



Memorandum

230491

To: Brad Weeks and Justin Gove, City of South Portland Water Resource Protection

From: Christopher Taylor, P.E. Sebago Technics
Daniel Riley, P.E., Sebago Technics

Date: September 8, 2023

Subject: Willard Beach Force Main Replacement Summary of Work

Introduction

This memorandum provides a summary of the analysis and design conducted to date for the replacement or rehabilitation of the existing sewer force main located in Willard Beach from the City of South Portland's Willard Pump Station at Fisherman's Lane to Myrtle Avenue.

History/Existing Conditions

The combined sewer system for the Willard Beach neighborhood flows to the pump station located off Fisherman's Lane. From the pump station, the flow is conveyed via a 12-inch ductile iron force main beneath Willard Beach and Myrtle Avenue to a manhole and gravity sewer located at the intersection of Myrtle Avenue and Fort Road and further conveyed to the City's wastewater treatment plant. The pump station and 12-inch ductile iron force main were constructed in the 1970's according to the record drawings. The length of the force main is approximately 1,600 feet.

Three breaks in the force main have occurred in the last three years that have resulted in emergency repairs, discharge of untreated sewerage, closure of Willard Beach, and disturbance of the dune vegetation. Evidence from the recent breaks indicates that the existing force main has deteriorated due to age and saltwater impacts and the City plans an emergency repair to replace the force main in the beach

Design Alternatives

As part of the replacement planning two alternatives have been considered including:

1. Partial Replacement: Replacement of the force main in the beach from the Willard pump station to Myrtle Avenue.
2. Full Replacement and Relocation of the force main out of Willard Beach

To evaluate these alternatives, the city consulted with Sebago Technics and Woodard and Curran to design an alternative to replace the force main for the section along Willard Beach and to evaluate alternatives to reroute the force main to avoid disturbance to Willard Beach.

Alternative 1 Partial Replacement:

All of the recent breaks occurred in the 800 foot section of force main located in Willard Beach. Observations made by the City during the repairs of these breaks indicate corrosion of the pipe, likely due to its age and saltwater exposure.

The partial replacement alternative is to install a new, corrosion resistant, High Density Polyethylene (HDPE) pipe for approximately 800 feet along Willard Beach. The force main would follow a similar route as the existing force main and connect to the existing force main in Myrtle Avenue.

The City has engaged Woodard and Curran to evaluate the required force size and provide recommendations for pipe materials as summarized in a memorandum titled “Willard Beach Emergency Force Main Project Force Main Sizing Review” dated July 11, 2023 (Revised August 14, 2023) (copy enclosed). The recommendations.

The city has engaged SW Cole Engineers to perform subsurface investigations in the beach to support a replacement design

A preliminary design of this alternative has been prepared and presented to Local Contractors for pricing. The construction cost for this alternative was quoted at approximately \$560,000 and included restoration of the dune vegetation.

Alternative 2 Full Replacement and Relocation:

Sebago Technics has prepared a conceptual plan and cost estimate to replace the full length of the force main from the pump station to a terminus manhole, relocating the force main out of the beach area.

Any alternate routing of the force main would begin at the pump station on Fisherman’s Lane and end at the terminus manhole at the intersection of Fort Road and Myrtle Avenue. The alternate route if Willard Beach is avoided is to install a force main within the public streets including Fisherman’s Lane, Franklin Terrace, Preble Street, and Fort Road.

A plan is enclosed showing the alternate routing. The length of the alternate force main route is approximately 2,000 feet. This is approximately 400 feet longer than the existing force main. This alternate route would result in disturbance and reconstruction of the streets along the force main. Due to the narrow widths of the roads installation of the force main would likely require the replacement and

adjustments to water and sewer services, and storm drainage infrastructure along the route in addition to pavement and sidewalk repair.

Other Considerations related to this alternative that are not required for the Partial Replacement Alternative include:

- Work within the existing pump station to reconfigure equipment to allow for a discharge toward Fisherman's Lane
- Evaluation of the pump equipment and potential upgrades that may be required. The alternate route increases head loss due to additional force main length and elevation
- Potential utility conflicts along the route; potential ledge removal, extensive traffic control, and disruption in the local streets
- Excavation support/dewatering during construction specifically along Fisherman's Lane a location where sand and tidal groundwater are a concern given the close location of residences to the street.

Construction of this alternative is estimated to cost \$2,150,000.

Design Work

The design of the partial force main replacement has been advanced to an 85% level to understand the challenges and prepare for construction. A summary of the design work that has been conducted is summarized below.

Survey:

An existing conditions survey has been conducted along Willard Beach in the area of the existing force main. The survey work included gathering topographic data via aerial drone lidar, field locating site features including structures, pavement, playground equipment, significant vegetation, signs, poles, etc., and locating overhead and underground utilities including rims and inverts on sewer and drainage structures.

Geotechnical:

S.W. Cole has conducted borings and probes in Willard Beach along the proposed force main route. We are awaiting the results of the subsurface investigations.

Design:

A design plan set has been prepared for a new force main to be constructed along Willard Beach from the pump station on Fisherman's Lane to the end of Myrtle Avenue. The alignment and routing of the proposed force main was coordinated with the Water Resource Protection Department and contractors. The proposed force main has been located to avoid disturbance to existing structures, provide separation from the existing force main, and provide greater separation from the ocean. The proposed force main

location and depth will provide additional resilience from storms and rising sea levels. A restoration planting plan has been prepared to restore the dune vegetation along this section of Willard Beach.

Several pipe materials and sizes were analyzed by Woodward and Curran as replacement alternatives. A memorandum summarizing their findings is enclosed. The recommended pipe material and size for the partial replacement of the force main was HDPE 12-inch diameter.

This type of pipe is resistant to corrosion and butt fused to create a jointless run of pipe and allows for a flexible alignment to address crossings of existing utilities in the beach. The material can be fabricated in segments at grade and lowered into the excavation minimizing excavation support and dewatering compared to a jointed pipe installation. The construction and installation of the new main in segments are planned to minimize the duration of the pump station shutdown to the time needed to make connections into the pump station and to the existing force main in Myrtle Avenue.

HDPE pipe experiences expansion and contraction due to temperature and pressure differential. A concrete ground anchor has been included in the design to resist this movement and prevent separation in the existing ductile iron pipe push-on joints. The final design of the anchor is awaiting the results of the subsurface investigations and geotechnical recommendations.

Meetings and communication were held with a local pipe/material supplier (EJ Prescott), and a contractor (Shaw Brothers) to review the proposed plans and approach to construction and receive input on material availability, construction sequence, methods, and schedule.

Permitting:

A Natural Resources Protection Act Permit-By-Rule was submitted to the Maine Department of Environmental Protection (DEP) for the proposed work in a coastal sand dune.

Conclusion

The recommendation to repair the Willard Beach force main is to replace approximately 800 feet of the force main that runs along Willard Beach with a 12-inch diameter HDPE force main. Plans have been prepared for the proposed work. Shaw Brothers has provided a quote to execute the work at \$558,200. This is significantly more economical than the other alternatives that have been evaluated.

Attachments

- Technical Memorandum by Woodward and Curran, dated July 11, 2023 (Revised August 14, 2023)
- Preliminary Plans for Partial Replacement Alternative
- Conceptual Plans and Cost Estimate for Full Replacement Alternatives



TECHNICAL MEMORANDUM

TO: Justin Gove, P.E.
Engineering Division Manager
Water Resource Protection
City of South Portland, Maine

PREPARED BY: Jason Kreil, P.E.

REVIEWED BY: Megan McDevitt, P.E.

DATE: July 11, 2023; **Revised August 14, 2023**

RE: Willard Beach Emergency Force Main Project
Force Main Sizing Review

The purpose of this Technical Memorandum (TM) is to evaluate the sizing of the emergency replacement Willard Beach Force Main and provide a recommendation of sizing and pipe material for the replacement pipeline.

BACKGROUND

The City of South Portland's Willard Beach Force Main is a 12-inch diameter ductile iron pipe located along Willard Beach within established sand dunes that provide erosion protection to the beach adjacent to several homes located along the shoreline. The force main is approximately 1,600 feet long and starts at a pump station located on Fisherman's Lane, travels through the sand dunes along the edge of the beach to Myrtle Avenue, and then travels up Myrtle Avenue where it terminates at a structure located at the intersection of Myrtle Avenue and Fort Road. See **Figure 1**.

There have been three leaks on the force main within the last three years, with the last leak occurring on June 1, 2023. One leak was located close to the pump station and the other two leaks were in the sand dunes just south of Myrtle Avenue. Because of the break history associated with this force main, this project has been declared an emergency and time is of the essence to identify and initiate a rehabilitation or replacement solution for the roughly 700-foot-long section of force main located within Willard Beach.

FORCE MAIN SIZING EVALUATION

Woodard & Curran (W&C) reviewed information provided by the City of South Portland including the following:

- Drawing JS-93-29, Titled "South Portland, Maine, New Sewage Works – Contract No. 4, Willard Beach Pumping Station, Structural, Sheet 7 of 20, Record Plan, No Date" prepared by Fay, Spofford & Thorndike, Inc. Engineers, Boston, Mass., Dated July, 1973.



- Drawing JS-93-31, Titled "South Portland, Maine, New Sewage Works – Contract No. 4, Willard Brach Pumping Station, Mechanical, Sheet 9 of 20, Record Plan, No Date" prepared by Fay, Spofford & Thorndike, Inc. Engineers, Boston, Mass., Dated July, 1973.
- Drawing JS-93-16, Titled "South Portland, Maine, New Sewage Works – Contract No. 5, Intercepting and Force Main Sewers, Willard Beach and Myrtle Ave. (12" F.M. Sewer, Willard Beach P.S. to Fort Rd.), Willard Beach, Sheet 14 of 20, Revised – Record Plan, No Date" prepared by Fay, Spofford & Thorndike, Inc. Engineers, Boston, Mass., Dated July, 1973.
- Emails from Justin Gove, Engineering Division Manager, dated June 8th, June 12th and July 3rd, and containing the previously referenced record drawings, drawdown test and pressure, flow rates, and pump curves and nameplates.

Figure 1: Project Overview Map





REFERENCES, STANDARDS, & REGULATORY

The following documents were used to evaluate the force main.

- New England Interstate Water Pollution Control Commission (NEIWPC), "Technical Report #16 – Guides for Design of Wastewater Treatment Works", 2011 Edition Revised in 2016. (TR-16)
- Water Environment Federation (WEF), "Manual of Practice No. FD-4, Design of Wastewater and Stormwater Pumping Stations", 1993.
- Metcalf & Eddy, Inc., "Wastewater Engineering: Collection and Pumping of Wastewater", McGraw-Hill, 1981.
- Jones, Sanks, Tchobanoglous, "Pump Station Design – Revised 3rd Edition", Butterworth-Heinemann, 2008.
- Ductile Iron Pipe Research Association (DIPRA), "Handbook of Ductile Iron Pipe, Sixth Edition", 1984
- Palermo, Mike, "What is the ultimate pressure capability of Class 52 Ductile Iron Pipe?", McWane Ductile, 5/21/2021

WILLARD BEACH PUMPING STATION INFORMATION

W&C understands the following about the Willard Beach Pumping Station and force main:

- Typical dry weather flows of 150-300 gallons per minute (gpm) and a Peak Wet Weather Flow of 4,500 gpm.
- Maximum operating pressure of 65 psi.
- Force main is 12-inch diameter Ductile Iron (DI), Class Unknown
 - The length of the main is 1,611 linear feet (LF).
 - The force main contains one blowoff (cleanout) manhole at the low point of the main.
 - Record plans indicate a cover over the pipe between 5.5 vertical feet (VF) and approximately 10 VF, however, it is our understanding that the sand dunes have been modified by wave action and the pipe reportedly has significantly more soil cover.

PUMP STATION & FORCE MAIN ANALYSIS

W&C evaluated varying pumping rates, pressures, and velocities of wastewater in the existing force main at the observed flow rates and at optimal flow rates against accepted published pump station and force main design criteria, including:

- Velocity
- Pressure/Total Dynamic Head

- Fluid Acceleration time/Pause Time
- Pressure wave/surge potential
- Detention time
- Buoyancy



Velocity

Force main should be designed to have a minimum velocity of 2 feet per second (fps) for level keeping variable speed pump stations and 3 fps for draw and fill stations to prevent the settlement or resuspension of wastewater solids in the pipe. Optimal velocities for balancing pump horsepower and preventing the settlement of solids are between 3 and 5 feet per second. While there isn't a maximum published velocity, the maximum practical velocity is generally considered to be 8 fps as horsepower, pipe pressures, and potential for surge increase quickly above 8 fps. W&C calculated velocities for the current flows provided by the City and for the minimum and optimal velocities. Velocity associated with various flow rates are presented in **Table 1**.

Table 1 – Existing Force Main Velocity versus Flow Rates (12-inch DI)

Flow Rate (gpm)	Calculated Velocity (fps)	Compliance with TR-16	Note
150	0.4	No	Lower Limit of Dry Weather Flow Rate per City; Potential for Deposition of Sediment
300	0.9	No	Upper Limit of Dry Weather Flow Rate per City; Potential for Deposition of Sediment
700	2	Yes	Recommended Minimum Flow Rate per standard TR-16 (Variable Speed)
1050	3	Yes	Recommended Minimum Flow Rate per standard TR-16 (Fill and Draw)
1,750	5	Yes	Upper Limit of Optimal Range
4,500	12.8	Yes	Wet Weather Flow Rate per City; Exceeds Maximum Practical Velocity

Velocity calculations were performed assuming the existing force main to be Class 52 DI with cement lining and have a nominal inside diameter of 12 inches. The dry weather flow



rates reported are significantly lower than the minimum recommended pumping flow rates for a 12-inch diameter pipe, which may result in sedimentation and additional maintenance of the pipe. Target flows for a 12-inch diameter pipe would be between 700 and 1,750 gpm. The 4,500-gpm wet weather flow rate results in a velocity above recommended and requires significantly high horsepower pumps. High velocity can scour the interior of pipeline.

Pressure/Total Dynamic Head (TDH)

Using the results of the drawdown test performed by the City (4,500 gpm at 65 psi), the Hazen Williams friction coefficient for the pipe was calculated to be approximately 110. New DI pipe with cement lining typically would use a Friction coefficient of 120. The lower coefficient is indicative of a degraded pipe, which is expected based on the recent failures that have occurred. Static head was estimated at 35 feet using force main elevation information from the record plans provided by the City. **Table 2** presents the pressure and head in the existing force main.

Table 2 – Force Main Working Pressure versus Flow Rates

Flow Rate (gpm)	Total Dynamic Head (TDH, feet)	Pressure (psi)
150	35	15
300	36	15.5
700	38	16.5
1050	42	18.5
1,750	55	23.65
4,500	152	65.7

The working pressure rating for Class 52 DI pipe is 350 psi (DIPRA Handbook of Ductile Iron Pipe), and each of the flow rate conditions calculated well below that threshold. The 350-psi rating assumes the pipe is restrained and in good condition. Failure to restrain the pipe, deterioration of the pipe from interior attack of wastewater, or exterior corrosion from soil or groundwater may reduce that pressure rating. Surge pressures/transients are discussed in more detail later in this memorandum.

Fluid Acceleration/Pump Pause Time

Pause time is the point in the startup sequence during which a flow rate is less than the minimum noted by the pump manufacturer. Effectively, pause time is the time for the pump to accelerate the column of water from 0 to design velocity. Based on preliminary analysis, the time to accelerate the water column is just under 10 seconds, which is considered the threshold



for making modifications to the pump or system to prevent high radial forces at the pump, which may reduce the life of the pump shaft or bearings. The pause time for increasing the velocity from 0 fps to 12.8 fps is 9.4 seconds. This risk can be mitigated by increasing the pump speed over a short period using a soft starter or variable frequency drive. For a station in constant operation, the risk is further reduced as the velocity range is smaller when the pumps are already running. Increase in velocity in the force main would increase the risk associated with fluid acceleration/pump pause time.

Pressure Wave/Surge Potential

With high velocity or long mains, surges in pressures (also referred to as transients or water hammer) require evaluation. The pressure wave velocity, the speed in which the pressure wave travels through the pipe, is directly related to the wall thickness and elastic modulus of the pipe. DI pipe's rigid walls results in a wave velocity of about 4,000 fps.

The wave velocity is used to calculate the potential surge pressure that the pipe may experience. Surge or water hammers are commonly caused by a pump shutting off quickly or a sudden valve closure (check or isolation valve) and can send a pressure wave through the system much higher than the working pressure normally experienced in the system. Using a maximum velocity change of 12.8 fps to 0 fps, the potential maximum surge pressure of the existing force main could exceed 700 psi calculated using the Joukowsky relation. With the potential for high surge pressures, W&C recommends the City protect the pipe from potential rapid velocity changes by including slow closing check valves and surge relief valves. While VFD can provide this protection under normal operation, a sudden pump stoppage resulting from power failure will not provide the required surge/transient protection. Surge protection is more critical with only part of the force main being replaced.

Wastewater Detention Time

Detaining wastewater for longer periods of time can result in the water in the force main entering an anaerobic state and generating hydrogen sulfide (H₂S). Hydrogen sulfide can cause odor issues and can precipitate from the wastewater in the form of sulfuric acid. Sulfuric acid attacks and corrodes metal, such as uncoated DI pipe, and concrete structures downstream of the force main discharge. Significant amounts of H₂S or sulfuric acid may also negatively impact wastewater treatment facility process. Detention time was calculated for the dry weather low flow periods, which is the flow most likely to result in high detention time. The force main length is 1,611 LF with an associated volume of approximately 9,500 gallons. Based on the flow dry weather flows provided, the anticipated maximum wastewater detention time in the force main is approximately 1.2 hours, well below the threshold for hydrogen sulfide generation and the potential for odor at the discharge location. Higher flow rates further reduce the transit time through the main.

Pipe Buoyancy

The existing pipe has approximately 8 to 10 feet of soil cover within the limits of the proposed repair. Pipe buoyancy calculations indicate that the pipe exceeds a factor of safety (FS) of 2.



FORCE MAIN MATERIAL ALTERNATIVES

W&C evaluated three pipe materials for replacement of the existing force main. Those materials include Ductile Iron, C-900 Polyvinylchloride (PVC) and High-Density Polyethylene (HDPE – PE4710). Pipe diameters were selected accounting for the velocity across the operating range of the Willard Pump Station and potential for surge pressures or hydraulic transients described in detail previously in this memorandum. The evaluation of materials included varying pipe sizes and dimension/pressure ratings to meet the flow and environmental conditions and maintain or improve reliability and resiliency. A comparison of each material is presented in **Table 3**. **Table 4** presents an analysis of selected sizes and materials, while **Table 5** presents the larger pool of sizes and pressure ratings evaluated including calculated parameters for comparison. In general, the interior smoothness (higher Hazen Williams (HW) C friction coefficient) in the partially replaced force main should result in less total pressure than the existing force main. This slight reduction in head loss and pressure will allow the pump to be more efficient and provide slightly higher pumping rates. This flow rate can be maintained at 4,500 gpm or lower by making a minor adjustment to the variable frequency drives.

Table 3 – Force Main Material Comparison

Material	Pros	Cons
Ductile Iron	<ul style="list-style-type: none"> • Strength • Durability • Abrasion resistance (increased with P401 Lining) • Class 52 or greater can handle occasional surge pressures without damage 	<ul style="list-style-type: none"> • Metallic, susceptible to corrosion • Higher cost • Gaskets can leak over time • Heavy
PVC (C900)	<ul style="list-style-type: none"> • Lighter, easier to handle • Lower cost than DI • Non-Corrosive • Smooth interior, higher HW C value 	<ul style="list-style-type: none"> • Susceptible to damage by surge/transient – requires protective measures • Less durable than DI • Gaskets can leak over time
HDPE (PE 4710)	<ul style="list-style-type: none"> • Fused joint eliminates leaking joints • Lower cost than DI • Non-Corrosive • Can be thermally fused above/ below ground or electrically fused in place • 40 foot lengths • Smooth interior, higher HW C Value 	<ul style="list-style-type: none"> • Susceptible to damage by surge/transient and therefore less durable than DI– requires protective measures • Can creep/stretch over time • lower abrasion resistance • thicker wall requires larger nominal pipe diameter



Table 4 – Selected Force Main Size and Material Comparison

Material	Nominal Pipe Size (in)	Pipe Class/ Dimension Ratio (DR)	Working Pressure Rating (psi)	Pipe Inside Diameter (in)	Min. Wall Thickness (in)	Comment
Ductile Iron	12	Thickness Class 52 or heavier	350	12.46 (Before coating)	0.37	Recommend Protecto 401™ ceramic epoxy interior and exterior coating
C900 PVC	12	DR 14	305	11.20	0.943	
	12	DR 18	235	11.65	0.733	
HDPE (PE4710)	16	DR 7	333	11.15	2.286	
	14	DR 7	333	10.66	2.186	
	14	DR 9	250	11.69	1.7	
	14	DR 11	200	12.35	1.4	More readily available per vendor

Table 5 – Force Main Comparison Evaluation Summary



	Pipe Material						
	DI	PVC		HDPE			
Nominal Diameter (in)	12	12	12	16	14	14	14
Dimension Ration/ Pipe Class	52	14	18	7	7	9	11
Working Pressure (psi)	350	305	235	333	333	250	200
Outside Diameter (in)	13.2	13.2	13.2	17.4	15.3	15.3	15.3
Wall Thickness (in)	0.37	0.943	0.733	2.486	2.186	1.7	1.4
Inside Diameter (in)	12.46 ¹	11.2	11.65	12.13	10.66	11.69	12.35
Flow (gpm)	4500	4500	4500	4500	4500	4500	4500
Velocity (fps)	12.8	14.7 ²	13.5 ²	12.5 ²	16.1 ²	13.4 ²	12.1²
Hazen Williams Friction, C	120	140	140	140	140	140	140
Pressure, TDH (ft) ³	140	137	131	126	146	130	123
Pressure, PSI (ft) ³	61	60	57	55	64	57	54
Pause Time (sec)	9.8	11.3 ²	10.4 ²	9.6 ²	12.4 ²	10.3 ²	9.3²
Sonic Wave, Vc (fps)	3909	1474 ²	1279 ²	1218 ²	1218 ²	1040 ²	922²
Surge (psi)	728	348 ²	291 ²	258 ²	327 ²	244 ²	202²
Force Main Volume (gal)³	9464	8935	9228	9554	8603	9259	9708
Detention Time at 150 gpm (hours) ³	1.2	1	1.2	1.2	1.1	1.1	1.2

- Notes:
1. Published inside diameter for thickness class 52 DI pipe (unlined).
 2. For PVC and HDPE, Velocity, Pause Time, Sonic Wave, and Surge calculation are for the proposed material and are not a composite with the 900 linear feet of DI to remain.
 3. Pressure, Volume and Detention Time are a composite of the proposed pipe and existing DI pipe.



RECOMMENDATION

Based on the flow and pressure information provided and our consideration of the project factors as described herein, we recommend a 16-inch nominal diameter PE 4710 HDPE DR 7 pipe with fittings of the same material. This pipe offers the benefit of an inside diameter like the existing pipe, maintaining velocity and pressures, and reduces the potential for requiring changes or upgrades to the pumps. Though the fused joints are effectively restrained, bends should use thrust blocks to prevent movement. The HDPE is non-corrosive to wastewater and soil or groundwater attack. HDPE pipe is available in longer sections resulting in fewer joints. Pipe segments are thermally fused, creating a continuous pipe versus gasketed bell and spigot joints. The HDPE pipe maintains a similar fluid acceleration/pump pause time to the current system. The lower modulus of elasticity (i.e., more flexible pipe) has a lower pressure wave velocity and subsequently a lower surge pressure than the ductile iron.

Per subsequent discussions with the City, the Contractor and the Pipe Vendor, we understand that PE 4710 HDPE DR 7 in 16-inch diameter is not readily available and the ancillary HDPE fittings are not currently available. The Pipe Vendor indicated that DR 11 HDPE is more readily available for both the pipe and fittings and is easier to work with. Woodard & Curran reviewed the parameters presented in Table 5 above for the DR 11 HDPE 14-inch diameter pipe, identifying surge as the critical factor to consider in the design of the replacement force main. The overall interior pipe dimension is slightly larger than the assumed DI pipe, therefore velocity is slightly lower than the existing condition. Subsequently, pressure, pause time, sonic wave velocity, and surge pressure are slightly reduced and detention time of wastewater in the pipe is slightly increased as compared to the DR 7 pipe.

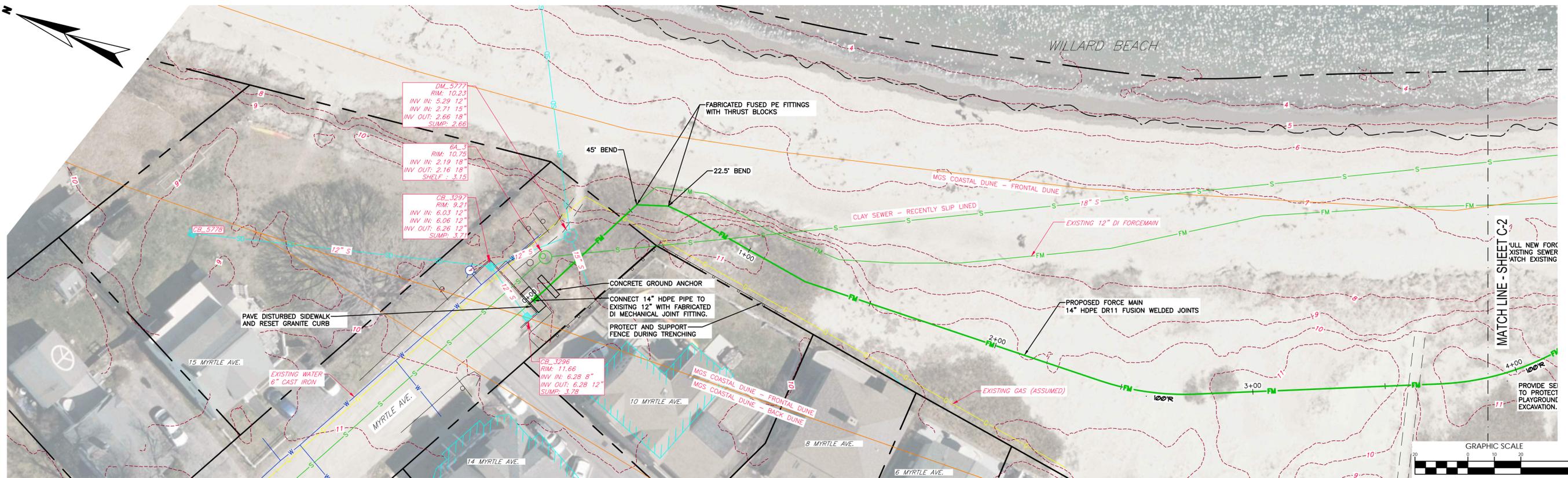
We recommend that the connection or restrained transition coupling between the HDPE and DI be sufficient to withstand the potential for corrosion and exposure to salt water.

We understand that only the first 700 linear feet of pipe is currently being considered for replacement. This may result in differing pressure wave velocities in the two pipes. A transient analysis should be considered when the design is finalized to confirm surge within the two different pipe materials. As the pressure wave and surge may be higher than that present in **Table 5** above for the full HDPE force main, W&C recommends that surge mitigation measures, including slow closing check valves and a surge relief valve, be included to protect the new pipe and existing DI pipe. Surge management may also include vacuum relief valves at the pumping station. The surge relief valve should be set to no higher than 1.5 times the actual working pressure of the main ($55 \text{ psi} \times 1.5 = 82.5 \text{ psi}$). Slow closing check valves may be oil dampened or air cushioned swing check valves by DeZurik, Pratt, or equal. The surge relief valve can be angled or straight vertical style by DeZurik, Ross, or equal. The surge pressure in the DR11 HDPE pipe is near the working pressure, however, surge pressures with the dual material pipe can be higher than the HDPE alone. The City acknowledged the surge mitigation requirement and indicated that the slow closing check valve, at a minimum, will be included to protect the force main pipe in the event of a power failure or rapid valve closure during a high flow event.

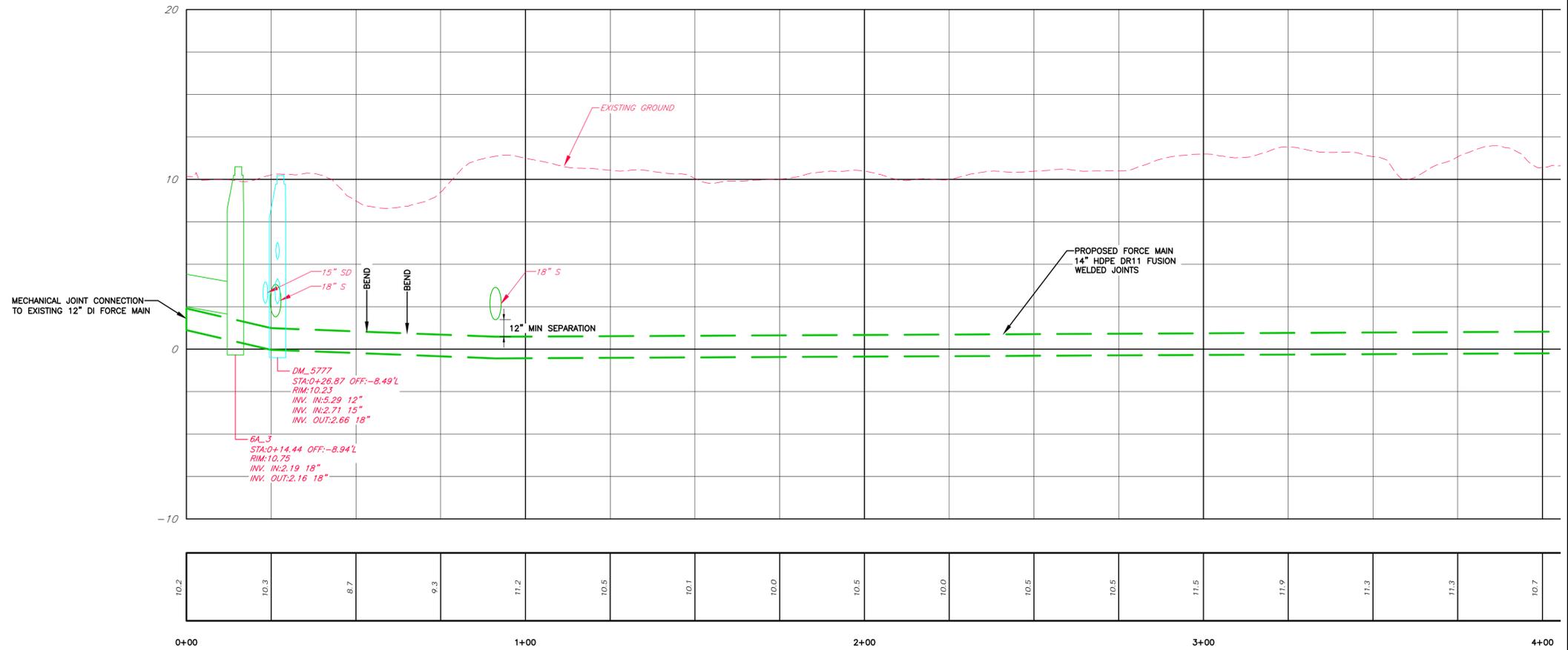
We understand for constructability, vertical alignment may change from existing alignment. Manholes with air release valves may be required at intermediate high points to prevent degradation of force main performance. For ease of access and maintenance, manholes should be located outside of the sand dunes to the greatest extent possible.

The recommended pipe should maintain a minimum cover of 4 feet for frost protection and 3 feet to prevent the potential for flotation of the pipe. Precast concrete pipe anchors installed at pipe manufacturer recommended spacing should be considered if the soil cover is less than 4 feet or there is potential for erosion of cover soil to reduce or eliminate the cover over the pipe. If erosion exposes the pipe, the anchors will also serve to hold the pipe in place.





PLAN VIEW
1"=20'



PROFILE:
SCALE: 1" = 20' HORIZ.
1" = 4' VERT.

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ISSUED FOR PERMIT	08/20/23	DLR	PROGRESS SET
PROGRESS SET	08/07/23	CPT	

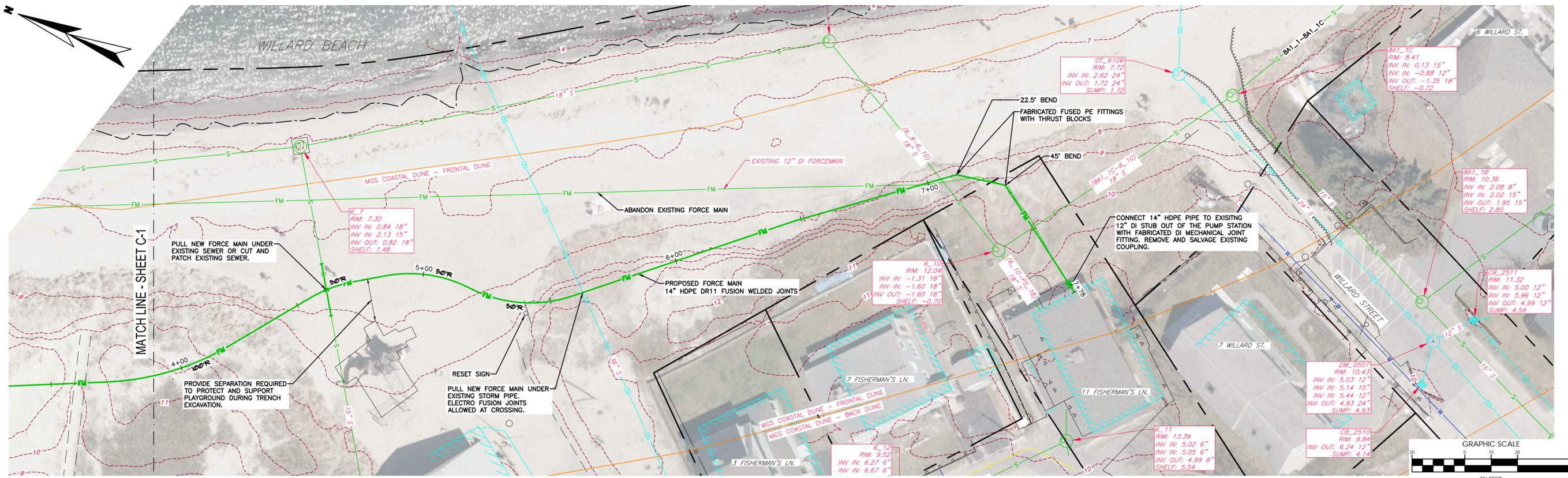
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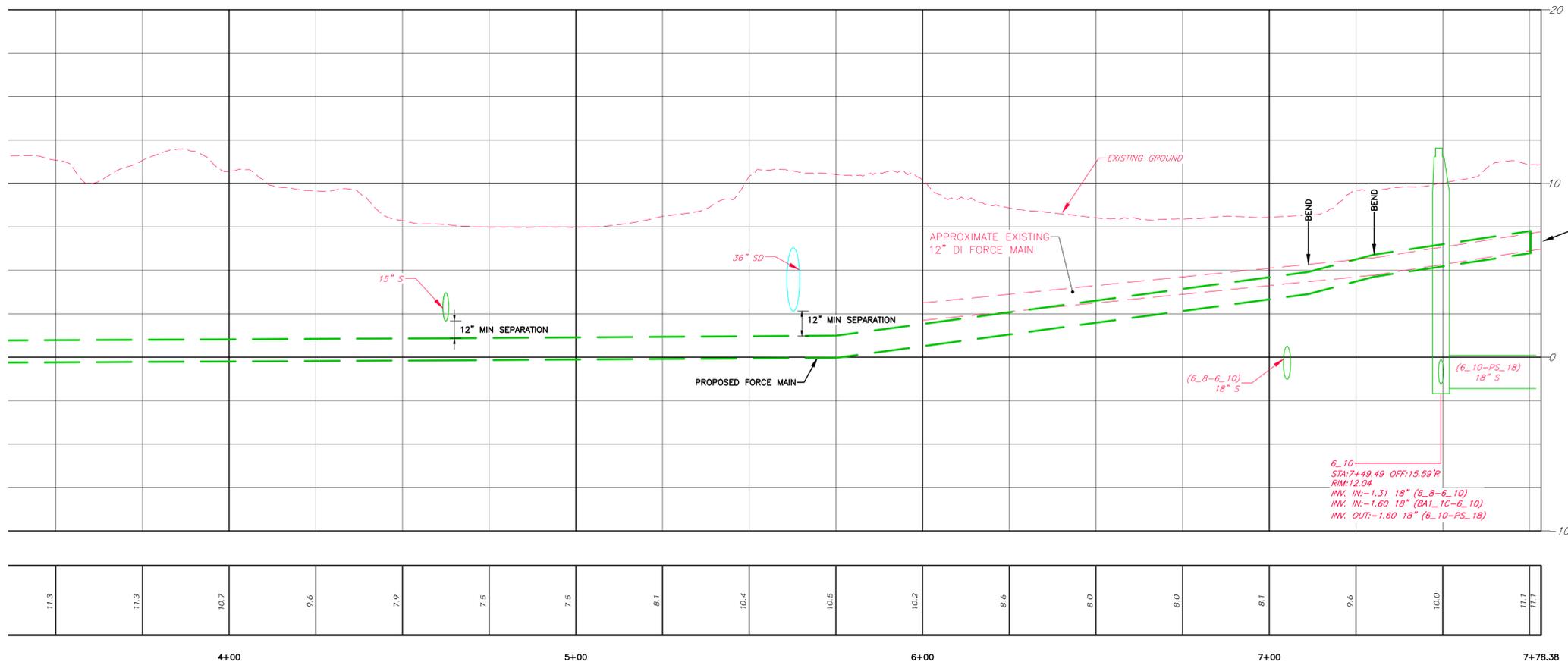
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CITY OF SOUTH PORTLAND
 WILLARD BEACH FORCE MAIN REPLACEMENT
 MYRTLE AVE
 SOUTH PORTLAND, MAINE
 PLAN AND PROFILE



PLAN VIEW
1"=20'



PROFILE:
SCALE: 1" = 20' HORIZ.
1" = 4' VERT.

DATE	ISSUED FOR	BY	REVISIONS
09/20/23	PERMIT	ABB	
09/07/23	PROGRESS SET	CTAYLOR	

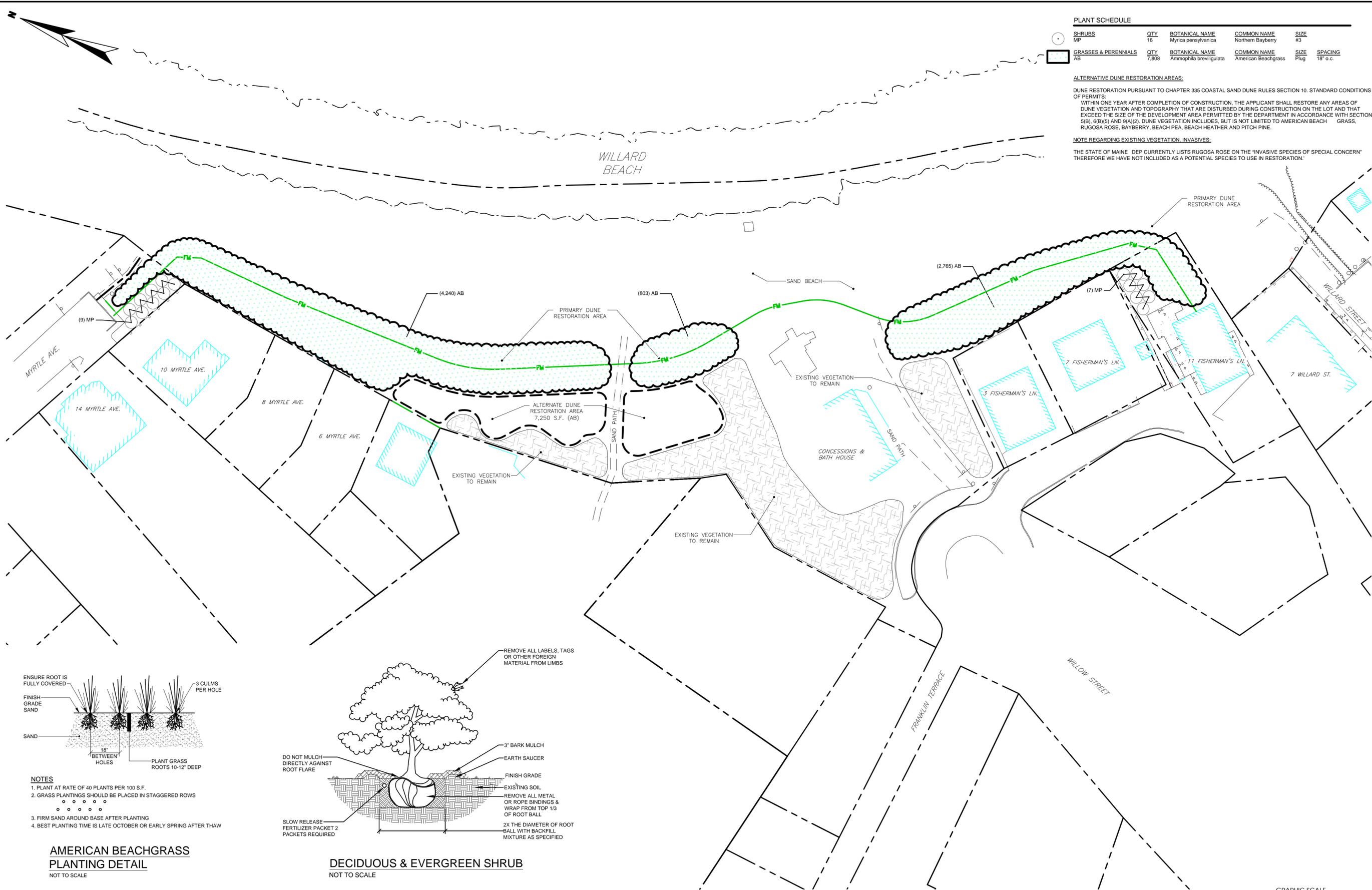
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ABB	XX/XX/XXXX	DLR	XX/XX/XXXX
PROJECT NO.	230491	SCALE	AS NOTED

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NOT FOR CONSTRUCTION

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CITY OF SOUTH PORTLAND
WILLARD BEACH FORCE MAIN REPLACEMENT
MYRTLE AVE
SOUTH PORTLAND, MAINE
PLAN AND PROFILE



PLANT SCHEDULE

SHRUBS	QTY	BOTANICAL NAME	COMMON NAME	SIZE
MP	16	Myrica pensylvanica	Northern Bayberry	#3

GRASSES & PERENNIALS	QTY	BOTANICAL NAME	COMMON NAME	SIZE	SPACING
AB	7,808	Ammophila brevifluta	American Beachgrass	Plug	18" o.c.

ALTERNATIVE DUNE RESTORATION AREAS:

DUNE RESTORATION PURSUANT TO CHAPTER 335 COASTAL SAND DUNE RULES SECTION 10. STANDARD CONDITIONS OF PERMITS:

WITHIN ONE YEAR AFTER COMPLETION OF CONSTRUCTION, THE APPLICANT SHALL RESTORE ANY AREAS OF DUNE VEGETATION AND TOPOGRAPHY THAT ARE DISTURBED DURING CONSTRUCTION ON THE LOT AND THAT EXCEED THE SIZE OF THE DEVELOPMENT AREA PERMITTED BY THE DEPARTMENT IN ACCORDANCE WITH SECTIONS 5(B), 6(B)(5) AND 9(A)(2). DUNE VEGETATION INCLUDES, BUT IS NOT LIMITED TO AMERICAN BEACH GRASS, RUGOSA ROSE, BAYBERRY, BEACH PEA, BEACH HEATHER AND PITCH PINE.

NOTE REGARDING EXISTING VEGETATION, INVASIVES:

THE STATE OF MAINE DEP CURRENTLY LISTS RUGOSA ROSE ON THE "INVASIVE SPECIES OF SPECIAL CONCERN" THEREFORE WE HAVE NOT INCLUDED AS A POTENTIAL SPECIES TO USE IN RESTORATION.

REVISIONS

NO.	DATE	DESCRIPTION
1	07/20/23	ISSUED FOR PERMIT
2	07/27/23	PROGRESS SET

ISSUED FOR PERMIT BY RULE

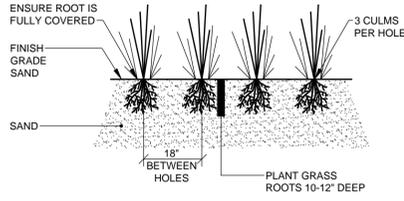
APPROVED BY	ABB
APPROVED BY CPT	XX/XX/XXXX
DATE	XX/XX/XXXX
CHECKED BY	DLR
DATE	XX/XX/XXXX
PROJECT NO.	230491
SCALE	AS NOTED

PROGRESS PRINT

NOT FOR CONSTRUCTION

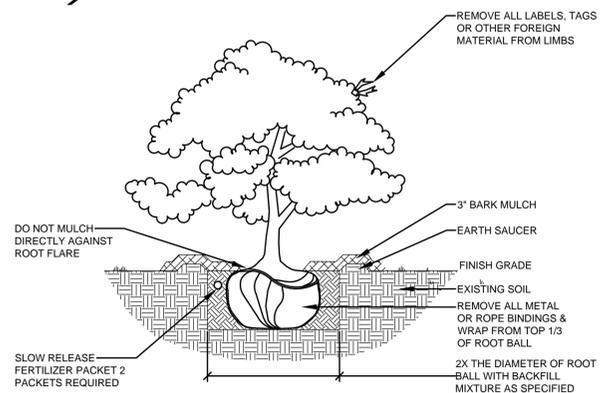
Water Resource Protection
 111 Waterman Drive
 South Portland, ME 04106-9422
 Ph # 207-767-7615
 Fax # 207-767-8697

CITY OF SOUTH PORTLAND
 WILLARD BEACH FORCE MAIN REPLACEMENT
 MYRTLE AVE
 SOUTH PORTLAND, MAINE
 LANDSCAPE RESTORATION PLAN



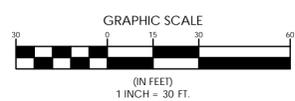
- NOTES**
1. PLANT AT RATE OF 40 PLANTS PER 100 S.F.
 2. GRASS PLANTINGS SHOULD BE PLACED IN STAGGERED ROWS
 3. FIRM SAND AROUND BASE AFTER PLANTING
 4. BEST PLANTING TIME IS LATE OCTOBER OR EARLY SPRING AFTER THAW

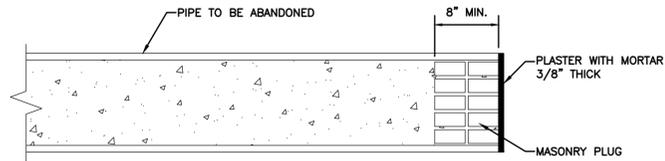
AMERICAN BEACHGRASS PLANTING DETAIL
 NOT TO SCALE



DECIDUOUS & EVERGREEN SHRUB
 NOT TO SCALE

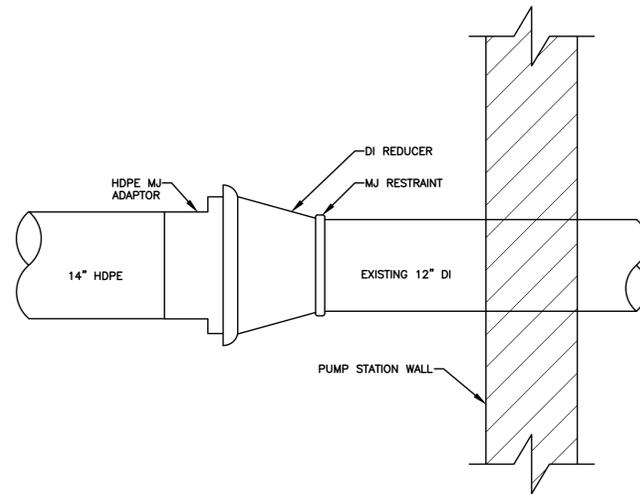
PLAN VIEW
 1"=30'



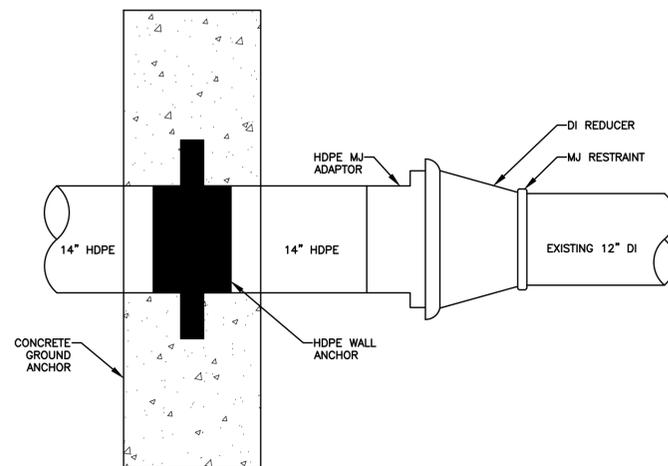


- NOTES:**
1. PIPE PLUGS SHALL BE INSTALLED TO THE SATISFACTION OF THE CITY ENGINEER.
 2. BACKFILL IS TO BE EITHER FLOWABLE CONCRETE BACKFILL OR FINE AGGREGATE.
 3. CAP PVC PIPE.

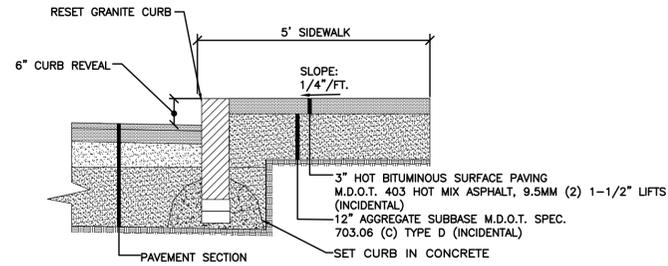
ABANDONED PIPE AND PLUG DETAIL
N.T.S.



CONNECTION TO EXISTING AT PUMP STATION
NOT TO SCALE

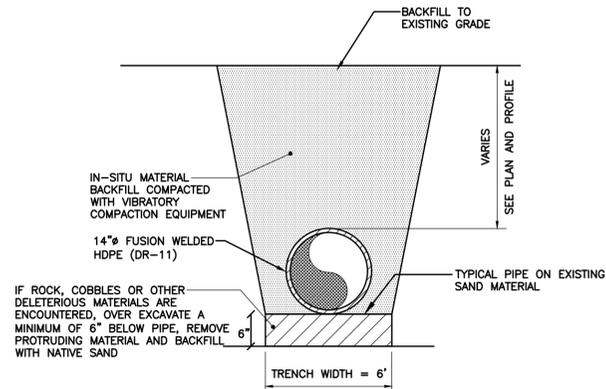


CONNECTION TO EXISTING AT MYRTLE AVE
NOT TO SCALE



- NOTES:**
1. COMPACT GRAVEL SUBBASE, BASE COURSE TO 95% OF MAXIMUM DENSITY USING HEAVY ROLLER COMPACTION.
 2. CONTRACTOR SHALL SET GRADE STAKES MARKING SUBBASE AND FINISH GRADE ELEVATIONS FOR CONSTRUCTION REFERENCE.

BITUMINOUS SIDEWALK & GRANITE CURB
NTS



- NOTES:**
1. BACKFILL TRENCH BACKFILL MATERIAL IN 12" LIFTS.

TYPICAL FUSION WELDED HDPE
INSTALLATION DETAIL
N.T.S.

PIPE SPECIFICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. THIS SECTION INCLUDES FORCE-MAIN, PRESSURE SANITARY SEWERAGE OUTSIDE THE BUILDING.

1.2 DEFINITIONS

- A. HDPE: HIGH-DENSITY POLYETHYLENE PIPE.

1.3 PERFORMANCE REQUIREMENTS

- A. FORCE-MAIN, PRESSURE-PIPING PRESSURE RATING: AT LEAST EQUAL TO SYSTEM OPERATING PRESSURE BUT NOT LESS THAN 200 PSIG.

1.4 SUBMITTALS

- A. PRODUCT DATA: FOR PIPING AND GASKETS.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. DO NOT STORE PLASTIC PIPE AND FITTINGS IN DIRECT SUNLIGHT.
B. PROTECT PIPE, PIPE FITTINGS, AND SEALS FROM DIRT AND DAMAGE.

PART 2 - PRODUCTS

2.1 HDPE PIPE AND FITTINGS

- A. PIPE: HDPE POTABLE WATER PE4710, DUCTILE IRON PIPE SIZES (DIPS), MANUFACTURED IN ACCORDANCE WITH ASTM F714 AND AWWA C906, PRESSURE RATING DR11.

- B. FITTINGS: HDPE, BUTT-FUSION TYPE, PRESSURE RATING TO MEET OR EXCEED PIPE PRESSURE RATING, MANUFACTURED BY PIPE MANUFACTURER.

2.2 DUCTILE IRON FITTINGS

- A. MATERIAL SHALL BE ASTM A536 LATEST, GRADE 70-50-05, IN ACCORDANCE WITH AND C153 (LATEST REVISION) FOR FITTINGS 3" THRU 24".

- B. FITTINGS SHALL BE CEMENT LINED AWWA C104 (LATEST REVISION) OR FUSION BONDED EPOXY COATED WITH A 5 MIL NOMINAL THICKNESS PER AWWA C550 AND C116.

- C. INTERIOR SEAL COATED AWWA C104 WITH MINIMUM OF 4 MILS DRY FILM THICKNESS.

- D. EXTERIOR BITUMINOUS COATED, 4 MILS MINIMUM DRY FILM THICKNESS OR FUSION BONDED EPOXY COATED WITH A 5 MIL NOMINAL THICKNESS PER AWWA C550 AND C116.

- E. MECHANICAL JOINT WITH ACCESSORIES FURNISHED: D.I. GLANDS, GASKETS, COR-BLU T-BOLTS AND NUTS.

- F. CLASS 350 PRESSURE RATING IN ACCORDANCE WITH AWWA C153 - 3"-24" SIZES.

2.3 PIPE JOINT RESTRAINTS

- A. THE JOINT RESTRAINT RING AND ITS WEDGING COMPONENTS SHALL BE MADE OF DUCTILE IRON CONFORMING TO ASTM A536-80.

- B. RESTRAINER MUST RESTRAIN UP TO 350 PSI OF WORKING PRESSURE WITH A 2:1 SAFETY FACTOR.

- C. TORQUE LIMITING TWIST OFF NUTS SHALL BE USED TO ENSURE PROPER ACTUATION OF THE RESTRAINING WEDGES WHERE APPLICABLE.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. INSPECT EACH PIPE LENGTH BEFORE INSTALLATION. REMOVE ANY DAMAGED OR DEFECTIVE PIPE.

- B. GENERAL LOCATIONS AND ARRANGEMENTS: DRAWING PLANS AND DETAILS INDICATE GENERAL LOCATION AND ARRANGEMENT OF UNDERGROUND SANITARY SEWERAGE PIPING. LOCATION AND ARRANGEMENT OF PIPING LAYOUT TAKE DESIGN CONSIDERATIONS INTO ACCOUNT. INSTALL PIPING IN A DRY TRENCH. INSTALL PIPING AS INDICATED, TO EXTENT PRACTICAL. WHERE SPECIFIC INSTALLATION IS NOT INDICATED, FOLLOW PIPING MANUFACTURER'S WRITTEN INSTRUCTIONS.

- C. INSTALL PROPER SIZE INCREASERS, REDUCERS, AND COUPLINGS WHERE DIFFERENT SIZES OR MATERIALS OF PIPES AND FITTINGS ARE CONNECTED.

- D. INSTALL FORCE-MAIN, PRESSURE PIPING ACCORDING TO THE FOLLOWING:

1. INSTALL PIPING WITH FUSED RESTRAINED JOINTS AT FITTINGS FOR HORIZONTAL AND VERTICAL CHANGES IN DIRECTION.

2. INSTALL PIPING BELOW FROST LINE.

3. NPS 10 AND NPS 12: HDPE, ASTM PIPE; MOLDED PE FITTINGS; AND HEAT-FUSION JOINTS.

- E. PLACE AND COMPACT ENOUGH BACKFILL MATERIAL BETWEEN THE PIPE AND SIDES OF THE TRENCH TO HOLD THE PIPE IN CORRECT ALIGNMENT.

- F. CLEAR INTERIOR OF PIPING OF DIRT AND SUPERFLUOUS MATERIAL AS WORK PROGRESSES. MAINTAIN SWAB OR DRAG IN PIPING, AND PULL PAST EACH JOINT AS IT IS COMPLETED. PLACE CAP ON END OF INCOMPLETE PIPING AT END OF DAY AND WHEN WORK STOPS.

3.2 PIPE JOINT CONSTRUCTION

- A. JOIN FORCE-MAIN, PRESSURE PIPING ACCORDING TO THE FOLLOWING:

1. PE, AWWA FITTINGS; AND HEAT-FUSION JOINTS.

2. JOIN DISSIMILAR PIPE MATERIALS WITH MECHANICAL JOINT DUCTILE IRON FITTINGS.

3.3 PIPE INSULATION

- INSTALL 2-IN. THICK X 4-FT. WIDE INSULATION OVER PIPE WHEN NOTED ON PLANS OR AS DIRECTED BY THE OWNER'S REPRESENTATIVE.

DATE	09/20/23
ISSUED FOR PERMIT	CPT
ISSUED FOR PERMIT BY RULE	CPT
PROGRESS SET	CPT

REVISIONS	
ISSUED FOR PERMIT BY RULE	
PROGRESS SET	
ISSUED FOR PERMIT BY RULE	
PROGRESS SET	

DRAWN BY	ABB
APPROVED BY	CPT
DATE	XX/XX/XXXX
CHECKED BY	DLR
DATE	XX/XX/XXXX
PROJECT NO.	230491
SCALE	AS NOTED

PROGRESS PRINT

NOT FOR CONSTRUCTION

Water Resource Protection
111 Waterman Drive
South Portland, ME 04106-9422
Ph # 207-767-7615
Fax # 207-767-9897

City of South Portland

CITY OF SOUTH PORTLAND
WILLARD BEACH FORCE MAIN REPLACEMENT
MYRTLE AVE
SOUTH PORTLAND, MAINE

DWG
C502



TAX PARCELS	PUMP STATION	DRAIN MANHOLE	WATER NODE	SERVICE CONNECTIONS
2' CONTOUR	SMH	OUTLET CONTROL	WATER MAINS	DRAINAGE PIPES
10' CONTOUR	SMH BI-DIRECTIONAL	OUTFALLS	SEWER & COMBINED SEWER PIPES	GRAVITY
FORCE MAIN ALTERNATE ROUTE	TEE JUNCTURE	WATER STRUCTURES	PIPE TYPE	LATERAL
SEWER STRUCTURES	LATERAL POINTS	HYDRANT	FORCE MAIN	UNDERDRAIN
CATCH BASIN IN SEWER	DRAIN STRUCTURES	WATER VALVE	GRAVITY	
CATCH BASIN	CATCHBASIN	WATER SERVICE VALVE	STORM	

0 30 60 120 180 240 300 Feet

2024/11/08
 1001 1983 StatePlane Maine West FIPS 1802 (NAD 83)

EXTERNAL DATA SOURCES
 Maine Geospatial
 City of South Portland
 2020 USGS LIDAR Contours
 ESRI World Imagery

REV.	BY	DATE	STATUS

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 Tel: 207-200-2100

ALTERNATE FORCE MAIN ROUTING EXHIBIT
 OF:
 WILLARD BEACH
 SOUTH PORTLAND, MAINE
 FOR:
 CITY OF SOUTH PORTLAND
 25 COTTAGE ROAD
 SOUTH PORTLAND, MAINE 04106

DESIGNED	MTM
DRAWN	MTM
CHECKED	
DATE	6/28/2023
SCALE	1" = 60'
PROJECT	230491

South Portland Willard Beach Force Main Replacement

ALTERNATIVE 1B - Pump Station to Franklin via Fisherman's Lane

Item	Unit	Quantity	Cost	Item Total	Note
12" Storm Drain	LF	260	\$ 185	\$ 48,100	
4' Catch Basins	EA	10	\$ 7,000	\$ 70,000	
12" Sewer Pipe	LF	2010	\$ 290	\$ 582,900	
Road Restoration	SY	3300	\$ 105	\$ 346,500	
Curb and Sidewalk	LF	635	\$ 75	\$ 47,625	
4"/6" Longside Sewer Laterals	EA	19	\$ 3,500	\$ 66,500	
1" Copper Longside Water Service	EA	18	\$ 5,100	\$ 91,800	
Water Main Crossing	EA	4	\$ 5,800	\$ 23,200	
Reconfigure Pump Station	EA	1	\$ 75,000	\$ 75,000	
Excavation Support along Fishermans	ALLOW	1	\$ 30,000	\$ 30,000	
			Subtotal	\$ 1,381,625	
Engineering (Design, Permitting & CA)			20%	\$ 276,325	
Misc/Incidentals			25%	\$ 345,406	
Contingency			10%	\$ 138,163	
			Total	\$ 2,141,519	