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December 23, 2021

Kevin Brander, P.E.
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205B Lowell Street Wilmington, MA 01887

Todd J. Borci
Office of Environmental Stewardship US EPA New England
5 Post Office Square Suite 100 (OES 04-4)
Boston, MA 02109-3912

RE: Charles River and Alewife Brook/Upper Mystic River CSO Variances
MWR205 & SOM007A/MWR205A Somerville Marginal CSO Reduction Project, Study and Preliminary Design

Dear Mr. Brander and Mr. Borci:

The Massachusetts Water Resources (MWRA) is pleased to submit the Somerville-Marginal CSO Facility Evaluation report and the Somerville Marginal CSO Facility New Pipe Connection Preliminary Design Assessment report. MWRA is submitting these reports to the Massachusetts Department of Environmental Protection ("MassDEP") for review and approval in accordance with the MassDEP's *Final Determination to Adopt a Variance for Combined Sewer Overflow Discharges to Alewife Brook/Upper Mystic River Basin* (August 30, 2019) and *Final Determination to Adopt a Variance for Combined Sewer Overflow Discharges to Charles River Basin* (August 30, 2019) (collectively the "Variances"). These reports are the second of three system optimization measures to study under the Variances, with the intent of evaluating whether implementation of these measures will improve combined sewer overflow (CSO) performance and water quality.

The Typical Year model results showed that the Somerville Marginal CSO Facility's activation frequency is well below the Long-Term Control Plan (LTCP) level of control with current activations occurring 30 times in a typical year, versus the 39 activation allowed under the LTCP. However, the treated discharge volume (99.71 MG, Q4-2021 conditions) exceeds the LTCP required level of control (60.58 MG) by approximately 39 MG.

Using the MWRA hydraulic model, evaluations were performed for specific alternatives that may reduce overflows from the Somerville-Marginal CSO Facility that discharges from outfalls MWR205 (Mystic River) and SOM007A/MWR205A (Upper Mystic River). CSO discharges

from MWR205 or SOM007A/MWR205A is dependent on the tidal elevation when a CSO activation is occurring, with SOM007A/MWR205A being the high tide discharge.

The evaluations included the benefit and feasibility of:

- increasing the capacity of the connection to the Somerville-Medford Branch Sewer; and

- removing stormwater including the Ten Hills and/or Mystic Avenue/I-93 stormwater flows from the Massachusetts Department of Transportation's (MassDOT) 72-inch drain that enters the combined sewer system upstream of the Somerville Marginal CSO Facility.

The details of these evaluations are include in the attached Somerville-Marginal CSO Facility Evaluation Report. The report showed that a significant reduction in the discharge could be achieved by the installing a supplemental connection from the 85 x 90-inch influent sewer upstream of the Somerville Marginal Facility to a manhole on the MWRA's 42-inch Somerville Medford Branch Sewer. The connection was determined to require a control gate that would be modulated based on critical system levels, in order to not impact hydraulically connected systems in larger storm events. Analysis of the removal of the stormwater from the MassDOT and local neighborhoods was not recommended for further advancement given the smaller benefit in CSO performance, as well as concerns with discharging new sources of stormwater to the receiving water and the increase bacterial load that would accompany these new stormwater discharges.

The new connection option is predicted to reduce the CSO volume from the Somerville Marginal Facility to within approximately 2-3 MG (3-5%) of the LTCP target. Furthermore, with respect to activation frequencies: (a) MWR205 is predicted to drop from 30 to 17 or 18, well below the LTCP target of 39; (b)The activation frequency for SOM007A/MWR205A would drop from 5 activations to 3, meeting the LTCP activation goal. The model shows an increase in treated discharge volume at Prison Point by approximately 9.5 MG but an overall reduction of 29 MG in total CSO discharge. MWRA continues to track Somerville's Union Square, Poplar St. Pump Station project that is expected to offset a portion, if not all, of this increased CSO volume at Prison Point.

Following this study, MWRA retained Hazen and Sawyer to evaluate design options which are presented in the attached Somerville Marginal CSO Facility New Pipe Connection Preliminary Design Assessment. The assessment provides a discussion on why connecting from the 42-inch drain that discharges to the 85 X 90-inch influent sewer into the Somerville Medford Branch Sewer is the appropriate alternative. The memorandum also includes details on the proposed chamber that will be constructed and house a control gate. The preliminary assessment's cost estimate to implement this new connection is estimated to be approximately $1.3M. MWRA will move forward with the design of this new connection in the coming year.

Please do not hesitate to contact me at dave.coppes@mwra.com, should you have questions or require any additional information regarding MWRA's progress to date in meeting CSO variance requirements.

Very truly yours,

David W. Coppes, P.E.
Chief Operating Officer

cc: Fred Laskey, Executive Director
Carolyn Francisco-Murphy, General Counsel
Rebecca Weidman, Director, Environmental and Regulatory Affairs
John Colbert, P.E., Chief Engineer
Betsy Reilley, Director, Environmental Quality

Task 8.4: Somerville-Marginal CSO Facility Evaluation

CSO Post Construction Monitoring and Performance Assessment
MWRA Contract No. 7572

December 21, 2021

Project number: 60559027

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Figures

Tables

1. Introduction

1.1 Somerville Marginal CSO Facility System Overview

The MWRA's Somerville Marginal CSO Facility provides screening, disinfection, and dechlorination of combined sewer flows prior to discharge at outfalls MWR205 and SOM007A/MWR205A. The facility is activated by opening influent sluice gates when the upstream water surface is approximately 5.5-ft. deep, maximizing wastewater storage in the upstream combined system. Outfall MWR205 is located in tidal waters of the Mystic River immediately downstream of the Amelia Earhart Dam, and discharges treated CSO from the Somerville Marginal CSO Facility along with separate stormwater that enters the Somerville Marginal Conduit downstream of the CSO facility. Outfall SOM007A/MWR205A is a relief outfall off of the Somerville Marginal Conduit that discharges to the freshwater reach of the Mystic River upstream of the Amelia Earhart Dam when the Somerville Marginal CSO Facility activates during high tide (see Figure 1-1).

Typical Year model runs conducted as part of the MWRA's Post Construction Compliance Monitoring Program (PCCMP) consistently showed that the Somerville Marginal CSO Facility activation frequency was consistent with the LTCP level of control, but the treated discharge volume exceeded the LTCP goal. The performance as reported in Semiannual Report No. 7 based on Q1Q2-2021 conditions was 30 activations and 99.66 million gallons (MG) for outfall MWR205, compared to the LTCP goals of 39 activations and 60.58 MG. Additionally, the performance at SOM007A/MWR205A based on the Q1Q2-2021 conditions model was 5 activations and 4.50 million gallons, compared to the LTCP values of 3 activations and 3.48 million gallons. Meter data collected in 2018 and 2019 indicated that stormwater flows entering the combined sewer system upstream of the facility were higher than those simulated with prior models. As described below, in accordance with a condition in the Alewife Brook/Upper Mystic River CSO Variance, MWRA conducted evaluations of specific projects with the goal of reducing overflows to the Somerville Marginal CSO Facility and discharges from outfalls MWR205 and SOM007A/MWR205A.

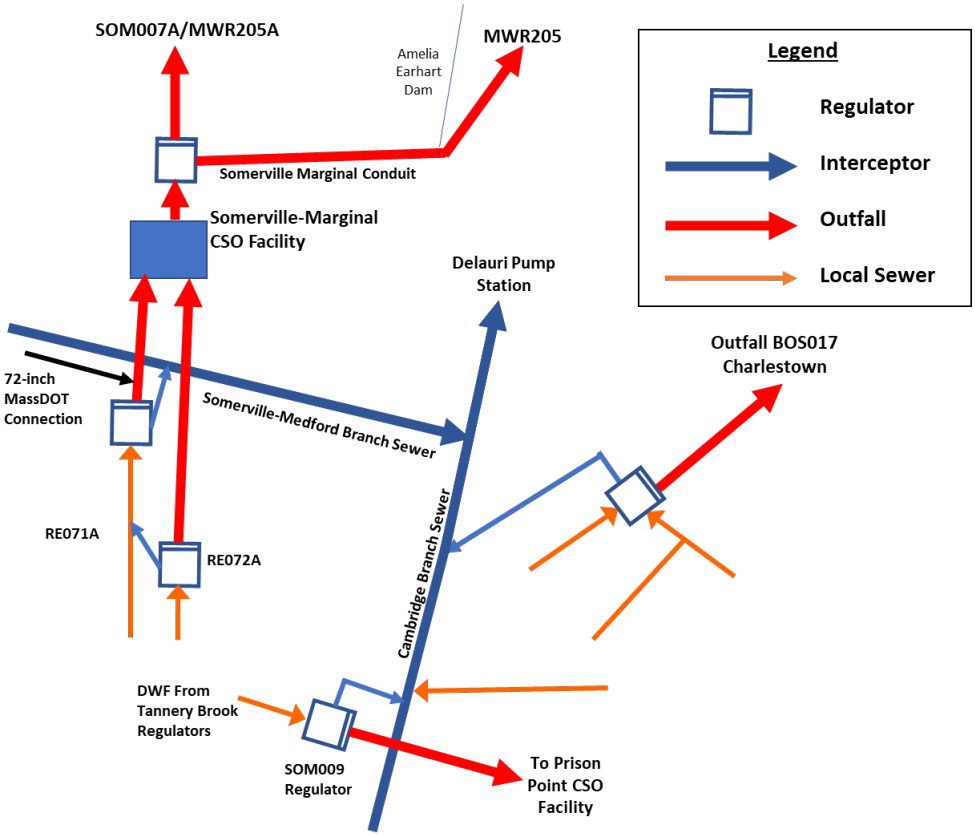

Figure 1-1. Schematic of Somerville Marginal CSO Facility System

1.2 Variance Requirements and Evaluations Conducted

The 2019 Alewife Brook/Upper Mystic River Variance specified a range of activities to be undertaken by MWRA during the variance period to further evaluate opportunities to reduce CSO discharges to Somerville Marginal. In particular, Exhibit A of the Variance identified a series of

> *specific additional system optimization measures that MWRA will undertake during a 5-year variance period…intended to further MWRA's goals of improving water quality in … the Upper Mystic River, and Alewife Brook. These measures are consistent with the requirements of 40CFR 131.14, and allow for progress to be made towards attaining the designated use(s) and water quality criteria. Collectively with the other elements of the CSO Variance requirements, these efforts comprise the pollutant Minimization Program to be implemented during the course of the CSO Variance*[1].

Specifically, for the Somerville Marginal CSO Facility, Exhibit A states that MWRA will

> *Evaluate alternatives to reduce CSO activation frequency and volume at the Somerville Marginal CSO Treatment Facility, and associated CSO outfalls SOM007A/MWR205A, and MWR205, while avoiding any increase in the frequency and volume of CSO discharges at MWRA's Prison Point CSO Treatment Facility (MWR203), and CSO outfalls CAM017 and BOS017. Alternatives to be evaluated, at a minimum, will include:*
>
> - *Construction of dry weather connection relief/control from the City of Somerville's CSO regulator RE071A to MWRA's Somerville-Medford Branch Sewer; and*
> - *Relocation of MassDOT I-93 drainage from upstream to downstream of the Somerville-Marginal facility to reduce the frequency and volume of facility activations*[1].

In accordance with the variance requirements, the MWRA undertook the evaluation of a range of alternatives including the two bulleted items above. The specific evaluations are listed below, along with the corresponding section of the report in which they are presented.

- Evaluation and implementation of near-term improvements to reduce CSO discharge activation frequency and volume (Section 2).
- Model updates in the Ten Hills and I-93 stormwater areas tributary to the 72-inch combined sewer upstream of the Somerville Marginal CSO Facility (Section 3).
- Evaluations of alternatives (Section 4)
    - Evaluation of increasing the size of the existing 18-inch dry weather flow connection to the Somerville-Medford Branch Sewer (Section 4.2)
    - Evaluation of a new connection between the 85x90-inch influent combined sewer and the 42-inch Somerville-Medford Branch Sewer (Section 4.3.1)
    - Evaluation of a new connection between a 42-inch storm drain tributary to the 85x90-inch influent combined sewer and the Somerville-Medford Branch Sewer (Section 4.3.2)
    - Qualitative Assessment of Poplar Street Pump Station (Section 4.3.3)

[1] Massachusetts Department of Environmental Protection. 2019. *Final Determination to Adopt a Variance for Combined Sewer Overflow Discharges to Alewife Brook/Upper Mystic River Basin*.

2. Near Term Improvements

MWRA identified two opportunities for near term improvements to reduce discharges at outfalls MWR205 and SOM007A/MWR205A: modifications to the operation of the Somerville Marginal Facility influent gates, and repair of a leaking tide gate at outfall MWR205. These opportunities are discussed below.

2.1 Somerville Marginal Facility Influent Gate Operation

MWRA investigated the benefits of adjusting the operation of the Somerville Marginal Facility influent gates. The gates were originally set to close at the end of a storm when the upstream water surface elevation reached elevation 105.5 ft. The model was used to evaluate the potential benefits of raising the elevation at which the gates closed to maximize in-system storage and minimize flow into the facility. Closing the gate at a higher elevation essentially would stop flow into the facility sooner, shortening the duration of discharge. After several iterations, it was found that closing the gates at elevation 106.5 (approximately 4 feet of combined flow in the influent chamber) maximized in-system storage without causing negative impacts upstream.

The MWRA's model was used to estimate the benefits of adjusting the gate operation in reducing CSO at outfall MWR205 and SOM007A/MWR205A. Table 2-1 shows the LTCP goals along with the predicted CSO activation frequency and volume for the Typical Year with mid-2020 system conditions with the gates closing at elevation 105.5 ft., and mid-2020 system conditions with gates closing at elevation 106.5 ft. As indicated in Table 2-1, raising the elevation at which the gates closed at the end of a storm was predicted to decrease the annual volume at outfall MWR205 from 109.28 to 101.74 MG. The volume at outfall SOM007A/MWR205A was predicted to increase slightly (0.07 MG), which is attributed to the margin of error expected in a hydraulic model of this type. The activation frequencies at outfalls MWR205 and SOM007A/MWR205A were not predicted to change. As a result of these findings, MWRA implemented the change in operating procedure for the Somerville Marginal Facility influent gates, and that change was incorporated into the model.

Table 2-1 Comparison of Alternative Influent Gate Operation for 2019 Conditions Typical Year

Outfall	Mid-2020 System Conditions With Gate Close at el. 105.5 (1)		Mid-2020 System Conditions With Gate Close at el. 106.5 (1)		Long Term Control Plan	
	Activation Frequency	Volume (MG)	Activation Frequency	Volume (MG)	Activation Frequency	Volume (MG)
Upper Mystic River						
SOM007A/MWR205A	6	4.84	6	4.91	3	3.48
Mystic/Chelsea Confluence						
MWR205 (Somerville Marginal Facility)	30	109.28	30	101.74	39	60.58

1. Grey shading indicates model prediction is greater than LTCP value.

2.2 Repair of Tide Gate at Outfall MWR205

MWRA had identified that the tide gate located at the end of Outfall MWR205 was leaking, allowing water to enter the outfall pipe and potentially reducing available storage in the outfall pipe during periods of higher tide. MWRA used the hydraulic model to assess the impact of the leaking tide gate and to estimate the effect of repairing the leaking tide gate in reducing CSO at outfalls MWR205 and SOM007A/MWR205A. Table 2-2 shows the LTCP goals along with the predicted CSO activation frequency and volume for the Typical Year with mid-2020 system conditions for the baseline condition and with the tide gate repaired. As indicated in Table 2-2, repairing the tide gate was not predicted to change the activation frequency at outfall MWR205 or SOM007A/MWR205A, but was predicted to slightly decrease the discharge volume in the Typical Year (0.46 MG at MWR205 and 0.34 MG at SOM007A/MWR205A).

Table 2-2. Comparison of Mid-2020 Typical Year Results to Mid-2020 Typical Year Results with Tide Gate Repaired

Outfall	Mid-2020 System Conditions [1]		Mid-2020 System Conditions With Tide Gate Repaired [1]		Long Term Control Plan	
	Activation Frequency	Volume (MG)	Activation Frequency	Volume (MG)	Activation Frequency	Volume (MG)
Upper Mystic River						
SOM007A/MWR205A	6	4.91	6	4.57	3	3.48
Mystic/Chelsea Confluence						
MWR205 (Somerville Marginal Facility)	30	101.74	30	101.28	39	60.58

1. Grey shading indicates model prediction is greater than LTCP value.

This finding showed that the leaking tide gate was having a minor impact on CSO discharges at SOM007A/MWR205A. In accordance with maintenance requirements of its NPDES permit, MWRA performed a detailed inspection and assessment of the gate condition and commenced design services to replace the tide gate. MWRA awarded the construction contract to replace the gate in the MWR205 outfall in July 2021 and the work is scheduled to be completed in the summer of 2022.

3. Model Updates Associated with the Ten Hills and I-93 Stormwater Areas

Two separate stormwater areas that are currently tributary to a 72-inch combined sewer upstream of the Somerville-Marginal CSO Facility were identified as candidates for relocation: an area in the Ten Hills neighborhood, and a portion of the elevated I-93 drainage system. Figure 3-1 shows the modeled representation of the piping in the vicinity of the Somerville Marginal CSO Facility, and the relative locations of the Ten Hills and I-93 drainage areas.

In the fall of 2020, MWRA installed a flow meter at the downstream end of the Ten Hills drainage system to better quantify the stormwater from this area that is tributary to Somerville Marginal CSO Facility (Figure 3-1). Additional information provided by the City of Somerville was incorporated into the model to refine the delineations of the Ten Hills and I-93 drainage areas, and pipe lengths and headloss coefficients were also refined to better represent system conditions. MWRA conducted water quality sampling of the Ten Hills flow during dry and wet weather and found no evidence of potential illicit connections to the storm drain.

3.1 Model Updates Based on Meter Data

Meter data for the period November 6, 2020 through December 4, 2020 were compared to the modeled flows from that area in the mid-2020 conditions version of MWRA's model. As indicated in Figure 3-2, the model of the Ten Hills area was overpredicting the observed flow. A review the model found issues with the configuration of the hydrology parameters, causing the predicted flows to be too high. The model was updated and the Ten Hills area was calibrated to match the meter data as shown in Figure 3-3.

Following the recalibration of the Ten Hills area, three subcatchments were added to the model to represent the I-93 and Mystic Avenue drainage areas. These areas had originally been represented as a part of larger subcatchments in the MWRA's model but needed to be isolated in order to assess the impact of potentially re-routing this drainage. The original 38.7 acres of tributary area was subdivided into 15.3 acres for Ten Hills, 6.8 acres for the I-93 tributary stormwater, and 16.6 acres of additional drainage area from Mystic Avenue. These changes did not affect the calibration of the drainage from the Ten Hills area.

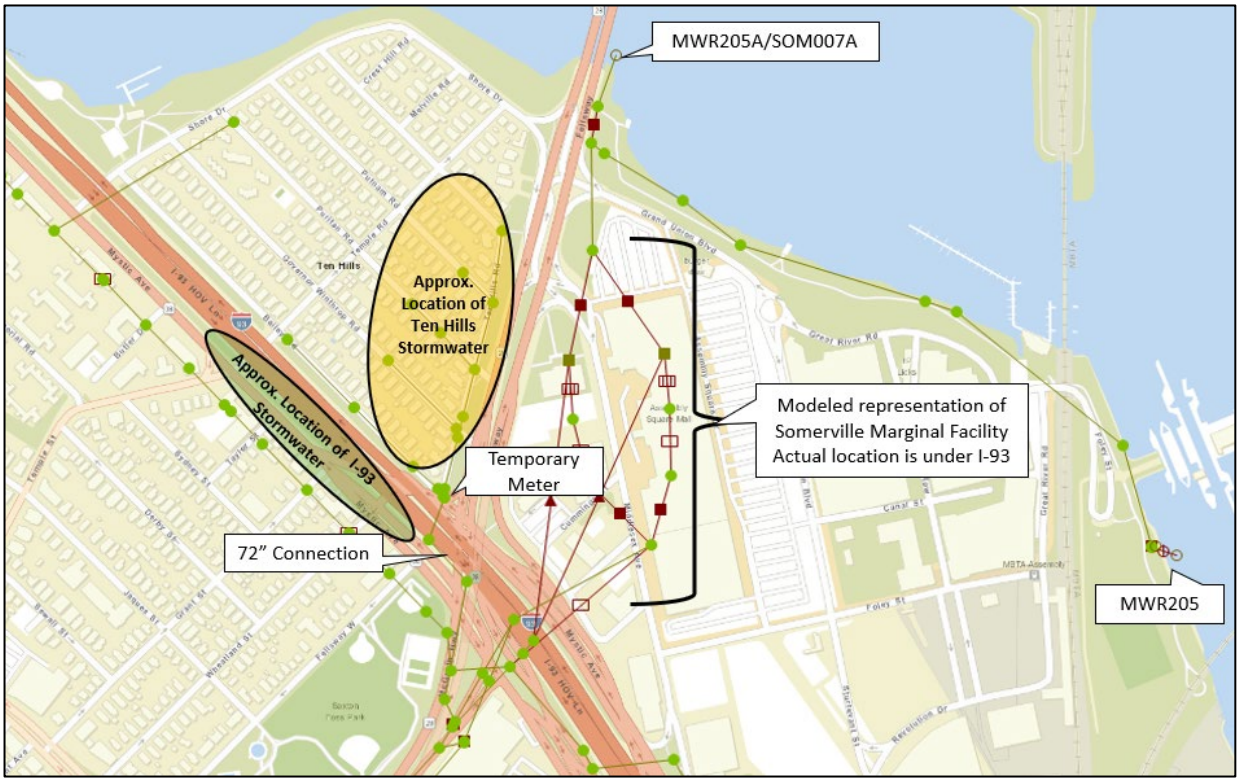

Figure 3-1. Stormwater Tributary to Somerville-Marginal CSO Facility

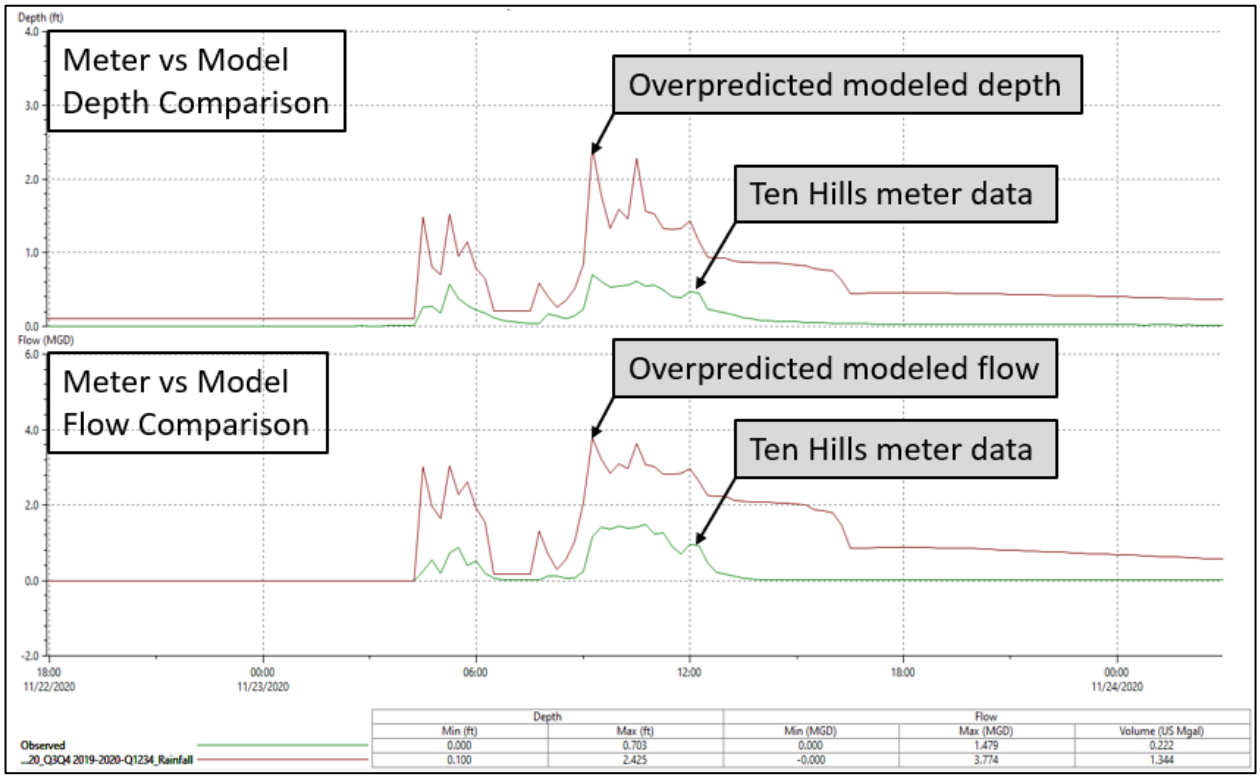

Figure 3-2. Ten Hills Meter vs Model Results Before Recalibration

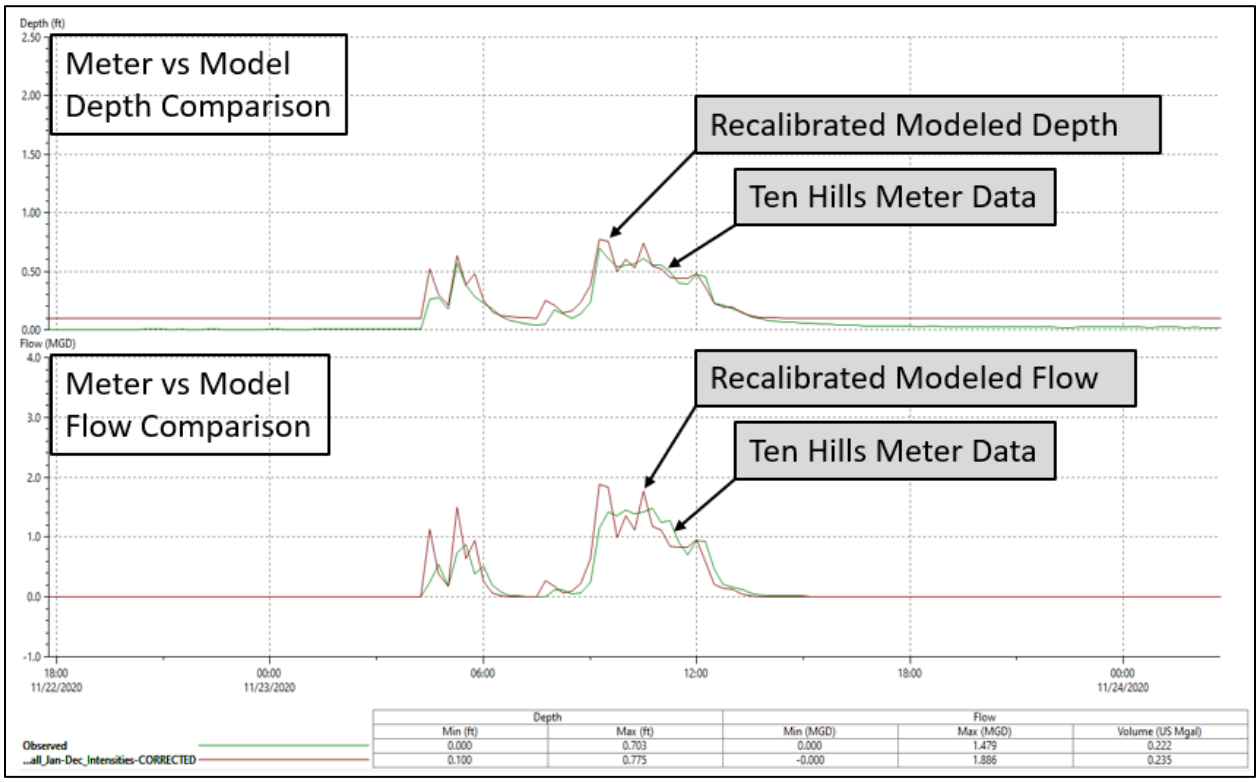

Figure 3-3. Recalibrated Ten Hills Meter vs Model Results

Since the calibration of the Ten Hills area resulted in a reduction in the modeled stormwater flows from that area, it was possible that the calibration at the Somerville Marginal Facility could have been affected. As a check, the Ten Hills calibration was incorporated into the 2019-conditions model, and this version was compared to the 2019 meter data. The results indicated that the Ten Hills calibration caused the modeled overflow volume at the Somerville Marginal Facility to drop approximately 10 MG below the metered volume, but did not affect the activation frequency. To increase overflow volume without increasing the activation frequency, the impervious area upstream of regulator RE072A was increased and the MWRA's model was updated based on Somerville's model pipe characteristics in this area. Updates included matching dry weather flow pipe lengths, roughness, and the addition of 90-degree bend losses in the RE072A and RE071A area. With these changes implemented and increasing the upstream impervious area by 4 percent, the updated model returned to closely matching the 2019 meter data. Table 3-1 presents a comparison of the 2019 meter data, the 2019-conditions model results from Semiannual Report No. 4 (prior to the Ten Hills area updates), and 2019-conditions model with the Ten Hills updates and recalibration.

Table 3-1. Comparison of 2019 Meter Data to 2019 SAR4 Model Results and Recalibrated Ten Hills 2019 Model Results

Outfall	January – December 2019					
	2019 Meter Data		2019 System without Ten Hills Recalibration (from SAR 4)		2019 Conditions with Ten Hills Recalibration	
	Activation Frequency	Volume (MG)	Activation Frequency	Volume (MG)	Activation Frequency	Volume (MG)
Upper Mystic River						
SOM007A/MWR205A	12	N/A	8	14.52	9	15.07
Mystic/Chelsea Confluence						
MWR205 (Somerville Marginal Facility)	27	96.41	26	98.89	28	98.07
Upper Inner Harbor						
MWR 203 (Prison Point)	17	276.63	15	260.96	17	271.85

The model changes implemented as part of the Ten Hills recalibration were incorporated into the MWRA's mid-2020 conditions model and subsequent configurations.

3.2 Summary of Baseline Conditions in comparison to LTCP targets

Baseline conditions for the alternatives analysis presented below in Section 4 was the Q1-2021 model as presented in Semiannual Report No. 6. Typical Year performance under Q1-2021 conditions and the LTCP goals for the two outfalls downstream of the Somerville Marginal Facility, along with the Prison Point Facility, is presented in Table 3-2. As indicated in Table 3-2, the Somerville Marginal CSO Facility (outfall MWR205) was 40 MG over the LTCP goal for volume, but was 9 activations under the LTCP goal.

3.3 Factors Contributing to CSO Discharges at Somerville-Marginal

Multiple factors contribute to the combined sewer overflows at the Somerville Marginal CSO Facility:

1. Capacity of the existing dry weather flow connections from regulators RE071A and RE072A.
2. Capacity of the Somerville-Medford Branch Sewer
3. Combined and stormwater flows from the 72-inch combined sewer and 42-inch storm drains entering downstream of regulators RE071A and RE072A.

Table 3-2. Comparison of Q1-2021 Typical Year Reults to LTCP Goals

Outfall	Q1-2021 System Conditions (1)		LTCP	
	Activation Frequency	Volume (MG)	Activation Frequency	Volume (MG)
Upper Mystic River				
SOM007A/MWR205A	5	4.50	3	3.48
Mystic/Chelsea Confluence				
MWR205 (Somerville Marginal Facility)	30	100.58	39	60.58
Upper Inner Harbor				
MWR 203 (Prison Point)	17	253.66	17	243

(1) Grey shading indicates model prediction is greater than LTCP value.

Figure 3-4 shows the path of the profiles from DeLauri Pump Station through the regulators upstream of the Somerville Marginal Facility that are presented in Figure 3-5 and Figure 3-6. Figure 3-5 presents the peak hydraulic grade line along the route shown in Figure 3-4 for the largest storm in the Typical Year (October 23, 1992). As indicated in Figure 3-5, the peak hydraulic grade line in the Somerville-Medford Branch Sewer was within nearly 7 feet of grade indicating that limited capacity was available in the interceptor to convey additional wet weather flow. Figure 3-6 shows the peak hydraulic grade line for a smaller storm in the Typical Year (January 14, 1992) that still resulted in an activation of the Somerville Marginal Facility. As indicated in this figure, the model predicted that the facility activated resulting in treated CSO discharge because the dry weather flow connection was acting as a restriction. Although the interceptor was surcharged, capacity was still available in the interceptor because the hydraulic grade line was substantially more than 7 feet below grade. These results indicated that it would be possible to potentially reduce the activation frequency and volume at the Somerville Marginal CSO Facility by increasing flow to the interceptor for smaller storms. However, for larger storm events where the interceptor was at full capacity, a control structure would likely be necessary to mitigate adverse impacts to the hydraulic grade line. This understanding helped to shape the development of alternatives presented below in Section 4.

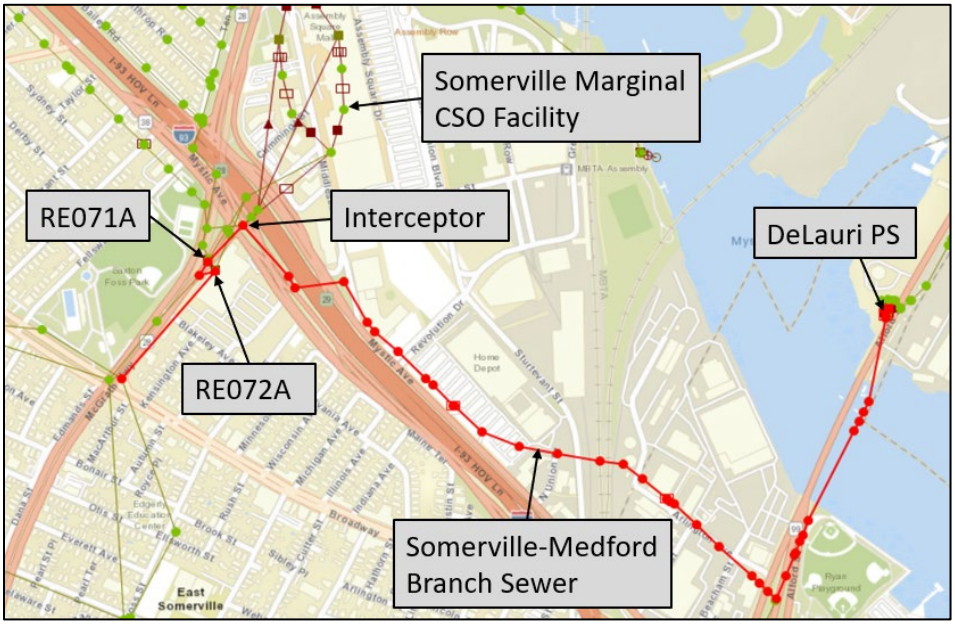

Figure 3-4. Alignment of Somerville Marginal CSO Event Profiles

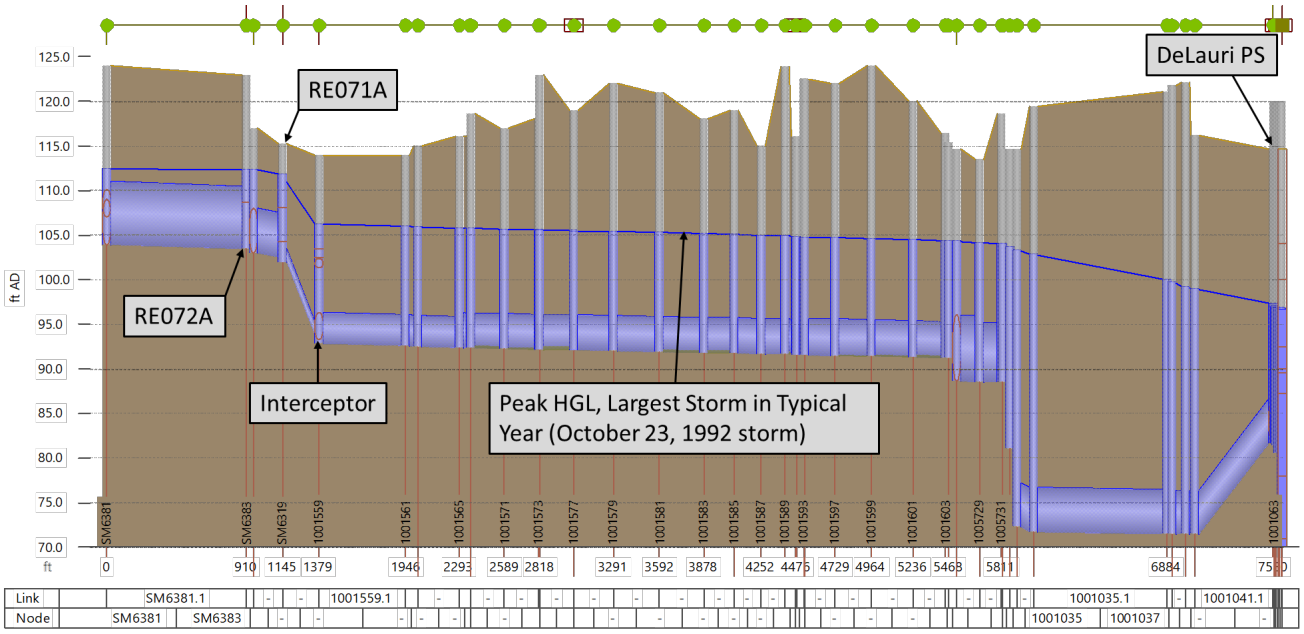

Figure 3-5. Somerville Marginal Facility Activation on 10/23/1992

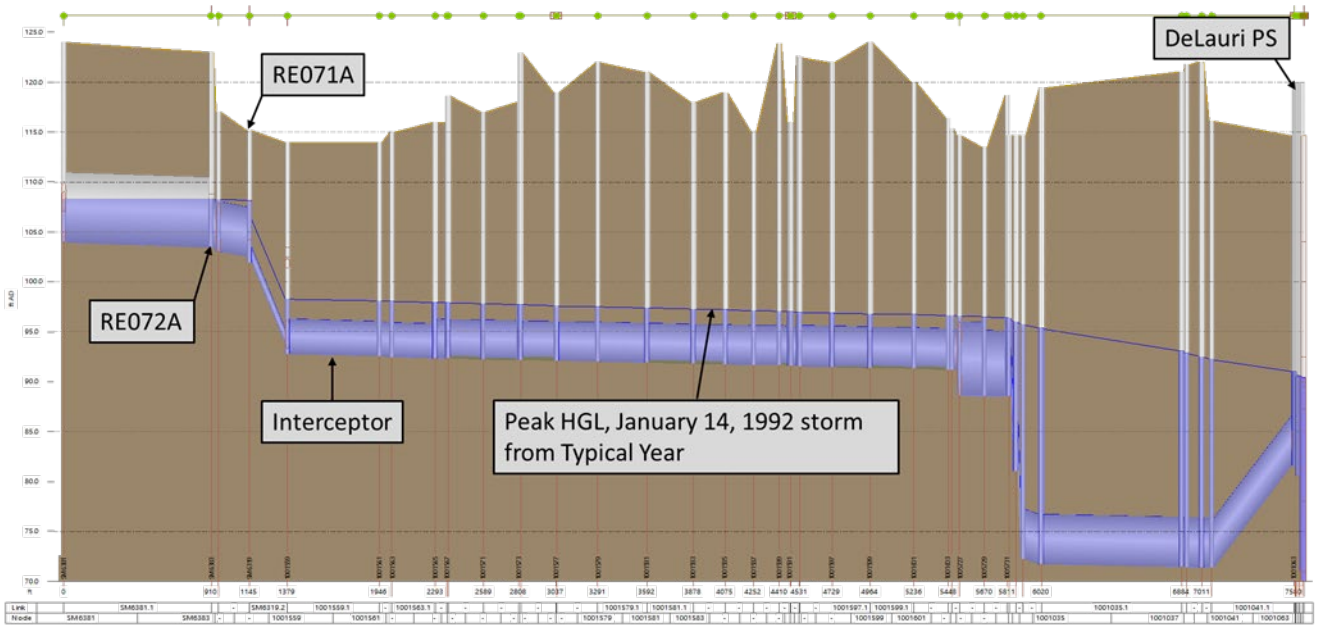

Figure 3-6. Somerville Marginal Facility Activation on 1/14/1992

4. Alternative Evaluations

4.1 Removing Ten Hills/I-93 Catchment Areas from the Area Tributary to the Somerville Marginal CSO Facility

Two separate stormwater areas that are currently tributary to the 72-inch combined sewer upstream of the Somerville Marginal CSO Facility were identified as candidates for relocation either to a new storm drain outfall or to the existing outfall conduit downstream the Somerville Marginal Facility: an area in the Ten Hills neighborhood, and a portion of the elevated I-93 drainage system. Figure 3-1 above shows the modeled representation of the piping in the vicinity of the Somerville Marginal CSO Facility, and the relative locations of the Ten Hills and I-93 drainage areas.

Following MWRA's metering of the Ten Hills area and the model refinements to match the meter data, the Q1-2021 model was used to evaluate the diversion of the Ten Hills and I-93/Mystic Ave drainage areas to a new stormwater outfall, effectively removing the stormwater from the Somerville Marginal CSO Facility tributary area. Table 4-1 presents a comparison of the run with the Ten Hills and I-93 drainage removed to the Q1-2021 conditions and the LTCP goals. As indicated in Table 4-1, removal of the stormwater was predicted to reduce the volume at outfall MWR205 by about 7 MG, with no change to the activation frequency. This alternative was also predicted to reduce the volume at the Prison Point CSO Facility by about 6 MG, with no change to the activation frequency. The impact on Prison Point was due to the hydraulic connectivity between the Somerville-Medford Branch Sewer, the Cambridge Branch Sewer, and the Prison Point Facility (see Figure 1-1 above). These modest reductions in volume were not sufficient to bring the Somerville Marginal Facility into attainment with the LTCP goal for volume. Given that the Somerville Marginal Facility provides disinfection of CSO discharges at MWR205 and SOM007A/MWR205A, bypassing stormwater around the facility would also increase the stormwater bacterial load to the receiving waters. Since other alternatives were subsequently identified that provided better performance at the Somerville Marginal Facility (see sections below) without creating an increased bacterial load to the receiving water, the alternative to divert the upstream stormwater was not recommended for further evaluation.

Table 4-1. Comparison of 2021 Q1 Typical Year Results to Alternatives with Removal of Ten Hills and I-93 Stormwater

Outfall	Q1-2021 System Conditions (1)		Q1-2021 System Conditions With Ten Hills & I-93 Removed (1)		Long Term Control Plan	
	Activation Frequency	Volume (MG)	Activation Frequency	Volume (MG)	Activation Frequency	Volume (MG)
Upper Mystic River						
SOM007A/MWR205A	5	4.50	5	4.17	3	3.48
Mystic/Chelsea Confluence						
MWR205 (Somerville Marginal Facility)	30	100.58	30	93.61	39	60.58
Upper Inner Harbor						
MWR203 (Prison Point)	17	253.66	17	247.81	17	243
Total		358.74		345.59		307.06
Net Reduction				-13.15		

(1) Grey shading indicates model prediction is greater than LTCP value.

4.2 Increasing the Existing 18-inch Interceptor Connection to 24-inch

MWRA conducted an evaluation to assess the benefit of increasing the capacity of the existing connection to the Somerville-Medford Branch Sewer upstream of the Somerville Marginal Facility. The existing connection is an 18-inch diameter pipe. The MWRA's model was used to estimate the benefits of increasing the size of the connection to 24-inch diameter, in terms of reducing CSO to move closer towards the LTCP levels of control at outfalls MWR205 and SOM007A/MWR205A. Table 4-2 shows the LTCP goals along with the predicted CSO activation frequency and volume for the Typical Year with Q1-2021 system conditions and with the size of the connection increased to 24 inches. As indicated in Table

4-2, increasing the size of the connection to the Somerville-Medford Branch Sewer was predicted to reduce the annual activations at outfall MWR205 from 30 to 24, and reduce the volume from 100.58 to 70.06 MG. At outfall MWR205A/SOM007A, this alternative was predicted to reduce the activation frequency from 5 to 3, and the volume from 4.50 to 3.44 MG. Therefore, with this alternative, outfall MWR205A/SOM007A would meet the LTCP goals for activations and volume. Outfall MWR205 would be well below the LTCP goal for activation, but the volume would still be over the target by about 9.5 MG.

Table 4-2. Comparison of Q1-2021 Typical Year Results to Q1-2021 Typical Year Results with Connection Increased to 24-inches

Outfall	Q1-2021 System Conditions [1]		Q1-2021 System Conditions with DWF Connection Increased to 24-in.[1]		Q1-2021 System Conditions with DWF Connection Increased to 24-in. &Ten Hills & I-93 Removed[1]		Long Term Control Plan	
	Activation Frequency	Volume (MG)	Activation Frequency	Volume (MG)	Activation Frequency	Volume (MG)	Activation Frequency	Volume (MG)
Upper Mystic River								
SOM007A/MWR205A	5	4.50	3	3.44	3	3.13	3	3.48
Mystic/Chelsea Confluence								
MWR205 (Somerville Marginal Facility)	30	100.58	24	70.06	24	65.42	39	60.58
Upper Inner Harbor								
MWR203 (Prison Point)	17	253.66	17	264.36	17	266.45	17	243
Total		358.74		345.59		335		307.06
Net Reduction				-13.15		-23.74		

(1) Grey shading indicates model prediction is greater than LTCP value.

However, Table 4-2 also indicates that as a result of increasing the dry weather flow connection, the treated volume at Prison Point was predicted to increase by about 11 MG. This predicted increase was due to the hydraulic connectivity between Prison Point and the interceptor network downstream of the Somerville-Medford Branch Sewer (see Figure 1-1 above). The 24-inch connection alternative was then evaluated in conjunction with the removal of the Ten Hills and I-93 drainage, to see if removal of the drainage would mitigate the increase in volume at the Prison Point Facility. As indicated in Table 4-2, this alternative was predicted to further reduce the volume at the Somerville Marginal Facility by about 5 MG, but did not reduce the volume at the Prison Point Facility.

The alternative to increase the size of the interceptor connection to 24-inch diameter was also predicted to cause adverse impacts on the peak hydraulic grade line in the Somerville-Medford Branch Sewer in larger storms, with or without the diversion of the Ten Hills and I-93 drainage. This alternative was therefore not recommended for further evaluation. However, an alternative and more effective approach to increasing the flow to the interceptor by adding a new interceptor connection was subsequently identified, as described in the section below.

4.3 Adding a New Interceptor Connection

The model was used to evaluate an alternative that involved construction of a new interceptor connection between the influent conduit to Somerville Marginal CSO Facility downstream of the RE-072 regulator weirs and the Somerville-Medford Branch Sewer. This connection would supplement the hydraulic capacity of the existing 18-inch connection. This connection would allow combined flow which enters the facility influent conduit downstream of the weirs to drain directly to the interceptor. Currently, that combined flow has to fill up the influent conduits and back up over the regulator weirs in order to reach the interceptor. The new connection would also supplement the capacity of the existing 18-inch connection from RE-071 to take advantage of available capacity in the Somerville-Medford Branch sewer under some storm events. Two options were identified, as shown schematically in Figure 4-1.

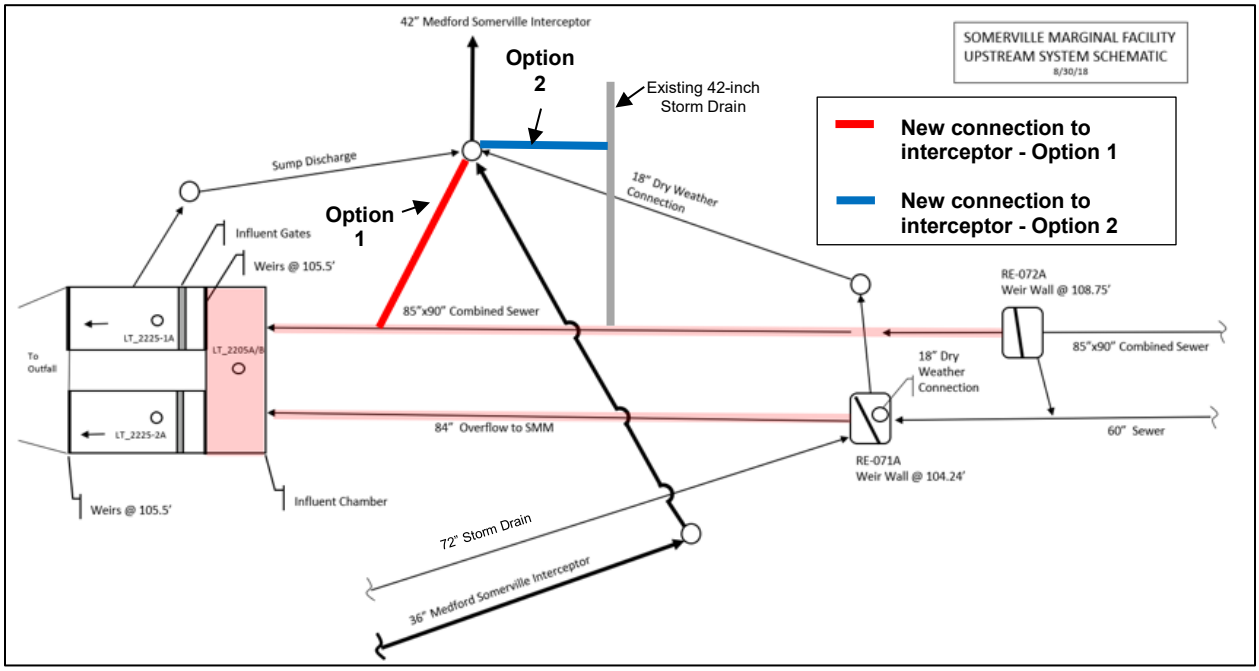

Figure 4-1. Somerville Marginal CSO Facility Upstream System Schematic

4.3.1 Option 1: New Connection from the 85 x 90-inch Influent Combined Sewer to the Somerville-Medford Branch Sewer.

Option 1 was modeled as a 36-inch piped connection between the 85 x 90-inch influent combined sewer and an existing manhole on the 42-inch Somerville-Medford Branch Sewer. After running several model simulations, the same issues were encountered as were found for the original alternative of upsizing the existing interceptor connection: too much flow was getting into the 42-inch interceptor during larger storms, increasing the discharge volume at Prison Point and causing adverse HGL impacts along the Somerville-Medford Branch Sewer. To address these issues, a gate was added to the connection that could be throttled based on level measured at multiple locations. Three control points were added in the model to control when the gate is opened and closed to maximize the reduction of activation frequency and volume at the Somerville Marginal CSO Facility without having negative impacts in other parts of the system. The gate would be used to control the flow going to the 42-inch interceptor during certain storm events. The gate would be controlled based on set points at the following three locations:

- Interceptor at connection location: Gate closes at elevation 105.0 and opens at elevation 102.0
- Upstream Critical Low Point: Gate closes at elevation 108.5 and opens at elevation 107.5
- Prison Point influent: Gate closes at elevation 103.0 and opens at elevation 100.0

The proposed locations of the control points are shown in Figure 4-2 below. Level sensors would need to be installed at the interceptor and at the upstream critical location as part of this project. The Prison Point influent sensor is an existing sensor which would have to be incorporated into the gate controls. Table 4-3 presents the CSO discharge activation frequency and volume for the Typical Year for the baseline condition, Option 1 and the two variations of Option 2 (described further below). The baseline condition in Table 4-3 is the MWRA's Q1-2021 Conditions model. Compared to the baseline condition, the discharges at outfall MWR205 are predicted to drop from 30 activations with 100.58 MG for the baseline to 18 activations and 62.85 MG for Option 1. Option 1 would result in an increase of 9.43 MG in discharge volume at the Prison Point CSO Facility, resulting in a net reduction in discharge from the system of 29 MG.

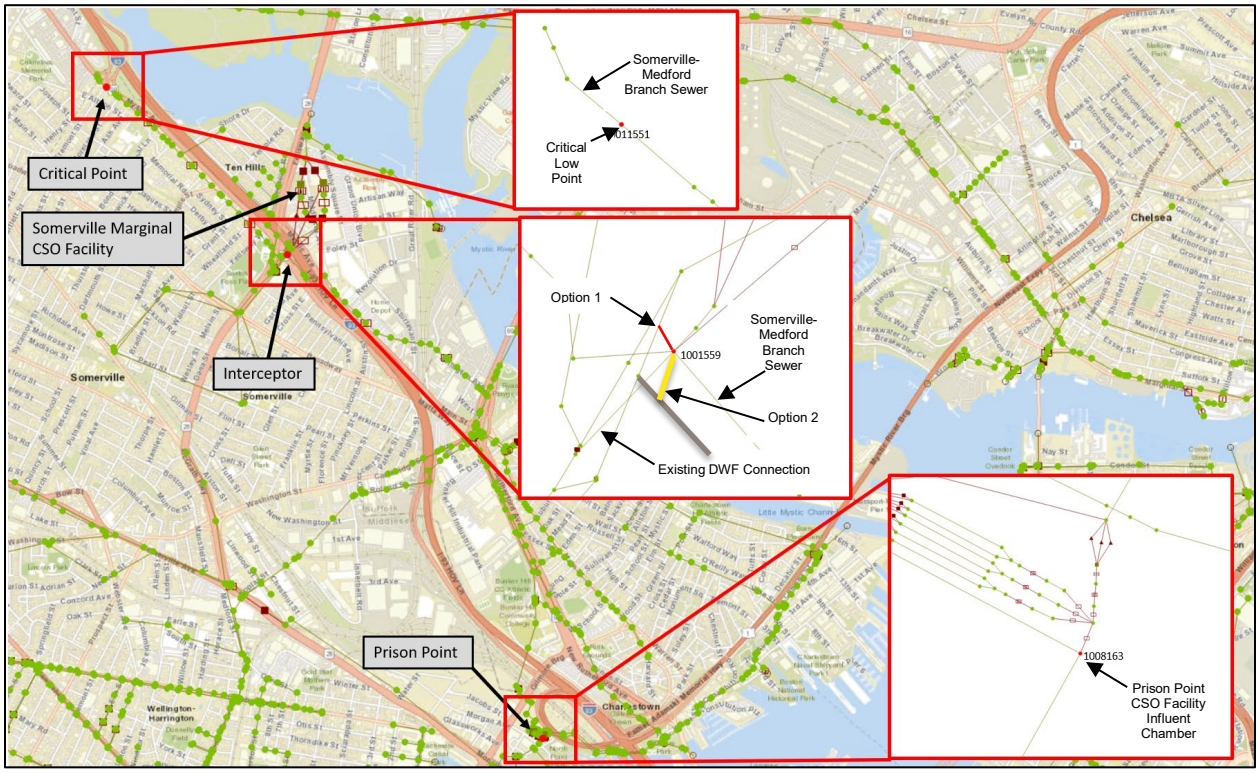

Figure 4-2. Proposed Gate Control Point Locations

Table 4-3. Results for Alternatives at Somerville Marginal

Outfall	Baseline (Q1-2021 Conditions)		Option 1		Option 2 – 36-inch gate		Option 2 – 42-inch gate		Long Term CSO Control Plan	
	Activation Frequency (1)	Volume (MG) (1)	Activation Frequency(1)	Volume (MG) (1)	Activation Frequency(1)	Volume (MG) (1)	Activation Frequency(1)	Volume (MG) (1)	Activation Frequency	Volume (MG)
SOM007A/ MWR205A	5	4.50	3	3.65	3	3.59	3	3.63	3	3.48
MWR205 (Somerville Marginal Facility)	30	100.58	18	62.85	17	63.34	17	62.43	39	60.58
BOS017	6	0.34	4	0.45	4	0.45	4	0.45	1	0.02
MWR203 (Prison Point)	17	253.66	17	263.09	17	262.55	17	263.60	17	243
Total		359.08		330.04		329.93		330.10		307.08
Net Reduction				-29.04		-29.15		-28.98		

Notes:

(1) Grey shading indicates model prediction is greater than LTCP value.

The impact of Option 1 on the peak hydraulic grade line in the interceptor and upstream pipe network was initially checked by screening for locations where the hydraulic grade line was predicted to increase by more than 3 inches at any model node where the HGL was within 7 feet of grade in the Typical Year, or by more than 6 inches at any model node where the HGL was within 7 feet of grade in the 5-year storm. Neither of these two conditions were observed in the model for Option 1. The peak hydraulic grade line along the portion of the Somerville-Medford Branch Sewer affected by the increased flow was then plotted for baseline conditions (Q1-2021 Conditions) in comparison to Option 1 for the Typical Year and for the 5-year storm. Figure 4-3 shows the location plan of the interceptor profile in red.

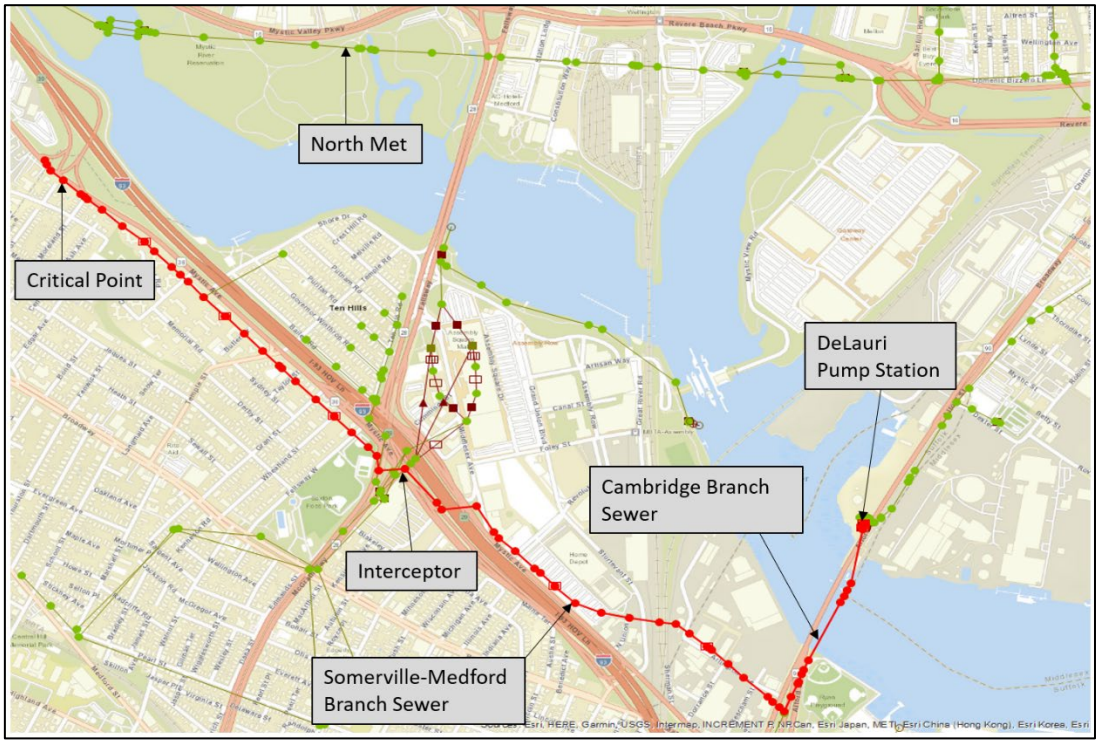

Figure 4-3. Locations of Somerville-Medford Branch Sewer Peak HGL Profiles

Figure 4-4 shows the peak hydraulic grade line profile for the baseline and Option 1 for the Typical Year. This plot indicates that the peak hydraulic grade line in the interceptor in the Typical Year is not predicted to be affected by Option 1 because of the operation of the gate.

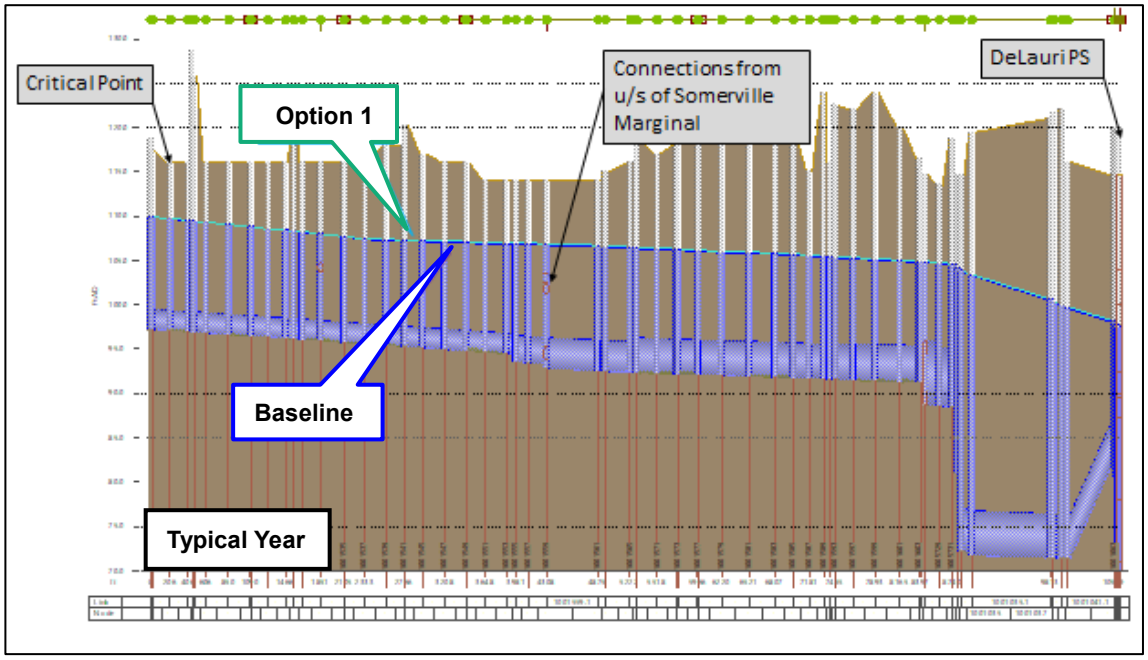

Figure 4-4. Somerville-Medford Branch Sewer Typical Year Peak HGL Profile, Option 1 vs Baseline Conditions

Figure 4-5 shows the peak hydraulic grade line profile for the Baseline and Option 1 for the 5-year storm for the portion of the Somerville-Medford Branch Sewer affected by the increased flow. This plot indicates the peak hydraulic grade line in the 5-year storm is not predicted to be affected by Option 1 because of the operation of the gate. Flooding is predicted at the upstream critical point for the baseline condition, and similar flooding is predicted by the model with Option 1.

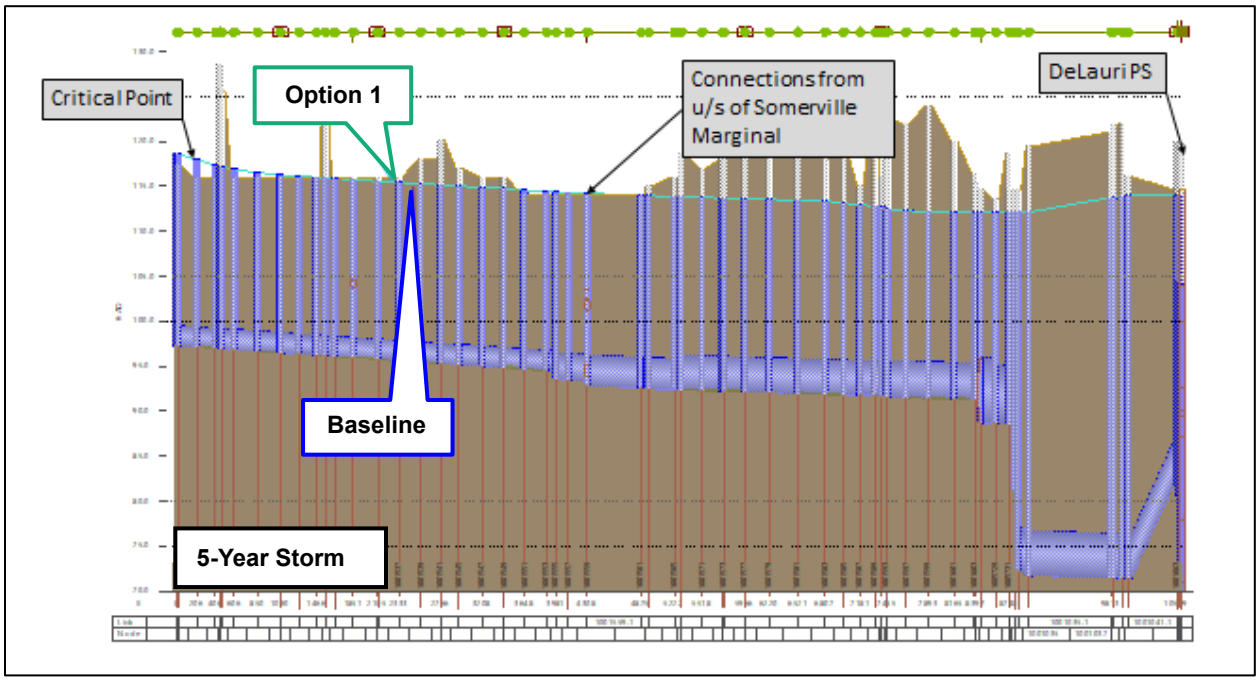

Figure 4-5. Somerville-Medford Branch Sewer 5-Year Peak HGL Profile, Option 1 vs Baseline Conditions

4.3.2 Option 2: New Connection from the 42-inch Storm Drain to the Somerville-Medford Branch Sewer

In discussions with the City of Somerville regarding the potential implementation of Option 1, it was noted that the bottom half of the 85 x 90-inch combined sewer that the Option 1 connection would tie into sits in a concrete cradle. Since the 36-inch connection for Option 1 would need to tie in at the invert of the 85 x 90-inch combined sewer, the presence of the concrete cradle would complicate the construction. It was suggested that an existing 42-inch storm drain that currently connects to the existing 85 x 90-inch combined sewer upstream of the proposed Option 1 connection could potentially be used to make the connection to the interceptor. The 42-inch storm drain had not been explicitly included in the MWRA's model, and the tributary area had been included in a larger stormwater subcatchment that was tributary to the 85 x 90-inch combined sewer downstream of regulator RE072A. In order to model this option, the 42-inch storm drain was added to the MWRA's model based on pipe lengths, inverts, and roughness factors from the City of Somerville's model. The area tributary to the 42-inch drain was redelineated from an approximately 40-acre subcatchment in MWRA's model entering the system downstream of regulator RE072A. The area tributary to the 42-inch storm drain was calculated to be 28.9 acres based on topography data, street mapping, and information from the City of Somerville's model (Figure 4-6). This area was subtracted from the previously mentioned 40-acre subcatchment in MWRA's model entering downstream of RE072A.

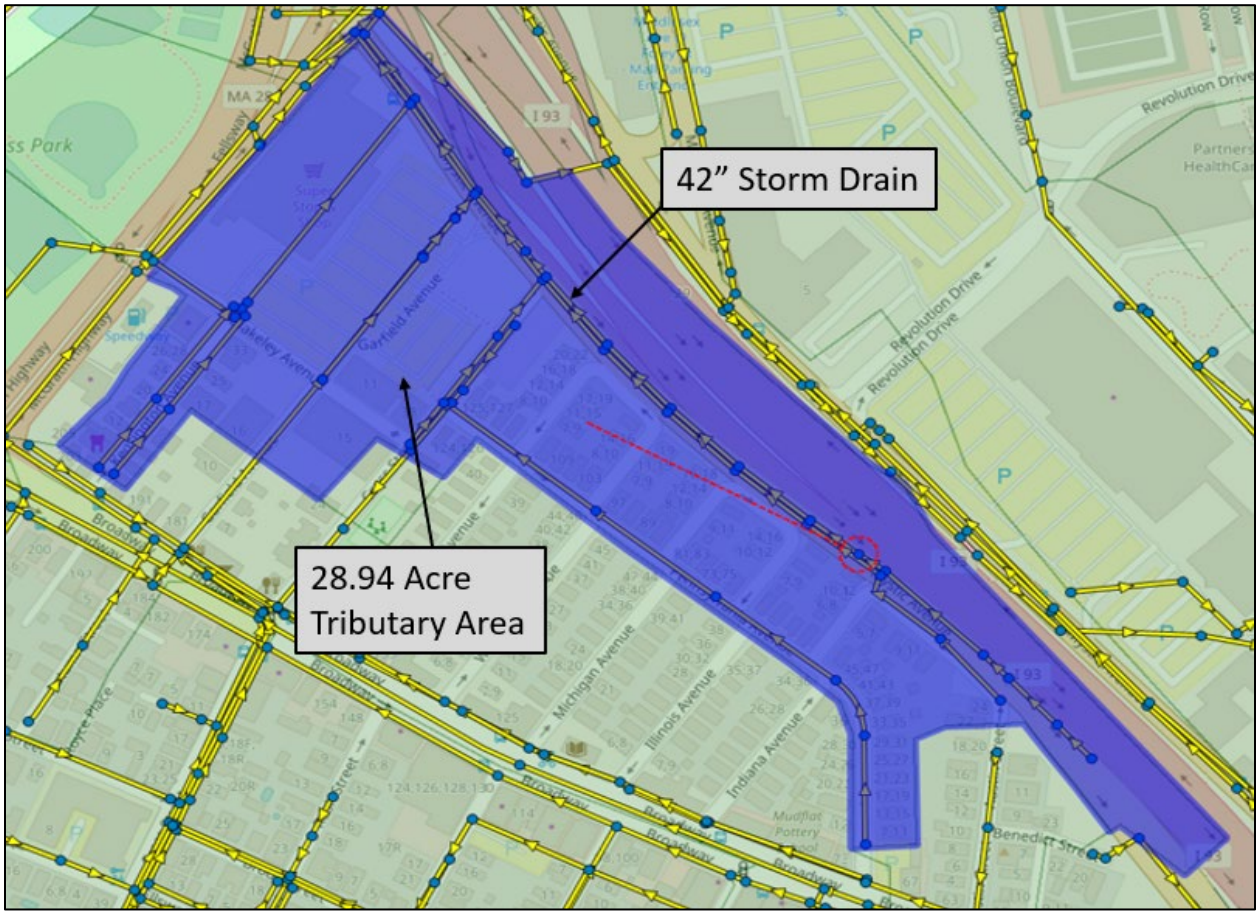

Figure 4-6. Area Tributary to 42-inch Drain

Option 2 was modeled as a connection between the existing 42-inch storm drain and a manhole on the 42-inch Somerville Medford Interceptor. Option 2 is shown schematically in Figure 4-7. Given the proximity of the 42-inch drain to the interceptor, the connection was modeled as a chamber with a 100 square foot area between the 42-inch storm drain and the interceptor. A gate within the chamber would control the flow going into the interceptor. The gate would be controlled based on the same sensors and set points as identified for Option 1. Two versions of the gate were modeled, one as a 36-inch diameter gate and the other as a 42-inch diameter gate. The results for both options are presented above in Table 4-3. The CSO volume at the Somerville Marginal Facility is predicted to be about 0.5 MG higher for the Option 2 version with a 36-inch gate compared to Option 1, while the volume at Prison Point is predicted to be about 0.5 MG lower. The 42-inch gate version of Option 2 is predicted to provide 0.4 MG less volume at the Somerville-Marginal CSO Facility compared to Option 1, while the volume at Prison Point is predicted to be about 0.5 MG higher.

Using the gate set points described earlier, the model was run for the Typical Year and 5-year storm events to assess impacts to the hydraulic grade line for the 42-inch gate version of Option 2. Figure 4-8 presents a profile for the baseline and the 42-inch gate version of Option 2 for the Typical Year for the portion of the Somerville-Medford Branch Sewer affected by the increased flow. This plot indicates the peak hydraulic grade line is not predicted to be affected by Option 2 with the 42-inch gate because of the operation of the gate.

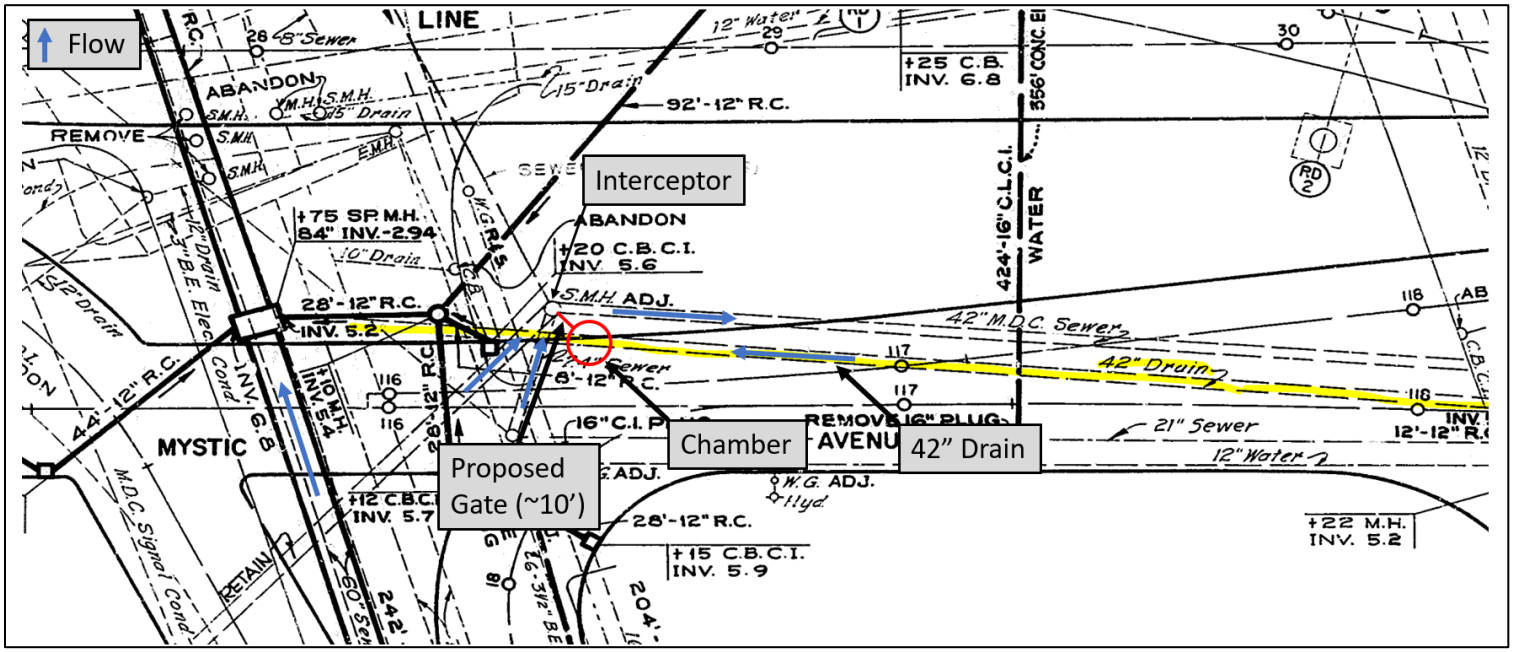

Figure 4-7. Proposed Option 2 Configuration

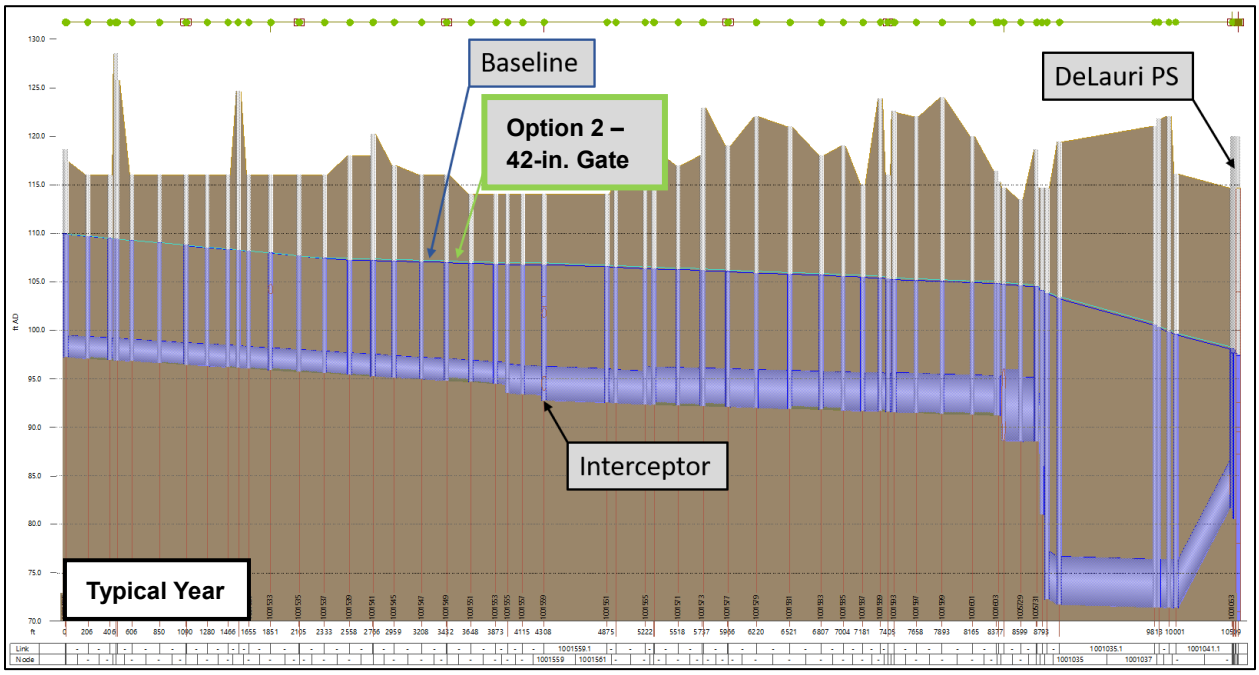

Figure 4-8. Somerville-Medford Branch Sewer Typical Year Peak HGL Profile, Option 2 vs Baseline Conditions

Figure 4-9 shows the peak hydraulic grade line profile for the baseline and Option 2 alternative with the 42-inch gate for the 5-year storm for the portion of the Somerville-Medford Branch Sewer affected by the increased flow. This plot indicates the peak hydraulic grade line is not predicted to be affected by Option 2 because of the operation of the gate. Flooding is predicted at the upstream critical point for the baseline condition, and similar flooding is predicted by the model with Option 2 with the 42-inch gate.

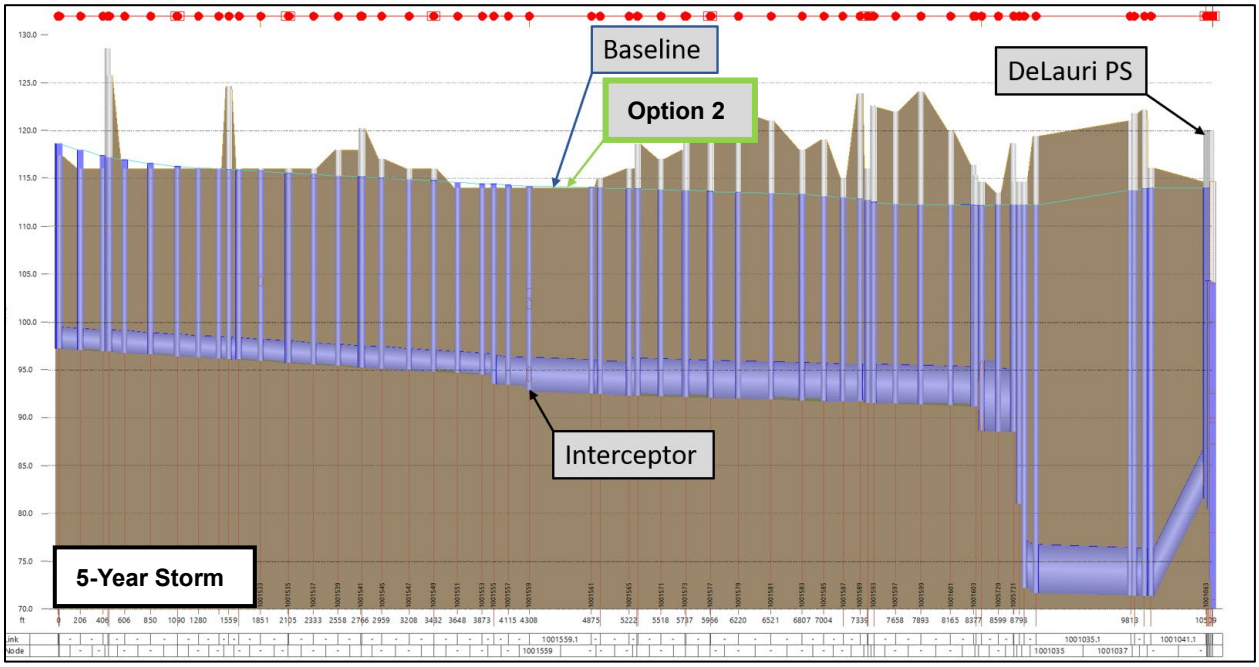

Figure 4-9. Somerville-Medford Branch Sewer 5-Year Peak HGL Profile, Option 1 vs Baseline Conditions

4.3.3 Poplar Street Pump Station

The City of Somerville expects to complete a large stormwater conduit along Somerville Avenue and Union Square and a related pumping station on Poplar Street over the next few years that will allow the City to remove large quantities of stormwater from its sewer system and subsequently MWRA's Cambridge Branch Sewer. The separated stormwater will be pumped into a storm drain recently constructed by the MBTA to serve portions of the Green Line Extension (GLX). The GLX drain conveys stormwater to the Charles River Basin via the Millers River. While this City of Somerville project is intended to lower the risk of flooding in the Union Square area and offset the impacts of major planned development projects, it will also reduce the wet weather burden on MWRA's Cambridge Branch Sewer, thereby reducing overflows to MWRA's Prison Point CSO facility and potentially reducing treated discharges at Prison Point. This potential outcome was consistent with preliminary modeling conducted using the MWRA's model to evaluate the potential benefit of the Poplar Street Pump Station.

5. Conclusions/Next Steps

The findings of the evaluations to reduce discharges at the Somerville Marginal CSO Facility are summarized as follows:

- **Near Term Improvements:** The MWRA has implemented a change in the operational procedure at the Somerville Marginal Facility and is proceeding with repairs to the tide gate at outfall MWR205. These near-term improvements are providing relatively small reductions in the discharge volume at the Somerville Marginal Facility.
- **Relocating Stormwater:** Relocating the Ten Hills and I-93 storm drain areas downstream of the facility was predicted to reduce the volume at outfall MWR205 by about 7 MG, with no change to the activation frequency. This alternative was also predicted to reduce the volume at the Prison Point CSO Facility by about 6 MG, with no change to the activation frequency. These modest reductions in volume were not sufficient to bring the Somerville Marginal Facility into attainment with the LTCP goal for volume. Given flows through Somerville Marginal CSO facility are disinfected, diverting stormwater flows around the facility, would also increase the stormwater bacterial load to the receiving waters. Since other alternatives were subsequently

identified that provided better performance at the Somerville Marginal Facility, the alternative to divert the upstream stormwater was not recommended for further evaluation.

- **Relieve Existing DWF Connection:** Increasing the size of the existing dry weather flow connection was predicted to provide a substantial reduction in the discharge volume at the Somerville Marginal CSO Facility, but was predicted to have adverse impacts on the hydraulic grade lines in the area. Since a more effective and constructible approach to increasing the flow to the interceptor by adding a new interceptor connection was subsequently identified, this alternative was not recommended for further evaluation.
- **New Connection Option 1:** This option consisted of adding a new connection with a control gate between the 85 x 90-inch influent line to the Somerville Marginal CSO Facility and the Somerville-Medford Branch Sewer. The control gate would limit flows to the interceptor during larger storm events, and would be controlled based on level set points monitored at three locations. This option was predicted to reduce the CSO volume at the Somerville Marginal Facility to within approximately 2 to 3 MG (3-5%) of the LTCP target. The difference between the predicted volume with this alternative and the LTCP target volume for the treated discharge from the Somerville Marginal Facility would be considered immaterial. The activation frequency would drop from 30 to 17 or 18, depending on the option implemented, well below the LTCP target of 39. This option would increase the treated discharge volume at Prison Point by approximately 9.5 MG, but the net change would be an overall substantial reduction (29 MG) in total CSO discharge. It is recommended that this option be evaluated further as part of preliminary design.
- **New Connection Option 2:** This option consisted of providing a connecting chamber between a 42-inch storm drain tributary to the 85 x 90-inch influent combined sewer and the interceptor, with either a 36-inch or 42-inch control gate. The performance of this option was similar to New Connection Option 1 described above. It is recommended that this option be evaluated further as part of preliminary design.
- **City of Somerville Drainage Improvements.** Further reductions in CSO activation frequency and volume are anticipated at the Somerville Marginal and/or Prison Point CSO Facilities as a result of drainage improvements being undertaken by the City of Somerville, including construction of the Poplar Street Pump Station.

Next Steps

The MWRA is currently moving forward with selection of Option 1 or 2 for the new interceptor connection depending on the viability of using the existing 42-inch storm drain and constructability, and will then prepare a detailed design for construction of the new connection and control gate.

Hazen Technical Memorandum

December 21, 2021

To: Meredith Norton, Program Manager, MWRA

From: Scott Bonett, PE, Associate Vice President
Sean McFee, PE, Associate
Laura Bobier, PE, Senior Associate

Re: Massachusetts Water Resources Authority
Technical Assistance Contract 7691, Task Order 10 Somerville Marginal CSO Facility New Pipe Connection Preliminary Design Assessment

90425-010

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1. Project Description and Background

The Massachusetts Water Resources Authority (MWRA) operates and maintains 227 miles of interceptor sewers ranging from 8-inches to 11-feet in diameter. The MWRA receives wastewater from 43 communities, including Boston, Cambridge, Chelsea, and Somerville, which have partially combined collection systems. The Somerville Marginal Combined Sewer Overflow (CSO) Facility is one of MWRA's four CSO treatment facilities. The Somerville Marginal CSO Facility discharges screened, chlorinated, and dechlorinated effluent through outfalls MWR205 (Mystic River) or SOM007/MWR205A (Upper Mystic River) when facility activations occur during high tides. The Somerville Marginal CSO Treatment Facility is located on Mystic Avenue underneath Route 93 and has a peak capacity of 245 million gallons per day (mgd).

Prior to recent hydraulic model updates and recalibration, model predictions (by AECOM) had indicated that the number of CSO activations in the Typical Year (annual average conditions) were in compliance with the MWRA's Long-Term Control Plan (LTCP) goals for outfall MWR205 and SOM007A/MWR205A. However, recent hydraulic model predictions of CSO discharge volume is greater than the LCTP goal. The results are summarized in Table 1-1.

Table 1-1: Typical Year Model Results (by AECOM)

Outfall	Scenario	Activation Frequency	Discharge Volume (MG)
MWR205	Q1-2021 System Conditions	30	100.58
	LTCP Goals	39	60.58
SOM007A/ MWR205A	Q1-2021 System Conditions	5	4.50
	LTCP Goals	3	3.48

As a result of this modeling analysis, MWRA identified two alternatives to reduce CSO volume at the Somerville Marginal CSO Treatment Facility. Both options involve constructing a relief connection from the City of Somerville's 85-inch x 90-inch (85x90) brick Somerville Marginal Interceptor to MWRA's Somerville Medford Branch Sewer (Section 35). A record drawing excerpt showing the existing utilities at the intersection of Mystic Avenue and McGrath Highway is presented in Figure 1-1.

Figure 1-1: Existing Utilities at Intersection of Mystic Avenue and McGrath Highway

The two alternatives are:

1. Direct connection from the 85x90-inch interceptor to an existing sewer manhole (SMH) on Section 35 of the Somerville Medford Branch Sewer.

2. Direct connection from a 42-inch storm drain to an existing SMH on Section 35 of the Somerville Medford Branch Sewer. The drain is an existing connection to the 85x90-inch interceptor.

AECOM, working under direction of the MWRA, performed hydraulic model simulations of both alternatives and concluded that the two options are hydraulically similar. This analysis also showed that both alternatives require the installation of a control gate to prevent flows during larger storm events from adversely impacting the downstream collection systems or the hydraulically connected Prison Point CSO facility. This evaluation compares the alternatives, presents several layout options, and summarizes the constructability, cost, access and maintainability of each option. A recommendation of the preferred alternative to move forward with into design is then provided.

2. Information Review

2.1 Available Documentation

Record and historical inspection information was reviewed to determine the existing conditions of the structures. The following documentation was reviewed:

- Contract No. 2116 Metropolitan Sewer Record Plan for Section 35 – Charlestown, Somerville, and Medford dated January 1896;

- Metropolitan District Commission Somerville Marginal Conduit and Pretreatment Facility drawings prepared by Charles A. Maguire and Associates dated August 1971;
- Marginal Combined Sewer Preliminary Design Evaluation for the City of Somerville prepared by Kleinfelder dated June 2015;
- CCTV inspection videos of the 85x90 brick combined sewer dated July 27, 2020; and
- Bid Documents for the Marginal Combined Sewer Rehabilitation Project for the City of Somerville prepared by Kleinfelder dated October 2021.

2.2 Site Visits

Hazen conducted two site visits, including one day of confined space entries, to obtain additional information and confirm the accuracy of the record drawings. The first site visit occurred on September 15, 2021. The covers of the three structures, the 85x90 brick sewer, SMH on Section 35 of the Somerville Medford Branch sewer, and the Somerville storm drain manhole (DMH), were opened and visually inspected from the ground surface. The locations of the access points are presented in Figure 2-1. No sediment was observed in the 85x90 combined brick sewer. The flow in the SMH on MWRA Section 35 was heavy with some swirling observed. The manhole cover for the DMH could not be completely removed, but no flow was observed.

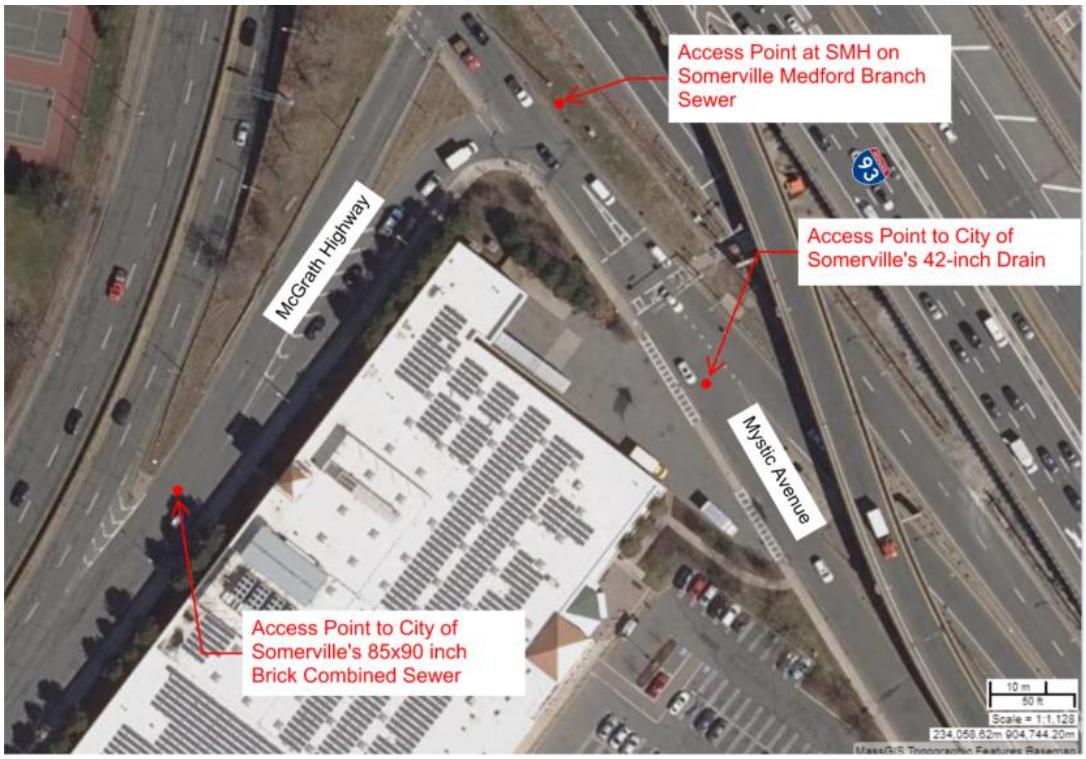


Figure 2-1: Access Points for Each Structure

Hazen performed confined space entries into the three structures on October 20, 2021. The 85x90 brick combined sewer was accessed via the manhole at Station 109+45. The pipe was in fair condition except for a large fracture at the crown, from which the second course of bricks is visible. This fracture appears to be the result of deformation in the pipe crown. If the pipe is not rehabilitated, the fracture may continue to increase in width, and the pipe would continue to deform. The pipe and manholes along this combined sewer will be rehabilitated by the City of Somerville; the project was recently bid and is under review by the City of Somerville. Construction is expected to be complete prior to the start of the relief connection construction being evaluated in this report.

The SMH on Section 35 of the Somerville Medford Branch Sewer, located in the grassy median off Mystic Avenue, was also entered. The structure was in good condition, but there was evidence of surcharging. As shown in Figure 2-2, rags and debris have accumulated on the ladder rungs.

Figure 2-2: Evidence of Surcharge Conditions in the Section 35 SMH

The available record information indicates that this manhole was originally constructed in January 1896 and is elliptical in shape. Measurements taken during the confined space entry indicate that the manhole riser is 4 feet in diameter indicating that at least the manhole riser was replaced at some point. It was difficult to determine the invert elevations of the pipes due to the manhole riser configuration and heavy flow, but the estimates made during the site visit correlate with the available record information. Thus, for the purpose of this evaluation herein, pipe invert information from the record drawings will be used. The inlet elevations are summarized in Table 2-1. The elevations in the table are in Metropolitan District Commission Base (MDC) datum.

Table 2-1: SMH Pipe Elevations

Pipe	Type	Elevation (ft)
12” Sump Pump Connection	Inlet	101.40
18” Dry Weather Connection	Inlet	93.89
36” Somerville Medford Branch Sewer	Inlet	93.31
42” Somerville Medford Branch Sewer	Outlet	92.77

There is a discrepancy between the available documentation on the diameter of the drain on Mystic Avenue. The drawings for the Somerville Marginal Conduit and Pretreatment Facilities project prepared by Charles A. Maguire and Associates dated August 1971 indicate the drain is 42 inches in diameter. The as bid design drawings for the Marginal Combined Sewers Rehabilitation Project prepared by Kleinfelder dated October 2021 indicate the drain is a 48-inch diameter reinforced concrete pipe. Measurements taken during the confined space entry confirm the drain is a 42-inch reinforced concrete pipe (RCP). The pipe is in good condition with no evidence of corrosion. Neither flow nor sediment were observed during the confined space entry.

3. Alternatives Analysis

Two alternatives were evaluated in this effort:

1. Direct connection from the 85x90-inch interceptor to an existing sewer manhole (SMH) on Section 35 of the Somerville Medford Branch Sewer.

2. Direct connection utilizing a 42-inch storm drain to an existing SMH on Section 35 of the Somerville Medford Branch Sewer. The drain is an existing connection to the 85x90-inch interceptor.

3.1 Alternative 1: 85x90 Somerville Marginal Interceptor to Somerville Medford Branch Sewer

The first alternative involves installing a relief connection directly from the 85x90 brick sewer. This connection would be made at the invert of the brick pipe at approximately Station 113+00 and connect to the sewer manhole located on Section 35 of the Somerville Medford Branch Sewer; this diversion of flow would reduce the CSO activations and volume at MWR205 and SOM007A/MWR205A. The new connection should be made at a 90-degree angle, requiring a gate structure. The construction of this alternative would involve installing a gate structure and approximately 36 linear feet of 36-inch pipe, 15 feet deep. The layout for this alternative is presented in Figure 3-1.

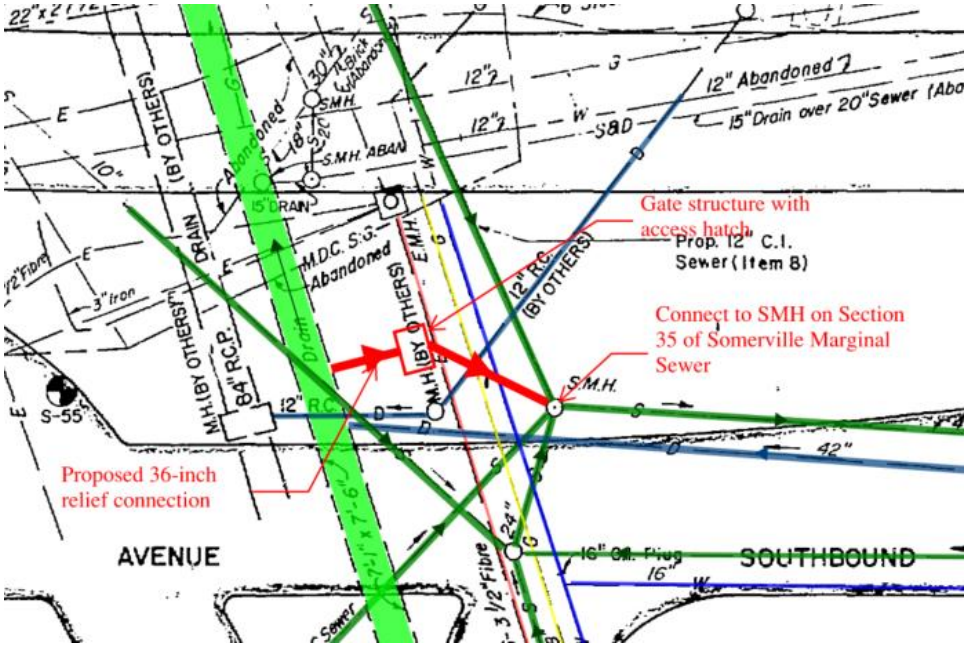
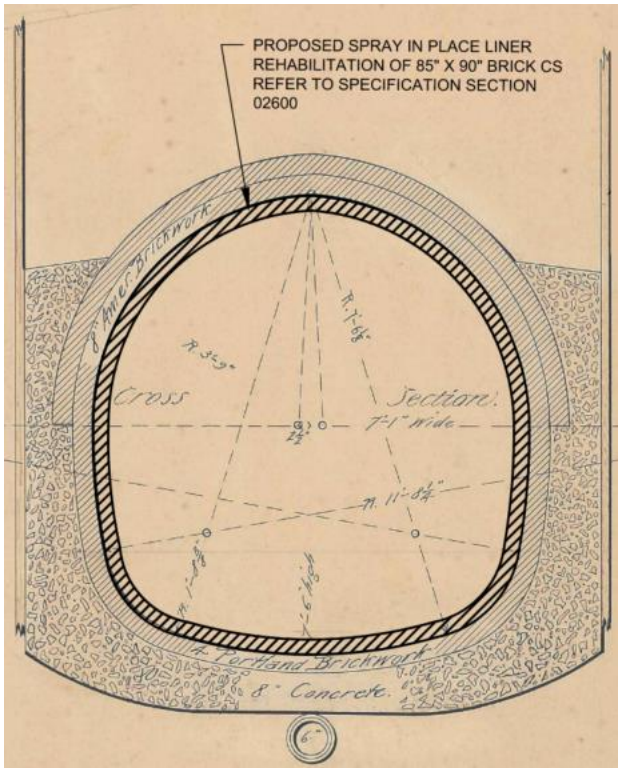


Figure 3-1: Somerville Marginal Interceptor to Somerville Medford Branch Sewer Layout

The 85x90 brick sewer was constructed in approximately 1897. Figure 3-2 shows a cross section of the pipe taken from the bid drawings for the rehabilitation project prepared by Kleinfelder dated October 2021. Based on the Marginal Combined Sewers Preliminary Design Evaluation prepared by Kleinfelder and dated June 2015, the sewer is supported by timber piles with a timber pile cap. The crown of the sewer consists of a two-course brick arch, the invert of the pipe consists of one course of brick, and the invert and walls of the sewer are supported by a concrete cradle. During the original construction, the sewer was stabilized with timber sheeting which allowed the sewer to be stable during temporary construction conditions such as unbalanced soil loads and balanced soil loads without the weight of the soil on the crown of the sewer. The timber sheeting is likely no longer functional, but it is not required when the sewer is in its final load condition with balanced soil and soil weight loading the brick arch. Due to structural stability concerns raised by visual observations identifying cracks and fractures that have formed at the crown of the pipe, the City of Somerville will be rehabilitating the sewer with a spray in place cementitious or geopolymer liner. The liner will be designed to act compositely with the sewer and withstand the final load conditions. Installing a relief connection at the invert of this pipe would require cutting through the concrete cradle, the brick sewer, and newly installed liner which would weaken the structural integrity of the sewer. Construction of the relief connection would also require excavation and expose the newly lined sewer to temporary construction load conditions that was not accounted for in the City's design.

Tying into the rehabilitated brick sewer at the invert poses structural and construction risk. To mitigate this risk, a segment of the brick sewer would need to be demolished and replaced with concrete.



Source: *Marginal Combined Sewers Rehabilitation Project, Bid Drawings* by Kleinfelder dated October 2021

Figure 3-2: Cross Section of 85x90" Somerville Marginal Interceptor

3.1.1.1 Flow Bypass Requirements

Bypass of wet weather flow would be required during construction of the 36-inch connection to the 85x90 brick combined sewer. The 85x90 brick combined sewer is only used for wet weather flow and does not convey dry weather flow where the new connection would be located; therefore, dry weather flow bypass will not be required. The contractor will be required to dewater infiltration in the pipe and maintain dry conditions during construction. The pipe would tie into the existing SMH on the Somerville Medford Branch sewer at approximately 102.9 feet elevation. The connection to the manhole would be above all other pipes connecting to the SMH discussed in Section 2.2. Bypass of the Somerville Medford Branch sewer would not be required.

3.2 Alternative 2: Somerville Drain to Somerville Medford Branch Sewer

The second alternative would utilize an existing 42-inch drain connection in the 85x90 brick combined sewer. The drain connects to the 85x90 brick combined sewer at Station 112+67 and passes the Section 35 SMH further upstream. Flow would be intercepted in the existing drain and diverted into the Somerville Medford Branch Sewer, before it ends up in the 85x90 inch Marginal Combined Sewer or flow from the 85x90 combined sewer could flow into the 42-inch drain and be passed into the Somerville Medford Branch Sewer depending on system hydraulics. As part of the City of Somerville's Marginal Conduit rehabilitation project, the 85x90 inch brick combined sewer was cleaned and video inspected. It

was determined that the 42-inch drain connects at the invert of the brick pipe. Figure 3-3 presents a clip of the video inspection showing the 42-inch pipe.

Figure 3-3: CCTV Image of the 42-inch Drain Connection to 85x90-inch Combined Sewer

AECOM simulated 36-inch and 42-inch gate connections for this alternative with similar results. The model results comparing the two sizes are presented in Table 3-1. The hydraulic model simulated a chamber with a 100 square foot area to connect to the Somerville Medford Branch sewer.

Table 3-1: Model Results for Different Connection Sizes (by AECOM)

	36-inch		42-inch	
Parameter	**Activation Frequency**	**Volume (MG)**	**Activation Frequency**	**Volume (MG)**
SOM007A/MWR205A	3	3.59	3	3.63
MWR205	17	63.34	17	62.43
BOS017	4	0.45	4	0.45
MWR203 (Prison Point)	17	262.55	17	263.60
Total	-	329.93	-	330.10
Net Change	-	-29.15	-	-28.98

Record information indicates that the structures along the 85x90 brick sewer are supported by piles. It is anticipated that piles will be required for any proposed structures.

Three different layouts were considered for connecting to the 42-inch drain to the Somerville Medford Branch sewer. It is assumed all layouts will require pile installation; details will be established in final design. The ground elevation presented in subsequent sections was obtained from the Marginal Combined Sewer Rehabilitation Project bid documents for the City of Somerville prepared by Kleinfelder dated October 2021.

3.2.1 Alternative 2.1 - Chamber Connection with 36-inch to SMH

Alternative 2.1 involves constructing a chamber downstream of the SMH on Section 35 and connecting back to the SMH with a 36-inch pipe. Due to concerns associated with connecting a 42-inch pipe to a 4-foot manhole riser, the 36-inch connection only was considered for this alternative. The proposed pipe material is lined ductile iron; however, PVC could be considered to minimize headloss (PVC has a smoother internal pipe surface with a lower resulting Manning's "n" value). The control gate would be installed within the chamber in the grassy area off the roadway. The site plan for this alternative is presented in Figure 3-4.

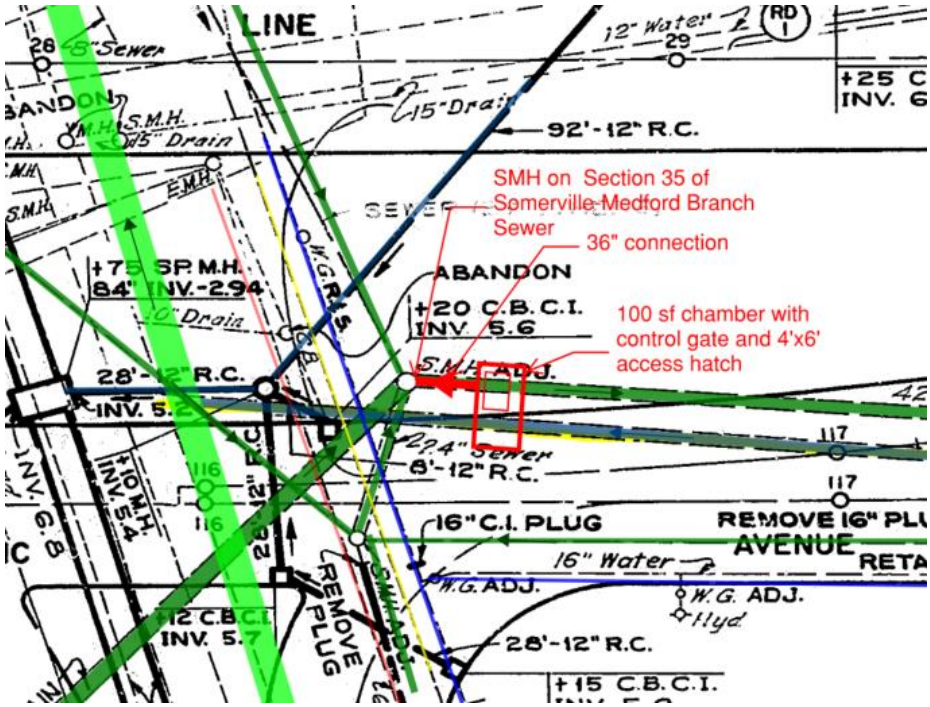


Figure 3-4: Alternative 2.1 Site Plan

3.2.1.1 Manhole Lining System

For this layout, manhole rehabilitation is recommended for the entire riser after the connection is installed at the SMH. The liner will be applied from approximately elevation 116.5 to 96.3, the crown of the pipes. Manhole preparation for the lining system includes power washing and crack repair prior to the application of the liner. The surface will need to be dry prior to liner application. While various manhole lining systems are available, a 100% solids epoxy coating system is recommended to repair the concrete after demolition of the riser. Pressure injection is recommended for structural crack repair and any leaking crack and joint repair. The 100% solids epoxy specified will be P-301 Epoxy Spray System manufactured by Warren Environmental, Uroflex 61 manufactured by Epoxytec, AquataPoxy A-6 Series manufactured by Raven Lining Systems, or equal. When cured, the 100% solids epoxy system forms a continuous, tight-fitting, hard, impermeable surfacing that is resistant to chemicals and bacteria.

3.2.1.2 Flow Bypass Requirements

Flow bypass is required for the manhole lining in Alternative 2.1, but not required for the entire construction duration. Specifications would require the contractor to prevent any debris from falling into the Section 35 SMH during coring, but no bypass is required during the core due to the higher elevation of the connection. The pipe and chamber over the drain line can be installed without requiring a flow bypass. A short period of dry weather would be required to cut into the drain once the chamber is installed.

3.2.1.3 Chamber Layout

Based on review of available documentation, the 42-inch drain has a 1% slope. The chamber would be installed on the 42-inch drain line approximately 50 feet upstream of the 85x90 brick sewer at invert elevation 103.4. That elevation would be maintained, and the 36-inch relief connection will tie into the SMH at the same elevation, 103.4. The invert elevations of the existing and proposed pipes to the SMH are summarized in Table 3-2.

Table 3-2: Relief Connection Elevations at SMH (MDC)

Pipe	Elevation (ft)
36” Relief Connection	103.40
12” Sump Pump Connection	101.40
18” Dry Weather Connection	93.89
36” Somerville Medford Branch Sewer	93.31
42” Somerville Medford Branch Sewer	92.77

Preliminary plans and section views for this alternative are presented in Figure 3-5. The foundation design would need to consider the 12-inch sump pump connection in the SMH.

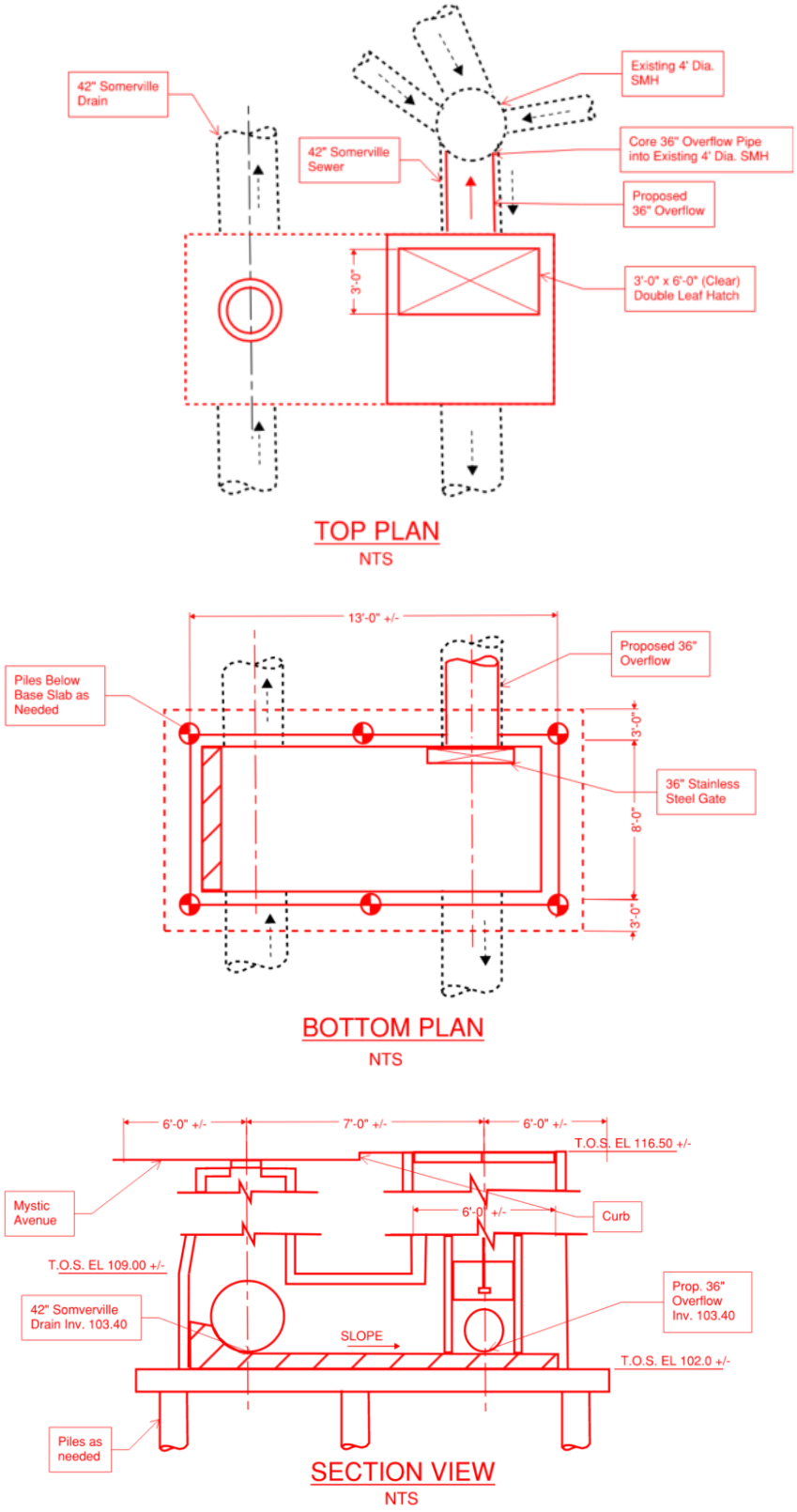


Figure 3-5: Alternative 2.1 Chamber Plans and Section

This alternative was not modeled by AECOM but was eliminated from consideration due to the anticipated increased headloss through the chamber and pipe.

3.2.2 Alternative 2.2 - Chamber Connection to SMH

Alternative 2.2 involves constructing a chamber to connect the 42-inch drain directly to the SMH on Section 35 of the Somerville Medford Branch Sewer. Sections of the manhole riser will be removed to allow for construction of the chamber and gate. The site plan for this alternative is presented in Figure 3-6. There is a MassDOT traffic camera pole adjacent to the SMH that may need to be relocated if this alternative is selected.

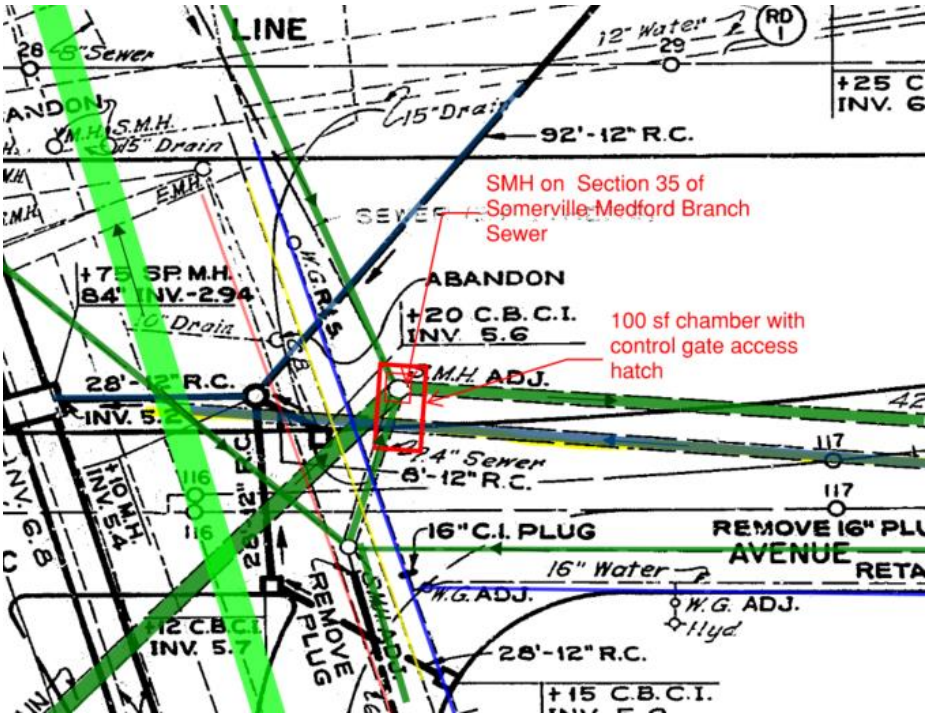


Figure 3-6: Alternative 2.2 Site Plan

3.2.2.1 Manhole Lining System

Manhole rehabilitation is recommended from approximately elevation 101.0 to 96.3, from the bottom of the new chamber to the crown of the pipes. The proposed liner system would be as described in Section 3.2.1.1.

3.2.2.2 Flow Bypass Requirements

Flow bypass is required for the manhole liner application, but not required for the entire construction duration of this alternative. The pipe and chamber over the drain line can be installed without requiring a

flow bypass. Flow in the manhole will need to be protected during demolition of the manhole riser. Specifications would require the contractor to prevent any debris from falling into the Section 35 SMH during chamber installation, but no bypass is required due to the higher elevation. A short period of dry weather would be required to cut into the drain once the chamber is installed.

3.2.2.3 Chamber Layout

Based on review of available documentation, the 42-inch drain has a 1% slope. The chamber would be installed on the 42-inch drain line approximately 35 feet upstream of the 85x90 brick sewer at invert elevation 103.2. The chamber will be sloped towards the gate and SMH. The invert elevations of the existing and proposed pipes to the SMH are summarized in Table 3-3. A 36-inch or a 42-inch control gate can be accommodated in the proposed chamber.

Table 3-3: Relief Connection Elevations at SMH (MDC)

Pipe	Elevation (ft)
Control Gate	103.20
12” Sump Pump Connection	101.33
18” Dry Weather Connection	93.79
36” Somerville Medford Branch Sewer	93.31
42” Somerville Medford Branch Sewer	92.77

Preliminary plans and section views for this alternative are presented in Figure 3-7. It is unknown if the existing SMH was constructed on piles. If not, additional support for the manhole may be required to prevent settling. The foundation design will need to consider the 12-inch sump pump connection in the SMH. The pile layout and installation would also need to consider the existing pipe located beneath the chamber. Due to the pipe congestion, pile installation would be challenging.

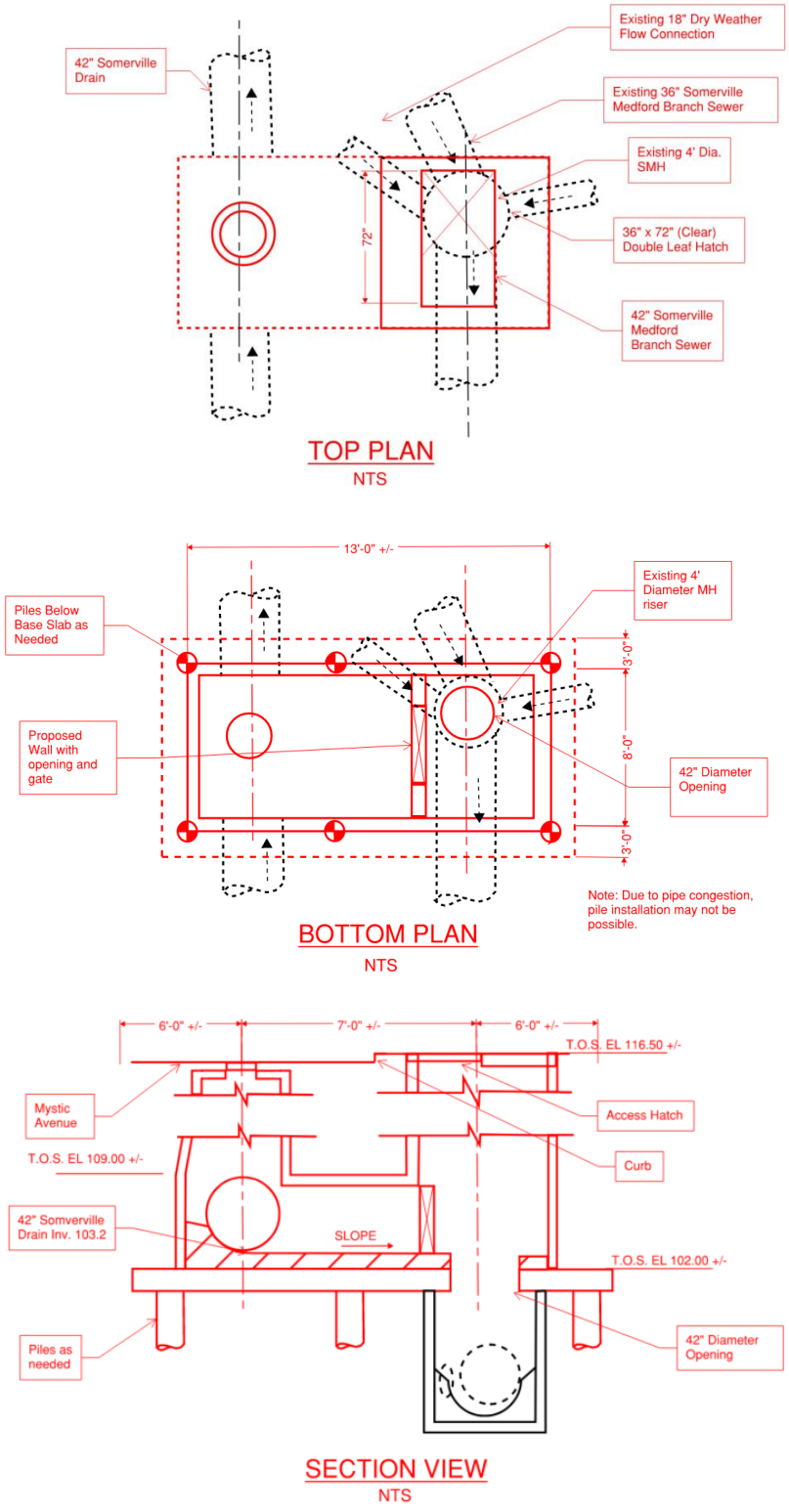


Figure 3-7: Alternative 2.2 Chamber Plans and Section

3.2.3 Alternative 2.3 - Chamber Connection with Doghouse MH

Alternative 2.3 involves constructing a chamber to connect the 42-inch drain to the Somerville Medford Branch Sewer downstream of the SMH. The connection to the 42-inch sewer will be through a doghouse structure in the chamber with the control gate. The site plan for this alternative is presented in Figure 3-8.

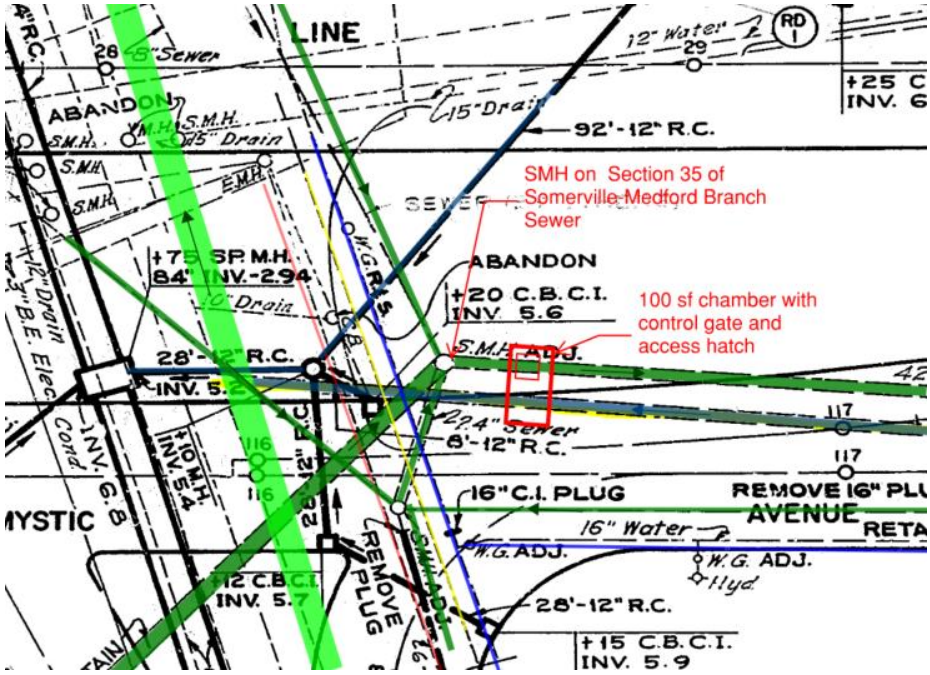


Figure 3-8: Alternative 2.3 Site Plan

Based on review of available documentation, the 42-inch drain has a 1% slope. The chamber would be installed on the 42-inch drain line approximately 50 feet upstream of the 85x90 brick sewer at invert elevation 103.4. The floor of the chamber will be sloped toward the control gate and 42-inch sewer. A 36-inch or a 42-inch control gate can be accommodated in the proposed chamber.

3.2.3.1 Flow Bypass Requirements

Flow bypass is not required for this alternative. The chamber structure can be constructed without disrupting flow in the 42-inch drain or the 42-inch sewer. The connection to the 42-inch sewer will be through a doghouse structure. Once the structure is installed and the gate tested, the contractor will cut an opening in the top of the sewer.

3.2.3.2 Chamber Layout

Plans and sections for Alternative 2.3 are presented in Figure 3-9. If borings indicate unsuitable soils are present, a more complex structure will be required.

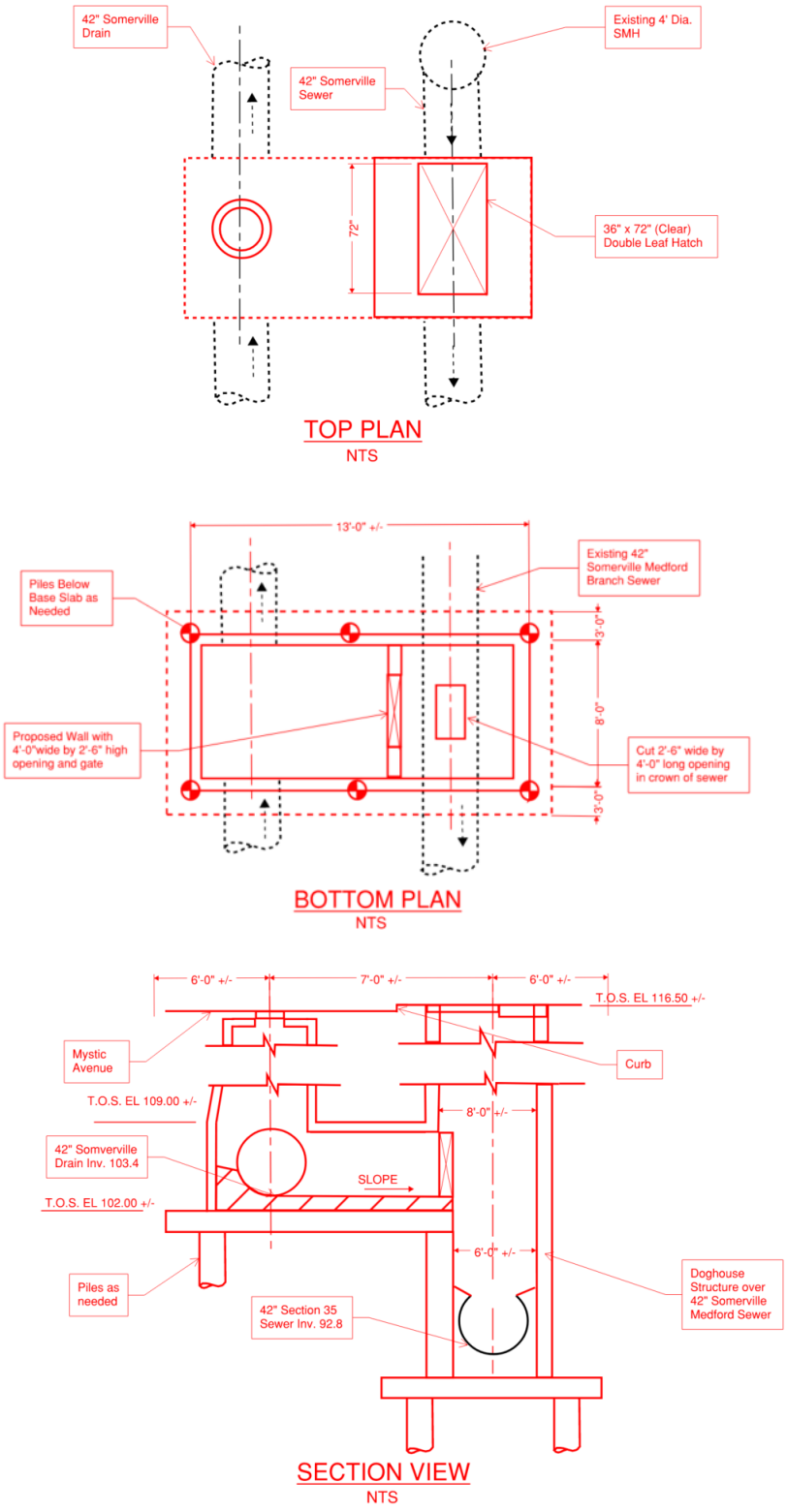


Figure 3-9: Alternative 2.3 Chamber Plans and Section

3.3 Recommendation

In general, the layouts presented in Alternative 2 are recommended over Alternative 1, mainly due to structural concerns and construction risks with tying into the invert of the 85x90 brick combined sewer. The 42-inch drain is in good condition and newer than the 85x90 brick combined sewer and provides an opportunity to intercept wet weather flow before it reaches the 85x90 sewer. There are significant structural concerns with cutting into the existing brick sewer, regardless of the liner installation. In addition, using the 42-inch drain provides less risk associated with construction during wet weather since much of the work can occur in wet weather if needed. Wet weather bypass would be required for work in the 85x90 brick combined sewer while the section of the 85x90 brick sewer is demolished and replaced with concrete and the 36-inch connection is being constructed.

The connection to the 42-inch RCP drain is recommended utilizing the layout described in Alternative 2.3. This layout avoids connecting to the SMH on Section 35, eliminating the need for manhole rehabilitation and removes the risk associated with connecting to the structure. Alternative 2.1 is structurally preferred because it minimizes the impact to the SMH and existing sewer below, but was not modeled by AECOM.

Cost estimates were not developed for all layouts, but based on a qualitative comparison, they are generally similar in cost, with the 36-inch direct connection to the 85x90 brick sewer presenting more risk (and potentially slightly higher cost).

4. Preliminary Design Assessment

4.1 Connection Hydraulics

The proposed connection will divert flow from the 85x90 brick sewer and the Somerville Marginal CSO Treatment Facility to interceptors downstream, which are hydraulically connected to the Prison Point CSO Treatment Facility. An unrestricted connection would convey too much flow under larger storm resulting in higher CSO discharge volumes from the Prison Point CSO facility and unacceptable increases in the hydraulic grade line along the Somerville Medford sewer. The need for berms and baffles is not anticipated to support directing the flow to the supplemental connection.

A gate is proposed to control flow downstream while optimizing the volume reduction at the Somerville Marginal CSO facility. Three control point locations were identified to throttle flow based on measured level at multiple locations. The level will be monitored at the relief connection to the Somerville Marginal Branch Sewer, the influent to the Prison Point CSO facility, and at the upstream critical low point along the Somerville Medford Branch Sewer. Hydraulic modeling identified the upstream critical low point along the Somerville Medford Branch Sewer to be near 700 Mystic Avenue. The control gate is discussed further in Section 4.3.1.

4.2 Utility Survey Findings

Review of the record information indicated that there are other utilities located near the proposed construction area. Gas, electrical conduit, water main, and drainage lines are located between the 85x90 brick combined sewer and the SMH on Section 35 of the Somerville Medford Branch sewer. However, none appear to be located between the 42-inch sewer and the 42-inch drain. The topographic survey, to be performed during final design, will identify any other utilities not shown on the record information. The contract specifications will require the contractors to protect the existing utilities during construction.

The 1894 land taking records for the Somerville Medford Branch sewer were reviewed to determine if the work can occur within the existing easement. The records are included in Appendix A. The location of the easement relative to the existing infrastructure at this desktop level of evaluation was not able to be confirmed. Thus, the easement limits will be confirmed during final design based on the utility survey effort and easement/deed research. Depending on the area of disturbance (for the proposed gate structure and the electrical cabinet/conduits), a temporary easement may be required for construction.

4.3 Preliminary Design Criteria

4.3.1 Control Gate

The control gate would be used to throttle flow during larger storms. The set points were established through hydraulic modeling (by AECOM) and are summarized in Table 4-1. The set points identified in the table are in MDC datum.

Table 4-1: Control Gate Set Points

Location	Open Elevation	Close Elevation
Relief Connection	102.0	105.0
Upstream Critical Low Point	107.5	108.5
Prison Point CSO Facility Influent	100.0	103.0

As noted previously, level sensors will be installed at the relief connection and upstream on the Somerville Medford Branch Sewer. There is an existing level sensor at the influent of the Prison Point CSO facility that will be integrated into the control strategy for the gate. Based on modeling performed by AECOM, the control gate will not need to modulate and will operate in an open/close fashion.

4.3.1.1 Type and Material

Sluice and slide gates were considered for control gates for this installation. Sluice gates are cast iron, are subject to corrosion, and would not be recommended for this application. Stainless steel slide gates are resistant to corrosion, durable, and reliable. Thus, a stainless steel slide gate is recommended.

The gate can be operated electrically or hydraulically. An electrically actuated operator is not suitable for this application due to the chance of flooding or draining from the roadway. A rising stem actuator is not

recommended due to the proximity to Mystic Avenue. A control gate with a hydraulically actuated operator (e.g., Trident) is recommended. The hydraulic actuator is submersible and explosion proof.

As discussed in Section 3.2, the 36-inch and 42-inch control gates provided similar hydraulic results. The hydraulic actuator requires a minimum clearance above the gate for operation. A 42-inch gate would not have sufficient clearance in the chamber. A 36-inch control gate is recommended. An example cut sheet of the proposed gate and actuator is included in Appendix B. Three manufacturers will be listed in the specification for bid.

4.3.1.2 Power Supply

Power for the gate may be supplied either by direct connection to the utility or through power obtained at the Somerville Marginal CSO Treatment Facility. For a direct connection, a new electrical service will be established near the chamber. Coordination with the electric utility provider, Eversource, would be needed to install a new service. To power the gate from the Somerville Marginal CSO Treatment Facility, the gate would tie into existing electric service and panels, and conduit installed between the CSO facility and the proposed gate structure.

The control panel for the gate can be either local, adjacent to the roadway, or remote. A remote control panel located at the Somerville Marginal CSO Treatment Facility is recommended to provide a secure location for the panel in a fenced area. Since the control panel will be located at the CSO Treatment Facility, power supply from the facility is recommended. During final design, a more detailed evaluation of available power connections at the CSO facility would be required.

There should be an emergency power source for the gate. This should be included in the Somerville Marginal CSO Treatment Facility upgrade if not already present. For backup signals to the control points, cellular transmitters, such as Teleg manufactured by Trimble Water, are recommended. Units will be specified to transmit level data at least every 30 seconds.

4.3.2 Connection Layout

The chamber details will be determined during final design and the layout will be as shown in Section 3.2.3.1. The overall site layout is presented in Figure 4-1. The chamber will house the 36-inch stainless steel, hydraulically actuated control gate.

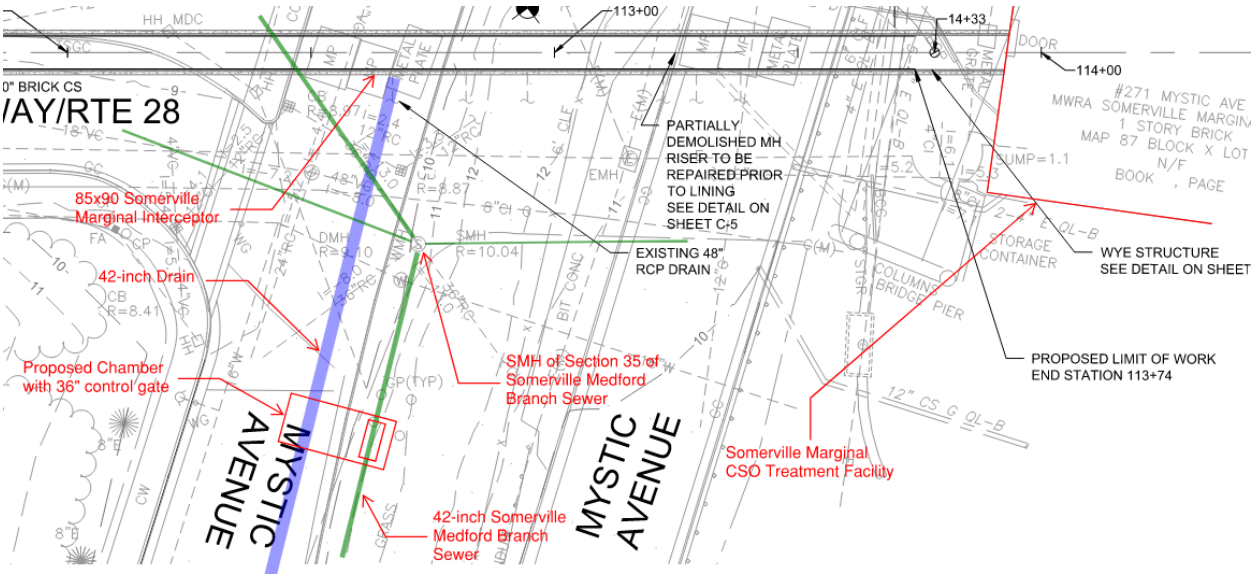


Figure 4-1: Chamber Site Plan

4.4 Constructability

4.4.1 Maintenance of Flow

As discussed in Section 3.2, the construction of the relief connection will not require flow bypass. Construction of the relief connection and chamber does not directly affect the existing flows and would not require bypass. The 42-inch drain will be temporarily supported and the chamber foundation formed below. A period of dry weather will be required to connect into the 42-inch drain once the chamber is installed.

4.4.2 Traffic Management

Construction will be performed partially within the roadway and will require a traffic management plan. The work will take place within Mystic Avenue. Figure 4-2 shows the SMH and approximate location of the drain in the right travel lane. Traffic will need to merge into one lane and utilize the right shoulder to avoid the construction zone. The traffic management plan will be developed during final design. The Contractor will be required to adhere to the traffic management plan during construction.

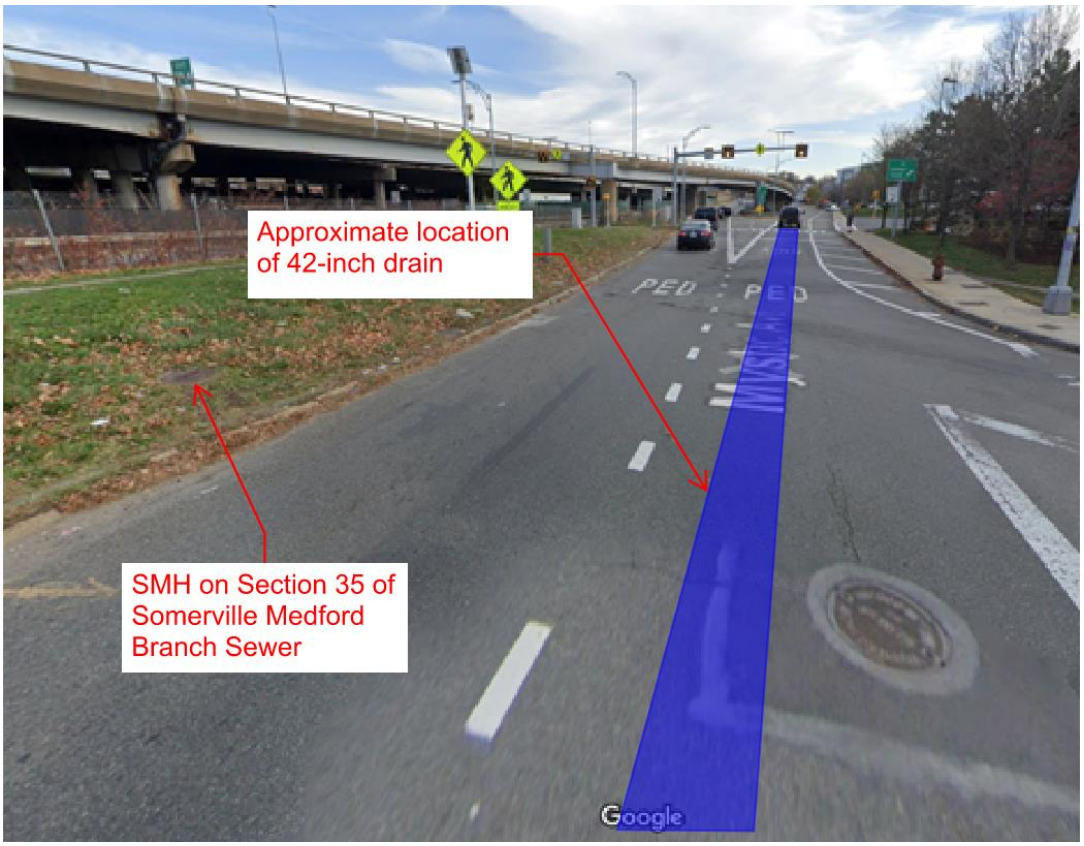


Figure 4-2: Mystic Avenue Facing Southeast

4.5 Permitting Requirements

A MWRA 8(m) Permit Application is required for work associated with this project and work will not begin until the MWRA issues this permit. Hazen will submit the 8(m) permit application during design and it will be executed by the contractor once the contract is awarded. A copy of the MWRA 8(m) Permit Application and Permit will be included as an appendix to the Technical Specifications.

The Contractor will be required to submit a Construction Access Permit through the Department of Conservation and Recreation for work on Mystic Avenue. Street opening permits are also required for work within public ways in the City of Somerville, which includes submittal of the traffic management plan. The work will not take place on McGrath Highway and will not require a State Highway Access Permit through MassDOT.

The Contractor shall complete the National Pollutant Discharge Elimination System (NPDES) General Permit for Construction Dewatering, BRP WM 10 for discharging any groundwater encountered during construction.

The site was checked to determine if it was located within a flood zone. Per FEMA, the site is located within Zone X, meaning there is a 0.2% chance of an annual flood. No additional permits for construction in a floodplain are required.

The site is not located within 100 feet of a wetland and a Request for Determination of Applicability with the Somerville Conservation Commission is not required.

4.6 Project Schedule

The project schedule is summarized in Table 4-2. Submittals and pre-construction documentation is expected to take two months for completion. The current lead time on a stainless steel gate is approximately 24 weeks from shop drawing approval, which delays contractor mobilization. The construction duration is estimated at approximately 11 months, which includes mobilization, site preparation, excavation, installation of the chamber and structural supports, cutting into the 42-inch drain, site restoration, and instrumentation and controls. The duration assumes regular working hours but working hours will be evaluated after discussions with MassDOT and DCR. A detailed schedule is included in Appendix C.

Table 4-2: Anticipated Construction Schedule

Item	Date
Advertise for Bid	October 2022
Bid Opening	November 2022
Award	January 2023
Submittal Phase	January 2023 – March 2023
Construction Phase	July 2023 – December 2023

4.7 Opinion of Construction Cost

The opinion of construction cost is summarized in Table 4-3. A detailed cost estimate is included in Appendix D. This is a Class 4 estimate for this level of design, which carries a typical accuracy range of -10% to +50%. Currently, the industry is seeing contractors bid more aggressively on work, leading to high market volatility. Although Hazen used a conservative approach to building the estimate, there is a chance that prices can come in higher than expected should market conditions change. The cost estimate will be updated in each subsequent design deliverable for the project.

Table 4-3: Opinion of Construction Cost

Item	Unit	Cost
Relief Connection	LS	$984,000
Preliminary Design Contingency	25%	$246,000
Contract Allowances and Unit Prices	2.5%	$31,000
Total Cost		$1,261,000

5. Next Steps

The preliminary design will be advanced to final design to be publicly bid for construction as an M.G.L Chapter 149 project. It is anticipated that no filed subbids will be required as the electrical work is estimated below $25,000. This will be reevaluated as the design progresses. As part of Task Order No. 10 under Contract 7691, Hazen will prepare detailed design drawings and specifications. The documents will

be submitted at the 90% and 100% milestones with Authority comments incorporated after each submittal.

Below is a list of items to be evaluated further in final design, as discussed in the memorandum:

- Perform survey of the area, including easement review
- Identify utility conflicts
- Conduct geotechnical investigations
- Perform structural analysis for piles
- Confirm construction details of chamber to connect to the 42-inch drain
- Perform further evaluation of the proposed gate's electrical connection/power available at the Somerville Marginal CSO Treatment Facility
- Develop detailed traffic management plan

Appendix A: Section 35 Land Taking Records

656

NORTH

SOMERVILLE

&

MEDFORD

Sec. 35

BOOK 2282

PAGE 195

6/15/1894

Commonwealth of Massachusetts.

OFFICE OF THE

METROPOLITAN SEWERAGE COMMISSIONERS.

To all to whom these Presents shall come:—

Whereas Hosea Kingman, *of Bridgewater, in the county of Plymouth,* ***Tilly Haynes,*** *of Boston, in the county of Suffolk, and* ***Harvey N. Collison,*** *of said Boston, all inhabitants of the Commonwealth of Massachusetts, now constitute the Board named the Metropolitan Sewerage Commissioners, having been duly appointed by the Governor, by and with the advice and consent of the Council, and having duly qualified, and having duly organized under and in pursuance of an Act of the General Court, entitled "An Act to provide for the building, maintenance and operation of a system of sewage disposal for the Mystic and Charles River valleys," approved June seventh, A.D. eighteen hundred and eighty-nine, and being chapter four hundred and thirty-nine of the Acts of said year, as amended by chapter two hundred and seventy of the Acts of the year eighteen hundred and ninety;*

And whereas *said Board of Metropolitan Sewerage Commissioners have adjudged the following described lands and estate necessary for the carrying out under the provisions of said Acts of the recommendations and plans contained in the report of the State Board of Health to the Legislature of eighteen hundred and eighty-nine, and for the construction, maintenance and operation of the system of sewage disposal provided for by said Acts;*

Now, therefore, *we, the said Board of Metropolitan Sewerage Commissioners, acting for and in behalf of the said Commonwealth, under, by virtue and in pursuance of the power and authority conferred upon and vested in us by said Acts, have taken, and by these presents do take for the said Commonwealth the right to carry and conduct under the following described lands, and therein to construct, to operate and forever to maintain an underground main sewer and connecting sewers, drains, manholes and underground appurtenances, and to repair and renew the same, to wit:—*

A certain parcel of land in Somerville in the County of Middlesex and Commonwealth aforesaid, shown by red lines on a plan entitled "Commonwealth of Massachusetts. Plan of land in Somerville and Medford," signed by Howard A. Carson, Chief Engineer, and by said Commissioners, of even date, and to be recorded herewith, said to be now or late of the Boston and Maine Railroad, extending from the boundary line between said Somerville and that portion of said Boston called Charlestown to Mystic Avenue, being twenty (20) feet wide, ten feet on each side of a centre line described as follows:-- Beginning at a point in the said boundary line three hundred and seventy-two and fifty-five hundredths (372.55) feet southwesterly from a stone bound on said boundary line, and running in a northwesterly direction, at an angle on the north of 71° 12' 30" with the said boundary line, one hundred and sixty six (166) feet;

Thence, deflecting towards the west, making an angle of 181° 30', and running one hundred [illegible] hundredths

line, one hundred and sixty-six (166) feet;

thence, deflecting towards the west, making an angle of 161° 30', and running one hundred and seventy-five and ninety-five hundredths (175.95) feet; thence, deflecting towards the west, making an angle of 171° 15', and running one hundred and ninety-four and thirty-six hundredths (194.36) feet; thence, deflecting towards the west, making an angle of 170° 52', and running five hundred and forty-six and eight hundredths (546.08) feet, to a point on the northeasterly line of Mystic Avenue one hundred and twenty-seven and fifty-five hundredths (127.55) feet, easterly from a drill-hole in a stone bound at the westerly corner of Austin Street and said Mystic Avenue, as shown on said plan.

Also, all that portion of said Mystic Avenue, sixty-six (66) feet wide, in said Somerville and in Medford in said County of Middlesex, shown by red lines on said plan, extending from a line running at right

angles across said Mystic Avenue in Somerville from a point one hundred and twenty-five and thirty five hundredths feet southeasterly from the stone bound at the westerly corner of Austin Street and said Mystic Avenue above mentioned to a line running at right angles across said Mystic Avenue in Medford from a point fifty (50) feet northwesterly from the middle of a stone bound on the westerly side of Mystic Avenue and on the boundary line between said Somerville and Medford, as shown on said plan.

In Witness Whereof, we, the said Hosea Kingman, Tilly Haynes and Harvey N. Collison, Com-

missioners as aforesaid, have hereunto set our hands and seals, this twelfth day of

In Witness Whereof, *we, the said Hosea Kingman, Tilly Haynes and Harvey N. Collison, Commissioners as aforesaid, have hereunto set our hands and seals, this* ~~twelfth~~ *day of* June *A. D. eighteen hundred and ninety-four.*

Signed and sealed in presence of

Herbert C. Brayton

Hosea Kingman

Tilly Haynes

Harvey N. Collison

Barnstable, June 15, 1894 2 h 40 m P. M. *Received and entered with* Middlesex So. Dist *Deeds, libro* 2282 *folio* 195

Attest: Chas B Stevens

Register.

105

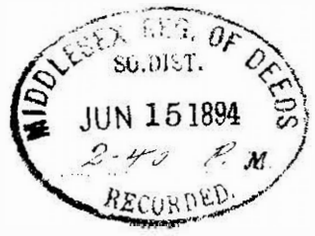
Commonwealth of Massachusetts.

TAKING OF ESTATE

IN Somerville and Medford

Boston and Maine Railroad

See Plan Filed No 123.



Lot 25

OFFICE OF

METROPOLITAN SEWERAGE COMMISSIONERS.

~ 40

16

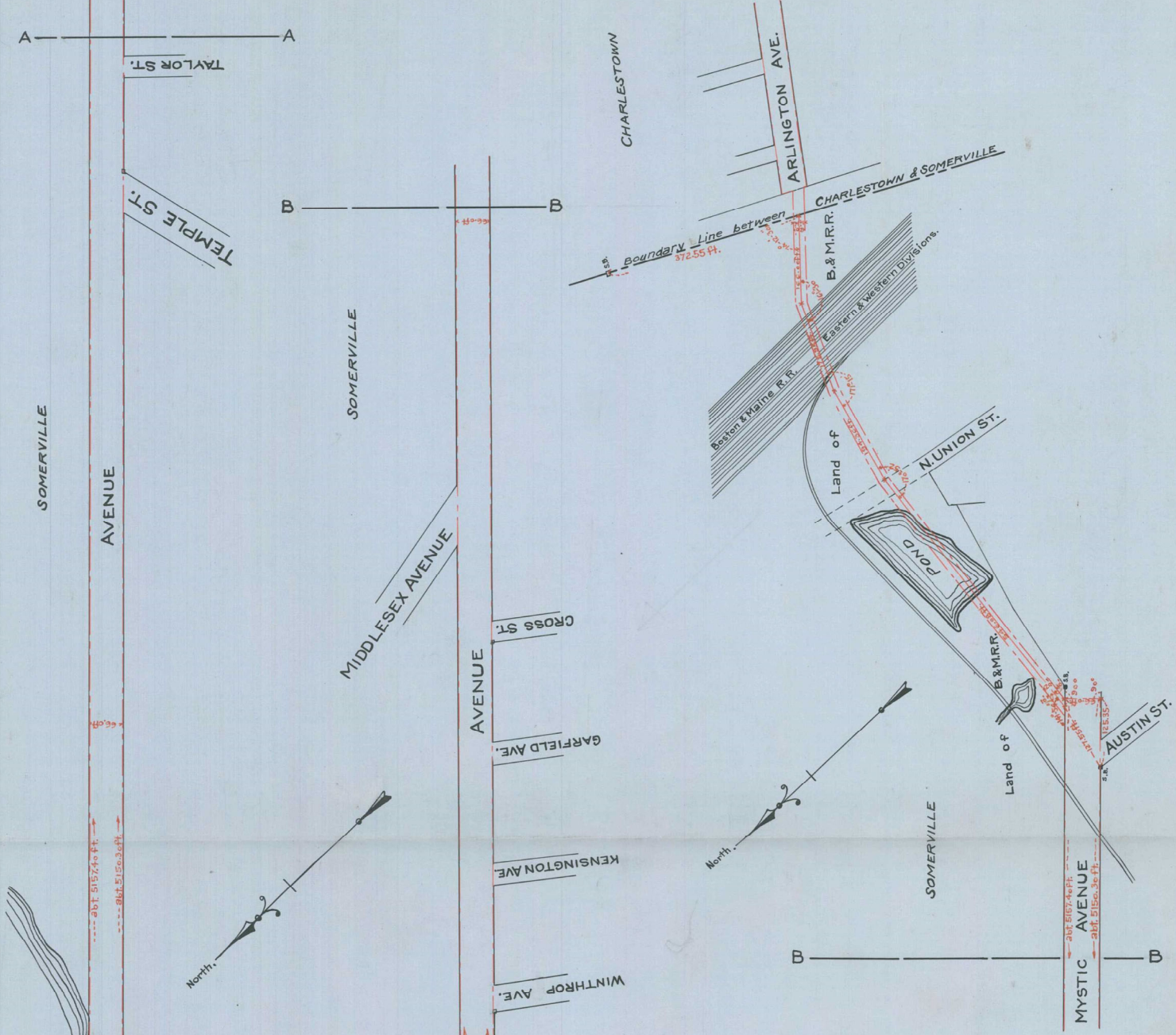
Taking of Estate

in

Somerville & Medford.

Boston & Maine Railroad.

Section 30.



2282-195

Commonwealth of Massachusetts.
Plan of Land
in
SOMERVILLE AND MEDFORD.

Howard A. Carson Chief Engineer.

Scale, 1 inch = 80 ft. June 9, 1894.

Hosea Kingman
Tilly Haynes
Harvey N. Collison
} METROPOLITAN SEWERAGE COMMISSIONERS.

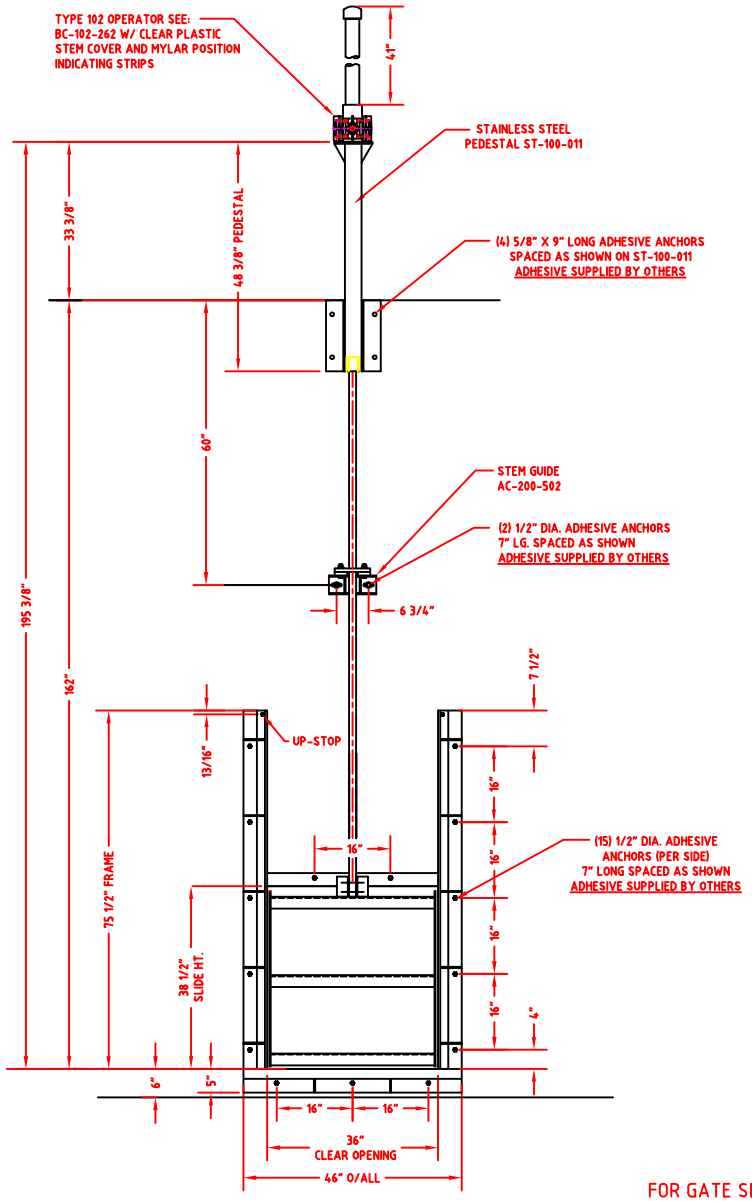
(Original on file.)
(Scale of this plan: 1 in. = 150 ft.)

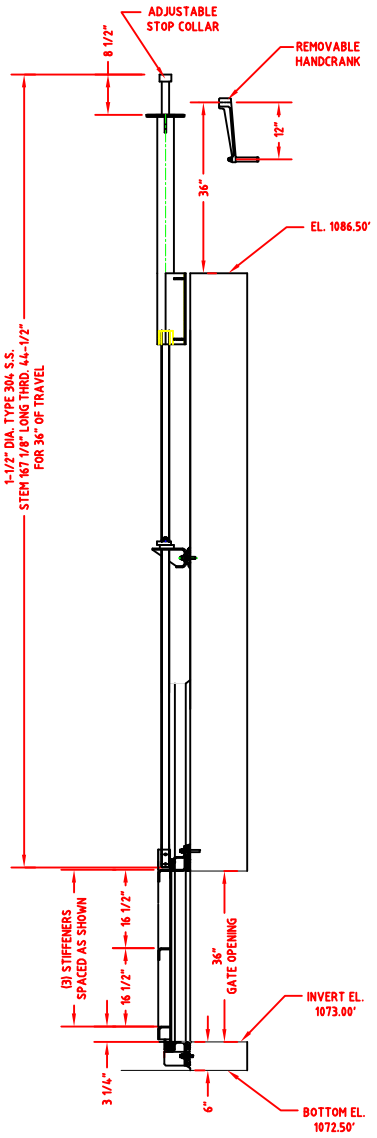
METROPOLITAN SEWERAGE COMMISSION.	
Number 1986	

MIDDLESEX REGISTRY OF DEEDS, SO. DIST.
CAMBRIDGE, MASS.
COPY OF PLAN
Recorded June 15, 1894 at 2 h 40 m P. M
As Filed Plan No. 123

Attest: Edmund D. Dudley Register

Appendix B: Control Gate Cut Sheets





FOR GATE SECTIONS SEE: BC-925-196-S2
HORIZONTAL STIFFENERS = 2-1/2" X 2-1/2" X 1/4" ANGLE
VERTICAL STIFFENERS = 2-1/2" X 1/4" FLAT BAR

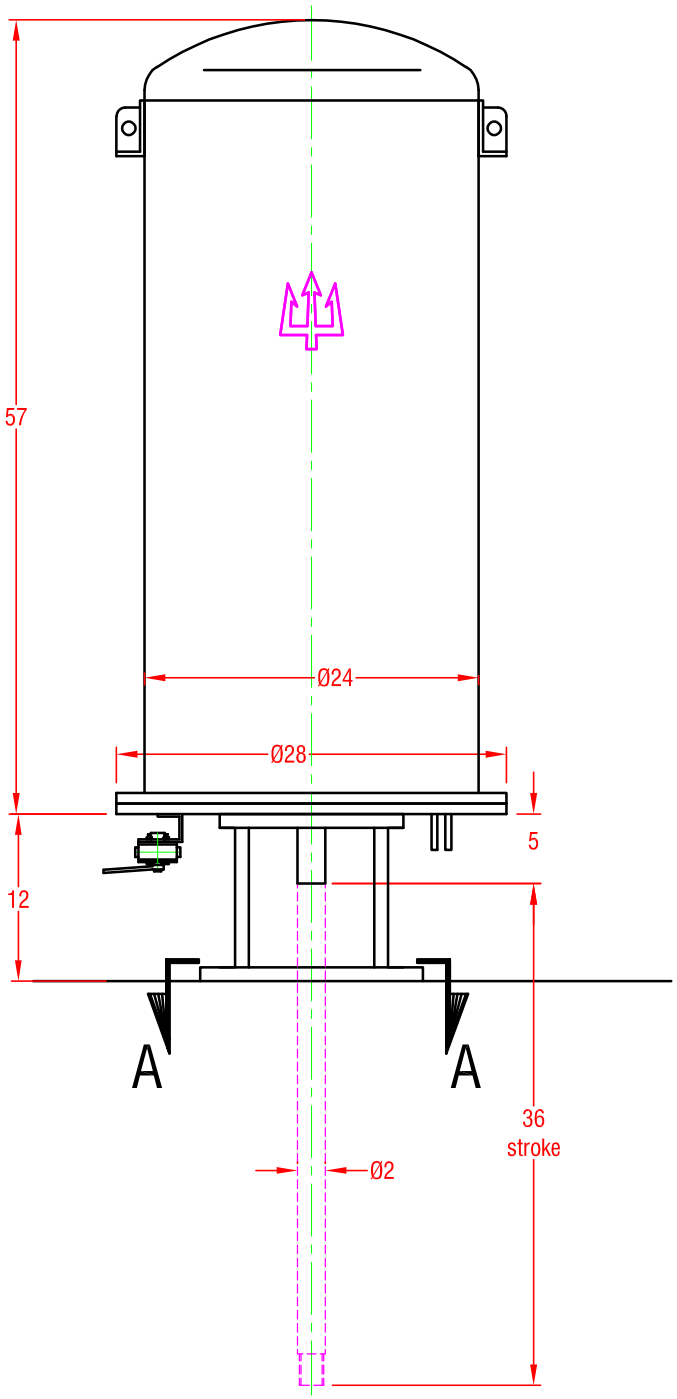
Rev.		Date	Eng.	Chk.
A	Original Issue	10/25/05	SB	
Rev.	Rev. Record	Date	Eng.	Chk.

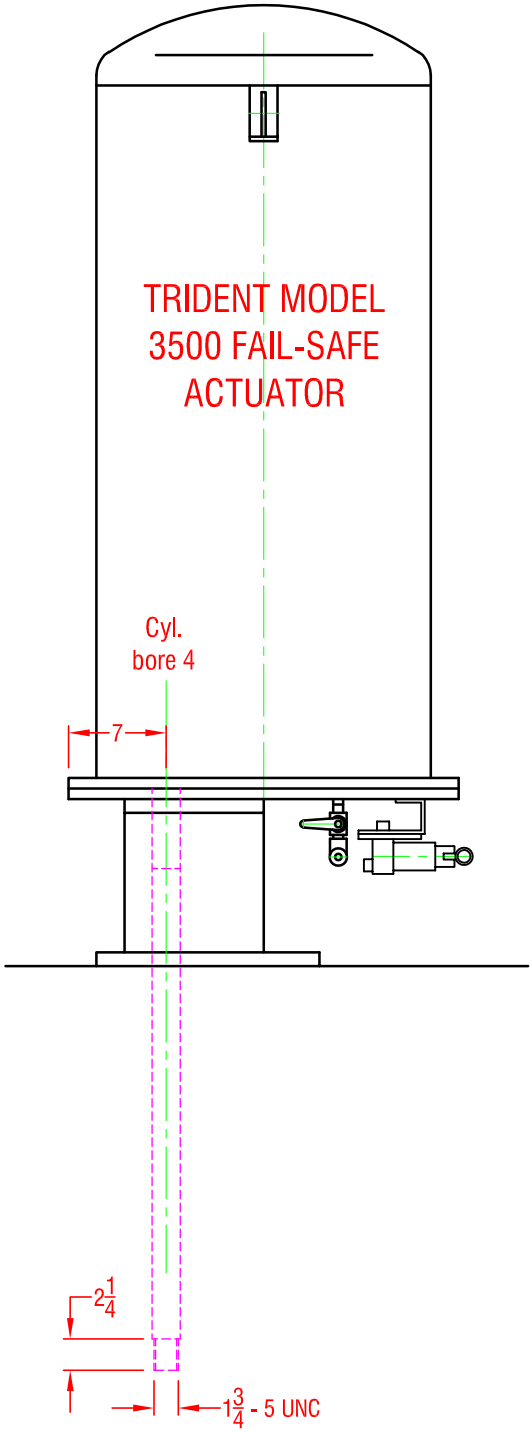
Whipps, Inc.
370 SOUTH ATHOL RD.
ATHOL, MA 01331

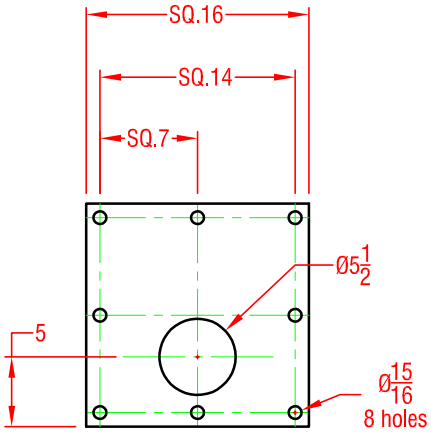
DO NOT SCALE THIS DRAWING
Work to Dimensions
Linear Dimensions are Inches
Requested Concrete Opening Tolerances
Height & Width ±1/4"
Squareness ±3/8 Diagonal
THIRD ANGLE PROJECTION

Title: SERIES 925 SLIDE GATE 36" x 36"
Project: CUCAMONGA REGIONAL PLANT #4
Location: TERTIARY FILTERS
Drg. No.: BC-925-197
S.O. No.: 17485

Quantity: 2	Scale: FD			
Tag No's: G-5110 & G-5120		Seating	Unseating	
		Design Head	13.0'	13.0'
		Leakage Rate GPM/ft of seal	0.1	0.2







section A-A

QTY: 2
FAIL-SAFE EXTENDED
FAIL-SAFE RETRACTED

REV.	DESCRIPTION	DATE
0		

Trident Actuators
329 Center Ave., Mamaroneck, NY 10543

Drawn by:	Job #:	Scale:
Adolf S.	610	1/12

Client: NEORSD Mill Creek Tunnel Contract MTC-3

Mill Creek:	Gate Size	GATE ID
Hydro Gate Corp.	48"w x 36"h	

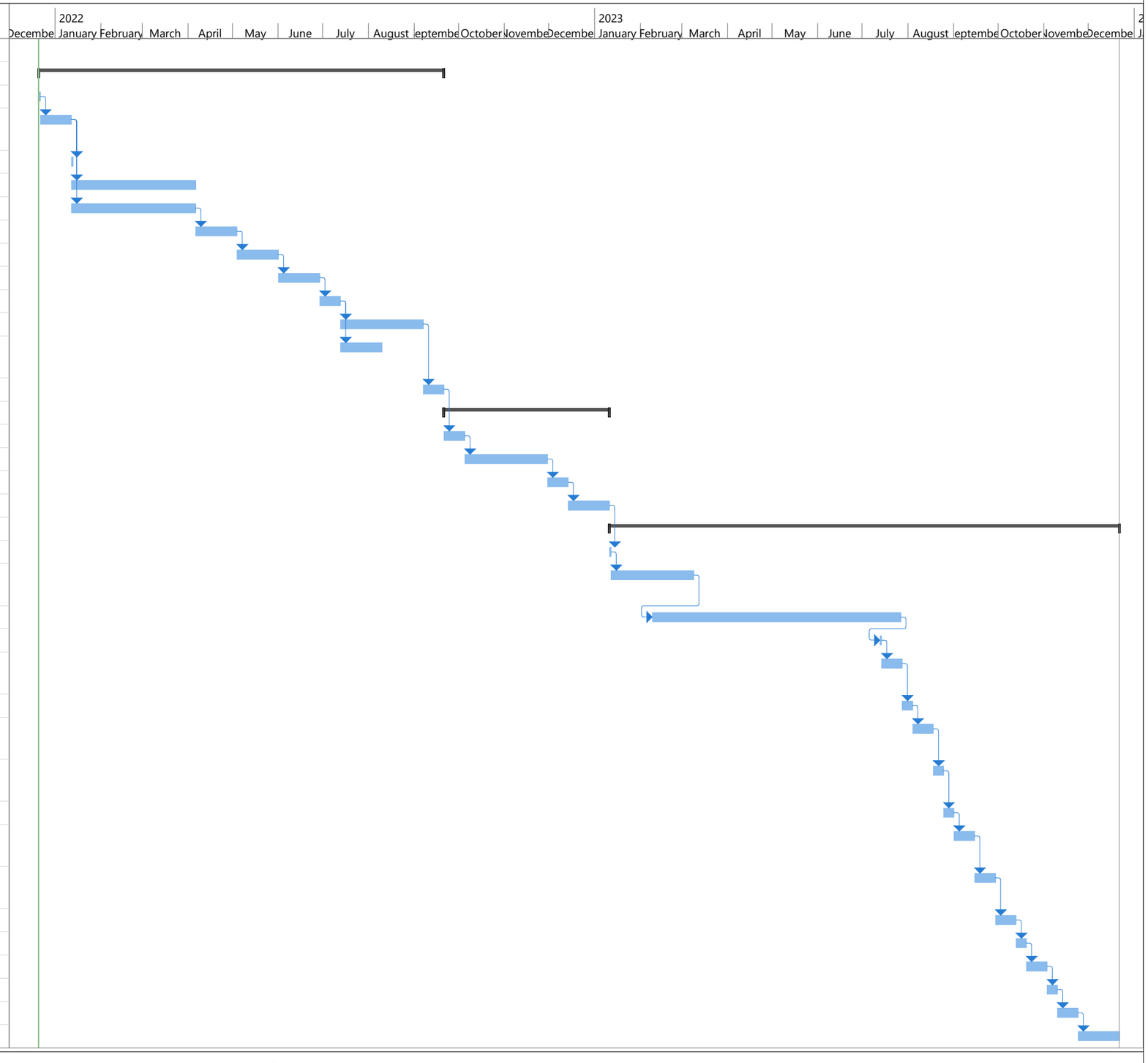
Title: INSTALLATION & ASSEMBLY

Date:	Drawing #:	Rev:
05-20-11.	M-610-36	0

Appendix C: Construction Schedule

Preliminary Schedule
Somerville Marginal Pipe Connection

ID	Task Mode	Task Name	Duration	Start	Finish
1					
2		**Design**	**196 days**	**Tue 12/21/21**	**Tue 9/20/22**
3		Submit Final Tech Memo	1 day	Tue 12/21/21	Tue 12/21/21
4		Authority Review and Acceptance of Tech Memo	15 days	Wed 12/22/21	Tue 1/11/22
5		Preliminary Design Workshop	1 day	Wed 1/12/22	Wed 1/12/22
6		Permit Review and Preparation	60 days	Wed 1/12/22	Tue 4/5/22
7		Submit 90% Design	60 days	Wed 1/12/22	Tue 4/5/22
8		90% MWRA Review	20 days	Wed 4/6/22	Tue 5/3/22
9		100% Design/Draft Permit Subm	20 days	Wed 5/4/22	Tue 5/31/22
10		100% MWRA Review	20 days	Wed 6/1/22	Tue 6/28/22
11		100% R1 Design Submittal	10 days	Wed 6/29/22	Tue 7/12/22
12		Permit Review by Agencies	40 days	Wed 7/13/22	Tue 9/6/22
13		100% R1 MWRA Procurement Review	20 days	Wed 7/13/22	Tue 8/9/22
14		Bid Documents Submittal	10 days	Wed 9/7/22	Tue 9/20/22
15		**Bid and Award**	**80 days**	**Wed 9/21/22**	**Tue 1/10/23**
16		Procurement to post Advertisen	10 days	Wed 9/21/22	Tue 10/4/22
17		Bid and Award	40 days	Wed 10/5/22	Tue 11/29/22
18		Evaluation of bids	10 days	Wed 11/30/22	Tue 12/13/22
19		Management Approves Contrac	20 days	Wed 12/14/22	Tue 1/10/23
20		**Construction**	**247 days**	**Wed 1/11/23**	**Thu 12/21/23**
21		Notice to Proceed	1 day	Wed 1/11/23	Wed 1/11/23
22		Submittals and Pre-Construction Documentation	40 days	Thu 1/12/23	Wed 3/8/23
23		Gate Lead Time	120 days	Thu 2/9/23	Wed 7/26/23
24		Mobilization to site	1 day	Thu 7/13/23	Thu 7/13/23
25		Sewer - Sheeting Installation and Excavation	10 days	Fri 7/14/23	Thu 7/27/23
26		Sewer - Pile Installation	5 days	Fri 7/28/23	Thu 8/3/23
27		Sewer - Form, Pour, and Cure Doghouse Structure	10 days	Fri 8/4/23	Thu 8/17/23
28		Drain - Sheeting Installation and Excavation	5 days	Fri 8/18/23	Thu 8/24/23
29		Drain - Pile Installation	5 days	Fri 8/25/23	Thu 8/31/23
30		Drain - Form, Pour, and Cure Chamber Foundation and Walls	10 days	Fri 9/1/23	Thu 9/14/23
31		Chamber Roof and Riser Installations	10 days	Fri 9/15/23	Thu 9/28/23
32		Temporary Restoration and Pavi	10 days	Fri 9/29/23	Thu 10/12/23
33		Gate Installation	5 days	Fri 10/13/23	Thu 10/19/23
34		Electrical and Instrumentation	10 days	Fri 10/20/23	Thu 11/2/23
35		Startup and Testing	5 days	Fri 11/3/23	Thu 11/9/23
36		Final Restoration and Paving	10 days	Fri 11/10/23	Thu 11/23/23
37		Punchlist/final completion	20 days	Fri 11/24/23	Thu 12/21/23



Appendix D: Detailed Cost Estimate

Hazen

MWRA
Somerville Marginal CSO Facility New Pipe Connection
Preliminary
Estimate Summary - Work Breakdown Structure (WBS) - Market Adjusted

Date: 12/4/2021

	Description					Total
	Option 2.3					*$ 424,961*
	Subtotal:					**$ 424,961**
	Special Conditions	*5.0%*	*on*	*$*	*424,961*	*$ 21,248*
	Small Tools (Applied on Labor)	*2.0%*	*on*	*$*	*249,675*	*$ 4,994*
	Incidental Overtime (Applied on Labor)	*5.0%*	*on*	*$*	*249,675*	*$ 12,484*
	Direct Costs Subtotal:					**$ 463,687**
	General Conditions					*$ 132,185*
	Indirect Costs Subtotal:					**$ 132,185**
	Direct and Indirect Costs Total:					**$ 595,872**
	Add-On / Mark-Up					
	Labor Escalation at 3.5% annually	*2.3%*	*on*	*$*	*377,234*	*$ 8,752*
	Material/Equipment Escalation at 5% annually	*3.3%*	*on*	*$*	*218,638*	*$ 7,228*
	Subtotal:					**$ 611,852**
	Value of Subcontracted Work assumed at 20%			*$*	*122,370*	
	Subcontractor Overhead, Profit and Fee	*50.0%*	*on*	*$*	*122,370*	*$ 61,185*
	Subtotal:					**$ 673,037**
	Prime Contractor Overhead	*10.0%*	*on*	*$*	*489,482*	*$ 48,948*
	Subtotal:					**$ 721,985**
	Prime Contractor Profit	*40.0%*	*on*	*$*	*538,430*	*$ 215,372*
	Subtotal:					**$ 937,357**
	Prime Profit on Subcontracted Work	*10.0%*	*on*	*$*	*183,556*	*$ 18,356*
	Subtotal:					**$ 955,713**
	Bond and Insurance	*3.0%*				*$ 28,671*
	Subtotal:					**$ 984,384**
	Design Contingency	*25.0%*				*$ 246,096*
	Subtotal:					**$ 1,230,480**
	Contract Allowances and Unit Prices	*2.5%*				*$ 30,762*
	Total (rounded):					**$ 1,261,000**

Note: Project Assumptions NTP: 5/1/22, 183 CCD (6 months)