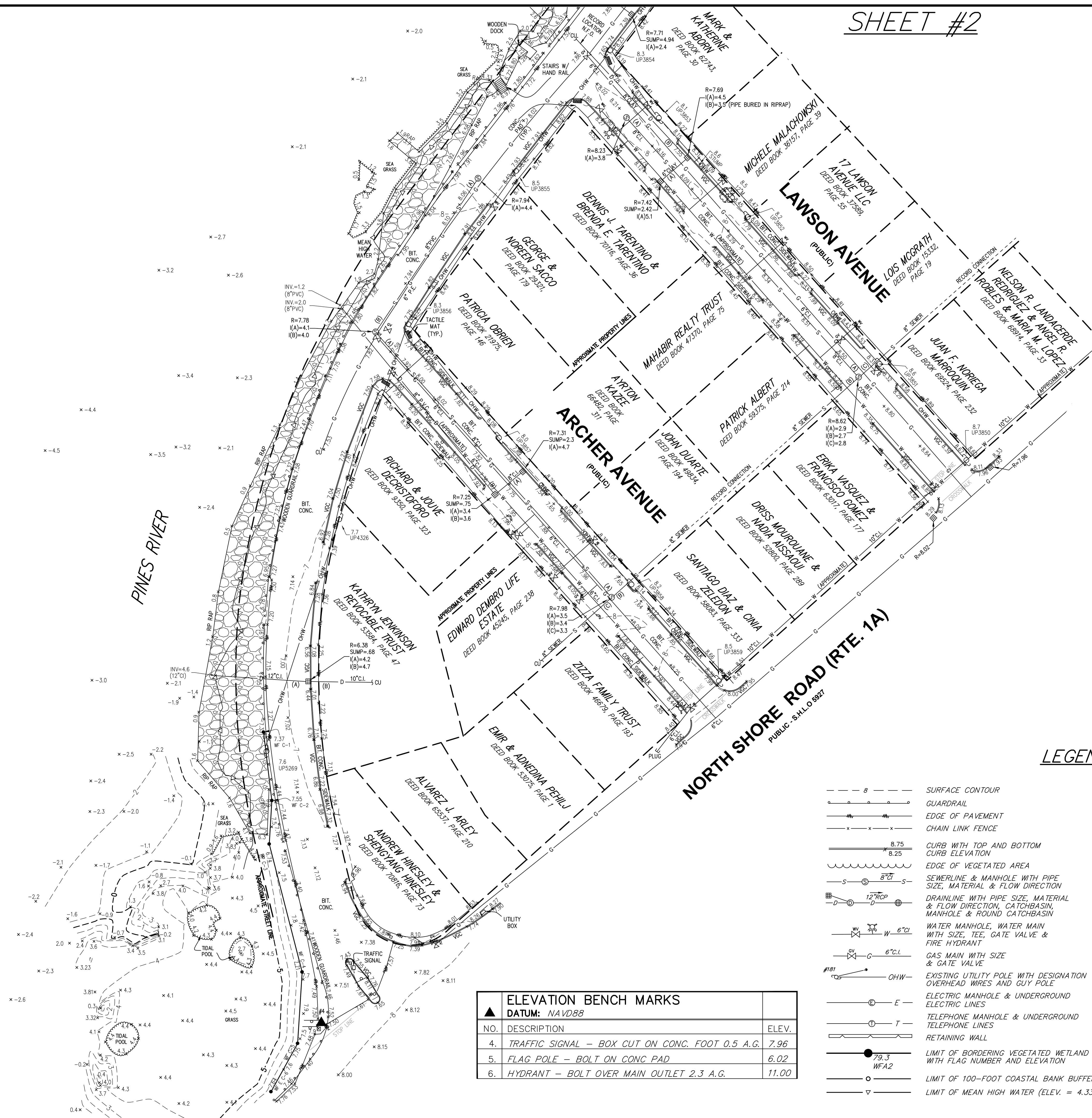
HANCOCK ASSOCIATES

Civil Engineers

Land Surveyors

Wetland Scientists

185 CENTRE STREET, DANVERS, MA 01923
VOICE (978) 777-3050, FAX (978) 774-7816
WWW.HANCOCKASSOCIATES.COM



LEGEND

---	8	SURFACE CONTOUR
---	12"	GUARDRAIL
---	---	EDGE OF PAVEMENT
---	---	CHAIN LINK FENCE
---	8.75	CURB WITH TOP AND BOTTOM
---	8.25	CURB ELEVATION
---	---	EDGE OF VEGETATED AREA
---	---	SEWERLINE & MANHOLE WITH PIPE
---	---	SIZE, MATERIAL & FLOW DIRECTION
---	---	DRAINLINE WITH PIPE SIZE, MATERIAL
---	---	& FLOW DIRECTION, CATCHBASIN,
---	---	MANHOLE & ROUND CATCHBASIN
---	---	WATER MANHOLE, WATER MAIN
---	---	WITH SIZE, TEE, GATE VALVE &
---	---	FIRE HYDRANT
---	---	GAS MAIN WITH SIZE
---	---	& GATE VALVE
---	---	EXISTING UTILITY POLE WITH DESIGNATION
---	---	OVERHEAD WIRES AND GUY POLE
---	---	ELECTRIC MANHOLE & UNDERGROUND
---	---	ELECTRIC LINES
---	---	TELEPHONE MANHOLE & UNDERGROUND
---	---	TELEPHONE LINES
---	---	RETAINING WALL
---	---	LIMIT OF BORDERING VEGETATED WETLAND
---	---	WITH FLAG NUMBER AND ELEVATION
---	---	LIMIT OF 100-FOOT COASTAL BANK BUFFER ZONE
---	---	LIMIT OF MEAN HIGH WATER (ELEV. = 4.33)

x 8.56	SPOT ELEVATION
7.48	PROMINENT DECIDUOUS TREE
12" M	WITH ELEVATION, SIZE AND SPECIES
*	LIGHT POLE
C.I.	CAST IRON
P.E.	PLASTIC
PVC	POLYVINYL CHLORIDE
SMH	SEWER MANHOLE
DMH	DRAIN MANHOLE
CB	CATCH BASIN
RCB	ROUND CATCH BASIN
CU	CONNECTION UNKNOWN
o	BOLLARD
—	SIGN
o	MANHOLE (UNKNOWN UTILITY)
VGC	VERTICAL GRANITE CURB
BIT. CONC.	BITUMINOUS CONCRETE
N.F.O.	NOT FIELD OBSERVED

TREE ABBREVIATIONS

M MAPLE

SCALE: 1" = 30'



ELEVATION BENCH MARKS		
DATUM: NAVD88		
NO.	DESCRIPTION	ELEV.
4.	TRAFFIC SIGNAL - BOX CUT ON CONC. FOOT 0.5 A.G.	7.96
5.	FLAG POLE - BOLT ON CONC PAD	6.02
6.	HYDRANT - BOLT OVER MAIN OUTLET 2.3 A.G.	11.00

EXISTING CONDITIONS PLAN OF LAND IN REVERE, MA

PROJ DATE: Jan 26, 2025 2:29 pm

FILE: I:\Data 3D Projects\2479-Fuss&O'Neill-Revere\Survey\DWG

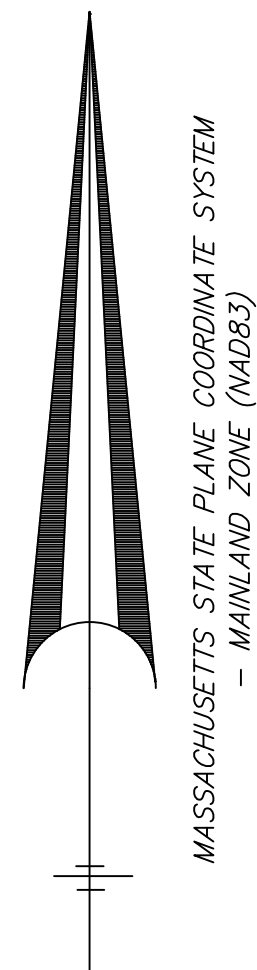
DWG: 28479ec6.dwg

LAYOUT: Park (1)

SHEET: 1 OF 5

PROJECT NO.:

28479



SHEET #3

NOTES:

- 1) THE HORIZONTAL DATUM FOR THIS SURVEY IS THE MASSACHUSETTS COORDINATE SYSTEM, NAD 1983, MAINLAND ZONE. THE VERTICAL DATUM FOR THIS SURVEY IS THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88). SAID DATUMS WERE ESTABLISHED VIA GPS OBSERVATIONS UTILIZING REALIZATION NAD83(2011) AND GEOID 12A.
- 2) UNDERGROUND UTILITIES SHOWN HEREON ARE COMPILED FROM FIELD LOCATIONS OF STRUCTURES AND FROM AVAILABLE RECORD INFORMATION ON FILE AT THE CITY ENGINEERING OFFICES, CITY D.P.W., MASS HIGHWAY DEPT. AND UTILITY COMPANIES. OTHER UNDERGROUND UTILITIES MAY EXIST. IT SHALL BE THE RESPONSIBILITY OF THE DESIGN ENGINEER AND THE CONTRACTOR TO VERIFY THE LOCATION, SIZE & ELEVATION OF ALL UTILITIES WITHIN THE AREA OF PROPOSED WORK AND TO CONTACT "DIG-SAFE" AT 811 AT LEAST 72 HOURS PRIOR TO ANY EXCAVATION, DEMOLITION OR CONSTRUCTION.
- 3) PORTIONS OF THE PROPERTY SHOWN HEREON ARE LOCATED IN THE FEMA FLOOD ZONE "AE" WITH A BASE FLOOD ELEVATION OF 10 FEET. FLOOD ZONE INFORMATION WAS COMPILED FROM THE FEMA MAP OF COMMUNITY NO. 2502500028J AS REVISED TO MARCH 16, 2016.
- 4) MEAN HIGH WATER ELEVATION (4.33 NAVD88) WAS OBTAINED FROM THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION WEBSITE, TIDAL STATION #8443970, BOSTON, MA.
- 5) LIMITS OF COASTAL BANK DETERMINED FROM A PDF ENTITLED "WETLAND DELINEATION SKETCH MILLS AVENUE, REVERE, MASSACHUSETTS" DELINEATED BY LEC ENVIRONMENTAL CONSULTANTS, INC ON AUGUST 31, 2022.
- 6) EVIDENCE OF UNDERGROUND WATER LINES EXIST ON SITE. A PORTION OF THE INFORMATION REGARDING SAID LINES WAS UNAVAILABLE AT THE TIME OF THIS SURVEY. (SEE NOTE 2)
- 7) EVIDENCE OF UNDERGROUND ELECTRIC LINES EXIST AT UTILITY POLES AND ELECTRIC HANDHOLES. NO INFORMATION REGARDING THE LOCATION OF SAID LINES WAS AVAILABLE AT THE TIME OF THE SURVEY.

MILLS AVENUE

Revere, Massachusetts 02151

PREPARED FOR:

FUSS & O'NEILL, INC

108 Myrtle Street, Suite 502
Quincy, Massachusetts 02171

HANCOCK ASSOCIATES

Civil Engineers

Land Surveyors

Wetland Scientists

185 CENTRE STREET, DANVERS, MA 01923
VOICE (978) 777-3050, FAX (978) 774-7816
WWW.HANCOCKASSOCIATES.COM

LEGEND

— 8 —	SURFACE CONTOUR	× 8.56	SPOT ELEVATION
— 7.48 —	GUARDRAIL	7.48	PROMINENT DECIDUOUS TREE WITH ELEVATION, SIZE AND SPECIES
— 12" M —	EDGE OF PAVEMENT	☆	LIGHT POLE
— x — x —	CHAIN LINK FENCE	C.I.	CAST IRON
— 8.75 —	CURB WITH TOP AND BOTTOM CURB ELEVATION	P.E.	PLASTIC
— 8.25 —	EDGE OF VEGETATED AREA	PVC	POLYVINYL CHLORIDE
— S — S —	SEWERLINE & MANHOLE WITH PIPE SIZE, MATERIAL & FLOW DIRECTION	SMH	SEWER MANHOLE
— 12" RCP —	DRAINLINE WITH PIPE SIZE, MATERIAL & FLOW DIRECTION, CATCHBASIN, MANHOLE & ROUND CATCHBASIN	DMH	DRAIN MANHOLE
— W 6" CI —	WATER MANHOLE, WATER MAIN WITH SIZE, TEE, GATE VALVE & FIRE HYDRANT	CB	CATCH BASIN
— 6" CI —	GAS MAIN WITH SIZE & GATE VALVE	RCB	ROUND CATCH BASIN
— OHW —	EXISTING UTILITY POLE WITH DESIGNATION OVERHEAD WIRES AND GUY POLE	CU	CONNECTION UNKNOWN
— E —	ELECTRIC MANHOLE & UNDERGROUND ELECTRIC LINES	•	BOLLARD
— T —	TELEPHONE MANHOLE & UNDERGROUND TELEPHONE LINES	—	SIGN
—	RETAINING WALL	⊙	MANHOLE (UNKNOWN UTILITY)
— 79.3 —	LIMIT OF BORDERING VEGETATED WETLAND WITH FLAG NUMBER AND ELEVATION	VGC	VERTICAL GRANITE CURB
— WFA2 —	LIMIT OF 100-FOOT COASTAL BANK BUFFER ZONE	BIT. CONC.	BITUMINOUS CONCRETE
—	LIMIT OF MEAN HIGH WATER (ELEV. = 4.33)	N.F.O.	NOT FIELD OBSERVED

TREE ABBREVIATIONS

M MAPLE

SCALE: 1" = 30'

0 30 60 120

ELEVATION BENCH MARKS

DATUM: NAVD88

NO.	DESCRIPTION	ELEV.
4.	TRAFFIC SIGNAL — BOX CUT ON CONC. FOOT 0.5 A.G.	7.96
5.	FLAG POLE — BOLT ON CONC PAD	6.02
6.	HYDRANT — BOLT OVER MAIN OUTLET 2.3 A.G.	11.00

SHEET #1

EXISTING CONDITIONS PLAN OF LAND IN REVERE, MA

PROJ DATE: Jan 26, 2025, 2:33 PM

FILE: C:\Users\jml\OneDrive\Projects\2502500028J-Fuss&O'Neill-Revere\Drawings\DWG

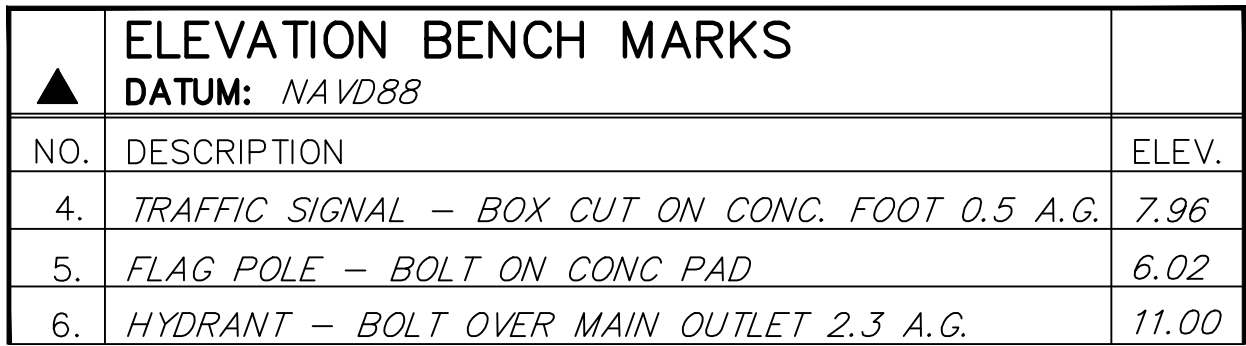
DWG: 28479ec6.dwg

LAYOUT: Park (2)

SHEET: 2 OF 5

PROJECT NO.:

28479



SHEET #4

1) THE HORIZONTAL DATUM FOR THIS SURVEY IS THE MASSACHUSETTS COORDINATE SYSTEM, NAD 1983, MAINLAND ZONE. THE VERTICAL DATUM FOR THIS SURVEY IS THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAV88). SAID DATUMS WERE ESTABLISHED VIA GPS OBSERVATIONS UTILIZING REALIZATION NAD83(2011) AND GEOID 12A.

2) UNDERGROUND UTILITIES SHOWN HEREON ARE COMPILED FROM FIELD LOCATIONS OF STRUCTURES AND FROM AVAILABLE RECORD INFORMATION ON FILE AT THE CITY ENGINEERING OFFICES, CITY D.P.W., MASS HIGHWAY DEPT. AND UTILITY COMPANIES. OTHER UNDERGROUND UTILITIES MAY EXIST. IT SHALL BE THE RESPONSIBILITY OF THE DESIGN ENGINEER AND THE CONTRACTOR TO VERIFY THE LOCATION, SIZE & ELEVATION OF ALL UTILITIES WITHIN THE AREA OF PROPOSED WORK AND TO CONTACT "DIG-SAFE" AT 811 AT LEAST 72 HOURS PRIOR TO ANY EXCAVATION, DEMOLITION OR CONSTRUCTION.

3) PORTIONS OF THE PROPERTY SHOWN HEREON ARE LOCATED IN THE FEMA FLOOD ZONE "AE" WITH A BASE FLOOD ELEVATION OF 10 FEET. FLOOD ZONE INFORMATION WAS COMPILED FROM THE FEMA MAP OF COMMUNITY NO. 25025C0028J AS REVISED TO MARCH 16, 2016.

4) MEAN HIGH WATER ELEVATION (4.33 NAVD88) WAS OBTAINED FROM THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION WEBSITE, TIDAL STATION #8443970, BOSTON, MA.

5) LIMITS OF COASTAL BANK DETERMINED FROM A PDF ENTITLED "WETLAND DELINEATION SKETCH MILLS AVENUE, REVERE, MASSACHUSETTS" DELINEATED BY LEC ENVIRONMENTAL CONSULTANTS, INC ON AUGUST 31, 2022.

6) EVIDENCE OF UNDERGROUND WATER LINES EXIST ON SITE. A PORTION OF THE INFORMATION REGARDING SAID LINES WAS UNAVAILABLE AT THE TIME OF THIS SURVEY. (SEE NOTE 2)

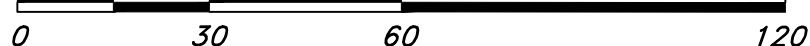
7) EVIDENCE OF UNDERGROUND ELECTRIC LINES EXIST AT UTILITY POLES AND ELECTRIC HANDHOLES. NO INFORMATION REGARDING THE LOCATION OF SAID LINES WAS AVAILABLE AT THE TIME OF THE SURVEY.

	<i>SURFACE CONTOUR</i>
	<i>GUARDRAIL</i>
	<i>EDGE OF PAVEMENT</i>
	<i>CHAIN LINK FENCE</i>
	<i>CURB WITH TOP AND BOTTOM CURB ELEVATION</i>
	<i>EDGE OF VEGETATED AREA</i>
	<i>SEWERLINE & MANHOLE WITH PIPE SIZE, MATERIAL & FLOW DIRECTION</i>
	<i>DRAINLINE WITH PIPE SIZE, MATERIAL & FLOW DIRECTION, CATCHBASIN, MANHOLE & ROUND CATCHBASIN</i>
	<i>WATER MANHOLE, WATER MAIN WITH SIZE, TEE, GATE VALVE & FIRE HYDRANT</i>
	<i>GAS MAIN WITH SIZE & GATE VALVE</i>
	<i>EXISTING UTILITY POLE WITH DESIGNATION OVERHEAD WIRES AND GUY POLE</i>
	<i>ELECTRIC MANHOLE & UNDERGROUND ELECTRIC LINES</i>
	<i>TELEPHONE MANHOLE & UNDERGROUND TELEPHONE LINES</i>
	<i>RETAINING WALL</i>
	<i>LIMIT OF BORDERING VEGETATED WETLAND WITH FLAG NUMBER AND ELEVATION</i>
	<i>LIMIT OF 100-FOOT COASTAL BUFFER</i>
	<i>LIMIT OF MEAN HIGH WATER (ELEV. = 4)</i>

8.56	SPOT ELEVATION
7.48  12" M	PROMINENT DECIDUOUS TREE WITH ELEVATION, SIZE AND SPECIES
☆	LIGHT POLE
C.I.	CAST IRON
P.E.	PLASTIC
PVC	POLYVINYL CHLORIDE
SMH	SEWER MANHOLE
DMH	DRAIN MANHOLE
CB	CATCH BASIN
RCB	ROUND CATCH BASIN
CU	CONNECTION UNKNOWN
o	BOLLARD
	SIGN
Ⓢ	MANHOLE (UNKNOWN UTILITY)
VGC	VERTICAL GRANITE CURB
C. CONC.	BITUMINOUS CONCRETE
N.F.O.	NOT FIELD OBSERVED

M *MAPLE*

SCALE: 1" = 30'



MILLS
AVENUE

Revere, Massachusetts 02151

FUSS &
O'NEILL,
INC

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Land Surveyors

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NO.	BY	APP	DATE	ISSUE/REVISION DESCRIPTION
DATE: 6/26/2025				DRAWN BY: JML/CLB
SCALE: 1"=30'				CHECK BY: JAE

EXISTING CONDITIONS PLAN OF LAND IN REVERE, MA

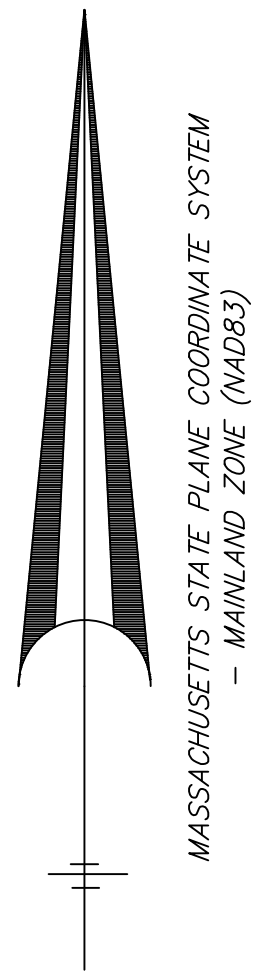
PLOT DATE: Jun 26, 2025 2:50 pm
PATH: F:\CIVIL 3D Projects\28479-Fuss&Nell-Revere\Surv\DWG

DWG: 28479ec6.dwg

LAYOUT: Park (3

SHEET: 3 OF

28479



SHEET #5

NOTES:

- 1) THE HORIZONTAL DATUM FOR THIS SURVEY IS THE MASSACHUSETTS COORDINATE SYSTEM, NAD 1983, MAINLAND ZONE. THE VERTICAL DATUM FOR THIS SURVEY IS THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88). SAID DATUMS WERE ESTABLISHED VIA GPS OBSERVATIONS UTILIZING REALIZATION NAD83(2011) AND GEOID 12A.
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MILLS AVENUE

Revere, Massachusetts 02151

PREPARED FOR:

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HANCOCK ASSOCIATES

Civil Engineers

Land Surveyors

Wetland Scientists

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VOICE (978) 777-3050, FAX (978) 774-7816
WWW.HANCOCKASSOCIATES.COM

LEGEND

	SURFACE CONTOUR		SPOT ELEVATION
	GUARDRAIL		PROMINENT DECIDUOUS TREE WITH ELEVATION, SIZE AND SPECIES
	EDGE OF PAVEMENT		LIGHT POLE
	CHAIN LINK FENCE		CAST IRON
	CURB WITH TOP AND BOTTOM		PLASTIC
	CURB ELEVATION		POLYVINYL CHLORIDE
	EDGE OF VEGETATED AREA		SEWER MANHOLE
	SEWERLINE WITH PIPE SIZE, MATERIAL & FLOW DIRECTION		DRAIN MANHOLE
	DRAINLINE WITH PIPE SIZE, MATERIAL & FLOW DIRECTION, CATCHBASIN, MANHOLE & ROUND CATCHBASIN		CATCH BASIN
	WATER MANHOLE, WATER MAIN WITH SIZE, TEE, GATE VALVE & FIRE HYDRANT		ROUND CATCH BASIN
	GAS MAIN WITH SIZE & GATE VALVE		CONNECTION UNKNOWN
	EXISTING UTILITY POLE WITH DESIGNATION OVERHEAD WIRES AND GUY POLE		BOLLARD
	ELECTRIC MANHOLE & UNDERGROUND ELECTRIC LINES		SIGN
	TELEPHONE MANHOLE & UNDERGROUND TELEPHONE LINES		MANHOLE (UNKNOWN UTILITY)
	RETAINING WALL		VERTICAL GRANITE CURB
	LIMIT OF BORDERING VEGETATED WETLAND WITH FLAG NUMBER AND ELEVATION		BITUMINOUS CONCRETE
	LIMIT OF 100-FOOT COASTAL BANK BUFFER ZONE		NOT FIELD OBSERVED
	LIMIT OF MEAN HIGH WATER (ELEV. = 4.33)		

TREE ABBREVIATIONS

M MAPLE

SCALE: 1" = 30'

0 30 60 120

ELEVATION BENCH MARKS		
NO.	DESCRIPTION	ELEV.
4.	TRAFFIC SIGNAL - BOX CUT ON CONC. FOOT 0.5 A.G.	7.96
5.	FLAG POLE - BOLT ON CONC PAD	6.02
6.	HYDRANT - BOLT OVER MAIN OUTLET 2.3 A.G.	11.00

SHEET #3

EXISTING CONDITIONS PLAN OF LAND IN REVERE, MA

PROJ. DATE: Jan 26, 2025, 2:52 pm

FILE: I:\Data 30 Projects\24478-Fuss&O'Neill-Revere\Sur\JMC2

DWG: 28479ec6.dwg

LAYOUT: Park (4)

SHEET: 4 OF 5

PROJECT NO.:

28479



ELEVATION BENCH MARKS		
DATUM: NAVD88		
NO.	DESCRIPTION	ELEV.
4.	TRAFFIC SIGNAL - BOX CUT ON CONC. FOOT 0.5 A.G.	7.96
5.	FLAG POLE - BOLT ON CONC PAD	6.02
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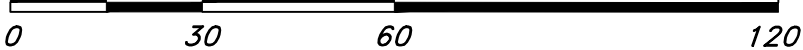
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TREE ABBREVIATIONS

SCALE: 1" = 30'



Revere, Massachusetts 02151

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Quincy, Massachusetts 02171

Civil Engineers

Land Surveyors

Wetland Scientists

185 CENTRE STREET, DANVERS, MA 01923
VOICE (978) 777-3050, FAX (978) 774-7816
WWW.HANCOCKASSOCIATES.COM

NO	RY	APP	DATE	ISSUE /REVISION DESCRIPTION
----	----	-----	------	-----------------------------

DATE: 6/26/2025	DRAWN BY: JML/CLB
SCALE: 1"=30'	CHECK BY: JAE

**EXISTING CONDITIONS
PLAN OF LAND
IN
REVERE, MA**

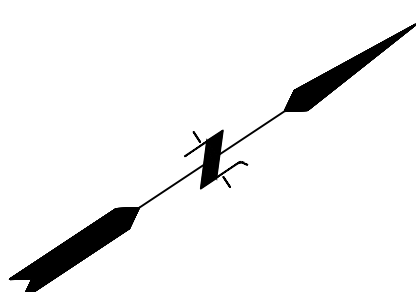
PLOT DATE: Jun 26, 2025 2:59 pm
PATH: F:\CIVIL 3D Projects\28479-Fuss&CNeil-Revere\Surv\DWG

DWG: 28479ec6.dwg

LAYOUT: Park (5

PROJECT NO.: 28479

Appendix B – Concept Plans



CS-101

**FUSS &
O'NEILL**

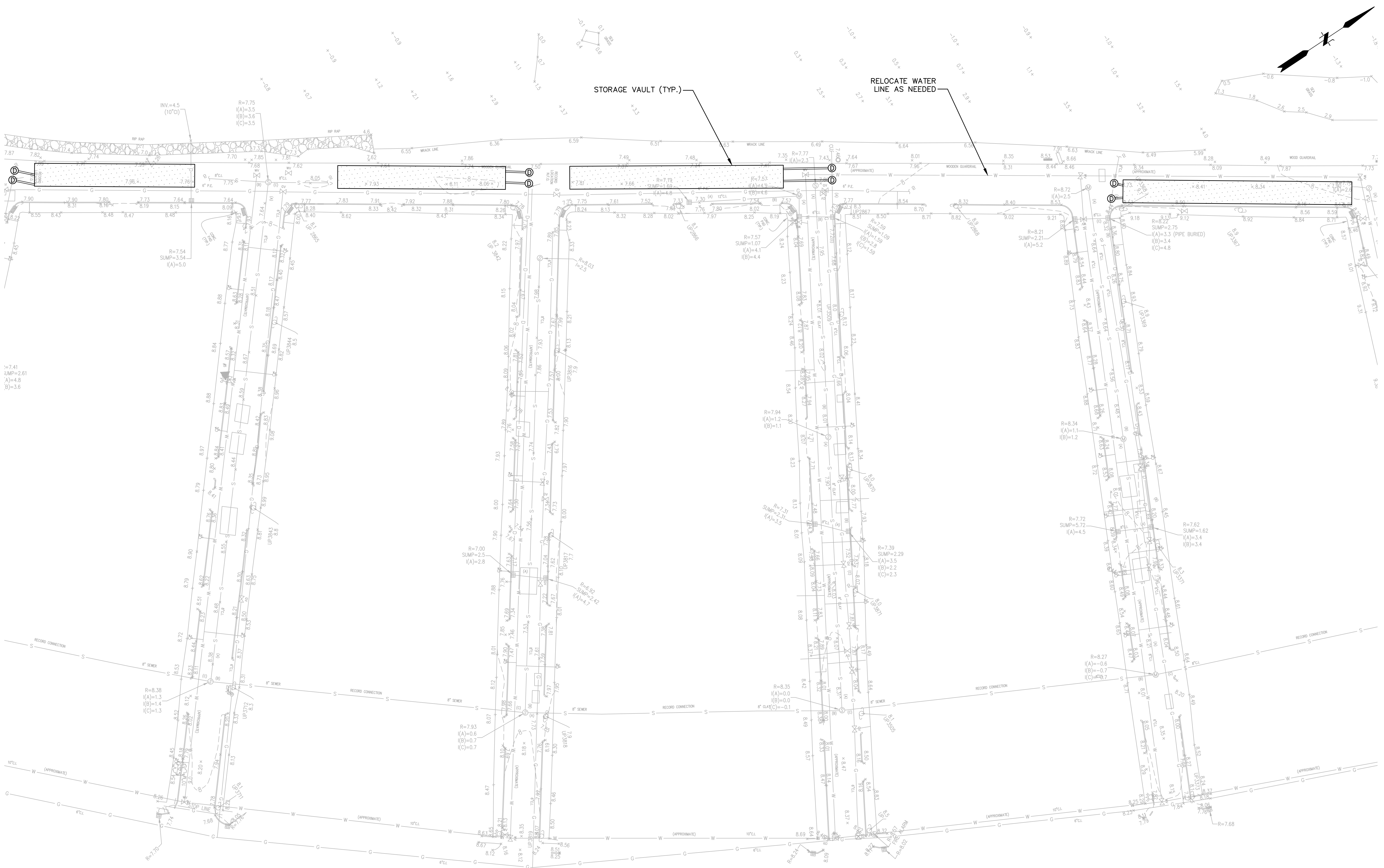
1250 HANCOCK STREET, SUITE 815N
QUINCY, MA 02169
617.282.4675
www.fando.com

SCALE:	HORZ.: 1" = 30'
	VERT.: -
DATUM:	
	HORZ.: -
	VERT.: -

0 15' 30' 60'

GRAPHIC SCALE

[illegible]





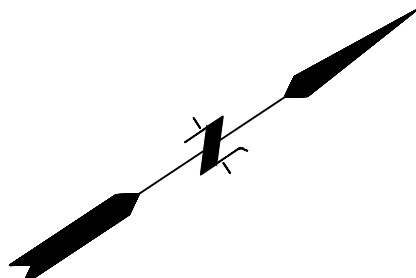
CS-103

**FUSS &
O'NEILL**

1250 HANCOCK STREET, SUITE 815
QUINCY, MA 02169
617.282.4675
www.fando.com

SEAL

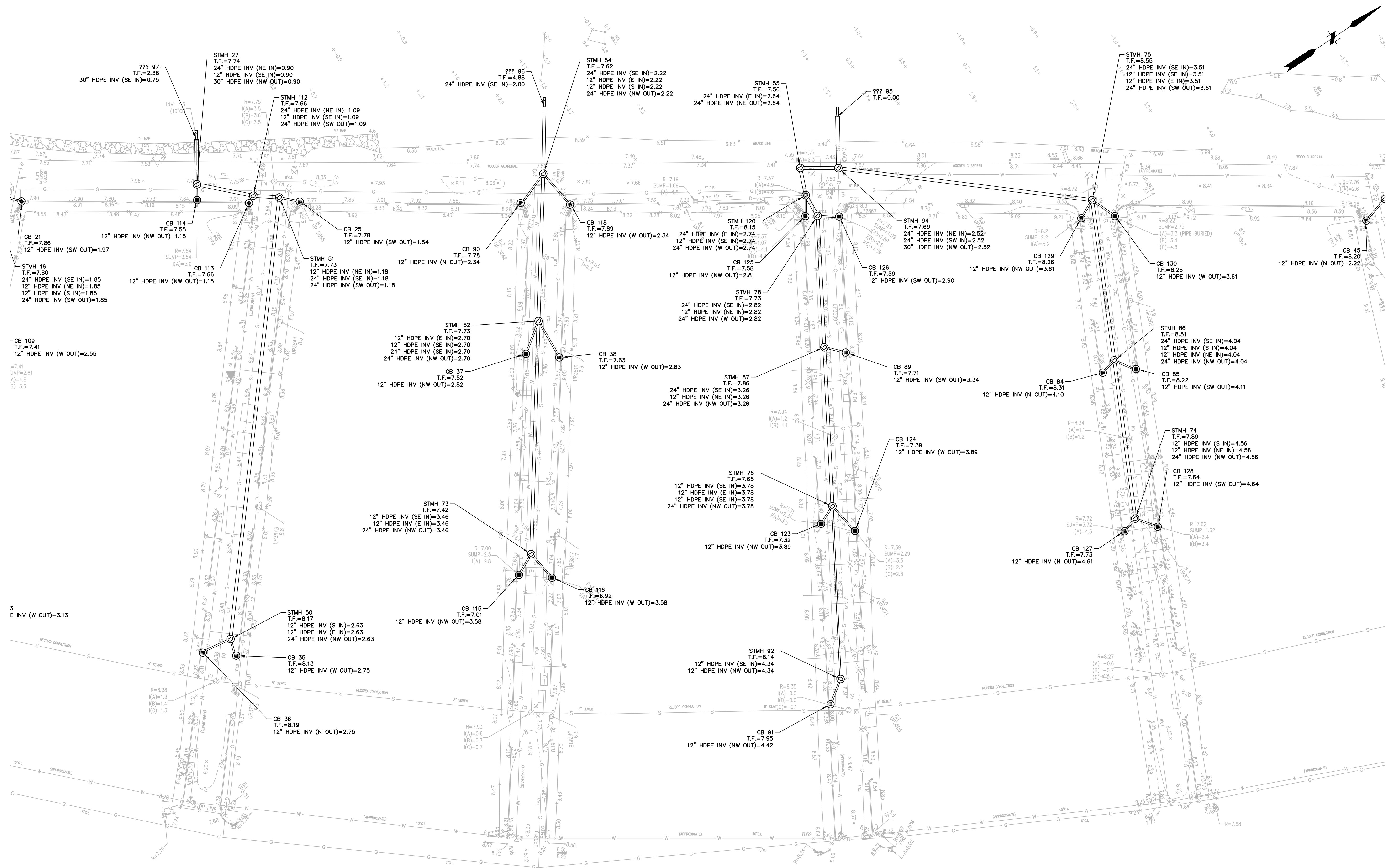
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LAYER STATE:

CS-101

DRAFT – NOT FOR CONSTRUCTION



DRAFT – NOT FOR CONSTRUCTION

PROJECT INFORMATION

PROJECT NO.: 20230160.R10

DATE: 06/23/2026

PROJECT NAME

RIVERSIDE NEIGHBORHOOD

DRAINAGE IMPROVEMENT CONCEPT PLANS

CONCEPT 1 - GRAVITY ONLY, SEVEN DISCHARGE POINTS

REVERSE

OWNER

MASSACHUSETTS

DESIGNER

FUSS & O'NEILL

1250 HANCOCK STREET, SUITE 815N

QUINCY, MA 02169

617.282.4675

www.fido.com

SCALE

HORIZ.: 1" = 30'

VERT.: -

DATUM:

HORIZ.: -

VERT.: -

0

15'

30'

45'

60'

GRAPHIC SCALE

SEAL

No.

DATE

DESCRIPTION

DESIGNER/REVIEWER

CS-102



CS-103

**FUSS &
O'NEILL**

1250 HANCOCK STREET, SUITE 815N
QUINCY, MA 02169
617.282.4675
www.fando.com

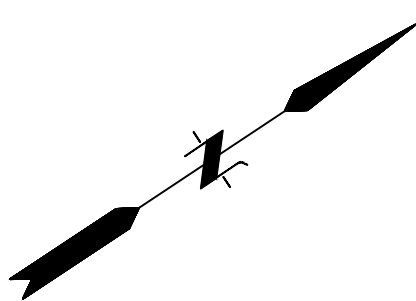
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	VERT.: -
DATUM:	
	HORZ.: -
	VERT.: -

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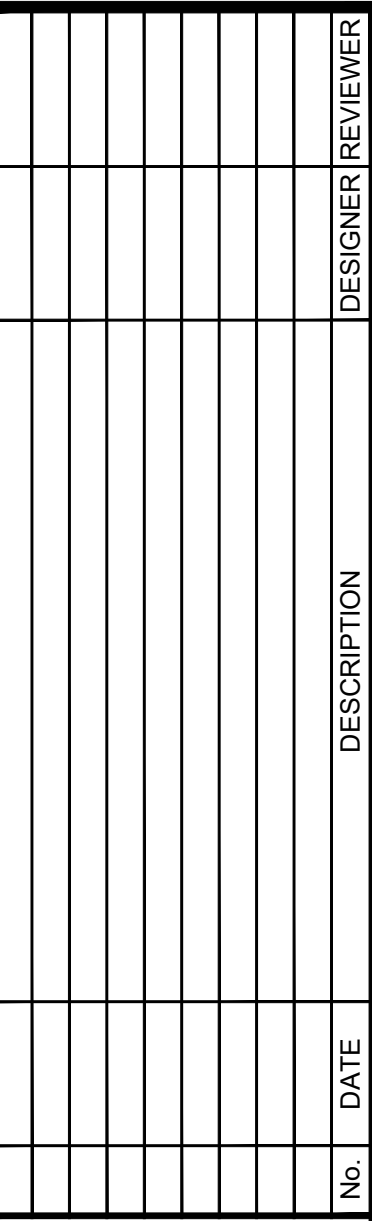
GRAPHIC SCALE

SEAL

[illegible]

CS-101

DRAFT – NOT FOR CONSTRUCTION

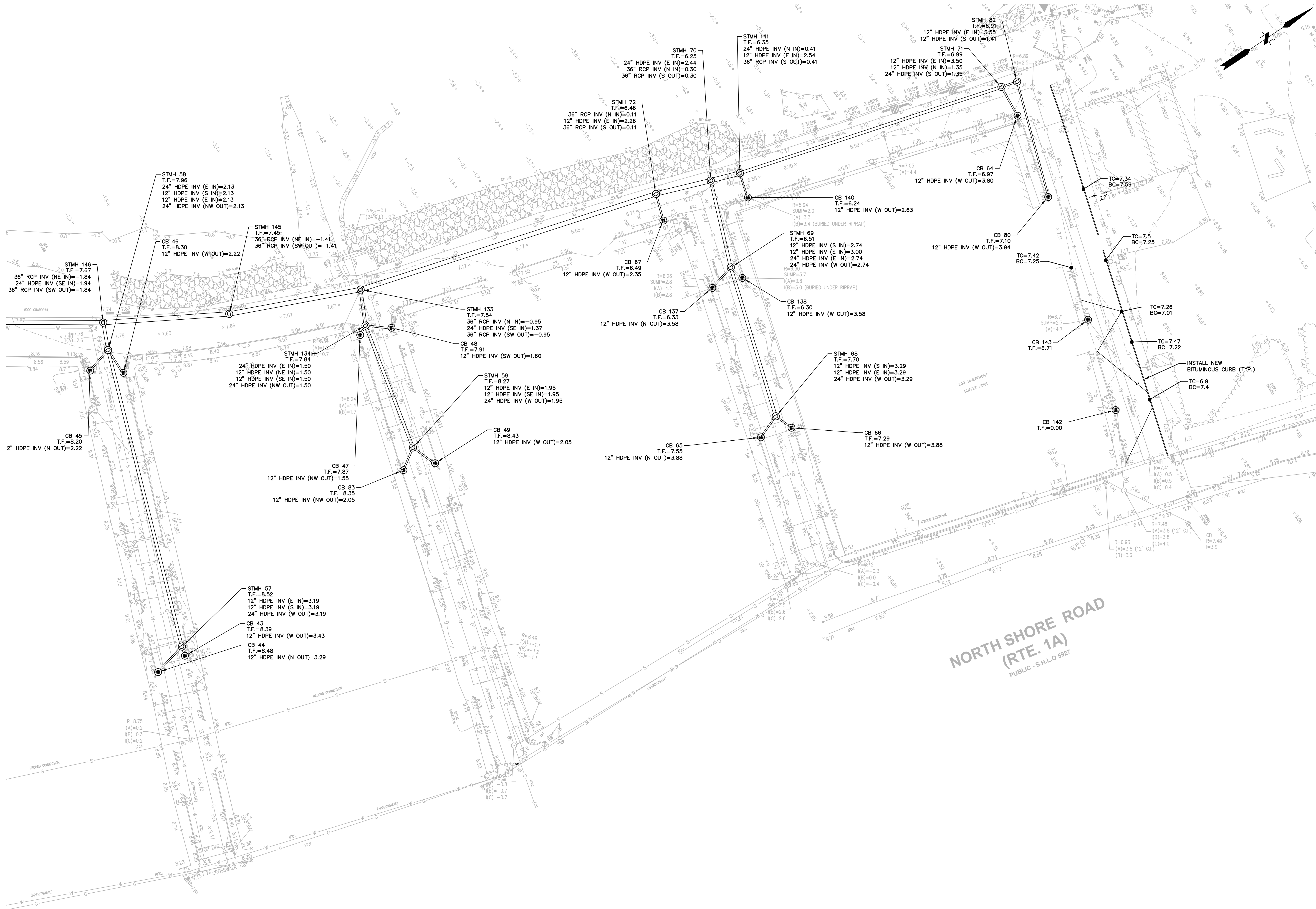


SCALE:	HORZ.: 1" = 30'
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DATUM:	
	HORZ.: -
	VERT.: -
	
GRAPHIC SCALE	

REVERE	CONCEPT 2 - GRAVITY SYSTEM WITH PUMP NEAR FRANK AVENUE	MASSACHUSETTS
--------	--	---------------

CS-102

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NORTH SHORE ROAD
(RTE. 1A)
PUBLIC - S.H.L.O 5927

RIVERSIDE NEIGHBORHOOD
DRAINAGE IMPROVEMENT CONCEPT PLANS
CONCEPT 2 - GRAVITY SYSTEM WITH PUMP NEAR
FRANK AVENUE
MASSACHUSETTS
REVERE

PROJ. No.: 20230160.R10
DATE: 06/23/2026

CS-103

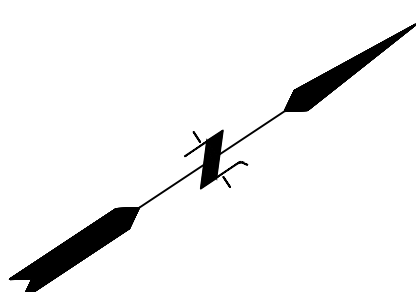
FUSS & O'NEILL
1250 HANCOCK STREET, SUITE 815N
QUINCY, MA 02169
617.262.4675
www.foss.com

SCALE:
HORIZ.: 1" = 30'
VERT.: -
DATUM:
HORIZ.: -
VERT.: -
GRAPHIC SCALE
0 15' 30' 60'

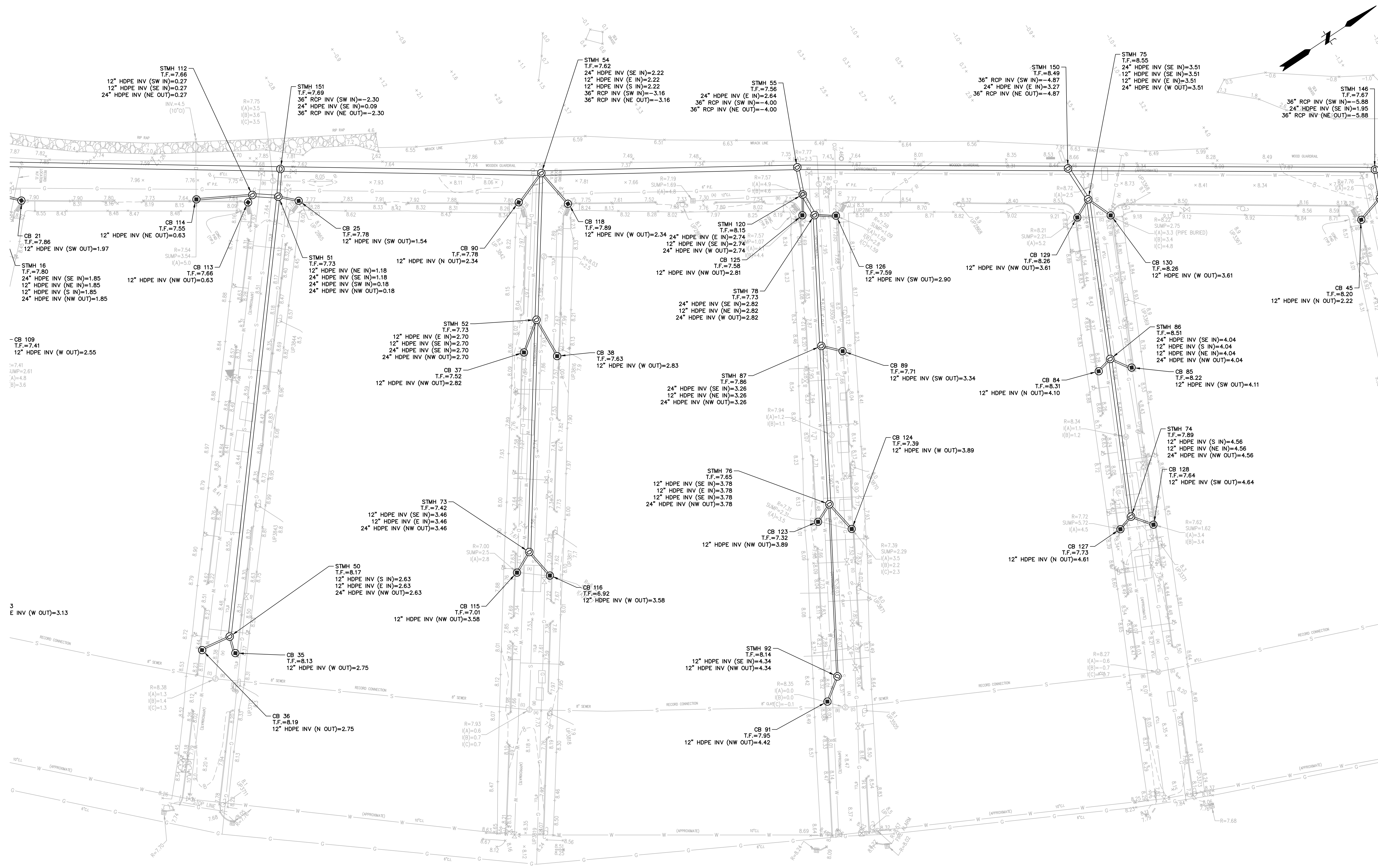
SEAL

No. DATE DESCRIPTION DESIGNER REVIEWER

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CS-101

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SEAL

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O'NEILL**

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QUINCY, MA 02169
617.282.4675
www.fando.com

RIVERSIDE NEIGHBORHOOD

DRAINAGE IMPROVEMENT CONCEPT PLANS

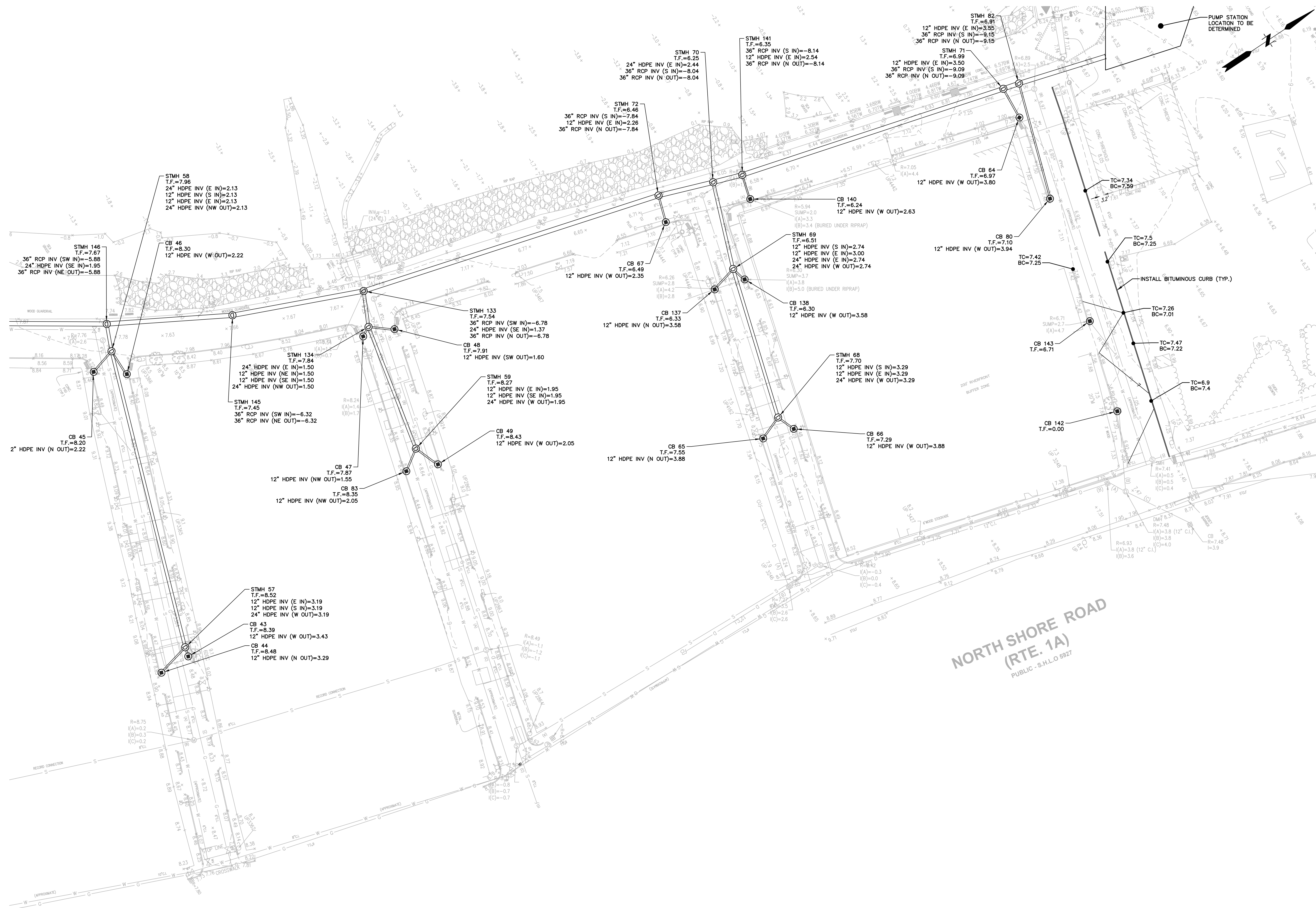
CONCEPT 3 - GRAVITY SYSTEM WITH PUMP NEAR
BOATWORKS PROPERTY

MASSACHUSETTS
REVERE

PROJ. No.: 20230160.R10
DATE: 06/23/2026

CS-102

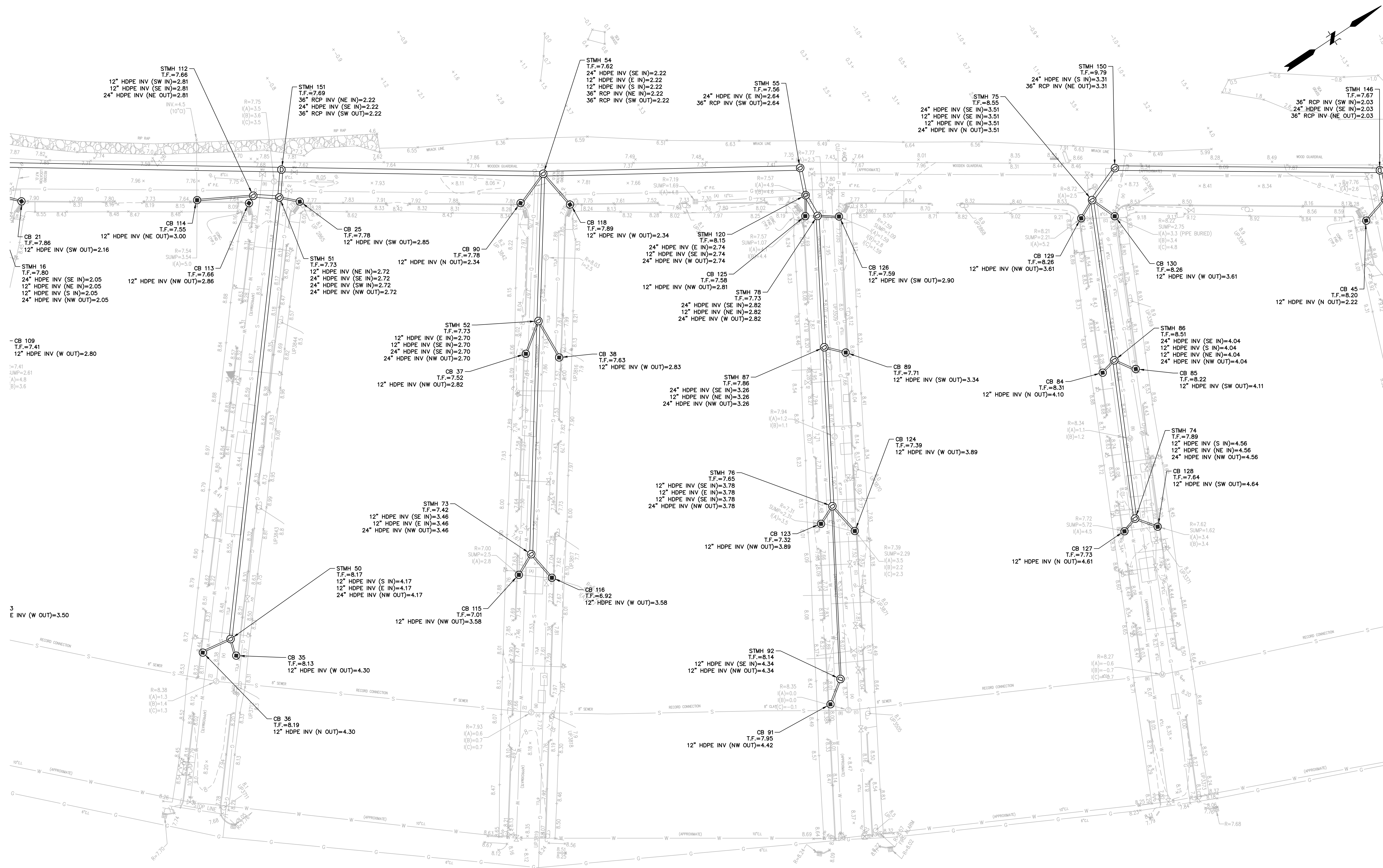
DRAFT – NOT FOR CONSTRUCTION



**NORTH SHORE ROAD
(RTE. 1A)
PUBLIC - S.H.L.O 5927**

DRAFT – NOT FOR CONSTRUCTION

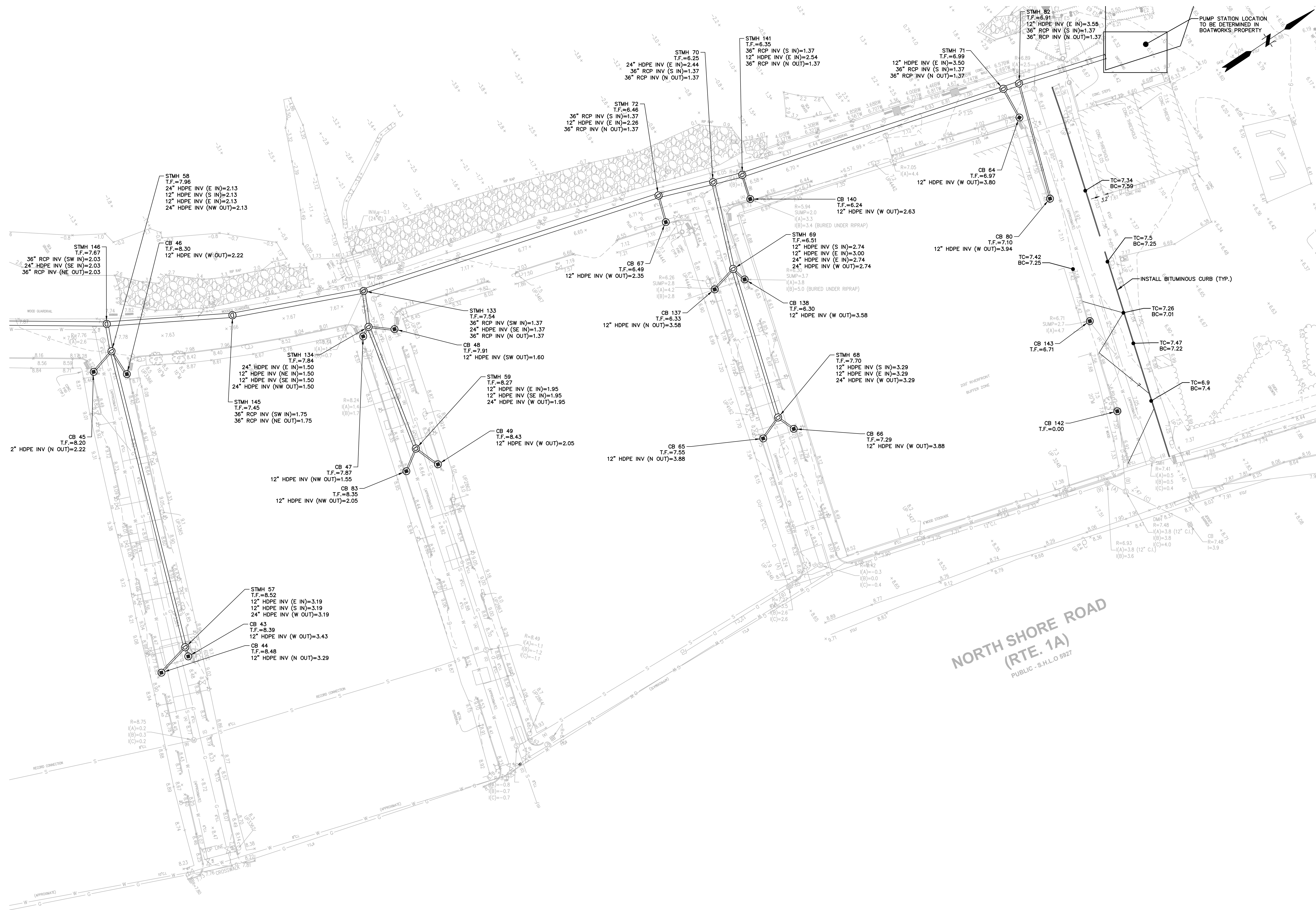
PROJ. No.: 20230160.R10 DATE: 06/23/2026 CS-103		RIVERSIDE NEIGHBORHOOD DRAINAGE IMPROVEMENT CONCEPT PLANS CONCEPT 3 - GRAVITY SYSTEM WITH PUMP NEAR BOATWORKS PROPERTY REVERSE MASSACHUSETTS		FUSS & O'NEILL 1250 HANCOCK STREET, SUITE 815N QUINCY, MA 02269 617.282.4675 www.fando.com		SCALE: HORIZ.: 1" = 30' VERT.: - DATUM: HORIZ.: - VERT.: - 0 15' 30' 60' GRAPHIC SCALE		SEAL		No. DATE DESCRIPTION DESIGNER REVIEWER	



PROJ. No.: 20230160.R10
DATE: 06/23/2026

CS-102

CS-102



DRAFT – NOT FOR CONSTRUCTION



NORTH SHORE ROAD
(RTE. 1A)
PUBLIC - S.H.L.O 5927

DESIGNER REVIEWER	
DESCRIPTION	
DATE	
No.	
SEAL	
SCALE: HORZ.: 1" = 30'	
VERT.: -	
DATUM: -	
VERT.: -	
GRAPHIC SCALE	
FUSS & O'NEILL 1250 HANCOCK STREET, SUITE 815N QUINCY, MA 02269 617.262.4675 www.fuss.com	
RIVERSIDE NEIGHBORHOOD DRAINAGE IMPROVEMENT CONCEPT PLANS CONCEPT 5 - GRAVITY SYSTEM WITH DISCHARGE NEAR BOATWORKS MASSACHUSETTS REVERSE	
PROJ. No.: 20230160.R10 DATE: 06/23/2026	
CS-103	

**Mills Avenue Neighborhood
Site Improvement Plans
Revere, MA**

Planning Level Construction Cost Estimate - Concept 5

Description	Unit of Measure	Unit Cost	Quantity	Total Cost
Drainage Construction Costs				
LAY AND INSTALL 12" HDPE DRAIN PIPE	FT	\$ 161.50	962	\$ 155,363.00
LAY AND INSTALL 24" HDPE DRAIN PIPE	FT	\$ 257.50	2,133	\$ 549,247.50
LAY AND INSTALL 36" RCP DRAIN PIPE	FT	\$ 401.50	2,283	\$ 916,624.50
FURNISH AND INSTALL CATCH BASIN	EA	\$ 5,500.00	61	\$ 335,500.00
FURNISH AND INSTALL STORM DRAIN MANHOLE	EA	\$ 6,000.00	48	\$ 288,000.00
DRAINAGE STRUCTURE REMOVED	EA	\$ 10,000.00	27	\$ 270,000.00
OUTFALL STRUCTURE	EA	\$ 85,000.00	1	\$ 85,000.00
TIDE GATE	EA	\$ 50,000.00	1	\$ 50,000.00
SET 6" GATE AND GATE BOX	EA	\$ 3,250.00	1	\$ 3,250.00
PUMP STATION ALLOWANCE	ALLOW	\$ 100,000.00	1	\$ 100,000.00
RELOCATION OF UTILITIES ALLOWANCE	ALLOW	\$ 500,000.00	1	\$ 500,000.00
Subtotal				\$3,252,985.00
Excavation Costs				
COMMON FILL	CY	\$ 10.00	1,000	\$ 10,000.00
CRUSHED STONE	CY	\$ 75.00	940	\$ 70,530.00
CLASS B TRENCH EXCAVATION	CY	\$ 50.00	125	\$ 6,250.00
TEST PITS	CY	\$ 150.00	100	\$ 15,000.00
Subtotal				\$101,780.00
Site Resotration Costs				
CURBING REMOVED AND RESET	FT	\$ 55.00	348	\$ 19,140.00
BITUMINOUS CURBING	FT	\$ 32.50	256	\$ 8,320.00
GRAVEL BORROW FOR SUBBASE	CY	\$ 55.00	5,852	\$ 321,846.35
TEMP PAVING (assumed 1")	TON	\$ 300.00	527	\$ 158,010.00
PAVEMENT STANDARD MILLING	SY	\$ 17.00	17,555	\$ 298,439.34
SUPERPAVE SURFACE COURSE - 12.5	TON	\$ 220.00	1,463	\$ 321,846.35
SUPERPAVE INTERMEDIATE COURSE - 12.5	TON	\$ 197.50	1,463	\$ 288,930.25
EROSION AND SEDIMENTATION CONTROLS	LS	\$ 10,000.00	1	\$ 10,000.00
Subtotal				\$1,426,532.30
Miscellaneous				
5% MOBILIZATION	LS	\$ 239,064.86	1	\$ 239,064.86
25% CONSTRUCTION CONTINGENCY	LS	\$1,255,090.54	1	\$ 1,255,090.54
Subtotal				\$1,494,155.40
TOTAL				\$6,275,453
			(Rounded)	\$6,275,500
Date: 11/21/25	Prepared By: LDH		Checked By: SDT	

Notes:

- 1) Construction cost estimate based on a compilation of recent bid tabulations for similar projects in Massachusetts within the last three years.

Appendix C – Existing Conditions H&H Analysis Figures



Legend

- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

MaxDepth(FT)

0.06 - 0.25
0.25 - 0.5
0.5 - 0.75
0.75 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 3

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Existing, 1-Year Storm, MHW

FUSS & O'NEILL





CB 3566

CB 1219

CB 4723

Legend

- Manhole
 - Catchbasin
 - Outfall
 - Conduits
- MaxDepth(FT)
- 0.06 - 0.25
 - 0.25 - 0.5
 - 0.5 - 0.75
 - 0.75 - 1.0
 - 1.0 - 1.5
 - 1.5 - 2.0
 - 2.0 - 3

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Existing, 1-Year Storm, MLW

FUSS & O'NEILL

0 150 300 Feet



Legend

- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

MaxDepth(FT)

0.06 - 0.25
0.25 - 0.5
0.5 - 0.75
0.75 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 3

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Existing, 2-Year Storm, MHW

FUSS & O'NEILL





Legend

- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

MaxDepth(FT)

0.06 - 0.25
0.25 - 0.5
0.5 - 0.75
0.75 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 3

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Existing, 2-Year Storm, MLW

FUSS & O'NEILL





Gibson Field

CB 4723

CB 1219

CB 3566

Legend

- Manhole
 - Catchbasin
 - ▲ Outfall
 - Conduits
- MaxDepth(FT)**
- 0.06 - 0.25
 - 0.25 - 0.5
 - 0.5 - 0.75
 - 0.75 - 1.0
 - 1.0 - 1.5
 - 1.5 - 2.0
 - 2.0 - 3

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Existing, 10-Year Storm, MHW

FUSS & O'NEILL

0 150 300 Feet



Gibson Field

CB 4723

CB 1219

CB 3566

Legend

- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

MaxDepth(FT)

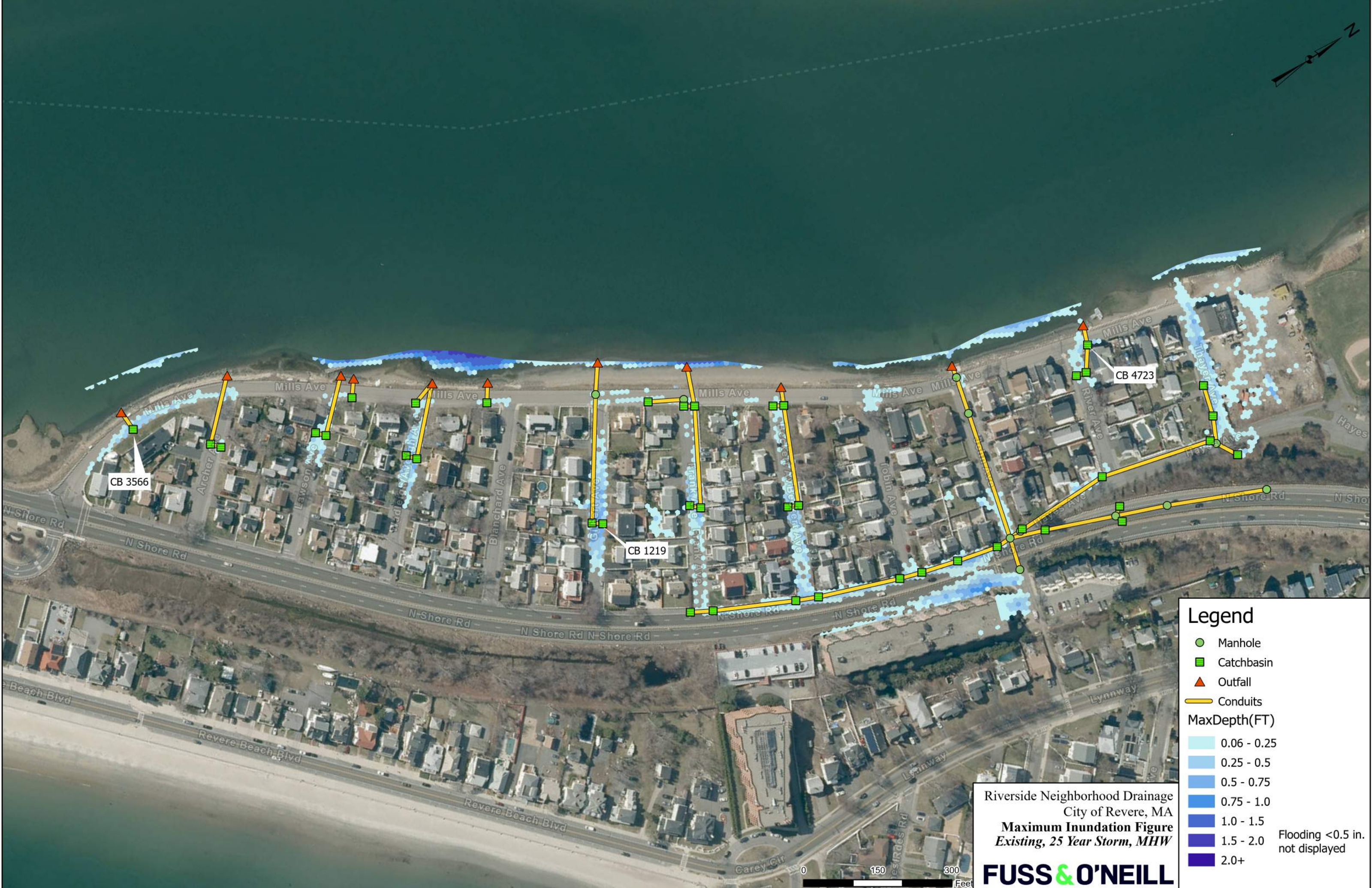
- 0.06 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Existing, 10-Year Storm, MLW

FUSS & O'NEILL

0 150 300 Feet



CB 3566

CB 1219

CB 4723

Legend

- Manhole
- Catchbasin
- Outfall
- Conduits

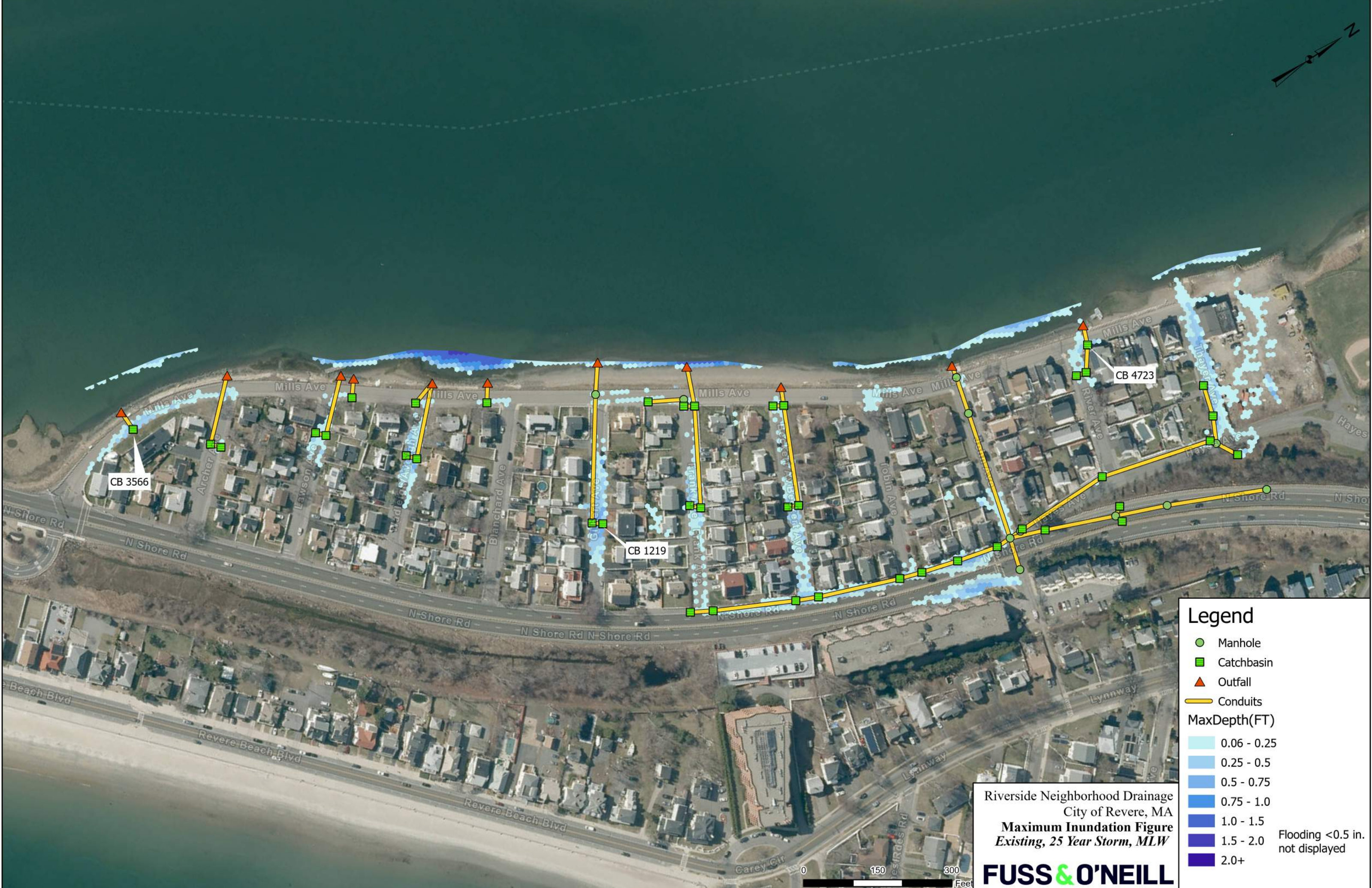
MaxDepth(FT)

0.06 - 0.25
0.25 - 0.5
0.5 - 0.75
0.75 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Existing, 25 Year Storm, MHW

FUSS & O'NEILL



Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Existing, 25 Year Storm, MLW

FUSS & O'NEILL

Legend

- Manhole
 - Catchbasin
 - Outfall
 - Conduits
- MaxDepth(FT)**
- 0.06 - 0.25
 - 0.25 - 0.5
 - 0.5 - 0.75
 - 0.75 - 1.0
 - 1.0 - 1.5
 - 1.5 - 2.0
 - 2.0+

Flooding <0.5 in.
not displayed



Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Existing, 1-Year Storm, MHW
2050
FUSS & O'NEILL

Legend

- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

MaxDepth(FT)

0.06 - 0.25
0.25 - 0.5
0.5 - 0.75
0.75 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0+

Flooding <0.5 in.
not displayed



Legend

- Manhole
- Catchbasin
- Outfall
- Conduits

MaxDepth(FT)

0.06 - 0.25
0.25 - 0.5
0.5 - 0.75
0.75 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Existing, 1-Year Storm, MHW
2070
FUSS & O'NEILL



Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Existing, 2-Year Storm, MHW
2050
FUSS & O'NEILL

Legend

- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

MaxDepth(FT)

0.06 - 0.25
0.25 - 0.5
0.5 - 0.75
0.75 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0+

Flooding <0.5 in.
not displayed



Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Existing, 2-Year Storm, MHW
2070
FUSS & O'NEILL

Legend

- Manhole
 - Catchbasin
 - Outfall
 - Conduits
- MaxDepth(FT)**
- 0.06 - 0.25
 - 0.25 - 0.5
 - 0.5 - 0.75
 - 0.75 - 1.0
 - 1.0 - 1.5
 - 1.5 - 2.0
 - 2.0+

Flooding <0.5 in.
not displayed



Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Existing, 10-Year Storm, MHW
2050
FUSS & O'NEILL

Legend

- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

MaxDepth(FT)

- 0.06 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0+

Flooding <0.5 in.
not displayed



Legend

- Manhole
- Catchbasin
- Outfall
- Conduits

MaxDepth(FT)

0.06 - 0.25
0.25 - 0.5
0.5 - 0.75
0.75 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Existing, 10-Year Storm, MHW
2070
FUSS & O'NEILL



Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Existing, 25 Year Storm, MHW
2050
FUSS & O'NEILL

Legend

- Manhole
- Catchbasin
- Outfall
- Conduits

MaxDepth(FT)

0.06 - 0.25	Flooding <0.5 in. not displayed
0.25 - 0.5	
0.5 - 0.75	
0.75 - 1.0	
1.0 - 1.5	
1.5 - 2.0	
2.0+	



Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Existing, 25 Year Storm, MHW
2070
FUSS & O'NEILL

Legend

- Manhole
- Catchbasin
- Outfall
- Conduits

MaxDepth(FT)

0.06 - 0.25
0.25 - 0.5
0.5 - 0.75
0.75 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0+

Flooding <0.5 in.
not displayed

Appendix D – Gravity Only H&H Analysis Figures



Legend

- Manhole
- Catchbasin
- Outfall
- Conduits

MaxDepth(FT)

0.06 - 0.25
0.25 - 0.5
0.5 - 0.75
0.75 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Prop Gravity, 1-Year Storm, MLW

FUSS & O'NEILL



Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Prop Gravity, 1-Year Storm, MHW

FUSS & O'NEILL

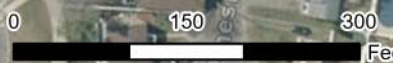
Legend

- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

MaxDepth(FT)

- 0.06 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0+

Flooding <0.5 in.
not displayed





Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Prop Gravity, 2-Year Storm, MLW

FUSS & O'NEILL

Legend

- Manhole
 - Catchbasin
 - ▲ Outfall
 - Conduits
- MaxDepth(FT)**
- 0.06 - 0.25
 - 0.25 - 0.5
 - 0.5 - 0.75
 - 0.75 - 1.0
 - 1.0 - 1.5
 - 1.5 - 2.0
 - 2.0+

Flooding <0.5 in.
not displayed



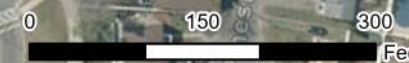
Legend

- Manhole
 - Catchbasin
 - ▲ Outfall
 - Conduits
- MaxDepth(FT)**
- 0.06 - 0.25
 - 0.25 - 0.5
 - 0.5 - 0.75
 - 0.75 - 1.0
 - 1.0 - 1.5
 - 1.5 - 2.0
 - 2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Prop Gravity, 2-Year Storm, MHW

FUSS & O'NEILL





Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Prop Gravity, 10-Year Storm, MLW

FUSS & O'NEILL

Legend

- Manhole
 - Catchbasin
 - ▲ Outfall
 - Conduits
- MaxDepth(FT)**
- 0.06 - 0.25
 - 0.25 - 0.5
 - 0.5 - 0.75
 - 0.75 - 1.0
 - 1.0 - 1.5
 - 1.5 - 2.0
 - 2.0+

Flooding <0.5 in.
not displayed



CB 3566

CB 1219

CB 4723

Legend

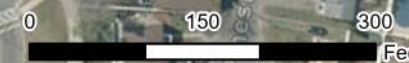
- Manhole
- Catchbasin
- Outfall
- Conduits

MaxDepth(FT)

0.06 - 0.25
0.25 - 0.5
0.5 - 0.75
0.75 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Prop Gravity, 10-Year Storm, MHW
FUSS & O'NEILL





Legend

- Manhole
 - Catchbasin
 - ▲ Outfall
 - Conduits
- MaxDepth(FT)**
- 0.06 - 0.25
 - 0.25 - 0.5
 - 0.5 - 0.75
 - 0.75 - 1.0
 - 1.0 - 1.5
 - 1.5 - 2.0
 - 2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Prop Gravity, 25-Year Storm, MLW

FUSS & O'NEILL



Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Prop Gravity, 25-Year Storm, MHW

FUSS & O'NEILL

Legend

- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

MaxDepth(FT)

- 0.06 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0+

Flooding <0.5 in.
not displayed



Legend

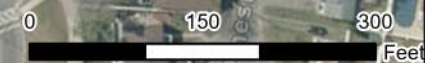
- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

MaxDepth(FT)

- 0.06 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Prop Gravity, 1Year Storm, MHW
2050
FUSS & O'NEILL





Legend

- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

MaxDepth(FT)

- 0.06 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Prop Gravity, 1 Year Storm, MHW
2070

FUSS & O'NEILL



Legend

- Manhole
- Catchbasin
- Outfall
- Conduits

MaxDepth(FT)

0.06 - 0.25
0.25 - 0.5
0.5 - 0.75
0.75 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0+

Flooding <0.5 in. not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Prop Gravity, 2-Year Storm, MHW
2050
FUSS & O'NEILL



Legend

- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

MaxDepth(FT)

- 0.06 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Prop Gravity, 2 Year Storm, MHW
2070

FUSS & O'NEILL



Legend

- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

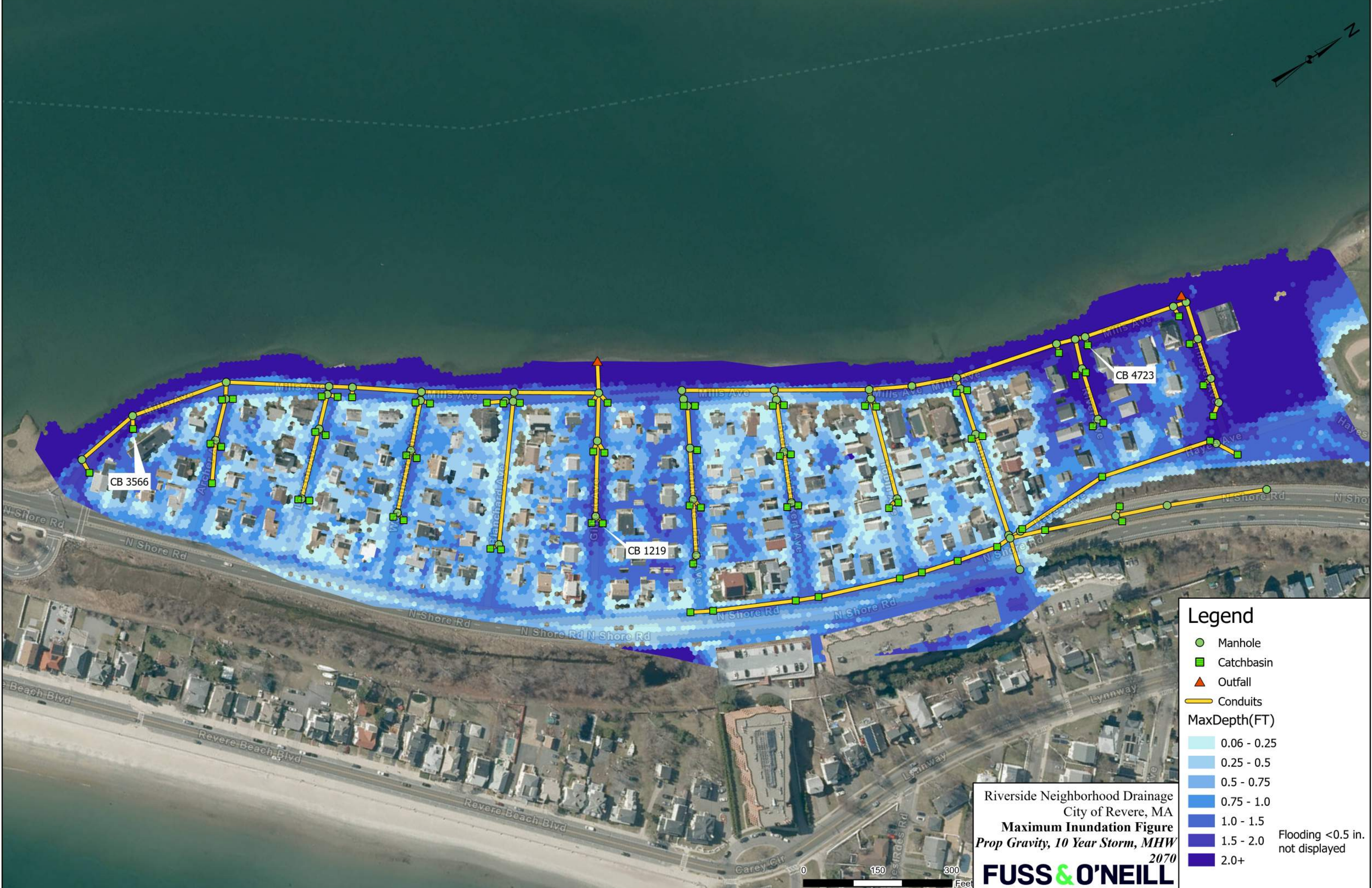
MaxDepth(FT)

- 0.06 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Prop Gravity, 10-Year Storm, MHW
2050

FUSS & O'NEILL



Legend

- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

MaxDepth(FT)

- 0.06 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Prop Gravity, 10 Year Storm, MHW
2070

FUSS & O'NEILL



Legend

- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

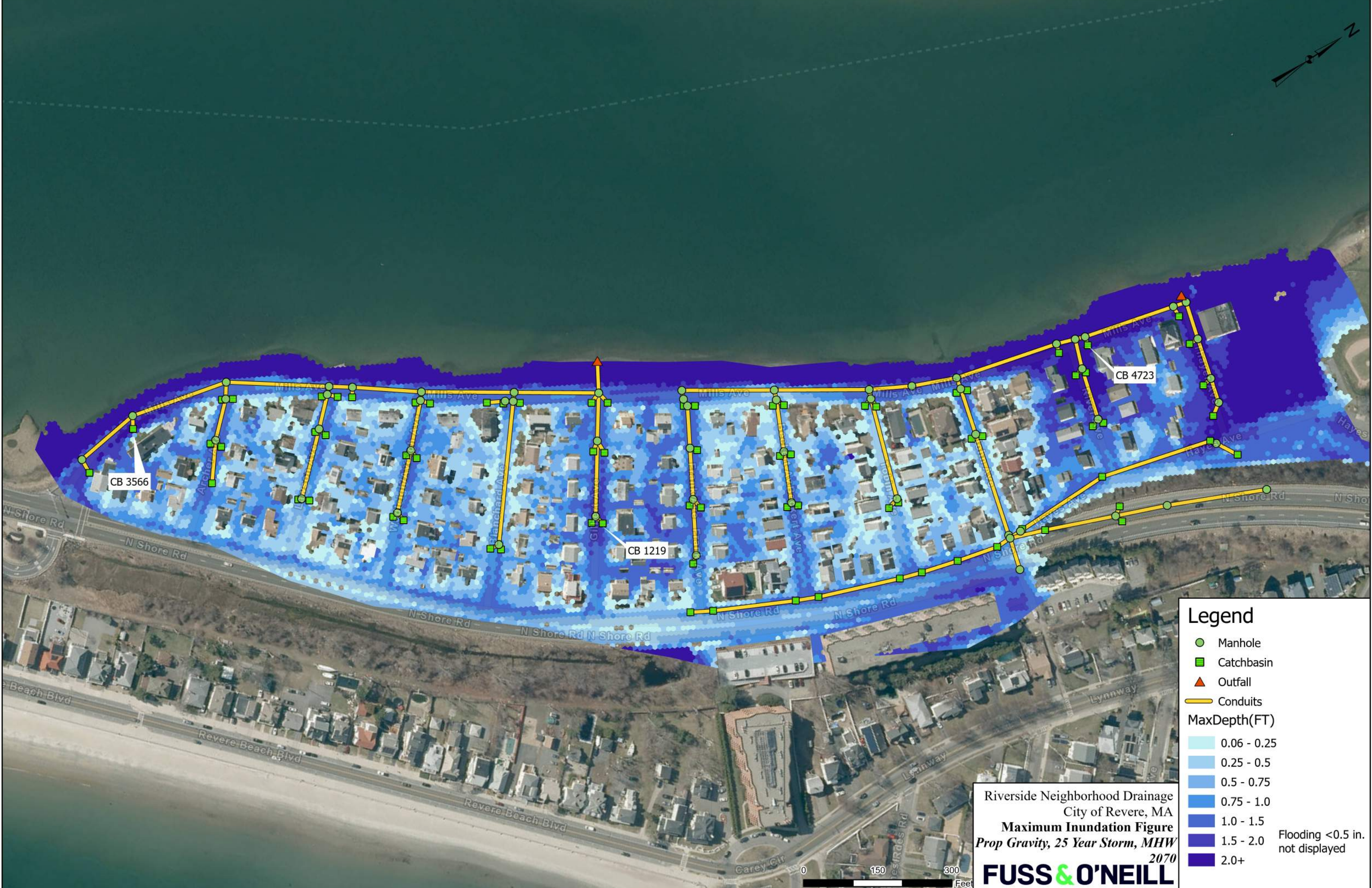
MaxDepth(FT)

- 0.06 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Prop Gravity, 25-Year Storm, MHW
2050

FUSS & O'NEILL



Legend

- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

MaxDepth(FT)

- 0.06 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Prop Gravity, 25 Year Storm, MHW
2070

FUSS & O'NEILL

Appendix E – Proposed Pump and Berm H&H Analysis Figures



Legend

- Manhole
- Catchbasin
- Outfall
- Conduits

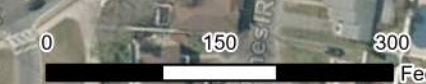
MaxDepth(FT)

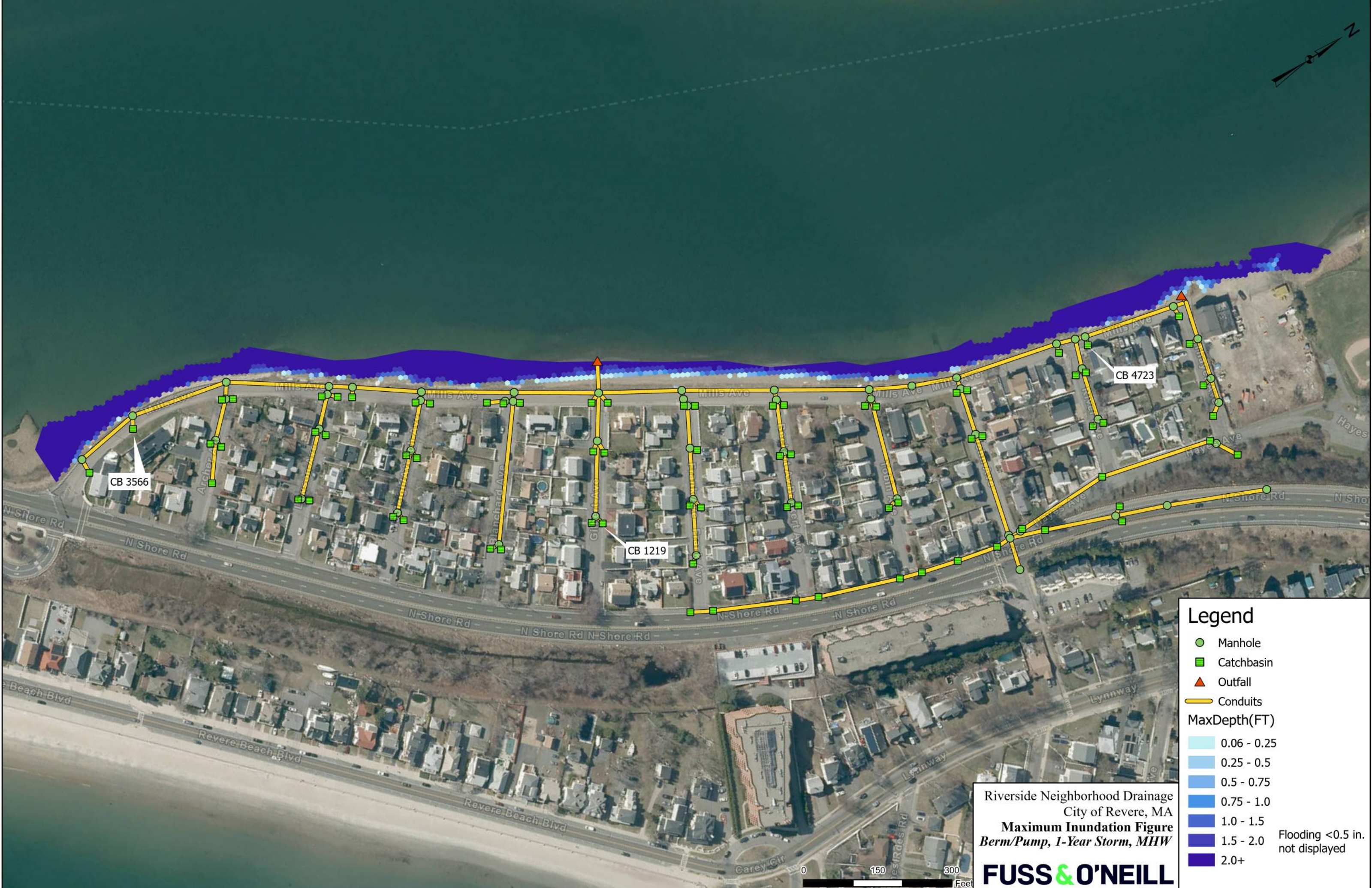
0.06 - 0.25
0.25 - 0.5
0.5 - 0.75
0.75 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Berm/Pump, 1-Year Storm, MLW

FUSS & O'NEILL





Legend

- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

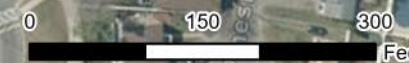
MaxDepth(FT)

- 0.06 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Berm/Pump, 1-Year Storm, MHW

FUSS & O'NEILL





Legend

- Manhole
- Catchbasin
- Outfall
- Conduits

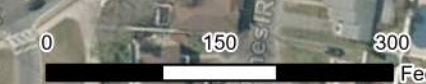
MaxDepth(FT)

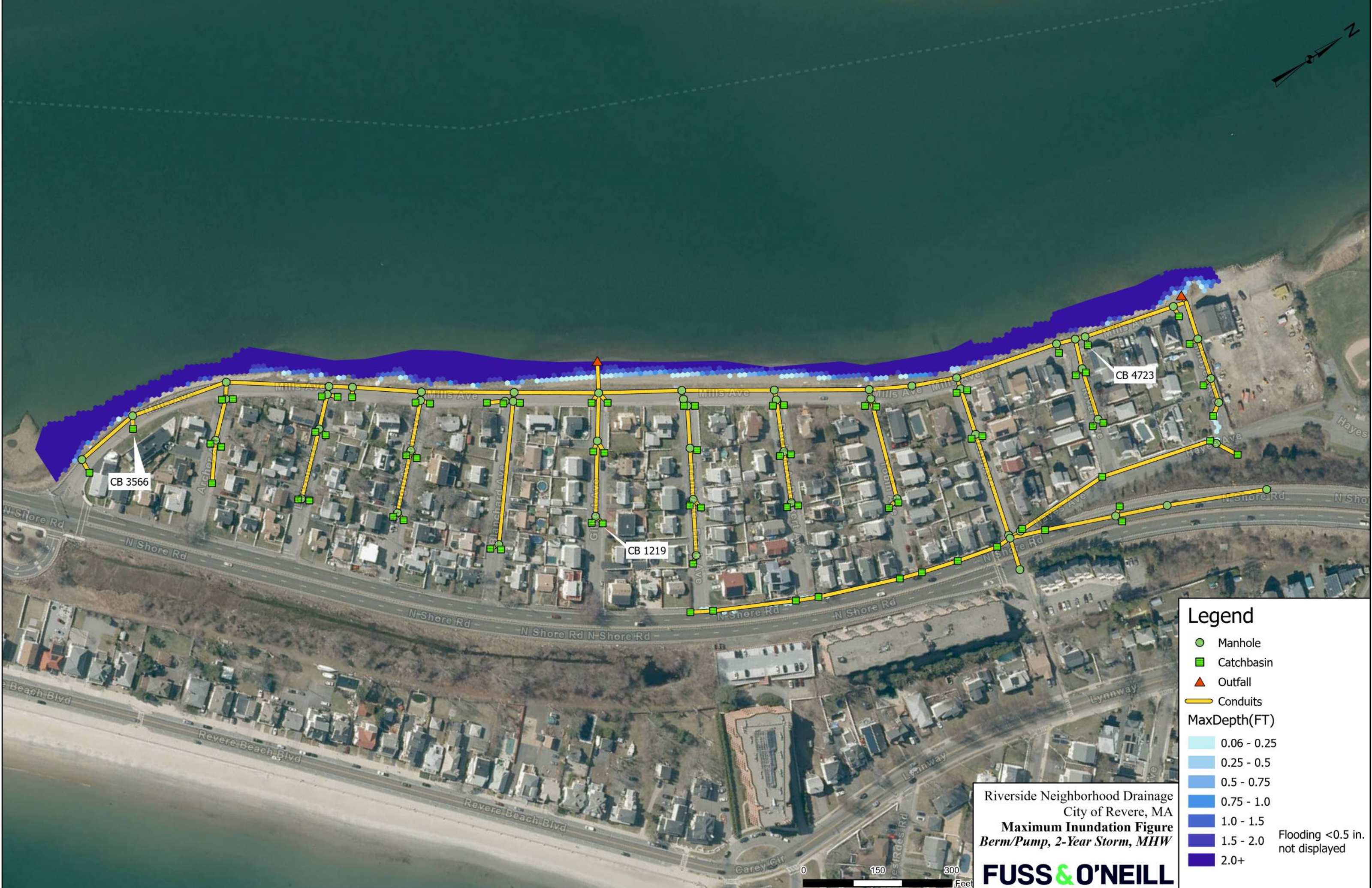
0.06 - 0.25
0.25 - 0.5
0.5 - 0.75
0.75 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Berm/Pump, 2-Year Storm, MLW

FUSS & O'NEILL





Legend

- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

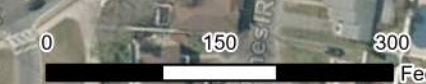
MaxDepth(FT)

0.06 - 0.25
0.25 - 0.5
0.5 - 0.75
0.75 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Berm/Pump, 2-Year Storm, MHW

FUSS & O'NEILL





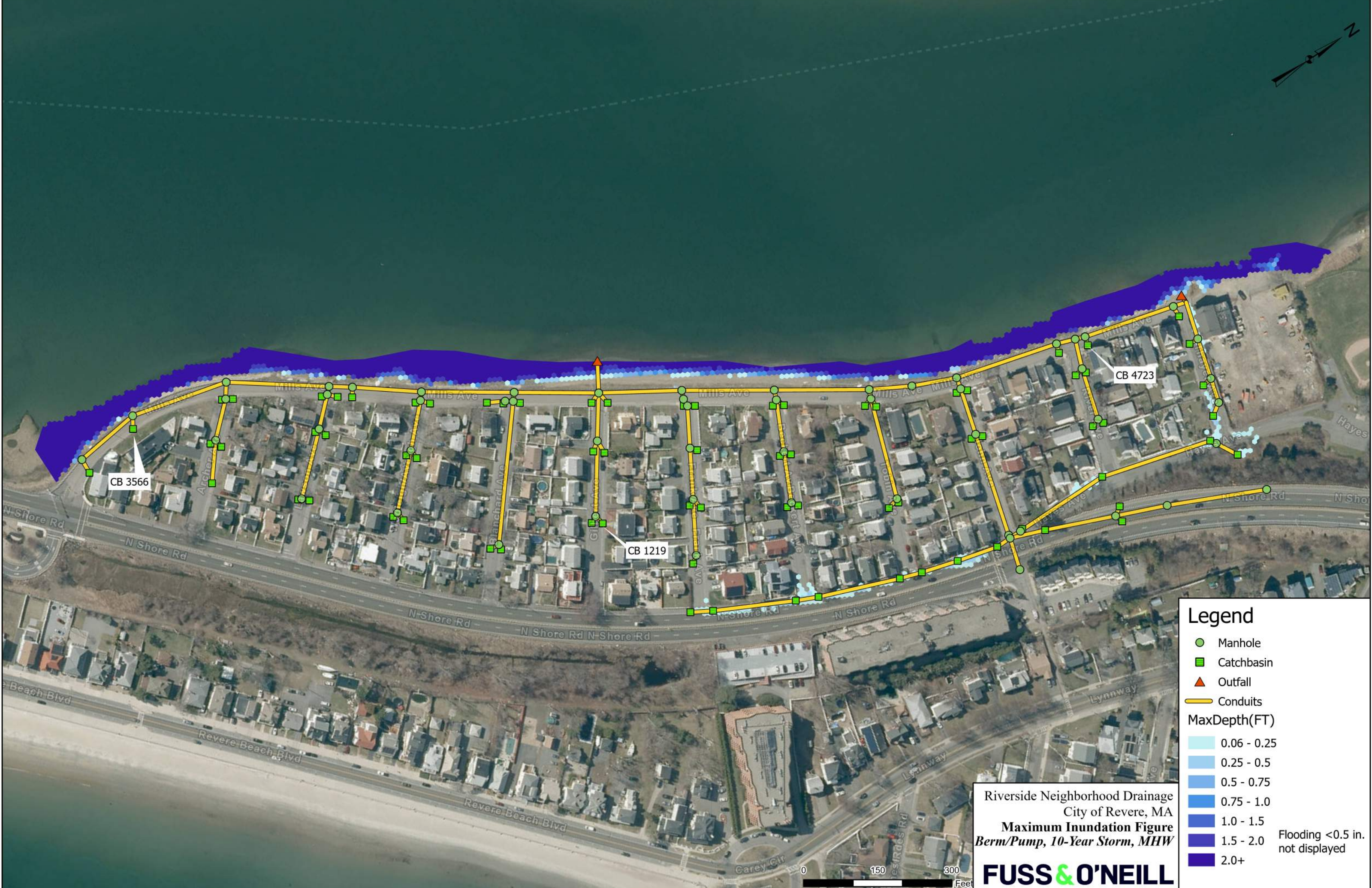
Legend

- Manhole
 - Catchbasin
 - ▲ Outfall
 - Conduits
- MaxDepth(FT)**
- 0.06 - 0.25
 - 0.25 - 0.5
 - 0.5 - 0.75
 - 0.75 - 1.0
 - 1.0 - 1.5
 - 1.5 - 2.0
 - 2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Berm/Pump, 10-Year Storm, MLW

FUSS & O'NEILL



Legend

- Manhole
- Catchbasin
- Outfall
- Conduits

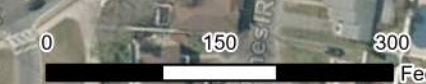
MaxDepth(FT)

0.06 - 0.25
0.25 - 0.5
0.5 - 0.75
0.75 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Berm/Pump, 10-Year Storm, MHW

FUSS & O'NEILL





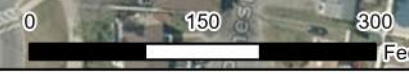
Legend

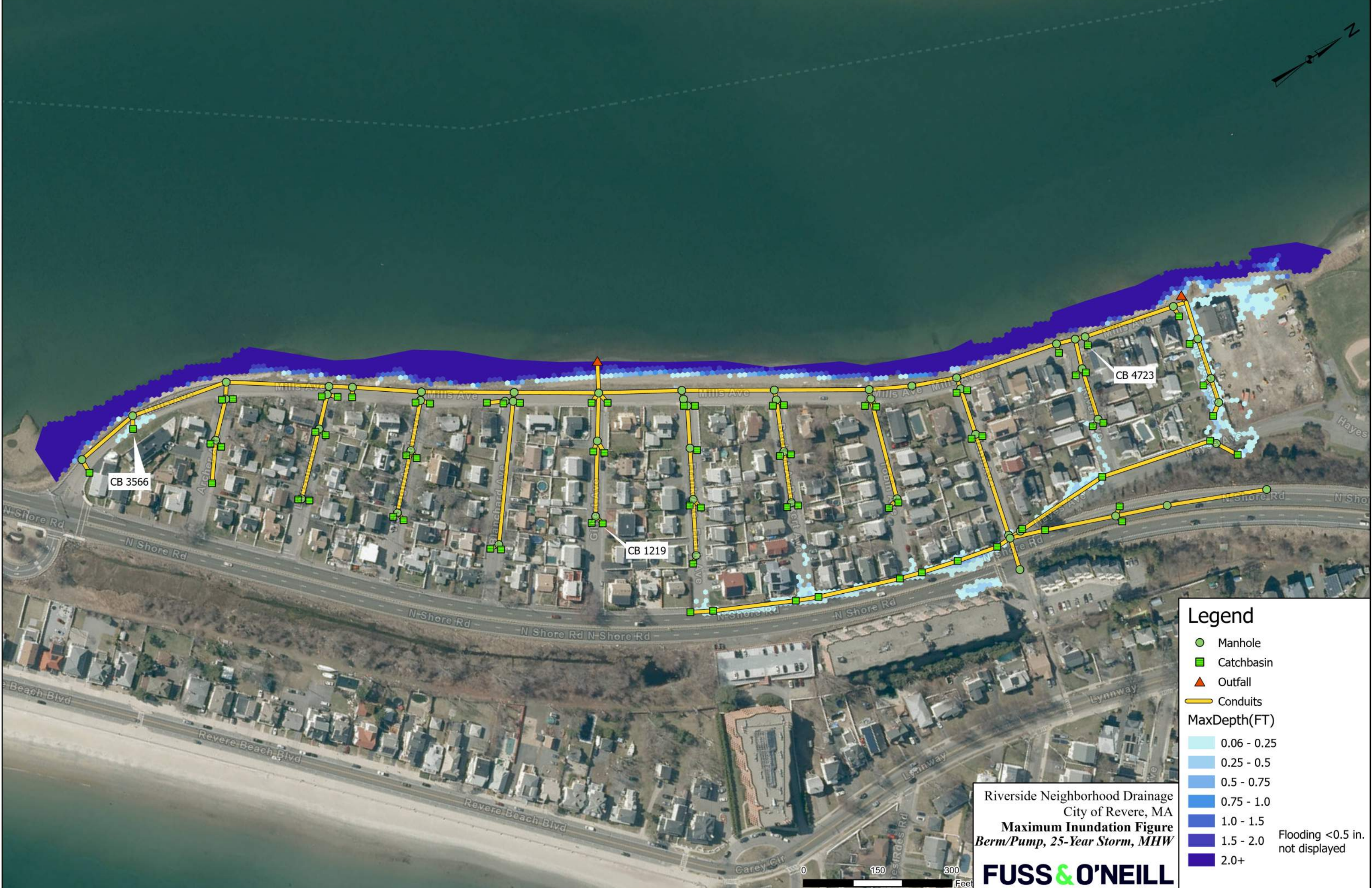
- Manhole
 - Catchbasin
 - ▲ Outfall
 - Conduits
- MaxDepth(FT)**
- 0.06 - 0.25
 - 0.25 - 0.5
 - 0.5 - 0.75
 - 0.75 - 1.0
 - 1.0 - 1.5
 - 1.5 - 2.0
 - 2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Berm/Pump, 25-Year Storm, MLW

FUSS & O'NEILL





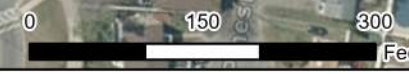
Legend

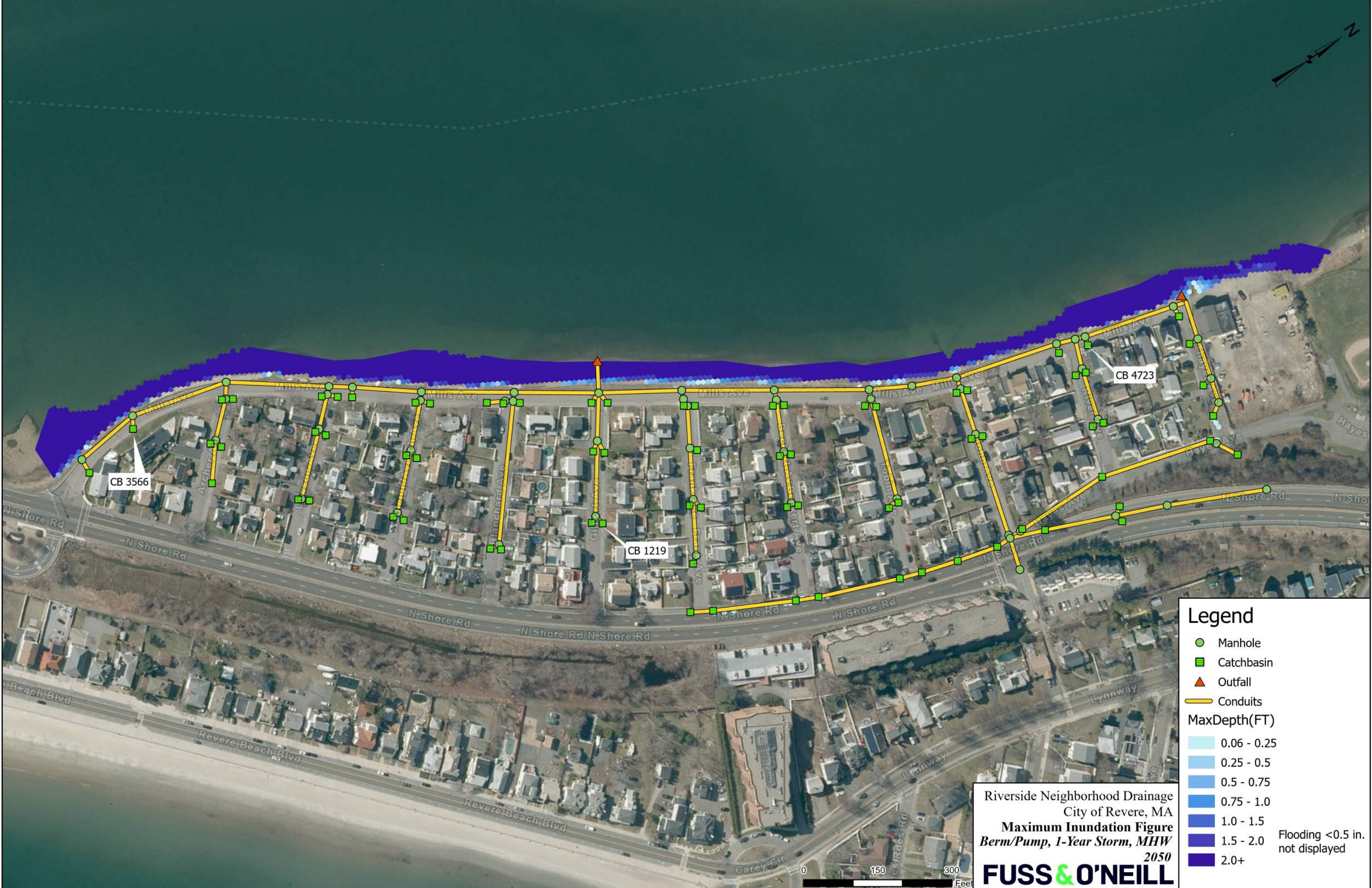
- Manhole
 - Catchbasin
 - ▲ Outfall
 - Conduits
- MaxDepth(FT)**
- 0.06 - 0.25
 - 0.25 - 0.5
 - 0.5 - 0.75
 - 0.75 - 1.0
 - 1.0 - 1.5
 - 1.5 - 2.0
 - 2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Berm/Pump, 25-Year Storm, MHW

FUSS & O'NEILL





Legend

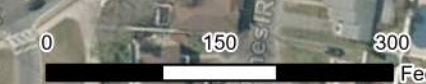
- Manhole
- Catchbasin
- Outfall
- Conduits

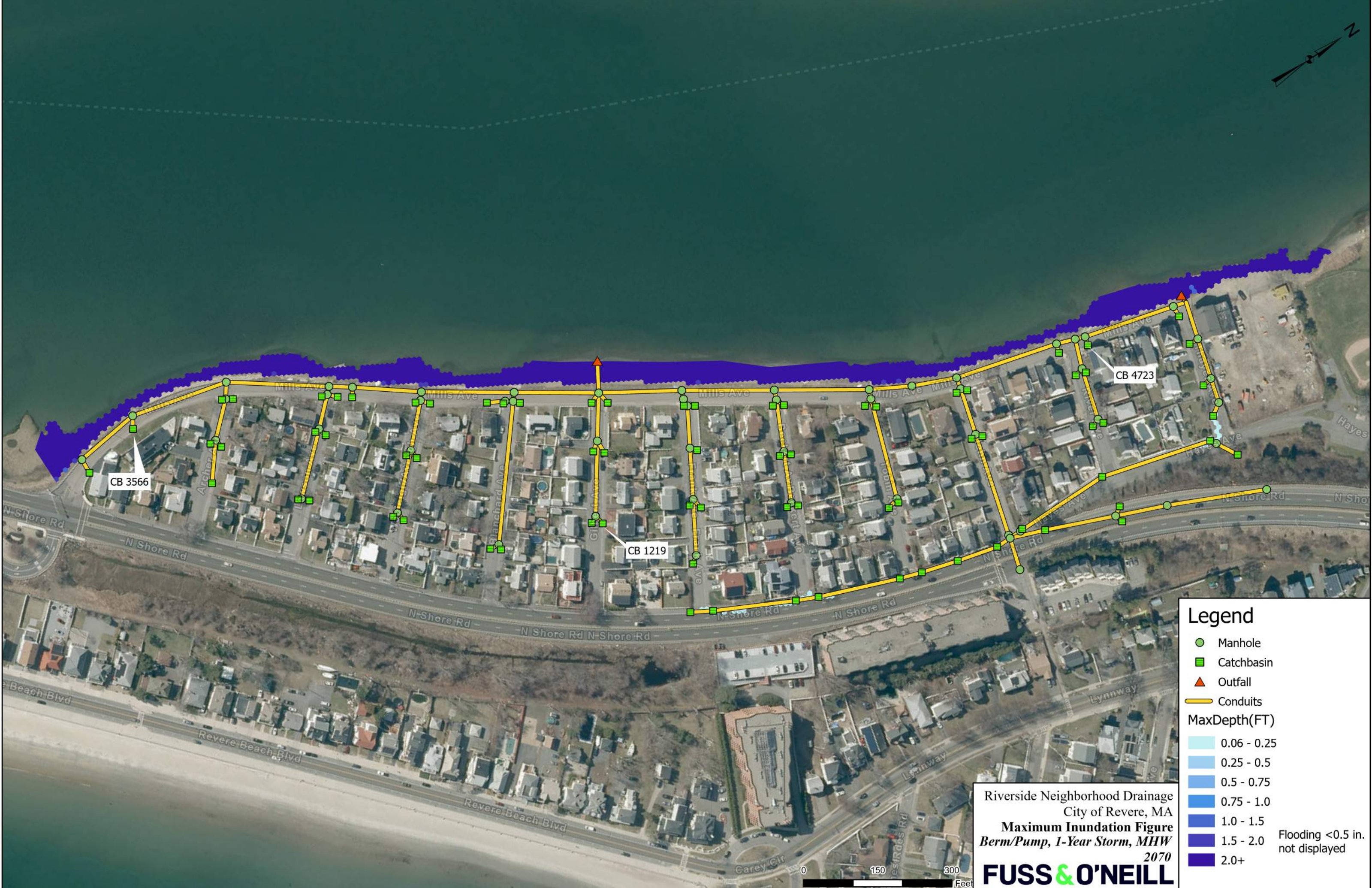
MaxDepth(FT)

0.06 - 0.25
0.25 - 0.5
0.5 - 0.75
0.75 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0+

Flooding <0.5 in. not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Berm/Pump, 1-Year Storm, MHW
2050
FUSS & O'NEILL





Legend

- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

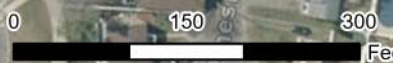
MaxDepth(FT)

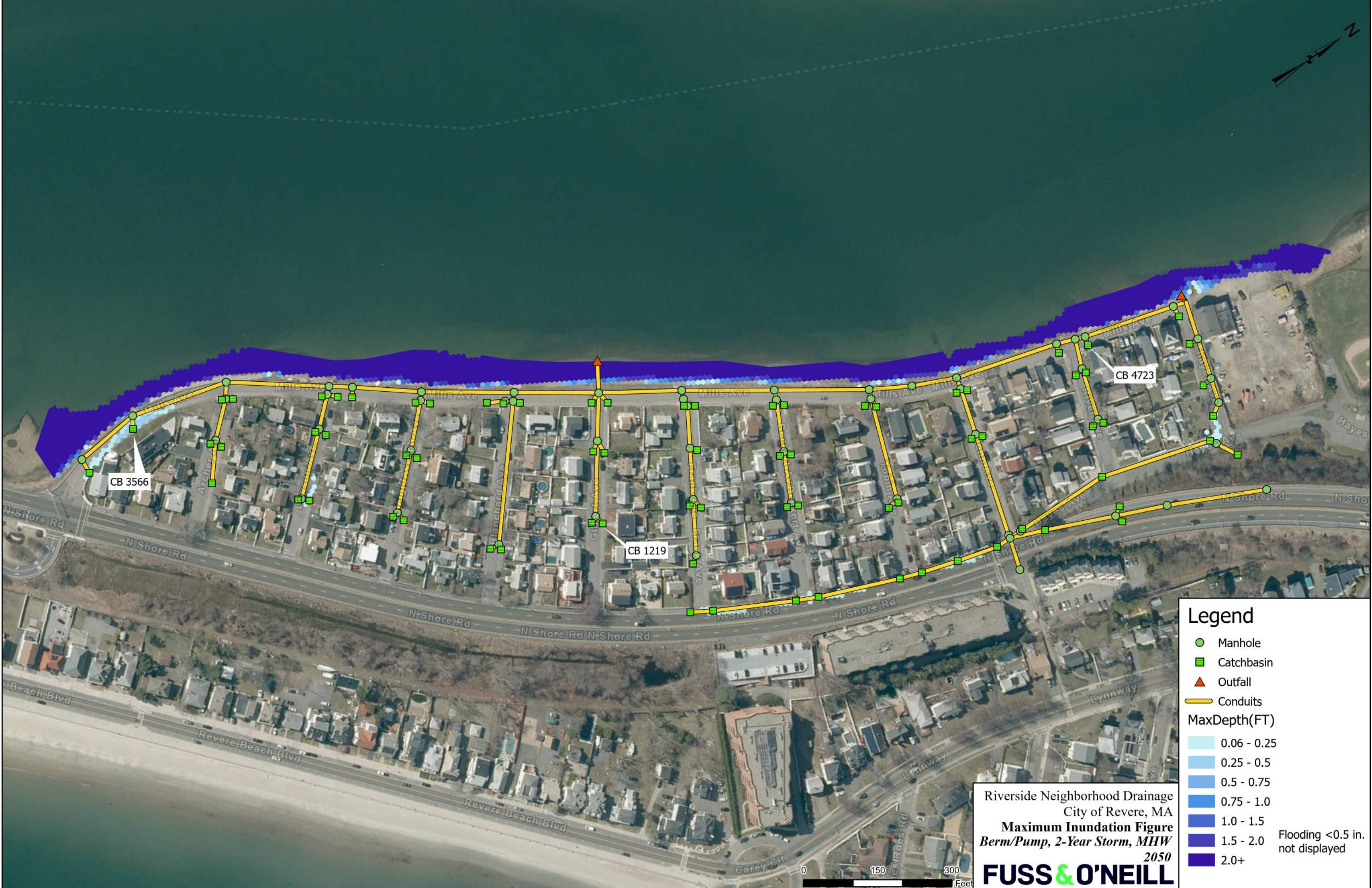
- 0.06 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Berm/Pump, 1-Year Storm, MHW
2070

FUSS & O'NEILL





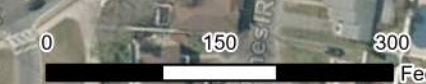
Legend

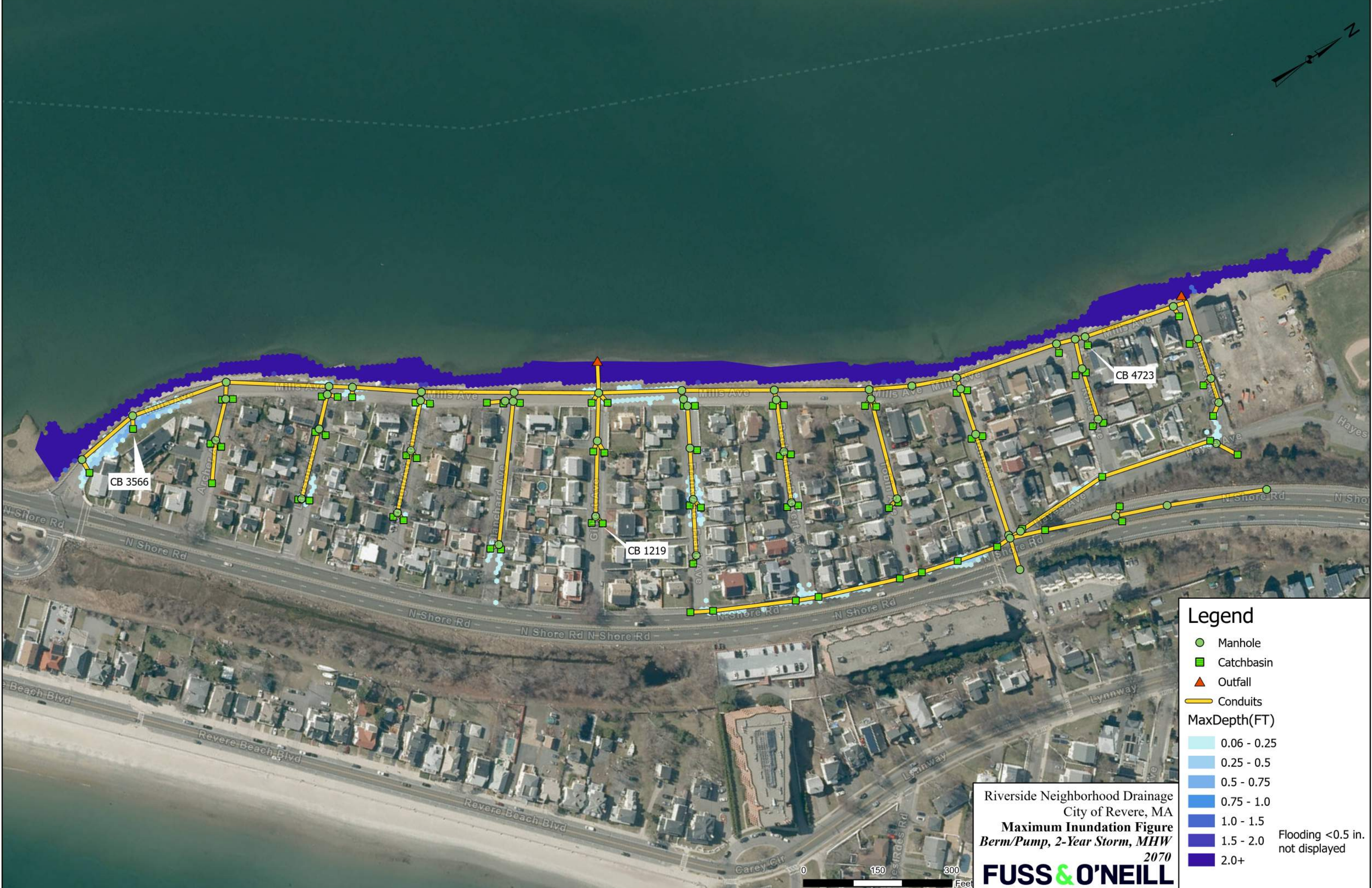
- Manhole
- Catchbasin
- Outfall
- Conduits

MaxDepth(FT)

0.06 - 0.25	Flooding <0.5 in. not displayed
0.25 - 0.5	
0.5 - 0.75	
0.75 - 1.0	
1.0 - 1.5	
1.5 - 2.0	
2.0+	

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Berm/Pump, 2-Year Storm, MHW
2050
FUSS & O'NEILL





Legend

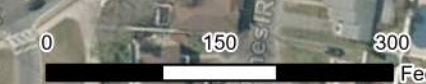
- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

MaxDepth(FT)

0.06 - 0.25
0.25 - 0.5
0.5 - 0.75
0.75 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Berm/Pump, 2-Year Storm, MHW
2070
FUSS & O'NEILL





CB 3566

CB 1219

CB 4723

Legend

- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

MaxDepth(FT)

- 0.06 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Berm/Pump, 10-Year Storm, MHW
2050

FUSS & O'NEILL

0 150 300 Feet



Legend

- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

MaxDepth(FT)

0.06 - 0.25
0.25 - 0.5
0.5 - 0.75
0.75 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Berm/Pump, 10-Year Storm, MHW
2070
FUSS & O'NEILL



CB 3566

CB 1219

CB 4723

Legend

- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

MaxDepth(FT)

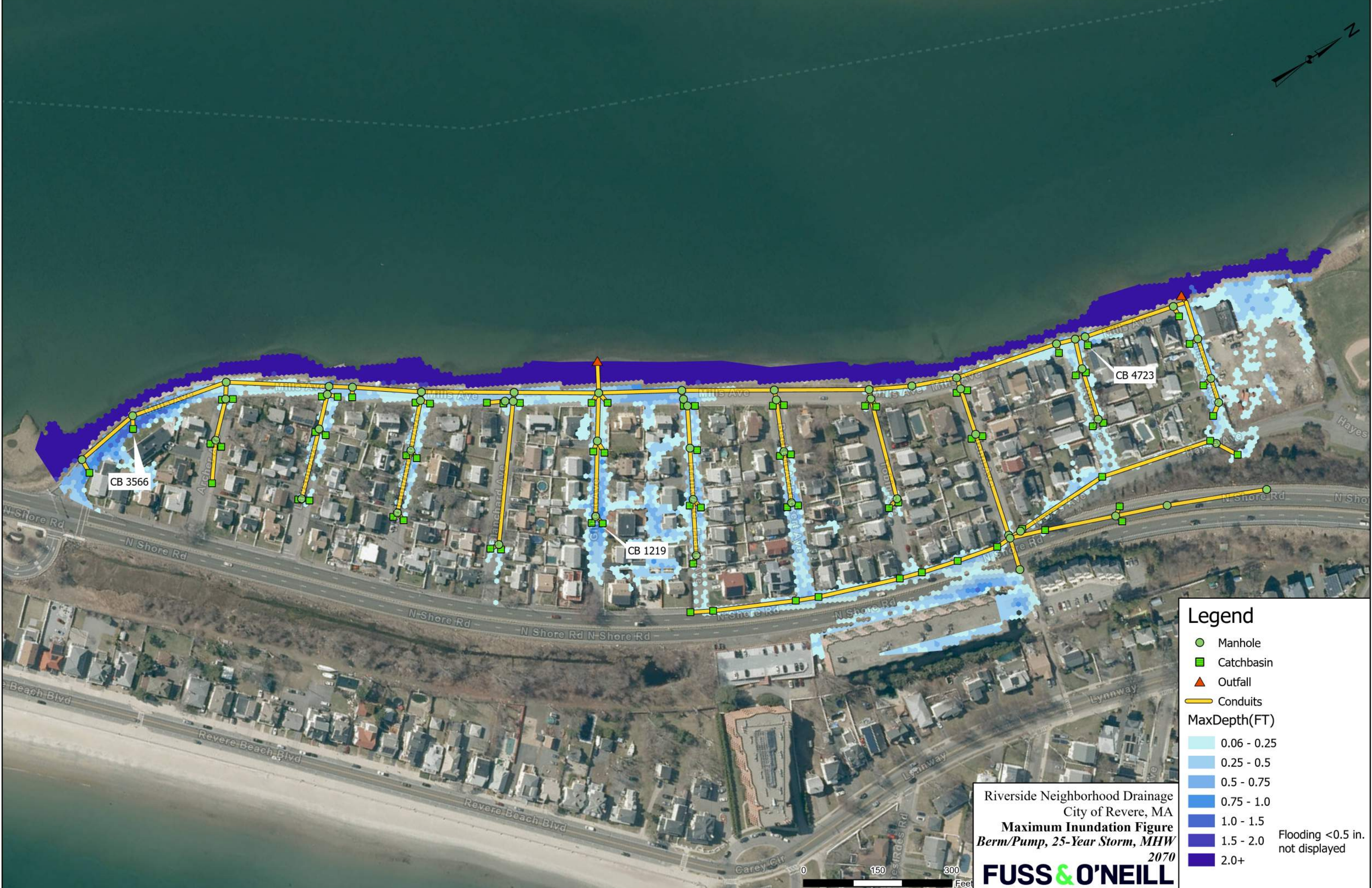
- 0.06 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Berm/Pump, 25-Year Storm, MHW
2050

FUSS & O'NEILL

0 150 300 Feet



Legend

- Manhole
- Catchbasin
- ▲ Outfall
- Conduits

MaxDepth(FT)

- 0.06 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0+

Flooding <0.5 in.
not displayed

Riverside Neighborhood Drainage
City of Revere, MA
Maximum Inundation Figure
Berm/Pump, 25-Year Storm, MHW
2070

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Appendix F – Depth and Duration Tables

Riverside Neighborhood

Existing Conditions Current Climate

Reference Point DCB01219 (Gilbert CB)

Struct Depth 2.22

	Existing MHW				Existing MLW			
Storm Event	1	2	10	25	1	2	10	25
Depth (ft)	2.83	3.02	3.28	3.41	2.53	2.90	3.23	3.36
Flooding Depth (ft)	0.61	0.80	1.06	1.19	0.31	0.68	1.01	1.14
Duration (hr)	0.26	0.43	1.07	1.63	0.12	0.24	0.73	1.05
Duration (min)	15.37	25.64	64.38	97.74	7.43	14.33	44.02	62.88

Reference Point DCB03566 (Mills Ave CB)

Struct Depth 2.39

	Existing MHW				Existing MLW			
Storm Event	1	2	10	25	1	2	10	25
Depth (ft)	1.42	1.85	2.83	3.04	1.42	1.85	2.83	3.04
Flooding Depth (ft)	-0.97	-0.54	0.44	0.65	-0.97	-0.54	0.44	0.65
Duration (hr)	0.00	0.00	0.18	0.23	0.00	0.00	0.18	0.23
Duration (min)	0.00	0.00	11.05	13.57	0.00	0.00	11.05	13.57

Reference Point DCB04723 (Mills Ave CB)

Struct Depth 2.64

	Existing MHW				Existing MLW			
Storm Event	1	2	10	25	1	2	10	25
Depth (ft)	3.24	3.37	3.42	3.45	3.00	3.35	3.42	3.44
Flooding Depth (ft)	0.60	0.73	0.78	0.81	0.36	0.71	0.78	0.80
Duration (hr)	0.16	0.21	0.39	0.48	0.07	0.14	0.28	0.35
Duration (min)	9.70	12.30	23.34	28.50	3.93	8.21	16.63	21.28

Last Updated 6/29/2026 SAH

Riverside Neighborhood Existing Conditions 2050 Climate

Reference Point DCB01219 (Gilbert CB)

Struct Depth 2.22

	Existing MHW			
Storm Event	1	2	10	25
Depth (ft)	3.19	3.29	3.51	3.56
Flooding Depth (ft)	0.97	1.07	1.29	1.34
Duration (hr)	23.80	23.80	23.80	23.80
Duration (min)	1428.00	1428.00	1428.00	1428.00

Reference Point DCB03566 (Mills Ave CB)

Struct Depth 2.39

	Existing MHW			
Storm Event	1	2	10	25
Depth (ft)	3.19	3.22	3.27	3.29
Flooding Depth (ft)	0.80	0.83	0.88	0.90
Duration (hr)	23.80	23.80	23.80	23.80
Duration (min)	1428.00	1428.00	1428.00	1428.00

Reference Point DCB04723 (Mills Ave CB)

Struct Depth 2.64

	Existing MHW			
Storm Event	1	2	10	25
Depth (ft)	4.05	4.06	4.08	4.09
Flooding Depth (ft)	1.41	1.42	1.44	1.45
Duration (hr)	23.80	23.80	23.80	23.80
Duration (min)	1428.00	1428.00	1428.00	1428.00

Last Updated 6/29/2026 SAH

Riverside Neighborhood Existing Conditions 2070 Climate

Reference Point DCB01219 (Gilbert CB)

Struct Depth 2.22

	Existing MHW			
Storm Event	1	2	10	25
Depth (ft)	4.57	4.58	4.62	4.63
Flooding Depth (ft)	2.35	2.36	2.40	2.41
Duration (hr)	23.80	23.80	23.80	23.80
Duration (min)	1428.00	1428.00	1428.00	1428.00

Reference Point DCB03566 (Mills Ave CB)

Struct Depth 2.39

	Existing MHW			
Storm Event	1	2	10	25
Depth (ft)	5.06	5.08	5.12	5.13
Flooding Depth (ft)	2.67	2.69	2.73	2.74
Duration (hr)	23.80	23.80	23.80	23.80
Duration (min)	1428.00	1428.00	1428.00	1428.00

Reference Point DCB04723 (Mills Ave CB)

Struct Depth 2.64

	Existing MHW			
Storm Event	1	2	10	25
Depth (ft)	5.97	5.98	6.02	6.02
Flooding Depth (ft)	3.33	3.34	3.38	3.38
Duration (hr)	23.80	23.80	23.80	23.80
Duration (min)	1428.00	1428.00	1428.00	1428.00

Riverside Neighborhood

Prop Gravity Current Climate

[illegible]

Last Updated 6/29/2026 SAH

Riverside Neighborhood
Prop Gravity 2050 Climate

Reference Point DCB01219 (Gilbert CB)

Struct Depth 1.42

CB 116

	Prop Gravity MHW			
Storm Event	1	2	10	25
Depth (ft)	2.03	2.26	3.32	3.59
Flooding Depth (ft)	0.61	0.84	1.90	2.17
Duration (hr)	22.96	22.96	22.96	22.96
Duration (min)	1377.60	1377.60	1377.60	1377.60

Reference Point DCB03566 (Mills Ave CB)

Struct Depth 3.00

CB 98

	Prop Gravity MHW			
Storm Event	1	2	10	25
Depth (ft)	4.06	4.10	4.16	4.18
Flooding Depth (ft)	1.06	1.10	1.16	1.18
Duration (hr)	23.26	23.26	23.26	23.26
Duration (min)	1395.60	1395.60	1395.60	1395.60

Reference Point DCB04723 (Mills Ave CB)

Struct Depth 3.61

CB 140

	Prop Gravity MHW			
Storm Event	1	2	10	25
Depth (ft)	4.73	4.74	4.75	4.76
Flooding Depth (ft)	1.12	1.13	1.14	1.15
Duration (hr)	23.37	23.37	23.37	23.37
Duration (min)	1402.20	1402.20	1402.20	1402.20

Last Updated 6/29/2026 SAH

Riverside Neighborhood
Prop Gravity 2070 Climate

Reference Point DCB01219 (Gilbert CB)

Struct Depth 1.42

CB 116

	Prop Gravity MHW			
Storm Event	1	2	10	25
Depth (ft)	3.75	3.76	3.79	3.79
Flooding Depth (ft)	2.33	2.34	2.37	2.37
Duration (hr)	23.16	23.16	23.16	23.16
Duration (min)	1389.60	1389.60	1389.60	1389.60

Reference Point DCB03566 (Mills Ave CB)

Struct Depth 3.00

CB 98

	Prop Gravity MHW			
Storm Event	1	2	10	25
Depth (ft)	5.90	5.91	5.96	5.96
Flooding Depth (ft)	2.90	2.91	2.96	2.96
Duration (hr)	23.22	23.22	23.22	23.22
Duration (min)	1393.20	1393.20	1393.20	1393.20

Reference Point DCB04723 (Mills Ave CB)

Struct Depth 3.61

CB 140

	Prop Gravity MHW			
Storm Event	1	2	10	25
Depth (ft)	6.61	6.61	6.63	6.64
Flooding Depth (ft)	3.00	3.00	3.02	3.03
Duration (hr)	23.45	23.45	23.45	23.45
Duration (min)	1407.00	1407.00	1407.00	1407.00

Riverside Neighborhood

Struct Depth	1.42
--------------	------

Prop PumpBerm MHW				Prop PumpBerm MLW			
1	2	10	25	1	2	10	25
0.49	0.61	1.02	1.36	0.49	0.61	1.02	1.36
-0.93	-0.81	-0.40	-0.06	-0.93	-0.81	-0.40	-0.06
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Struct Depth	3.00
--------------	------

Prop PumpBerm MHW				Prop PumpBerm MLW			
1	2	10	25	1	2	10	25
1.06	1.19	2.92	3.71	0.47	0.60	1.49	3.18
-1.94	-1.81	-0.08	0.71	-2.53	-2.40	-1.51	0.18
0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.02
0.00	0.00	0.00	4.42	0.00	0.00	0.00	1.12

Struct Depth	3.61
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[illegible]

Last Updated 6/29/2026 SAH

Riverside Neighborhood
Prop PumpBerm 2050 Climate

Reference Point DCB01219 (Gilbert CB)

Struct Depth 1.42

CB 116

	Prop PumpBerm MHW			
Storm Event	1	2	10	25
Depth (ft)	0.60	1.21	3.44	3.60
Flooding Depth (ft)	-0.82	-0.21	2.02	2.18
Duration (hr)	0.00	0.00	0.28	0.32
Duration (min)	0.00	0.00	16.67	19.45

Reference Point DCB03566 (Mills Ave CB)

Struct Depth 3.00

CB 98

	Prop PumpBerm MHW			
Storm Event	1	2	10	25
Depth (ft)	1.89	3.90	4.40	4.58
Flooding Depth (ft)	-1.11	0.90	1.40	1.58
Duration (hr)	0.00	0.11	0.41	0.51
Duration (min)	0.00	6.32	24.38	30.81

Reference Point DCB04723 (Mills Ave CB)

Struct Depth 3.61

CB 140

	Prop PumpBerm MHW			
Storm Event	1	2	10	25
Depth (ft)	1.29	1.76	2.86	2.98
Flooding Depth (ft)	-2.32	-1.85	-0.75	-0.63
Duration (hr)	0.00	0.00	0.00	0.00
Duration (min)	0.00	0.00	0.00	0.00

Last Updated 6/29/2026 SAH

Riverside Neighborhood
Prop PumpBerm 2070 Climate

Reference Point DCB01219 (Gilbert CB)

Struct Depth 1.42

CB 116

	Prop PumpBerm MHW			
Storm Event	1	2	10	25
Depth (ft)	0.68	3.18	3.62	3.63
Flooding Depth (ft)	-0.74	1.76	2.20	2.21
Duration (hr)	0.00	0.20	0.44	0.63
Duration (min)	0.00	11.96	26.33	37.69

Reference Point DCB03566 (Mills Ave CB)

Struct Depth 3.00

CB 98

	Prop PumpBerm MHW			
Storm Event	1	2	10	25
Depth (ft)	2.82	4.28	4.79	4.87
Flooding Depth (ft)	-0.18	1.28	1.79	1.87
Duration (hr)	0.00	0.27	0.70	0.87
Duration (min)	0.00	15.95	42.28	52.03

Reference Point DCB04723 (Mills Ave CB)

Struct Depth 3.61

CB 140

	Prop PumpBerm MHW			
Storm Event	1	2	10	25
Depth (ft)	1.61	2.57	3.19	4.10
Flooding Depth (ft)	-2.00	-1.04	-0.42	0.49
Duration (hr)	0.00	0.00	0.00	0.09
Duration (min)	0.00	0.00	0.00	5.47

Appendix G – 75% Design Plan

REVERE RIVERSIDE NEIGHBORHOOD RESILIENCE

REVERE · MASSACHUSETTS

RIVERSIDE NEIGHBORHOOD STORMWATER IMPROVEMENTS

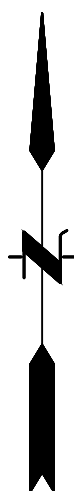
JULY 2026

PROJECT TEAM

HANCOCK ASSOCIATES
185 CENTRE ST
DANVERS, MA 01923
978-777-3050

SHEET INDEX

Sheet no.	Sheet Title
GI-001	Cover Sheet
CN - 001-002	General Notes
CS -100	Site Overview Key Plan
CP-101 - CP-103	Site Preparation Plans
CR-101 - CR - 105	Mills Avenue Plan & Profiles
CR-106 - CR-116	Side Road Plan & Profiles
CR-201	Pump Station Plan
CD-501	Pump Station Details
CD-502 - CD-508	Construction Details



LOCATION MAP

SCALE: 1" = 1000'

PREPARED BY

**FUSS &
O'NEILL**

1250 HANCOCK STREET, SUITE 815N
QUINCY, MA 02169
617.282.4675
www.fando.com

PREPARED FOR

CITY OF REVERE

DEPARTMENT OF PLANNING & COMMUNITY
DEVELOPMENT
281 BROADWAY, MEZZANINE LEVEL
REVERE, MA 02151

DRAFT PLANS - NOT FOR CONSTRUCTION

PROJ. No.: 20230160.R10
DATE: 04/07/2026

GI-001

1. EXISTING CONDITIONS DEPICTED ON THIS PLAN ARE BASED ON A PLAN ENTITLED: "EXISTING CONDITIONS PLAN OF LAND IN REVERE, MA" DATED MARCH 17, 2025 PREPARED BY HANCOCK ASSOCIATES.
2. TOPOGRAPHIC ELEVATIONS ARE BASED ON NAD83 MASSACHUSETTS STATE PLANE, MAINLAND ZONE DATUM.
3. NATURAL RESOURCES WERE DELINEATED BY HANCOCK ASSOCIATES AND LEC CONSULTANTS AND APPROVED THROUGH AN ORDER OF RESOURCE AREA DELINEATION ISSUED BY THE REVERE CONSERVATION COMMISSION ISSUED NOVEMBER 10, 2023.
4. THE SITE IS LOCATED WITH ZONE A 100 YEAR FLOOD ZONE ACCORDING TO FEMA FLOOD INSURANCE RATE MAPS (FIRM) 2025C0036J AND 2025C0028J, BOTH ISSUED MARCH 16, 2016.

1. SYMBOLS AND LEGENDS OF PROJECT FEATURES ARE GRAPHIC REPRESENTATIONS AND ARE NOT NECESSARILY SHOWN ON THE DRAWINGS TO SCALE OR TO THEIR ACTUAL DIMENSION OR LOCATION. COORDINATE LOCATION OF UTILITIES SHOWN ON DRAWINGS AND FIELD MEASUREMENTS OF SUPPLIED PRODUCTS FOR LAYOUT OF THE PROJECT FEATURES.
2. DO NOT RELY SOLELY ON ELECTRONIC VERSIONS OF DRAWINGS, SPECIFICATIONS, AND DATA FILES THAT ARE PROVIDED BY THE ENGINEER. FIELD VERIFY LOCATION OF PROJECT FEATURES.
3. PERFORM NECESSARY CONSTRUCTION NOTIFICATIONS, APPLY FOR AND OBTAIN NECESSARY PERMITS PAY FEES, AND POST BONDS ASSOCIATED WITH THE WORK AS REQUIRED BY THE CONTRACT DOCUMENTS.
4. LOCATION OF UTILITIES SHOWN HEREON ARE THE RESULT OF SURFACE EVIDENCE AS LOCATED BY FIELD SURVEY, PLANS OF RECORD, INFORMATION FURNISHED BY THE RESPECTIVE UTILITY COMPANIES, AND OTHER AVAILABLE SOURCES. THIS PLAN DOES NOT NECESSARILY DEPICT THE EXACT LOCATION OF ALL UTILITIES WHICH MAY EXIST AT THIS TIME WITHIN THE PREMISES SURVEYED. LOCATIONS SHOULD BE VERIFIED BY THE RESPECTIVE UTILITY COMPANY BEFORE BEING RELIED UPON. ALL FIELD CHANGES MUST BE APPROVED BY THE ENGINEER.
- 4.1. LOCATION AND INVERTS OF EXISTING UTILITIES SHALL BE VERIFIED WITH THE ENGINEER PRIOR TO CONSTRUCTION. ALL FIELD CHANGES MUST BE APPROVED BY THE ENGINEER.
- 4.2. FUSS & O'NEILL MAKES NO GUARANTEES THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA. FUSS & O'NEILL FURTHER DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED. FUSS & O'NEILL HAS SPECIFICALLY INSPECTED THE UNDERGROUND UTILITIES. BEFORE CONSTRUCTION, CALL DIG SAFE SYSTEMS FOR CLEARANCE.

1. AN APPROVED SET OF PLANS SHALL BE KEPT ON SITE AT ALL TIMES.
2. WITHIN LOCAL RIGHTS-OF-WAY, PERFORM THE WORK IN ACCORDANCE WITH LOCAL MUNICIPAL STANDARDS.
3. WITHIN STATE RIGHTS-OF-WAY, PERFORM THE WORK IN ACCORDANCE WITH THE MASS DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS.
4. BE RESPONSIBLE FOR SITE SECURITY AND JOB SAFETY. PERFORM CONSTRUCTION ACTIVITIES IN ACCORDANCE WITH OSHA STANDARDS AND LOCAL REQUIREMENTS.
5. DISPOSE OF DEMOLITION DEBRIS IN ACCORDANCE WITH APPLICABLE FEDERAL, STATE AND LOCAL REGULATIONS, ORDINANCES AND STATUTES.
6. THIS PROJECT DISTURBS MORE THAN ONE ACRE OF LAND OR IS A PHASE OF A LARGER PROJECT THAT DISTURBS MORE THAN AN ACRE AND REQUIRES THE COMPLETION OF A STORMWATER POLLUTION PREVENTION PLAN (SWPPP) AND THE FILING OF A CONSTRUCTION GENERAL PERMIT (CGP). THE SWPPP SHALL REMAIN ON SITE AT ALL TIMES. PRIOR TO THE START OF CONSTRUCTION SUBMIT A NOTICE OF INTENT TO OBTAIN COVERAGE UNDER THE CGP.
7. COMPLY WITH THE CONDITIONS OF THE CITY OF REVERE, COMMONWEALTH OF MASSACHUSETTS, AND ANY FEDERAL PERMITS ISSUED FOR THE PROJECT.
8. NOTIFY CITY OF REVERE PLANNING BOARD AND CONSERVATION COMMISSION IN WRITING A MINIMUM OF 72 HOURS PRIOR TO CONSTRUCTION.
11. ALLOW AGENTS OR MEMBERS REPRESENTING THE CITY OF REVERE OR OTHER LOCAL, STATE, OR FEDERAL AUTHORITIES TO ENTER AND INSPECT THE SITE.
12. POST MASSDEP SIGN NUMBER ASSIGNED IN ACCORDANCE WITH THE ORDER OF CONDITIONS.
13. UPON COMPLETION OF THE WORK, SUBMIT A COMPLETED REQUEST FOR A CERTIFICATE OF COMPLIANCE (WPA FORM 8A) AND ANY REQUIRED SUPPORTING DOCUMENTATION REQUIRED BY THE CONSERVATION COMMISSION.
14. NOTIFY THE ENGINEER A MINIMUM OF ONE WEEK PRIOR TO THE INSTALLATION OF STORMWATER BMPs.
- 14.1. STORMWATER BMPs MUST BE INSPECTED BY THE ENGINEER DURING CONSTRUCTION. SCHEDULE THE WORK IN A MANNER THAT ALLOWS THE ENGINEER TO NOTIFY THE CONSTRUCTION OF THE STORMWATER BMPs.
- 14.2. RE-WORK REQUIRED AS A RESULT OF A FAILURE TO NOTIFY THE ENGINEER OF BMP INSTALLATION SHALL BE DONE AT NO COST TO THE OWNER.

1. CALL DIG-SAFE 811 OR 1-888-DIG-SAFE A MINIMUM OF 72 HOURS PRIOR TO CONSTRUCTION.
2. STOP WORK IN THE VICINITY OF SUSPECTED CONTAMINATED SOIL, GROUNDWATER OR OTHER MEDIA. IMMEDIATELY NOTIFY THE OWNER SO THAT APPROPRIATE TESTING AND SUBSEQUENT ACTION CAN BE TAKEN. RESUME WORK IN THE IMMEDIATE VICINITY ONLY UPON DIRECTION BY THE OWNER.
3. PROTECT ALL SLOPES, VEGETATION, PAVING, WALKS, AND IMPROVEMENTS OUTSIDE THE AREAS TO BE AFFECTED BY THE CONSTRUCTION OF THIS PROJECT.
4. CATCH BASINS WITHIN THE WORK AREA OR DOWN STREAM OF DRAINAGE FLOW SHALL BE PROTECTED WITH CATCH BASIN SILT SACKS.
5. WATER AND CALCIUM CHLORIDE MUST BE AVAILABLE AT ALL TIMES FOR DUST CONTROL.

1. REMOVE AND DISPOSE OF EXISTING UTILITIES, FOUNDATIONS AND UNSUITABLE MATERIAL BENEATH AND FOR A DISTANCE OF 10 FEET BEYOND THE PROPOSED BUILDING FOOTPRINT INCLUDING EXTERIOR COLUMNS, UNLESS OTHERWISE NOTED.
2. TREES, BRUSH AND STUMPS REMOVED BY CLEARING & GRUBBING OPERATIONS SHALL BE TRANSPORTED OFF THE PROJECT SITE TO AN APPROVED DISPOSAL LOCATION.
3. ITEMS TO BE STOCKPILED ON-SITE FOR REUSE OR TO BE RELOCATED SHALL BE PROTECTED FROM CONSTRUCTION OPERATIONS; IF DAMAGED DURING CONSTRUCTION THEY SHALL BE REPLACED IN-KIND AT NO ADDITIONAL COST TO THE OWNER.

1. DO NOT CLOSE OR OBSTRUCT ROADWAYS, SIDEWALKS, FIRE HYDRANTS, AND UTILITIES WITHOUT APPROPRIATE PERMITS.
2. WORK IS RESTRICTED TO THE HOURS OF 7:00 AM TO 5:00 PM, MONDAY THROUGH FRIDAY EXCLUDING HOLIDAYS UNLESS OTHERWISE APPROVED BY THE OWNER AND THE CITY OF REVERE.

1. PROVIDE PROPER TRANSITIONS BETWEEN EXISTING AND PROPOSED SITE IMPROVEMENTS. FIELD VERIFY EXISTING PAVEMENT AND GROUND ELEVATIONS AT THE INTERFACE WITH PROPOSED PAVEMENTS AND DRAINAGE STRUCTURES BEFORE START OF CONSTRUCTION.
2. PRIOR TO ORDERING MATERIALS AND BEGINNING CONSTRUCTION, FIELD VERIFY PROPOSED UTILITY ROUTES AND IDENTIFY ANY INTERFERENCES OR OBSTRUCTIONS WITH EXISTING UTILITIES OR PUBLIC RIGHTS-OF-WAY.
3. DIMENSIONS ARE FROM FACE OF CURB, FACE OF BUILDING, FACE OF WALL, AND CENTER LINE OF PAVEMENT MARKINGS, UNLESS NOTED OTHERWISE.

1. PROVIDE 6 INCHES OF TOPSOIL AND SEED TO AREAS DISTURBED DURING CONSTRUCTION AND NOT DESIGNATED TO BE RESTORED WITH IMPERVIOUS SURFACES (BUILDINGS, PAVEMENTS, WALKS, ETC.) UNLESS OTHERWISE NOTED. REQUIRED SEED MIX:
 - 50% KENTUCKY BLUEGRASS
 - 40% TALL FESCUE
 - 10% PERENNIAL RYEGRASS(REFER TO LANDSCAPE:IF APPLICABLE, UPDATE PER LANDSCAPE PLAN)
2. REPAIR DAMAGES RESULTING FROM CONSTRUCTION LOADS, AT NO ADDITIONAL COST TO OWNER.
3. RESTORE AREAS DISTURBED BY CONSTRUCTION OPERATIONS OUTSIDE OF THE WORK AREA TO THEIR ORIGINAL CONDITION OR BETTER, AT NO ADDITIONAL COST TO OWNER.

1. TERMINATE EXISTING UTILITIES IN CONFORMANCE WITH LOCAL, STATE AND INDIVIDUAL UTILITY COMPANY STANDARD SPECIFICATIONS AND DETAILS. COORDINATE UTILITY SERVICE DISCONNECTS WITH UTILITY REPRESENTATIVES.
2. THE TYPE, SIZE AND LOCATION OF DEPICTED UNDERGROUND UTILITIES ARE APPROXIMATE REPRESENTATIONS OF INFORMATION OBTAINED FROM FIELD LOCATIONS OF VISIBLE FEATURES, EXISTING MAPS AND PLANS OF RECORD, UTILITY MAPPING, AND OTHER SOURCES OF INFORMATION. OBTAINED FROM THE ENGINEER. ASSUME NO GUARANTEE AS TO THE COMPLETENESS, SERVICEABILITY, EXISTENCE, OR ACCURACY OF UNDERGROUND FACILITIES. FIELD VERIFY THE EXACT LOCATIONS, SIZES, AND ELEVATIONS OF THE POINTS OF CONNECTIONS TO EXISTING UTILITIES.
3. IMMEDIATELY INFORM THE ENGINEER IN WRITING IF EXISTING UTILITY CONDITIONS CONFLICT OR DIFFER FROM THAT INDICATED AND IF THE WORK CANNOT BE COMPLETED AS INDICATED.
4. PAY ALL FEES AND COSTS ASSOCIATED WITH UTILITY MODIFICATIONS AND CONNECTIONS, REGARDLESS OF THE ENTITY THAT PERFORMS THE WORK.
5. COORDINATE THE WORK AND WORK SCHEDULE WITH UTILITY COMPANIES. PROVIDE ADEQUATE NOTICE TO UTILITIES TO PREVENT DELAYS IN CONSTRUCTION.
6. INSTALL PROPOSED PRIVATE UTILITY SERVICES ACCORDING TO THE REQUIREMENTS PROVIDED BY, AND APPROVED BY THE AUTHORITY HAVING JURISDICTION (WATER, SEWER, GAS, TELEPHONE, ELECTRIC, FIRE ALARM, ETC.). COORDINATE FINAL DESIGN LOCATIONS AND LOCATIONS WITH OWNER AND ARCHITECT.
7. COORDINATE WITH UTILITY COMPANIES FOR THE REMOVAL/RELOCATION OF OVERHEAD WIRE AND POLES.
8. THE PLUMBING CONTRACTOR IS RESPONSIBLE FOR INSTALLATION OF DRAINAGE AND UTILITIES WITHIN 10 FEET OF BUILDING FOOTPRINT.
9. NOTIFY ADJUTING PROPERTY OWNERS AND THE CITY OF REVERE A MINIMUM OF 5 BUSINESS DAYS PRIOR TO DISRUPTION OF UTILITY SERVICE.
10. ALL WATER SERVICE AND SEWER SERVICE CONNECTIONS SHALL BE COORDINATED WITH THE CITY OF REVERE DEPARTMENT OF PUBLIC WORKS AND WATER DEPARTMENT.

1. DISTURBANCE OF SOIL SURFACES IS REGULATED BY STATE LAW AND LOCAL ORDINANCE. WORK SHALL COMPLY WITH THE FOLLOWING CRITERIA TO PREVENT OR MINIMIZE SOIL EROSION.
2. PRIOR TO THE COMMENCEMENT OF CONSTRUCTION ACTIVITIES, INSTALL EROSION AND SEDIMENT CONTROL DEVICES AS SHOWN ON THE PLAN. MAINTAIN EROSION CONTROL DEVICES IN EFFECTIVE CONDITION DURING CONSTRUCTION.
3. INSTALL, INSPECT, MAINTAIN, AND/OR REPLACE TEMPORARY AND PERMANENT EROSION CONTROL DEVICES TO ENSURE PROPER OPERATION IN A TIMELY MANNER THROUGHOUT THE LIFE OF THE PROJECT. MAINTAIN PERMANENT MEASURES UNTIL CONSTRUCTION OF THE PROJECT IS COMPLETED OR UNTIL IT IS ACCEPTED BY THE OWNER. DISPOSE OF SEDIMENT IN AN UPLAND AREA.
- 3.1. STABILIZE DISTURBED AREAS WITHIN 30 FEET OF RESOURCE AREAS WITHIN 7 DAYS OF ACHIEVING FINAL GRADES. AREAS THAT HAVE NOT ACHIEVED FINAL GRADES BUT WILL REMAIN INACTIVE FOR 7 DAYS SHALL BE TEMPORARY STABILIZED.
4. INSPECT EROSION AND SEDIMENT CONTROLS DAILY AND REMOVE ACCUMULATED SEDIMENTS AS NEEDED. REPAIR OR CORRECT ANY ISSUES, AND NOTIFY THE CONSERVATION COMMISSION IMMEDIATELY.
5. MAINTAIN A STOCKPILE OF ADDITIONAL EROSION AND SEDIMENT CONTROL DEVICES ON SITE AT ALL TIMES. AT A MINIMUM, A STOCKPILE OF AT LEAST 100 FEET OR 10% OF THE TOTAL AMOUNT OF DEVICES CURRENTLY DEPLOYED AT THE SITE, WHICHEVER IS GREATER.
6. CLEAN ROADS, CONTROL DUST, AND TAKE NECESSARY MEASURES TO ENSURE THAT THE SITE AND ALL ROADS BE MAINTAINED IN A MUD- AND DUST-FREE CONDITION AT ALL TIMES THROUGHOUT THE LIFE OF THE CONTRACT. DUST CONTROL SHALL INCLUDE, BUT IS NOT LIMITED TO, WATER AND/OR CRUSHED STONE OR COARSE GRAVEL, SUBJECT TO THE APPROVAL OF THE ENGINEER.
7. VEHICLE TRAFFIC ENTERING OR EXITING THE PROJECT SITE SHALL PASS OVER CONSTRUCTION ENTRANCE(S). MAINTAIN THE CONSTRUCTION ENTRANCE(S) IN A CONDITION THAT WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO THE SURROUNDING ROADWAYS. THIS WILL REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE OR ADDITIONAL LENGTH AS CONDITIONS DEMAND AND REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT. ALL SEDIMENT SPILLED, DROPPED, WASHED, OR TRACKED ONTO THE SURROUNDING ROADWAYS MUST BE REMOVED IMMEDIATELY.
8. INSTALL PERIMETER SEDIMENT CONTROL BARRIERS AS SHOWN ON THE SITE PLANS OR AS MAY BE REQUIRED TO PREVENT SEDIMENT FLOW TO STORM DRAINS OR SURFACE WATERS. A ROW OF STAKED HAYBALES OR A SILT FENCE SHALL ALSO BE INSTALLED AROUND ANY SOIL STOCKPILE. AFTER A SLOPE FINISHES, THE SEDIMENT CONTROL BARRIER MUST BE REMOVED. IF A BARRIER IS NECESSARY IF ONE-HALF THE ORIGINAL HEIGHT OF THE BARRIER BECOMES FILLED WITH SEDIMENT, REPLACE BARRIER IMMEDIATELY IF BARRIER DECOMPOSED OR BECOMES INEFFECTIVE.

15. CONTROL OF ALLOWABLE NON-STORMWATER DISCHARGES: IF ALLOWABLE NON-STORM WATER DISCHARGES ARE OCCURRING AT THE SITE, SUCH DISCHARGES SHALL BE VISUALLY OBSERVED AND RECORDED. THE LIST OF EXPECTED SOURCES OF ALLOWABLE NON-STORM WATER DISCHARGES FOR THIS PROJECT ARE AS FOLLOWS: (1) DISCHARGE FROM VEHICLE WASHDOWN WHERE NO DETERGENTS ARE USED, (2) EXTERNAL BUILDING WASHDOWN WHERE NO DETERGENTS ARE USED, (3) THE USE OF WATER CONTROL DUST, (4) FIRE HYDRANT FLUSHINGS, (5) LAWN WATERING, (6) POTABLE WATER SOURCES INCLUDING WATERLINE FLUSHINGS, (7) IRRIGATION DRAINAGE, (8) PAVEMENT WASHWATERS WHERE SPILLS OR LEAKS OF TOXIC OR HAZARDOUS MATERIALS HAVE NOT OCCURRED (UNLESS ALL SPILLED MATERIALS HAVE BEEN REMOVED) AND WHERE NO DETERGENTS ARE USED, AND (9) FOUNDATION OR FOOTING DRAINS WHERE FLOWS ARE NOT CONTAMINATED WITH PROCESS SUCH AS SOLVENTS OR CONTAMINATED BY CONTACT WITH SOILS WHERE SPILLS OR LEAKS OF TOXIC OR HAZARDOUS MATERIALS HAS OCCURRED.
16. GOOD HOUSEKEEPING: THE PROJECT SITE SHALL PROVIDE FOR THE MINIMIZATION OF EXPOSURE OF CONSTRUCTION DEBRIS (INCLUDING, BUT NOT LIMITED TO, INSULATION, WIRING, PAINTS AND PAINT CANS, SOLVENTS, WALL BOARD, ETC.) TO PRECIPITATION BY MEANS OF DISPOSAL AND/OR PROPER SHELTER OR COVER. CONSTRUCTION WASTE MUST BE PROPERLY DISPOSED OF IN ORDER TO AVOID EXPOSURE TO PRECIPITATION AT THE END OF EACH WORKING DAY.
17. UPON COMPLETION OF CONSTRUCTION AND ESTABLISHMENT OF PERMANENT GROUND COVER, REMOVE AND DISPOSE OF TEMPORARY EROSION CONTROL MEASURES, CLEAN SEDIMENT AND DEBRIS FROM TEMPORARY MEASURES AND FROM PERMANENT STORM DRAIN AND SANITARY SEWER SYSTEMS.

BC	BOTTOM OF CURB
BOT	BOTTOM
BOW	BOTTOM OF WALL
CB	CATCH BASIN
C.L.D.I.P.	CEMENT LINED DUCTILE IRON PIPE
DEH	DRAINAGE MANHOLE
ELEV	ELEVATION
FF	FINISHED FLOOR
FG	FINISHED GRADE
HDPE	HIGH DENSITY POLYETHYLENE
HYD	HYDRANT
INV	INVERT
M&P	MAINTAIN & PROTECT
MAX.	MAXIMUM
MIN.	MINIMUM
OHW	OVERHEAD WIRE
PVC	POLYVINYL CHLORIDE
R&D	REMOVE & DISPOSE
R&R	REMOVE & RESET
SMH	SANITARY SEWER MANHOLE
TC	TOP OF CURB
TF	TOP OF FRAME
TW	TOP OF WALL
TYP.	TYPICAL

SEAL

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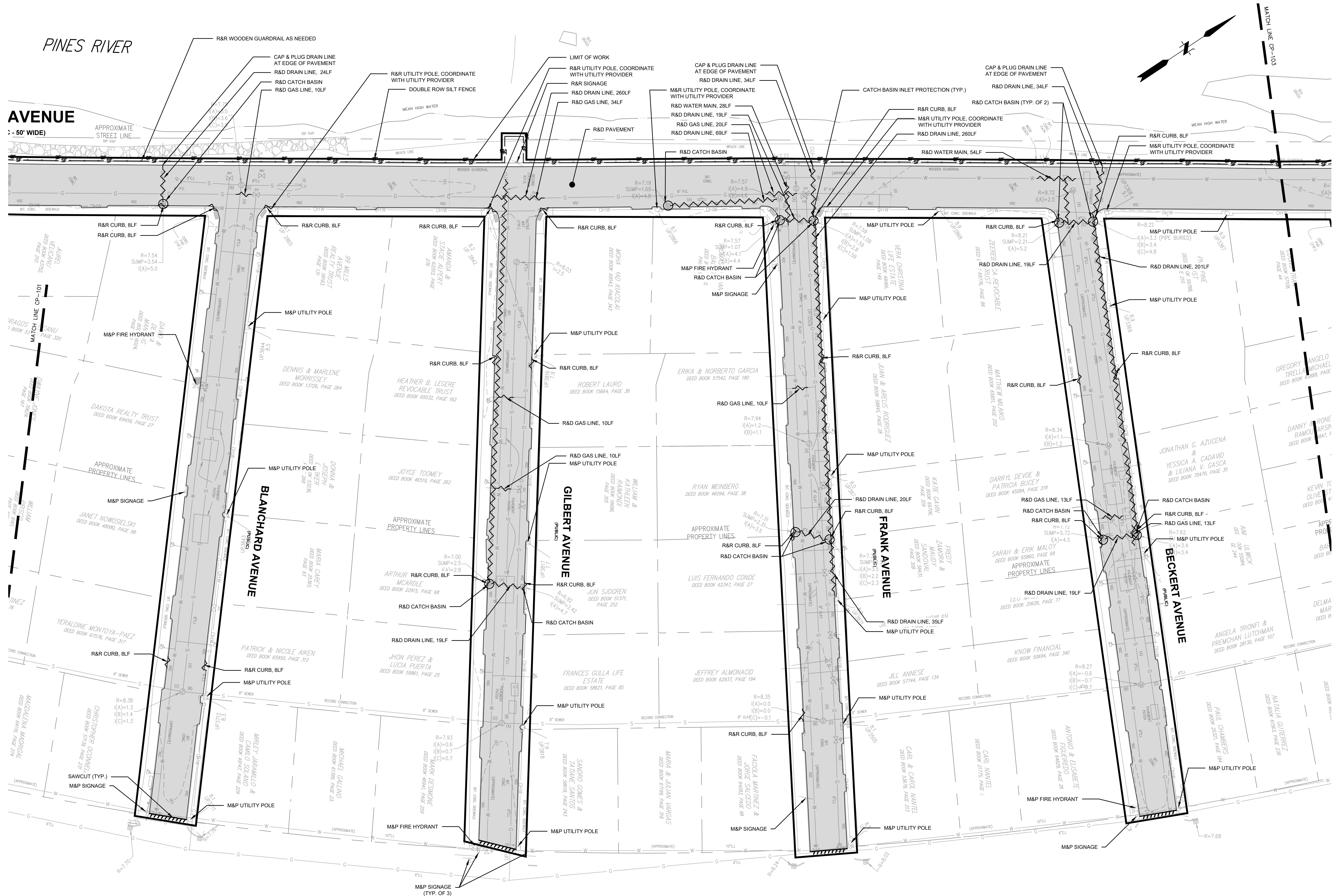
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CN-001

DRAFT PLANS - NOT FOR CONSTRUCTION

CP-101



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GRAPHIC SCALE	

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CITY OF REVERE

SITE PREPARATION PLAN

REVERE RIVERSIDE NEIGHBORHOOD

REVERE MASSACHUSETTS

PROJ. No.: 20230160.R10
DATE: 04/07/2026

CP-102

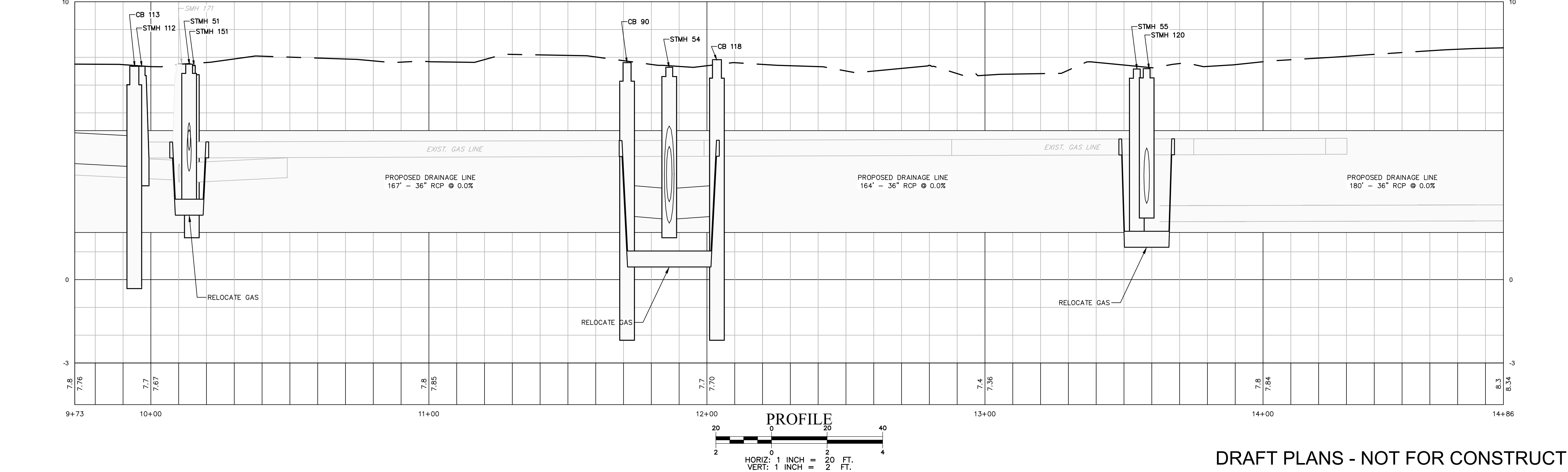
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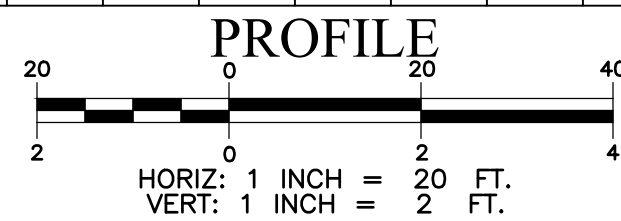
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CR-103



CR-104 PROJECT NO.: 20230160.R10 DATE: 04/07/2026	CITY OF REVERE PLAN & PROFILE REVERSE RIVERSIDE NEIGHBORHOOD REVERSE MASSACHUSETTS	 1250 HANCOCK STREET, SUITE 815N QUINCY, MA 02169 617.282.4675 www.fandoc.com	SCALE:		SEAL
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CITY OF REVERE

PLAN & PROFILE

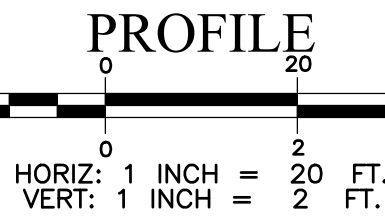
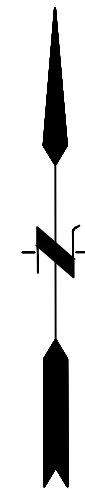
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MASSACHUSETTS

PROJ. No.: 20230160.R10
DATE: 04/07/2026

CR-104

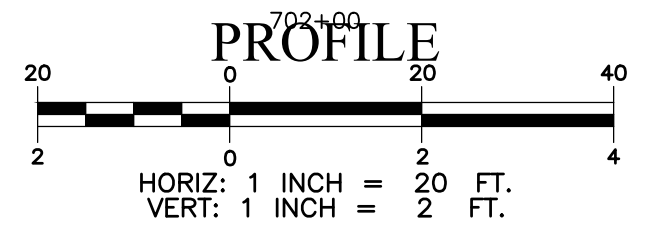
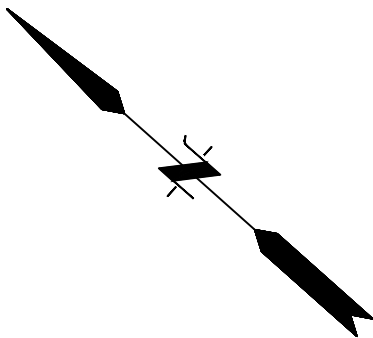
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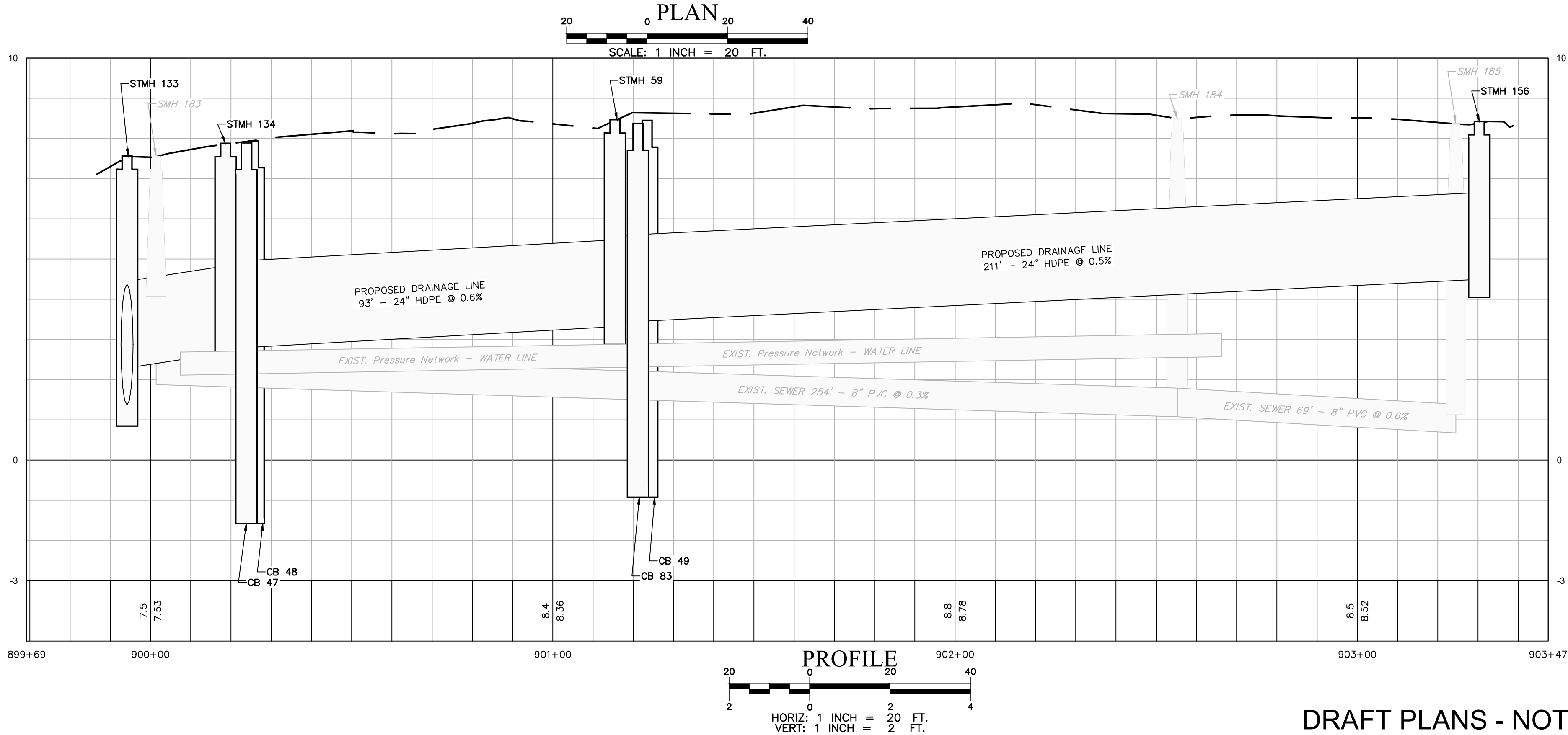
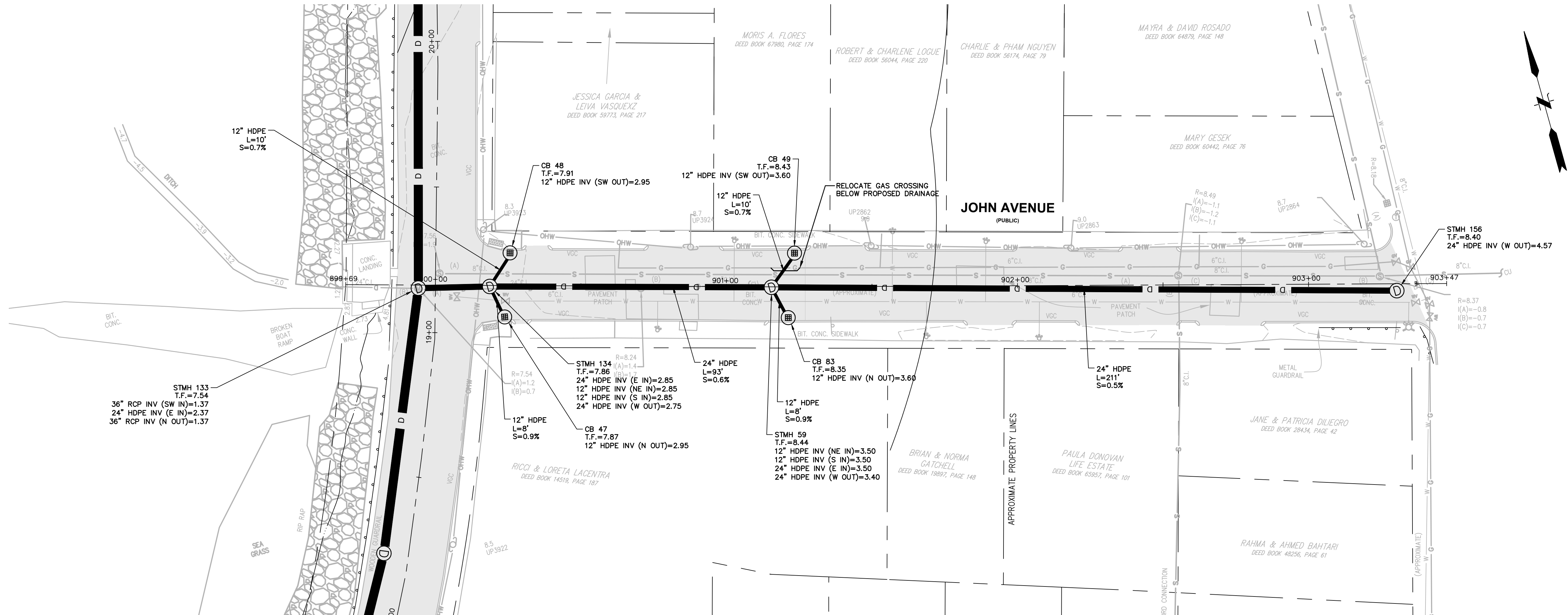
MASSACHUSETTS

CR-106



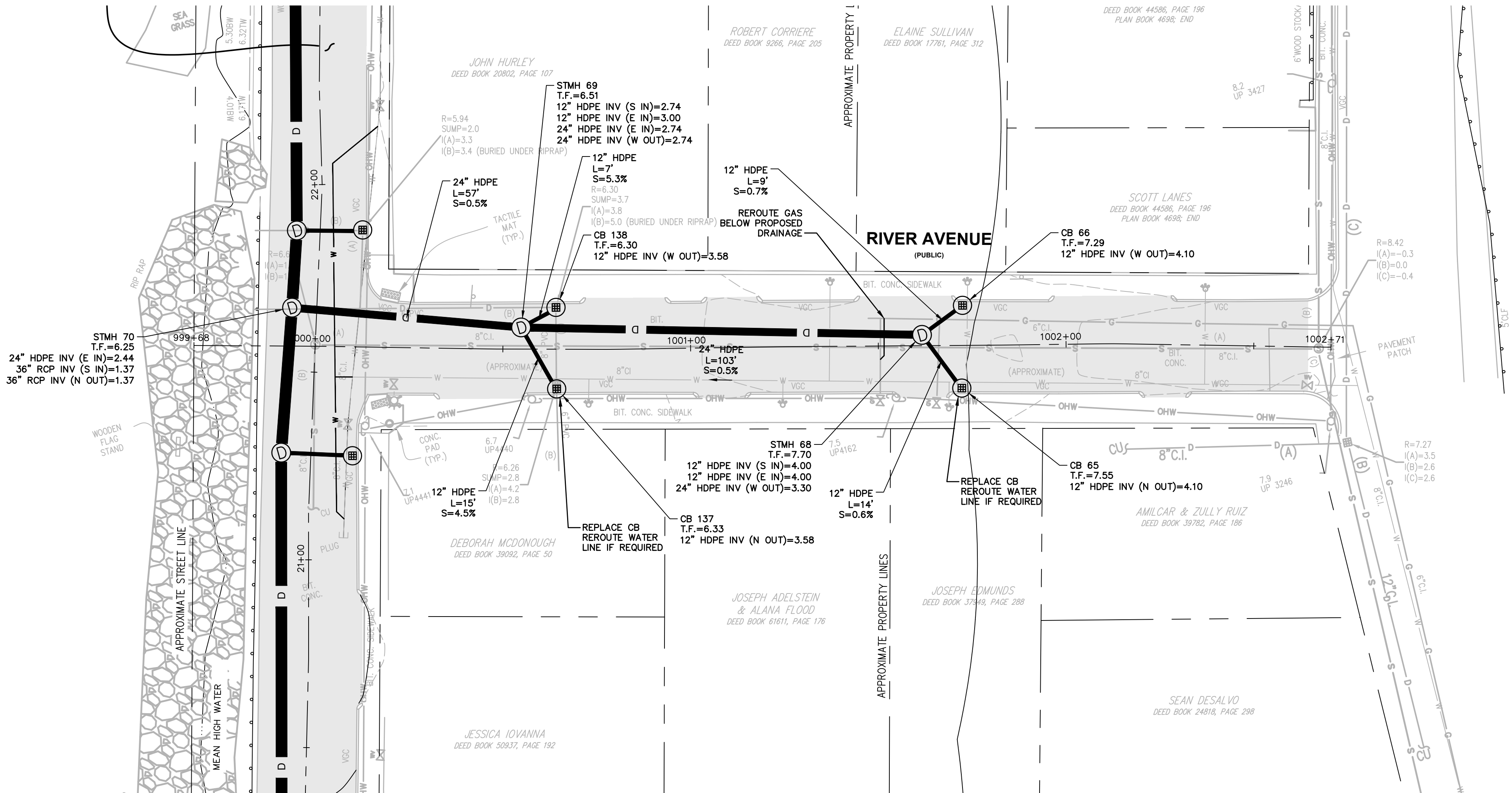
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CITY OF REVERE PLAN & PROFILE REVERE RIVERSIDE NEIGHBORHOOD REVERE MASSACHUSETTS	 1250 HANCOCK STREET, SUITE 815N QUINCY, MA 02269 617.252.4875 www.fando.com	SCALE:	SEAL			
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CR-112						

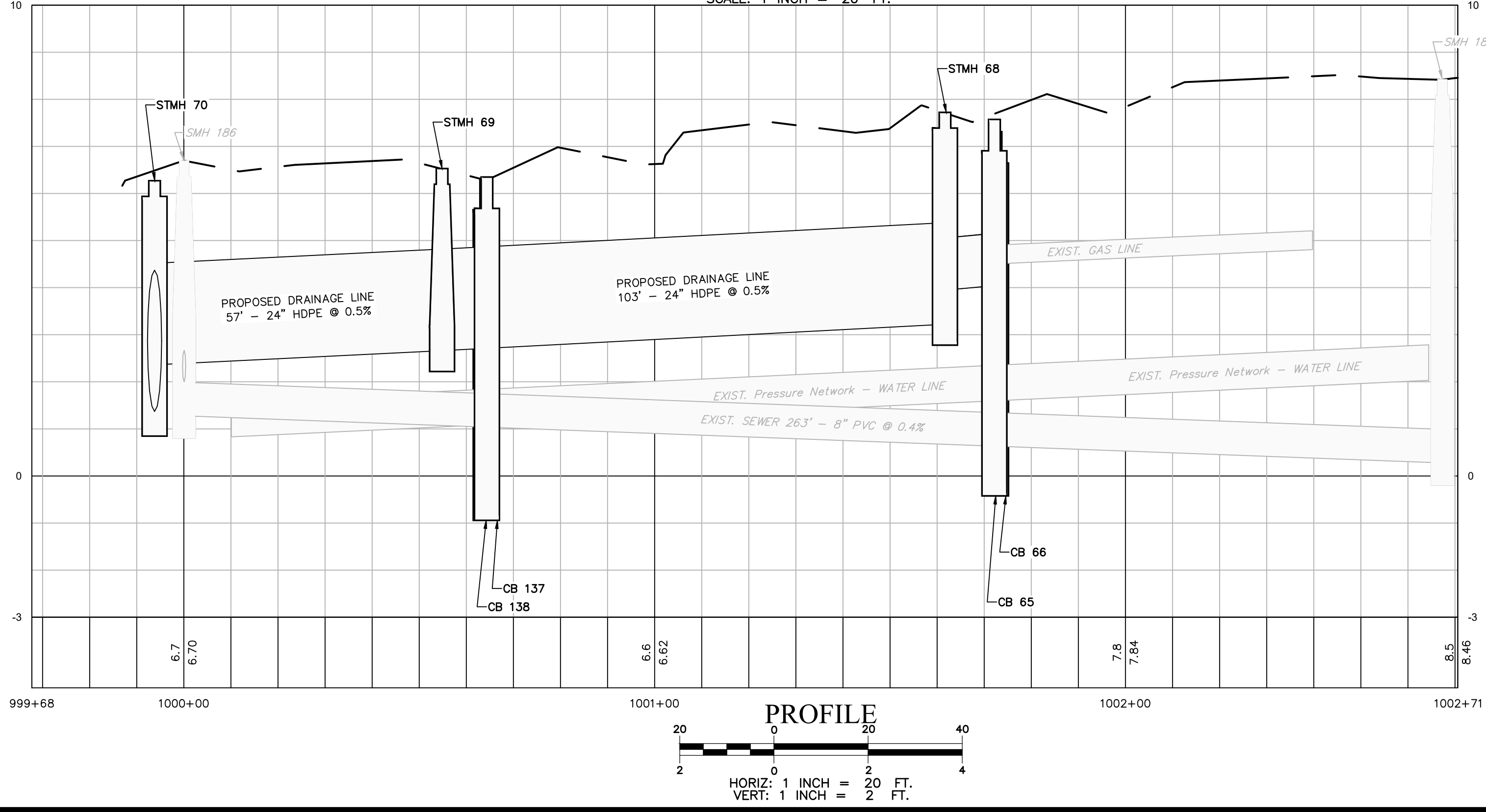


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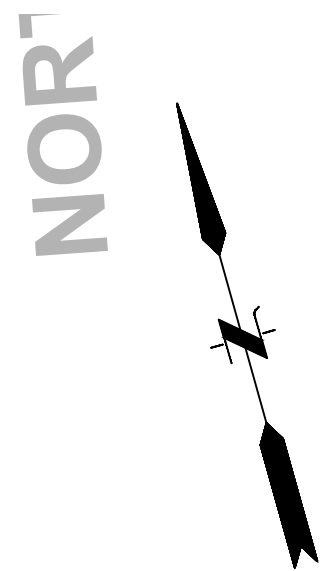
CITY OF REVERE		REVERE RIVERSIDE NEIGHBORHOOD		REVERE	
PLAN & PROFILE					
MASSACHUSETTS					
FUSS & O'NEILL 1250 HANCOCK STREET, SUITE 815N QUINCY, MA 02169 617.282.4675 www.fandc.com					
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CR-114					
SEAL		No.		DATE	
DESCRIPTION		DESIGNER		REVIEWER	



PLAN
SCALE: 1 INCH = 20 FT.



PROFILE
HORIZ: 1 INCH = 20 FT.
VERT: 1 INCH = 2 FT.



DRAFT PLANS - NOT FOR CONSTRUCTION

CITY OF REVERE		REVERE RIVERSIDE NEIGHBORHOOD		REVERE	
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MASSACHUSETTS					
PROJ. No.: 20230160.R10		DATE: 04/07/2026		CR-115	
FUSS & O'NEILL		1250 HANCOCK STREET, SUITE 815N QUINCY, MA 02169 617.282.4675 www.fandc.com			
SCALE: HORIZ: AS NOTED VERT: - DATUM: - HORIZ: - VERT: -		SEAL			
No.		DATE		DESCRIPTION	
DESIGNER		REVIEWER			



EN

NOT TO SCALE

HAYES AVENUE

THAYER AVENUE

—REVISE ROAD GRADING TO
DRAIN TOWARDS PROPOSED
CATCH BASINS

CITY OF REVERE

PUMP STATION PLAN

REVERE RIVERSIDE NEIGHBORHOOD

REVERE

**FUSS &
O'NEILL**

1250 HANCOCK STREET, SUITE 815N
QUINCY, MA 02169
617.282.4675
www.fando.com

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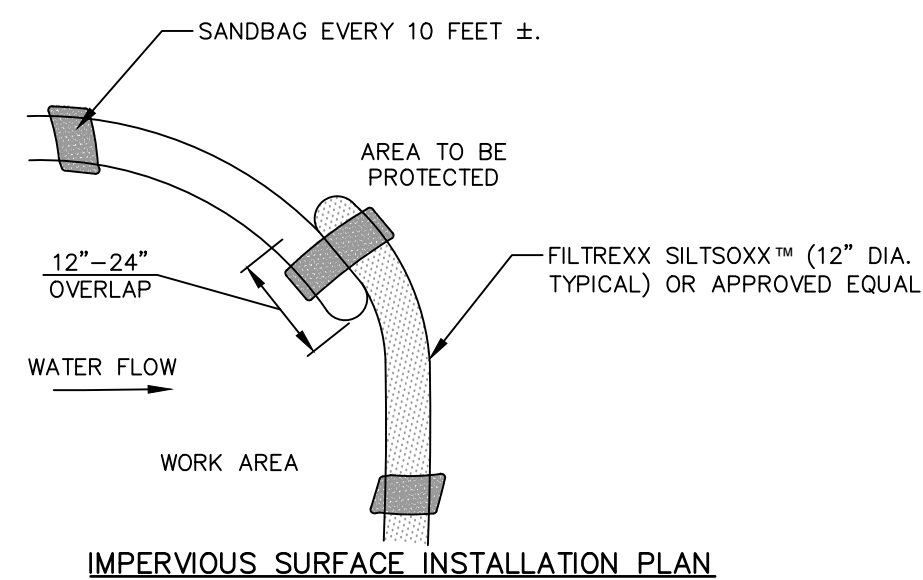
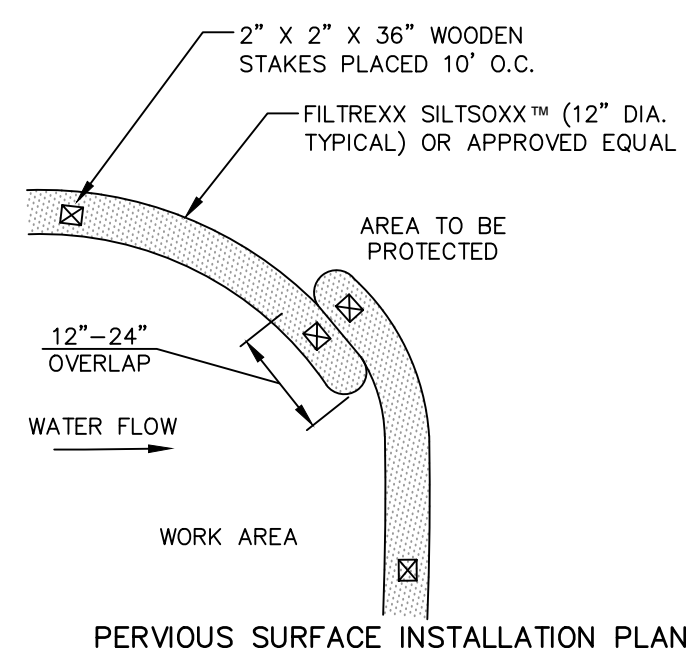
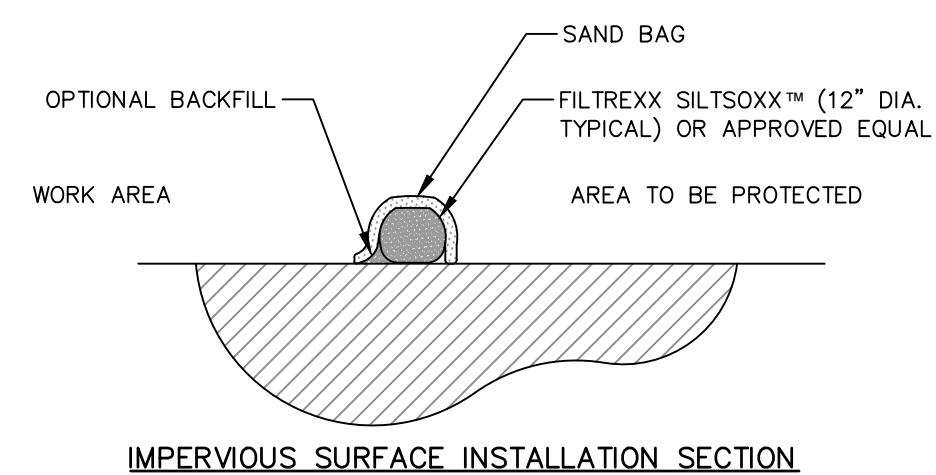
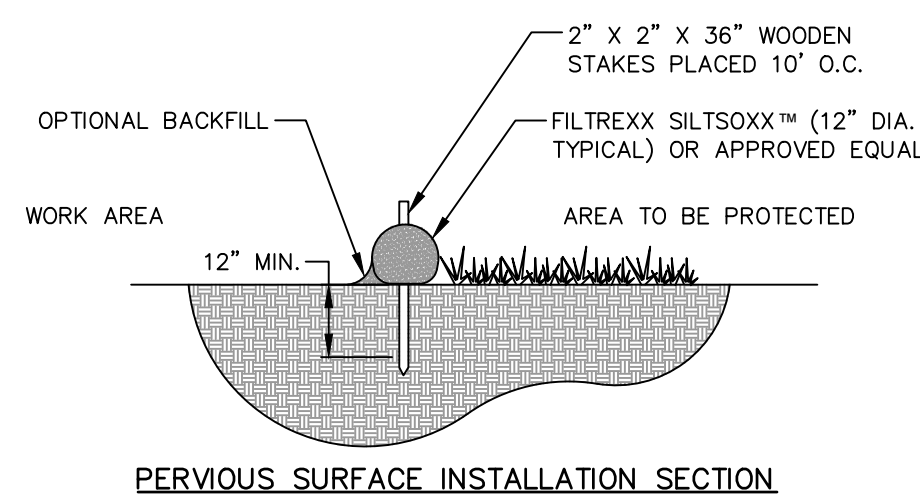
DATE _____

DESCRIPTION

REVIEWED	DESIGNED
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DRAFT PLANS - NOT FOR CONSTRUCTION

CS-201

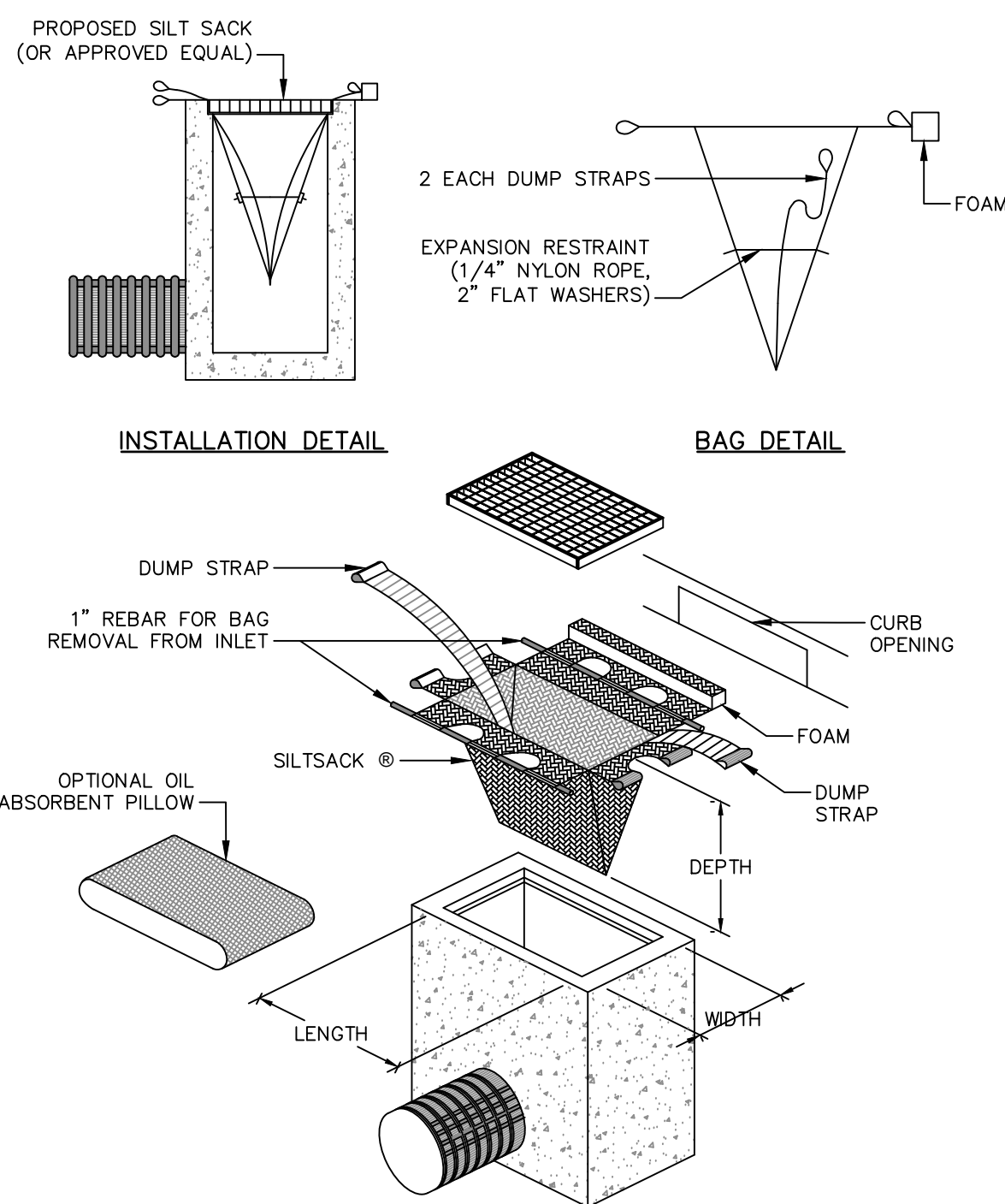


NOTES:

1. FILTER MEDIA™ FILL TO MEET APPLICATION REQUIREMENTS.
2. UPON SATISFACTORY STABILIZATION OF UPGRADE AREAS, COMPOST MATERIAL TO BE DISPERSED ON SITE, AS DETERMINED BY ENGINEER.

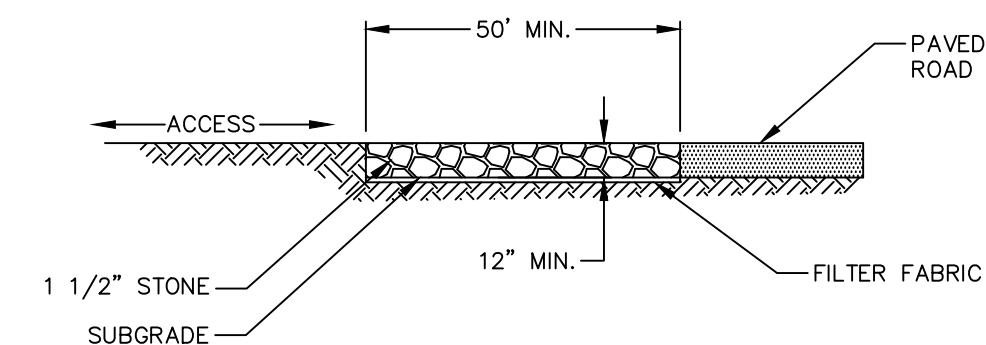
COMPOST FILTER SOCK

NOT TO SCALE



INLET PROTECTION

NOT TO SCALE

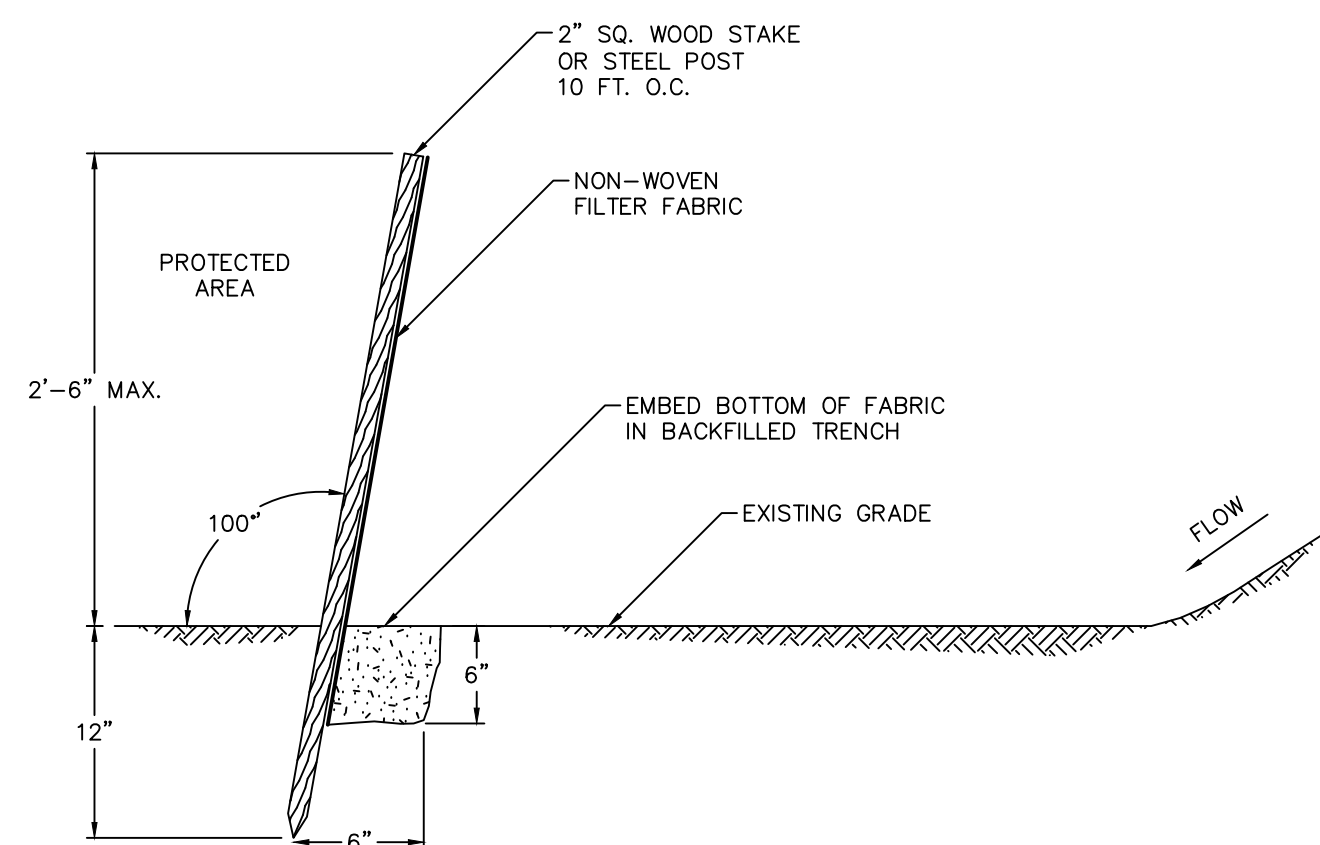


NOTES:

- 1.) MAINTAIN ANTI-TRACKING APRON IN GOOD CONDITION THROUGHOUT CONSTRUCTION PERIOD.
- 2.) ADJACENT ROADWAY SHALL BE SWEEPED DAILY TO REMOVE ANY MATERIAL THAT MAY BE TRACKED ONTO PAVEMENT.
- 3.) WIDTH OF APRON SHALL NOT BE LESS THAN WIDTH OF INGRESS OR EGRESS.

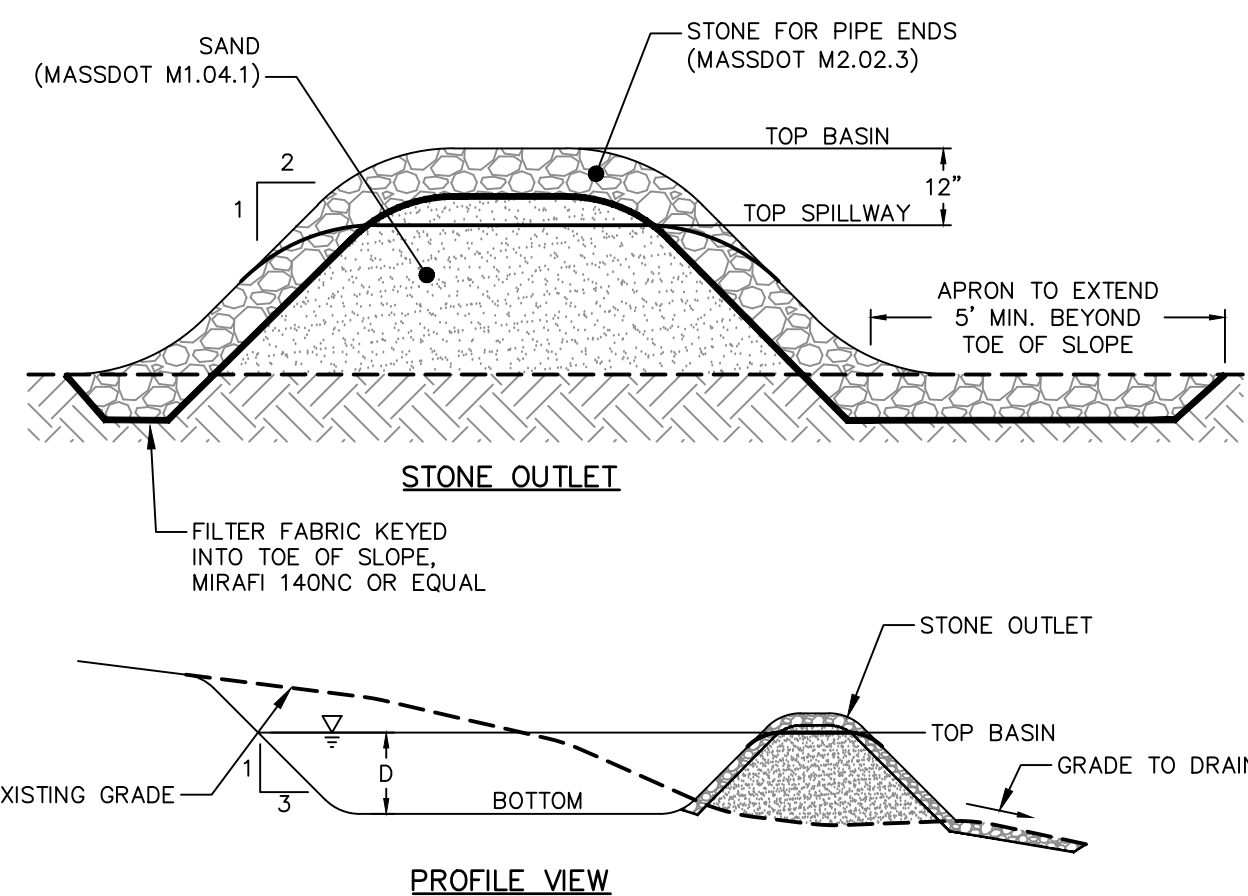
CONSTRUCTION ENTRANCE

NOT TO SCALE



SILT FENCE

NOT TO SCALE

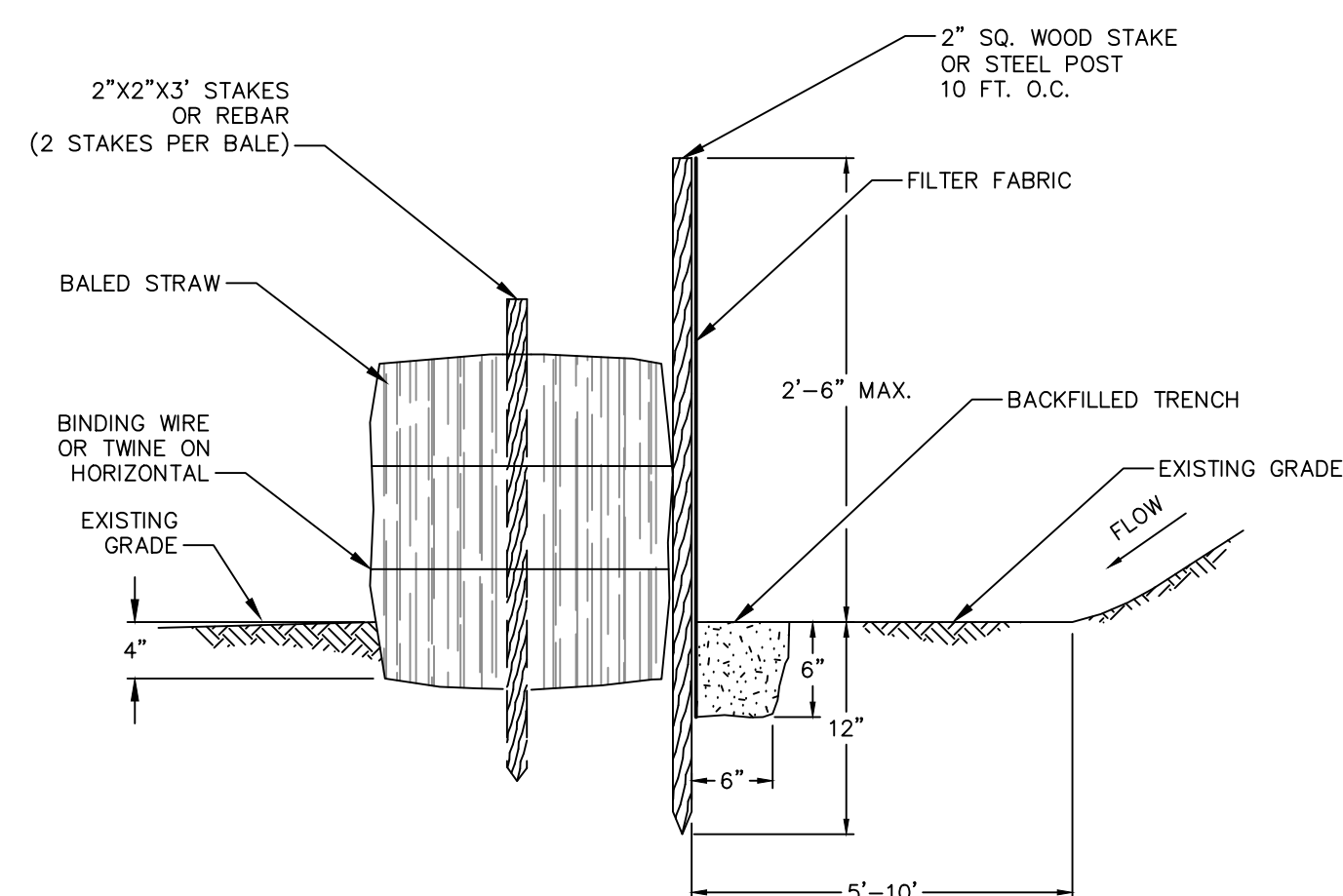


NOTES:

1. CONSTRUCT TEMPORARY SEDIMENT TRAP IN ACCORDANCE WITH THE MASSACHUSETTS EROSION AND SEDIMENT CONTROL GUIDELINES FOR URBAN AND SUBURBAN AREAS AND BASED ON ACTUAL FIELD CONDITIONS.
2. WHERE REQUIRED, TEMPORARILY MODIFY STORMWATER STRUCTURES TO LOWER INLET ELEVATION TO AFTW BASIN TO PREVENT INLET PROTECTION AT ALL INLETS.
3. STONE FOR STONE BUMP SHALL BE PLACED MECHANICALLY OR BY HAND. STONE SHALL NOT BE DUMPED DIRECTLY INTO BASIN.
4. CONTRACTOR TO INSTALL TEMPORARY SEDIMENT TRAPS AS NECESSARY. CONTRACTOR TO CONSULT WITH ENGINEER REGARDING SEDIMENT TRAP SIZING AND LOCATION.

TEMPORARY SEDIMENT TRAP

NOT TO SCALE



SILT FENCE AND HAYBALE

NOT TO SCALE

[illegible]

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VERT.:	
DATUM:	
HORIZ. -	
VERT. -	

**FUSS &
O'NEILL**

1250 HANCOCK STREET, SUITE 815
QUINCY, MA 02169
617.282.4675
www.fando.com

CITY OF REVERE

CONSTRUCTION DETAILS

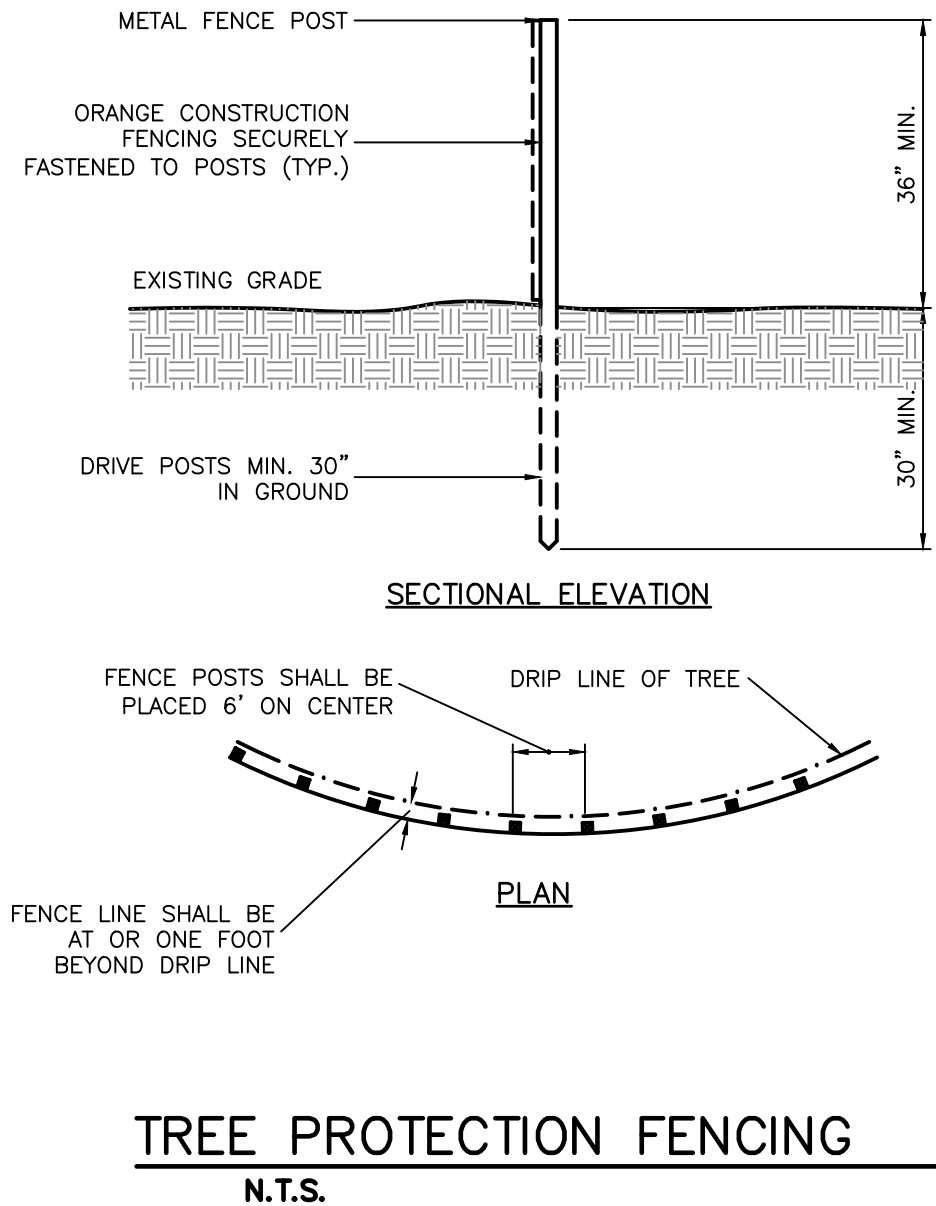
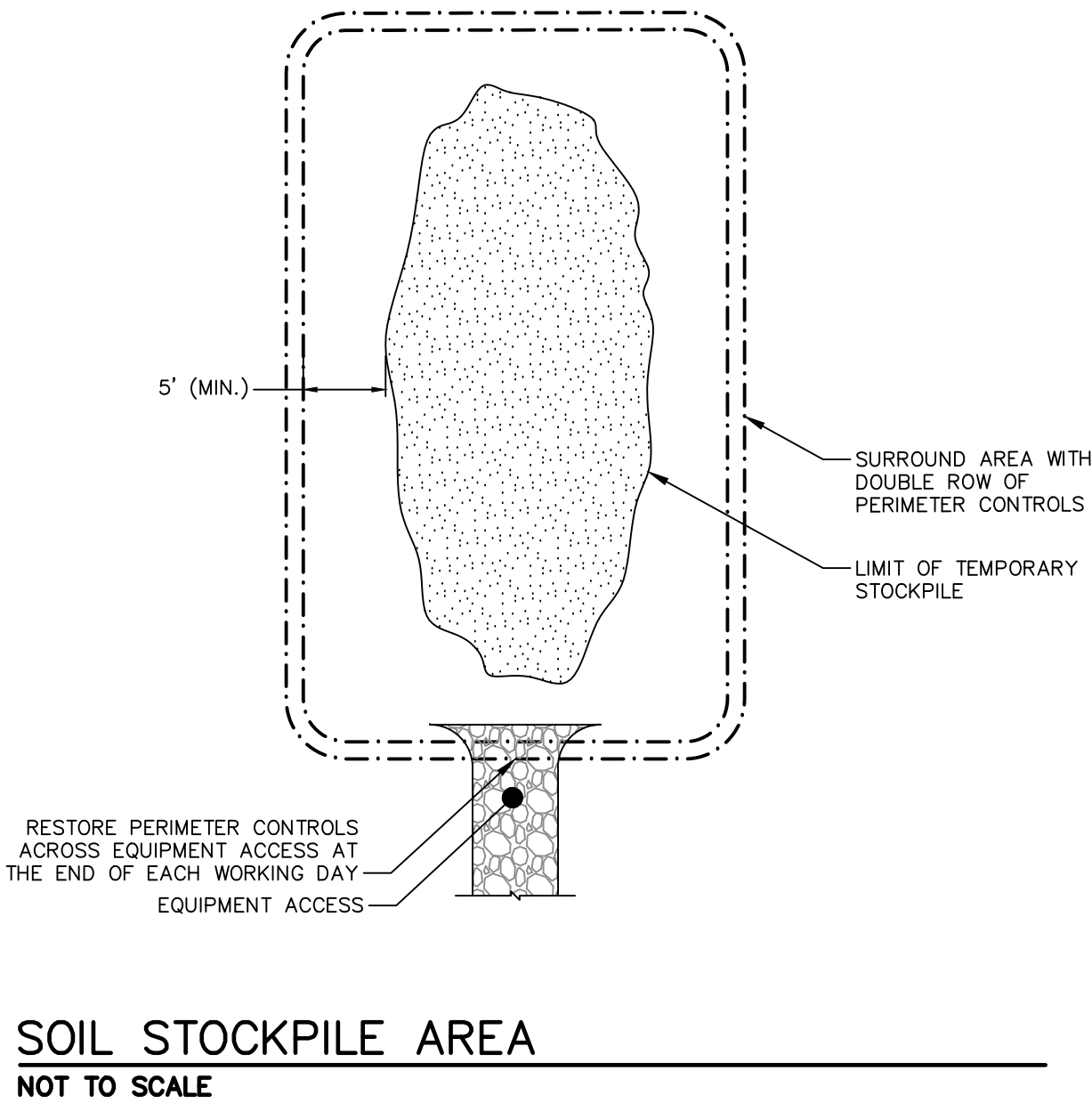
REVERE RIVERSIDE NEIGHBORHOOD

REVERE MASSACHUSETTS

PROJ. No.: 20230160.R10
DATE: 04/07/2026

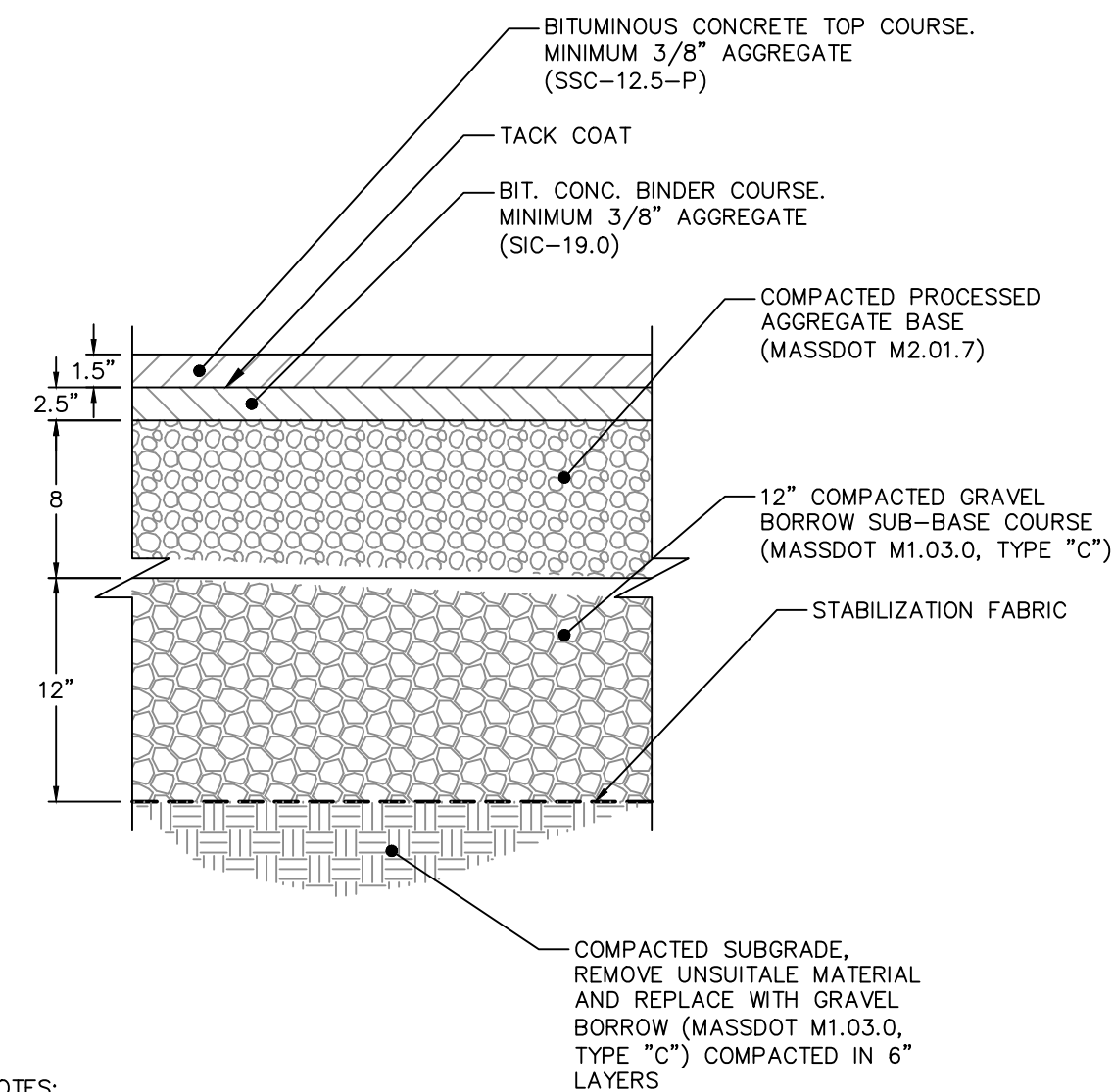
CD-502

DRAFT PLANS - NOT FOR CONSTRUCTION



DRAFT PLANS - NOT FOR CONSTRUCTION

PROJ. No.: 20230160.R10	
DATE: 04/07/2026	
CD-503	
CITY OF REVERE	
CONSTRUCTION DETAILS	
REVERE RIVERSIDE NEIGHBORHOOD	
REVERE MASSACHUSETTS	
FUSS & O'NEILL	
1250 HANCOCK STREET, SUITE 815N QUINCY, MA 02169 617.282.4675 www.fando.com	
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DESCRIPTION	
DESIGNER	REVIEWER

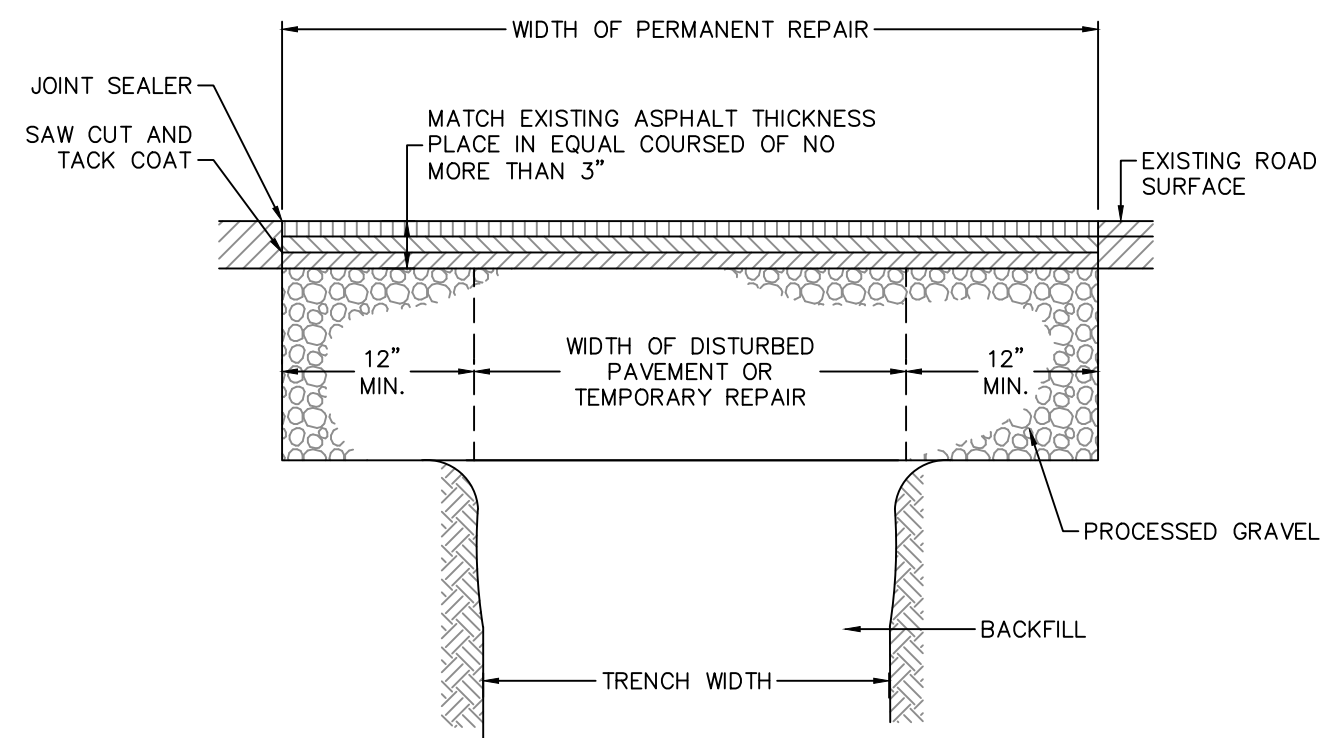


NOTES:

1. THE SOIL MUST HAVE A MOISTURE CONTENT DRY OF OPTIMUM AS DETERMINED BY THE MOISTURE-DENSITY RELATIONSHIP TEST METHOD ASTM D1557.
2. THE SOIL MUST BE COMPACTED TO 98% OF THE MAXIMUM STANDARD PROCTOR DENSITY AS DETERMINED BY THE MOISTURE-DENSITY RELATIONSHIP TEST METHOD ASTM D698.
3. THE SOIL SHALL NOT BE USED IF THE MATERIAL CONTAINS ORGANIC MATTER, RUBBLE, DEBRIS, OR ANY OTHER DELETERIOUS MATERIAL.
4. FINAL CONCRETE AND PAVING DESIGNS SHALL BE SPECIFIED IN GEOTECHNICAL RELATIONSHIP REPORT AND A GEOTECHNICAL REPORT, OWNER TO APPROVE FINAL PAVEMENT AND MATERIALS SPECIFICATION, PRIOR TO CONSTRUCTION.

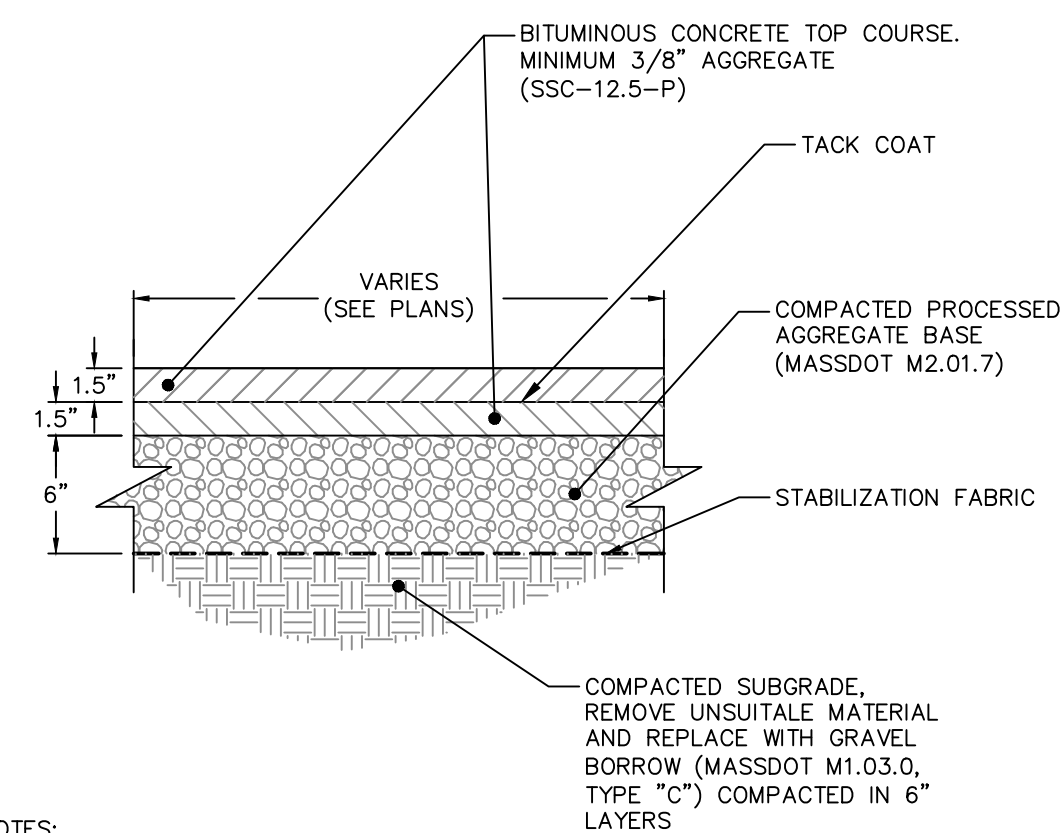
ASPHALT PAVEMENT SECTION

NOT TO SCALE



PERMANENT ASPHALT REPAIR

NOT TO SCALE



NOTES:

1. THE SOIL MUST HAVE A MOISTURE CONTENT DRY OF OPTIMUM AS DETERMINED BY THE MOISTURE-DENSITY RELATIONSHIP TEST METHOD ASTM D1557.
2. THE SOIL MUST BE COMPACTED TO 98% OF THE MAXIMUM STANDARD PROCTOR DENSITY AS DETERMINED BY THE MOISTURE-DENSITY RELATIONSHIP TEST METHOD ASTM D698.
3. THE SOIL SHALL NOT BE USED IF THE MATERIAL CONTAINS ORGANIC MATTER, RUBBLE, DEBRIS, OR ANY OTHER DELETERIOUS MATERIAL.
4. FINAL CONCRETE AND PAVING DESIGNS SHALL BE SPECIFIED IN GEOTECHNICAL RELATIONSHIP TEST METHOD ASTM D1557. GEOTECHNICAL REPORT, OWNER TO APPROVE FINAL PAVEMENT AND MATERIALS SPECIFICATION, PRIOR TO CONSTRUCTION.

ASPHALT WALK

NOT TO SCALE

[illegible]

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VERT.:	
DATUM:	
HORIZ.: -	
VERT.: -	

**FUSS &
O'NEILL**

1250 HANCOCK STREET, SUITE 810
QUINCY, MA 02169
617.282.4675
www.fando.com

CITY OF REVERE

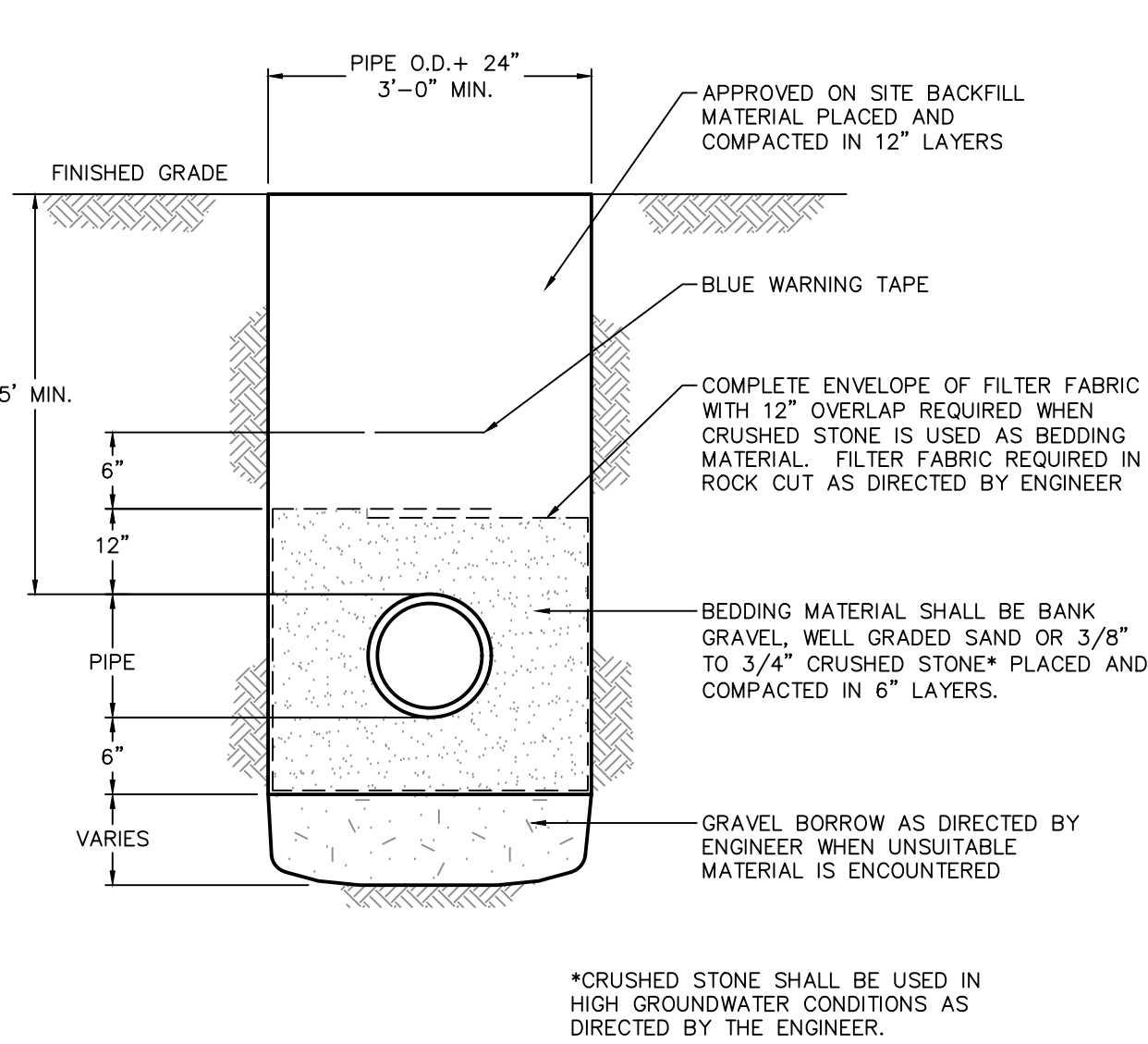
CONSTRUCTION DETAILS

REVERE RIVERSIDE NEIGHBORHOOD

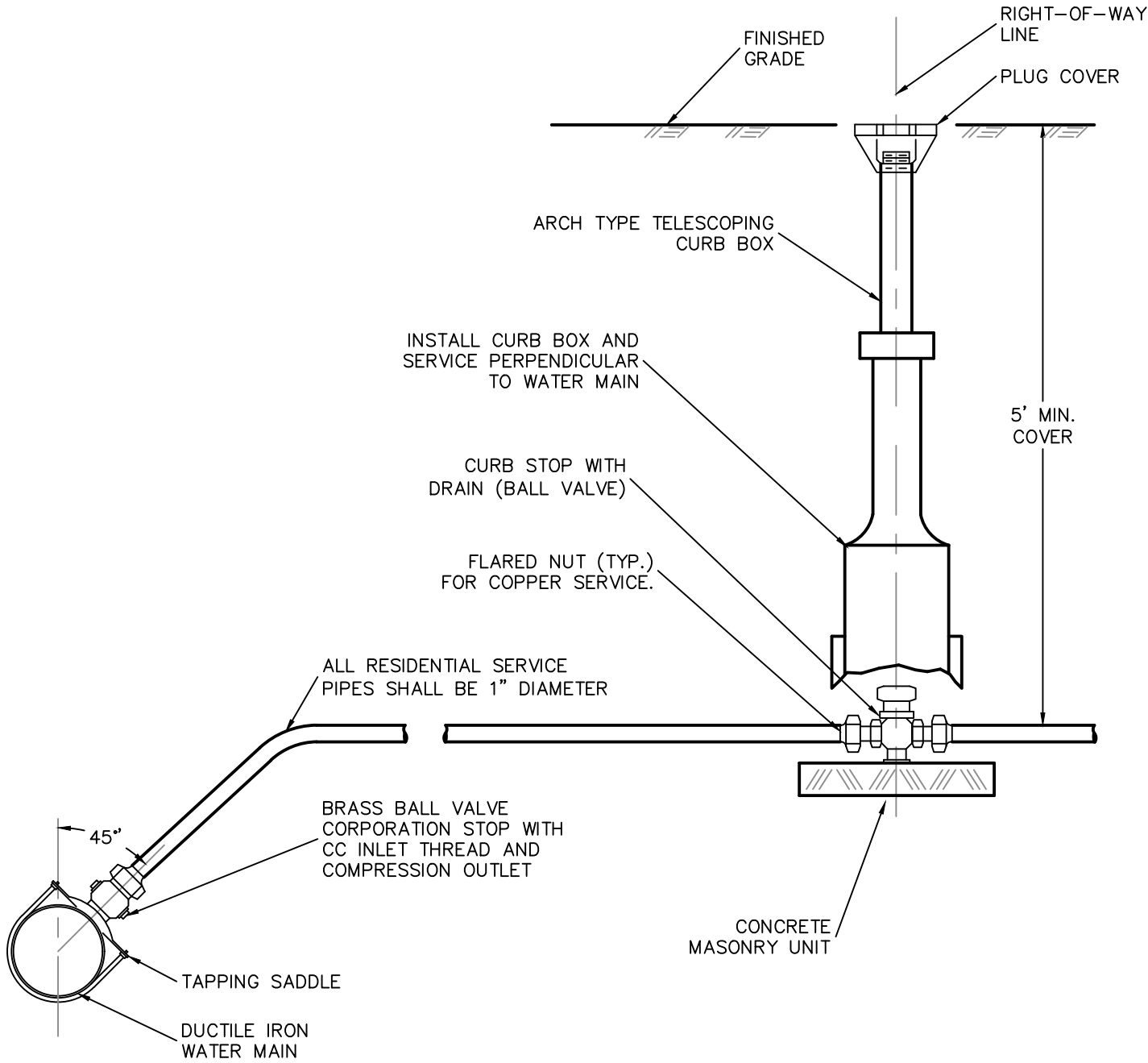
REVERE MASSACHUSETTS

PROJ. No.: 20230160.R10
DATE: 04/07/2026

CD-507



WATER MAIN TRENCH
NOT TO SCALE



WATER SERVICE CONNECTION
NOT TO SCALE

PROJ. No.: 20230160.R10		DATE: 04/07/2026		CD-508	
CITY OF REVERE		CONSTRUCTION DETAILS		REVERE RIVERSIDE NEIGHBORHOOD	
				REVERE	
				MASSACHUSETTS	
FUSS & O'NEILL		1250 HANCOCK STREET, SUITE 815N		QUINCY, MA 02169	
		617.282.4675		www.fando.com	
SCALE:		HORIZ.: NOT TO SCALE		VERT.: -	
		DATUM:		HORIZ.: -	
				VERT.: -	
SEAL		No.		DATE	
				DESCRIPTION	
				DESIGNER	
				REVIEWER	

Appendix H – Cost Estimate

1250 Hancock Street, Suite 815N
Quincy, MA 02169

F:\P2023\0160\R10\Prelim OPCC\Revere Cost Estimate 2026XXXX.xlsx

Appendix I – Draft Specifications

TECHNICAL SPECIFICATIONS

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DIVISION 00 – BIDDING AND CONTRACT REQUIREMENTS

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01 21 00 ALLOWANCES
01 22 00 UNIT PRICES
01 30 00 ADMINISTRATIVE REQUIREMENTS
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01 50 00 TEMPORARY FACILITIES AND CONTROLS
01 51 00 TEMPORARY UTILITIES
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01 55 00 TRAFFIC CONTROL
01 57 13 TEMPORARY EROSION AND SEDIMENTATION CONTROL
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Revere Riverside Neighborhood
Revere, MA

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33 14 16	WATER UTILITY DISTRIBUTION PIPING
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33 42 11	STORMWATER GRAVITY PIPING

END OF SECTION

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BID FORM

The undersigned declares that the only persons or parties interested in this Bid as principals are as stated; that the Bid is made without any collusion with other persons, firms, or corporations; that he/she has carefully examined all the Contract Documents as prepared by Fuss & O'Neill, at 281 Broadway, Revere, MA 021521 and **dated XXXXXX**. The undersigned declares that he/she has informed himself fully regarding all conditions pertaining to the Work and the place where it is to be done, and from them the undersigned makes this Bid. These prices shall cover all expenses incurred in performing the Work required under the Contract Documents, of which this Bid Form is a part.

All bids shall remain open for a period of 60 days, excluding Saturdays, Sundays, and legal holidays, after the actual date of the opening of the Bids.

The Bid Security shall be sealed in a separate envelope from the Bid and then attached to the envelope containing the Bid.

If a Notice of Award accompanied by the Agreement and all other applicable Contract Documents is delivered to the undersigned within thirty days, excluding Saturdays, Sundays, and legal holidays, after the actual date of the opening of the Bids, the undersigned will within five days, excluding Saturdays, Sundays, and legal holidays, after the date of receipt of such notification, execute and return the Agreement and all other applicable Contract Documents to the OWNER. The premiums for all Bonds required shall be paid by CONTRACTOR and shall be included in the Contract Price. The undersigned further agrees that the Bid Security accompanying this Bid shall become the property of the OWNER if the Bidder fails to execute the Agreement as stated above.

The undersigned hereby agrees that the Contract Time to complete the work shall be **350** Calendar Days (Referred to in the contract as the Substantial Completion Date), commencing ten days following the effective date of the Agreement, excluding winter shutdown periods and final paving, grading, and seeding in accordance with the terms as stated in the Agreement. Winter shutdown is from November 15 to April 1, and is weather dependent.

The undersigned further agrees to pay OWNER, as liquidated damages, \$1,000.00 per day for each calendar day beyond the Contract Time Limit or extension thereof that the Work remains incomplete, in accordance with the terms of the Agreement.

This bid will include any Addenda issued during the bid period. The undersigned acknowledges receipt of addenda numbered: _____, _____, _____, _____

In accordance with the above understanding, the undersigned proposes to perform the Work, furnish all materials and complete the Work in its entirety in the manner and under the conditions required at the prices listed as follows:

REVERE, MASSACHUSETTS
REVERE RIVERSIDE NEIGHBORHOOD RESILIENCE
BID NO. XXXXX

Bid Form

BASE BID

<u>Item No.</u>	<u>Estimated Quantity</u>	<u>Item Description</u>	<u>Unit Price In Figures</u>	<u>Amount In Figures</u>
1		REMOVE AND DISPOSAL OF PAVEMENT		
	<u>SY</u>		<u>\$</u>	<u>\$</u>
		PER SQUARE YARD		
2		REMOVE AND REPLACE UTILITY POLE		
	<u>EA</u>		<u>\$</u>	<u>\$</u>
		PER EACH		
3		TREE PROTECTION		
	<u>EA</u>		<u>\$</u>	<u>\$</u>
		PER EACH		
4		EXCAVATION BELOW NORMAL GRADE AND GRAVEL REFILL		
	<u>CY</u>		<u>\$</u>	<u>\$</u>
		PER CUBIC YARD		
5		CLASS A TRENCH EXCAVATION		
	<u>CY</u>		<u>\$</u>	<u>\$</u>
		PER CUBIC YARD		
6		DRAINAGE STRUCTURE REMOVED		
	<u>EA</u>		<u>\$</u>	<u>\$</u>
		PER EACH		

Subtotal Page \$

Revere Riverside Neighborhood
Revere, MA

7		REMOVE AND DISPOSE DRAINAGE PIPE (ALL SIZE)		
	<u>EA</u>		\$	\$
		PER EACH		
8		GRAVEL BORROW		
	<u>CY</u>		\$	\$
		PER CUBIC YARD		
9		GRAVEL BORROW FOR RIPRAP		
	<u>CY</u>		\$	\$
		PER CUBIC YARD		
10		CATCH BASIN - MUNICIPAL STANDARD		
	<u>EA</u>		\$	\$
		PER EACH		
11		DRAIN MANHOLE - MUNICIPAL STANDARD		
	<u>EA</u>		\$	\$
		PER EACH		
12		SANITARY SEWER MANHOLE MUNICIPAL STANDARD		
	<u>EA</u>		\$	\$
		PER EACH		
13		SANITARY STRUCTURE ADJUSTED		
	<u>EA</u>		\$	\$
		PER EACH		
15		DRAIN CHECK VALVE		
	<u>EA</u>		\$	\$
		PER EACH		
16		42 INCH DRAINAGE PIPE FLARED END - OPTION		
	<u>EA</u>		\$	\$
		PER EACH		

Subtotal Page \$

Revere Riverside Neighborhood
Revere, MA

17	36 INCH REINFORCED CONCRETE PIPE CLASS IV		
	FT	\$	\$
	PER LINEAR FOOT		
18	42 INCH REINFORCED CONCRETE PIPE CLASS IV		
	FT	\$	\$
	PER LINEAR FOOT		
19	HEAVY CLEANING SANITARY SEWER PIPE		
	FT	\$	\$
	PER LINEAR FOOT		
20	8 INCH POLYVINYL CHLORIDE SANITARY SEWER PIPE		
	FT	\$	\$
	PER LINEAR FOOT		
21	12 INCH CORRUGATED PLASTIC PIPE		
	FT	\$	\$
	PER LINEAR FOOT		
22	18 INCH CORRUGATED PLASTIC PIPE		
	FT	\$	\$
	PER LINEAR FOOT		
23	24 INCH CORRUGATED PLASTIC PIPE		
	FT	\$	\$
	PER LINEAR FOOT		
24	STONE FOR PIPE ENDS		
	SY	\$	\$
	PER SQUARE YARD		

Subtotal Page \$

Revere Riverside Neighborhood
Revere, MA

25	CEMENT LINED DUCTILE IRON WATER PIPE (MECHANICAL JOINT)		
	FT	\$	\$
	PER LINEAR FOOT		
26	CEMENT LINED DUCTILE IRON FITTINGS FOR WATER PIPE.		
	LBS	\$	\$
	PER POUND		
27	TEMPORARY WATER MAIN BYPASS PIPING		
	LS	\$	\$
	LUMP SUM		
28	3/4 INCH COPPER TUBING TYPE K		
	FT	\$	\$
	PER LINEAR FOOT		
29	3/4 INCH CORPORATION COCK		
	EA	\$	\$
	PER EACH		
30	CURB STOP		
	EA	\$	\$
	PER EACH		
31	MISCELLANEOUS CONCRETE		
	CY	\$	\$
	PER CUBIC YARD		
32	REINSTATE SERVICE CONNECTIONS		
	EA	\$	\$
	PER EACH		
33	WATER FOR ROADWAY DUST CONTROL		
	MGL	\$	\$
	PER ONE THOUSAND GALLONS		

Subtotal Page \$

Revere Riverside Neighborhood
Revere, MA

34	<u> </u> TON	SUPERPAVE SURFACE COURSE - 9.5 (SSC - 9.5)	<u> </u> \$	<u> </u> \$
		PER TON	<u> </u>	<u> </u>
35	<u> </u> TON	SUPERPAVE INTERMEDIATE COURSE - 19.0 (SIC - 19.0)	<u> </u> \$	<u> </u> \$
		PER TON	<u> </u>	<u> </u>
36	<u> </u> FT	SAWCUTTING ASPHALT PAVEMENT	<u> </u> \$	<u> </u> \$
		PER LINEAR FOOT	<u> </u>	<u> </u>
37	<u> </u> SY	REMOVE AND DISPOSE CONCRETE SIDEWALKS	<u> </u> \$	<u> </u> \$
		PER SQUARE YARD	<u> </u>	<u> </u>
38	<u> </u> FT	GRANITE CURB TYPE VA1 - STRAIGHT	<u> </u> \$	<u> </u> \$
		PER LINEAR FOOT	<u> </u>	<u> </u>
39	<u> </u> FT	GRANITE CURB TYPE VA1 - CURVED	<u> </u> \$	<u> </u> \$
		PER LINEAR FOOT	<u> </u>	<u> </u>
40	<u> </u> FT	GRANITE TRANSITION CURB FOR PEDESTRIAN CURB RAMPS - STRAIGHT	<u> </u> \$	<u> </u> \$
		PER LINEAR FOOT	<u> </u>	<u> </u>
41	<u> </u> FT	CURB REMOVED AND DISCARDED	<u> </u> \$	<u> </u> \$
		PER LINEAR FOOT	<u> </u>	<u> </u>

Subtotal Page \$

Revere Riverside Neighborhood
Revere, MA

42	INDIVIDUAL (TIMBER GUARDRAIL) POST REMOVED AND RESET		
	FT		
		\$	\$
	PER LINEAR FOOT		
43	SEDIMENTATION FENCE		
	FT		
		\$	\$
	PER LINEAR FOOT		
44	SILT SACK		
	EA		
		\$	\$
	PER EACH		
45	GEOTEXTILE FABRIC FOR PERMANENT EROSION CONTROL		
	SY		
		\$	\$
	PER SQUARE YARD		
46	CEMENT CONCRETE PEDESTRIAN CURB RAMP		
	TON		
		\$	\$
	PER TON		
47	TACTILE WARNING SURFACING		
	SY		
		\$	\$
	PER SQUARE YARD		
48	HOT MIX ASPHALT SIDEWALK OR DRIVEWAY		
	TON		
		\$	\$
	PER TON		
49	SIGN REMOVED AND RESET		
	EA		
		\$	\$
	PER EACH		
50	ENGINEER'S FIELD OFFICE AND EQUIPMENT (TYPE A)		
	MO		
		\$	\$
	PER MONTH		

Subtotal Page \$

Revere Riverside Neighborhood
Revere, MA

51		SEDIMENT CONTROL BARRIER		
	LF		\$	\$
		PER LINEAR FOOT		
52	LS	TRAFFIC MANAGEMENT		
			\$	\$
		LUMP SUM		
53	LS	ROADWAY FLAGGER		
			\$	\$
		PER HOUR		
54		12 INCH REFLECTORIZED WHITE LINE (PAINTED)		
	LF		\$	\$
		PER LINEAR FOOT		
55	LS	MOBILIZATION / DEMOBILIZATION		
			\$	\$
		LUMP SUM		
AL	LS	PRICE ADJUSTMENT		
LO		2% Construction Cost Subtotal	\$	\$
W-1		LUMP SUM		
ALLOW-2	LS	CLASS A ROCK EXCAVATION		
		\$10,000	\$10,000	
		ALLOWANCE		\$10,000
ALLOW-3	LS	TEST PIT FOR EXPLORATION		
			\$5,000	\$5,000
		\$5,000		
		ALLOWANCE		

Subtotal Page \$

Revere Riverside Neighborhood
Revere, MA

Subtotal Page \$ _____

Revere Riverside Neighborhood
Revere, MA

Subtotal Page 00 41 13 - 2	\$ _____
Subtotal Page 00 41 13 - 3	\$ _____
Subtotal Page 00 41 13 - 4	\$ _____
Subtotal Page 00 41 13 - 5	\$ _____
Subtotal Page 00 41 13 - 6	\$ _____
Subtotal Page 00 41 13 - 7	\$ _____
Subtotal Page 00 41 13 - 8	\$ _____

SUBTOTAL BASE BID PRICE \$ _____

TOTAL BASE BID \$ _____

BID SUMMARY

TOTAL BASE BID

_____	(\$ _____)
(use words)	(figures)

Revere Riverside Neighborhood
Revere, MA

The undersigned agrees that extra work, if any, will be performed in accordance with Article 10 of the Conditions of the Contract and will be paid for in accordance with Article 11 of the Conditions of the Contract.

The bidding and award of the Contract shall be in full compliance with M.G.L. Chapter 30, Section 39M.

The undersigned must furnish a 100 percent Performance Bond and a 100 percent Payment Bond with a surety company acceptable to the OWNER.

The above prices shall include all labor, materials, bailing, shoring, removal, overhead, profit, insurance and incidentals required to complete the Work.

Pursuant to M.G.L. Ch. 62C, sec. 49A, I certify under the penalties of perjury that I, to my best knowledge and belief, have filed all state tax returns and paid all state taxes required under law.

The undersigned hereby certifies that he/she is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the work.

The undersigned bidder hereby certifies he/she will comply with the minority workforce percentage ratio and specific affirmative action steps contained in the EEO/AA provisions of this Contract, including compliance with the Minority/Woman Business Enterprise as required under these contract provisions. The Contractor receiving the award of the contract shall be required to obtain from each of its subcontractors a copy of the certification by said subcontractor, regardless of tier, that it will comply with the minority workforce ratio and specific affirmative action steps contained in these EEO/AA contract provisions and submit it to the contracting agency prior to the award of such subcontract.

The undersigned hereby certifies under the penalties of perjury that this bid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used in this section, the word "person" shall mean any natural person, joint venture, partnership, corporation, or other business or legal entity.

The undersigned further certifies under penalty of perjury that the said undersigned is not presently debarred from doing public construction work in the Commonwealth under the provisions of Section 29F of Chapter 29, or any other applicable debarment provisions of any other chapter of the General Laws or any rule or requisition promulgated hereunder.

Social Security Number or Federal
Identification Number

Signature of Individual or Corporate Name

By: _____
Corporate Officer (if applicable)

Revere Riverside Neighborhood
Revere, MA

Notice of acceptance should be mailed, or delivered to the following:

(Name)

By: _____
(Title)

Business Address

City and State

Email

Date _____

Revere Riverside Neighborhood
Revere, MA

The bidder shall complete the section below that is applicable to their type of business:

AN INDIVIDUAL

Name (typed or printed): _____

By: _____ (SEAL)

(Individual's signature)

Doing business as: _____

A PARTNERSHIP

Partnership Name: _____ (SEAL)

By: _____
(Signature of general partner -- attach evidence of authority to sign)

Name (typed or printed): _____

A CORPORATION

Corporation Name: _____ (SEAL)

State of Incorporation: _____

Type (General Business, Professional, Service, Limited Liability): _____

By: _____
(Signature -- attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____
(CORPORATE SEAL)

Attest _____
(Signature of Corporate Secretary)

Date of Qualification to do business in _____ is ____ / ____ / ____.

A JOINT VENTURE

Name of Joint Venture: _____

First Joint Venturer Name: _____ (SEAL)

By: _____
(Signature of first joint venture partner -- attach evidence of authority to sign)

Name (typed or printed): _____

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Revere, MA

Title: _____

Second Joint Venturer Name: _____ (SEAL)

By: _____

(Signature of first joint venture partner -- attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

(Each joint venturer must sign. The manner of signing for each individual, partnership, and corporation that is a party to the joint venture should be in the manner indicated above.)

Bidder's Business Address: _____

Phone No.: _____ FAX No.: _____

E-mail: _____ FAX No.: _____

SUBMITTED ON _____, 20 ____.

State Contractor License No. _____.

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BIDDERS REFERENCE FORM

Bidders Name: _____

Project Title:

The bidder must provide five (5) references for drainage, water, and sewer replacement projects of similar size and scope performed & completed within the past five (5) years.

(1) Project Name: _____ Contact: _____

Address: _____ Phone: () _____

Description and date(s) of work:

(2) Project Name: _____ Contact: _____

Address: _____ Phone: () _____

Description and date(s) of work:

(3) Project Name: _____ Contact: _____

Address: _____ Phone: () _____

Description and date(s) of work:

(4) Reference Name: _____ Contact: _____

Address: _____ Phone: () _____

Description and date(s) of work:

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(5) Reference Name: _____ Contact: _____

Address: _____ Phone: () _____

Description and date(s) of work:

References will be contacted to confirm the bidder's skills, abilities, and qualifications to faithfully perform the work specified. The Authority reserves the right to contact references not listed above. The Bidder will be given the opportunity to explain any unfavorable references received from such outreach.

END OF SECTION

SECTION 01 10 00 - SUMMARY

PART 1 GENERAL

1.1 PROJECT

- A. Project Name: Revere Riverside Neighborhood Resilience
- B. Owner's Name: City of Revere, MA.
- C. Engineer's Name: Fuss & O'Neill.
- D. The Project consists of the construction of drainage system upgrades in the Riverside neighborhood.

1.2 CONTRACT DESCRIPTION

- A. The work of each separate prime contract is identified in this section and on Drawings.

1.3 DESCRIPTION OF ALTERATIONS WORK

- A. Scope of alterations work is indicated on drawings.

1.4 OWNER OCCUPANCY

- A. Owner intends to occupy the Project upon Substantial Completion.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.

1.5 CONTRACTOR USE OF SITE AND PREMISES

- A. Construction Operations: Limited to areas noted on Drawings.
 - 1. Locate and conduct construction activities in ways that will limit disturbance to site.
- B. Provide access to and from site as required by law and by Owner:
 - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.

1.6 SPECIFICATION SECTIONS APPLICABLE TO CONTRACT

- A. Unless otherwise noted, provisions of the sections listed below apply to contract. Specific items of work listed under individual contract descriptions constitute exceptions.
- B. Section 01 20 50 –Measurement and Payment.
- C. Section 01 21 00 – Allowances.

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- D. Section 01 22 00 – Units Prices.
- E. Section 01 30 00 – Administrative Requirements.
- F. Section 01 40 00 - Quality Requirements.
- G. Section 01 45 29 - Testing Laboratory Services.
- H. Section 01 50 00 - Temporary Facilities and Controls.
- I. Section 01 51 00 - Temporary Utilities.
- J. Section 01 52 13 - Field Offices
- K. Section 01 55 00 - Traffic Control.
- L. Section 01 57 13 - Temporary Erosion and Sediment Control.
- M. Section 01 58 13 - Temporary Project Signage.
- N. Section 01 70 00 - Execution and Closeout Requirements.
- O. Section 01 71 23 – Field Engineering.
- P. Section 01 78 00 - Closeout Submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 20 50 - MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes measurement and payment paragraphs for the Work to be completed under each pay item (lump sum and unit price) for each item on the Bid Form.
- B. All Work shall be measured and paid for in accordance with the MassDOT Standard Specifications for Highways and Bridges (2026 Edition), including all applicable Divisions, Subsections, and Standard Drawings, except as modified herein.
- C. The following MassDOT Subsections shall govern Work under this Contract, as applicable:
 - 1. Subsection 120 – Excavation
 - 2. Subsection 140 – Rock Excavation
 - 3. Subsection 201–210 – Drainage Structures
 - 4. Subsection 230–260 – Pipe Installation (sanitary and drainage systems)
 - 5. Subsection 303 – Water Mains and Appurtenances
 - 6. Subsection 450 – Hot Mix Asphalt Pavements
 - 7. Subsection 501–509 – Granite Curb and Pedestrian Elements
 - 8. Subsection 580–594 – Curb Removal and Resetting
 - 9. Subsection 601 – Guardrail (as applicable)
 - 10. Subsection 697–698 – Erosion and Sediment Controls
 - 11. Subsection 701–702 – Concrete Sidewalks and Ramps
 - 12. Subsection 734–751 – Signs and Landscaping
 - 13. Subsection 850 – Temporary Traffic Control
 - 14. Subsection 854–860 – Pavement Markings and Traffic Control Devices
 - 15. Subsection 901 – Concrete Structures (where applicable)
- D. Where discrepancies occur between this Section and the MassDOT 2026 Standard Specifications, the MassDOT Specification shall govern unless modified by the Contract Documents.

- E. No separate payment will be made for incidental Work required to complete any item unless specifically listed as a separate Bid Item.

1.3 DEFINITIONS

- A. Payment Items: The Contractor's distribution of the Contract Sum through listed work items, as outlined in this Specification.
 - 1. Each item is specified to include a defined scope of services. However, not all materials, labor, equipment, or services of a payment item are guaranteed to be listed or specified.
 - 2. Include costs associated with items of work required to complete the defined scope of services within the appropriately specified payment item.
 - 3. Payment items include all necessary material, plus cost for delivery, installation, applicable taxes, overhead, and profit.
- B. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Price by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 REMOVE AND DISPOSE PAVEMENT (ITEM 1)

- A. Measurement
 - 1. Remove and Dispose Pavement will be measured by the number of square yards of existing pavement removed and disposed within limits shown on the Contract Drawings. This includes paved roadways and sidewalks.
 - 2. Measurement will be based on the actual surface area removed, regardless of pavement thickness
- B. Payment
 - a. Payment for Remove and Dispose Pavement shall be at the Contract unit price per square yard.
 - b. Payment shall constitute full compensation for sawcutting where required, breaking, removal, loading, hauling, disposal of pavement materials, stockpiling where directed, backfilling incidental voids, cleanup, labor, equipment, tools, and all incidental work necessary to complete the item. Excavation below the pavement structure will be paid under the applicable excavation or trenching item.

3.2 UTILITY POLE REMOVAL AND REPLACEMENT (ITEM 2)

1. Measurement
 - a. Utility Pole Removal and Replacement will be measured by the number of utility poles removed and replaced, complete and accepted by the Engineer.
 - b. A measured unit shall include removal of the existing utility pole, installation of the replacement utility pole, transfer of all utility attachments, reconnection of services, disposal of surplus materials, restoration of disturbed areas, and all associated work required by the utility owner to place the replacement pole into service.
2. Payment
 - a. Payment will be made at the Contract unit price per each. Payment shall include all labor, materials, equipment, tools, transportation, excavation, backfill, disposal, restoration, coordination, permitting, scheduling, temporary support, service transfers, testing, inspections, and all incidental work necessary to complete the utility pole removal and replacement.
 - b. All utility pole removal and replacement work shall be performed by, or under the direction of, the owning utility company and shall be coordinated with the Owner or Owner's representative. The Contractor shall provide all necessary coordination with the utility owner to facilitate completion of the work.
 - c. No separate payment will be made for coordination, utility scheduling, temporary utility support, traffic control required solely for utility operations, multiple mobilizations, or any incidental work required to complete the utility pole removal and replacement.

3.3 TREE PROTECTION (ITEM 3)

1. Measurement
 - a. Tree Protection will be measured by the number of each tree protected in accordance with the Contract Documents.
2. Payment
 - a. Payment shall be made at the Contract unit price for each Tree Protection. Payment shall include furnishing all materials, installation of tree protection fencing, approved pruning performed by qualified personnel, maintenance of protection during construction, periodic adjustments, replacement of damaged materials, removal upon completion of construction, disposal of materials, labor, equipment, tools, and all incidental work required to protect designated trees.
 - b. Replacement of damaged trees shall be at Contractor's expense.

3.4 EXCAVATION BELOW NORMAL GRADE AND GRAVEL REFILL (ITEM 4)

1. Measurement
 - a. Measurement of earth excavation and gravel refill below normal grade will extend only downward for a depth determined by the Engineer in the field and for a width as defined for rock excavation. Normal grade is defined as 8-in below the bottom of the pipe to achieve 5-ft of cover. Measurement for excavation below grade shall be a minimum of one foot depth.

- b. If the trench bottom is below normal grade through error by the Contractor or if improper dewatering softens the subgrade and additional excavation in the trench is required before laying the pipe, such removal and replacement of material will not be measured for payment.
- 2. Payment
 - a. Payment for earth excavation and gravel refill below normal grade will be made for the quantity as above determined at the price per cubic yard bid in the Bid Form. Payment shall be full compensation for excavation and disposal of all materials below normal grade, furnishing, placing, and compacting gravel and all else incidental thereto for which separate payment is not provided under other items in the Bid Form. Excavation below normal grade for the purposes of replacing unsuitable soils shall include the placement of geotextile fabric between the native soil and the replacement material in this item.

3.5 CLASS A TRENCH EXCAVATION (ITEM 5)

- 1. Measurement
 - a. Measured by cubic yard of trench excavation below existing grade within the authorized trench limits shown in the Contract Documents.
- 2. Payment
 - a. Payment shall be made at the Contract unit price per cubic yard. Payment shall include excavation, sheeting and bracing when incidental, dewatering, handling groundwater, trench maintenance, loading, hauling, temporary stockpiling, disposal of surplus material, trimming trench bottoms, protection of adjacent utilities and structures, backfilling incidental voids not paid under other items, labor, equipment, tools, and all incidental work necessary to complete the work.
 - b. Bedding, borrow, and backfill materials will be paid under their respective items where applicable.

3.6 DRAINAGE STRUCTURE REMOVED (ITEM 6)

- 1. Measurement
 - a. Drainage Structure Removed will be measured by the number of drainage structures removed as shown in the Contract Documents.
- 2. Payment
 - a. Payment shall be made at the Contract unit price for each drainage structure removed. Payment shall include removal of frames, grates, covers, castings, masonry, concrete structures, pipes immediately connected to the structure where required, excavation necessary for removal, plugging or capping remaining pipes as directed, loading, hauling, disposal of materials, backfilling, compaction, restoration of disturbed areas, labor, equipment, tools, and all incidental work necessary to complete the removal.

3.7 REMOVAL AND DISPOSAL OF DRAINAGE PIPE (ALL SIZES) (ITEM 7)

1. Measurement
 - a. Removal and Disposal of Drainage Pipe (All Sizes) will be measured by the number of linear feet of existing drainage pipe removed and legally disposed of, measured along the centerline of the pipe between the inside faces of adjacent drainage structures or between other approved limits as shown in the Contract Documents.
 - b. Measurement for payment will be made to the nearest foot and will include all pipe sizes designated for removal within the Contract Documents.
2. Payment
 - a. Payment shall be made at the Contract unit price per linear foot. Payment shall constitute full compensation for disconnecting and removing existing drainage pipe of any size and material; cutting and plugging or capping remaining pipe where required; removal of collars, couplings, fittings, and miscellaneous appurtenances; loading, hauling, and legally disposing of all removed materials; protecting existing utilities and facilities; maintaining drainage during removal operations; temporary supports as required; labor; equipment; tools; and all incidental work necessary to complete the removal and disposal of the existing drainage pipe.
 - b. Trench excavation, trench support, dewatering, bedding, backfill, drainage structure removal, drainage structure installation, new drainage pipe installation, pavement restoration, and other separately identified contract items will be paid under their respective contract items unless otherwise specified.

3.8 GRAVEL BORROW (ITEM 8)

1. Measurement
 - a. Gravel Borrow will be measured by the cubic yard of material incorporated into the completed work and as shown in the Contract Documents. Its use is approved and when furnished, placed, and compacted for supplemental pavement subbase, asphalt and concrete sidewalks, and for miscellaneous uses will be measured in cubic yards at actual in-place dimensions as determined by the Engineer. When used for supplemental pavement subbase the widths for payment shall not exceed those defined for initial trench pavement (six feet). The maximum depth measured for roadway subbase shall be one foot. No allowance will be made for loss from consolidation of material. Truck measurement will not be permitted. Excavated material which is used as pavement subbase will not be measured for payment.
2. Payment
 - a. Payment shall be made at the Contract unit price per cubic yard. Payment shall include furnishing, excavation at the borrow source, processing where required, loading, hauling, placing, spreading, grading, moisture conditioning, compacting, testing incidental to construction, labor, equipment, tools, and all incidental work necessary to complete the item.

3.9 GRAVEL BORROW FOR RIPRAP (ITEM 9)

1. Measurement
 - a. Gravel Borrow for Riprap will be measured by the cubic yard of material placed beneath riprap or otherwise incorporated into the completed work as shown in the Contract Documents.
2. Payment
 - a. Payment shall be made at the Contract unit price per cubic yard. Payment shall include furnishing approved material, loading, hauling, placing, shaping, grading, compacting where required, trimming to required lines and grades, labor, equipment, tools, and all incidental work necessary to complete the work. Placement of the riprap stone will be paid under the applicable riprap item.

3.10 CATCH BASIN – MUNICIPAL STANDARD (ITEM 10)

1. Measurement
 - a. Catch Basin – Municipal Standard will be measured by the number of complete catch basins constructed, reconstructed, or installed in accordance with the Contract Documents.
2. Payment
 - a. Payment shall be made at the Contract unit price for each Catch Basin – Municipal Standard. Payment shall constitute full compensation for furnishing and installing all precast or cast-in-place concrete components, frames, grates, covers, steps where required, mortar, joint sealants, connectors, excavation necessary to install the structure, dewatering, bedding, adjusting to finished grade, backfilling, compaction, disposal of surplus material, testing incidental to construction, labor, equipment, tools, and all incidental work necessary to complete the installation.
 - b. Drainage pipe connections and pipe excavation will be paid under their respective contract items unless otherwise specified.

3.11 DRAINAGE MANHOLE – MUNICIPAL STANDARD (ITEM 11)

1. Measurement
 - a. Drainage Manhole – Municipal Standard will be measured by the number of complete manholes constructed or installed in accordance with the Contract Documents.
2. Payment
 - a. Payment shall be made at the Contract unit price for each Manhole – Municipal Standard. Payment shall include furnishing and installing all precast or cast-in-place concrete sections, base, cone, adjusting rings, frame and cover, steps where required, joint sealants, connectors, excavation necessary for installation, dewatering, bedding, backfilling, compaction, adjustment to final grade, disposal of surplus material, testing incidental to construction, labor, equipment, tools, and all incidental work necessary to complete the manhole. Pipe connections and sewer or drain pipe installation will be paid under their respective items.

3.12 SANITARY SEWER MANHOLE – MUNICIPAL STANDARD (ITEM 12)

1. Measurement
 - a. Sanitary Sewer Manhole – Municipal Standard will be measured by the number of complete sanitary sewer manholes installed in accordance with the Contract Documents.
2. Payment
 - a. Payment shall be made at the Contract unit price for each Sanitary Sewer Manhole – Municipal Standard. Payment shall include furnishing and installing all precast or cast-in-place concrete components, bases, cones, adjusting rings, frames, covers, watertight joints, resilient pipe connectors, benching and channels, excavation necessary for installation, dewatering, bedding, backfilling, compaction, adjustment to finished grade, testing, disposal of surplus material, labor, equipment, tools, and all incidental work necessary to complete the work. Sanitary sewer pipe will be paid under the applicable pipe item.

3.13 SANITARY STRUCTURE ADJUSTED (ITEM 13)

1. Measurement
 - a. Sanitary Structure Adjusted will be measured by the number of existing sanitary sewer structures adjusted to the required finished elevation as shown in the Contract Documents.
2. Payment
 - a. Payment shall be made at the Contract unit price for each Sanitary Structure Adjusted. Payment shall include removing and resetting frames and covers, furnishing adjusting rings or masonry as required, reconstructing the chimney section where necessary, mortar, joint sealants, temporary traffic protection, restoration of adjacent pavement or sidewalk immediately surrounding the adjustment, labor, equipment, tools, and all incidental work necessary to complete the adjustment.

3.14 TRASH RACK (ITEM 14)

1. Measurement
 - a. Trash Rack will be measured by the number of complete trash racks furnished and installed at the locations as shown in the Contract Documents.
 - b. The intent of the trash racks are to protect the outfall drainage pipes and drainage network from large debris.
2. Payment
 - a. Payment shall be made at the Contract unit price for each Trash Rack. Payment shall include furnishing all steel members, galvanized coatings or protective coatings, anchors, bolts, brackets, welding, fabrication, delivery, installation, concrete anchorage where required, field adjustments, labor, equipment, tools, and all incidental work necessary to complete the installation.

3.15 DRAIN CHECK VALVE (ITEM 15)

1. Measurement
 - a. Drain Check Valve will be measured by the number of drain check valves furnished, installed, tested, complete, and accepted by the Engineer.
 - b. A measured unit shall include furnishing the drain check valve assembly, all fittings, adapters, couplings, hardware, appurtenances, and all work necessary to install the valve on the drainage system in accordance with the Contract Documents.
2. Payment
 - a. Payment will be made at the Contract unit price per each. Payment shall include furnishing the drain check valve assembly, fittings, adapters, couplings, connectors, hardware, labor, equipment, tools, testing, installation, and all incidental work necessary to complete the work.
 - b. Excavation, trenching, backfilling, bedding, and pavement or surface restoration required for installation of the drain check valve shall be included in the Contract unit price unless separate contract items are provided for such work.
 - c. No separate payment will be made for field adjustments, temporary bypass pumping (where required), dewatering, coordination, testing, or any incidental work necessary to complete the installation of the drain check valve.

3.16 42 INCH DRAINAGE PIPE FLARED END – OPTION (ITEM 16)

1. Measurement
 - a. 42 Inch Drainage Pipe Flared End – Option will be measured by the number of complete flared end sections furnished and installed as shown in the Contract Documents.
2. Payment
 - a. Payment shall be made at the Contract unit price for each 42 Inch Drainage Pipe Flared End – Option. Payment shall include furnishing the flared end section, excavation necessary for installation, bedding, joint materials, connection to drainage pipe, anchorage where required, backfilling, compaction, grading around the outlet, erosion protection immediately adjacent to the installation where required, labor, equipment, tools, and all incidental work necessary to complete the installation.

3.17 36 INCH REINFORCED CONCRETE PIPE, CLASS IV (ITEM 17)

1. Measurement
 - a. 36 Inch Reinforced Concrete Pipe, Class IV will be measured by the number of linear feet of pipe installed along the centerline of the pipe between the inside faces of adjoining drainage structures or other terminal appurtenances.
2. Payment
 - a. Payment shall be made at the Contract unit price per linear foot. Payment shall include furnishing the pipe, joint materials, delivery, laying, alignment, jointing, testing incidental to installation, labor, equipment, tools, and all incidental work necessary to complete the installation. Excavation, bedding, backfill, drainage

structures, and dewatering will be paid under their respective contract items unless otherwise specified.

3.18 42 INCH REINFORCED CONCRETE PIPE, CLASS IV (ITEM 18)

1. Measurement
 - a. 42 Inch Reinforced Concrete Pipe, Class IV will be measured by the number of linear feet of pipe installed along the centerline of the pipe between the inside faces of adjoining drainage structures or other terminal appurtenances.
2. Payment
 - a. Payment shall be made at the Contract unit price per linear foot. Payment shall include furnishing the pipe, joint materials, delivery, laying, alignment, jointing, testing incidental to installation, labor, equipment, tools, and all incidental work necessary to complete the installation. Excavation, bedding, backfill, drainage structures, and dewatering will be paid under their respective contract items unless otherwise specified.

3.19 HEAVY CLEANING SANITARY SEWER PIPE (ITEM 19)

1. Measurement
 - a. Heavy Cleaning Sanitary Sewer Pipe shall be measured by the number of linear feet of existing sanitary sewer pipe cleaned within the limits shown on the plans or as directed by the Owner. Measurement shall be made along the centerline of the pipe between the inside faces of adjacent manholes or other approved limits. Only pipe lengths successfully cleaned and accepted by the Engineer shall be measured for payment.
2. Payment
 - a. Payment shall be made at the Contract unit price per linear foot for Heavy Cleaning Sanitary Sewer Pipe. Payment shall constitute full compensation for furnishing all labor, materials, equipment, and incidentals necessary to perform heavy cleaning of existing sanitary sewer mains, including mechanical cleaning, hydraulic cleaning, combination jet/vacuum cleaning, root cutting, grease removal, removal of sediment, debris, encrustation, and other obstructions; multiple cleaning passes as required to achieve the specified level of cleanliness; removal, handling, transportation, and lawful disposal of all recovered debris; temporary bypass pumping or flow control incidental to the cleaning operation where required to perform the work safely; coordination with the Owner; protection of existing utilities and facilities; maintenance of sewer service during operations; cleanup of the work area; and all other incidental work necessary to complete the item.

3.20 8 INCH POLYVINYL CHLORIDE SANITARY SEWER PIPE (ITEM 20)

1. Measurement
 - a. 8 Inch Polyvinyl Chloride Sanitary Sewer Pipe will be measured by the number of linear feet of pipe installed along the centerline of the pipe between the inside faces of adjoining sanitary sewer structures.

2. Payment

- a. Payment shall be made at the Contract unit price per linear foot. Payment shall include furnishing the pipe, fittings, couplings, joint materials, delivery, laying, alignment, testing, leakage testing, deflection testing, cleaning, temporary plugs, labor, equipment, tools, and all incidental work necessary to complete the installation. Trench excavation, bedding, backfill, dewatering, and sanitary sewer manholes will be paid for under their respective contract items unless otherwise specified.

3.21 12 INCH CORRUGATED PLASTIC PIPE ((ITEM 21))

1. Measurement

- a. 12 Inch Corrugated Plastic Pipe will be measured by the number of linear feet of pipe installed along the centerline of the pipe between the inside faces of adjoining drainage structures or terminal appurtenances.

2. Payment

- a. be made at the Contract unit price per linear foot. Payment shall include furnishing the pipe, couplings, joint materials, delivery, laying, alignment, joining, testing incidental to installation, labor, equipment, tools, and all incidental work necessary to complete the installation. Trench excavation, bedding, backfill, dewatering, drainage structures, and end sections will be paid under their respective contract items unless otherwise specified.

3.22 18 INCH CORRUGATED PLASTIC PIPE (ITEM 22)

1. Measurement

- a. 18 Inch Corrugated Plastic Pipe will be measured by the number of linear feet of pipe installed along the centerline of the pipe between the inside faces of adjoining drainage structures or terminal appurtenances.

2. Payment

- a. Payment shall be made at the Contract unit price per linear foot. Payment shall include furnishing the pipe, couplings, joint materials, delivery, laying, alignment, joining, testing incidental to installation, labor, equipment, tools, and all incidental work necessary to complete the installation. Trench excavation, bedding, backfill, dewatering, drainage structures, and end sections will be paid under their respective contract items unless otherwise specified.

3.23 24 INCH CORRUGATED PLASTIC PIPE (ITEM 23)

1. Measurement

- a. 24 Inch Corrugated Plastic Pipe will be measured by the number of linear feet of pipe installed along the centerline of the pipe between the inside faces of adjoining drainage structures or terminal appurtenances.

2. Payment

- a. Payment shall be made at the Contract unit price per linear foot. Payment shall include furnishing the pipe, couplings, joint materials, delivery, laying, alignment, joining, testing incidental to installation, labor, equipment, tools, and all incidental work necessary to complete the installation. Trench excavation, bedding, backfill,

dewatering, drainage structures, and end sections will be paid under their respective contract items unless otherwise specified.

3.24 STONE FOR PIPE ENDS (ITEM 24)

1. Measurement
 - a. Stone for Pipe Ends will be measured by the number of square yards of stone protection installed at pipe end treatments as shown in the Contract Documents.
2. Payment
 - a. Payment shall be made at the Contract unit price per square yard. Payment shall include furnishing stone, filter fabric where required, excavation incidental to placement, grading, shaping, placement, adjustment of individual stones, disposal of surplus material, labor, equipment, tools, and all incidental work necessary to complete the installation.

3.25 CEMENT LINED DUCTILE IRON WATER PIPE (MECHANICAL JOINT) ((ITEM 25)

1. Measurement
 - a. Cement Lined Ductile Iron Water Pipe (Mechanical Joint) will be measured by the number of linear feet of pipe installed along the centerline between the centers of fittings or the inside faces of adjoining structures, with no deductions for valves or fittings, as applicable. Measurement for payment does not signify that the water main is accepted. Measurement will be to the nearest foot.
2. Payment
 - a. Payment shall be made at the Contract unit price per linear foot. Payment shall constitute full compensation for furnishing and installing the Cement Lined Ductile Iron Water Pipe (Mechanical Joint), including pipe, mechanical joints, restrained joints where specified, gaskets, glands, bolts, nuts, delivery, unloading, laying, alignment, cutting, joint assembly, thrust restraint where required, disinfection, hydrostatic testing, leakage testing, flushing, temporary plugs and bulkheads, protection of existing utilities, coordination with utility owners, labor, equipment, tools, and all incidental work necessary to complete the installation.
 - b. Payment shall also include disconnecting, removing, loading, hauling, and legally disposing of the existing water main, regardless of pipe size, including all existing pipe, fittings, valves, hydrants, service saddles, restrained joints, miscellaneous appurtenances, abandoned service connections where required, and other components necessary to complete the removal.
 - c. Trench excavation, trench support, dewatering, bedding, backfill, pavement restoration, new valves, new hydrants, new service connections, corporation cocks, curb stops, gate boxes, and other separately identified contract items will be paid under their respective contract items unless otherwise specified.

3.26 CEMENT LINED DUCTILE IRON FITTINGS FOR WATER PIPE (ITEM 26)

1. Measurement
 - a. Cement Lined Ductile Iron Fittings for Water Pipe (tees, bends, crosses, reducers, solid sleeves, etc.) will be measured by the number of pounds of fittings furnished and incorporated into the completed work, based on the manufacturer's published weights. This excludes cement lining, based on tabular weights obtained from the

current ANSI Standards. The weight of the fittings shall not include the weight of glands, bolts, nuts, gaskets, or accessories.

2. Payment

- a. Payment shall be made at the Contract unit price per pound. Payment shall include furnishing fittings, cement lining, coatings, mechanical joint accessories, glands, bolts, nuts, gaskets, joint restraint where specified, delivery, installation, labor, equipment, tools, and all incidental work necessary to complete the installation.

3.27 TEMPORARY WATER MAIN BYPASS PIPING (ITEM 27)

1. Measurement

- a. The Contractor shall submit a temporary water bypass plan for review by the Engineer. Regardless of approach, temporary water required to complete the work will be paid under this item on a lump sum basis inclusive of the temporary water main, connections, and fittings actually furnished, installed, disinfected, tested, and removed by the Contractor. Smaller pipes which are provided for temporary service connections, house connections, or other purposes shall be included in the lump sum price.

2. Payment

- a. Payment for furnishing, installing, disinfecting, maintaining, and removing temporary bypass pipe and services of all sizes, will be made for the respective quantities as above determined, at the applicable price per lump sum. Such Price and Payment shall be full compensation for furnishing all labor, equipment and materials for installing the pipe, for all excavation including removing existing pavements, placing and removing decking, berms, backfilling, protecting and maintaining the temporary piping during the construction period, temporary and permanent paving where the temporary pipe and services cross the street or driveways, furnishing, installing and connecting temporary service pipes to existing hydrants, and providing temporary hydrants and other facilities required in connection with the temporary service piping and dewatering of mains for the purpose of replacing water mains, providing tap holes, pressure reducing valves if necessary, chlorinating temporary pipe, restoring lawns, restoring sidewalks and other surfaces in private or public property disturbed by the Contractor's operations, all as specified and all else incidental thereto for which separate payment is not provided under other items in the Bid Form. Temporary services from temp main to customers is included in this pay item including connection to sill cocks or excavation to service box if necessary.

3.28 3/4 INCH COPPER TUBING TYPE K (ITEM 28)

1. Measurement

- a. 3/4 Inch Copper Tubing Type K will be measured by the number of linear feet of tubing installed.

2. Payment

- a. Payment shall be made at the Contract unit price per linear foot. Payment shall include furnishing copper tubing, fittings, couplings, joint materials, installation, testing, flushing, disinfection where required, labor, equipment, tools, and all incidental work necessary to complete the installation. Corporation cocks, curb stops, and service reconnections will be paid under their respective contract items.

3.29 3/4 INCH CORPORATION COCK (ITEM 29)

1. Measurement
 - a. 3/4 Inch Corporation Cock will be measured by the number of corporation cocks furnished and installed.
2. Payment
 - a. Payment shall be made at the Contract unit price for each Curb Stop. Payment shall include furnishing the curb stop, curb stop box, fittings, installation, adjustment to finished grade, testing, labor, equipment, tools, and all incidental work necessary to complete the installation.

3.30 CURB STOP (ITEM 30)

1. Measurement
 - a. Curb Stop will be measured by the number of curb stops furnished and installed.
2. Payment
 - a. Payment shall be made at the Contract unit price for each 3/4 Inch Corporation Cock. Payment shall include furnishing the corporation cock, tapping sleeve where required, tapping the water main, installation, testing, disinfection, labor, equipment, tools, and all incidental work necessary to complete the installation.

3.31 MISCELLANEOUS CONCRETE (ITEM 31)

1. Measurement
 - a. Miscellaneous Concrete will be measured by the number of cubic yards of concrete placed as shown in the Contract Documents.
 - b. Concrete placed for thrust blocks, encasements, collars, and miscellaneous purposes as shown in the Contract Documents will be measured in cubic yards.
2. Payment
 - a. Payment for concrete thrust blocks, encasements, collars, and concrete used for miscellaneous purposes shall include furnishing all concrete materials, mixing, transporting, placing, consolidating, finishing, curing, protection, construction joints, forming, stripping forms, reinforcing incidental to miscellaneous concrete items where not separately paid, labor, equipment, tools, and all incidental work necessary to complete the work, complete as shown on the Drawings and as specified herein.

3.32 REINSTATE SERVICE CONNECTIONS (ITEM 32)

1. Measurement
 - a. Reinstate Service Connections will be measured by the number of existing utility service connections successfully reinstated as shown in the Contract Documents.
2. Payment
 - a. Payment shall be made at the Contract unit price for each service connection reinstated. Payment shall include locating existing services, disconnecting and reconnecting services as required, furnishing incidental fittings and couplings, testing, restoration of service, coordination with utility owners and property

owners, excavation incidental to reconnection, backfilling, disposal of surplus material, labor, equipment, tools, and all incidental work necessary to complete the work. New service pipe, corporation cocks, curb stops, and other separately listed pay items will be paid under their respective contract items.

3.33 WATER FOR ROADWAY DUST CONTROL (ITEM 33)

1. Measurement
 - a. Water for Roadway Dust Control will be measured by the number of thousand gallons (MGL) of water furnished, applied, and accepted by the Engineer. Quantities shall be determined from calibrated distributor tank capacities or other approved methods.
2. Payment
 - a. Payment shall be made at the Contract unit price per thousand gallons. Payment shall include furnishing water, loading, transporting, applying water as directed, maintaining approved application equipment, labor, equipment, tools, and all incidental work necessary to control dust during construction. No separate payment will be made for water applied for compaction, curing concrete, testing, or other construction operations where such water is incidental to other contract items.

3.34 SUPERPAVE SURFACE COURSE – 9.5 (SSC-9.5) (ITEM 34)

1. Measurement
 - a. Superpave Surface Course – 9.5 will be measured by the number of tons of hot mix asphalt incorporated into the completed work. Quantities shall be determined from certified weigh slips for material accepted and placed in accordance with the Contract Documents.
2. Payment
 - a. Payment shall be made at the Contract unit price per ton. Payment shall include furnishing all asphalt mixture, heating, hauling, placement, spreading, paving, joint construction, rolling, compaction, finishing, labor, equipment, tools, and all incidental work necessary to complete the work. Tack coat, pavement milling, temporary pavement markings, and adjusting castings will be paid under their respective contract items unless otherwise specified.

3.35 SUPERPAVE INTERMEDIATE COURSE – 19.0 (SIC-19.0) (ITEM 35)

1. Measurement
 - a. Superpave Intermediate Course – 19.0 will be measured by the number of tons of asphalt mixture incorporated into the completed work as determined from certified weigh slips.
2. Payment
 - a. Payment shall be made at the Contract unit price per ton. Payment shall include furnishing all asphalt mixture, transporting, placement, spreading, joint construction, rolling, compaction, finishing, labor, equipment, tools, and all incidental work necessary to complete the work. Tack coat and pavement preparation will be paid under their respective contract items unless otherwise specified.

3.36 SAWCUTTING ASPHALT PAVEMENT (ITEM 36)

1. Measurement
 - a. Sawcutting Asphalt Pavement will be measured by the number of linear feet of completed sawcuts as shown in the Contract Documents.
2. Payment
 - a. Payment shall be made at the Contract unit price per linear foot. Payment shall include layout, furnishing all equipment, cutting to the required depth, water, slurry control, cleanup, disposal of slurry and debris, labor, equipment, tools, and all incidental work necessary to complete the work.

3.37 REMOVE AND DISPOSE OF CONCRETE SIDEWALK (ITEM 37)

1. Measurement
 - a. Remove and Dispose of Concrete Sidewalk will be measured by the number of square yards of existing concrete sidewalk removed and properly disposed of, complete and accepted by the Engineer.
 - b. The measured area shall include full-depth removal of the existing concrete sidewalk, including sidewalk panels, and any incidental saw cutting required to provide neat and straight edges at the limits of removal.
2. Payment
 - a. Payment will be made at the Contract unit price per square yard. Payment shall constitute full compensation for saw cutting, breaking, removal, loading, hauling, transportation, and lawful disposal of existing concrete sidewalk; removal of reinforcing steel or welded wire fabric, where present; protection of adjacent facilities; labor, equipment, tools, and all incidental work necessary to complete the work.
 - b. Excavation below the existing sidewalk subbase, replacement of unsuitable material, installation of new sidewalk, loam and seed, pavement restoration, or other work specified as separate Contract items will be paid for under their respective Contract items.
 - c. No separate payment will be made for temporary pedestrian access, dust control, cleanup, disposal fees, restoration of minor disturbed areas, or any incidental work required to complete the removal and disposal of the concrete sidewalk.

3.38 GRANITE CURB TYPE VA1 – STRAIGHT (ITEM 38)

1. Measurement
 - a. Granite Curb Type VA1 – Straight will be measured by the number of linear feet of curb installed along the front arris of the completed curb. The measurement will be made along the edging at the lowest exposed level.
2. Payment
 - a. Payment shall be made at the Contract unit price per linear foot. Payment shall include all excavation, removal and disposal of existing curbing, furnishing granite curb, excavation incidental to installation, concrete foundation where required, setting, alignment, jointing, backing, finishing, backfilling, disposal of surplus

material, labor, equipment, tools, and all incidental work necessary to complete the installation.

3.39 GRANITE CURB TYPE VA1 – CURVED (ITEM 39)

1. Measurement
 - a. Granite Curb Type VA1 – Curved will be measured by the number of linear feet of completed curb installed along the arris face of the curb. The measurement will be made along the edging at the lowest exposed level.
2. Payment
 - a. Payment shall be made at the Contract unit price per linear foot. Payment shall include removal and disposal of existing curved curbing, furnishing curved granite curb, excavation incidental to installation, concrete foundation where required, setting, alignment, jointing, backing, finishing, backfilling, labor, equipment, tools, and all incidental work necessary to complete the work.

3.40 GRANITE TRANSITION CURB FOR PEDESTRIAN CURB RAMPS – STRAIGHT (ITEM 40)

1. Measurement
 - a. Granite Transition Curb for Pedestrian Curb Ramps – Straight will be measured by the number of linear feet installed.
2. Payment
 - a. Payment shall be made at the Contract unit price per linear foot. Payment shall include furnishing transition granite curb, cutting where required, excavation incidental to installation, concrete foundation, setting, alignment, jointing, finishing, backfilling, labor, equipment, tools, and all incidental work necessary to complete the installation.

3.41 CURB REMOVED AND DISCARDED (ITEM 41)

1. Measurement
 - a. Curb Removed and Discarded will be measured by the number of linear feet of curb removed and disposed of.
2. Payment
 - a. Payment shall be made at the Contract unit price per linear foot. Payment shall include removal, loading, hauling, disposal, excavation incidental to removal, backfilling incidental voids, cleanup, labor, equipment, tools, and all incidental work necessary to complete the removal.

3.42 INDIVIDUAL (TIMBER GUARDRAIL) POST REMOVED AND RESET (ITEM 42)

1. Measurement
 - a. Individual Timber Guardrail Post Removed and Reset will be measured by the number of existing guardrail posts, and associated timber rails, removed, reset, as shown in the Contract Documents.

2. Payment

- a. Payment shall be made at the Contract unit price for each post removed and reset. Payment shall include removal of the existing post, excavation, furnishing replacement hardware as required, resetting the post to proper alignment and grade, backfilling, compaction, reconnecting guardrail components, labor, equipment, tools, and all incidental work necessary to complete the work.

3.43 SEDIMENTATION FENCE (ITEM 43)

1. Measurement

- a. Sedimentation Fence will be measured by the number of linear feet of fence installed, maintained, as shown in the Contract Documents.

2. Payment

- a. Payment shall be made at the Contract unit price per linear foot. Payment shall include furnishing posts, geotextile fabric, fastening hardware, trenching, installation, maintenance throughout construction, repairs, removal upon completion where required, disposal of materials, labor, equipment, tools, and all incidental work necessary to complete the work.

3.44 SILT SACK (ITEM 44)

1. Measurement

- a. Silt Sack will be measured by the number of silt sacks installed, maintained, as shown in the Contract Documents.

2. Payment

- a. Payment shall be made at the Contract unit price for each Silt Sack. Payment shall include furnishing the silt sack, installation, maintenance, sediment removal, replacement when required, removal upon completion, disposal of collected sediment and materials, labor, equipment, tools, and all incidental work necessary to complete the work.

3.45 GEOTEXTILE FABRIC FOR PERMANENT EROSION CONTROL (ITEM 45)

1. Measurement

- a. Geotextile Fabric for Permanent Erosion Control will be measured by the number of square yards of fabric incorporated into the completed work.

2. Payment

- a. Payment shall be made at the Contract unit price per square yard. Payment shall include furnishing geotextile fabric, surface preparation, placement, overlaps, fastening, anchoring, trimming, labor, equipment, tools, and all incidental work necessary to complete the installation. Riprap or other overlying materials will be paid under their respective contract items.

3.46 CEMENT CONCRETE PEDESTRIAN CURB RAMP (ITEM 46)

1. Measurement
 - a. Cement Concrete Pedestrian Curb Ramp will be measured by the number of square yards of completed curb ramp surface constructed, as shown in the Contract Documents.
 - b. The intent of is to reconstruct any existing ADA compliant ramp disturbed by the work as needed.
2. Payment
 - a. Payment shall be made at the Contract unit price per square yard. Payment shall include excavation incidental to construction, furnishing and placing concrete, reinforcing where required by the plans, forming, finishing, curing, construction all joint types, detectable warning panel installation where specified, grading, backfilling, disposal of surplus material, labor, equipment, tools, and all incidental work necessary to complete the curb ramp.

3.47 TACTILE WARNING SURFACING (ITEM 47)

1. Measurement
 - a. Tactile Warning Surfacing will be measured by the number of square feet of completed detectable warning surface installed in accordance with the Contract Documents.
 - b. Measurement shall include only the exposed detectable warning surface installed at curb ramps, blended transitions, and pedestrian street crossings where shown on the Plans or directed by the Engineer. No separate measurement will be made for anchoring devices, adhesives, fasteners, trimming, or other incidental materials required for installation.
2. Payment
 - a. Payment shall be made at the Contract unit price per square foot.
 - b. Payment shall include furnishing and installing the detectable warning surface, all anchors, adhesives, fasteners, bedding materials where required by the manufacturer, cutting and fitting, surface preparation, layout, alignment, field trimming, replacement of damaged panels, protection during construction, labor, equipment, tools, and all incidentals necessary to complete the work in accordance with the Contract Documents and the MassDOT Standard Specifications.
 - c. No separate payment will be made for incidental materials, hardware, sealing, cleanup, or replacement of damaged tactile warning surfaces resulting from the Contractor's operations, as these costs shall be included in the Contract unit price for Tactile Warning Surfacing.

3.48 HOT MIX ASPHALT SIDEWALK OR DRIVEWAY (ITEM 48)

1. Measurement
 - a. Hot Mix Asphalt Sidewalk or Driveway will be measured by the number of tons of asphalt mixture incorporated into the completed work as determined from certified weigh slips.

2. Payment

- a. Payment shall be made at the Contract unit price per ton. Payment shall include furnishing all asphalt mixture, hauling, placement, spreading, grading, rolling, compaction, joint construction, finishing, labor, equipment, tools, and all incidental work necessary to complete the work. Excavation, gravel base, processed aggregate base, and tack coat will be paid under their respective contract items unless otherwise specified.

3.49 SIGN REMOVED AND RESET (ITEM 49)

1. Measurement

- a. Sign Removed and Reset will be measured by the number of existing signs actually removed, stored where required, reinstalled at the designated location, and accepted by the Owner.

2. Payment

- a. Payment shall be made at the Contract unit price for each Sign Removed and Reset. Payment shall include removing the existing sign panel, posts, brackets, and hardware as required; temporary storage; furnishing replacement hardware incidental to reinstallation; resetting the sign to the required line, grade, and orientation; excavation incidental to resetting; backfilling; disposal of damaged or unusable incidental materials; labor, equipment, tools, and all incidental work necessary to complete the work. New sign panels and posts specifically called for on the plans will be paid under their respective contract items.

3.50 ENGINEER'S FIELD OFFICE AND EQUIPMENT (TYPE A) (ITEM 50)

1. Measurement

- a. Engineer's Field Office and Equipment (Type A) will be measured by the number of months that the office and required equipment are provided, maintained, and available for the exclusive use of the Engineer in accordance with the Contract Documents.

2. Payment

- a. Payment shall be made at the Contract unit price per month. Payment shall include furnishing, transporting, installing, maintaining, heating, cooling, lighting, utilities, communications, office furniture, equipment, cleaning, snow removal, security, routine maintenance, final removal of the office and equipment, restoration of the site, labor, materials, equipment, tools, and all incidental work necessary to satisfy the Contract requirements.

3.51 SEDIMENT CONTROL BARRIER (ITEM 51)

1. Measurement

- a. Sediment Control Barrier will be measured by the number of linear feet installed, maintained, as shown in the Contract Documents.

2. Payment

- a. Payment shall be made at the Contract unit price per linear foot. Payment shall include furnishing all barrier materials, installation, anchorage, maintenance throughout construction, repairs, sediment removal, replacement when necessary,

removal upon completion where required, disposal of materials, labor, equipment, tools, and all incidental work necessary to complete the work.

3.52 TRAFFIC MANAGEMENT (ITEM 52)

1. Measurement
 - a. Traffic Management Control will be measured for payment on a Lump Sum basis. No separate measurement will be made for individual traffic control devices, personnel, equipment, maintenance, relocations, or other incidental traffic management activities required to complete the Work in accordance with the Contract Documents.
2. Payment
 - a. Payment shall be made at the Contract Lump Sum price. Payment shall include preparation, implementation, maintenance, modification, and removal of the Traffic Management Plan; furnishing, installing, operating, maintaining, relocating, replacing, and removing all temporary traffic control devices; temporary signs, barricades, drums, cones, vertical panels, delineators, portable changeable message signs, arrow boards, temporary pavement markings, flaggers, traffic control supervision, temporary pedestrian accommodations, inspections, maintenance, emergency response, labor, materials, equipment, tools, transportation, and all incidental work necessary to maintain traffic and complete the Work in accordance with the Contract Documents and applicable MassDOT Standard Specifications. No separate payment will be made for any work incidental thereto.

3.53 ROADWAY FLAGGER (ITEM 53)

1. Measurement
 - a. Roadway Flagger will be measured by the actual number of hours authorized by the Engineer during which qualified flaggers are actively engaged in traffic control operations.
2. Payment
 - a. Payment shall be made at the Contract unit price per hour. Payment shall include furnishing qualified personnel, personal protective equipment, communication devices, hand signaling devices, setup and removal of incidental flagging equipment, labor, supervision, and all incidental work necessary to perform flagging operations.

3.54 12 INCH REFLECTORIZED WHITE LINE (PAINTED) (ITEM 54)

1. Measurement
 - a. 12 Inch ReflectORIZED White Line (Painted) will be measured by the number of linear feet of pavement marking installed as shown in the Contract Documents.
2. Payment
 - a. Payment shall be made at the Contract unit price per linear foot. Payment shall include surface cleaning, layout, furnishing paint and glass beads, application, protection of fresh markings, labor, equipment, tools, and all incidental work necessary to complete the work.

3.55 MOBILIZATION/DEMOBILIZATION (ITEM 55)

1. Measurement
 - a. Measurement of Mobilization/Demobilization shall be on a lump sum basis. The Contract price for this item shall not exceed five percent (5%) of the Base Bid, excluding this item.
2. Payment
 - a. Payment shall be made at the Contract lump sum price for Mobilization/Demobilization. Payment shall constitute full compensation for all preparatory and closeout operations, including movement of personnel, equipment, materials, and supplies; establishment and removal of field offices, storage areas, staging areas, temporary utilities, and other temporary facilities; permits incidental to mobilization; startup costs; bonds; insurance; initial and final traffic control; project coordination; site cleanup; removal of temporary construction facilities, equipment, excess materials, and debris; restoration of staging and storage areas; and all labor, equipment, tools, transportation, and incidental work necessary to complete the Work that is not included in other Contract items.
 - b. Payment for Demobilization shall include the removal of temporary erosion and sedimentation control measures designated for removal, temporary signs, fencing, sanitary facilities, stockpile areas, and all other temporary works, as well as final cleanup and restoration of areas disturbed by the Contractor's operations, unless otherwise provided under separate Contract items.
 - c. Final payment for this item shall not be made until all Work has been completed, temporary facilities have been removed, required restoration has been performed, the Project site has been cleaned to the satisfaction of the Engineer, and the Work has been accepted.

3.56 PRICE ADJUSTMENT (ALLOW-1)

1. Measurement
 - a. Measurement for asphalt adjustment will be on the actual square yards of pavement placed and adjusted based on the monthly change in the base price of asphalt cement to the current base price. Conversion from square yards to tons shall use the 0.054 SY/ton/inch pavement depth factor to calculate the adjustment.
 - b. Measurement for diesel adjustment will be on the actual amount of fuel expended and adjusted based on the monthly change in the base price of diesel to the current base price.
 - c. Measurement for gasoline adjustment will be on the actual amount of fuel expended and adjusted based on the monthly change in the base price of gasoline to the current base price.
 - d. Measurement for asphalt adjustment will be on the actual square yards of pavement placed and adjusted based on the monthly change in the base price of asphalt cement to the current base price. Conversion from square yards to tons shall use the 0.054 SY/ton/inch pavement depth factor to calculate the adjustment.
2. Payment

- a. Allowance payment for will be added or subtracted based on the initial monthly base price of the respective items difference from the current base price.

3.57 CLASS A ROCK EXCAVATION (CY) (ALLOW-2)

1. Measurement

- a. Class A Rock Excavation will be measured by the cubic yard of material classified as rock in accordance with the Standard Specifications and removed within the authorized excavation limits established by the Engineer.
- b. When rock is encountered, the material shall be uncovered, and the Engineer notified. The Engineer will then take cross sections of the rock surface. If the Contractor fails to uncover the ledge, notify the Engineer, and allow ample time for cross sectioning the undisturbed material, the Contractor shall have no right-of-claim to any classification other than that allowed by the Engineer. Removal of debris shall be classified as rock as defined below.
- c. Measurement of rock excavation in pipe trenches will extend to the width specified below:

Utility	Depth from Ground	Pay Width
	Surface to Invert of Pipe	(Nominal Pipe Diameter) 0 – 24-in
Main	0 ft – 8ft	5 ft
Main	8.1 ft – 12 ft	7 ft
Service	0 ft – 8 ft	3 ft

- d. Payment depth for rock which is encountered in a trench shall be no less than three feet (3') when removal can be accomplished only by drilling and blasting or by use of jack (air or hydraulic) hammers.
- e. Payment for rock removed, using the same or equal equipment as utilized for normal trench excavation, shall be limited to the actual depth removed within the limits established by the contract documents.
- f. Measurement for depth shall be from the top of the rock formation to the normal depth of the pipe as shown on the Drawings.
- g. Boulders and concrete structures exceeding 1 cu yd in volume when encountered in excavation will be measured for payment. Removal of boulders of whatever size will not be paid for when encountered in borrow areas.

2. Payment

- a. Payment shall be at the Contract unit price per cubic yard. Payment shall include drilling, controlled blasting where permitted, hammering, ripping, wedging, splitting, excavation, loading, hauling, disposal or reuse of excavated rock, dewatering, scaling, trimming excavation surfaces, protection of adjacent facilities, compliance with blasting regulations, backfilling, and providing borrow for any deficiency of trench backfill, labor, equipment, tools, and all incidental work necessary to complete the excavation, for which payment is not provided under other items in the Bid Form.

3.58 TEST PIT FOR EXPLORATION (CY) (ALLOW-3)

1. Measurement
 - a. Test Pit for Exploration will be measured by the cubic yard of material excavated within the limits authorized by the Engineer.
 - b. Test pits will likely be required to determine depth, size, and exact limits of existing utilities. Test pits completed by the Contractor to facilitate the Contractor's convenience of work not ordered by the Owner or Engineer will not be paid. The Contractor must receive approval in writing from the Owner or Engineer for test pits beyond the extent called out on the contract drawings.
2. Payment
 - a. Payment shall be at the Contract unit price per cubic yard. Payment shall include for cutting and removing pavement, excavation, support of excavation, utility exposure, support of existing utilities, maintenance of excavation, temporary shoring as required for safety, dewatering, inspection coordination, backfilling with suitable material, compaction, restoration of disturbed surfaces, loading, hauling, disposal of excess material, labor, equipment, tools, and all incidental work necessary to complete the test pit.

END OF SECTION

SECTION 01 21 00 - ALLOWANCES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cash allowances.
- B. Contingency allowance.
- C. Inspecting and testing allowances.

1.2 CASH ALLOWANCES

- A. Costs Included in Cash Allowances: Cost of product to Contractor or subcontractor, less applicable trade discounts, less cost of delivery to site, less applicable taxes.
- B. Costs Not Included in Cash Allowances: Product delivery to site and handling at the site, including unloading, uncrating, and storage; protection of products from elements and from damage; and labor for installation and finishing.
- C. Engineer Responsibilities:
 - 1. Consult with Contractor for consideration and selection of products, suppliers, and installers.
- D. Contractor Responsibilities:
 - 1. Obtain proposals from suppliers and installers and offer recommendations.
 - 2. On notification of which products have been selected, execute purchase agreement with designated supplier and installer.
 - 3. Arrange for and process shop drawings, product data, and samples. Arrange for delivery.
 - 4. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.
- E. Differences in costs will be adjusted by Change Order.

1.3 CONTINGENCY ALLOWANCE

- A. Contractor's costs for products, delivery, installation, labor, insurance, payroll, taxes, bonding, equipment rental, overhead and profit will be included in Change Orders authorizing expenditure of funds from this Contingency Allowance.
- B. At closeout of Contract, funds remaining in Contingency Allowance will be credited to Owner by Change Order.

1.4 INSPECTING AND TESTING ALLOWANCES

- A. Costs Included in Inspecting and Testing Allowances: Cost of engaging an inspecting or testing agency; execution of inspecting and tests; and reporting results.
- B. Costs Not Included in the Inspecting and Testing Allowances:
 - 1. Costs of incidental labor and facilities required to assist inspecting or testing agency.
 - 2. Costs of testing services used by Contractor separate from Contract Document requirements.
 - 3. Costs of retesting upon failure of previous tests as determined by Engineer.
- C. Payment Procedures:
 - 1. Submit one copy of the inspecting or testing firm's invoice with next application for payment.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 22 00 - UNIT PRICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. List of unit prices, for use in preparing Bids.
- B. Measurement and payment criteria applicable to Work performed under a unit price payment method.
- C. Defect assessment and non-payment for rejected work.

1.2 RELATED REQUIREMENTS

- A. Section 01 20 50 - Measurement and Payment: Description of how units shall be measured and paid for.

1.3 COSTS INCLUDED

- A. Unit Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

1.4 UNIT QUANTITIES SPECIFIED

- A. Quantities indicated in the Bid Form are for bidding and contract purposes only. Quantities and measurements of actual Work will determine the payment amount.

1.5 MEASUREMENT OF QUANTITIES

- A. Measurement methods delineated in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of the individual specification section govern.
- B. Take all measurements and compute quantities. Measurements and quantities will be verified by Engineer.
- C. Assist by providing necessary equipment, workers, and survey personnel as required.
- D. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
- E. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.
- F. Measurement by Area: Measured by square dimension using mean length and width or radius.
- G. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.

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- H. Stipulated Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as a completed item or unit of the Work.
- I. Perform surveys required to determine quantities, including control surveys to establish measurement reference lines. Notify Engineer prior to starting work.
- J. Contractor's Engineer Responsibilities: Sign surveyor's field notes or keep duplicate field notes , calculate and certify quantities for payment purposes.

1.6 PAYMENT

- A. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work that is incorporated in or made necessary by the Work and accepted by the Engineer, multiplied by the unit price.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 30 00 - ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General administrative requirements.
- B. Preconstruction meeting.
- C. Progress meetings.
- D. Construction progress schedule.
- E. Coordination drawings.
- F. Submittals for review, information, and project closeout.
- G. Number of copies of submittals.
- H. Requests for Interpretation (RFI) procedures.
- I. Submittal procedures.

1.2 RELATED REQUIREMENTS

- A. Section 01 70 00 - Execution and Closeout Requirements: Additional coordination requirements.

1.3 GENERAL ADMINISTRATIVE REQUIREMENTS

- A. Comply with requirements of Section 01 70 00 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
 - 1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.

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2. Contractor and Engineer are required to use this service.
 3. It is Contractor's responsibility to submit documents in allowable format.
 4. Subcontractors, suppliers, and Engineer's consultants will be permitted to use the service at no extra charge.
 5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
 6. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
 7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
- B. Submittal Service: The selected service is: email.
- C. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Engineer and Contractor participating; further training is the responsibility of the user of the service.
- D. Project Closeout: Engineer will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

3.2 PROGRESS MEETINGS

- A. Attendance Required:
1. Contractor.
 2. Owner.
 3. Engineer.
 4. Contractor's superintendent.
 5. Major subcontractors.
- B. Agenda:
1. Review minutes of previous meetings.
 2. Review of work progress.
 3. Field observations, problems, and decisions.
 4. Identification of problems that impede, or will impede, planned progress.

5. Review of submittals schedule and status of submittals.
 6. Maintenance of progress schedule.
 7. Corrective measures to regain projected schedules.
 8. Planned progress during succeeding work period.
 9. Coordination of projected progress.
 10. Maintenance of quality and work standards.
 11. Effect of proposed changes on progress schedule and coordination.
 12. Other business relating to work.
- C. Record minutes and distribute copies within two days after meeting to participants, with two copies to Engineer, Owner, participants, and those affected by decisions made.

3.3 CONSTRUCTION PROGRESS SCHEDULE

- A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
1. Include written certification that major contractors have reviewed and accepted proposed schedule.
- D. Within 10 days after joint review, submit complete schedule.
- E. Submit updated schedule with each Application for Payment.

3.4 COORDINATION DRAWINGS

- A. Provide information required by Project Coordinator for preparation of coordination drawings.
- B. Review drawings prior to submission to Engineer.

3.5 REQUESTS FOR INTERPRETATION (RFI)

- A. Definition: A request seeking one of the following:
1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.

2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
 1. Prepare a separate RFI for each specific item.
 - a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
 - b. Do not forward requests which solely require internal coordination between subcontractors.
 2. Prepare in a format and with content acceptable to Owner.
 3. Prepare using software provided by the Electronic Document Submittal Service.

3.6 NUMBER OF COPIES OF SUBMITTALS

- A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

3.7 SUBMITTAL PROCEDURES

- A. General Requirements:
 1. Use a single transmittal for related items.

3.8 SUBMITTAL REVIEW

- A. Submittals for Review: Engineer will review each submittal, and approve, or take other appropriate action.
- B. Submittals for Information: Engineer will acknowledge receipt and review. See below for actions to be taken.
- C. Engineer's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
- D. Engineer's and consultants' actions on items submitted for review:
 1. Authorizing purchasing, fabrication, delivery, and installation:
 - a. "Approved", or language with same legal meaning.
 - b. "Approved as Noted, Resubmission not required", or language with same legal meaning.
 - 1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.

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- c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
 - 2. Not Authorizing fabrication, delivery, and installation:
- E. Engineer's and consultants' actions on items submitted for information:
- 1. Items for which no action was taken:
 - a. "Received" - to notify the Contractor that the submittal has been received for record only.
 - 2. Items for which action was taken:
 - a. "Reviewed" - no further action is required from Contractor.

END OF SECTION

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Submittals.
- B. Quality assurance.
- C. Testing and inspection agencies and services.
- D. Control of installation.
- E. Defect Assessment.

1.2 RELATED REQUIREMENTS

- A. Section 01 21 00 - Allowances: Allowance for payment of testing services.
- B. Section 01 30 00 - Administrative Requirements: Submittal procedures.

1.3 REFERENCE STANDARDS

- A. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2018.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Designer's Qualification Statement: Submit for Engineer's knowledge as contract administrator, or for Owner's information.
 - 1. Include information for each individual professional responsible for producing, or supervising production of, design-related professional services provided by Contractor.
 - a. Full name.
 - b. Professional licensure information.
 - c. Statement addressing extent and depth of experience specifically relevant to design of items assigned to Contractor.
- C. Design Data: Submit for Engineer's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
- D. Test Reports: After each test/inspection, promptly submit two copies of report to Engineer and to Contractor.

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- E. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Engineer, in quantities specified for Product Data.
 - 1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
 - 2. Certificates may be recent or previous test results on material or product, but must be acceptable to Engineer.
- F. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- G. Manufacturer's Field Reports: Submit reports for Engineer's benefit as contract administrator or for Owner.
 - 1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.
 - 2. Owner.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
 - 1. Prior to start of work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
 - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
 - 3. Qualification Statement: Provide documentation showing testing laboratory is accredited under IAS AC89.

1.6 TESTING AND INSPECTION AGENCIES AND SERVICES

- A. Owner will employ services of an independent testing agency to perform certain specified testing; payment for cost of services will be derived from allowance specified in Section 01 21 00; see Section 01 21 00 and applicable sections for description of services included in allowance.
- B. Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.
- C. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- D. Contractor Employed Agency:

1. Laboratory: Authorized to operate in Massachusetts.
2. Laboratory Staff: Maintain a full-time registered Engineer on staff to review services.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.2 TESTING AND INSPECTION

- A. Testing Agency Duties:
 1. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.
 2. Perform specified sampling and testing of products in accordance with specified standards.
 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 4. Promptly notify Engineer and Contractor of observed irregularities or non-compliance of Work or products.
 5. Perform additional tests and inspections required by Engineer.
 6. Submit reports of all tests/inspections specified.
- B. Limits on Testing/Inspection Agency Authority:
 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.

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2. Agency may not approve or accept any portion of the Work.
3. Agency may not assume any duties of Contractor.
4. Agency has no authority to stop the Work.

C. Contractor Responsibilities:

1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
 - c. To facilitate tests/inspections.
 - d. To provide storage and curing of test samples.
 4. Notify Engineer and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- D. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Engineer.
- E. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.3 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not complying with specified requirements.

END OF SECTION

SECTION 01 45 29 – TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section consists of requirements for the services of Independent Testing Laboratories to perform specified testing of work and materials at the Project site or at point of manufacture.

1.2 REQUIREMENTS

- A. The Contractor shall pay all charges of the Testing Laboratory. Employment of Testing Laboratory shall in no way relieve Contractor of his obligation to perform work in accordance with Contract.
- B. The Contractor will select and employ an Independent Testing Laboratory, approved by the Engineer and holding current certification with the State of Massachusetts, prior to the commencement of the Work, to perform soil testing services as well as other field testing services required by the Contract Documents.

1.3 SUBMITTALS

- A. Contractor shall submit for Engineer's approval the name and qualifications of the Independent Testing Laboratory prior to the commencement of work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 LABORATORY DUTIES

- A. Demonstrate expertise in providing testing services as specified in the Contract Documents.
- B. Test the samples submitted by Contractor.
- C. Cooperate with Owner and Contractors; provide qualified personnel promptly on notice. Perform specified inspections, sampling and testing of materials and methods of construction; ascertain compliance with requirements of Contract Documents.
- D. The Testing Laboratory shall perform specified inspections, sampling, testing of materials and methods of construction as described in the Contract Documents.

- E. The Testing Laboratory shall promptly notify the Engineer of observed irregularities or deficiencies of work or products and shall perform additional testing as required. The Testing Laboratory shall promptly submit two (2) copies of written reports for each test and inspection to the Engineer and one copy to the Contractor. Each report shall include:
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Testing laboratory name, address, and telephone number.
 - 4. Name and signature of field and/or laboratory inspector.
 - 5. Date, time, and location of sampling or inspection.
 - 6. Record of temperature and weather conditions.
 - 7. Date of test.
 - 8. Identification of products and Specification Section.
 - 9. Location of sample or test in the Project. Sample locations shall be shown on site plan sketch.
 - 10. Type of inspection or test.
 - 11. Results of test and compliance with Contract Documents.
 - 12. Interpretation of test results.
- F. The Testing Laboratory shall not be authorized to release, revoke, alter or enlarge upon any requirements of the Contract Documents and Laboratory shall not approve or accept any portion of the Work that does not conform to these Specifications.
- G. Laboratory may not assume any duties of the Contractor; and the Laboratory has no authority to stop work.

3.2 CONTRACTOR'S RESPONSIBILITY

- A. Cooperate with Laboratory personnel and provide access to work and facilitate the execution of the Laboratory's required services.
- B. Provide to Laboratory representative samples of materials to be tested in required quantities.
- C. Furnish labor and facilities to provide access to work to be tested, to obtain and handle samples at the site, and to facilitate inspections and tests.
- D. Notify Laboratory sufficiently in advance of operations to allow for its assignment of personnel and schedule of tests.
- E. Arrange with Laboratory, and pay for, any additional samples and testing required for Contractor's convenience.

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- F. Arrange with Laboratory, and pay for, any additional inspections, sampling and testing required when initial tests indicate that work does not comply with Contract Documents.
- G. Arrange for and conduct any inspections required by State and/or local building, fire protection, safety, health or environmental officials.
- H. Testing shall be provided by the Contractor; the Contractor will supply any laborers and equipment necessary for performing the testing at no additional cost. This work may include, but is not limited to providing materials and samples and revising or repairing work to meet the intent of the plans and specifications. The Contractor is also responsible for any costs associated with conformance testing performed by an Independent Laboratory.

END OF SECTION

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Dewatering
- B. Temporary utilities.
- C. Temporary Controls: Barriers, enclosures, and fencing.
- D. Vehicular access and parking.
- E. Waste removal facilities and services.
- F. Project identification sign.
- G. Field offices.

1.2 RELATED REQUIREMENTS

- A. Section 01 51 00 - Temporary Utilities.
- B. Section 01 52 13 - Field Offices
- C. Section 01 55 00 - Traffic Control
- D. Section 01 70 00 - Execution and Closeout Requirements.

1.3 DEWATERING

- A. Provide temporary means and methods for dewatering all temporary facilities and controls.
- B. Maintain temporary facilities as directed by Engineer consistent with the projects erosion and sedimentation control plan.

1.4 TEMPORARY UTILITIES - SEE SECTION 01 51 00

- A. Owner will provide the following:
 - 1. Water supply, consisting of connection to existing facilities.

1.5 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades required by governing authorities for public rights-of-way and for public access to existing building.

- C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.6 TRAFFIC CONTROL - SEE SECTION 01 55 00

- A. Coordinate access and haul routes with governing authorities and Owner.
- B. Provide and maintain access to fire hydrants, free of obstructions.
- C. Provide means of removing mud from vehicle wheels before entering streets.
- D. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

1.7 WASTE REMOVAL

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site periodically.
- C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers.

1.8 PROJECT IDENTIFICATION

- A. Provide project identification sign of design and construction indicated on drawings.
- B. Erect on site at location indicated.
- C. No other signs are allowed without Owner permission except those required by law.

1.9 FIELD OFFICES - SEE SECTION 01 52 13

- A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.
- B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.
- C. Locate offices a minimum distance of 30 feet from existing and new structures.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 51 00 - TEMPORARY UTILITIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Temporary Utilities: Provision of electricity, lighting, heat, ventilation, and water.

1.2 RELATED REQUIREMENTS

- A. Section 01 50 00 - Temporary Facilities and Controls:

1.3 REFERENCE STANDARDS

- A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

1.4 TEMPORARY ELECTRICITY

- A. Power Service Characteristics: 120/208 volt, three phase, four wire.
- B. Provide power outlets for construction operations, with branch wiring and distribution boxes located as required. Provide flexible power cords as required.
- C. Provide main service disconnect and over-current protection at convenient location and meter.
- D. Permanent convenience receptacles may be utilized during construction.
- E. Provide adequate distribution equipment, wiring, and outlets to provide single phase branch circuits for power and lighting.

1.5 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

- A. Provide and maintain LED, compact fluorescent, or high-intensity discharge lighting as suitable for the application for construction operations in accordance with requirements of 29 CFR 1926 and authorities having jurisdiction.
- B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
- C. Maintain lighting and provide routine repairs.

1.6 TEMPORARY WATER SERVICE

- A. Provide and maintain suitable quality water service for construction operations at time of project mobilization.
- B. Connect to existing water source.
 - 1. Exercise measures to conserve water.

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PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 52 13 - FIELD OFFICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Temporary field offices for use of Engineer.
- B. Temporary field offices for use of Contractor.
- C. Maintenance and removal.

1.2 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: use of premises and responsibility for providing field offices.
- B. Section 01 55 00 – Traffic Control: Parking and access to field offices.

PART 2 PRODUCTS

2.1 MATERIALS, EQUIPMENT, FURNISHINGS

- A. Materials, Equipment, Furnishings: Serviceable, new or used, adequate for required purpose.

2.2 CONSTRUCTION

- A. Portable or mobile buildings, or buildings constructed with floors raised above ground, securely fixed to foundations, with steps and landings at entrance doors.
- B. Fire Extinguishers: Appropriate type fire extinguisher at each office.

2.3 ENVIRONMENTAL CONTROL

- A. Heating, Cooling, and Ventilating: Automatic equipment to maintain comfort conditions.

2.4 CONTRACTOR OFFICE AND FACILITIES

- A. Size: For Contractor's needs and to provide space for project meetings.
- B. Other Furnishings: Contractor's option.

2.5 OWNER AND ARCHITECT/ENGINEER OFFICE

- A. Area: At least 150 sq ft, with minimum dimension of 8 ft.
- B. Furnishings:
 - 1. One desk 54 by 30 inch, with three drawers.
 - 2. One metal, double-door storage cabinet under table.
 - 3. One waste basket per desk and table.

PART 3 EXECUTION

3.1 PREPARATION

- A. Fill and grade sites for temporary structures to provide drainage away from buildings.

3.2 INSTALLATION

- A. Install office spaces ready for occupancy 15 days after date fixed in Notice to Proceed.

3.3 MAINTENANCE AND CLEANING

- A. Weekly janitorial services for offices; periodic cleaning and maintenance for offices.
- B. Maintain approach walks free of mud, water, and snow.

3.4 REMOVAL

- A. At completion of Work remove buildings, foundations, utility services, and debris. Restore areas.

END OF SECTION

SECTION 01 55 00 - TRAFFIC CONTROL

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes operations necessary to maintain vehicular and pedestrian traffic flow on public and private access ways and roads:
- B. Traffic controls include, but are not limited to, the following as indicated on the Contract Drawings:
 - 1. Barricades, signs, and temporary lighting to inform the general public of hazard's during construction of the Work.
 - 2. Relocation, maintenance, removal, and repair of traffic control devices.
 - 3. Access roads, parking areas, existing pavements, and construction parking controls
 - 4. Flag persons, as required
 - 5. Removal of mud deposited by site vehicles.

1.2 SUMMARY

- A. Construction Phasing Plan: Prior to initial mobilization, the Contractor shall submit, to the Engineer, a Construction Phasing Plan that includes phased Temporary Traffic Control Plans and Detour Plans for approval. The plans shall meet the following requirements in order to obtain approval:
 - 1. General:
 - a. Each traffic control setup shall meet minimum standards set for in Part 6 of the Manual on Uniform Traffic Control Devices, latest edition with revisions.
 - b. The first phase of traffic control shall comply with the Contract Drawings.
 - c. Temporary through traffic road closures may be implemented when approved by City, Owner, and Engineer for subsequent phases of traffic control. For all phases of traffic control, emergency vehicle and local access must be maintained at all times. If road closures are to be implemented, access to residences and businesses shall be maintained to the maximum extent possible.
 - d. Trenching shall be covered with steel plating during non-working hours.
- B. Notice to Police, Fires, and Residents: The Contractor shall notify the Revere, MA Police and Fire Departments and all affected residences and businesses, in writing, of alterations to roadway operations no less than three days prior to enacting such alterations. Correspondence must include:

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1. Date(s) closures and/or modification will be in effect.
2. Description of closure area, operation change, and/or parking restriction.
3. Alternative route(s) to access residences/businesses, if necessary.
4. Construction foreman name and field telephone number.

1.3 DEFINITIONS

A. Trafficmen

1. Local Police Officers: Uniformed, off-duty police officers. Contractor is responsible for coordinating for police detail if determined necessary.

1.4 QUALITY ASSURANCE

- A. Where “MassDOT Standard Specifications” is used, it shall mean “Massachusetts Department of Transportation Standard Specifications for Road and Bridge Construction” amended 2026, and issued supplements.

PART 2 – PRODUCTS

2.1 TRAFFIC CONTROL DEVICES

- A. Traffic Drums: MassDOT Standard Specifications, Section 851.1.
- B. Traffic Cones: MassDOT Standard Specifications, Section 851.1.
- C. Construction Barricades: MassDOT Standard Specifications, Section 851.2.
- D. Temporary Construction Signs: MassDOT Standard Specifications, Section 850.43.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Traffic control shall be implemented as indicated in the Contract Drawings.
- B. Do not barricade streets without prior approval of local authorities. Keep closures to as brief a period as possible.
- C. Coordinate with City Police to provide details as required for the proper directing and control of traffic during the Work. The Contractor shall be responsible for scheduling details. Police details paid for by owner.

3.2 TRAFFIC CONTROL DEVICES

- A. Furnish, erect, maintain, relocate, and dismantle barricades, warning signs, lights, and traffic control items as necessary, to protect the Work, to provide for public safety, as required by the Engineer, and in accordance with the requirements of Section 850 of the Massachusetts Department of Transportation (MassDOT) Standard Specifications for Highways and Bridges, the approved Traffic Control Plans and the latest edition of the MUTCD.
- B. Furnish, erect, maintain, relocate, and dismantle temporary trench bridging for vehicular and pedestrian traffic across trenches. Prevent slippery surface conditions resulting from construction operations and maintain safe passage at all times in accordance with Section 850 and applicable MassDOT Standard Details.
- C. Traffic Drums: Place traffic drums in accordance with Section 851.1 of the MassDOT Standard Specifications and applicable Standard Details.
- D. Traffic Cones: Provide traffic cones in sufficient number to adequately control traffic on roadways during construction and in accordance with Section 851.1 of the MassDOT Standard Specifications and applicable Standard Details.
- E. Construction Barricades: Install in accordance with Section 851.2 of the MassDOT Standard Specifications and applicable Standard Details.
- F. Temporary Construction Signs: Install in accordance with Section 850.43 of the MassDOT Standard Specifications.

3.3 ACCESS ROADS

- A. Use of existing on-site streets and driveways for construction traffic is not permitted.
- B. Use of designated existing on-site streets and driveways for construction traffic is permitted.
- C. Tracked vehicles not allowed on paved areas.
- D. Provide detours as necessary for unimpeded traffic flow.
- E. Detour location as approved by Engineer & Owner.
- F. Provide and maintain access to fire hydrants free of obstructions.

3.4 PARKING

- A. Use of designated areas of existing parking facilities by construction personnel is permitted.
- B. When site space is not adequate, provide additional off-site parking.

3.5 PREPARATION

- A. Clear areas, provide surface and storm drainage of road, parking, area premises, and adjacent areas.

3.6 FLAG PERSONS

- A. Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

3.7 CONSTRUCTION PARKING CONTROL

- A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and Owner's operations.

3.8 TRAFFIC CONTROL OFFICERS

- A. Comply with local authorities and State police regarding the services of trafficmen for construction projects including requirements for canceling scheduled trafficmen.

3.9 TRAFFIC SIGNS AND SIGNALS

- A. At approaches to site and on site, install at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.

3.10 MAINTENANCE

- A. Maintain traffic and parking areas in a sound condition free of excavated material, construction equipment, products, mud, snow, and ice.
- B. Maintain existing paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.

3.11 REMOVAL, REPAIR

- A. Repair damage caused by installation.

END OF SECTION

SECTION 01 57 13 - TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 specification Sections apply to the work of this Section.

1.2 SECTION INCLUDES

- A. Prevention of erosion due to construction activities.
- B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
- C. Restoration of areas eroded due to insufficient preventive measures.

1.3 RELATED REQUIREMENTS

- A. Section 31 22 00 - Grading: Temporary and permanent grade changes for erosion control.
- B. Section 31 23 23 - Fill: Soil product information.
- C. Section 32 92 19 - Seeding: Permanent turf for erosion control.

1.4 REFERENCE STANDARDS

- A. ASTM D98 - Standard Specification for Calcium Chloride; 2015.
- A. ASTM D3786/D3786M - Standard Test Method for Bursting Strength of Textile Fabrics-- Diaphragm Bursting Strength Tester Method; 2018 (Reapproved 2023).
- B. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc-Type Apparatus; 2021.
- C. ASTM D4491/D4491M - Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 2022.
- D. ASTM D4533/D4533M - Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2015 (Reapproved 2023).
- E. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 2015a (Reapproved 2023).
- F. ASTM D4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile; 2021a.
- G. ASTM D4833/D4833M - Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products; 2007 (Reapproved 2020).

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- H. ASTM D4873/D4873M - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples; 2017 (Reapproved 2021).
- I. ASTM G155 - Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials; 2021.
- J. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; Current Edition.
- K. Erosion Control Standards - "Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas" prepared by Franklin, Hamden, Hampshire Conservation Districts.; May 2003.
- L. Standard Specifications - "The Commonwealth of Massachusetts, Massachusetts Department of Transportation, Standard Specifications for Highways and Bridges" and supplements, excluding provisions for "Method of Measurement" and "Basis of Payment"; 2025 Edition.

1.5 SUBMITTALS

- A. Certificates of Compliance: For each product specified.
- B. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.

PART 2 PRODUCTS

2.1 CONSTRUCTION ENTRANCE

- A. Stone: See Section 31 23 23 - Fill.
- B. Separation Fabric: See Section 31 23 23 - Fill.

2.2 MATERIALS

- A. Mulch: Use one of the following:
 - 1. Straw.
- B. Grass Seed For Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.
- C. Bales: Air dry, rectangular straw bales.
 - 1. Cross Section: 14 by 18 inches, minimum.
 - 2. Bindings: Wire or string, around long dimension.
- D. Bale Stakes: One of the following, minimum 3 feet long:

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1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot.
2. Wood, 2 by 2 inches in cross section.

2.3 SILT FENCE

- A. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
1. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
 2. Permittivity: 0.05 sec^{-1} , minimum, when tested in accordance with ASTM D4491/D4491M.
 3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355/D4355M after 500 hours exposure.
 4. Tensile Strength: 100 pounds-force, minimum, in cross-machine direction; 124 pounds-force, minimum, in machine direction; when tested in accordance with ASTM D4632/D4632M.
 5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632/D4632M.
 6. Tear Strength: 55 pounds-force, minimum, when tested in accordance with ASTM D4533/D4533M.
 7. Puncture Strength: 50 pounds-force minimum, when tested in accordance with ASTM D4833/D4833M.
- B. Silt Fence Posts: One of the following, minimum 5 feet long:
1. Hardwood, 2 by 2 inches in cross section.

2.4 EROSION CONTROL BALES

- A. Straw Bales: Air dry, rectangular straw bales, weighing 40 to 120 pounds per bale.
1. Bindings: Wire or string, around long dimension.
- B. Posts: One of the following, minimum 5 feet long:
1. Hardwood, 2 by 2 inches in cross section.

2.5 COMPOST FILTER SOCK

- A. Tubular Mesh Sleeve: High Density Polyethylene mesh that meets the following:
1. Maximum Opening Size: $3/8$ inches.

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2. Ultraviolet Resistance: Retaining at least 80 percent of tensile strength, when tested in accordance with ASTM G155 after 1000 hours exposure.
- B. Compost: Weed free and derived from well-decomposed source of organic matter conforming to the following:
1. PH: 5.0 to 8.0
 2. Maximum Moisture Content: 60 percent
 3. Particle Size:
 - a. 2 inch sieve: 100 percent passing
 - b. 3/8 inch sieve: 0 to 40 percent passing

2.6 INLET PROTECTION

- A. Regular Flow Silt Sacks: Woven polypropylene that meets the following:
1. Tensile Strength: 300 pounds-force minimum, when tested in accordance with ASTM D4632/D4632M.
 2. Tear Strength: 120 pounds-force minimum, when tested in accordance with ASTM D4533/D4533M.
 3. Puncture Strength: 120 pounds-force minimum, when tested in accordance with ASTM D4833/D4833M.
 4. Elongation: 20 to 30 percent, when tested in accordance with ASTM D4632/D4632M.
 5. Average Opening Size: 40 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
 6. Permittivity: 0.55 sec^{-1} , minimum, when tested in accordance with ASTM D4491/D4491M.
 7. Flow Rate: 40 gallons/minute/square foot minimum, when tested in accordance with ASTM D4491/D4491M.
 8. Ultraviolet Resistance: Retaining at least 80 percent of tensile strength, when tested in accordance with ASTM D4355/D4355M after 500 hours exposure.
 9. Mullen Burst: 800 psi minimum, when tested in accordance with ASTM D3786/D3786M.

2.7 EROSION CONTROL BLANKET

- A. Blanket: Biodegradable rolled blanket made of straw or coconut fibers, netting, and thread conforming to the following:
1. Minimum width: 6 feet
 2. Minimum Weight: 8 ounces per square yard

3. Overlap: Approximately 2 to 5 inches
4. Minimum Mesh Size: .625 by .625 inches

2.8 DEWATERING BAG

- A. Filter Bag (Silt Bag): Manufactured non-woven geotextile fabric bag, sewn with high-strength thread, with a spout to accommodate a 4-inch discharge hose (maximum), and attached straps with geotextile fabric conforming to the following:
 1. Tensile Strength: 250 pounds-force minimum, when tested in accordance with ASTM D4632/D4632M.
 2. Puncture Strength: 165 pounds-force minimum, when tested in accordance with ASTM D4833/D4833M.
 3. Average Opening Size: 40 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
 4. Permittivity: 1.3 sec^{-1} , minimum, when tested in accordance with ASTM D4491/D4491M.
 5. Flow Rate: 70 gallons/minute/square foot minimum, when tested in accordance with ASTM D4491/D4491M.
 6. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355/D4355M after 500 hours exposure.
 7. Mullen Burst: 550 psi minimum, when tested in accordance with ASTM D3786/D3786M.

2.9 TEMPORARY SEDIMENT TRAP

- A. Stone: See Section 31 23 23 - Fill.
- B. Separation Fabric: See Section 31 23 23 - Fill.

2.10 DUST CONTROL

- A. Calcium Chloride: ASTM D98, Type 1 or Type 2.
- B. Water: Potable.

PART 3 EXECUTION

3.1 GENERAL

- A. Minimize environmental damage during construction. Prevent discharge of fuel, oil, lubricants, and other fluids. Mitigate effects of discharge.
- B. Install erosion and sediment control measures prior to clearing, demolition or construction.

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- C. Construct erosion and sediment control measures in accordance with standards and specifications of the Erosion Control Standards, the EPA (NPDES), and municipal regulations.
- D. Attend a preconstruction meeting with the Engineer and municipality to review permit conditions and construction methods.
- E. Construction yards outside of the work limits may require a separate wetland application, depending on the location.
- F. Supply a 24-hour contact name and number as part of the erosion control plan.
- G. Provide additional sedimentation and erosion control as required by municipality, state, Authorities Having Jurisdiction, or Owner to address field conditions.
- H. Implement and maintain the soil erosion and sediment controls show on the Drawings. Inform parties engaged on the construction site of the requirements and objectives of the plan. Notify the proper municipal agency of transfer of this responsibility.
- I. Do not discharge directly into wetland resource areas or watercourses where dewatering is necessary. Utilize methods and devices permitted by Authorities Having Jurisdiction and appropriate regulations to minimize and retain suspended solids including pumping water into a temporary sedimentation basin and providing surge protection at inlet and outlet of pumps. Dewatering devices shall be located on the upland side of the limit of work.
 - 1. If pumping operation results in turbidity problems, stop pumping until means of controlling turbidity are determined and implemented.

3.2 EXAMINATION

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.3 PREPARATION

- A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.4 SCOPE OF PREVENTIVE MEASURES

- A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.
- B. Construction Entrances: Traffic-bearing aggregate surface.
 - 1. Provide at each construction entrance. Consult with City of Revere and Engineer regarding most appropriate locations.
 - 2. Where necessary to prevent tracking of mud outside of construction area, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.
- C. Linear Sediment Barriers: Made of silt fences, erosion control bales, or compost filter socks.

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1. Provide linear sediment barriers:
 - a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
 - b. Along the top of the slope or top bank of drainage channels and swales that traverse disturbed areas.
 - c. Along the toe of cut slopes and fill slopes.
 - d. Perpendicular to flow across the bottom of existing and new drainage channels and swales that traverse disturbed areas or carry runoff from disturbed areas; space at maximum of 200 feet apart.
 - e. Across the entrances to culverts that receive runoff from disturbed areas.
 2. Space sediment barriers with the following maximum slope length upslope from barrier:
 - a. Slope of Less Than 2 Percent: 100 feet.
 - b. Slope Between 2 and 5 Percent: 75 feet.
 - c. Slope Between 5 and 10 Percent: 50 feet.
 - d. Slope Between 10 and 20 Percent: 25 feet.
 - e. Slope Over 20 Percent: 15 feet.
- D. Inlet Protection: Protect catch basins and other stormwater inlets with inlet protection throughout construction until disturbed areas are stabilized.
1. Remove and dispose of sediment from control structures.
- E. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using one of the following measures:
1. Filter fabric wrapped around hollow concrete blocks blocking entire inlet face area; use one piece of fabric wrapped at least 1-1/2 times around concrete blocks and secured to prevent dislodging; orient cores of blocks so runoff passes into inlet.
 2. Straw bale row blocking entire inlet face area; anchor into pavement.
- F. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.
- G. Erosion Control Blanket
1. Install on slopes 3:1 or steeper.

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H. Dewatering Bags

1. Position bag to follow natural contours and so that pumped water will filter through bag and flow downhill or towards drainage system. Place bag on porous sublayer of stone, or in the bed of a truck to maximize water flow through surface area of bag.
2. Dispose of fabric bag when it can no longer efficiently filter sediment or pass water at a reasonable rate.

I. Temporary Sediment Traps

1. Adjust location, size, elevation, and discharge point to accommodate changes in construction.

J. Soil Stockpiles: Protect using one of the following measures:

1. Cover with polyethylene film, secured by placing soil on outer edges.
2. Cover with mulch at least 4 inches thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches of straw or hay.
3. If left bare for more than 15 days, cover with temporary vegetation.

K. Stabilization: Within 7 days of completion of final grading, stabilize surfaces with permanent vegetation or matting to minimize exposure.

1. If surfaces will be left bare for more than 30 days, stabilize with temporary vegetation.
 - a. Use mulch if outside of planting seasons.

L. Dust Control

1. Conduct construction operations and activities to minimize the creation and dispersion of dust. If the Owner determines that water and or calcium chloride is required for more effective dust control, provide such measures at no additional cost.
2. Apply water or calcium chloride uniformly over the surface when dust becomes a nuisance or when directed by the Engineer. Provide shut-off valve in convenient location on water truck, to allow for regulating water flow.

3.5 INSTALLATION

A. Install erosion and sediment controls in accordance with the Erosion Control Standards and manufacturer's recommendations where indicated on the Drawings.

B. Silt Fences:

1. Store and handle fabric in accordance with ASTM D4873/D4873M.
2. Install with top of fabric at nominal height and embedment indicated on drawings.

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3. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches, with extra post.
4. Fasten fabric to wood posts using one of the following:
 - a. Four nails per post with 3/4 inch diameter flat or button head, 1 inch long, and 14 gauge, 0.083 inch shank diameter.
 - b. Five staples per post with at least 17 gauge, 0.0453 inch wire, 3/4 inch crown width and 1/2 inch long legs.
5. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches high with post spacing not more than 4 feet.

C. Straw Bale Rows:

1. Install bales in continuous rows with ends butting tightly, with one bale at each end of row turned uphill.
2. Install bales so that bindings are not in contact with the ground.
3. Embed bales at least 4 inches in the ground.
4. Anchor bales with at least two stakes per bale, driven at least 18 inches into the ground; drive first stake in each bale toward the previously placed bale to force bales together.
5. Fill gaps between ends of bales with loose straw wedged tightly.
6. Place soil excavated for trench against bales on the upslope side of the row, compacted.

D. Compost Filter Socks

1. Place compost filter socks directly over the ground. Drive wooden stakes through the center of the filter socks to anchor them to the ground. To ensure optimum performance, heavy vegetation shall be cut down or removed, and extremely uneven surfaces shall be graded to ensure that the compost filter sock uniformly contacts the ground surface.
2. The ends of the filter sock should be directed upslope, to prevent stormwater from running around the end of the sock.
3. For placement on frozen ground, pavement, or shallow bedrock provide cement blocks or sand bags to hold the sock in place.

E. Mulching Over Large Areas:

1. Dry Straw and Hay: Apply 2-1/2 tons per acre; anchor using dull disc harrow or emulsified asphalt applied using same spraying machine at 100 gallons of water per ton of mulch.

F. Mulching Over Small and Medium Areas:

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1. Dry Straw and Hay: Apply 4 to 6 inches depth.

G. Temporary Seeding:

1. When hydraulic seeder is used, seedbed preparation is not required.
2. When surface soil has been sealed by rainfall or consists of smooth undisturbed cut slopes, and conventional or manual seeding is to be used, prepare seedbed by scarifying sufficiently to allow seed to lodge and germinate.
3. If temporary mulching was used on planting area but not removed, apply nitrogen fertilizer at 1 pound per 1000 sq ft.
4. On soils of very low fertility, apply 10-10-10 fertilizer at rate of 12 to 16 pounds per 1000 sq ft.
5. Incorporate fertilizer into soil before seeding.
6. Apply seed uniformly; if using drill or cultipacker seeders place seed 1/2 to 1 inch deep.
7. Irrigate as required to thoroughly wet soil to depth that will ensure germination, without causing runoff or erosion.
8. Repeat irrigation as required until grass is established.

3.6 MAINTENANCE

- A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches or more rainfall at the project site, and daily during prolonged rainfall.
- B. Repair deficiencies immediately.
- C. Construction Entrance:
 1. Maintain in good condition throughout construction period.
 2. Sweep adjacent roadways daily to remove tracked material from pavement.
- D. Silt Fences:
 1. Promptly replace fabric that deteriorates unless need for fence has passed.
 2. Remove silt deposits that exceed one-third of the height of the fence.
 3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
- E. Straw Bale Rows:
 1. Promptly replace bales that fall apart or otherwise deteriorate unless need has passed.
 2. Remove silt deposits that exceed one-half of the height of the bales.

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3. Repair bale rows that are undercut by runoff or otherwise damaged, whether by runoff or other causes.

F. Compost Filter Socks:

1. Remove sediment deposits when sediment accumulates to one-half the of the height of the compost filter sock.
2. Repair or replace split, torn, or unraveling socks. Replace broken or split stakes. Sagging or slumping compost filter socks must be repaired with additional stakes or replaced. Repair or replace at locations where rills and other evidence of concentrated runoff have occurred beneath the socks.

G. Inlet Protection:

1. Remove, clean, and reinstall silt sack when sediment accumulates to half capacity of sack.

H. Dewatering Bag:

1. Maintain in good condition throughout construction period.

I. Clean out temporary sediment control structures weekly and relocate soil on site.

J. Place sediment in appropriate locations on site; do not remove from site.

3.7 CLEAN UP

- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Engineer.
- B. Clean out temporary sediment control structures that are to remain as permanent measures.
- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION

SECTION 01 58 13 - TEMPORARY PROJECT SIGNAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Project identification sign.

1.2 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: Responsibility to provide signs.

PART 2 PRODUCTS

2.1 SIGN MATERIALS

- A. Structure and Framing: New, wood, structurally adequate.
- B. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4-inch thick, standard large sizes to minimize joints.
- C. Rough Hardware: Galvanized.
- D. Paint and Primers: Exterior quality, two coats; sign background of orange color.
- E. Lettering: Pre-cut vinyl self-adhesive products, white.

2.2 PROJECT IDENTIFICATION SIGN

- A. One painted sign of construction, design, and content indicated on drawings, location designated.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install sign surface plumb and level, with butt joints. Anchor securely.

3.2 MAINTENANCE

- A. Maintain signs and supports clean, repair deterioration and damage.

3.3 REMOVAL

- A. Remove signs, framing, supports, and foundations at completion of Project and restore the area.

END OF SECTION

SECTION 01 70 00 - EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Cutting and patching.
- C. Cleaning and protection.
- D. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
- E. General requirements for maintenance service.

1.2 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Survey work: Submit the name, address, and telephone number of Surveyor before starting survey work.
 - 1. Submit documentation verifying accuracy of survey work.
 - 2. Submit a copy of as-built drawings signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
 - 3. Submit surveys and survey logs for the project record.
- C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
 - 1. Structural integrity of any element of Project.
 - 2. Integrity of weather exposed or moisture resistant element.
 - 3. Efficiency, maintenance, or safety of any operational element.
 - 4. Visual qualities of sight exposed elements.
 - 5. Work of Owner or separate Contractor.

1.3 COORDINATION

- A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Notify affected utility companies and comply with their requirements.

- C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of work of separate sections.
- G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.1 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.4 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. Perform whatever cutting and patching is necessary to:
 - 1. Complete the work.
 - 2. Fit products together to integrate with other work.
 - 3. Match work that has been cut to adjacent work.
 - 4. Repair areas adjacent to cuts to required condition.
 - 5. Repair new work damaged by subsequent work.
 - 6. Remove and replace defective and non-complying work.
- C. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- D. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- E. Restore work with new products in accordance with requirements of Contract Documents.

3.5 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe and other closed or remote spaces.
- C. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.6 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.7 FINAL CLEANING

- A. Use cleaning materials that are nonhazardous.
- B. Clean site; sweep paved areas, rake clean landscaped surfaces.
- C. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.8 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
- B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- C. Notify Engineer when work is considered ready for Engineer's Substantial Completion inspection.
- D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Engineer's Substantial Completion inspection.
- E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Engineer's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Engineer.
- F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

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- G. Notify Engineer when work is considered finally complete and ready for Engineer's Substantial Completion final inspection.
- H. Complete items of work determined by Engineer listed in executed Certificate of Substantial Completion.
- I. Clean all storm and sanitary sewer system components.
- J. Submit as-built drawings to Owner and Engineer for review and acceptance.

3.9 MAINTENANCE

- A. Provide service and maintenance of components indicated in specification sections.
- B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.

END OF SECTION

SECTION 01 71 23 - FIELD ENGINEERING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Field engineering services by Contractor.
- B. Land surveying services by Contractor.
- C. Construction surveying by Contractor.

1.2 RELATED REQUIREMENTS

- A. Section 01 22 00 - Unit Prices: Bid pricing for hourly salary-and-benefits rates for personnel providing field engineering services if required.

1.3 DESCRIPTION OF SERVICES

- A. Specific services listed in this section are in addition to, and do not supersede, general Execution and Closeout Requirements.
- B. Sole responsibility for establishing all locations, dimensions and levels of items of work.
- C. Sole responsibility for provision of all materials required to establish and maintain benchmarks and control points, including batter boards, grade stakes, structure elevation stakes, and other items.
- D. Keeping a transit, theodolite, or TST (total station theodolite with electronic distance measurement device); leveling instrument; and related implements such as survey rods and other measurement devices, at the project site at all times.
- E. Provision of facilities and assistance necessary for Engineer to check lines and grade points placed by Contractor.
 - 1. Performance of excavation or embankment work until after all cross-sectioning necessary for determining payment quantities for Unit Price work have been completed and accepted by Engineer.
- F. Preparation and maintenance of daily reports of activity on the work. Submission of reports containing key progress indicators and job conditions to Engineer.
 - 1. Number of employees at the Site.
 - 2. Major equipment and materials installed as part of the work.
 - 3. Location of areas in which construction was performed.
 - 4. Work performed, including field quality control measures and testing.
 - 5. Weather conditions.

6. Delays encountered, amount of delay incurred, and the reasons for the delay.
 7. Instructions received from Engineer or Owner, if any.
- G. Preparation and maintenance of professional-quality, accurate, well organized, legible notes of all measurements and calculations made while surveying and laying out the work.

1.4 REFERENCE STANDARDS

- A. FGDC-STD-007.1 - Geospatial Positioning Accuracy Standards - Part 1: Reporting Methodology; 1998.
- B. FGDC-STD-007.2 - Geospatial Positioning Accuracy Standards - Part 2: Standards for Geodetic Networks; 1998.
- C. FGDC-STD-007.4 - Geospatial Positioning Accuracy Standards - Part 4: Architecture, Engineering, Construction, and Facilities Measurement; 2002.
- D. State Plane Coordinate System for Massachusetts.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Submit in addition to items required in Section 01 70 00 - Execution and Closeout Requirements.
- C. Informational Submittals: Submit the following:
 1. Field Engineering: Submit daily reports, with content as indicated in this section.
 2. Final property as-built survey.

1.6 QUALITY ASSURANCE

- A. Field Engineer's Qualifications: As established in Section 01 70 00 - Execution and Closeout Requirements.
- B. Land Surveyor's Qualifications: As established in Section 01 70 00 - Execution and Closeout Requirements.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify layout information shown on drawings in relation to property survey and existing benchmarks.
- B. Notify Owner's representative and Engineer of discrepancies immediately in writing before proceeding to lay out work.

- C. Locate and protect existing benchmarks, base lines, and demarcations. Preserve permanent reference points during construction.

3.2 FIELD ENGINEERING

- A. Maintain field office files, drawings, specifications, and record documents.
- B. Coordinate field engineering services with Contractor's subcontractors, installers, and suppliers as appropriate.
- C. Prepare layout and coordination drawings for construction operations.
- D. Check and coordinate the work for conflicts and interferences and immediately advise Engineer and Owner of all discrepancies of which Contractor is aware.
- E. Cooperate as required with Engineer and Owner in observing the work and performing field inspections.
- F. Review and coordinate work on a regular basis with shop drawings and Contractor's other submittals.
- G. Check the location, line and grade of every major element as the work progresses. Notify the Engineer when deviations from required lines or grades exceed allowable tolerances. Include in such notifications a thorough explanation of the problem, and a proposed plan and schedule for remedying the deviation. Do not proceed with remedial work without Owner's concurrence of the remediation plan.

3.3 LAND SURVEYING

- A. General: Follow standards for geospatial positioning accuracy.
 - 1. FGDC-STD-007.1 as amended by Authority Having Jurisdiction.
 - 2. FGDC-STD-007.2 as amended by Authority Having Jurisdiction.
 - 3. FGDC-STD-007.4 as amended by Authority Having Jurisdiction.
- B. Coordinate survey data with the State Plane Coordinate System of Massachusetts.
- C. Contractor is responsible for the restoration of all property corners and control monuments damaged or destroyed by construction-related activities. Any disturbed monuments must be replaced at Contractor's expense by a surveyor licensed in Massachusetts and approved by the Engineer.
 - 1. Temporarily suspend work at such points and for such reasonable times as the Owner may require for resetting monuments. The Contractor will not be entitled to any additional compensation or extension of time.

3.4 REPORTS

- A. Submit two copies of Contractor's daily reports at Engineer's field office (or electronically) by 9:00 AM the next working day after the day covered in the associated report. Daily report shall be signed by responsible member of Contractor's staff, such as project manager or superintendent, or foreman designated by Contractor as having authority to sign daily reports.

3.5 RECORDS

- A. Maintain at the Site a complete and accurate log of control and survey work as it progresses.
 - 1. Organize and record survey data in accordance with recognized professional surveying standards, Laws and Regulations, and prevailing standards of practice in Massachusetts. Record Contractor's surveyor's original field notes, computations, and other surveying data in Contractor-furnished hard-bound field books. Contractor is solely responsible for completeness and accuracy of survey work, and completeness and accuracy of survey records, including field books. Survey records,(including field books) may be rejected by Owner due to failure to organize and maintain survey records in a manner that allows reasonable and independent verification of calculations, and/or allows identification of elevations, dimensions, and grades of the work.
 - 2. Illegible notes or data, and erasures on any page of field books, are unacceptable. Do not submit copied notes or data. Corrections by ruling or lining out errors will be unacceptable unless initialed by the surveyor. Violation of these requirements may require re-surveying the data questioned by Engineer.
- B. Submit three copies of final property as-built survey to Owner. Include on the survey a certification, signed by the surveyor, that principal metes, bounds, lines, and levels of the Project are accurately positioned as shown on the survey. Include the following information:

END OF SECTION

SECTION 01 78 00 - CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Project record documents.
- B. Operation and maintenance data.
- C. Warranties and bonds.

1.2 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Individual Product Sections: Specific requirements for operation and maintenance data.
- C. Individual Product Sections: Warranties required for specific products or Work.
- D. Record/As-Built Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal: Submit one (1) electronic PDF set of Marked-up Record Prints. Engineer will initial and date each and mark whether general scope of changes, additional information recorded, and quality of drafting are acceptable. Engineer will return prints for organizing into sets, printing, binding, and final submittal. The purpose of this submittal is for the Engineer to indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1. Submit PDF electronic file(s) of As-Built Prints.
 - 2. The Final As-Built Drawings must be stamped by a professional land surveyor in the Commonwealth of Massachusetts with written verification that the project was constructed in accordance with the approved design plans or approved field modifications. The As-Built drawing will be submitted to the Owner and Engineer for review for consistency with the Construction Drawings.
- E. Record Product Data: Submit annotated PDF electronic files of each submittal. Also, submit CADD drawings with all control points.
- F. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

1.3 SUBMITTALS

- A. Project Record Documents: Submit documents to Engineer with claim for final Application for Payment.
- B. Operation and Maintenance Data:
 - 1. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 - 2. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Engineer comments. Revise content of all document sets as required prior to final submission.
 - 3. Submit two sets of revised final documents in final form within 10 days after final inspection.
- C. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.

- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 - 1. Changes made by Addenda and modifications.
- F. Record Drawings: Legibly mark each item to record actual construction including:
 - 1. Field changes of dimension and detail.
 - 2. Details not on original Contract drawings.

3.2 OPERATION AND MAINTENANCE DATA

- A. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- B. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- C. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.3 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of warranty until Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.

END OF SECTION

SECTION 02 03 42 - REMOVAL AND SALVAGE OF CONSTRUCTION MATERIALS

PART 1 GENERAL

1.1 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL PROCEDURES

- A. Drawings indicating existing construction, building services, and site utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction, building services, and site utilities arrangements are as indicated.
 - 2. Beginning of work constitutes acceptance of existing conditions that are apparent upon examination at that time.

3.2 ENVIRONMENTAL CONTROLS

- A. Comply with federal, state, and local regulations pertaining to water, air, solid waste, recycling, chemical waste, sanitary waste, sediment, and noise pollution.

3.3 ITEMS TO BE SALVAGED

- A. General: Salvage elements and components to the maximum extent possible as indicated on the plans.

3.4 MATERIALS TO BE REMOVED

- A. Remove existing elements as indicated and as allow direct access to construction elements indicated to be salvaged for reuse.
- B. Protect existing historic elements.
 - 1. Perform cutting to accomplish removals neatly, minimizing overcutting.

3.5 CLEANING

- A. Upon completion of work, clean dust, dirt, and debris caused by salvage and demolition operations from portions of existing structure to remain and adjacent areas. Remove and transport debris and rubbish in accordance local regulations regarding hauling and disposal.

END OF SECTION

SECTION 02 41 13 - SELECTIVE SITE DEMOLITION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 specification Sections apply to the work of this Section.

1.2 SECTION INCLUDES

- A. Selective demolition of built site elements.
- B. Abandonment and removal of existing utilities and utility structures.
- C. Clearing and grubbing.
- D. Repair and restoration.
- E. Debris removal.

1.3 RELATED REQUIREMENTS

- A. Section 01 57 13 - Temporary Erosion and Sediment Control.
- B. Section 31 10 00 - Site Clearing: Vegetation and existing debris removal; earth stripping and stockpiling.
- C. Section 31 23 23 - Fill: Filling holes, pits, and excavations generated as a result of removal operations.

1.4 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- C. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.
- D. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- E. Utilities to be Abandoned: Pipes, structures, and appurtenances that are to be abandoned and left in their existing location.
- F. Utilities to be Removed: Pipes, structures, and appurtenances that are to be abandoned and taken out of their existing location and legally disposed of at an off-site location.

1.5 REFERENCE STANDARDS

- A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).
- C. Standard Specifications - "The Commonwealth of Massachusetts, Massachusetts Department of Transportation, Standard Specifications for Highways and Bridges" and supplements, excluding provisions for "Method of Measurement" and "Basis of Payment"; 2025 Edition.

1.6 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - 1. Use sufficiently detailed photographs or video.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.
- C. Site Plan: Indicate:
 - 1. Vegetation to be protected.
 - 2. Areas for temporary construction and field offices, if applicable.
 - 3. Areas for temporary and permanent placement of removed and salvaged materials.
- D. Demolition Plan: Submit demolition plan as required by OSHA and local AHJs.
 - 1. Indicate extent of demolition, removal sequencing, bracing and shoring, and location and construction of barricades and fences.
 - 2. Demolition firm qualifications.
- E. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.7 QUALITY ASSURANCE

- A. Utility piping, structures, and appurtenances shall be removed or abandoned-in-place in accordance with the requirements of the Contract Documents and authorities having jurisdiction. In the event of a conflict, the more stringent requirements shall apply.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Fill Material: See Section 31 23 23.
- B. Sedimentation Barrier: See Section 01 57 13 – Temporary Erosion and Sediment Control.

2.2 FLOWABLE FILL

- A. Flowable Fill: Standard Specifications, Section M4.08.0.

PART 3 EXECUTION

3.1 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Comply with applicable requirements of NFPA 241.
 - 3. Use of explosives is not permitted.
 - 4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 5. Provide, erect, and maintain temporary barriers and security devices.
 - 6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 - 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 8. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
 - 9. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
 - 10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Protect existing structures and other elements to remain in place and not removed.

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1. Provide bracing and shoring.
 2. Prevent movement or settlement of adjacent structures.
 3. Stop work immediately if adjacent structures appear to be in danger.
- D. Minimize production of dust due to demolition operations. Do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- E. Perform demolition in a manner that maximizes salvage and recycling of materials.
1. Dismantle existing construction and separate materials.
 2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.
- F. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.
- G. Identify potential runoff areas.
- H. Construction Fencing: See Section 01 50 00 - Temporary Facilities and Controls.
- I. Boundary Demarcations: See Section 01 71 23 – Field Engineering.
- J. Identify preexisting debris, junk, and trash on-site.
- K. Protect and maintain benchmarks and survey control points from disturbance during constructing.

3.2 EXISTING UTILITIES

- A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Unless otherwise indicated, existing utilities may be abandoned in place as follows:
1. Pipes indicated to be abandoned shall be plugged at each end with non-shrink grout. Where applicable, pipes shall be depressurized and drained.

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- a. Pipes over 12 inches in diameter shall be removed or filled with flowable fill.
 - b. For lines longer than 100 feet, the pipe shall be cut and plugged in select locations so that no length of abandoned pipe exceeds 100 feet.
 - c. Pipes that connect to existing structures should be removed within 5 feet of the structure, and the existing invert plugged with non-shrink grout.
 - d. Pipes to be abandoned that connect to existing structures should be removed to within 5 feet of the structure, and the existing invert plugged with non-shrink grout.
2. Portions of structures shall be removed for a distance of 4 feet below finished grade.
 3. Where applicable, valves shall be closed and left in place. Valve stems and curb boxes shall be removed.
- H. Grouting: Mix and install grout for plugging utility pipes to be abandoned-in-place.
1. Clean surfaces that will come into contact with grout.
 2. Avoid air entrapment during placement of grout.
 3. Place grout in pipes for a depth of not less than 24 inches and completely fill the entire diameter of the pipe.
 4. Cure placed grout.

3.3 CLEARING AND GRUBBING

- A. Clearing: Cut trees, stumps, shrubs, downed timber, and other vegetation for removal within identified area as indicated on drawings according to 29 CFR 1910.266. Follow recommendations of ANSI Z133 and best local practices for species involved.
- B. Do not remove or damage vegetation beyond limits indicated on drawings.
1. Paving: 10 feet each side of surface walkways, patios, surface parking, and utility lines less than 12 inches in diameter.
 2. Minor Utility Trenches: 10 feet each side of utility lines less than 12 inches in diameter.
 3. Roadways and Main Utility Trenches: 15 feet each side.

3.4 SELECTIVE REMOVAL AND TRIMMING

- A. Selective Removal: Individual tree and shrub identified for removal as indicated on drawings according to 29 CFR 1910.266.
- B. Selective Trimming: Individual limbs and branches cut back according to ANSI A300 Part 1 identified for removal as indicated on drawings. Follow recommendations of ANSI Z133 and best local practices for species involved.

3.5 REMOVED VEGETATION PROCESSING

- A. Do not burn, bury, landfill, or leave on-site, except as indicated on drawings.
- B. Trees: coordinate with Owner for potential replanting off-site.
- C. Sod: Reuse on-site if possible; otherwise coordinate with Owner on reuse off-site.

3.6 REPAIR AND RESTORATION

- A. Remaining Existing Facilities, Utilities, and Site Features: If damaged due to this work, repair or replace to original condition.
- B. Vegetation: Replace damaged or destroyed vegetation identified to remain as indicated on drawings at no cost to Owner:
 - 1. Outside removal limits.

3.7 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 10 14 53 - TRAFFIC SIGNAGE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 specification Sections apply to the work of this Section.

1.2 SECTION INCLUDES

- A. This Section includes the removal, storage, protection, replacement, and reinstallation of existing traffic signs and sign supports affected by construction.
- B. Work includes furnishing all labor, materials, equipment, and incidentals necessary to:
 - 1. Remove existing traffic signs and sign supports.
 - 2. Protect and store signs designated for reuse.
 - 3. Furnish and install new sign posts, foundations, hardware, and mounting accessories as required.
 - 4. Reinstall existing signs or install new signs as directed by the Owner.
 - 5. Restore all disturbed areas.

1.3 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. FHWA MUTCD - Manual on Uniform Traffic Control Devices; 2023, with Editorial Revision (2025).
- C. Standard Drawings for Signs and Supports - "The Commonwealth of Massachusetts, Department of Public Works, Standard Drawings for Signs and Supports"; 1990.
- D. Standard Specifications - "The Commonwealth of Massachusetts, Massachusetts Department of Transportation, Standard Specifications for Highways and Bridges" and supplements, excluding provisions for "Method of Measurement" and "Basis of Payment"; Current Version

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data:
 - 1. Sign posts.
 - 2. Breakaway hardware.

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3. Mounting brackets.
 4. Foundations, where applicable
- C. Prior to removal, prepare an inventory identifying:
1. Existing sign location.
 2. Sign size.
 3. Sign legend.
 4. Existing support type.
 5. Existing condition.
- D. Photograph each sign assembly before removal.

1.5 QUALITY ASSURANCE

- A. Traffic control shall conform to the requirements of the MUTCD and applicable Massachusetts Department of Transportation standards.
- B. Installation shall be performed by personnel experienced in roadway signage installation.

PART 2 PRODUCTS

2.1 GENERAL

- A. Signs, foundations, and supports shall conform with the following:
1. Standard Specifications.
 2. FHWA MUTCD.
 3. AASHTO LTS.
- B. Accessibility Compliance: Signs are required to comply with ADA Standards and MA AABR. In the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- C. Materials shall comply with MassDOT Subsection 828 Traffic Signs & Subsection 840 Sign Supports.

2.2 MATERIALS

- A. Reflective Sheeting: Standard Specifications, Subsection 828.41 and Section M9.30.0.
- B. Sign Panels: Standard Specifications, Subsection 828.42.
1. Aluminum panels.

- C. Posts: Standard Specifications, Subsection 840.20 and Subsection M8.18.3.
- D. Legends: Standard Specifications, Subsection 828.43.

2.3 FABRICATION

- A. General: Standard Specifications, Subsection 828.50.
- B. Reflective Sheeting: Standard Specifications, Subsection 828.51.
- C. Sign Panels: Standard Specifications, Subsection 828.52.
 - 1. Fabricate aluminum sign blanks free of buckles, warps, dents, cockles, burrs and defects. Cut to size and shape and punch mounting holes prior to metal degreasing and application of reflective sheeting.
 - 2. Complete fabrication of aluminum sign blanks including cutting to size and shape and the punching of mounting holes prior to metal degreasing and the application of reflective sheeting.
- D. Posts: Standard Specifications, Subsection 840.40.
- E. Legends: Standard Specifications, Subsection 828.53.

2.4 SIGN TYPES

- A. Flat Signs: Signage media without frame.
 - 1. Edges: Square.
 - 2. Corners: Square.
 - 3. Frame Finish: Natural (clear) anodized.
- B. Radius / Curved Signs: One-piece, curved extruded aluminum media holder securing flat, flexible sign media by curved lip on two sides; other two sides closed by end caps; concealed mounting attachment.

2.5 HARDWARE

- A. Provide new galvanized mounting hardware including bolts, nuts, washers, brackets, bands, clamps, and miscellaneous fasteners.
- B. Reuse existing hardware only when approved by the Owner.

2.6 SIGN POSTS

- A. Unless otherwise directed by the Owner, replacement posts shall match the existing type and shall comply with MassDOT Standard Specifications subsection 840.
- B. Acceptable post types include:

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1. Square perforated galvanized steel tube posts.
2. Galvanized U-channel posts.
3. Galvanized round steel posts.
4. Breakaway sign support systems meeting current MassDOT requirements.

2.7 HARDWARE

- A. Furnish new galvanized bolts, nuts, washers, brackets, bands, clamps, and miscellaneous hardware.
- B. Reuse existing hardware only when approved by the Owner.

2.8 FOUNDATIONS

- A. Provide new concrete foundations where required by existing conditions or directed by the Owner, and conforming to MassDOT subsection 840 and the applicable MassDOT Standard Drawings.

PART 3 EXECUTION

3.1 REMOVAL

- A. Carefully remove existing traffic signs and supports without damage.
- B. Signs designated for reuse shall remain the property of the City of Revere.
- C. Protect sign faces from scratching, bending, twisting, or other damage during removal and storage.
- D. Dispose of signs designated for disposal in accordance with applicable regulations

3.2 STORAGE

- A. Store reusable signs in a secure location.
- B. Stack signs to prevent damage to reflective sheeting.
- C. Protect reflective sheeting from scratching, bending, twisting, abrasion, and weather exposure.

3.3 REINSTALLATION

- A. Reinstall signs at locations shown on the Drawings or as directed by the Owner.
- B. Existing sign panels may be installed on:
 1. Existing posts.
 2. New posts.
 3. New supports.

Selection of support type shall be as directed by the Owner.

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- C. The City of Revere reserves the right to require replacement of any existing sign post with a new post or support assembly where existing materials are damaged, deteriorated, no longer comply with current standards, or where relocation necessitates replacement.
- D. Install all posts plumb and signs level.
- E. Orient signs to provide optimum visibility to approaching traffic.
- F. Install mounting heights and lateral offsets in accordance with the MUTCD and MassDOT requirements.
- G. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

3.4 TEMPORARY TRAFFIC CONTROL

- A. Provide temporary traffic control necessary to safely perform the Work.
- B. Temporary traffic control shall conform to:
 - 1. MassDOT Subsection 850 – Traffic Controls for Construction and Maintenance Operations
 - 2. MUTCD
 - 3. Massachusetts Amendments to the MUTCD

3.5 FIELD ADJUSTMENTS

- A. Final sign locations shall be subject to approval by the Owner.
- B. Minor adjustments in location may be directed by the Owner without additional compensation.

3.6 FIELD QUALITY CONTROL

- A. The Owner shall inspect each relocated or newly installed sign.
- B. Adjust sign location, orientation, mounting height, and alignment as directed until accepted by the Owner.

3.7 DAMAGE

- A. Any sign damaged during removal, storage, transportation, or reinstallation shall be replaced at no additional cost to the Owner.
- B. Replacement signs shall match existing size, legend, sheeting, and material unless otherwise directed by the Owner.

END OF SECTION

SECTION 31 22 00 - GRADING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 specification Sections apply to the work of this Section.

1.2 SECTION INCLUDES

- A. Rough grading.
- B. Fine grading.

1.3 RELATED REQUIREMENTS

- A. Section 31 23 16 - Excavation.
- B. Section 31 23 16.13 – Trenching.
- C. Section 31 23 16.26 - Rock Removal.
- D. Section 31 23 23 - Fill.

1.4 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 22 00 - Unit Prices for additional requirements.
- B. See Section 01 20 50 – Measurement and Payment for requirements

1.5 SUBMITTALS

- A. See Section 01 30 00 – Administrative Requirements for submittal procedures.
- B. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.6 QUALITY ASSURANCE

- A. Perform in accordance with State of Massachusetts, Highway Department standards.
 - 1. Maintain one copy on-site.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Gravel: Excavated on-site.
 - 1. Graded according to ASTM D2487 Group Symbol GW, GP, or SP.

- B. Other Fill Materials: See Section 31 23 23.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify survey bench mark and intended elevations for grading areas are as indicated.
- B. Verify the absence of standing or ponding water.

3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Stake and flag locations of known utilities.
- C. Locate, identify, and protect above- and below-grade utilities to remain.
- D. Notify utility company to remove and relocate utilities.
- E. Provide temporary means and methods to remove standing or ponding water from areas prior to grading.
- F. Protect site features to remain, including but not limited to bench marks, survey control points, and fences.
- G. Remove topsoil in accordance with Section 31 10 00.
- H. Excavate materials in accordance with Section 31 23 16.
- I. Remove rock in accordance with Section 31 23 16.26.
- J. Fill and backfill in accordance with Section 31 23 23.

3.3 ROUGH GRADING

- A. Excavate and fill subgrade material to elevations indicated on plans.
- B. Replace displaced subgrade in accordance with Section 31 23 23 Fill.
- C. Remove and replace unsuitable materials as specified fill.

3.4 FINE GRADING

- A. Scrape and spread subgrade material uniformly smooth and without disruptions as indicated on drawings.
- B. Slopes: Transition smoothly to adjacent areas.
- C. See Section 31 23 23 for final compaction.

3.5 FINISH GRADING

- A. Before Finish Grading:
 - 1. Verify trench backfilling have been inspected.
 - 2. Verify subgrade has been contoured and compacted.
- B. Remove debris, roots, branches, stones, in excess of 1/2 inch in size. Remove soil contaminated with petroleum products.
- C. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches.
- D. Place topsoil in areas where seeding are indicated.
- E. Place topsoil during dry weather.
- F. Remove roots, weeds, rocks, and foreign material while spreading.
- G. Near plants spread topsoil manually to prevent damage.
- H. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
- I. Lightly compact placed topsoil.
- J. Maintain stability of topsoil during inclement weather. Replace topsoil in areas where surface water has eroded thickness below specifications.

3.6 CLEANING

- A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.
- B. Remove unused stockpiled subsoil. Grade stockpile area to prevent standing water.
- C. Leave site clean and raked, ready to receive work.

END OF SECTION

SECTION 31 23 16 - EXCAVATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 specification Sections apply to the work of this Section.

1.2 SECTION INCLUDES

- A. Excavating for removal and installation of utilities.
- B. Trenching for utilities.
- C. Temporary excavation support and protection systems.

1.3 RELATED REQUIREMENTS

- A. Section 01 57 13 - Temporary Erosion and Sediment Control: Slope protection and erosion control.
- B. Section 02 41 13 - Selective Site Demolition: Shoring and underpinning existing structures.
- C. Section 31 22 00 - Grading: Grading.
- D. Section 31 23 16.26 - Rock Removal: Removal of rock during excavating.
- E. Section 31 23 23 - Fill: Fill materials, backfilling, and compacting.

1.4 REFERENCE STANDARDS

- A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

1.5 PRICE AND PAYMENT PROCEDURES

- A. Unit Prices:
 - 1. See Section 01 22 00 - Unit Prices for additional requirements.
- B. Measurement and Payment:
 - 1. See Section 01 20 50 – Measurement and Payment for requirements.

1.6 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Temporary Support and Excavation Protection Plan.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Bedding and Fill to Correct Over-Excavation:
 - 1. See Section 31 23 23 for bedding and corrective fill materials at general excavations.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the work are as indicated.
- B. Survey existing adjacent structures and improvements and establish exact elevations at fixed points to act as benchmarks.

3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, and protect utilities that remain and protect from damage.
- C. Notify utility company to remove and relocate utilities.
- D. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- E. Grade top perimeter of excavation to prevent surface water from draining into excavation. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by Engineer.

3.3 TEMPORARY EXCAVATION SUPPORT AND PROTECTION

- A. Excavation Safety: Comply with OSHA's Excavation Standard, 29 CFR 1926, Subpart P.
 - 1. Depending upon excavation depth, time that excavation is open, soil classification, configuration and slope of excavation sidewalls, design and provide an excavation support and protection system that meets the requirements of 29 CFR 1926, Subpart P:

3.4 EXCAVATING

- A. Excavate to accommodate new utility structures and construction operations.
- B. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- C. Provide temporary means and methods, as required, to remove all water from excavations until directed by Engineer. Remove and replace soils deemed suitable by classification and which are excessively moist due to lack of dewatering or surface water control.

3.5 SUBGRADE PREPARATION

- A. See Section 31 23 23 for subgrade preparation at general excavations.

3.6 FILLING AND BACKFILLING

- A. Do not fill or backfill until all debris, water, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from excavation.
- B. See Section 31 23 23 for fill, backfill, and compaction requirements at general excavations.

3.7 REPAIR

- A. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 31 23 23.

3.8 CLEANING

- A. Stockpile excavated material to be re-used in area designated on site in accordance with Section 31 22 00.
- B. Remove excavated material that is unsuitable for re-use from site.
- C. Remove excess excavated material from site.

3.9 PROTECTION

- A. Divert surface flow from rains or water discharges from the excavation.
- B. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
- C. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in satisfactory, undisturbed condition.
- D. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- E. Keep excavations free of standing water and completely free of water during concrete placement.

END OF SECTION

SECTION 31 23 16.13 - TRENCHING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 specification Sections apply to the work of this Section.

1.2 SECTION INCLUDES

- A. Backfilling and compacting for utilities outside the building to utility main connections.

1.3 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 20 50 – Measurement and Payment for requirements
- B. See Section 01 21 00 – Allowances for requirement
- C. See Section 01 22 00 – Unit Prices, for general requirements applicable to unit prices for earthwork.

1.4 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.
- B. Subgrade Elevations: Indicated on drawings.
- C. Subgrade Elevations: 4 inches below finish grade elevations indicated on drawings, unless otherwise indicated.
- D. Finish Grade Elevations: 4 inches above subgrade elevations indicated on drawings , unless otherwise indicated.

1.5 REFERENCE STANDARDS

- A. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop; 2022, with Errata .
- B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012 (Reapproved 2021).
- C. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)); 2012 (Reapproved 2021).

1.6 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Compaction Density Test Reports.

PART 2 EXECUTION

2.1 EXAMINATION

- A. Verify that survey bench marks and intended elevations for the work are as indicated.

2.2 TRENCHING

- A. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- B. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- C. Do not interfere with 45 degree bearing splay of foundations.
- D. Cut trenches wide enough to allow inspection of installed utilities.
- E. Hand trim excavations. Remove loose matter.
- F. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
- G. Remove excavated material that is unsuitable for re-use from site.
- H. Remove excess excavated material from site.
- I. Provide temporary means and methods, as required, to remove all water from trenching until directed by the Engineer. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.
- J. Determine the prevailing groundwater level prior to trenching. If the proposed trench extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Engineer.

2.3 PREPARATION FOR UTILITY PLACEMENT

- A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.
- B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

2.4 BACKFILLING

- A. Backfill to contours and elevations indicated using unfrozen materials.
- B. Employ a placement method that does not disturb or damage other work.
- C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

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- D. Maintain optimum moisture content of fill materials to attain required compaction density.
- E. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- F. Correct areas that are over-excavated.
 - 1. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.
- G. Compaction Density Unless Otherwise Specified or Indicated:
 - 1. Under paving, slabs-on-grade, and similar construction: 97 percent of maximum dry density.
- H. Reshape and re-compact fills subjected to vehicular traffic.

2.5 BEDDING AND FILL AT SPECIFIC LOCATIONS

2.6 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.
- B. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D1557 ("modified Proctor"), AASHTO T 180, or ASTM D698 ("standard Proctor").
- C. If tests indicate work does not meet specified requirements, remove work, replace and retest.

2.7 CLEANING

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

SECTION 31 23 16.26 - ROCK REMOVAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 specification Sections apply to the work of this Section.

1.2 SECTION INCLUDES

- A. Removal of discovered rock during excavation.

1.3 RELATED REQUIREMENTS

- A. Section 31 23 23 - Fill: Fill materials.

1.4 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 20 50 – Measurement and Payment for requirements
- B. See Section 01 21 00 – Allowances for requirement
- C. See Section 01 22 00 – Unit Prices, for general requirements applicable to unit prices for earthwork.

1.5 DEFINITIONS

- A. Site Rock: Rock material in beds, ledges, un-stratified masses, conglomerate deposits, and boulders of rock material 3/4 cubic yard or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D1586/D1586M.
- B. Trench Rock: Rock material in beds, ledges, un-stratified masses, conglomerate deposits, and boulders of rock material 1/6 cubic yard or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D1586/D1586M.

1.6 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify site conditions and note subsurface irregularities affecting work of this section.

3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum.

3.3 ROCK REMOVAL

- A. Excavate and remove rock by mechanical methods only; use of explosives is prohibited.
- B. Mechanical Methods: Drill holes and utilize expansive tools to fracture rock.
- C. Form level bearing at bottom of excavations.
- D. In utility trenches, excavate to 6 inches below invert elevation of pipe and 24 inches wider than pipe diameter.
- E. Remove excavated materials from site.
- F. Correct unauthorized rock removal in accordance with backfilling and compacting requirements of Section 31 23 23.

END OF SECTION

SECTION 31 23 23 - FILL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 specification Sections apply to the work of this Section.

1.2 SECTION INCLUDES

- A. Filling, backfilling, and compacting for utility installation, paving, and site utility structures.
- B. Backfilling and compacting for utility connections and installation.
- C. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.

1.3 RELATED REQUIREMENTS

- A. Section 01 57 13 - Temporary Erosion and Sediment Control: Slope protection and erosion control.
- B. Section 31 22 00 - Grading: Site grading.
- C. Section 31 23 16 - Excavation: Removal and handling of soil to be re-used.
- D. Section 31 23 16.26 - Rock Removal: Removal of rock during excavating.

1.4 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 22 00 - Unit Prices, for general requirements applicable to unit prices for earthwork.
- B. See Section 01 20 50 – Measurement and Payment for requirements.

1.5 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.
- B. Subgrade Elevations: 4 inches below finish grade elevations indicated on drawings, unless otherwise indicated.

1.6 REFERENCE STANDARDS

- A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil–Aggregate Subbase, Base, and Surface Courses; 2017 (Reapproved 2021).
- B. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2019.
- C. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.

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- D. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method; 2015, with Editorial Revision (2016).
- E. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)); 2012 (Reapproved 2021).
- F. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2017, with Editorial Revision (2020).
- G. ASTM D4491/D4491M - Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 2022.
- H. ASTM D4533/D4533M - Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2015 (Reapproved 2023).
- I. ASTM D4533/D4533M - Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2015 (Reapproved 2023).
- J. ASTM D4595 - Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method; 2017.
- K. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 2015a (Reapproved 2023).
- L. ASTM D4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile; 2021a.
- M. ASTM D5084 - Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter; 2016a.
- N. ASTM D6241 - Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe; 2014.
- O. ASTM D6637/D6637M - Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method; 2015.
- P. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2023.
- Q. CAM - The Compendium of Quality Assurance and Quality Control Requirements and Performance Standards for Selected Analytical Methods Used in Support of Response Actions for the Massachusetts Contingency Plan (MCP) WSC - 02 - 320; 2010.
- R. EPA Method 6010D - "EPA Method 6010D (SW-846): Inductively Coupled Plasma - Atomic Emission Spectrometry"; 2014.
- S. EPA Method 7471B - "EPA Method 7471B (SW-846): Mercury in Solid or Semisolid Wastes (Manual Cold-Vapor Technique)"; 2007.

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- T. EPA Method 8081B - SW-846 Test Method 8081B: Organochlorine Pesticides by Gas Chromatography; 2007.
- U. EPA Method 8082A - "SW-846 Test Method 8082A: Polychlorinated Biphenyls (PCBs) by Gas Chromatography"; 2006.
- V. EPA Method 8260D - "EPA Method 8260D (SW-846): Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)"; 2018.
- W. EPA Method 8270D - SW-846 Test Method 8270D: Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry; 2014.
- X. Massachusetts Contingency Plan - Section 310 subsection 40 of the Code of Massachusetts Regulations (CMR): Massachusetts Contingency Plan; Current Edition.
- Y. MassDEP EPH Method - Methods for the Determination of Extractable Petroleum HydroCarbons (EPH), Massachusetts Department of Environmental Protection, Bureau of Waste Site Cleanup; December 2019.
- Z. Standard Specifications - "The Commonwealth of Massachusetts, Massachusetts Department of Transportation, Standard Specifications for Highways and Bridges" and supplements, excluding provisions for "Method of Measurement" and "Basis of Payment"; 2025 Edition.

1.7 SUBMITTALS

- A. Material Test Reports - Physical: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated. Prepare separate reports for each type and application of material at a rate of one per 1,000 cubic yards with a minimum of two test submitted.
 - 1. Classification according to ASTM D2487.
 - 2. Sieve analysis according to ASTM C136/C136M.
 - 3. Laboratory compaction curve according to ASTM D1557.
- B. Material Test Reports - Chemical: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated. Prepare separate reports for each type and application of material at a rate of one per 500 cubic yards with a minimum of two test submitted. The Owner reserves the right to reject material based on the results of this testing.
 - 1. Volatile Organic Compounds (VOCs) according to EPA Method 8260D.
 - 2. Semi-Volatile Organic Compounds (SVOCs) according to EPA Method 8270D.
 - 3. Extractable Petroleum Hydrocarbons (EPH) with target Polycyclic Aromatic Hydrocarbons (PAHs) according to MassDEP EPH Method.
 - 4. Metals listed in CAM according to EPA Method 6010D and EPA Method 7471B.

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5. Polychlorinated Biphenyls (PCBs) according to EPA Method 8082A.
 6. Chlorinated Pesticides according to EPA Method 8081B.
 7. Soil imported to the site shall not contain oil or hazardous materials at concentrations greater than the reportable concentrations (RCs) in Subpart P "Massachusetts Oil and Hazardous Materials List" of the Massachusetts Contingency Plan.
- C. Soil/Material Origin: Provide a description for each originating off-site location or project from which imported soil/material is obtained, including known historical activities occurring on the site, and any possible releases that have occurred. Soil imported to the site shall not be classified as "remediation waste" as defined by the Massachusetts Contingency Plan.
- D. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.
- E. Compaction Density Test Reports.
- F. Detailed Earthwork Analysis: Prior to the start of construction, submit a detailed earthwork plan. The plan shall indicate the required cuts and fills for the entire site based on the required subgrades. The plan shall also include a detailed breakdown of the amount of materials that are required to be imported and exported from the site. The plan shall be prepared to a level of detail acceptable to the Engineer.

PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D2487, or a combination of these groups.
1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. General Fill: On-site satisfactory soil or imported Granular Fill.
- E. Gravel Borrow: Standard Specifications, Section M1.03.0 Type b.
- F. Processed Gravel: Standard Specifications, Section M1.03.1.
- G. Sand: Standard Specifications, Section M1.04.0, Type a and M1.04.1.

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H. Stone:

1. 1 1/2" Stone: Standard Specifications, Section M2.01.1.
2. 1 1/4" Stone: Standard Specifications, Section M2.01.3.
3. 3/4" Stone: Standard Specifications, Section M2.01.4.
4. 1/2" Stone: Standard Specifications, Section M2.01.5.
5. 3/8" Stone: Standard Specifications, Section M2.01.6.

I. Riprap:

1. Stone for Pipe Ends: Standard Specifications, Section M2.02.3.
2. Dumped Riprap: Standard Specifications, Section M2.02.2.
3. Rockfill: Standard Specifications, Section M2.02.1.

J. Structural Fill: Inert material that is hard, durable stone and coarse sand, free from loam and clay, surface coatings, and deleterious materials, and graded in accordance with ASTM C136/C136M, within the following limits:

1. 3 inch sieve: 100 percent passing.
2. 1/2 inch sieve: 50 to 85 percent passing.
3. No. 4 sieve: 40 to 75 percent passing.
4. No. 40 sieve: 10 to 35 percent passing.
5. No. 200 sieve: 0 to 10 percent passing.

K. Granular Fill: Inert material that is hard, durable stone and coarse sand, free from loam and clay, surface coatings, and deleterious materials, and graded in accordance with ASTM C136/C136M, within the following limits:

1. 3 inch sieve: 100 percent passing.
2. No. 10 sieve: 30 to 90 percent passing.
3. No. 40 sieve: 10 to 70 percent passing.
4. No. 200 sieve: 0 to 15 percent passing.

L. Topsoil: Standard Specifications, Section M1.05.0

1. Organic Soil Additives: Standard Specifications, Section M1.06.0
2. Inorganic Soil Additives: Standard Specifications, Section M6.01.0.

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- M. Low Permeability Soil: Soil free from loam and clay, surface coatings, and deleterious materials, with a maximum in-place permeability of 1×10^{-5} cm/s in accordance with ASTM D5084, and graded in accordance with ASTM C136/C136M, within the following limits:
1. 3 inch sieve: 100 percent passing.
 2. No. 10 sieve: 30 to 90 percent passing.
 3. No. 40 sieve: 10 to 70 percent passing.
 4. No. 200 sieve: 20 to 40 percent passing.

2.2 GEOTEXTILES

- A. Separation Fabric: Nonwoven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; and with the following minimum properties:
1. Tensile Strength: 270 pounds-force minimum, when tested in accordance with ASTM D4632/D4632M.
 2. Trapezoid Tear Strength: 105 pounds-force minimum, when tested in accordance with ASTM D4533/D4533M.
 3. CBR Puncture Strength: 725 pounds-force minimum, when tested in accordance with ASTM D6241.
 4. Average Opening Size: 100 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
 5. Flow Rate: 85 gallons/minute/square foot minimum, when tested in accordance with ASTM D4491/D4491M.
- B. Filter Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties:
1. Grab Tensile Strength: 120 pounds-force minimum, when tested in accordance with ASTM D4632/D4632M.
 2. Trapezoid Tear Strength: 50 pounds-force minimum, when tested in accordance with ASTM D4533/D4533M.
 3. CBR Puncture Strength: 310 pounds-force minimum, when tested in accordance with ASTM D6241.
 4. Average Opening Size: 70 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
 5. Flow Rate: 135 gallons/minute/square foot minimum, when tested in accordance with ASTM D4491/D4491M.

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- C. Stabilization Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties:
1. Tensile Strength (at ultimate):
 - a. Machine Direction (MD): 3,600 pounds-force minimum, when tested in accordance with ASTM D4595.
 - b. Cross Machine Direction (CMD): 3,600 pounds-force minimum, when tested in accordance with ASTM D4595.
 2. Tensile Strength (at 5 percent strain):
 - a. Machine Direction (MD): 1,500 pounds-force minimum, when tested in accordance with ASTM D4595.
 - b. Cross Machine Direction (CMD): 1,560 pounds-force minimum, when tested in accordance with ASTM D4595.
 3. Grab Tensile Strength:
 - a. Machine Direction (MD): 400 pounds-force minimum, when tested in accordance with ASTM D4632/D4632M.
 - b. Cross Machine Direction (CMD): 300 pounds-force minimum, when tested in accordance with ASTM D4632/D4632M.
 4. Trapezoid Tear Strength:
 - a. Machine Direction (MD): 135 pounds-force minimum, when tested in accordance with ASTM D4533/D4533M.
 - b. Cross Machine Direction (CMD): 125 pounds-force minimum, when tested in accordance with ASTM D4533/D4533M.
 5. CBR Puncture Strength: 1,450 pounds-force minimum, when tested in accordance with ASTM D6241.
 6. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
 7. Flow Rate: 60 gallons/minute/square foot minimum, when tested in accordance with ASTM D4491/D4491M.
- D. Geogrid: Stable structure composed of polypropylene resin, specifically manufactured to be inert to biological degradation, resistant to naturally encountered chemicals, and designed to increase the bearing capacity of roadbeds; and with the following minimum properties:
1. Tensile Strength (at ultimate):

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- a. Machine Direction (MD): 1,310 pounds-force minimum, when tested in accordance with ASTM D6637/D6637M.
- b. Cross Machine Direction (CMD): 1,970 pounds-force minimum, when tested in accordance with ASTM D6637/D6637M.
2. Tensile Strength (at 5 percent strain):
 - a. Machine Direction (MD): 810 pounds-force minimum, when tested in accordance with ASTM D6637/D6637M.
 - b. Cross Machine Direction (CMD): 1,340 pounds-force minimum, when tested in accordance with ASTM D6637/D6637M.
3. Rib Thickness: 0.05 inches minimum.
4. Grid Aperture Size:
 - a. Machine Direction (MD): 0.75 inches to 1.25 inches.
 - b. Cross Machine Direction (CMD): 1.0 inches to 1.5 inches.

2.3 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
 1. Red: Electric.
 2. Yellow: Gas, oil, steam, and dangerous materials.
 3. Orange: Telephone and other communications.
 4. Blue: Water systems.
 5. Green: Sewer systems.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that survey benchmarks and intended elevations for the Work are as indicated.
- B. Identify required lines, levels, contours, and datum locations.
- C. Verify areas to be filled are not compromised with surface or ground water.

3.2 PREPARATION

- A. Scarify and proof roll subgrade surface to a depth of 6 inches to identify soft spots.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.
- C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.3 FILLING

- A. Fill to contours and elevations indicated using unfrozen materials.
- B. Employ a placement method that does not disturb or damage other work.
- C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- D. Maintain moisture content of fill materials within 2 percent of optimum moisture content to attain required compaction density.
- E. Place and compact materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.
- F. Blend slope into level areas.
- G. Correct areas that are over-excavated.
 - 1. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.
- H. Compaction Density Unless Otherwise Specified or Indicated:
 - 1. Under pavements, walkways, and slabs-on-grade: 95 percent of maximum dry density.
 - 2. Under turf and unpaved areas: 85 percent of maximum dry density.
 - 3. For : utility trenches: 85 percent of maximum dry density.
- I. Reshape and re-compact fills subjected to vehicular traffic.
- J. Maintain temporary means and methods, as required, to remove all water while fill is being placed as required, or until directed by the Engineer. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

3.4 FILL AT SPECIFIC LOCATIONS

- A. Place and compact fill material in layers to required elevations as follows:

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1. Under footings, slabs, and walks, use structural fill.
2. Under flexible pavement, use processed gravel.
3. Under remaining areas, use general fill.

3.5 GEOTEXTILES

- A. Install and maintain geotextiles in accordance with the manufacturers' instructions.

3.6 FIELD QUALITY CONTROL

- A. Soil Fill Materials:
 1. Compaction density testing will be performed on compacted fill in accordance with ASTM D1556/D1556M or ASTM D6938.
 2. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D1557 ("modified Proctor").
 3. If tests indicate work does not meet specified requirements, remove work, replace and retest.
 4. Frequency of Tests:
 - a. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length, but no fewer than two tests.

3.7 CLEANING

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

SECTION 32 05 23 - CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 specification Sections apply to the work of this Section.

1.2 SECTION INCLUDES

- A. Concrete formwork.
- B. Exterior site cast-in-place concrete.
- C. Concrete reinforcement.
- D. Joint devices associated with concrete work.
- E. Miscellaneous concrete elements, including thrust blocks, and manholes.
- F. Concrete curing.

1.3 RELATED REQUIREMENTS

- A. Section 32 13 73 - Concrete Paving Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.
- B. Section 32 13 13 - Concrete Paving: Sidewalks, curbs and gutters.

1.4 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 22 00 - Unit Prices, for general requirements applicable to unit prices for earthwork.
- B. See Section 01 20 50 – Measurement and Payment for requirements.

1.5 REFERENCE STANDARDS

- A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).
- B. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- C. ACI PRC-305 - Guide to Hot Weather Concreting; 2020.
- D. ACI PRC-306 - Guide to Cold Weather Concreting; 2016.
- E. ACI PRC-308 - Guide to External Curing of Concrete; 2016.
- F. ACI PRC-347 - Guide to Formwork for Concrete; 2014 (Reapproved 2021).

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- G. ACI SPEC-117 - Specification for Tolerances for Concrete Construction and Materials and Commentary; 2010 (Reapproved 2015).
- H. ACI SPEC-301 - Specifications for Concrete Construction; 2020.
- I. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- J. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars; 2022.
- K. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.
- L. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2023.
- M. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2026a.
- N. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.
- O. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2017.
- P. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2020a.
- Q. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2022.
- R. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars; 2021.
- S. Standard Specifications - "The Commonwealth of Massachusetts, Massachusetts Department of Transportation, Standard Specifications for Highways and Bridges" and supplements, excluding provisions for "Method of Measurement" and "Basis of Payment"; 2025 Edition.

1.6 SUBMITTALS

- A. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
- B. Mix Design: Submit proposed concrete mix design.
 - 1. Indicate proposed mix design complies with requirements of ACI SPEC-301, Section 4 - Concrete Mixtures.
 - 2. Indicate proposed mix design complies with requirements of ACI CODE-318, Chapter 5 - Concrete Quality, Mixing and Placing.
- C. Test Reports: Submit report for each test or series of tests specified.

- D. Manufacturer's Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.
- E. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.7 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI SPEC-301 and ACI CODE-318.
- B. Follow recommendations of ACI PRC-306 when concreting during cold weather.

PART 2 PRODUCTS

2.1 FORMWORK

- A. Formwork Design and Construction: Comply with guidelines of ACI PRC-347 to provide formwork that will produce concrete complying with tolerances of ACI SPEC-117.
- B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
 - 1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.
 - 2. Earth Cuts: Do not use earth cuts as forms for vertical surfaces. Natural rock formations that maintain a stable vertical edge may be used as side forms.
 - 3. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.
 - 4. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches of concrete surface.

2.2 REINFORCEMENT MATERIALS

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
 - 1. Type: Deformed billet-steel bars.
 - 2. Finish: Epoxy coated in accordance with ASTM A775/A775M, unless otherwise indicated.
- B. Steel Welded Wire Reinforcement (WWR): Galvanized, plain type, ASTM A1064/A1064M.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:

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1. Portland Cement: Standard Specifications, Section M4.01.1.
 - a. Fly Ash: Standard Specifications Section M4.01.1.
 2. Normal-Weight Aggregates: Standard Specifications, Section M4.01.02.
- B. Water: Standard Specifications M4.01.3.

2.4 ADMIXTURES

- A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- B. Air-Entraining Admixture: Standard Specifications, Section M4.01.4 Type AEA.
- C. Water-Reducing Admixture: Standard Specifications, Section M4.01.4 Type A.
- D. Retarding Admixture: Standard Specifications, Section M4.01.4 Type B.

2.5 BONDING AND JOINTING PRODUCTS

- A. Epoxy Bonding System:
 1. Complying with ASTM C881/C881M and of Type required for specific application.
- B. Slab Isolation Joint Filler: Standard Specifications, Section M9.14.0.
- C. Slab Isolation Joint Filler: 1/2-inch thick, height equal to slab thickness, with removable top section forming 1/2-inch deep sealant pocket after removal.
- D. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with rectangular or round knockout holes for conduit or rebar to pass through joint form at 6 inches on center; ribbed steel stakes for setting.

2.6 CURING MATERIALS

- A. Absorptive Cover: Standard Specifications, Section M9.06.3.
- B. Moisture-Retaining Cover: Standard Specifications, Section M9.06.1.
- C. Clear, Waterborne, Membrane-Forming Curing Compound: Standard Specifications, Section M9.06.5.

2.7 CONCRETE MIX DESIGN

- A. Prepare design mixtures, proportioned according to the Standard Specifications, Section M4.01.6, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.

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2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
1. Compressive Strength (28 Days): As indicated on the Drawings (3000 psi minimum).
 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
 3. Slump Limit: 4 inches, plus or minus 1 inch.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as indicated in the Standard Specifications, Section M4.01.
- D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing admixture in concrete as required for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- E. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash: Standard Specifications, Section M4.01.6.

2.8 MIXING

- A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685/C685M. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.
- B. Transit Mixers: Comply with ASTM C94/C94M.
- C. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.2 PREPARATION

- A. Formwork: Comply with requirements of ACI SPEC-301. Design and fabricate forms to support all applied loads until concrete is cured and for easy removal without damage to concrete.
- B. Verify that forms are clean and free of rust before applying release agent.

- C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- D. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in accordance with bonding agent manufacturer's instructions.
 - 1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
- E. Where new concrete with integral waterproofing is to be bonded to previously placed concrete, prepare surfaces to be treated in accordance with waterproofing manufacturer's instructions. Saturate cold joint surface with clean water, and remove excess water before application of coat of waterproofing admixture slurry. Apply slurry coat uniformly with semi-stiff bristle brush at rate recommended by waterproofing manufacturer.
- F. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

3.3 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

- A. Fabricate and handle epoxy-coated reinforcing in accordance with ASTM D3963/D3963M.
- B. Comply with requirements of ACI SPEC-301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.
- C. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.
- D. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

3.4 PLACING CONCRETE

- A. Place concrete in accordance with ACI PRC-304.
- B. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- C. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- D. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.

3.5 SLAB JOINTING

- A. Locate joints as indicated on drawings.

- B. Anchor joint fillers and devices to prevent movement during concrete placement.
- C. Isolation and Expansion Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
 - 1. Install wherever necessary to separate slab from other building members, including columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.
- D. Load Transfer Construction and Contraction Joints: Install load transfer devices as indicated; saw cut joint at surface as indicated for contraction joints.
- E. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.
- F. Construction Joints: Where not otherwise indicated, use metal combination screed and key form, with removable top section for joint sealant.

3.6 CONCRETE FINISHING

- A. Repair surface defects, including tie holes, immediately after removing formwork.
- B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.
- C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
- D. Broom Finish: Wet concrete and sweep with broom perpendicular to pavement direction, not more than 24 hours after form removal.

3.7 CURING AND PROTECTION

- A. Comply with requirements of ACI PRC-308. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.
- D. Surfaces Not in Contact with Forms:
 - 1. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
 - 2. Final Curing: Begin after initial curing but before surface is dry.

- a. Moisture-Retaining Sheet: Lap strips not less than 3 inches and seal with waterproof tape or adhesive; secure at edges.
- b. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

3.8 FIELD QUALITY CONTROL

- A. Provide free access to concrete operations at project site and cooperate with appointed firm.
- B. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
- C. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.
- D. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for each day's pour plus one for every 25 cubic yards or less of each class of concrete placed.
- E. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
- F. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.9 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be determined by the Engineer. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

END OF SECTION

SECTION 32 11 23 - AGGREGATE BASE COURSES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aggregate base course.
- B. Paving aggregates.

1.2 RELATED REQUIREMENTS

- A. Section 31 22 00 - Grading: Preparation of site for base course.
- B. Section 31 23 16.13 - Trenching: Compacted fill over utility trenches under base course.
- C. Section 31 23 23 - Fill: Topsoil fill at areas adjacent to aggregate base course.
- D. Section 31 23 23 - Fill: Compacted fill under base course.
- E. Section 32 13 13 - Concrete Paving: Finish concrete surface course.

1.3 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 22 00 - Unit Prices for general requirements applicable to unit prices for earthwork.
- B. See Section 01 20 50 – Measurement and Payment for requirements.

1.4 REFERENCE STANDARDS

- A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil–Aggregate Subbase, Base, and Surface Courses; 2017 (Reapproved 2021).
- B. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop; 2022, with Errata .
- C. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2019.
- D. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012 (Reapproved 2021).
- E. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method; 2015, with Editorial Revision (2016).
- F. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)); 2012 (Reapproved 2021).
- G. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2015.

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- H. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2017, with Editorial Revision (2020).
- I. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2017, with Editorial Revision (2018).
- J. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2023.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Aggregate Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. When aggregate materials need to be stored on site, locate where indicated on drawings.
- B. Aggregate Storage, General:
 - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 - 2. Prevent contamination.
 - 3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS

2.1 MATERIALS

2.2 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for general requirements for testing and analysis of aggregate materials.
- B. If tests indicate materials do not meet specified requirements, change material and retest.
- C. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that survey bench marks and intended elevations for the work are as indicated.

3.2 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.

- B. Do not place aggregate on soft, muddy, or frozen surfaces.

3.3 INSTALLATION

- A. Place aggregate in maximum 4 inch layers and roller compact to specified density.
- B. Level and contour surfaces to elevations and gradients indicated.
- C. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
- D. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- E. Use mechanical tamping equipment in areas inaccessible to compaction equipment.
- F. Apply herbicide to finished surface.

3.4 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Scheduled Compacted Thickness: Within 1/4 inch.
- C. Variation From Design Elevation: Within 1/2 inch.

3.5 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for general requirements for field inspection and testing.

3.6 CLEANING

- A. Leave unused materials in a neat, compact stockpile.
- B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- C. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

SECTION 32 12 16 - ASPHALT PAVING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 specification Sections apply to the work of this Section.

1.2 SECTION INCLUDES

- A. Hot mix asphalt paving.

1.3 RELATED REQUIREMENTS

- A. Section 31 22 00 - Grading: Preparation of site for paving and base.
- B. Section 31 23 23 - Fill: Compacted subgrade for paving.
- C. Section 32 11 23 - Aggregate Base Courses: Aggregate base course.

1.4 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 22 00 - Unit Prices, for additional unit price requirements.
- B. See Section 01 20 50 – Measurement and Payment for requirements.

1.5 REFERENCE STANDARDS

- A. ASTM D979/D979M - Standard Practice for Sampling Bituminous Paving Mixtures; 2015.
- A. ASTM D1188 - Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples; 2015.
- B. ASTM D2041/D2041M - Standard Test Method for Theoretical Maximum Specific Gravity and Density of Asphalt Mixtures; 2019.
- C. ASTM D2726/D2726M - Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Asphalt Mixtures; 2019.
- D. ASTM D2950/D2950M - Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods; 2014.
- E. ASTM D3549/S3549M - Standard Test Method for Thickness or Height of Compacted Asphalt Mixture Specimens; 2018.
- F. Standard Specifications - "The Commonwealth of Massachusetts, Massachusetts Department of Transportation, Standard Specifications for Highways and Bridges" and supplements, excluding provisions for "Method of Measurement" and "Basis of Payment"; 2025 Edition.

1.6 QUALITY ASSURANCE

- A. Supplier Qualifications: A qualified supplier registered with and approved by the Massachusetts Department of Transportation.
- B. Obtain materials from same source throughout.

1.7 FIELD CONDITIONS

- A. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F, or surface is wet or frozen.
- B. Place bitumen mixture when temperature is not more than 15 F degrees below bitumen supplier's bill of lading and not more than maximum specified temperature.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Hot Mix Asphalt Material: Standard Specifications, M3.06.0.
- B. Aggregate: Standard Specifications, M3.06.2.
- C. Tack Coat: Standard Specifications, M3.03.3.
- D. Joint Sealer: Standard Specifications, M3.05.0.
- E. Hot Mix Asphalt for Sidewalks, Driveways, and Berms: Standard Specifications, M3.07.0.

2.2 ASPHALT PAVING MIXES AND MIX DESIGN

- A. Hot-Mix Asphalt Mixture Design: Standard Specifications, M3.06.4.

2.3 SOURCE QUALITY CONTROL

- A. Verification of Laboratory Trial Mix Formula: Standard Specifications, M3.06.5.
- B. Hot Mix Asphalt Production Facility: Standard Specifications, M3.12.0.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that compacted subgrade is dry and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

3.2 PATCHING

- A. Removal: Saw cut perimeter of patch and excavate existing pavement section to sound base.

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1. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated.
 2. Cut excavation faces vertically and remove excavated material.
 3. Recompress existing unbound-aggregate base course to form new subgrade.
- B. Tack Coat: Apply tack coat on asphalt or concrete surfaces over subgrade surface at uniform rate of .05 gal/sq yd to .15 gal/sq yd.
- C. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact.
1. Cover asphalt base course with tack coat.
 2. Cover with hot-mix surface layer compacted and finished flush with adjacent surfaces.

3.3 REPAIRS

- A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.
1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.
- B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.
1. Clean cracks and joints in existing hot-mix asphalt pavement.
 2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
 3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.4 SURFACE PREPARATION

- A. General: Immediately before placing hot mix asphalt, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Sweep loose granular particles from surface of unbound-aggregate intermediate course. Do not dislodge or disturb aggregate embedded in compacted surface of intermediate course.
- C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of .05 gal/sq yd.
1. Allow tack coat to cure undisturbed before applying hot mix asphalt paving.
 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.5 HOT MIX ASPHALT PLACING

- A. Machine place hot mix asphalt on prepared surface, spread uniformly, and strike off. Place by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
 - 1. Place hot mix asphalt surface course in single lift.
 - 2. Spread mix at minimum temperature of 250 F degrees.
 - 3. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
 - 4. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in hot mix asphalt paving mat.
 - 5. In areas inaccessible to pavers, use staked forms to maintain indicated line and grade. Prevent segregation of mix when placing mix by hand.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
 - 1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.6 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot mix asphalt course.
 - 1. Clean contact surfaces and apply tack coat to joints.
 - 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
 - 3. Offset transverse joints, in successive courses, a minimum of 24 inches.
 - 4. Compact joints as soon as hot mix asphalt will bear roller weight without excessive displacement.
 - 5. Compact material at joints to a density within 2 percent of specified course density.

3.7 COMPACTION

- A. General: Begin compaction as soon as placed paving material will bear roller weight without excessive displacement. Compact material with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.

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1. Complete compaction before mix temperature cools to 185 F degrees.
 2. To prevent adhesion of the mixture to the rolls, keep rolls moist with water. Excess liquid shall not be permitted.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot mix asphalt is still hot enough to achieve specified density. Continue rolling until course has been uniformly compacted to the following density:
1. Average Density: 95 percent of reference maximum theoretical density, but not less than 92 percent nor greater than 97 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while material is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh material. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.8 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Compacted Thickness: Within 1/4 inch of specified or indicated thickness.
- C. Variation from True Elevation: Within 1/2 inch.

3.9 FIELD QUALITY CONTROL

- A. Provide free access to asphalt operations at project site and cooperate with appointed firm.
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D3549/S3549M.
- C. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D979/D979M.

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1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D2041/D2041M, and compacted according to job-mix specifications.
 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D1188 or ASTM D2726/D2726M.
 - a. One core sample will be taken for every 1,000 square yards or less of installed pavement, with no fewer than three test performed.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D2950/D2950M and correlated with ASTM D1188 or ASTM D2726/D2726M.
- D. Replace and compact hot-mix asphalt where core tests were taken.
- E. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.10 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an approved landfill.
1. Do not allow excavated materials to accumulate on-site.

END OF SECTION

SECTION 32 13 13 - CONCRETE PAVING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 specification Sections apply to the work of this Section.

1.2 SECTION INCLUDES

- A. Concrete sidewalks, stair steps, integral curbs, gutters, median barriers, parking areas, and roads.

1.3 RELATED REQUIREMENTS

- A. Section 32 05 23 - Cement and Concrete for Exterior Improvements.
- B. Section 32 13 73 - Concrete Paving Joint Sealants: Sealing joints.
- C. Section 31 23 23 - Fill: Compacted subbase for paving.
- D. Section 32 17 26 - Tactile Warning Surfacing: Plastic tactile and detectable warning tiles for pedestrian walking surfaces.

1.4 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 22 00 - Unit Prices, for additional unit price requirements.
- B. See Section 01 20 50 – Measurement and Payment for requirements.

1.5 REFERENCE STANDARDS

- A. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- B. ACI PRC-305 - Guide to Hot Weather Concreting; 2020.
- C. ACI PRC-306 - Guide to Cold Weather Concreting; 2016.
- D. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2023.

1.6 SUBMITTALS

- A. Product Data: Provide data on joint filler, admixtures, and curing compound.
- B. Shop Drawings: Submit drawings of proposed joint layout. Include relevant building and site features.

PART 2 PRODUCTS

2.1 FORM MATERIALS

- A. Refer to 32 05 23 - Cement and Concrete for Exterior Improvements.

2.2 REINFORCEMENT

- A. Refer to 32 05 23 - Cement and Concrete for Exterior Improvements.

2.3 CONCRETE MATERIALS

- A. Refer to 32 05 23 - Cement and Concrete for Exterior Improvements.

2.4 ACCESSORIES

- A. Refer to 32 05 23 - Cement and Concrete for Exterior Improvements.

2.5 CONCRETE MIX DESIGN

- A. Refer to 32 05 23 - Cement and Concrete for Exterior Improvements.

2.6 MIXING

- A. Refer to 32 05 23 - Cement and Concrete for Exterior Improvements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

3.2 PREPARATION

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Coat surfaces of manhole frames with oil to prevent bond with concrete pavement.

3.3 FORMING

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.4 REINFORCEMENT

- A. Place reinforcement as indicated.

- B. Interrupt reinforcement at expansion joints.

3.5 COLD AND HOT WEATHER CONCRETING

- A. Follow recommendations of ACI PRC-305 when concreting during hot weather.
- B. Follow recommendations of ACI PRC-306 when concreting during cold weather.
- C. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

3.6 PLACING CONCRETE

- A. Place concrete in accordance with ACI PRC-304.
- B. Do not place concrete when base surface is wet.
- C. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.
- D. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.

3.7 JOINTS

- A. Align curb, gutter, and sidewalk joints.

3.8 FINISHING

- A. Area Paving: Light broom, texture perpendicular to pavement direction.
- B. Sidewalk Paving: Light broom, texture perpendicular to direction of travel with troweled and radiused edge 1/4 inch radius.

3.9 TOLERANCES

- A. Maximum Variation of Surface Flatness: 1/4 inch in 10 ft.
- B. Maximum Variation From True Position: 1/4 inch.

3.10 FIELD QUALITY CONTROL

- A. Provide free access to concrete operations at project site and cooperate with appointed firm.
- B. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
- C. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.

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- D. Compressive Strength Tests: ASTM C39/C39M; for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cu yd or less of each class of concrete placed.
 - 1. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
 - 2. Perform one slump test for each set of test cylinders taken.
- E. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.11 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.

END OF SECTION

SECTION 32 13 73 - CONCRETE PAVING JOINT SEALANTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 specification Sections apply to the work of this Section.

1.2 SECTION INCLUDES

- A. Self-leveling pourable joint sealants.

1.3 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 22 00 - Unit Prices, for additional unit price requirements.
- B. See Section 01 20 50 – Measurement and Payment for requirements.

1.4 REFERENCE STANDARDS

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).
- B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- D. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.
- E. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
- C. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.
- D. Manufacturer's qualification statement.
- E. Installer's qualification statement.

1.6 QUALITY ASSURANCE

- A. Maintain one copy of each referenced document covering installation requirements on site.

- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.
- D. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
 - 1. Adhesion Testing: In accordance with ASTM C794.
 - 2. Compatibility Testing: In accordance with ASTM C1087.
 - 3. Allow sufficient time for testing to avoid delaying the work.
 - 4. Deliver sufficient samples to manufacturer for testing.
 - 5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.

PART 2 PRODUCTS

2.1 SELF-LEVELING JOINT SEALANTS

- A. Self-Leveling Polyurethane Sealant for Horizontal Expansion Joints: ASTM C920, Grade P, Uses T; multi-component; explicitly approved by manufacturer for horizontal expansion joints.
 - 1. Movement Capability: Plus and minus 25 percent, minimum.
 - 2. Hardness Range: 30 to 35, Shore A, when tested in accordance with ASTM C661.
 - 3. Color: Match adjacent concrete surface.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.

3.2 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.3 INSTALLATION

- A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Provide joint sealant installations complying with ASTM C1193.
- C. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- D. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- E. Nonsag Sealants: Tool surface slightly recessed, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

3.4 POST-OCCUPANCY

- A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width, i.e., at low temperature in thermal cycle. Report failures immediately and repair them.

END OF SECTION

SECTION 32 16 14 - CURBING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 specification Sections apply to the work of this Section.

1.2 SECTION INCLUDES

- A. Vertical granite curbing.

1.3 RELATED REQUIREMENTS

- A. Section 32 12 16 - Asphalt Paving for asphalt curbs.
- B. Section 32 13 13 - Concrete Paving for expansion and isolation-joint materials, and monolithic cast-in-place concrete curbing and walks.

1.4 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 22 00 - Unit Prices, for additional unit price requirements.
- B. See Section 01 20 50 – Measurement and Payment for requirements.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide characteristics of curb, dimensions, and special shapes.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Mortar: Standard Specifications, Section M.4.02.15.
- B. Granite Curb and Edging: Standard Specifications, Section M.9.04.0.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Excavate, prepare foundation, set curb, and point joints in accordance with Section 501 of the Standard Specifications.
- B. Transition Curbing. Provide transition curbing for curb ramps where indicated.

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3.2 INSTALLATION TOLERANCES

- A. Curb Alignment: 1/4-inch maximum, as determined by using a 10-foot straight edge along front face of curb.

END OF SECTION

SECTION 32 16 23 – ASPHALT SIDEWALKS

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the construction of asphalt sidewalks and miscellaneous asphalt pedestrian pavement as shown on the Contract Drawings.
- B. Work includes:
 - 1. Excavation.
 - 2. Preparation of subgrade.
 - 3. Furnishing and placing gravel base.
 - 4. Furnishing and placing hot mix asphalt.
 - 5. Fine grading.
 - 6. Compaction.
 - 7. Joint construction.
 - 8. Surface restoration.
 - 9. Protection of completed work.

1.2 REFERENCES

- A. Massachusetts Department of Transportation (MassDOT) Standard Specifications for Highways and Bridges, including applicable provisions of:
 - 1. Division II – Construction Details
 - 2. Division III – Materials Specifications
 - 3. Subsection 460 – Hot Mix Asphalt Pavement
 - 4. Applicable sections governing excavation, embankment, and gravel base construction.
 - 5. Applicable MassDOT Standard Drawings.
- B. Americans with Disabilities Act (ADA).
- C. Public Rights-of-Way Accessibility Guidelines (PROWAG), where applicable.
- D. Applicable City standards.

1.3 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 22 00 - Unit Prices, for additional unit price requirements.
- B. See Section 01 20 50 – Measurement and Payment for requirements.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Asphalt mixture
 - 2. Asphalt: Provide data on primer
 - 3. Aggregate materials

PART 2 PRODUCTS

2.1 ASPHALT SIDEWALKS

- A. Gravel Subbase: Thickness as indicated on drawings.
- B. Asphalt Cement: ASTM D946/D946M.
 - 1. Provide Hot Mix Asphalt conforming to the requirements of the current MassDOT Standard Specifications for pedestrian pavement.
- C. Aggregate:
 - 1. Single Course: Pit run, washed, 3/8 inch (1 cm) stone; free of shale, clay, friable material and debris.
 - 2. Provide processed gravel conforming to applicable MassDOT material specifications.
- D. Primer: Homogenous, medium curing, liquid asphalt.
- E. Tack Coat meeting current MassDOT requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify compacted subgrade is acceptable, ready to support imposed loads and paving, and ready to receive work.

3.2 SUBBASE PREPARATION

- A. Proof-roll and compact the subgrade prior to placing gravel base.
- B. Remove unstable material and replace with approved material as directed by the Engineer.

- C. Subgrade shall be uniformly compacted and true to grade.

3.3 GRAVEL BASE

- A. Place processed gravel on the prepared subgrade to the thickness shown on the Drawings.
- B. Compact to not less than 95 percent of maximum dry density.
- C. Finished base shall be smooth, dense, and true to grade.

3.4 ASPHALT SIDEWALK INSTALLATION

- A. Place asphalt only when weather and surface conditions comply with MassDOT requirements.
- B. Apply tack coat where required.
- C. Place asphalt in one or more lifts to the thickness shown on the Drawings.
- D. Compact each lift to obtain a dense, smooth, uniform surface.
- E. Finished pavement shall be free of segregation, roller marks, depressions, cracking, and other defects.

3.5 TOLERANCES

- A. Finished sidewalk surface shall not vary more than 1/4 inch in 10 feet when tested with a straightedge.
- B. Provide positive drainage without ponding.
- C. Cross slope shall not exceed 2.0 percent unless otherwise shown.
- D. Running slope shall conform to the Contract Drawings and ADA requirements.

3.6 JOINTS

- A. Construct neat longitudinal and transverse joints.
- B. Saw cut existing pavement where new work joins existing asphalt pavement.
- C. Provide smooth transitions between new and existing pavement.

3.7 PROTECTION

- A. Protect completed sidewalk from traffic until sufficiently cooled and accepted.
- B. Repair damaged areas at no additional cost to the Owner.

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3.8 FIELD QUALITY CONTROL

- A. The Engineer may require density testing and asphalt mixture verification.
- B. Areas failing to comply with the Contract Documents shall be removed and replaced.

END OF SECTION

SECTION 32 17 23 - PAINTED PAVEMENT MARKINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 specification Sections apply to the work of this Section.

1.2 SECTION INCLUDES

- A. Painted pavement markings.

1.3 RELATED REQUIREMENTS

- A. Section 32 12 16 - Asphalt Paving.
- B. Section 32 13 13 - Concrete Paving.

1.4 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 22 00 - Unit Prices, for additional unit price requirements.
- B. See Section 01 20 50 – Measurement and Payment for requirements.

1.5 REFERENCE STANDARDS

- A. FHWA MUTCD - Manual on Uniform Traffic Control Devices; 2023.
- B. Standard Specifications - “The Commonwealth of Massachusetts, Massachusetts Department of Transportation, Standard Specifications for Highways and Bridges” and supplements, excluding provisions for “Method of Measurement” and “Basis of Payment”; 2025 Edition.

1.6 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- B. Certificates: Submit for each batch of paint stating compliance with specified requirements.
- C. Installer's qualification statement.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements for additional provisions.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver paint in containers of at least 5 gallons.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

1.9 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Thermoplastic Reflectorized Pavement Markings:
 - 1. White: Standard Specifications, Section M7.01.05.
 - 2. Yellow: Standard Specifications, Section M7.01.06.
- B. Glass Beads: Standard Specifications, Section M7.01.07.
- C. Temporary Marking Tape: Preformed, reflective, pressure sensitive adhesive tape in color(s) required; Contractor is responsible for selection of material of sufficient durability as to perform satisfactorily during period for which its use is required.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Identify existing markings for removal.
- B. Verification of Conditions: Verify that pavement is dry and ready for installation.
- C. Notify Engineer of unsatisfactory conditions before proceeding.
- D. Do not begin installation until substrates have been properly prepared.

3.2 PREPARATION

- A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Clean surfaces thoroughly prior to installation.
 - 1. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods.
- D. Where oil or grease are present, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application; after cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint.
- E. Establish survey control points to determine locations and dimensions of markings; provide templates to control paint application by type and color at necessary intervals.
- F. Temporary Pavement Markings: When required or directed by Engineer, apply temporary markings of the color(s), width(s) and length(s) as indicated or directed.
 - 1. After temporary marking has served its purpose, remove temporary marking by carefully controlled sandblasting, approved grinding equipment, or other approved method so that surface to which the marking was applied will not be damaged.
 - 2. At Contractor's option, temporary marking tape may be used in lieu of temporary painted marking; remove unsatisfactory tape and replace with painted markings at no additional cost to Owner.

3.3 INSTALLATION

- A. General:
 - 1. Position pavement markings as indicated on drawings.
 - 2. Field location adjustments require approval of Engineer.
- B. Begin pavement marking as soon as practicable after surface has been cleaned and dried.
- C. Do not apply paint if temperature of surface to be painted or the atmosphere is less than 50 degrees F or more than 95 degrees F.
- D. Apply in accordance with manufacturer's instructions using an experienced technician that is thoroughly familiar with equipment, materials, and marking layouts.
- E. Comply with FHWA MUTCD manual (<http://mutcd.fhwa.dot.gov>) for details not shown.

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- F. Apply uniformly painted markings of color(s), lengths, and widths as indicated on drawings true, sharp edges and ends.
 - 1. Apply paint in one coat only.
 - 2. Wet Film Thickness: 0.015 inch, minimum.
 - 3. Width Tolerance: Plus or minus 1/8 inch.
- G. Roadway Traffic Lanes: Use suitable mobile mechanical equipment that provides constant agitation of paint and travels at controlled speeds.
 - 1. Conduct operations in such a manner that necessary traffic can move without hindrance.
 - 2. Place warning signs at the beginning of the wet line, and at points well in advance of the marking equipment for alerting approaching traffic from both directions. Place small flags or other similarly effective small objects near freshly applied markings at frequent intervals to reduce crossing by traffic.
 - 3. If paint does not dry within expected time, discontinue paint operations until cause of slow drying is determined and corrected.
 - 4. Use hand application by pneumatic spray for application of paint in areas where a mobile paint applicator cannot be used.
- H. Symbols: Use a suitable template that will provide a pavement marking with true, sharp edges and ends, of the design and size indicated.

3.4 DRYING, PROTECTION, AND REPLACEMENT

- A. Protect newly painted markings so that paint is not picked up by tires, smeared, or tracked.
- B. Provide barricades, warning signs, and flags as necessary to prevent traffic crossing newly painted markings.
- C. Allow paint to dry at least the minimum time specified by the applicable paint standard and not less than that recommended by the manufacturer.
- D. Remove and replace markings that are applied at less than minimum material rates; deviate from true alignment; exceed length and width tolerances; or show light spots, smears, or other deficiencies or irregularities.
- E. Remove markings in manner to avoid damage to the surface to which the marking was applied, using carefully controlled sand blasting, approved grinding equipment, or other approved method.
- F. Replace removed markings at no additional cost to Owner.

3.5 TOLERANCES

- A. Maximum Variation From True Position: 3 inches (76 mm).

- B. Maximum Offset From True Alignment: 3 inches (76 mm).

3.6 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Perform field inspection for deviations from true alignment or material irregularities.
- C. If inspections indicate work does not meet specified requirements, rework and reinspect at no cost to Owner.

3.7 PROTECTION

- A. Replace damaged or removed markings at no additional cost to Owner.
- B. Preserve survey control points until pavement marking acceptance.

END OF SECTION

SECTION 32 17 26 - TACTILE WARNING SURFACING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 specification Sections apply to the work of this Section.

1.2 SECTION INCLUDES

- A. Tactile warning surfacing for pedestrian walking surfaces.

1.3 RELATED REQUIREMENTS

- A. Section 32 05 23 - Cement and Concrete for Exterior Improvements: Concrete for sidewalks and platforms.
- B. Section 32 13 13 - Concrete Paving: Concrete sidewalks.
- C. Section 32 17 23 – Painted Pavement Markings: Crosswalk, stop bars, and curb markings.

1.4 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 22 00 - Unit Prices, for additional unit price requirements.
- B. See Section 01 20 50 – Measurement and Payment for requirements.

1.5 REFERENCE STANDARDS

- A. 49 CFR 37 - Transportation Services for Individuals with Disabilities (ADA); current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.
- D. ATBCB PROWAG - Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way; 2011.

1.6 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, standard details, details specific to this project; written installation and maintenance instructions.
- B. Samples: For each product specified provide two samples, 8 inches square, minimum; show actual product, color, and patterns.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years documented experience.
- B. Installer Qualifications: Company certified in writing by product manufacturer as having successfully completed work substantially similar to the work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver to project site in manufacturer's protective wrapping and in manufacturer's unopened packaging.
- B. Store covered and elevated above grade and in manufacturer's unopened packaging until ready for installation. Maintain at ambient temperature between 40 and 90 degrees F.

1.9 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Plastic Tiles: Provide manufacturer's standard five year warranty against manufacturing defects, breakage or deformation.

PART 2 PRODUCTS

2.1 TACTILE AND DETECTABLE WARNING DEVICES

- A. Plastic Tactile and Detectable Warning Tiles: Comply with ADA Standards, glass fiber and carbon fiber reinforced, exterior grade, matte finish polyester sheet with truncated dome pattern, solid color throughout, internal reinforcing of sheet and of truncated domes, integral radius cut lines on back face of tile; with factory-applied removable protective sheeting.
 - 1. Installation Method: Cast in place.
 - 2. Pattern: In-line pattern of truncated domes complying with ADA Standards.
 - 3. Color: As selected by Engineer from manufacturer's standard range.

2.2 ACCESSORIES

- A. Fasteners: ASTM A666/A666M, Type 304 stainless steel
 - 1. Type: Countersunk, color matched composite sleeve anchors
 - 2. Size: 1/4 inch diameter and 1-1/2 inches long.
- B. Sealant: Elastomeric sealant of color to match adjacent surfaces; approved by surfacing tile manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. When installation location is near site boundary or property line, verify required location using property survey.
- B. Verify that work area is ready to receive work:
 - 1. If existing conditions are not as required to properly complete the work of this section, notify Engineer.
 - 2. Do not proceed with installation until deficiencies in existing conditions have been corrected.
- C. Verify that dimensions, tolerances, and attachment methods for work in this section are properly coordinated with other work on site.

3.2 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer's written instructions.
 - 1. Do not install damaged, warped, bowed, dented, abraded, or otherwise defective units.
 - 2. Do not install when ambient or substrate temperature has been below 40 degrees F during the preceding 8 daylight hours.
- B. Field Adjustment:
 - 1. Cut units to size and configuration shown on drawings.
 - 2. Locate relative to curb line in compliance with ATBCB PROWAG, Sections 304 and 305.
 - 3. Orient so dome pattern is aligned with the direction of ramp.
 - 4. Align truncated dome pattern between adjacent units.
- C. Install units fully seated to substrate, square to straight edges and flat to required slope.

3.3 INSTALLATION, CAST IN PLACE PLASTIC TILES

- A. When installing multiple adjacent units, leave a 3/16 inch gap between units to allow for expansion.
- B. Tamp and vibrate units as recommended by manufacturer.
- C. Place and position weights on units while concrete cures as recommended by manufacturer. Ensure no voids or air pockets exist between top surface of concrete and underside of units.

3.4 CLEANING PLASTIC UNITS

- A. Remove protective plastic sheeting within 24 hours of installation.

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- B. Remove excess sealant or adhesive from joints and edges.
- C. Clean four days prior to date of scheduled inspection.

3.5 PROTECTION

- A. Protect installed units from traffic, subsequent construction operations or other imposed loads until concrete is fully cured.
- B. Touch-up, repair or replace damaged products prior to Date of Substantial Completion.

END OF SECTION

SECTION 32 17 31 – TIMBER GUARDRAIL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 specification Sections apply to the work of this Section.

1.2 SUMMARY

- A. This Section includes the removal, storage, protection, replacement, and reinstallation of existing timber guardrail systems affected by construction.
- B. Work includes:
 - 1. Removal of timber rails, posts, offset blocks, hardware, and appurtenances.
 - 2. Salvage and storage of reusable materials.
 - 3. Furnishing and installing replacement timber members, posts, hardware, and miscellaneous components where directed by the Owner.
 - 4. Resetting and realignment of the timber guardrail.
 - 5. Excavation, backfilling, and restoration associated with guardrail removal and reinstallation.
 - 6. Disposal of materials determined to be unsuitable for reuse.

1.3 RELATED REQUIREMENTS

- A. Section 32 05 23 - Cement and Concrete for Exterior Improvements: Concrete foundation for posts.

1.4 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 22 00 - Unit Prices, for additional unit price requirements.
- B. See Section 01 20 50 – Measurement and Payment for requirements.

1.5 REFERENCE STANDARDS

- A. Standard Specifications - “The Commonwealth of Massachusetts, Massachusetts Department of Transportation, Standard Specifications for Highways and Bridges” and supplements, excluding provisions for “Method of Measurement” and “Basis of Payment”; 2025 Edition.
 - 1. Subsection 601 – Guardrail
 - 2. Applicable provisions of Division III – Materials Specifications
 - 3. Applicable MassDOT Highway Standard Drawings – Series 601 (Guardrail)

- B. AASHTO *Manual for Assessing Safety Hardware (MASH)* where applicable.
- C. FHWA Manual on Uniform Traffic Control Devices (MUTCD).

1.6 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, anchorage, and schedule of components.
- C. Product Data: Provide data on rail, posts, accessories, hardware and structural capabilities of rail section.
- D. Prior to removal, prepare an inventory identifying:
 - 1. Existing guardrail location.
 - 2. Rail length.
 - 3. Post spacing.
 - 4. Existing condition.
 - 5. Components requiring replacement.
- E. Photograph the existing guardrail before removal.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

- A. Comply with applicable code for rail height or location restrictions.

2.2 WOOD GUARD RAIL

- A. Replacement timber rails, posts, offset blocks, and miscellaneous timber members shall conform to the applicable MassDOT material specifications and dimensions for timber guardrail. Pressure treatment shall comply with current MassDOT requirements.
 - 1. Lumber: Standard Specifications, Section M8.07.0.A for Wood Posts.
- B. Hardware: Provide new galvanized bolts, nuts, washers, splice plates, connection hardware, and miscellaneous fasteners whenever existing hardware is damaged, corroded, or unsuitable for reuse.
 - 1. Reuse existing hardware only when approved by the Owner.
 - 2. Standard Specifications, Section M8.07.0.

PART 3 EXECUTION

3.1 REMOVAL

- A. Carefully remove the existing timber guardrail system without damaging components designated for reuse.
- B. Remove rails, posts, offset blocks, and hardware as required to complete the Work.
- C. Protect salvaged materials from damage during handling and storage.

3.2 STORAGE

- A. Store reusable timber members above ground on blocking.
- B. Protect timber members from excessive moisture, contamination, and physical damage.
- C. Store galvanized hardware in weather-protected containers.

3.3 REINSTALLATION

- A. Reinstall the timber guardrail at the locations shown on the Contract Drawings or as directed by the Owner.
- B. Restore the original alignment, elevation, and post spacing unless otherwise directed.
- C. Existing rails and posts may be reused when approved by the Owner.
- D. Where existing posts, rails, offset blocks, or hardware are damaged, deteriorated, or determined unsuitable for reuse, furnish and install new components conforming to the current MassDOT Standard Specifications and Standard Drawings.
- E. Install all components in accordance with MassDOT Subsection 601 – Guardrail and the applicable MassDOT Highway Standard Drawings.
- F. Backfill around posts with approved material and compact to provide a firm installation.

3.4 TOLERANCES

- A. Posts - Maximum Variation From Plumb: 1/2 inch.
- B. Rail - Maximum Offset From True Position: 1 inch.
- C. Rail - Maximum Variation From True Height: 1/2 inch.

3.5 FIELD QUALITY CONTROL

- A. The completed guardrail shall be straight, uniformly aligned, securely fastened, and free from visible defects.
- B. Adjust alignment and hardware as directed by the Engineer.

3.6 DAMAGE

- A. Replace any timber member or hardware damaged during removal, storage, transport, or reinstallation at no additional cost to the Owner.
- B. Replacement materials shall match the existing guardrail configuration unless otherwise directed by the Owner.

END OF SECTION

SECTION 33 01 10.58 - DISINFECTION OF WATER UTILITY PIPING SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Disinfection of site domestic water lines and site fire water lines specified in Section 33 14 16.

1.2 RELATED REQUIREMENTS

- A. Section 33 14 16 - Water Utility Distribution Piping.

1.3 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 22 00 – Unit Prices, for additional unit price requirements.
- B. See Section 01 20 50 – Measurement and Payment for requirements.

1.4 REFERENCE STANDARDS

- A. AWWA B300 - Hypochlorites; 2018.
- B. AWWA B301 - Liquid Chlorine; 2018.
- C. AWWA B302 - Ammonium Sulfate; 2023.
- D. AWWA B303 - Sodium Chlorite; 2018.
- E. AWWA C651 - Disinfecting Water Mains; 2023.

1.5 SUBMITTALS

- A. Test Reports: Indicate results comparative to specified requirements.
- B. Certificate: From authority having jurisdiction indicating approval of water system.
- C. Certificate: Certify that cleanliness of water distribution system meets or exceeds specified requirements.
- D. Disinfection report:
 - 1. Type and form of disinfectant used.
 - 2. Date and time of disinfectant injection start and time of completion.
 - 3. Test locations.
 - 4. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
 - 5. Date and time of flushing start and completion.

6. Disinfectant residual after flushing in ppm for each outlet tested.

1.6 QUALITY ASSURANCE

- A. Water Treatment Firm: Company specializing in disinfecting potable water systems specified in this Section with minimum three years documented experience.
- B. Testing Firm: Company specializing in testing potable water systems, certified by governing authorities of Massachusetts.

PART 2 PRODUCTS

2.1 DISINFECTION CHEMICALS

- A. Chemicals: AWWA B300 Hypochlorite, AWWA B301 Liquid Chlorine, AWWA B302 Ammonium Sulfate, and AWWA B303 Sodium Chlorite.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that piping system has been cleaned, inspected, and pressure tested.
- B. Schedule disinfecting activity to coordinate with start-up, testing, adjusting and balancing, demonstration procedures, including related systems.

3.2 DISINFECTION

- A. Use method prescribed by the applicable state or local codes, or health authority or water purveyor having jurisdiction, or in the absence of any of these follow AWWA C651.
- B. Provide and attach equipment required to perform the work.
- C. Inject treatment disinfectant into piping system.
- D. Maintain disinfectant in system for 24 hours.
- E. Flush, circulate, and clean until required cleanliness is achieved; use municipal domestic water.
- F. Replace permanent system devices removed for disinfection.

3.3 FIELD QUALITY CONTROL

- A. Test samples in accordance with AWWA C651.

END OF SECTION

SECTION 33 14 16 - WATER UTILITY DISTRIBUTION PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Water pipe for site conveyance lines.
- B. Pipe valves.

1.2 RELATED REQUIREMENTS

- A. Section 32 05 23 - Cement and Concrete for Exterior Improvements: Concrete for thrust restraints.
- B. Section 33 01 10.58 - Disinfection of Water Utility Piping Systems: Disinfection of site service utility water piping.

1.3 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 22 00 - Unit Prices, for additional unit price requirements.
- B. See Section 01 20 50 – Measurement and Payment for requirements

1.4 REFERENCE STANDARDS

- A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- B. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- C. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
- D. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- E. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.
- F. AWWA C104/A21.4 - Cement-Mortar Lining for Ductile Iron Pipe and Fittings; 2022.
- G. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2021.
- H. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2023.
- I. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2023.
- J. AWWA C153/A21.53 - Ductile-Iron Compact Fittings; 2019.
- K. AWWA C515 - Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service; 2020.
- L. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances; 2023.
- M. AWWA C800 - Underground Service Line Valves and Fittings; 2021.

- N. NSF 61 - Drinking Water System Components - Health Effects; 2023, with Errata.

1.5 SUBMITTALS

- A. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Field quality-control test reports.
- D. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with utility company requirements.
 - 1. Coordinate connection to water main with utility company.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers with labeling in place.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Comply with utility company standards or NSF 61 for materials for water-service piping and specialties for domestic water.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of water-distribution service without Owner's written permission.

1.9 WARRANTY

- A. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 WATER PIPE

- A. Ductile Iron Pipe: AWWA C151/A21.51:
 - 1. Class: Class 52.

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2. Lining: Cement lined, minimum 1/8 inch thick, and seal coated according to AWWA C104/A21.4.
 3. Joints: Push-on in accordance with AWWA C151/A21.51.
 - a. Gaskets: Styrene butadiene rubber (SBR) or vulcanized SBR gasket in accordance with AWWA C111/A21.11.
 4. Exterior Coating: Asphalt seal coat according to AWWA C151/A21.51.
 5. Fittings:
 - a. Ductile iron meeting the requirements of AWWA C110/A21.10.
 - b. Mechanical joint, ductile iron meeting the requirements of AWWA C153/A21.53.
 - c. Minimum Pressure Rating: 350 psig.
 - d. Gaskets: Styrene butadiene rubber (SBR) or vulcanized SBR gasket in accordance with AWWA C111/A21.11.
 6. Retainer Glands for Mechanical Joints:
 - a. Retainer gland body, wedges and wedge actuating components shall be ductile iron conforming to ASTM A536 and meet the minimum requirements of AWWA C111/A21.11.
 - b. Minimum Pressure Rating: 350 psig.
 - c. Coating: Epoxy or polyester based powder coating.
- B. Copper Tubing: ASTM B88, Type K, Annealed:
1. Fittings: ASME B16.18, cast copper, or ASME B16.22, wrought copper.
 2. Joints: Compression connection or AWS A5.8M/A5.8, BCuP silver braze.

2.2 VALVES, ACCESORIES, AND SPECIALTIES

- A. Resilient Wedge Gate Valves:
1. Type: Non-rising stem with triple o-ring seal meeting the requirements of AWWA C515.
 2. Ends: Mechanical joint in accordance with AWWA C111/A21.11.
 3. Minimum Pressure Rating: 250 psig.
 4. Coating: Interior and exterior epoxy coated to a minimum thickness of 10 mils in accordance with AWWA C550.
 5. Operation: 2 inch square nut, open right (clockwise) or open left (counter clockwise) with stainless steel extension rod.

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B. Curb Stops:

1. Type: Bronze ball valve conforming to AWWA C800.
2. Minimum Pressure Rating: 250 psig.
3. Ends: Compression connection for Type K copper.

C. Valve Boxes:

1. All buried valves and curb stops shall be provided with valve boxes.
2. Type: Cast iron, adjustable, and telescoping, heavy pattern type designed to prevent the direct transmission of traffic loads to the pipe or valve.
3. Size: Valve boxes shall have standard 5 1/4 inch opening.
4. Height: Minimum 36 inch flanged top and 36 inch bell bottom.
 - a. Maintain a minimum of 6 inches of vertical adjustment and 4 inches of overlap between sections.
 - b. Provide extension stems where required.
5. Cover: Cast iron with pick holes and the word "WATER" cast into the cover.

D. Tapping Sleeves:

1. Type: Full body mechanical joint style ductile iron tapping sleeve with gasket covering the entire surface in accordance with ASTM A536.
2. Minimum Pressure Rating: 250 psig.
3. Coordinate with utility company for requirements associated with tapping existing water mains.

E. Corporation Stops:

1. Type: Bronze ball valves conforming to AWWA C800.
2. Minimum Pressure Rating: 250 psig.
3. Inlet: AWWA standard threads.
4. Outlet: Compression connection for Type K copper.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that building service connection and municipal utility water main size, location, and invert are as indicated.

3.2 PREPARATION

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.

3.3 INSTALLATION - PIPE

- A. Install ductile iron piping and fittings to AWWA C600.
- B. Route pipe in straight line.
- C. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- D. Slope water pipe and position drains at low points.

3.4 INSTALLATION - VALVES, , BACKFLOW PREVENTERS

- A. Set valves on solid bearing.
- B. Center and plumb valve box over valve. Set box cover flush with finished grade.

3.5 FIELD QUALITY CONTROL

- A. Pressure test water piping to 200 pounds per square inch in accordance with AWWA C600 and utility company requirements.
 - 1. At a minimum, tests for leakage shall last for a minimum of two hours and no more than 1,000 feet shall be tested at one time.
 - 2. Notify the Owner not less than 48 hours prior to testing. Do not proceed with testing without written permission from the Owner.
- B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

END OF SECTION

SECTION 33 31 13 - SANITARY SEWERAGE GRAVITY PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sanitary sewerage drainage piping, fittings, and accessories.
- B. Connection of building sanitary drainage system to municipal sewers.
- C. Cleanout access.

1.2 RELATED REQUIREMENTS

- A. Section 32 05 23 - Cement and Concrete for Exterior Improvements: Concrete for cleanout base pad construction.
- B. Section 31 23 16 - Excavation: Excavating of trenches.
- C. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.
- D. Section 31 23 23 - Fill: Bedding and backfilling.

1.3 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 22 00 - Unit Prices, for additional unit price requirements.
- B. See Section 01 20 50 – Measurement and Payment for requirements.

1.4 DEFINITIONS

- A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.5 REFERENCE STANDARDS

- A. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.
- B. ASTM C32 - Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale); 2013 (Reapproved 2017).
- C. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.
- D. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- E. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
- F. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets; 2021.
- G. ASTM C615/C615M - Standard Specification for Granite Dimension Stone; 2023.

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- H. ASTM C836/C836M - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course; 2018 (Reapproved 2022).
- I. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals; 2018.
- J. ASTM C1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill; 2017.
- K. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2020.
- L. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2023.
- M. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals; 2020.
- N. ASTM D4101 - Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials; 2017, with Editorial Revision (2019).
- O. ASTM F679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings; 2021.
- P. ASTM F1417 - Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air; 2019.

1.6 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating pipe, pipe accessories.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
- E. Field Quality Control Submittals: Document results of field quality control testing.
- F. Project Record Documents:
 - 1. Record location of pipe runs, connections, manholes, cleanouts, and invert elevations.
 - 2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

PART 2 PRODUCTS

2.1 SEWER PIPE MATERIALS

- A. PVC Sewer Pipe: ASTM D3034, SDR 35 Type PSM, Poly(Vinyl Chloride) (PVC) material with integral bell and spigot push-on joints with elastomeric gaskets.
 - 1. Pipes with an inside nominal diameter of 18 inches to 27 inches shall comply with ASTM F679.
 - 2. Gaskets: ASTM D3212, elastomeric seals; resistant to common sewage and industrial wastes including oil and groundwater.

2.2 MANHOLE

- A. Precast Concrete Manholes: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for butyl rubber gasketed joints confirming to ASTM C443.
 - 1. Exterior Waterproof Coating: Factory applied liquid elastomeric waterproofing membrane system confirming to the requirements of ASTM C836/C836M, minimum two coats with a total thickness of 15 mils.
 - 2. Base: Monolithic combination base and riser section. Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation. Fabricate pipe openings and sleeves to accommodate outside diameter of pipe to be connected.
 - 3. Riser Sections: Lengths to provide depth indicated.
 - 4. Top Section: Eccentric-cone type or flat-slab-top .
- B. Steps: Manufactured from deformed, 1/2-inch steel reinforcement rod complying with ASTM C615/C615M and encased in polypropylene complying with ASTM D4101.
- C. Frame and Cover: ASTM A48/A48M Class A48 cast iron construction, machined flat bearing surface; sealing gasket.
 - 1. Cover: Removable, boltable; closed cover design; cover molded with the words "SANITARY".
- D. Pipe Connectors: Flexible pipe connector for pipe diameter indicated conforming to the requirements of ASTM C923.
- E. Invert Construction: Construct inverts in the field. Precast inverts are not allowed.
 - 1. Sewer Bricks: ASTM C32, Grade SM.
 - 2. Mortar: ASTM C270, Type M, with the following proportions:
 - a. 1 part Type I or Type II portland cement confirming to ASTM C150/C150M.
 - b. 2 parts sand for masonry mortar conforming to ASTM C144.

PART 3 EXECUTION

3.1 INSTALLATION - PIPE

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on drawings.
- B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
 - 1. Plastic Pipe: Also comply with ASTM D2321.
- C. Lay pipe to slope gradients noted on drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- D. Connect to building sanitary sewer outlet and municipal sewer system, through installed sleeves.

3.2 MANHOLES

- A. Place manhole sections plumb and level, trim to correct elevations, anchor to base pad.
- B. Set cover frames and covers level without tipping, to correct elevations.
- C. Coordinate with other sections of work to provide correct size, shape, and location.
- D. Install gaskets in accordance with manufacturer's recommendations. Fill space between pipe and manhole with grout.
- E. Construct inverts with smooth curves of longest possible radius tangent to adjoining pipes.

3.3 FIELD QUALITY CONTROL

- A. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- B. The Contractor is responsible for testing. Allow the Engineer and/or Owner to witness tests.
- C. Pipe Pressure Test: Perform air testing in of pipe sections between manholes in accordance with ASTM F1417 utilizing the time-pressure drop method for 1 psig.
- D. CCTV Pipe inspection: After cleaning, perform television inspection on all new gravity sanitary sewer installations under a no-flow condition.
 - 1. The television camera used for the inspection shall be one specifically designed and constructed for such inspection. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the Engineer and, if unsatisfactory, equipment shall be removed and new equipment provided.

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2. The camera shall be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the sewer's condition. In no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line.
 3. Measurement for location of defects shall be above ground by means of a meter device. Marking on the cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Accuracy of the distance meter shall be checked by use of a walking meter, roll-a-tape, or other suitable device.
 4. Documentation of the television results shall be as follows:
 - a. Television Inspection Logs: Printed location records shall be kept on-site and will clearly show the location in relation to an adjacent manhole of each defect observed during inspection. In addition, other points of significance such as location of laterals, unusual conditions, broken pipe and other discernible features will be recorded and a copy of such records will be supplied to the Owner.
 - b. Video Recordings: Provide a visual and audio record of problem areas of the lines that may be replayed. Recording playback shall be at the same speed that it was recorded. The video recordings shall be delivered digitally and saved on DVD or BluRay media and shall be turned over to the Owner at the completion of the Project.
 5. Re inspect areas that do not pass inspection, at no additional cost to the Owner.
- E. Manholes: Perform vacuum test according to ASTM C1244.
1. Test each manhole prior to backfilling.
 2. Re-test each manhole after backfilling and prior to placing casting.
 3. Replace leaking piping and structures using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION

SECTION 33 42 11 - STORMWATER GRAVITY PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 specification Sections apply to the work of this Section.

1.2 SECTION INCLUDES

- A. Stormwater drainage piping.
- B. Stormwater pipe accessories.
- C. Connection of drainage system to municipal sewers.

1.3 RELATED REQUIREMENTS

- A. Section 31 23 16 - Excavation: Excavating of trenches.
- B. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.
- C. Section 31 23 23 - Fill: Bedding and backfilling.

1.4 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 22 00 – Unit Prices, for additional unit price requirements.
- B. See Section 01 20 50 – Measurement and Payment for requirements

1.5 REFERENCE STANDARDS

- A. AASHTO M 252 - Standard Specification for Corrugated Polyethylene Drainage Pipe; 2023.
- B. AASHTO M 294 - Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter; 2021.
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- D. ASTM C14 - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe; 2020.
- E. ASTM C14M - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe (Metric); 2020.
- F. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe; 2022a.

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- G. ASTM C76M - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric); 2022a.
- H. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets; 2021.
- I. ASTM C443M - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric); 2021.
- J. ASTM C615/C615M - Standard Specification for Granite Dimension Stone; 2023.
- K. ASTM C891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures; 2020.
- L. ASTM C1173 - Standard Specification for Flexible Transition Couplings for Underground Piping Systems; 2018.
- M. ASTM C1479 - Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations; 2016.
- N. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2020.
- O. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials; 2021.
- P. ASTM D4101 - Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials; 2017, with Editorial Revision (2019).
- Q. ASTM F405 - Standard Specification for Corrugated Polyethylene (PE) Pipe and Fittings; 2013.
- R. ASTM F667/F667M - Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings; 2016 (Reapproved 2021).
- S. Standard Specifications - "The Commonwealth of Massachusetts, Massachusetts Department of Transportation, Standard Specifications for Highways and Bridges" and supplements, excluding provisions for "Method of Measurement" and "Basis of Payment"; 2025 Edition.

1.6 SUBMITTALS

- A. Product Data: Provide data indicating pipe, pipe accessories.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
- D. Field Quality Control Submittals: Document results of field quality control testing.
- E. Project Record Documents:
 - 1. Record location of pipe runs, connections, and invert elevations.

2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

PART 2 PRODUCTS

2.1 PLASTIC PIPE AND FITTINGS

- A. Pipe: ASTM D3350, High Density Polyethylene (HDPE) corrugated wall pipe with integrally formed smooth liner; meeting the requirements of AASHTO M 252, Type S, for diameters between 3 inches and 10 inches and AASHTO M 294, Type S, for diameters between 12 inches and 60 inches, soil-tight, bell and spigot joints with rubber gaskets, with pipe and fittings manufactured from virgin PE compounds with cell classification 3254420C.

2.2 CONCRETE PIPE AND FITTINGS

- A. Reinforced Concrete Pipe (RCP) and Fittings: Standard Specifications, Section M5.02.1.

2.3 NONPRESSURE TRANSITION COUPLINGS

- A. Flexible Coupling: Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

2.4 CLEANOUTS

- A. Plastic Cleanouts:
 1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.5 MANHOLES AND CATCH BASINS

- A. Normal-Traffic, Precast Concrete Manhole or Catch Basins: Standard Specifications M4.09.2.
- B. Frames, Grates, and Covers: Standard Specifications, Section M8.03.0.
 1. Manholes cover shall have the word "STORM" cast into the cover.
- C. Steps: Manufactured from deformed, 1/2-inch steel reinforcement rod complying with ASTM A615/A615M and encased in polypropylene complying with ASTM D4101.

2.6 CULVERT ENDS

- A. Reinforced Concrete Culvert Ends: Standard Specifications, Section M5.02.2.

2.7 PIPE ACCESSORIES

- A. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.

- B. Non-Woven Filter Fabric: Non-woven filter fabric shall meet the following requirements:
 - a. Filter fabric material shall conform to the following performance characteristics, measured per the test methods referenced:
 - 1) Nonwoven geotextile composed of polypropylene fibers that are inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids.
 - 2) Grab Tensile Strength: ASTM D 4632: 120 lbs.
 - 3) Grab Tensile Elongation: ASTM D 4632: 50%
 - 4) Trapezoidal Tear: ASTM D4533: 50 lbs.
 - 5) Puncture Strength: 340 lb; ASTM D6241.
 - 6) Apparent Opening Size: ASTM D 4751: 0.212 mm, 70 U.S. Sieve maximum
 - 7) Permittivity: ASTM D 4491: 0.15 sec ⁻¹, minimum
 - 8) UV Stability: 70 percent after 500 hours' exposure; ASTM D 4355.
 - 9) Flow Rate: ASTM D 4491: 135 gal/min/sf.
- C. Trace Wire: Magnetic detectable conductor, clear plastic covering, imprinted with "Stormwater Service" in large letters.
- D. Flared End Section:
 - 1. Concrete: Nonreinforced, ASTM C14 (ASTM C14M), Class 1.

2.8 CATCH BASIN, TRENCH DRAIN, CLEANOUT, AND AREA DRAIN COMPONENTS

- A. Lids and Drain Covers: Cast iron; medium duty proof load; lockable; hinged.
- B. Trench Drain System: Trench drain system assembled from factory fabricated, chemical-resistant vinyl ester polymer concrete castings in standard lengths; with or without built in slope; with integral joints and optional grating support rails; includes grating.

PART 3 EXECUTION

3.1 TRENCHING

- A. See Section 31 23 16.13 - Trenching for additional requirements.
- B. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.2 INSTALLATION

- A. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
 - 1. Plastic Pipe: Also comply with ASTM D2321.
 - 2. Concrete Pipe: Also comply with ASTM C1479.
- B. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- C. Connect to building storm drainage system, foundation drainage system, and utility/municipal system.
- D. Install continuous trace wire 6 inches above top of pipe; coordinate with Section 31 23 16.13.

3.3 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Install piping so cleanouts open in direction of flow in sewer pipe.
 - 1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
 - 2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
 - 3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic areas.
 - 4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads
- B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 inch by 18 inch by 12 inch deep. Set with tops 1 inch above surrounding earth grade.
- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.4 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C891.
- C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.
- D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

3.5 CATCH BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.

- B. Set frames and grates to elevations indicated.

3.6 CONNECTIONS

- A. Make connections to existing piping and underground manholes.
 - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6 inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3,000 psi.

3.7 FIELD QUALITY CONTROL

- A. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 - 1. Submit separate reports for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Re-inspect and repeat procedure until results are satisfactory.

3.8 PROTECTION

- A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

3.9 FIELD QUALITY CONTROL

- A. Drainage Piping and Structures:

Revere Riverside Neighborhood
Revere, MA

1. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.
 - a. In large, accessible piping, brushes and brooms may be used for cleaning.
 - b. Place plug in end of incomplete piping at end of day and when work stops.
 - c. Flush piping between structures to remove collected debris, if required by authorities having jurisdiction.
- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 1. Submit separate reports for each system inspection.
 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structure.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 4. Reinspect and repeat procedure until results are satisfactory.

3.10 CLEANING

- A. Clean interior of piping and structures of dirt and superfluous materials. Flush with water.
- B. Prior to completion of construction, clean existing storm drain pipe, structures, subsurface infiltration system of sediment and debris.

END OF SECTION

Appendix J – Community Engagement Presentations

**FUSS &
O'NEILL**



RIVERSIDE NEIGHBORHOOD DRAINAGE IMPROVEMENTS

Public Meeting #1

April 15th, 2026



Scott Turner, PE, FAICP



Sarah Frisbee, EIT



Sage Hardesty

In partnership with:



Funding provided by:

Housing Choice Grant
Community Development Block Grant

INTRODUCTIONS



AGENDA

- > Project Summary & Background
- > Existing Conditions Analysis
- > Proposed Flood Mitigation
- > Future Climate Considerations
- > Next Steps

PROJECT SUMMARY & BACKGROUND

What We Did:

- **Developed an existing conditions stormwater model** to understand the extent and impacts of current stormwater flooding within the Riverside Neighborhood.
- **Developed a proposed drainage improvement plan to expand** stormwater infrastructure and **reduce flood risk created by rainfall** in flood-prone areas.
- **Simulated the proposed plan** to evaluate the plan's performance vs existing conditions.
- **What We're Doing:**
- Gathering **stakeholder feedback** and evaluating next steps.

PROJECT AREA

TOTAL PROJECT AREA
22 acres

LIMITED DRAINAGE SYSTEM

11 Manholes
41 Catch basins
11 Outfalls
~4200 Linear Feet of Conduit

**Existing Streets less than
1% slope**



PROJECT BACKGROUND – FLOODING HISTORY

The Riverside Neighborhood has a history of flooding during significant inland and coastal storm events.

Flooding Facts:

“The number of flood events has tripled from the late 1990’s to the mid 2010’s”

“Boston has seen ~5.4 inches of sea level rise since 1995.”

**Data sourced from Building Adaptive Capacity in Revere,*

Woods Hole Group



Mills Ave - December 2022

The Riverside Neighborhood...

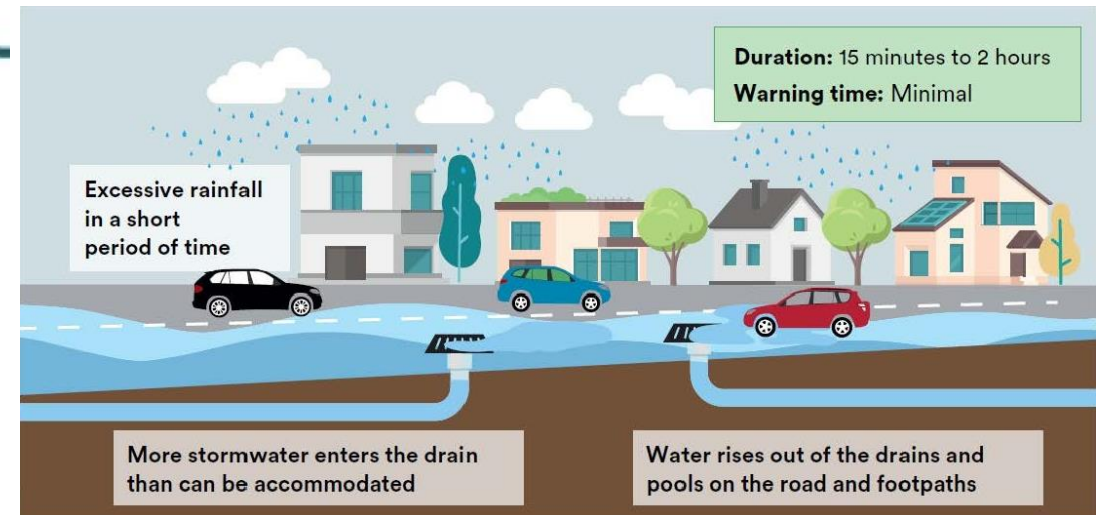
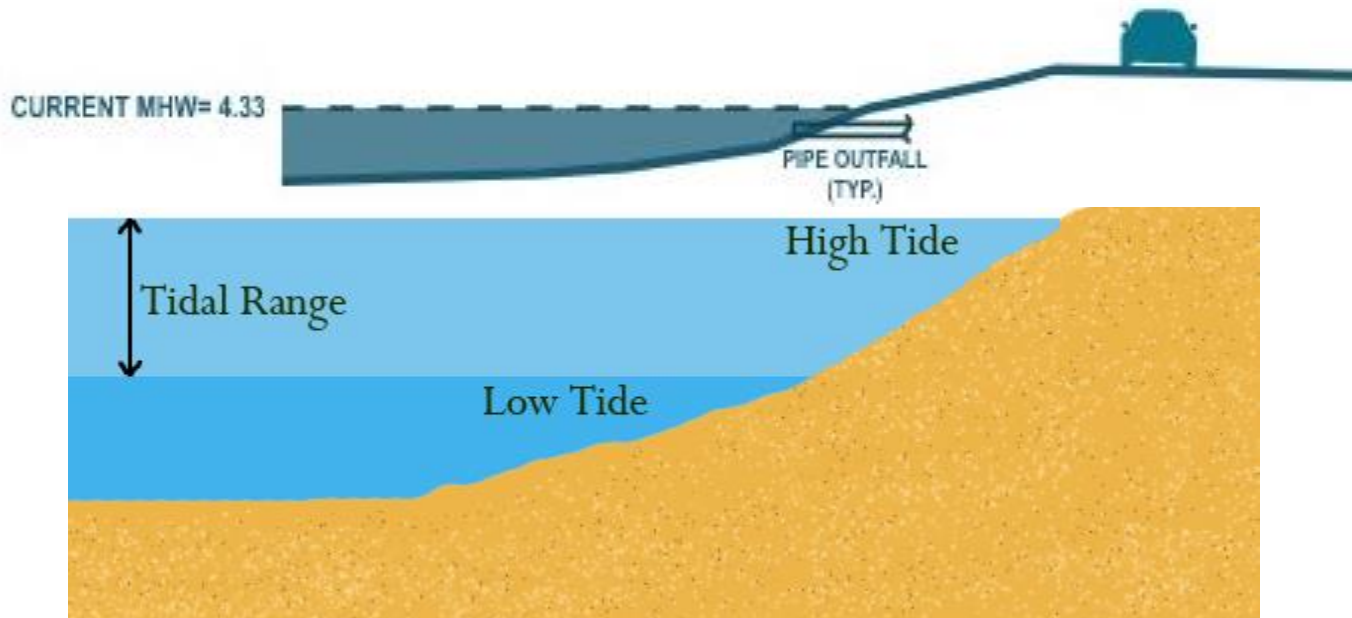
- Is a low-lying, flat residential coastal area
- Is affected by high tides and storm surge events
- Is vulnerable to future impacts of sea level rise
- Has a limited and undersized drainage systems

TYPE OF FLOODING

- The Riverside Neighborhood is vulnerable to two types of flooding:

Coastal flooding, where wind, tides, waves, and storm surge lead to flooding of low-lying coastal areas.

Stormwater flooding, where rainfall overwhelms the capacity of the stormwater system causing it to overflow onto the road.



FLOOD RECURRENCE INTERVAL

Recurrence Interval: The average number of years, over the long term, between subsequent events

25-year storm occurs on average once every 25 years.

% Annual Chance: the probability of a particular flood event happening in any given year

% Annual Chance = $100/\text{recurrence interval}$

25-year storm: $100/25 = 4\%$ Annual Chance

% Annual Chance is just a probability! It is possible for a given flood to occur twice in one year, in back-to-back years, or not at all for a period of years.



4% chance = 25-year flood

25 Year Flood: You have a jar with 100 marbles – 75 clear and 25 red. There is a 1 in 25 (or 4% chance) of you reaching into your jar and pulling out the red marble.

EXISTING CONDITIONS PCSWMM MODEL

- Developed **stormwater model**.
- Delineated watersheds (in orange) contributing runoff to Riverside stormwater infrastructure system.
- Produced results for **1-year, 2-year, and 10-year** storm events.
- Validated results based on prior observed conditions.



EXISTING CONDITIONS 1-YR STORM

- During the 1-YR event, the model reveals minor flooding on Mills Ave., Gilbert Ave., River Ave. and Thayer Ave.



EXISTING CONDITIONS 2-YR STORM

- During the 2-year event, the model reveals additional flooding on Mills Ave., Gilbert Ave., River Ave., and Thayer Ave.



EXISTING CONDITIONS 10-YR STORM

- During the 10-YR event, the model reveals worsening conditions in all previous flooded areas.
- Flood conditions expand to Beckert, Lawson, and Franklin Avenues.



CURRENT CLIMATE EXISTING CONDITIONS RESULTS SUMMARY

- Some roadways within Riverside neighborhood do not have catch basins to capture runoff or relieve flood condition.
- The existing stormwater system is undersized and surcharges during frequently occurring, small intensity rainfall events (1- & 2-year events).
- As precipitation events increase (10-year) the stormwater system becomes further limited and flood conditions expand to other affected roadways.
- Rainfall intensity and sea levels are predicted to increase under a changing climate, resulting in worsening existing conditions.

PROPOSED IMPROVEMENTS

Several iterations of drainage improvements were analyzed, and the following improvements were selected:

- **Expand Drainage System Coverage to all roadways**
- **Increase Pipe Sizes along Mills Avenue**
- **Increase pipe sizes throughout the project area**
- **Install Two New Large Outfalls**



PROPOSED CONDITIONS 1-YR STORM

- The proposed improvements eliminates flooding throughout the neighborhood for the current 1-year storm event.



PROPOSED CONDITIONS 2-YR STORM

- The proposed conditions eliminates flooding throughout the neighborhood for the current 2-year storm event.



PROPOSED CONDITIONS 10-YR STORM

- The proposed conditions eliminates flooding on some streets and reduces flood depths and durations throughout the neighborhood for the current 10-year storm event.



CURRENT CLIMATE PROPOSED CONDITIONS RESULTS SUMMARY

- All roadways within the Riverside neighborhood are serviced by the proposed stormwater drainage system.
- The proposed stormwater drainage system eliminates flooding throughout the neighborhood under the current 1 and 2-year storm events.
- The proposed drainage system eliminates flooding on some streets and reduces flood depths and durations throughout the neighborhood under the current 10-year storm event.
- Rainfall events and sea levels are predicted to increase in the future due to a changing climate, impacting the effectiveness of the proposed improvements.

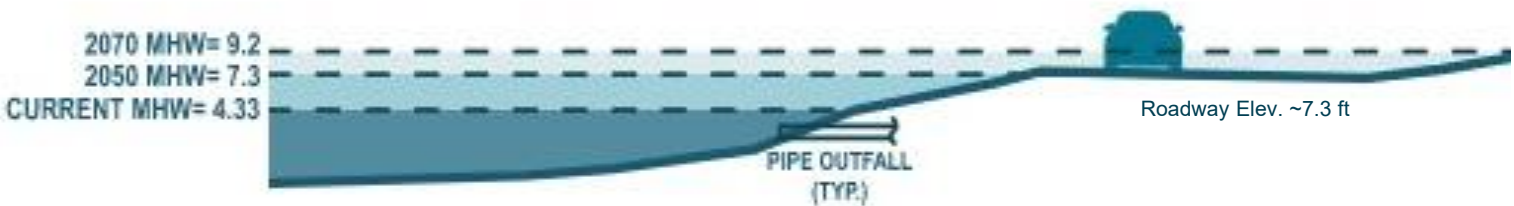
FUTURE CONDITIONS

The stormwater model was run with current climate and future climate conditions.

- **Under Future Conditions**, tides get higher and rainfall intensity increases.

Rainfall (in)	Future Climate Conditions		
24-hour Duration	Return Period (years)		
	1-Year	2-Year	10-Year
Current Climate	2.57	3.19	5.04
Year - 2050	3.1	3.9	6.2
Year - 2070	3.5	4.3	6.8

Tides	Future Climate Conditions		
Elev. NAVD88	Tidal Event		
	MLW	MHW	Dec-2022
Current Climate	-5.17	4.33	8.34
Year – 2050	-2.3	7.3	NA
Year – 2070	-0.7	9.2	NA



Mills Ave Roadway Cross Section

EXISTING CONDITIONS 2050 PROJECTED 1-YR STORM

Maximum inundation extents for 2- & 10-year storm events are similar to the depicted 1-year event.

- The projected 2050 tidal increases overtop the roadway of Mills Avenue and flood neighborhood.



2050 MHW =
EL. 7.3 NAVD88

EXISTING CONDITIONS 2070 PROJECTED 1-YR STORM

Maximum inundation extents for 2- & 10-year storm events are similar to the depicted 1-year event.

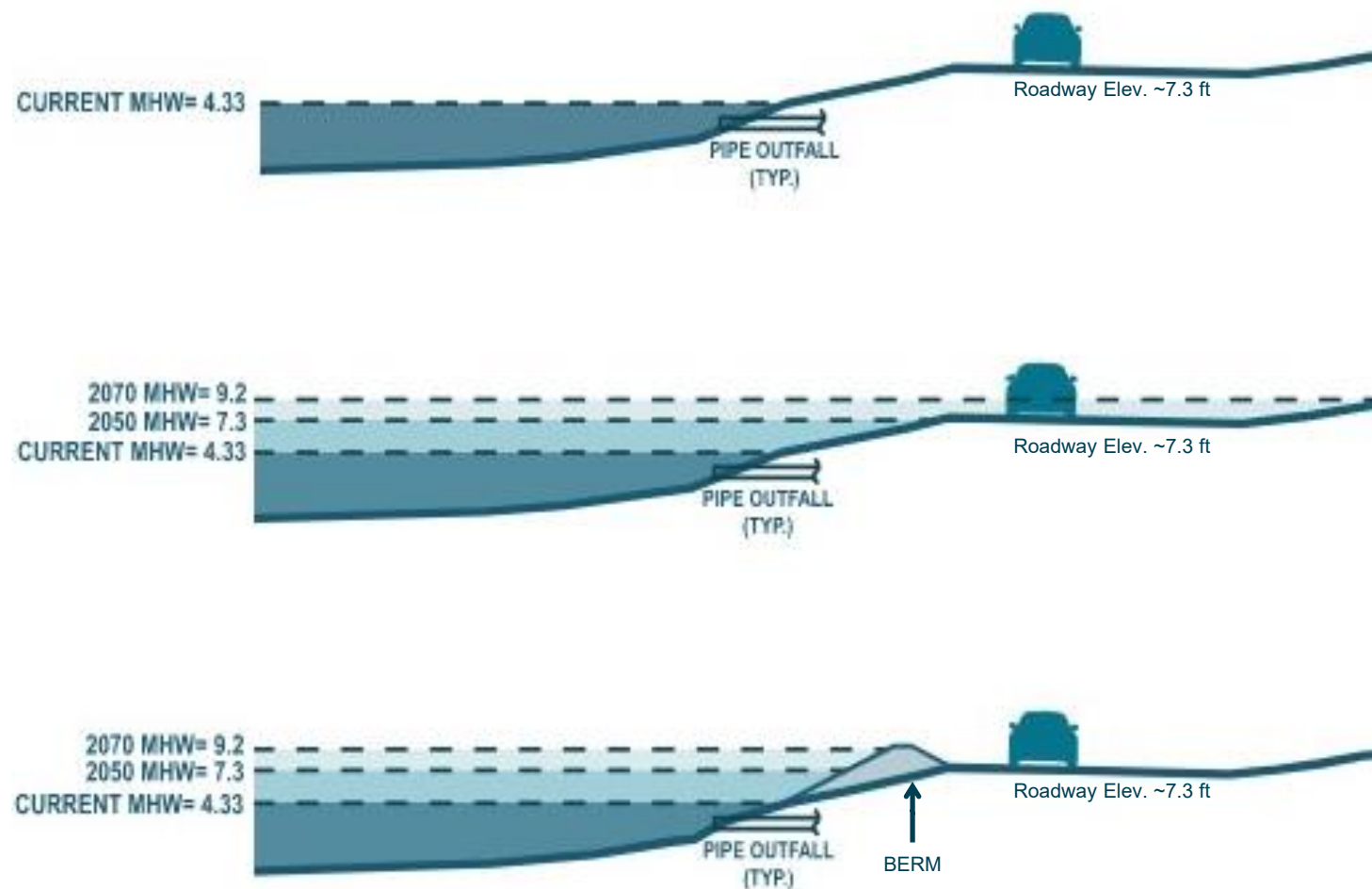
- The projected 2070 tidal increases significantly overtop the neighborhood.



2070 MHW =
EL. 9.2 NAVD88

PROPOSED IMPROVEMENTS CHALLENGES

- This phase of design focused on analyzing drainage improvements ***without the addition of a coastal berm***.
- Due to the elevation and vulnerability of the community, the design's effectiveness is impacted by projected future conditions with increased precipitation and tidal elevations.
 - **Without a coastal berm, the projected future tidal elevation is projected to be at or above the Mills Ave roadway elevations.**



Mills Ave Roadway Cross Section

PROPOSED CONDITIONS 2050 PROJECTED 1-YR STORM

Maximum inundation extents for 2- & 10-year storm events are similar to the depicted 1-year event.

- The projected 2050 tidal increases overtop the roadway of Mills Avenue and flood neighborhood.



2050 MHW =
EL. 7.3 NAVD88

PROPOSED CONDITIONS 2070 PROJECTED 1-YR STORM

Maximum inundation extents for 2- & 10-year storm events are similar to the depicted 1-year event.

- The projected 2070 tidal increases significantly overtop the neighborhood.



2050 MHW =
EL. 7.3 NAVD88

FUTURE CLIMATE RESULTS SUMMARY

- The influence from future sea level rise significantly impacts the effectiveness of the proposed improvements.
- Projected future increases to tidal elevations (2050 & 2070) will overtop Mills Ave and the neighborhood more frequently.
- The proposed drainage system improvements will provide temporary improvements.
- **Without additional coastal protection such as a coastal berm**, the proposed drainage system loses its benefit as the ocean begins to rise and overtops Mills Ave roadway overwhelming the maximum proposed improvements.

NEXT STEPS

- Continue to evaluate stormwater model results
- Formulate recommendations based on results.
- Prepare Cost Analysis.



Riverside Neighborhood, Revere, Massachusetts

Questions & Discussion

Project Contacts:

Elle Baker – City of Revere - ebaker@revere.org

Scott Turner – Fuss & O'Neill - Scott.Turner@fando.com

**FUSS &
O'NEILL**

Solve better. **Go further.**

**FUSS &
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RIVERSIDE NEIGHBORHOOD DRAINAGE IMPROVEMENTS

June 17th, 2026

**FUSS &
O'NEILL**



Scott Turner, PE, FAICP

In partnership with:



Funding provided by:

*Housing Choice Grant
Community Development Block Grant*

INTRODUCTIONS



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- > Existing Conditions Analysis
- > Proposed Flood Mitigation
- > Future Climate Considerations
- > Next Steps

PROJECT SUMMARY & BACKGROUND

What We Did:

- **Developed an existing conditions stormwater model** to understand the extent and impacts of current stormwater flooding within the Riverside Neighborhood.
- **Developed proposed drainage improvement plans to expand** stormwater infrastructure and **reduce flood risk created by rainfall** in flood-prone areas.
- **Developed planning level analysis of berm and pump performance.**
- **Simulated proposed plans** to evaluate the plan's performance vs existing conditions.
- **What We're Doing:**
- **Gathering stakeholder feedback** and evaluating next steps.

PROJECT AREA

TOTAL PROJECT AREA
22 acres

LIMITED DRAINAGE SYSTEM

11 Manholes
41 Catch basins
11 Outfalls
~4200 Linear Feet of Conduit

**Existing Streets less than
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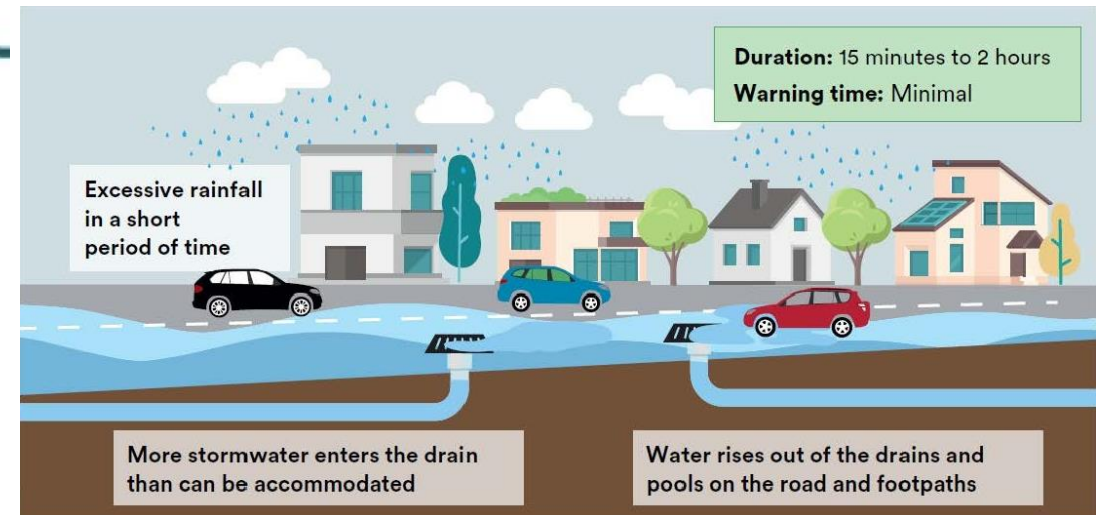
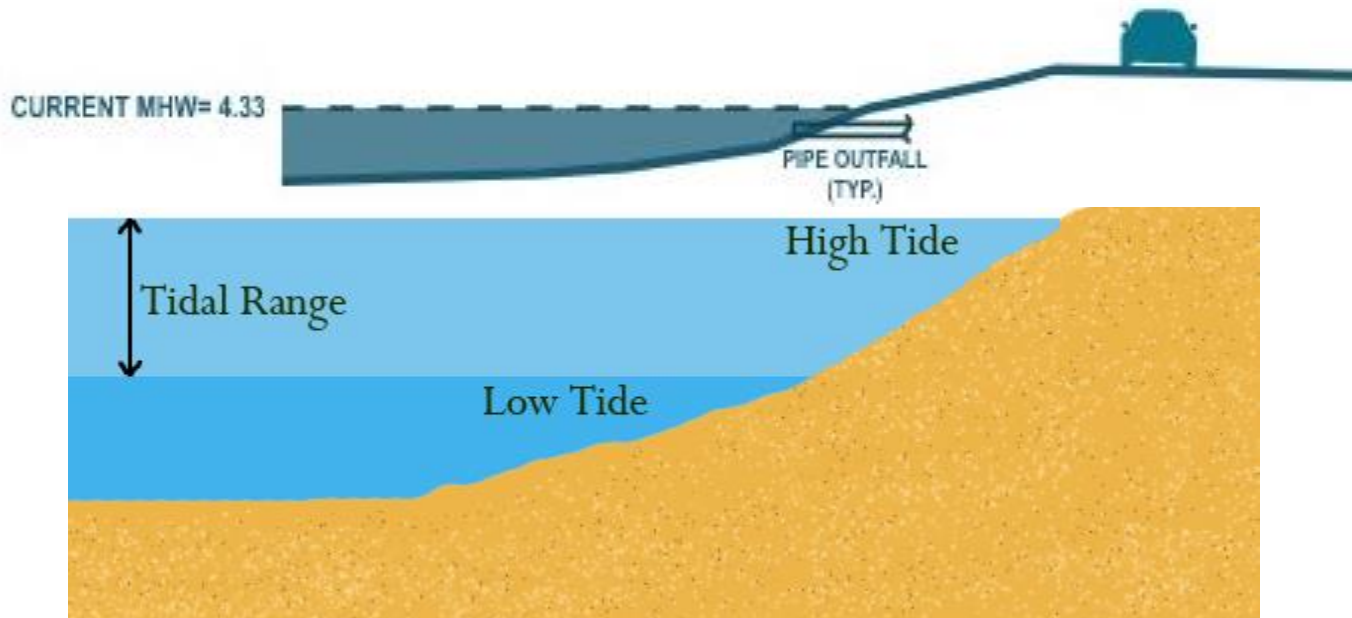


TYPE OF FLOODING

- The Riverside Neighborhood is vulnerable to two types of flooding:

Coastal flooding, where wind, tides, waves, and storm surge lead to flooding of low-lying coastal areas.

Stormwater flooding, where rainfall overwhelms the capacity of the stormwater system causing it to overflow onto the road.



EXISTING CONDITIONS PCSWMM MODEL

- Developed **stormwater model**.
- Delineated watersheds (in orange) contributing runoff to Riverside stormwater infrastructure system.
- Produced results for **1-year, 2-year, and 10-year** storm events.
- Validated results based on prior observed conditions.



EXISTING CONDITIONS 1-YR STORM (MHW)

- During the 1-YR MHW event, the model reveals minor flooding on Mills Ave, Gilbert Ave, River Ave and Thayer Ave.



Location	1-Year Storm Event			
	Existing System Current Climate Conditions			
	MLW		MHW	
	Peak Flood Depth (ft)	Max. Flood Duration (min)	Peak Flood Depth (ft)	Max. Flood Duration (min)
CB 3566 (Mills Ave)	0	0	0	0
CB 1219 (Gilbert Ave)	0.31	7.4	0.61	15.4
CB 4723 (Mills Ave)	0.36	3.9	0.60	9.7

MHW =
EL. 4.33 NAVD88

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EXISTING CONDITIONS 2-YR STORM (MHW)

- During the 2-YR MHW event, the model reveals worsening flooding on Mills Ave, Gilber Ave, River Ave and Thayer Ave.



Location	2-Year Storm Event			
	Existing System Current Climate Conditions			
	MLW		MHW	
	Peak Flood Depth (ft)	Max. Flood Duration (min)	Peak Flood Depth (ft)	Max. Flood Duration (min)
CB 3566 (Mills Ave)	0	0	0	0
CB 1219 (Gilbert Ave)	0.68	14.3	0.80	25.6
CB 4723 (Mills Ave)	0.71	8.2	0.73	12.3

MHW =
EL. 4.33 NAVD88



EXISTING CONDITIONS 10-YR STORM (MHW)

- During the 10-YR MHW event, the model reveals worsening conditions in all previous flooded areas.
- Flood conditions expand to Beckett, Lawson, and Franklin Avenues.



Location	10-Year Storm Event			
	Existing System Current Climate Conditions			
	MLW		MHW	
	Peak Flood Depth (ft)	Max. Flood Duration (min)	Peak Flood Depth (ft)	Max. Flood Duration (min)
CB 3566 (Mills Ave)	0.65	11.1	0.65	11.1
CB 1219 (Gilbert Ave)	1.01	44.0	1.06	64.4
CB 4723 (Mills Ave)	0.78	16.6	0.78	23.3

MHW =
EL. 4.33 NAVD88

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CURRENT CLIMATE EXISTING CONDITIONS RESULTS SUMMARY

- Some roadways within Riverside neighborhood do not have catch basins to capture runoff or relieve flood condition.
- The existing stormwater system is undersized and surcharges during frequently occurring, small intensity rainfall events (1- & 2-year events).
- As precipitation events increase (10-year) the stormwater system becomes further limited and flood conditions expand to other affected roadways.
- Rainfall intensity and sea levels are predicted to increase under a changing climate, resulting in worsening existing conditions.

PROPOSED “GRAVITY-ONLY” IMPROVEMENTS

- Several iterations of drainage improvements were analyzed, and the following improvements were selected:
 - Expand Drainage System Coverage** to collect runoff from **all roadways** within the Riverside neighborhood.
 - New Large Mainline Conduit** along Mills Ave to receive water from the side streets and route to the outfalls.
 - Two New Large Outfalls** on Mills Ave to drain the stormwater system via a 42-inch pipe.



PROPOSED “GRAVITY” CONDITIONS 1-YR STORM (MHW)

- The proposed conditions eliminates flooding throughout the neighborhood under the 1-year storm event with MLW and MHW tidal conditions.



MHW =
EL. 4.33 NAVD88

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PROPOSED “GRAVITY” CONDITIONS 2-YR STORM (MHW)



- The proposed conditions eliminates flooding throughout the neighborhood under the 2-year storm event with MLW and MHW tidal conditions.
- Minor surcharging from MASSDOT infrastructure that is not included within drainage improvement plan .

MHW =
EL. 4.33 NAVD88

PROPOSED “GRAVITY” CONDITIONS 10-YR STORM (MHW)

- The proposed conditions eliminates flooding on some streets and reduces flood depths and durations throughout the neighborhood under the 10-year storm event with MLW and MHW tidal conditions.



Location	10-Year Storm Event			
	Current Climate Conditions			
	Existing Cond.	Proposed Cond.		
	Peak Flood Depth (ft)	Max. Flood Duration (min)	Peak Flood Depth (ft)	Max. Flood Duration (min)
CB 3566 (Mills Ave)	0.65	11.1	0.03	0.2
CB 1219 (Gilbert Ave)	1.06	64.4	0	0
CB 4723 (Mills Ave)	0.78	23.3	0	0

MHW =
EL. 4.33 NAVD88

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CURRENT CLIMATE PROPOSED CONDITIONS RESULTS SUMMARY

- All roadways within the Riverside neighborhood are serviced by the proposed stormwater drainage system.
- The proposed stormwater drainage system eliminates flooding throughout the neighborhood under the current 1 and 2-year storm events.
- The proposed drainage system eliminates flooding on some streets and reduces flood depths and durations throughout the neighborhood under the current 10-year storm event.
- Rainfall events and sea levels are predicted to increase in the future due to a changing climate, impacting the effectiveness of the proposed improvements.

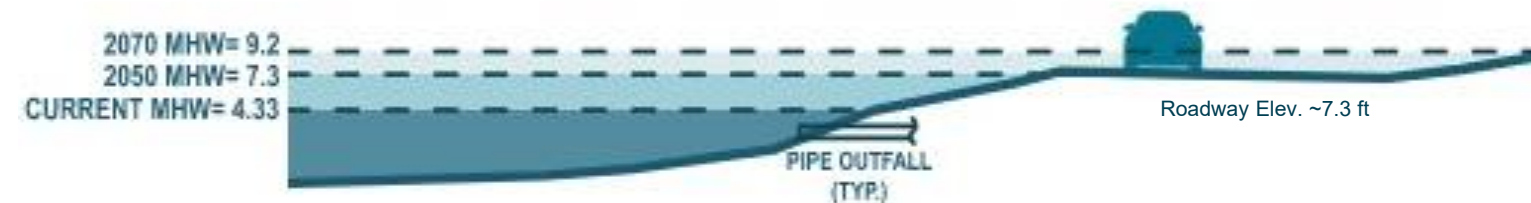
FUTURE CONDITIONS

The PCSWMM model was run with current climate and future climate conditions.

- Future Conditions**= Projected 2050 and 2070 Storm Precipitation + Projected 2050 and 2070 Tidal Elevations (mid century & late century)
- Design Storm Precipitation**
 - Future values come from Resilient Mass Climate Change Projection Dashboard
- Tide Elevations (MHW and MLW)**
 - Future climate tides come from Mass Coast Flood Risk Model (MC-FRM) tidal benchmarks.

Rainfall (in)	Future Climate Conditions		
24-hour Duration	Return Period (years)		
	1-Year	2-Year	10-Year
Current Climate	2.57	3.19	5.04
Year - 2050	3.1	3.9	6.2
Year - 2070	3.5	4.3	6.8

The future PCSWMM model includes future precipitation increases and future MHW tidal conditions.



Mills Ave Roadway Cross Section

Elev. NAVD88	Future Climate Conditions		
	Tidal Event		
	MLW	MHW	Dec-2022
Current Climate	-5.17	4.33	8.34
Year – 2050	-2.3	7.3	NA
Year – 2070	-0.7	9.2	NA

EXISTING CONDITIONS 2050 PROJECTED 2-YR STORM

Maximum inundation extents for 1- & 10-year storm events are similar to the depicted 2-year event.

- The projected 2050 tidal increases overtop the roadway of Mills Avenue and flood neighborhood.



2050 MHW =
EL. 7.3 NAVD88

EXISTING CONDITIONS 2070 PROJECTED 2-YR STORM (MHW)

Maximum inundation extents for 1- & 10-year storm events are similar to the depicted 2-year event.



- The tidal water surface elevation associated with projected 2070 MHW increases significantly overtop the roadway edge of Mills Avenue and flood the entire neighborhood.
- This heightened tailwater prevents the interior stormwater from being able to drain any roadways within the neighborhood.
- Given the neighborhood is coastal, the influence from future sea level rise is much greater than the increase in future precipitation intensity.

2070 MHW =
EL. 9.2 NAVD88

PROPOSED “GRAVITY” CONDITIONS 2070 PROJECTED 2-YR STORM (MHW)

Maximum inundation extents for 1- & 10-year storm events are similar to the depicted 2-year event.



- The tidal water surface elevation associated with projected 2070 MHW increases significantly overtop the roadway edge of Mills Avenue and flood the entire neighborhood.
- This heightened tailwater prevents improved proposed stormwater system from being able to drain any roadways within the neighborhood.

2050 MHW =
EL. 7.3 NAVD88

PRELIMINARY “PUMP” CONDITIONS 2070 PROJECTED 2-YR STORM (MHW)



- Coastal Berm protects from storm surge flood up to elevation 10.3.
- Centrifugal Pump significantly decreases flood depths and durations throughout the neighborhood.
- Analysis limited to Riverside neighborhood. Does not account potential storm surge entry around berm outside of neighborhood.

Location	2-Year Storm Event	
	Proposed Pump/Berm	
	Future 2070 Conditions	
Location	MHW	
	Peak Flood Depth (ft)	Max. Flood Duration (min)
CB 3566 (Mills Ave)	1.3	16
CB 1219 (Gilbert Ave)	0.9	11
CB 4723 (Mills Ave)	0	0

2070 MHW =
EL. 9.2 NAVD88

SUMMARY & NEXT STEPS

The influence from future sea level rise significantly impacts the effectiveness of the proposed improvements.

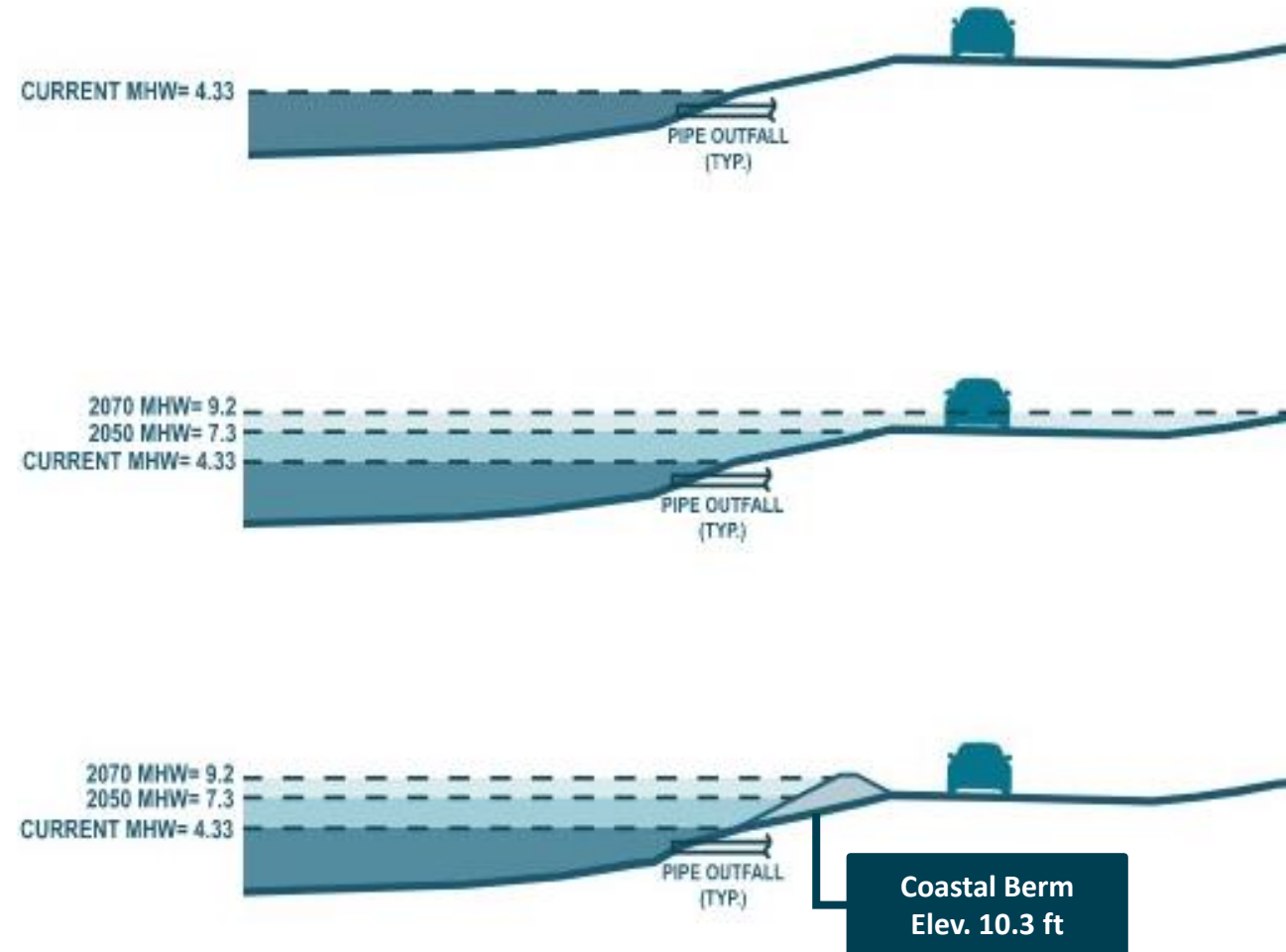
- Projected future increases to tidal elevations (2050 & 2070) will overtop Mills Ave and the neighborhood more frequently.
- **Without additional coastal protection such as a coastal berm**, the proposed drainage system loses its benefit as the ocean begins to rise and overtops Mills Ave roadway overwhelming the maximum proposed improvements.

NEXT Steps

- Continue to gather community feedback
- Formulate recommendations based on results.
- Prepare Cost Analysis.

Future Studies Beyond this Project

- Perform more detailed analysis and modelling of berm and pump option.
- Permitting feasibility.



Mills Ave Roadway Cross Section

Questions & Discussion

Project Contacts:

Elle Baker – City of Revere - ebaker@revere.org

Scott Turner – Fuss & O'Neill - Scott.Turner@fando.com

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