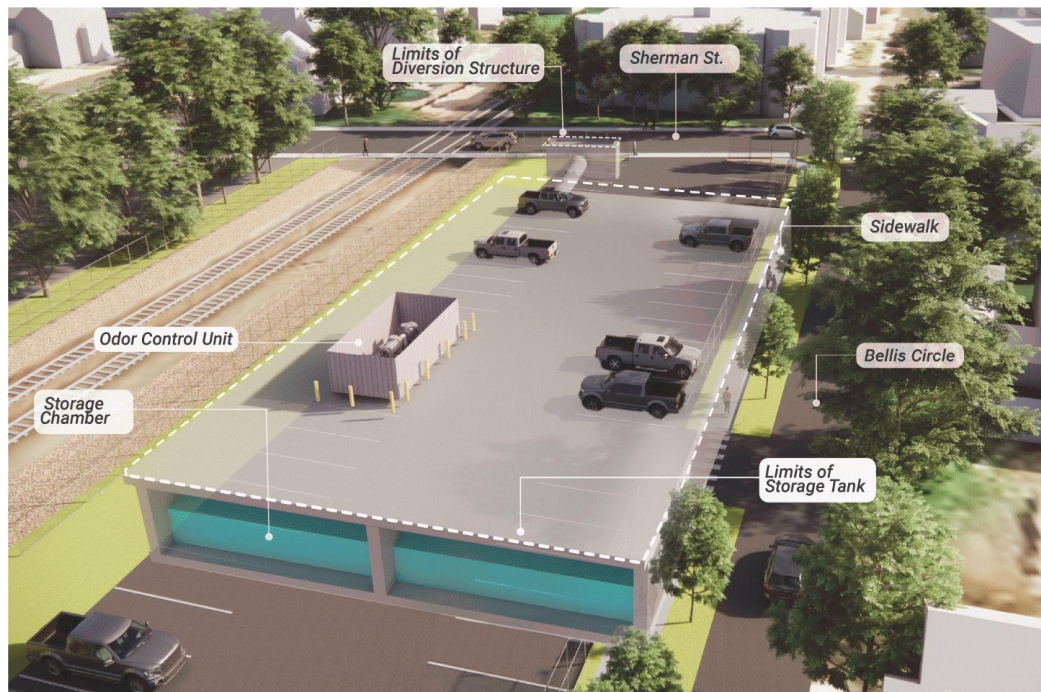


Sherman Street CSO Storage Tank

30% Basis of Design Report



CAMBRIDGE
DEPARTMENT
OF PUBLIC
WORKS



Stantec Consulting Services Inc.



Prepared for:
Cambridge Dept. of Public Works

Prepared by:
Stantec and Kleinfelder

October 14, 2026
Project/File:
195151145

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

Revision Schedule

Revision	Description	Author	Date	Quality Check	Date	Independent Review	Date

Disclaimer

The conclusions in this Report are Stantec's professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the scope of work was conducted and do not take into account any subsequent changes. The Report relates solely to the specific project for which Stantec and Kleinfelder was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient's own risk.

Stantec has assumed all information received from the Cambridge Dept. of Public Works (the "Client") and third parties in the preparation of the Report to be correct. While Stantec has exercised a customary level of judgment or due diligence in the use of such information, Stantec assumes no responsibility for the consequences of any error or omission contained therein.

This Report is intended solely for use by the Client in accordance with Stantec's contract with the Client. While the Report may be provided by the Client to applicable authorities having jurisdiction and to other third parties in connection with the project, Stantec disclaims any legal duty based upon warranty, reliance or any other theory to any third party, and will not be liable to such third party for any damages or losses of any kind that may result.

Prepared by:



Signature

Brandon Beauregard & Michelle Hancox

Printed Name

Approved by:



Signature

David VanHoven

Printed Name



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

TABLE OF CONTENTS

0.0	EXECUTIVE SUMMARY	0.1
1.0	INTRODUCTION	1.1
1.1	PROJECT BACKGROUND	1.1
1.2	STORAGE FACILITY.....	1.3
1.3	PRELIMINARY DESIGN APPROACH	1.4
1.4	PUBLIC OUTREACH AND COMMUNITY ENGAGEMENT	1.5
1.4.1	Community Safeguards.....	1.6
2.0	EXISTING CONDITIONS.....	2.1
2.1	LAND DEVELOPMENT	2.1
2.1.1	Historical Use of Site.....	2.1
2.1.2	Danehy Park.....	2.4
2.1.3	Bellis Circle Residences.....	2.4
2.1.4	Cambridge Montessori School	2.4
2.1.5	MBTA Railway Corridor.....	2.4
2.1.6	Existing Trees.....	2.4
2.2	UTILITIES.....	2.4
2.2.1	General.....	2.5
2.2.2	CAM401A CSO Regulator.....	2.5
2.2.3	Bellis Circle Flood Relief Facility	2.5
2.2.4	Local Water Distribution Mains.....	2.6
2.2.5	Rindge Avenue Drainage Improvements Pipeline.....	2.6
2.3	AREA PROJECTS.....	2.8
2.3.1	Danehy Park Environmental Studies	2.8
2.4	GEOTECHNICAL INVESTIGATION.....	2.9
2.4.1	Geotechnical History.....	2.9
2.4.2	Geotechnical Subsurface Explorations	2.9
2.5	ENVIRONMENTAL INVESTIGATION	2.10
2.5.1	Environmental History.....	2.10
2.5.2	Environmental Explorations.....	2.12
3.0	EVALUATIONS AND ANALYSES	3.1
3.1	HYDRAULIC MODELING ANALYSIS.....	3.1
3.1.1	Design Storms	3.1



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

3.1.2	Interconnectivity of CAM401A and MWR003 CSO Regulators.....	3.2
3.1.3	Future Sewer Separation	3.3
3.1.4	Storage Capacity Alternatives	3.3
3.1.5	Diversion Structure Performance.....	3.6
3.2	DIVERSION STRUCTURE SITING EVALUATION.....	3.8
3.3	STORAGE TANK STRUCTURE EVALUATION.....	3.15
3.3.1	Siting Overview.....	3.15
3.3.2	Conventional Cast-in-Place Concrete Structure.....	3.16
3.3.3	Hybrid Cast-in-Place Concrete Structure.....	3.22
3.3.4	AWWA D115 Tendon-Prestressed Concrete Water Tank	3.25
3.4	SOIL AND MATERIALS HAULING.....	3.28
3.5	PROCESS EVALUATION.....	3.29
3.5.1	Odor Control System	3.29
3.5.2	Tank Cleaning Technologies	3.37
3.5.3	Dewatering Approach	3.38
3.5.4	Solids Management	3.40
3.5.5	Electrical Transformer Evaluation.....	3.43
3.6	STORMWATER RUNOFF MANAGEMENT	3.47
4.0	RECOMMENDED FACILITIES	4.1
4.1	HYDRAULIC STRUCTURES	4.1
4.1.1	Diversion Structure and Pipeline	4.1
4.1.2	Storage Tank	4.4
4.1.3	Constructability Considerations	4.5
4.1.4	Dewatering Valve Vault.....	4.10
4.1.5	CAM401A CSO Regulator Modification	4.10
4.2	PROCESS MECHANICAL	4.12
4.2.1	Odor Control System	4.12
4.2.2	Flushing Equipment Selection.....	4.13
4.2.3	Dewatering Pump Selection and Configuration.....	4.14
4.2.4	Grit Capture Tank	4.17
4.3	CIVIL PIPELINES	4.19
4.3.1	Local Sewer and Drain Impacts.....	4.19
4.3.2	Local Water Main Impacts.....	4.19



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

4.3.3	Private Utility Impacts.....	4.19
4.4	SITE WORK AND LANDSCAPE IMPROVEMENTS	4.20
4.4.1	Paving	4.20
4.4.2	Plantings.....	4.20
4.4.3	Stormwater Management.....	4.20
4.4.4	Vehicle Access	4.21
4.5	ELECTRICAL	4.21
4.5.1	Electrical Utility Service.....	4.21
4.5.2	Electrical Distribution System	4.21
4.5.3	Backup Power	4.22
4.5.4	Exterior Lighting.....	4.22
4.6	INSTRUMENTATION AND CONTROL	4.22
4.6.1	I&C General: Design Standards	4.22
4.6.2	Control System	4.23
4.6.3	Network Communications	4.23
4.6.4	PLC Panel Hardware	4.23
4.6.5	Programming Software	4.24
4.6.6	Functional Description.....	4.25



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

5.0	PERMITTING	5.1
5.1	MBTA LICENSE FOR LAND SURVEY	5.1
5.2	MBTA LICENSE FOR CONSTRUCTION	5.1
5.3	CITY ZONING	5.2
5.4	STORMWATER CONTROL PERMIT	5.2
5.5	TREE REMOVAL PERMIT	5.2
5.6	CITY EXCAVATION AND TRENCH PERMIT	5.2
6.0	ADDITIONAL FIELD INVESTIGATIONS	6.1
6.1	SEWER CONDITION ASSESSMENT	6.1
6.2	MBTA UTILITIES	6.2
6.3	SUBSURFACE UTILITY EXPLORATION	6.2
6.4	TREE CONSIDERATIONS	6.3
7.0	COSTS AND SCHEDULE	7.1
7.1	CLASS 4 CONSTRUCTION COST ESTIMATE	7.1
7.2	DELIVERY SCHEDULE	7.1

LIST OF TABLES

Table 3-1. Summary of 10-Year Storm Used for Modeling	3.2
Table 3-2. CSO Spill Count and Volumes for CAM401A and MWR003 Under 2050 Typical Year	3.4
Table 3-3. Diversion Structure Alternatives and Tank Activations	3.8
Table 3-4. Structural Evaluation of Conceived Cast-in-Place Wall Requirements	3.18
Table 3-5. Pump Hydraulic Parameters	3.40
Table 3-6. Sediment Handling Matrix	3.43
Table 3-7. On-Site Stormwater Runoff Estimate	3.47
Table 4-1. Diversion Structure Design Parameters	4.2
Table 4-2. Tank Design Parameters	4.5
Table 4-3. Valve Vault Details	4.10
Table 4-4. Tipping Bucket Information	4.14
Table 4-5. Pump Parameters	4.17
Table 4-6. Grit Capture Tank Parameters	4.18
Table 4-7. List of Alarms	4.27
Table 4-8. List of Setpoints	4.28
Table 7-1. Delivery Schedule	7.2

LIST OF FIGURES

Figure 1-1. Site Locus Plan	1.2
Figure 1-2. Storage Tank Site at Grade Concept Rendering	1.3



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

Figure 1-3. Storage Tank Site Below Grade Concept Rendering	1.4
Figure 2-1. Aerial Photos of Historical and Present-Day Site (HistoryCambridge.org; Google 2025)	2.2
Figure 2-2. Birds Eye View of Study Area (Google Earth 2025)	2.3
Figure 2-3. Short Term Combined Sewer Snapshot.....	2.7
Figure 2-4. Cross Section of Utilities on Rindge Ave for a Fully Separated Scenario.....	2.8
Figure 3-1. Peak Flow Schematic During 8/14 Event of 2050 Typical Year	3.3
Figure 3-2. CSO Volume Distribution at CAM401A 2021-2024.....	3.5
Figure 3-3. Flood Depths and Extents Under Baseline Conditions and After Tank Improvements	3.6
Figure 3-4. CFD Model of Diversion Structure and CAM401A – 2050 Typical Year Maximum Flow	3.7
Figure 3-5. Diversion Structure Alternative 1	3.10
Figure 3-6. Diversion Structure Alternative 1 Flow Pattern	3.11
Figure 3-7. Diversion Structure Alternative 2	3.13
Figure 3-8. Diversion Structure Alternative 2 Flow Pattern	3.14
Figure 3-9. Conventional Cast-in-Place Concrete Tank Example (Stantec, 2007)	3.17
Figure 3-10. Conventional Cast-in-Place Layout – Initial Concept	3.19
Figure 3-11. Conventional Cast-in-Place Layout – Reduced Depth.....	3.20
Figure 3-12. Conventional Cast-in-Place Layout – Goal Adjusted	3.21
Figure 3-13. Diaphragm Wall and Secant-Pile Wall Methods of Construction (Keller)	3.22
Figure 3-14. Excavated Diaphragm Wall with Tieback Anchors (Keller)	3.23
Figure 3-15. Hybrid Cast-in-Place Layout.....	3.24
Figure 3-16. AWWA D115 Tendon-Prestressed Precast Rectangular Tank	3.26
Figure 3-17. AWWA D115 Tendon-Prestressed Cast-in-Place Circular Tank.....	3.27
Figure 3-18. Candidate Haul Route to New Street.....	3.29
Figure 3-19. RF System	3.32
Figure 3-20. VTS System.....	3.33
Figure 3-21. Typical Noise Levels and dB ratings.....	3.34
Figure 3-22. Perimeter Acoustic Panel Enclosure Example	3.35
Figure 3-23. Dedicated Fan and Motor Acoustic Enclosure	3.35
Figure 3-24. Grit Separator Tank.....	3.41
Figure 3-25. Sewer Flush Vault	3.42
Figure 3-26. Pad-Mounted Transformer Concept 1 - Truck Turning Radius Conflict	3.44
Figure 3-27. Pad-Mounted Transformer Concept 1 – Parking Space Conflict	3.44
Figure 3-28. Electrical Equipment Concept 2 – Utility Layout	3.45
Figure 3-29. Pad-Mounted Transformer Concept 2 - Truck Turning Radius Conflict	3.46
Figure 3-30. Pad-Mounted Transformer Concept 2 – Parking Space Conflict	3.46
Figure 3-31. On-Site Stormwater Management Alternative.....	3.49
Figure 3-32. Candidate Subsurface Infiltration System Products	3.50
Figure 4-1. Storage Tank Facility	4.3
Figure 4-2. Diversion Structure Section	4.4
Figure 4-3. Storage Tank Profile View	4.7
Figure 4-4. Sherman Street Southbound Detour.....	4.9
Figure 4-5. CAM 401A Modifications.....	4.11
Figure 4-6. Dewatering System Curve with Pump Selection	4.17
Figure 6-1. Root Ball Lateral	6.1
Figure 6-2. Crack Multiple	6.2



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

LIST OF APPENDICES

- APPENDIX A TREE ANALYSIS SITE WALK**
- APPENDIX B EXISTING CONDITIONS SURVEY**
- APPENDIX C GEOTECHNICAL ENGINEERING REPORT**
- APPENDIX D ENVIRONMENTAL MEMORANDUM**
- APPENDIX E CSO STORAGE TANK OPTIONS WORKSHOP**
- APPENDIX F TRUCK TURN FEASIBILITY**
- APPENDIX G 30% DESIGN DRAWINGS**
- APPENDIX H HYDRAULIC STRUCTURES DESIGN CRITERIA**
- APPENDIX I UPDATED CSO CONTROL PLAN**
- APPENDIX J 30% SPECIFICATION TABLE OF CONTENTS**
- APPENDIX K 30% OPCC**
- APPENDIX L RINDGE AVENUE DRAINAGE IMPROVEMENTS**

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

Abbreviations

AC	Alternating Current	H ₂ S	Hydrogen Sulfide
ACH	Air Changes per Hour	HMI	Human-machine interface
ACI	American Concrete Institute	HP	Horsepower
ADA	Americans with Disabilities	HSG	Hydrologic soil group
ATS	Automatic Transfer Switch	I&C	Instrumentation and Control
CCB	Cambridge City Base	I/O	Input/output
CCTV	Closed-Circuit Television	ICM	Integrated All Source Catchment Modeling
cfm	Cubic Feet per Minute	IEEE	Institute of Electrical and Electronics Engineers
cfs	Cubic Feet per Second	INC	Incorporated
CMR	Code of Massachusetts Regulations	IND	Industrial zoning district designation as referenced
dBA	A-weighted decibels	kVA	Kilovolt-ampere
DEP	Department of Environmental Protection	LCP	Local control panel
fps	Feet per second	LED	Light-emitting diode
FRP	Fiberglass reinforced plastic	LSP	Licensed Site Professional
GIS	Geographical Information Systems	LT	Low-head impeller trim as referenced
GNA	Gabriel Novac and Associates	MassDEP	Massachusetts Department of Environmental Protection
gpm	Gallons per minute	MBTA	Massachusetts Bay Transportation Authority
GRP	Glass Reinforced Polymer	MCP	Massachusetts Contingency Plan



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

NEC	National Electrical Code	RJ45	Registered Jack 45 Ethernet connector
NEMA	National Electrical Manufacturers Association	ROW	Right-of-way
NFPA	National Fire Protection Association	SCADA	Supervisory Control and Data Acquisition
MG	Million Gallon	SS-316	Type 316 stainless steel
min	Minimum	St	Street
MS	Microsoft, as referenced in operating system software	SU-30	Single-unit 30-foot design vehicle
MT	Medium-head impeller trim as referenced	SUE	Subsurface Utility Exploration
MWRA	Massachusetts Water Resources Authority	SVOCs	Semi-Volatile Organic Compound
NEC	National Electrical Code	TDH	Total dynamic head
NO	Number	Telecom	Telecommunications
NP	Flygt pump model designation as referenced	TP	Total phosphorus
O&M	Operations and maintenance	TSS	Total suspended solids
OIT	Operator Interface Terminal	UL	Underwriters' Laboratories
OPCC	Opinion of Probable Construction Cost	UPS	Uninterruptible power supply
P&ID	Process and Instrumentation Diagram	VAC	Volts alternating current
PLC	Programmable Logic Controller	VCP	Vendor control panel
PSI	Pounds per square inch	VDC	Volts direct current
QL-A	Quality Level A subsurface utility exploration	VFD	Variable frequency drive
QL-B	Quality Level B subsurface utility exploration		



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

0.0 EXECUTIVE SUMMARY

In 2023, the City of Cambridge acquired the #135 Sherman Street parcel (Site), which is located in close proximity to the CAM401A combined sewer overflow (CSO) regulator. Relief of the CAM401A regulator is one of many included in a joint Updated CSO Control Plan to reduce CSO events and volumes to receiving surface waters. The Site is a 0.9-acre parcel consisting of an undeveloped paved lot. The planned use of the Site was a below grade wet weather storage facility to provide relief of the CAM401A regulator, with the potential for an above grade Department of Public Works (DPW) building. A multi-use path known as the Danehy Park Connector was also considered for the northern side of the Site adjacent to an MBTA railway corridor.

A conceptual design of this multi-use facility was undertaken in Fall 2025, providing initial definition for a CSO storage tank, the potential future DPW building inclusive of a vehicle fleet stored above the tank, and the addition of a public sidewalk to serve the northern edge of Bellis Circle. Spatial allocations for the multi-use path were also made. The conceptual design concluded with a City decision to phase the CSO storage tank and new public sidewalk as a first construction project, with the remainder to follow as future phases.

This Basis Of Design Report is focused on the CSO storage tank and public sidewalk improvements.

Preliminary Design Approach

While the conceptual design identified several alternatives for the storage tank, many of them were re-examined through a preliminary design process that refined concepts or undertook more detailed evaluation. An evolved recommendation is presented based on:

- A second round of geotechnical and environmental investigation,
- Computational fluid dynamic (CFD) modeling of local weirs and conduits,
- Vendor discussions on operation and maintenance strategies and equipment,
- Technical assessment of odor control and sediment deposition risks,
- Trees identified by the City Arborist for protection,
- Historical record of all known existing utilities,
- Historical condition assessment of City owned utilities,
- Constructability considerations,
- Early coordination with MBTA officials and,

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

- A community engagement process that desires to reduce impacts to surrounding residents, schools, and businesses.

Key workshops were held with the City to review technical elements of the project:

- May 18, 2026 CSO Storage Tank Options Workshop: a meeting with Cambridge DPW to further evaluate the diversion structure weir configuration, tank layout and structure type, tank cleaning equipment, dewatering pump technology, solids handling approach, odor control equipment, and modifications to the CAM401A regulator.
- May 19, 2026 City Arborist Site Walk: all existing trees within the Site were evaluated for protection or as candidates for removal.
- June 9, 2026 Pump Vendor Meeting: a meeting with Cambridge DPW and Flygt pump representatives to review pump impeller offerings and history of pump maintenance in the City.

Community outreach events were also undertaken:

- May 28, 2026 Virtual Community Meeting: presentation on project status with structured question and answer.
- June 23, 2026 Pop Up Event: held at the project Site for abutters with unstructured question and answer.

Individual neighborhood abutter conversations were held by appointment on the following dates. These conversations gave neighbors a chance to speak with the project team directly to answer questions and address concerns.

- Monday, May 11, 2026
- Tuesday, May 12, 2026
- Wednesday, May 13, 2026

Hydraulic Analyses & CAM401A Regulator

Stantec prepared a computational fluid dynamic (CFD) model, in tandem with the Baseline Model for the CSO Control Plan, to engineer the proposed diversion structure and refine weir elevations for overflow into the CSO storage tank and at the CAM401A regulator. This modeling demonstrates that the facility can contain the 2050 Typical Year of storm events without activation of CAM401A.

Modifying the CAM401A regulator involves raising its weir, which is expected to raise the structural top slab and may require replacement of the internal rotating brush screen assembly. The project team is in discussion with the original vendor of this equipment to see if it can be successfully removed and reset.

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

Recommended Facilities

Through progression of the preliminary design and collaboration with the City, the following facilities were selected as a basis of design . The 30% BODR represents a preliminary stage in project development and should not be viewed as final or fixed. The recommendations establish a baseline for project design objectives and further review with City Departments, Permitting, CSO control planning, and Community Outreach will occur for further refinement. The 30% BODR recommendations are preliminary and may evolve or change as the design advances with stakeholder expectations. Refer to **Figure ES 1** a facility overview, and **Appendix G** for full sized 30% Design drawings.

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

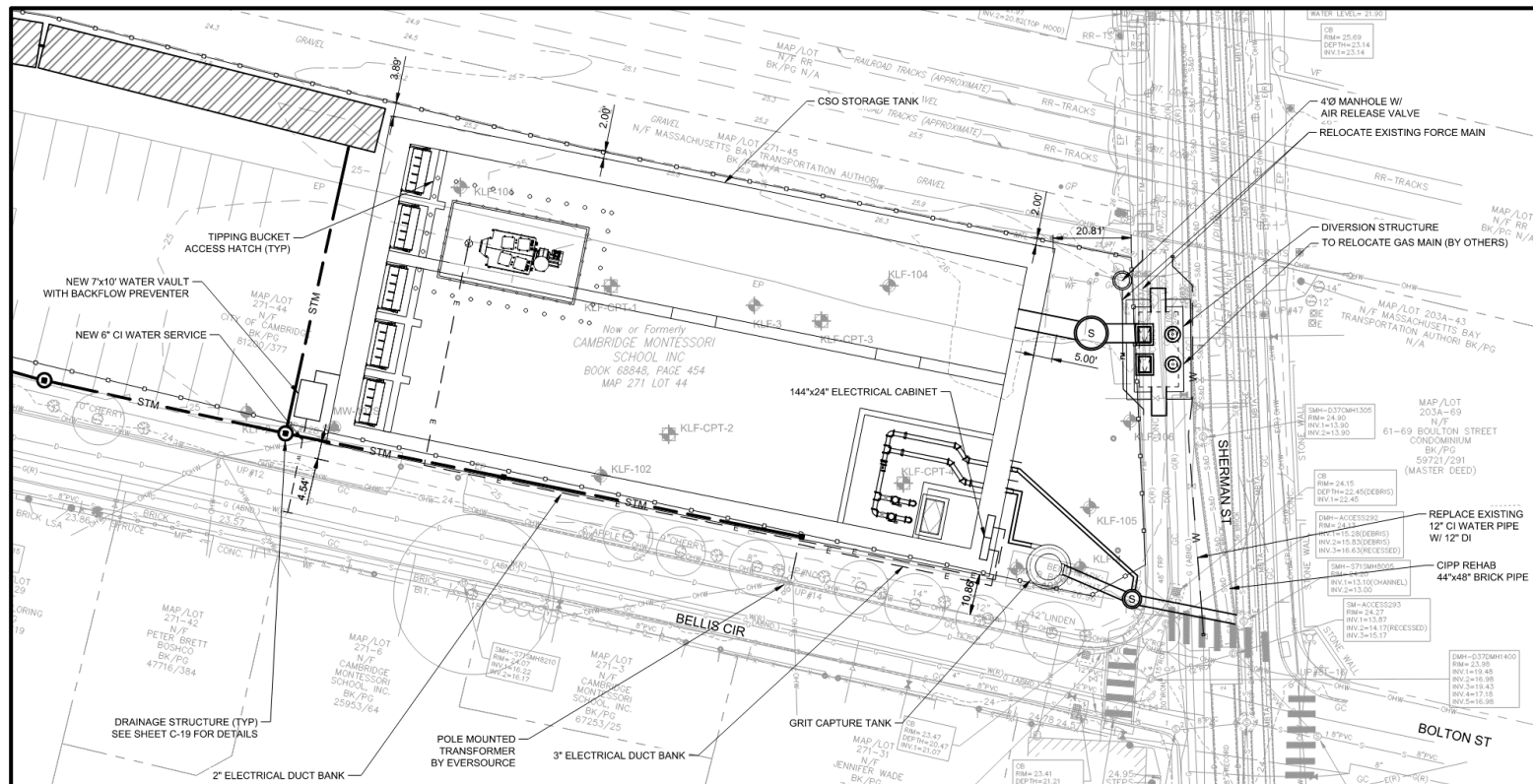


Figure ES 1. Plan View of Sherman Street CSO Storage Facility

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

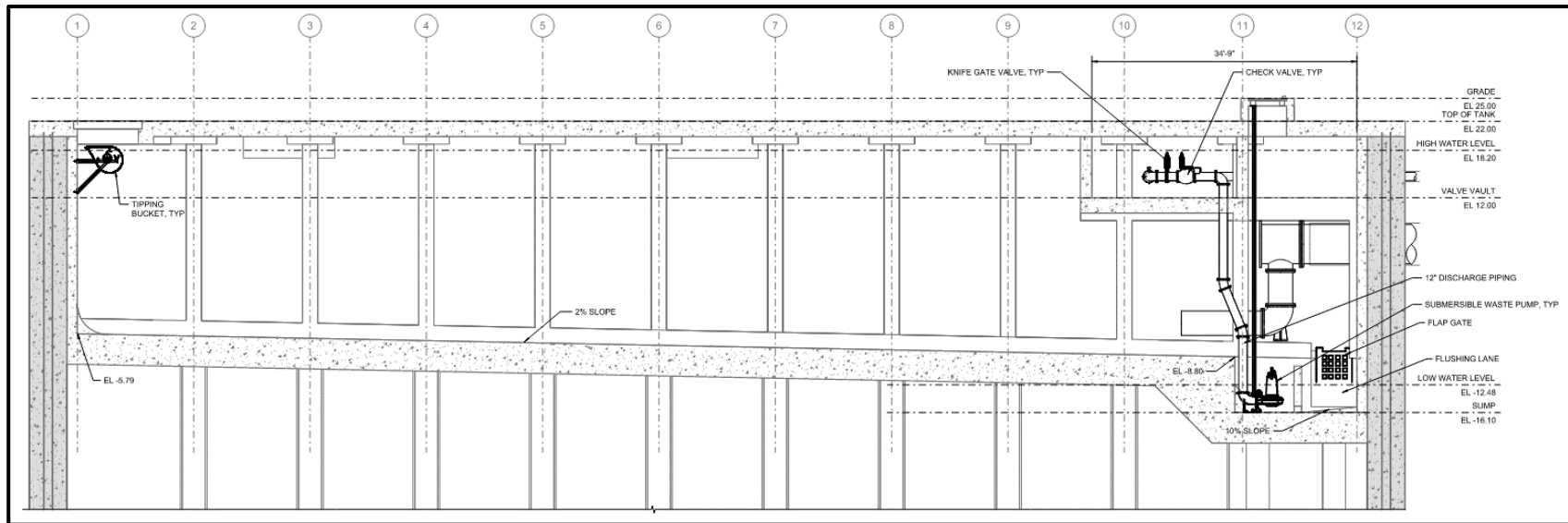


Figure ES 2. Section of Storage Tank Structure

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

Underground Storage Tank and Internal Equipment

The underground storage tank is a 2.1 MG rectangular structure involving cast-in-place construction with hybrid geotechnical walls, assumed to be secant piles but allowing for a diaphragm wall subject to market conditions. This strategy maximizes the tank width on a relatively narrow parcel to reduce operational depth for ease of maintenance while respecting reasonable setbacks for tree protection, a potential future DPW building, and reducing risks to nearby structures and utilities. Other tank construction methods considered only partially meet this objective.

The tank exterior is an estimated 181-ft by 81-ft and is situated on the east side of the parcel. The tank is partitioned as two chambers, the first to store ~1 MG for smaller storm events and then overflow to the second chamber for larger events. The tank is accessed by ductile iron hatches and manhole covers plus removable concrete panels at a large opening in the top slab.

As seen in **Figure ES 2** the tank floor slopes to a pump sump, approximately 40 feet below grade, that contains two submersible non-clog centrifugal pumps (Flygt N-series) in a lead/lag configuration with the ability to dewater the tank in 12 to 24 hours. The pumps are mounted on guide rails for removal by a truck-mounted crane. A discharge valve vault with hatches for man entry is located in the headspace of the tank.

Tipping buckets will be utilized for tank cleaning, arranged in the headspace of the tank with five flushing lanes. Each tipping bucket requires only a solenoid valve and a water supply to flush the floor. Each bucket is accessed by removable concrete panels with manhole covers for inspection of sealed bearings.

Diversion Structure

Flow is directed into the storage tank via a new cast-in-place concrete vault in Sherman Street. This diversion structure contains dual weirs up to 20-ft long so that the tank does not activate until the combined sewer is approaching a CSO activation. Combined sewage will be directed from the diversion structure to the storage tank by a 60-inch glass reinforced plastic (GRP) pipe. The weirs are sized to accommodate coarse bar racks (8-inch on center) to protect the tank dewatering pumps from large debris. Bar rack maintenance is a manual activity using a long-handled rake accessible from the ground surface via access hatches in the Sherman Street public sidewalk and gutter line.

Relocation of a 12-inch water main, 16-inch force main (Bellis Tank) and a 12-inch gas main is required at the location of this proposed structure, connected to a 48-inch FRP combined sewer. Cured in place pipe lining of a 44-inch by 48-inch brick combined sewer segment adjacent to the structure is recommended to strengthen this conduit, which may be undermined by the deep excavation of the vault.

Grit Capture Tank

When the CSO storage tank is dewatered, pumped flow is directed through a valve vault with options to discharge directly to the 27-inch by 36-inch brick/concrete sanitary sewer on Sherman Street, or first through a grit capture tank. The grit capture tank will retain sediment that originates from the combined

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

sewer – which has a history of sediment maintenance – that may otherwise impact the sanitary sewer. Sediment retained within the grit capture tank must be removed via vactor truck.

Odor Control System

An above ground packaged odor control system with activated carbon filter is proposed to mitigate impacts to the surrounding community by treating accumulated gases that vent from the storage tank. The system is sized for a flow of 75 million gallons per day (MGD), which is the peak inflow for a two-year / 24-hour 2050 design storm, equating to ventilation at a rate of 7,000 cubic feet per minute. Noise attenuation is provided using an acoustical barrier (solid fence and gate), allowing free access to the equipment for routine maintenance and inspection.

Electrical, Instrumentation and Controls

Electrical service is provided by a pole-mounted transformer at the edge of the parcel. Exterior enclosures contain variable speed drives for the pumps and a control cabinet with Verizon cellular networked with City SCADA for remote monitoring and control. Local automatic controls with level sensors and a flow meter allow this facility to operate unmanned. A hookup for a portable backup generator is provided to power the odor control system under a prolonged power outage.

Area Restoration and Landscaping

The site will be restored to its existing condition as a fenced paved lot with a grassed area, plus an ADA-compliant sidewalk along Bellis Circle. Facilities visible above grade consist of the electrical enclosures and the odor control system surrounded by an acoustical barrier.

The site restoration prioritizes preservation of trees identified by the City Arborist for protection. Supplemental tree plantings will complement the Bellis Circle roadway corridor. Native shrubs, grasses and groundcover plantings will be incorporated where appropriate to increase biodiversity, provide habitat value, and minimize long-term maintenance and irrigation requirements.

An on-site stormwater management system is proposed to meet the City's 25:2 stormwater runoff reduction standard for the impervious area introduced by the sidewalk, given that it is located within the parcel limits.

Existing roads and sidewalks disturbed by the construction will be restored using a mix of full-depth roadway construction, mill & overlay of asphalt and concrete walk replacement.

Capital Construction Cost

The estimated construction cost of the CSO storage tank is \$35.8 million as a first phase of construction. A 15% contingency is included in the estimate. The construction cost is based on construction commencing in September 2027 followed by an interim site restoration until future phases begin their own construction.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

Approach for Final Design

Final design consists of a 60% Design effort followed by a 100% Design effort. The typical design cycle is accelerated to meet City objectives for construction to begin in late Summer 2027. Several activities remain for the project team to complete the design as follows:

1. **Community Engagement.** Continued and meaningful involvement with area residents, the adjacent Montessori school, local businesses and public stakeholders is critical to the success of this project. The project team is devoted to this process and adapting designs where appropriate to incorporate feedback and protect sensitive abutters.
2. **MBTA License for Construction.** The 30% Design Drawings (**Appendix G**) will be re-packaged for formal MBTA review and acceptance, which is expected to take at least six months and could introduce new requirements. Through this process, the project team is also pursuing approval from the MBTA for temporary construction access on its parcel north of the Site and within the railway corridor to increase area for vehicle/material staging and create a temporary hauling route to New Street; however, the preliminary design as recommended is not reliant upon this access.
3. **Zoning.** The Sherman Street parcel is zoned C-1 Residential. Discussions between City departments are recommended to formalize the phased DPW infrastructure, building and community path improvements on this parcel.
4. **Potential Future DPW Building and Multi-Use Path.** Coordination with City staff advancing other projects conceived at the Site may introduce requirements to accommodate the function and construction of those future phases.
5. **Field Investigations.** Remaining field investigations include subsurface utility exploration (QL-A test pitting) of Sherman Street utilities that may be conflicting, a limited amount of CCTV pipeline inspection, and evaluation of tree roots by the City Arborist for the new sidewalk construction.
6. **Environmental Contamination.** The site has a history of impacted soil, likely from a historic underground storage tank. Though remediation efforts were undertaken by the prior landowner, provisions for encountering contaminated soil need to be included to protect public safety and control cost unknowns.
7. **CSO Control Plan Implementation.** The draft Plan is presently undergoing public review and subject to MassDEP/EPA approval. The final Plan may subject this project to technical requirements and/or a compliance schedule that differs from this report.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

1.0 INTRODUCTION

The 30% Basis of Design Report (BODR) advances the City of Cambridge's plan for a multi-use facility on its recently acquired #135 Sherman Street parcel, formerly #41 Bellis Circle (Site). The conceived facility consists of a combined sewer overflow (CSO) storage tank and a potential future Department of Public Works (DPW) building with a paved lot for vehicle storage to serve the growing needs of the City.

A Conceptual Design Report prepared by Stantec in 2025 provided definition of the facility, with a plan for construction in phases. The scope of this BODR is the preliminary design of the first phase: an underground 2.1 million gallon (MG) CSO storage tank on the east side of the parcel, plus a public sidewalk on the south edge of the parcel. This report does not advance preliminary design of the second phase of a potential future DPW building on the west side of the parcel but does include design considerations to coordinate siting of the work.

This report documents existing conditions local to the Site, refines hydraulic modeling related to City-wide CSO control planning, evaluates alternatives for different storage tank components, and presents overall findings and recommendations for final design of the storage tank.

1.1 PROJECT BACKGROUND

The City of Cambridge, City of Somerville and Massachusetts Water Resources Authority (MWRA) are exploring various strategies to meet their respective obligations under a joint Updated CSO Control plan that is under development. A primary strategy for the City of Cambridge is to create wet weather storage within its CAM401A combined sewer catchment.

The Site was acquired by the City in 2023, in part, for its position near the City's CAM401A CSO regulator and being of sufficient land area for wet weather storage (**Figure 1-1**). These types of facilities are often constructed underground to fill passively during a storm event, making the land area above grade available for other facilities. Similar stormwater storage tanks exist below the Danehy Park parking lot, under the Tobin Montessori School bus turnaround, at the pedestrian entry to the Main Library, and within the municipal Parking Lot 6 in Central Square. Each location demonstrates a mixed-use facility successfully constructed and in operation within the City of Cambridge.

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

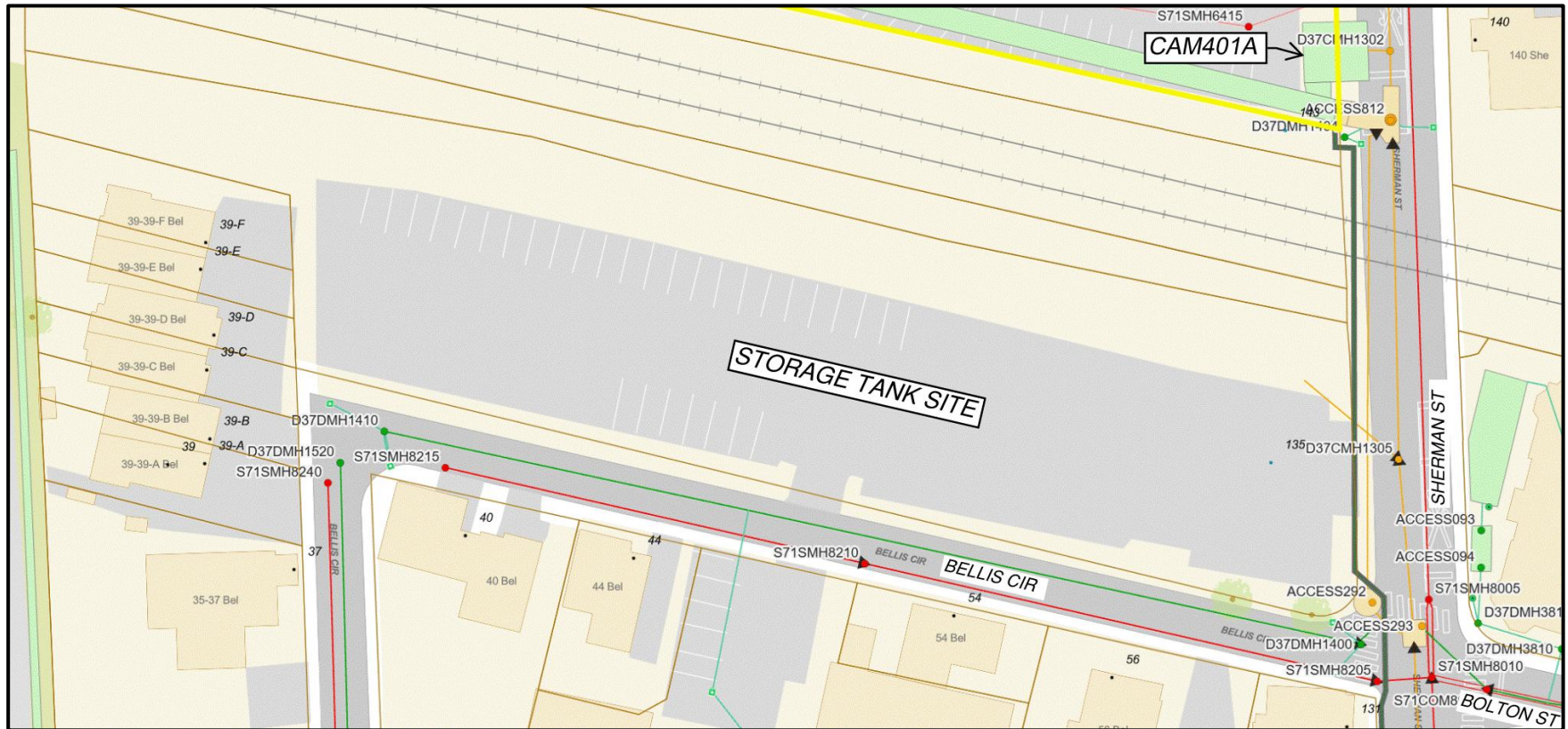


Figure 1-1. Site Locus Plan

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

1.2 STORAGE FACILITY

The CSO storage tank provides 2.1 MG of temporary detention during storm events. The primary elements consist of a diversion structure, underground concrete tank, dewatering pumps, and secondary equipment for tank cleaning and odor control. Upon completion of tank construction, the Site will be restored to match existing conditions except for a new pedestrian walkway serving Bellis Circle. Refer to **Figure 1-2** and **Figure 1-3** illustrating a concept rendering of the restored site at grade and below grade.

The target volume is inclusive of 0.4 MG conceived by the MWRA as a strategy to meet their own obligations under the joint Updated CSO Control Plan, as presented in the MWRA report titled Supplement to the 2021 Final Combined Sewer Overflow Post Construction Monitoring Program and Performance Assessment Report (AECOM, December 27, 2024).



Figure 1-2. Storage Tank Site at Grade Concept Rendering

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

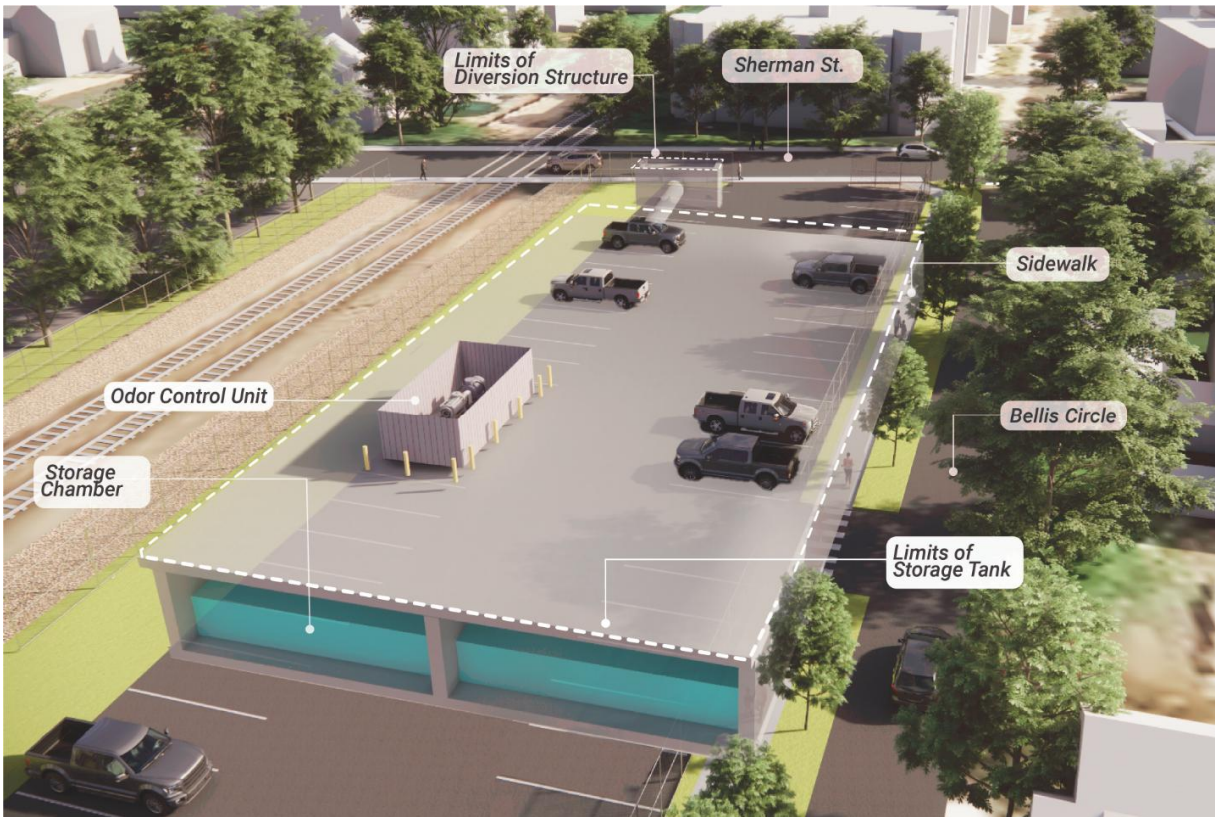


Figure 1-3. Storage Tank Site Below Grade Concept Rendering

1.3 PRELIMINARY DESIGN APPROACH

The preliminary design for the CSO storage tank explores various alternatives for the development of the Site. Given the near-term goal for wet weather storage, this report considers the potential future DPW building as a secondary use with an uncertain scope and schedule. As such, the structures and foundations for the wet weather storage tank and the potential future DPW building are designed to be segregated.

This preliminary design serves to define the following elements:

- Historical context and City planning initiatives
- Community Engagement Concerns
- Geotechnical and Environmental Investigations
- Existing Conditions



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

- Hydraulic Modeling
- Constructability
- Storage Tank Geometry and Structure Type
- Influent and Effluent Flow Conveyance
- Tank Cleaning and Solids Handling
- Odor Control
- Pedestrian Walkway and Stormwater Management
- 30% OPCC
- Project Schedule

1.4 PUBLIC OUTREACH AND COMMUNITY ENGAGEMENT

Community engagement is a critical component of a project of this scale within a dense, urban neighborhood. The City recognizes that successful implementation depends not only on sound engineering and environmental performance, but also on maintaining clear, transparent communication with residents and other stakeholders. This project is a key element of the City's ongoing commitment to reducing Combined Sewer Overflows (CSOs) in the Alewife watershed and adhering to its legal and environmental responsibilities. Throughout planning, design, and construction, the City is committed to making sure that the community understands the need for the project, its anticipated benefits, and the measures that will be taken to minimize impacts.

Public outreach began with the project's initial introduction at a Cambridge Health and Environment Committee public hearing in September 2025. At that meeting, the project team presented the first concepts for the proposed underground CSO storage tank and the future aboveground facility envisioned for the Site. The presentation focused on the need for additional CSO storage capacity and the project's role in reducing overflow discharges to the Alewife system.

The first dedicated in-person community meeting was held in December 2025. The meeting provided an overview of the project, with a primary focus on the proposed underground CSO storage tank. Attendees were able to review preliminary design information displayed on presentation boards throughout the meeting space and engage directly with members of the project team. This format provided opportunities for residents to ask questions, share concerns, and gain a more detailed understanding of the project's objectives and preliminary design approach.

In parallel with these public meetings, the project team worked with the City to provide regular updates for the City's project website, ensuring that project information remained accessible to the broader community.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

In May 2026, the City conducted individual conversations with abutting property owners and nearby residents. Appointments were offered to provide stakeholders with an opportunity to discuss project details, ask questions, and share feedback in a more focused setting. These discussions helped the project team better understand individual concerns and provided valuable input to inform ongoing design development.

Following these conversations, the City hosted a virtual public meeting in May 2026 and a community pop-up in June 2026 to provide an update on project progress and the next stages of design. The meeting included a detailed discussion of the project's purpose within Cambridge's Combined Sewer Overflow Program and its connection to the Draft Updated CSO Control Plan. The presentation emphasized the importance of addressing overflows at Outfall CAM401A, the City's most active CSO outfall, located adjacent to the project Site. Preliminary design concepts were presented, anticipated construction activities were discussed, and a project schedule outlining upcoming milestones was shared with attendees.

Community engagement will continue throughout design and construction. The City is committed to maintaining open lines of communication and providing timely information regarding project developments, anticipated construction activities, and potential neighborhood impacts. As design progresses, project information shared with the public will include details regarding vibration, noise, and dust monitoring programs, traffic management strategies, and procedures for pre-construction inspections of adjacent properties. Through these efforts, residents will remain informed and have clear expectations regarding project activities at every stage of implementation. Continuous outreach, engagement, and transparency are central to the City's commitment to delivering this critical infrastructure project while maintaining trust and collaboration with the surrounding community.

1.4.1 Community Safeguards

To summarize, as design continues, the project team will build in measures to protect nearby residents, schools, and park users. **Environmental testing completed to-date shows soil and groundwater conditions below applicable regulatory concern levels.** If contaminated soil or groundwater is encountered during construction, it will be handled under the required environmental procedures. The design also includes odor control and air quality checks, construction and noise monitoring, review of truck routes, tree protection where feasible, and continued communication with the surrounding community. These measures are intended to keep the work safe for the team on site, residents of the neighborhood, and those passing through; reduce disruption; and make sure neighbors know what to expect as the project moves forward.



2.0 EXISTING CONDITIONS

The Site is located on the corner of Sherman Street and Bellis Circle in North Cambridge, as depicted in **Figure 2-1**. The 0.9-acre parcel consists of an undeveloped paved lot adjacent to an MBTA Commuter Rail corridor (Fitchburg Line) to the north and abutting Danehy Park and single-family townhomes to the west. To the east lies multi-family residential buildings, and to the south lies the private elementary Cambridge Montessori School situated amongst single and multi-family residences. Vehicular access to the paved lot is achieved via two curb cuts, one on Sherman Street on the east of the Site and one on Bellis Circle on the south of the Site.

2.1 LAND DEVELOPMENT

The neighborhood immediately surrounding the Site has evolved over time. It is predominantly residential with remnants of an eclectic art community including the nearby Noca Glass School and public arts installations in Danehy Park as seen in **Figure 2-2**. Other nearby schools include the private Cambridge Friends School and public Peabody/Rindge School complex. Single-story commercial businesses operate to the south along Sherman Street, which serves as a busy thoroughfare for commuters.

2.1.1 Historical Use of Site

As of the early 1950s, the Site was located on the edge of a working clay pit, operated by the New England Brick Company as seen in **Figure 2-1**. From 1952-1971, the empty clay pit was then used as a landfill until being filled in with soils disposed by the MBTA's Red Line Subway construction. In the 1980s, the disposal site was revitalized into present day Danehy Park, and the Sherman Street parcel (yellow box in figure) was paved over in the 1990s, becoming a parking lot that has remained unchanged to date. Historic building foundations and train tracks may still exist on site below grade.

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

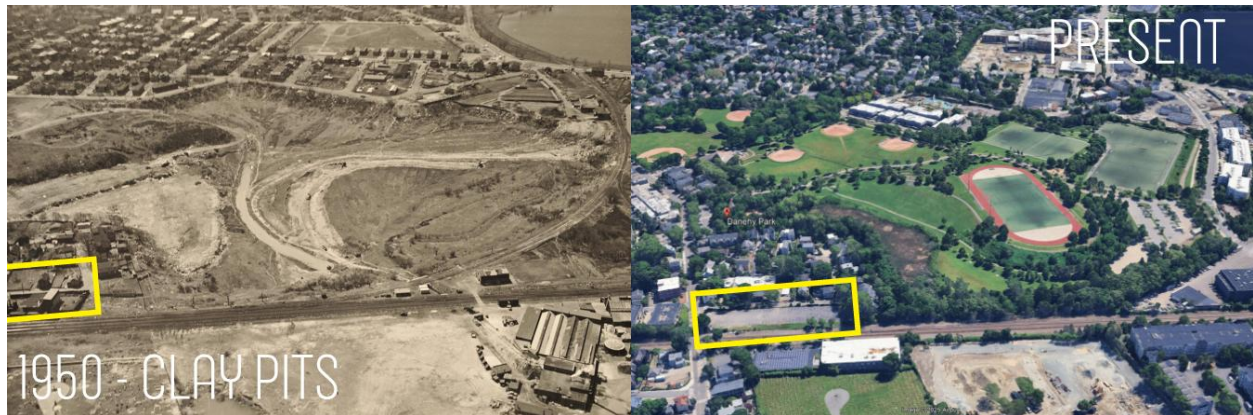


Figure 2-1. Aerial Photos of Historical and Present-Day Site (HistoryCambridge.org; Google 2025)

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK



Figure 2-2. Birds Eye View of Study Area (Google Earth 2025)



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

2.1.2 Danehy Park

Danehy Park is a 50-acre park immediately south and west of the Site. The park provides athletic fields, walking paths, playgrounds, public art, a dog park and community events.

2.1.3 Bellis Circle Residences

The Site is next to the Bellis Circle residences, and development of the Site will need to consider short-term construction impacts and long-term visual, noise, and odor mitigation for the community.

2.1.4 Cambridge Montessori School

The Cambridge Montessori School is a sensitive receptor adjacent to the Site, particularly regarding traffic flow and standing vehicles before and after school hours.

2.1.5 MBTA Railway Corridor

The railway corridor carries daily commuter trains for the Fitchburg Line and no freight trains. The railway crossing on Sherman Street is a signaled Highway-Rail Grade Crossing and the medians were upgraded in 2020 to eliminate the need for sounding train horns when passing through the area. While signals are activated, vehicular, pedestrian and bicycle traffic on the south side of the tracks are staged next to the Site.

2.1.6 Existing Trees

There are multiple existing trees along the perimeter of the Site ranging in good to poor condition. A site visit was held on May 19, 2026 with the City Arborist to assess tree locations and conditions noting trees subject to City of Cambridge Tree Protection Ordinance or being candidates for removal due to invasive, diseased and/or non-desirable species. Trees identified for protection or candidates for removal are documented in **Appendix A**. Refer to **Section 4.4.2** for additional discussion including proposed tree plantings and site restoration strategy.

2.2 UTILITIES

A utility survey was performed by WSP in Spring 2025 with base mapping generated as shown in **Appendix B**. The utility survey was generated from an on-the-ground field survey and review of historical record drawings. Additionally, in the Spring of 2026, BSI Engineering performed Quality Level B subsurface utility engineering (SUE) services to horizontally locate water, gas, electric, telecommunication and traffic control features within the limit of work. This field data was reviewed internally to further update and/or refine the base mapping as required.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

2.2.1 General

The Site abuts a congested utility corridor along Sherman Street that includes water mains, gas mains, underground telecommunications, electrical conduit, a stormwater force main, and large trunk sewers. There are two combined sewers (48-inch FRP, 44-inch x 48-inch Brick) and one sanitary sewer (27-inch x 36-inch Brick/Concrete). Utility poles with overhead electrical wires also exist on Sherman Street and the MBTA railway tracks operates approximately 20-ft north of the parcel.

Bellis Circle contains local utilities such as sanitary sewer, storm drain, water main and overhead electric/telecom. No utilities are mapped within the Site, other than a utility pole with a designated pole luminaire.

Most of the sewer and drain pipes are old brick, clay or portland (legacy concrete) materials, which are candidates for rehabilitation given their age.

2.2.2 CAM401A CSO Regulator

The City has various CSO regulators that allow hydraulic relief of its collection system during large rain events. The CAM401A regulator provides hydraulic relief of the neighborhood's local combined sewer system during wet weather, reducing the risk of basement backups and surface flooding by diverting excess combined sewage into a box culvert that runs along the MBTA railway corridor and ultimately discharges to the Alewife Brook.

The CAM401A regulator is located on the west side of Sherman Street immediately north of the MBTA railway and is unique because it is sited upstream in a City catchment, whereas most regulators are sited next to a water way. During dry weather, the Sherman Street combined sewer flows north to the Rindge Avenue combined sewer, which then flows west to an MWRA sewer interceptor at the headwaters of the Alewife Brook where a second CSO regulator MWR003 is located. Therefore, there is an interconnection between CAM401A and MWR003 that creates a hydraulic relationship between the two regulators, where improvements at one can increase or decrease CSO occurrences and volumes at the other.

2.2.3 Bellis Circle Flood Relief Facility

A stormwater storage facility known as the Bellis Tank is located in the parking lot for Danehy Park, west of Sherman Street. This storage tank was installed in 2002 to reduce localized flooding by collecting overland flows from the large wetland at the Park that impact Bellis Circle residences. The storage tank includes a pump station that dewater the tank via a 16-inch DI force main along Sherman Street, to the same MBTA railway culvert that receives overflows from the CAM401A regulator.

As part of that project, the City installed a spare 18-inch ductile iron pipe casing under the railroad crossing should the need arise for a future utility crossing. The spare casing starts and terminates approximately 40-ft south and 20-ft north of the railroad tracks, respectfully.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

2.2.4 Local Water Distribution Mains

As part of CAM401A regulator upgrades in 2004, a portion of old cast iron watermain was replaced with 12-inch ductile iron from the regulator to the northeast corner of the Site. Cast iron watermain remains to the east on Bolton Street, to the west on Bellis Circle, and further south on Sherman Street. The cast iron mains are candidates for replacement given their age.

2.2.5 Rindge Avenue Drainage Improvements Pipeline

Stantec has developed a conceptual layout for additional combined sewer, sanitary, and drainage infrastructure within Rindge Avenue. The primary goal was to provide additional short term combined sewer capacity to meet the requirements of the Draft Updated CSO Control Plan, with the additional criteria to accommodate future full separation of the sewer system.

To achieve this, an examination of existing conditions within the project area was performed. There are numerous existing utilities within the street that will impact the future construction. The large 48-inch diameter brick combined sewer in the middle of Rindge Avenue divides the roadway into north and south sections and collects all sewage from adjacent buildings on both sides of the street. Various smaller utilities are present including two gas mains (one live, one abandoned), two potable water pipes (16-inch and 6-inch/8-inch/10-inch), three electrical duct banks, and communication duct banks.

Each utility provider was contacted and provided maps of their infrastructure in Steel Place, Cambridge Park Drive, Alewife Brook Parkway, Rindge Avenue and Sherman Street, with the exception of the MBTA which was unresponsive to our many requests for information. These maps were compared to the survey completed for this project on Sherman Street, from Bellis Circle to Pemberton Street. Additionally, the City had advanced a design in 1990 that included a new sewer along several blocks of Rindge Avenue. This design was never built but the area was surveyed, and utility provider data was collected. This data was compared to current utility data to ensure accuracy and update any new or abandoned utilities.

Eversource had replaced an aging gas main in parts of Rindge Avenue by placing an 8-inch diameter gas main on the southern side of the street. The old 6-inch diameter gas main in the northern side of the street was abandoned in place. Removing this abandoned 6-inch gas main and relocating the 6-inch diameter water pipe, would open a corridor for up to a 30-inch diameter pipe on the northern side of the street. It is anticipated that this new pipe would be utilized as a combined sewer in the near term. House laterals from the northern side of the street could be tied into this new pipe during construction.

When the City is ready to fully separate the sewerage in the future, a 12-inch sanitary sewer pipe could be installed on the southern side of the street, possibly requiring the relocation of a 16-inch diameter water pipe and gas mains at select locations. There is less space on the south side of the street, making it a more optimal location for the smaller 12-inch sewer rather than the 30-inch pipe. House service laterals on the southern side of the street could be connected to this new 12-inch sanitary sewer, disconnecting them from the 48-inch pipe.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

To achieve future sewer separation, an 8-inch diameter sewer pipe may be required in the northern sidewalk. This sewer pipe would pick up laterals that cannot be redirected to the 12-inch sanitary sewer on the south side. The electrical duct banks near this sidewalk may be challenging to work around because Eversource could not provide us with the size and exact location of this duct bank. Test pits at various locations would be needed in determining how reasonable an assumption it would be to fit this 8-inch sewer in the sidewalk. Once this construction is complete, the 30-inch combined sewer could be converted to a storm drain, completing full separation of the street. While there are a number of details that need to be resolved to advance a full separation design, there appear to be feasible alternatives to add conveyance capacity and provide for future sewer separation.

Figure 2-4 shows a cross section of Rindge Avenue, as an example of the many utilities needed to work around to install the proposed new pipes. Refer to **Appendix L** for both the short and long term sewer plan on Rindge Ave.

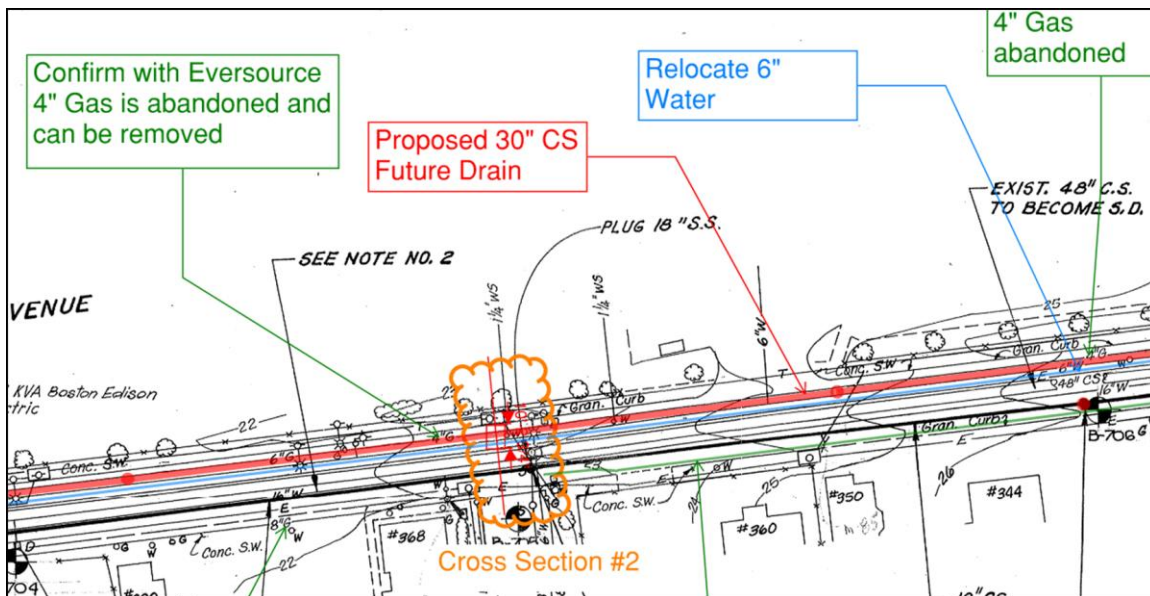


Figure 2-3. Short Term Combined Sewer Snapshot

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

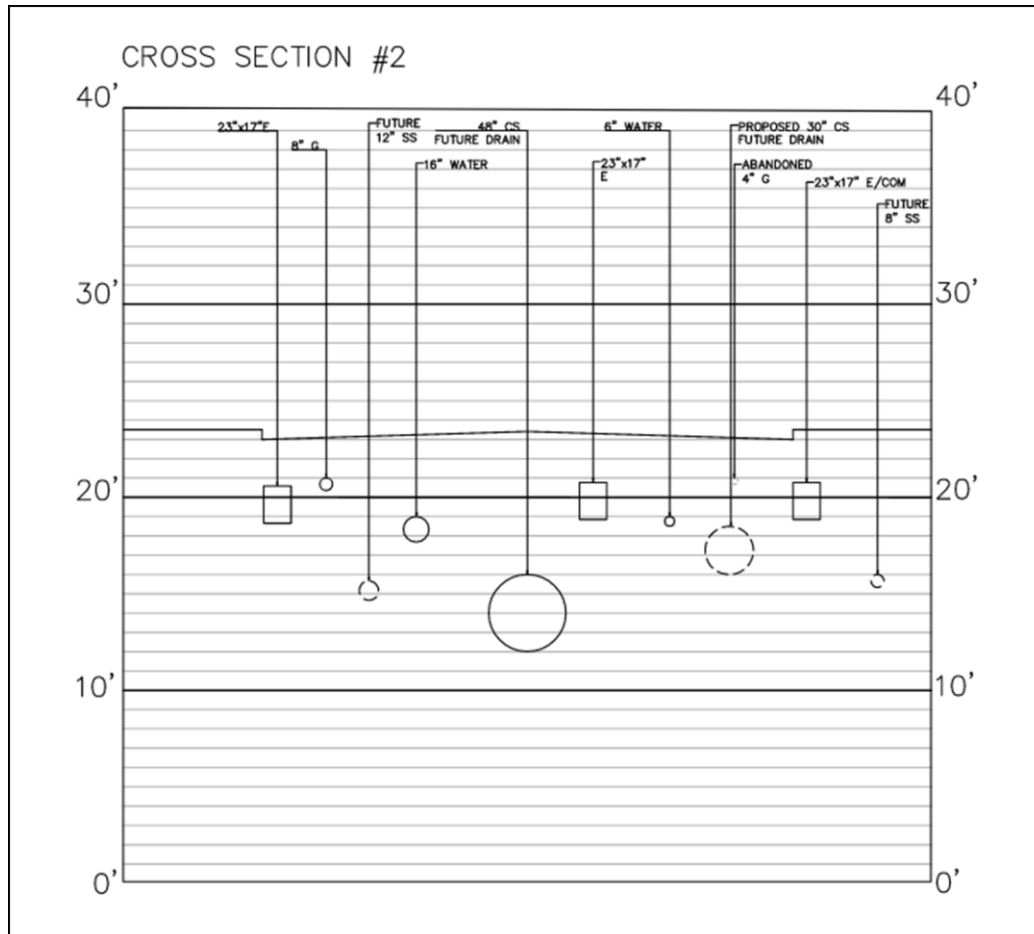


Figure 2-4. Cross Section of Utilities on Rindge Ave for a Fully Separated Scenario

2.3 AREA PROJECTS

2.3.1 Danehy Park Environmental Studies

Danehy Park is the site of a former landfill that was capped with soil in 1990. The management of the site is controlled by permitting through the Massachusetts Department of Environmental Protection (MassDEP), Division of Solid Waste. Post-closure management by the City involves semi-annual water quality monitoring, quarterly landfill gas monitoring, annual inspections of the stone-filled methane trench around the perimeter of the park, and production of an annual environmental monitoring report.

On March 22, 2023, a MassDEP release tracking number (RTN) 3-38051 was assigned for a two-hour notification due to the observation of methane concentrations greater than or equal to 10% of the lower explosive limit (LEL) in a subsurface utility conduit at Danehy Park. An Immediate Response Action (IRA)



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

Plan prepared in accordance with 310 CMR 40.0412 was submitted to MassDEP on May 19, 2023. The IRA Plan included a description of the release, site location and description, summary of response actions completed as of May 18, 2023, and the proposed activities to be conducted to address the reported condition. MassDEP provided written approval of the IRA Plan via email on May 25, 2023. The IRA Completion Report was submitted on January 16, 2025, prepared in accordance with the provisions set forth in the Massachusetts Contingency Plan (MCP) 310 CMR 40.0427. Ongoing activities are considered “Adequately Regulated” under the MCP.

A site-wide assessment of landfill gas and leachate-impacted groundwater within the former landfill commenced in 2024 and is underway. As part of the assessment, multiple groundwater monitoring wells were installed around the perimeter of Danehy Park, as well as one monitoring well on the #135 Sherman Street parcel (MW-102S). **June 2024 groundwater results of the monitoring wells installed as part of this assessment did not detect any volatile organic compounds (VOCs) or metals above applicable MCP GW-1 standards (drinking water standards), inclusive of the monitoring well within the Site (MW-102S).**

Based on available information, **no evidence of contaminated groundwater migrating from the former landfill to the Sherman Street Site has been observed.** There is a vent trench that surrounds the perimeter of Danehy Park that prevents the off-site migration of subsurface methane from the landfill.

2.4 GEOTECHNICAL INVESTIGATION

An initial round of geotechnical and hydrologic investigation was conducted for the Site as part of the conceptual design. More recently, a second round subsurface exploration program was completed to support the design and construction of the CSO tank. Detailed findings are provided in the Geotechnical Engineering Report (Kleinfelder, 2026) presented as **Appendix C**. The following sections summarize these findings. An exploration location plan with the surveyed boring locations and a locus plan of the Site are included in that report.

2.4.1 Geotechnical History

A subsurface investigation was completed by CDM Smith in March 2024, as part of the Danehy Park environmental evaluations, which encompasses a larger parcel located southwest of the Site. Relevant boring logs are included in the Geotechnical Engineering Report provided in **Appendix C**. The subsurface stratigraphy encountered generally consisted of inorganic granular fill underlain by silty sand or sandy silt overlying Boston Blue Clay, glacial till, and bedrock.

2.4.2 Geotechnical Subsurface Explorations

An initial subsurface exploration program was completed between April 7 and April 11, 2025. This concept phase aimed to assess the subsurface conditions within the study area and included soil characterization during test borings, the installation of groundwater monitoring wells, and in-situ hydraulic conductivity testing. Laboratory tests were performed on selected soil samples to evaluate their



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

geotechnical properties and behavior. A subsequent subsurface investigation program was completed between March 25 and April 3, 2026 and focused on collecting undisturbed samples in the clay, evaluating depth to bedrock, bedrock quality and strength characteristics, and improving seismic site class.

During the initial subsurface investigation program in 2025, four test borings, designated KLF-1 through KLF-4, were advanced to depths between approximately 26 and 65.25-ft below ground surface (bgs). Following completion, KLF-3 was converted into a groundwater monitoring well. The subsequent 2026 investigations included advancing six test borings, designated KLF-101 through KLF-106, between approximately 27 and 89-ft bgs and five cone penetration tests (CPTs) between approximately 63.6 and 67.5-ft bgs. Three of the CPTs were completed with shear wave velocity testing to evaluate seismic site class.

Ground surface elevations at the test borings ranged from approximately elevation (EL) 24.1 to 25.7 using the Cambridge City Base (CCB vertical datum, measured in feet), penetrating through asphalt then inorganic, granular fill. Trace amounts of brick and root pieces were observed within all borings in the upper 5-ft of fill. Beneath the fill layer, a layer of silty sand and sandy silt was encountered in the upper 11 to 15-ft, which was underlain by Boston Blue Clay (BBC). The BBC consisted of very soft to very stiff clay, interbedded with sand and gravel seams extending from approximately 10 to 63-ft bgs. Glacial till was encountered beneath the BBC at depths between approximately 59 and 69-ft bgs, or between EL -33.5 and EL -43.0. A discontinuous layer of weathered rock was encountered at KLF-101, KLF-103, and KLF-104 and ranged between approximately EL -48.0 to -54.0. Top of competent bedrock was encountered between approximately EL -48.5 and -54.0.

Following the development of the monitoring wells (MW-102S and KLF-3), groundwater levels were measured to be approximately 7 to 8-ft bgs, or approximately EL 16.8 and 17.8. In-situ hydraulic conductivity tests (slug tests) were conducted in each well, resulting in estimated hydraulic conductivities of approximately 4 ft/day for MW-102S (sandy silt) and 40 ft/day for KLF-3 (fill). These values are considered moderate for sedimentary unconsolidated materials with similar characteristics.

2.5 ENVIRONMENTAL INVESTIGATION

An environmental investigation was conducted to screen for soil and groundwater contamination at the Site. The following sections summarize these findings and further information can be referenced in the Environmental Conditions Memorandum (Kleinfelder, July 2026) as **Appendix D**. Maps of regulated disposal sites and the sampling locations at borings are also included in **Appendix D**.

2.5.1 Environmental History

The #135 Sherman Street parcel was developed as early as 1900 as the West Cambridge Depot with two railroad spurs in the western portion of the property. In the 1930s the property was occupied by the Diamond Coal Company with a coal shed, open coal bins and an office. Historical Sanborn Fire Insurance Maps depict an underground storage tank (UST) associated with the Diamond Coal Company. Sometime



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

between the 1960s and 1970, all above ground building structures were demolished with the exception of the railroad spurs, which were removed by 1990. Historical foundations may remain on the Site.

A 120-day notification was reported to MassDEP on August 1, 2016 for a release of oil observed in soil during a Phase II Environmental Site Assessment (Phase II ESA) of the Site, and RTN 3-0033725 was assigned. Concentrations of extractable petroleum hydrocarbons (EPH) and volatile petroleum hydrocarbons (VPH) exceeded Massachusetts Contingency Plan (MCP) Reportable Concentrations (RCs) for Category S-1 soils (RCS-1) in soil samples collected from a depth of 5 to 10-ft below ground surface (bgs) in a soil boring advanced during the investigation. Concentrations of VPH, EPH and volatile organic compounds (VOCs) were also detected in groundwater; however, these concentrations were below the applicable MCP RCGW-2 that applies to the Site. The Phase II investigation also included a ground penetrating radar (GPR) survey and no anomalies indicating the presence of USTs were observed.

A supplemental Phase II investigation was subsequently conducted in 2016 to evaluate extent of impacts to soil and further evaluate groundwater at the site. Results of soil samples collected from additional borings concluded that the release was likely attributed to a fuel oil tank associated with heating oil sales by the Diamond Coal Company, a former site occupant. The USTs were reportedly removed in the early 1980s.

Polycyclic aromatic hydrocarbons (PAHs) commonly found in historic fill material were also identified above MCP RCS-1 during the 2016 supplemental Phase II investigation. Field observations noted the presence of coal and coal ash in soil at the Site, thus release notification was not required per the MCP at 310 CMR 40.0317(9). The supplemental Phase II investigation did not detect any groundwater impacts.

In August 2016, an approximately 60-ft by 60-ft area of petroleum contaminated soil was excavated from the parking lot under a Release Abatement Measure (RAM) Plan. The average depth of the excavation was approximately 13 to 15-ft bgs. Some areas extended to a depth of approximately 18-ft bgs. A total of 21 endpoint soil samples were collected from the sidewalls and base of the excavation and submitted for laboratory analysis of EPH and VPH. Results indicated residual concentrations of VPH and EPH above applicable Method 1 S-1 soil standards in localized areas in the southern, western and eastern sidewalls; however, the Licensed Site Professional (LSP) of record determined that the benefit of additional excavation in these areas to reduce concentrations was not feasible in accordance with the MassDEP's Policy #WSC-04-160, Conducting Feasibility Evaluations under the MCP. Samples collected from the northern sidewall and base of the excavation did not detect VPH or EPH above laboratory reporting limits and/or applicable Method 1 S-1 soil standards. **A total of 2,893 tons of contaminated soil were excavated and transported for off-site recycling.**

Following soil excavation, additional soil borings and groundwater monitoring wells were installed to delineate soil endpoint sample results and assess groundwater in areas of residual contamination as well as the potential for off-site migration. **Soil sample results detected VPH and EPH constituents above laboratory reporting limits, but below applicable standards.** No groundwater concentrations detected exceeded the applicable Method 1 GW-2 or GW-3 standards.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

Following post-excavation soil and groundwater sampling, a Method 1 Risk Characterization was performed. **Results of the Method 1 Risk Characterization determined that a condition of No Significant Risk existed and a Permanent Solution with No Conditions (PSNC) was submitted by EBI Consulting in October 2016.** A copy of the PSNC is provided in **Appendix D**.

2.5.2 Environmental Explorations

An environmental sampling program was completed in April 2025 and March/April 2026 by Kleinfelder. This effort consisted of sampling soils extracted from geotechnical borings on the Site. A total of 10 soil borings (KLF-1 through KLF-4 and KLF-101 through KLF-106) were advanced within the planned work area to evaluate current site conditions.

Soil samples were field screened for total organic vapors (TOV) using a photoionization detector (PID). A total of 9 soil samples were collected for laboratory analysis of disposal characterization parameters including VOCs, semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), total petroleum hydrocarbons (TPH), MCP 14 metals, reactivity, corrosivity, ignitability and conductivity, to provide recommendations for soil disposal for the project. Groundwater samples were also collected for laboratory analysis of the same disposal characterization parameters from one newly installed monitoring well (KLF-3) and one existing monitoring well (MW-102S). Monitoring well MW-102S was installed in March 2024 by CDM Smith on behalf of the City of Cambridge to further delineate groundwater conditions associated with nearby Danehy Park.

The MCP establishes Reportable Concentrations (RCs) for contaminant concentrations based on receptors on or in the vicinity of the property. The applicable RC for soil within the project area is RCS-1, which applies to soil within 500 feet of residential properties. The applicable RC for groundwater within the project area is RCGW-2, which applies to groundwater outside of drinking water protection areas. If laboratory analytical results exceed the applicable RC's for the site, the responsible party is required to notify the MassDEP within 120-days of knowledge of this exceedance in accordance with the MCP at 310 Code of Massachusetts Regulations (CMR) 40.0315(1). If a 120-day notification is required based on an exceedance of the RCs, then further assessment and remediation, if needed, are required in accordance with the MCP.

The following results inform recommendations for additional soil sampling to be completed by the contractor's environmental professional described in **Section 4.1.3.3** of this report for soil management purposes during construction.

2.5.2.1 Laboratory Results

Five of the 9 soil samples were collected from fill material emplaced at the property and the remaining 4 soil samples were collected from native soil underlying historical fill. PID field screening results ranged from below the instrument detection limit to 18.9 parts per million by volume (ppmv) at boring KLF-102 (8-10 feet).



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

A variety of analytes were detected in soil and groundwater at the site, though none of the concentrations exceeded their respective MCP RCs; therefore, notification to MassDEP was not required. Concentrations detected below their respective MCP RCs are not considered to pose a significant risk to human health, public safety or the environment and no further assessment or remediation is required pursuant to the MCP. The following paragraphs summarize these analytes.

Arsenic, barium, beryllium, cadmium, chromium, lead, mercury, nickel, vanadium and zinc were detected in the native soil layer above laboratory reporting limits, but below RCS-1 for the soil samples collected from KLF-1, KLF-3, KLF-102 and KLF-104. PAHs benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene and chrysene were also detected below RCS-1 in the native soil of boring KLF-102 (8-10 feet).

Metals (arsenic, barium, beryllium, cadmium, chromium, lead, mercury, nickel, vanadium and zinc), the SVOC benzidine, PCB aroclor 1248 and PAHs (benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene and pyrene) were detected in the fill material layer above laboratory reporting limits, but below RCS-1, in soil samples collected from KLF-2 (0-5-ft), KLF-3 (0-5-ft), KLF-101 (2-6-ft), KLF-105 (1-4-ft) and KLF-106 (3-5-ft). None of the contaminants exceeded the US Environmental Protection Agency's "20 times rule"; therefore, analysis by the toxicity characteristic leaching procedure (TCLP) was not warranted.

Additionally, various contaminants (metals [arsenic, barium, chromium, lead, nickel, vanadium and zinc], naphthalene and SVOCs [isophorone, acenaphthene, acenaphthylene, anthracene, fluorene, benzo(g,h,i)perylene and pyrene] were detected in groundwater above laboratory reporting limits, but below their applicable RCGW-2.



3.0 EVALUATIONS AND ANALYSES

The following section presents an analysis of the CAM401A sewershed, and options evaluated for a CSO storage facility. Facility components include a diversion structure and pipeline, underground storage tank, odor control system, dewatering pump, and solids handling approach. For the recommended facility, refer to **Section 4.0**.

3.1 HYDRAULIC MODELING ANALYSIS

A hydraulic evaluation of the City collection system in the vicinity of CAM401A was completed to quantify the benefits of various sizes of a CSO storage tank at the Sherman Street Site.

The baseline conditions InfoWorks ICM hydraulic model (the Baseline Model) was utilized for hydraulic analysis of the CSO storage tank and City collection system. This model is a collaborative effort between the City of Cambridge, City of Somerville, and the Massachusetts Water Resources Authority (MWRA), who are developing a joint Updated CSO Control Plan. The Baseline Model includes City sanitary and combined sewers, City drain network, the Somerville collection system, and the MWRA interceptor network.

Baseline conditions in the Baseline Model were used to establish performance of the existing City collection system as documented in the Updated CSO Control Plan. Refer to **Appendix I** for the completed, on-going or planned projects included in the system baseline condition. These conditions were used as a base to compare performance of proposed improvement options. One Baseline project in particular, I/I mitigation improvements at the Walden Square apartments, is pertinent to the Sherman Street storage tank as it is intended to reduce wet-weather flows to the combined sewer in Sherman Street.

As part of the City's Updated CSO Control Plan, multiple alternatives were evaluated to reduce overflows from the CAM401A regulator. One of the preferred alternatives includes constructing a storage tank at the Sherman Street Site.

3.1.1 Design Storms

At a workshop held with the City in May 2025, it was decided that two design storms would be used to evaluate performance of the CSO storage tank. The first design storm is the 2050 Typical Year series to evaluate annual CSO reduction. The 2050 Typical Year was developed for the Updated CSO Control Plan and represents a year-long time series with varying rainfall events that are anticipated to represent typical conditions in the year 2050. The second storm is a 10-year, 24-hour, 2050 design storm to evaluate flood reduction benefits under an extreme rain event. **Table 3-1** lists properties of the 10-year storm.

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

Table 3-1. Summary of 10-Year Storm Used for Modeling

Duration	Time Horizon	Peak Intensity (in/hr)	Total Rainfall (in)
24-hour	2050	2.07	6.36

3.1.2 Interconnectivity of CAM401A and MWR003 CSO Regulators

The primary purpose of the Sherman Street CSO storage tank is to reduce overflows from the CAM401A regulator. However, due to the interconnectivity with the MWR003 regulator, wet weather storage alternatives also need to check CSO spills and volumes at MWR003. During rain events, wastewater flows in the Sherman Street combined sewer increase significantly, which causes surcharging in the sewer. In larger storms, surcharge increases to raise the water level, exceeding the crest elevation of the overflow weir in the CAM401A regulator, which causes a CSO spill to the drainage culvert. A schematic showing peak sewer flows in the vicinity of CAM401A during the August 14th wet-weather event in the 2050 Typical Year is presented in **Figure 3-1**. The August 14th event was selected because it has the highest rainfall peak intensity. Note that, in wet weather, the direction of flow reverses backwards (south) in the Sherman Street combined sewer from Pemberton Street to the CAM401A regulator. This is a common occurrence verified by City flow metering data.

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

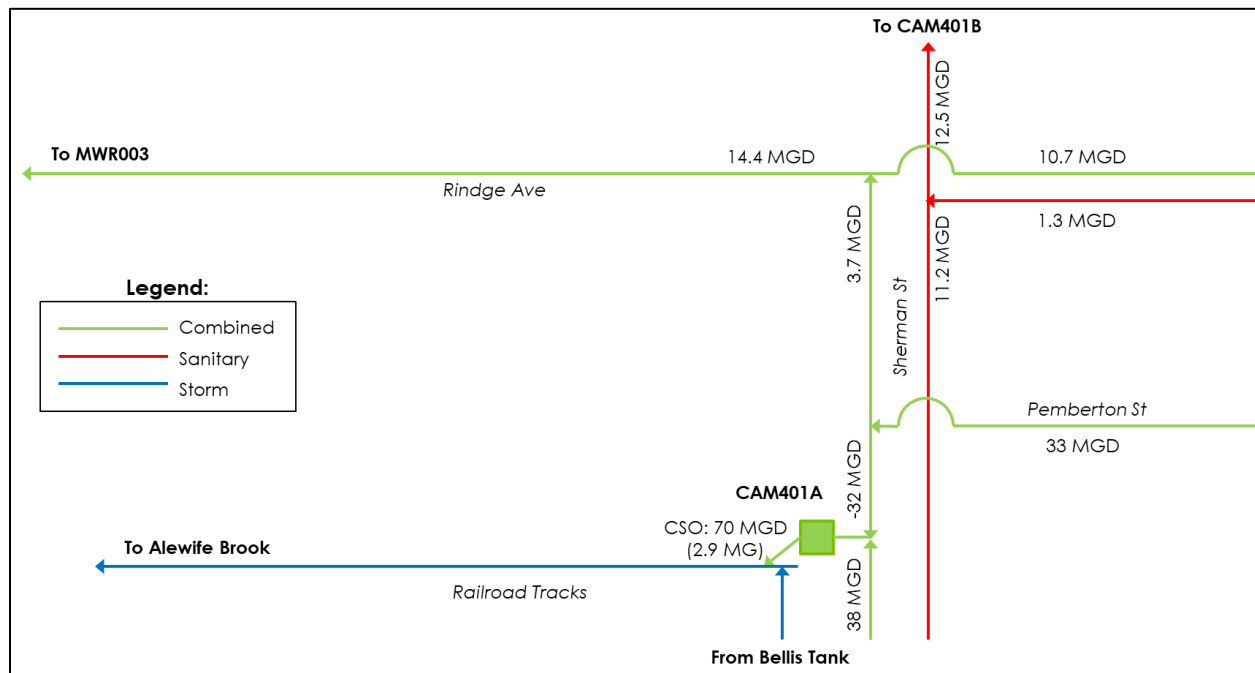


Figure 3-1. Peak Flow Schematic During 8/14 Event of 2050 Typical Year

3.1.3 Future Sewer Separation

As part of the ongoing efforts by the City to reduce CSOs, sewer separation continues to be completed in areas throughout the City. In the future, there is opportunity to convert the facility into stormwater storage upon separation of the CAM401A sewershed. This would allow stormwater to be pumped to a new storm drain or the culvert where CAM401A overflows, similar to the Bellis Tank discharge. The option of reconfiguring the tank in the future as a stormwater storage facility is being evaluated under an ongoing Sewer Separation Master Plan that is planned to be completed in the next couple years, and for that reason is not evaluated further in this report.

3.1.4 Storage Capacity Alternatives

Three primary storage volumes (2.1 MG, 1.5 MG, and 1.0 MG) were evaluated to assess CSO reduction at the CAM401A regulator and potential impacts to the MWR003 regulator. Smaller tank sizes were also evaluated but were shown to have little or no impact on CSO reduction. Evaluation of the 2050 Typical Year and the 10-year 2050 design storm also identified that the storage tank itself provides negligible flood relief to the City's collection system. As such, the overflow weir at the CAM401A regulator and the proposed diversion structure on Sherman Street were optimized for CSO reduction. The following weir alternatives were modeled in addition to the storage tank volume alternatives (2.1 MG, 1.5 MG, 1.0 MG):



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

- Raising the overflow weir crest in CAM401A from elevation 17.0 (CCB) to elevation 18.5 (CCB). Raising the overflow weir increases utilization of the City combined sewer in Sherman Street but raising it any higher would adversely impact water levels in the combined sewer during large rain events, causing increased flooding in Sherman Street near Walden Square.
- A 20-ft-long diversion weir at a crest elevation of 17.4 (CCB) upstream from the CAM401A regulator structure. The crest elevation was optimized so the tank would not start to fill until levels in the combined sewer were high enough to potentially cause a CSO spill at CAM401A. A weir length of 20-ft was required to eliminate CSOs in the 2050 Typical Year.

The 1.5 MG tank option was also evaluated with a conveyance upgrade along Rindge Avenue (modeled as a 60-inch combined sewer that would replace the existing 48-inch combined sewer) with a goal to eliminate CSO spills during the 2050 Typical Year at CAM401A. However, this option effectively conveys those CSO spills to the MWRA interceptor thereby increasing CSO spills and volume at MWR003, so it was ruled out as a viable option because of limitations in the regional hydraulics.

Table 3-2 lists the CSO spill counts and volumes for the storage alternatives evaluated. Baseline conditions are also listed for comparison. Tank volumes are listed in MG and are required for the CSO storage volume.

Table 3-2. CSO Spill Count and Volumes for CAM401A and MWR003 Under 2050 Typical Year

Scenario	CAM401A		MWR003	
	CSO Spills (# of Events / Volume MG)			
Baseline - No Storage Tank	12	11	3	1.1
2.1 MG Tank	0	0	3	1.1
1.5 MG Tank	4	0.7	3	1.2
1.5 MG Tank + Rindge Ave Conveyance	0	0	4	2.6
1.0 MG Tank	4	2.2	3	1.3

The model results listed in **Table 3-2** demonstrate that the optimum hydraulic performance is offered by a 2.1 MG storage tank that eliminates all CSO spills at CAM401A in the 2050 Typical Year without having an adverse impact on spills at MWR003. Smaller tank sizes do not eliminate CSO spills at CAM401A and increased conveyance capacity increases overflow spill volumes at MWR003. For this reason, a 2.1 MG tank was selected as the basis for preliminary design.

3.1.4.1 CAM401A Spill Volume Distribution

Overflow data from CAM401A from 2021 through 2024 was also evaluated to identify the number of events and associated spill volumes. **Figure 3-2** shows the percentage of events that fall within a given



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

volume range. As indicated in the figure, 44% of events are 0.25 MG or less and over 50% of events are 0.5 MG or less. Hydraulic modeling results for the 2050 Typical Year indicate a similar volume distribution. These findings demonstrate opportunity to partition the storage tank into primary and secondary storage chambers, thereby reducing tank maintenance for the majority of wet-weather events to only the primary chamber. A primary chamber volume will be targeted once structural and civil layouts are refined during final design, expected to be roughly 1 MG.

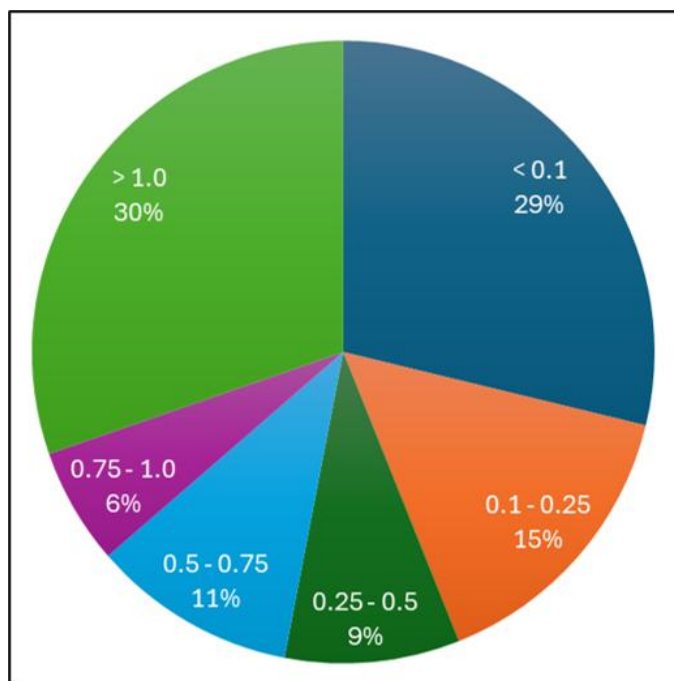


Figure 3-2. CSO Volume Distribution at CAM401A 2021-2024

3.1.4.2 Flood Relief Assessment

The addition of a CSO storage tank to the existing combined sewer system was modeled under the 10-year 2050 design storm to evaluate any reduction and/or negative impact with flooding. **Figure 3-3** compares peak flood extents and depths for Baseline Conditions and after the CSO tank is online. The 2.1 MG storage volume provides a negligible reduction in the peak depths and extents of flooding for the surrounding area. Peak flood volume is reduced by 0.3 MG, a 5% reduction, which demonstrates the storage tank does not offer significant co-benefits for flood relief by itself.

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

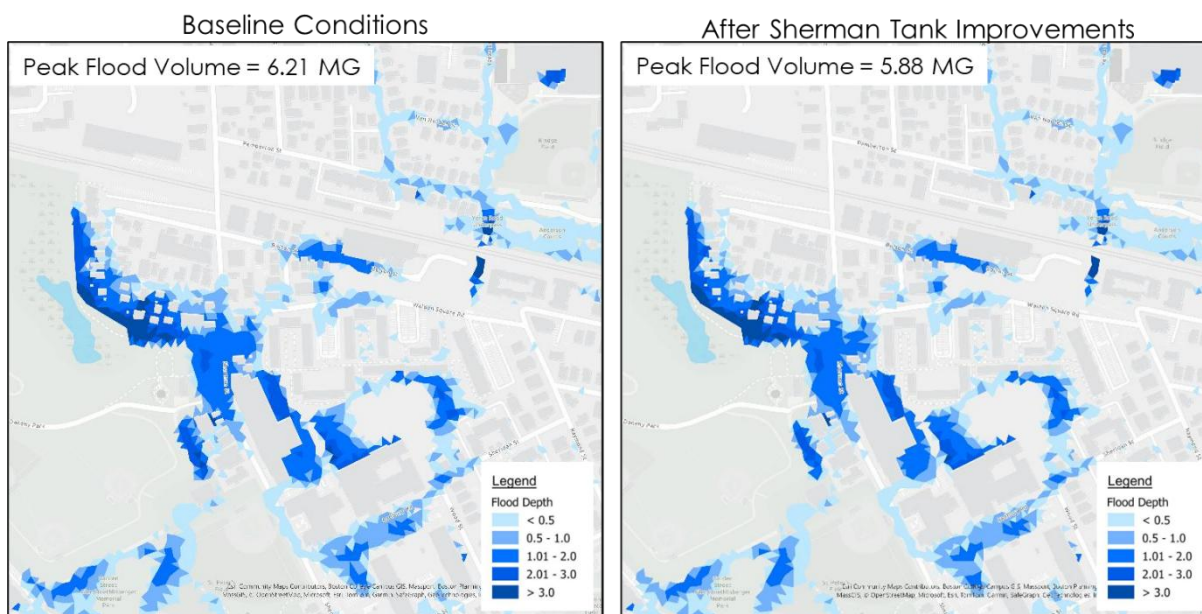


Figure 3-3. Flood Depths and Extents Under Baseline Conditions and After Tank Improvements

3.1.5 Diversion Structure Performance

The following section describes a hydraulic analysis undertaken at the start of preliminary design for the diversion structure conceived within Sherman Street to control overflow events into the tank. The structure's location was assumed to be that established by the conceptual design (**Figure 3-5**) and the results are presented herein.

3.1.5.1 CFD Analysis

A three-dimensional computational fluid dynamics (CFD) model was developed to support design of the proposed diversion structure, storage tank and its influent piping for the 2050 Typical Year. The CFD model includes the combined sewers on Sherman Street, the diversion structure, the CAM401A regulator, and the combined sewer downstream of CAM401A to Pemberton Street. Flow and level boundary conditions were assigned to the CFD model using the InfoWorks ICM model results. The CFD model is shown in **Figure 3-4**.

Analysis of the CFD model was used to quantify localized hydraulic losses and examine facility hydraulics at a resolution not available in the City-wide model. Key areas evaluated included diversion hydraulic performance, head losses through hydraulic control structures, storage tank filling characteristics, and available freeboard within the storage tank. The option of a coarse bar rack (steel bars spaced 8-inch on center) in the diversion structure was also included.

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

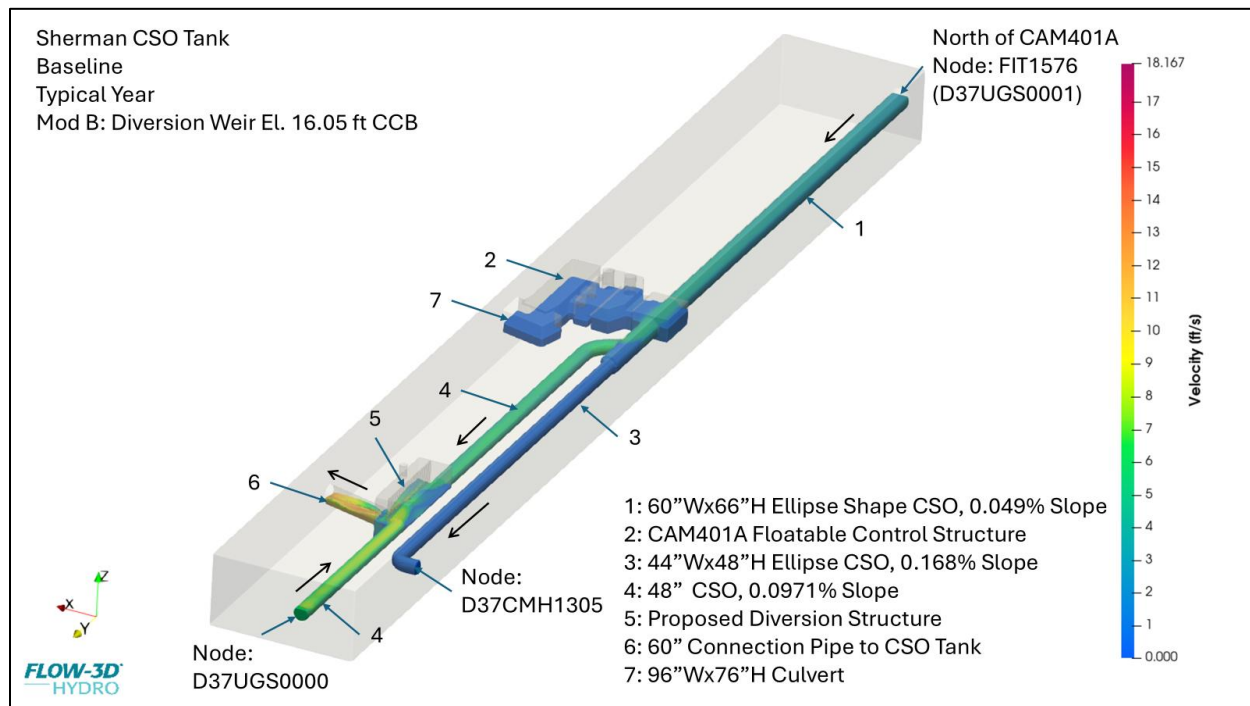


Figure 3-4. CFD Model of Diversion Structure and CAM401A – 2050 Typical Year Maximum Flow

CFD analyses demonstrated that the addition of a coarse bar rack to the diversion structure increases losses that necessitate modifications to the diversion weir length and crest elevation to prevent a CSO at CAM401A. Overall, it was found that the diversion weir crest elevation needs to be lowered to EL 16.05 (CCB) and the weir length increased to 25-ft long to provide the required diversion capacity to eliminate CSOs at CAM401A in the 2050 Typical Year.

3.1.5.2 Model Analysis

Following completion of the CFD analysis, the InfoWorks ICM model was updated to include an 8-inch bar screen and the weir elevation and length recommended from the CFD study. The Model was calibrated to match CFD water surface elevations by adjusting losses through the diversion structure, CAM401A and combined sewers.

After calibration, three diversion structure configurations were evaluated to identify a hydraulically effective and constructible alternative. Alternatives evaluated included:

- One diversion structure on the 48-inch FRP combined sewer with one 25-ft weir at crest EL 16.05 (CCB).
- Two diversion structures: One diversion structure on each Sherman Street combined sewer. The two-diversion structures alternative utilized a 20-ft and 15-ft long weir on the 48-inch FRP and 44-

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

inch x 48-inch Brick/Concrete sewers, respectively. The crest for each weir was set at EL 16.75 (CCB).

- One diversion structure on the 48-inch FRP combined sewer with two overflow weirs each 12.5-ft long (one on each side of the combined sewer pipe). The crest for each weir was set at EL 16.05 (CCB).

Table 3-3 summarizes the modeled alternatives and demonstrates that weir configuration affects the number of tank activations for the 2050 Typical Year. The results were reviewed with the City during a CSO Storage Tank Options Preliminary Design Meeting (**Appendix E**) and the favored alternative was for a single diversion structure on the 48-inch FRP combined sewer with two symmetrical 12.5-ft long weirs. This alternative presents the smallest footprint to minimize construction cost, reduces associated pedestrian and vehicular impacts on Sherman Street, and consumes less space that is needed for utility relocations. Additionally, having two short weirs simplifies options for maintaining a bar rack.

Table 3-3. Diversion Structure Alternatives and Tank Activations

Scenario	Tank Activations (>0.01 MG)
2 Diversions, 1 Weir each	16
1 Diversion, 1 Weir	25
1 Diversion, 2 Weirs	26

The one diversion two weir alternative achieves zero CSOs at CAM401A during the 2050 Typical Year simulation, with approximately half of activations filling up to 0.4 MG. While the model results indicate the storage tank activates more frequently, the increase is marginal considering the actual frequency will vary year to year. The peak diversion rate during the 2050 Typical Year is 75 MGD, with approximately 37.5 MGD conveyed over each weir. The maximum modeled water level at CAM401A is EL 18.4 (CCB), approximately 0.1-ft below the proposed overflow weir crest of EL 18.5 (CCB).

3.2 DIVERSION STRUCTURE SITING EVALUATION

An evaluation for siting the diversion structure on Sherman Street was performed. This double weir structure was assumed to have a 20-ft weir length, which is longer than the modeling results of a 12.5-ft weir with 8-inch bar rack spacing. The increased weir length was implemented as a contingency to accommodate further refinement of the bar rack spacing during final design.

The first alternative reviewed was installing the diversion structure approximately 40-ft south of the railroad tracks on the 48-inch combined sewer pipe (**Figure 3-5**). This location was evaluated based on the proximity to CAM401A and favorable CSO control performance. The diversion structure should be sited as close as possible to CAM401A to minimize head loss and optimize weir(s) operation. Overall, the diversion structure at this location maintains a desirable flow regime with a downstream conveyance in adjacent pipes and upstream conveyance within the 48-inch pipe (**Figure 3-6**). The hydraulics are

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

optimized, providing a cohesive operation with CAM401A and the proposed storage tank. Additionally, the diversion structure is sited outside the parking lot curb cuts and does not place repetitive heavy vehicle loads over the access hatches. This ultimately provides a dual benefit of maintaining the condition of access hatches and not obstructing the parking lot entrance with maintenance activities. The siting of the diversion structure also aligns associated tank operations in the northeast corner of the Site (e.g., bar rack maintenance, dewatering pumps/sump cleaning, grit capture tank maintenance), which is favorable to increase the distance from Bellis Circle residents. Within the roadway, there are anticipated utility relocations including a stormwater force main from Bellis Tank, a 12-inch Cast Iron water main, and a 12-inch Eversource gas main. A disadvantage is that a 17-inch tree removal is required to accommodate the diversion structure at this location.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

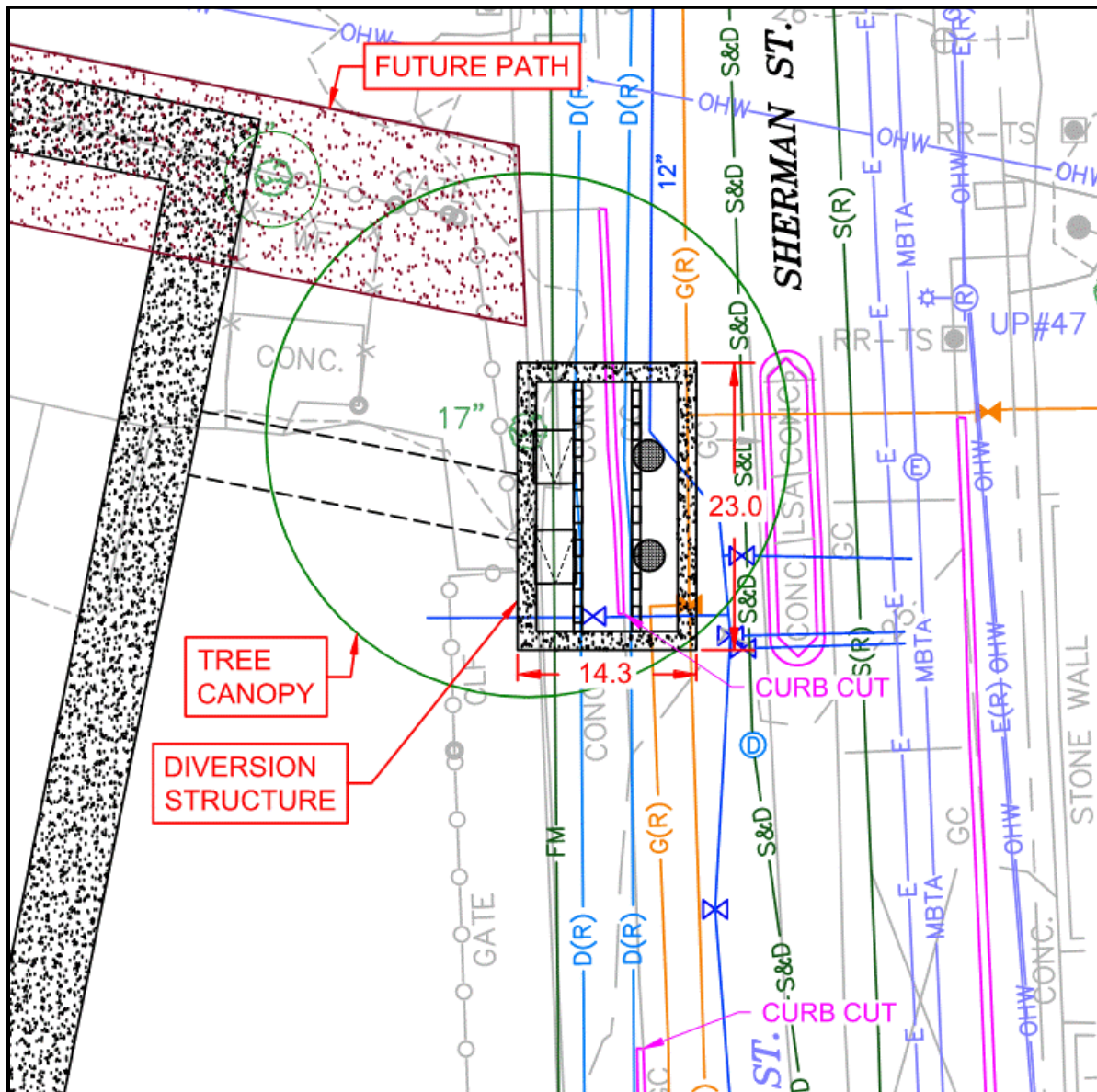


Figure 3-5. Diversion Structure Alternative 1

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

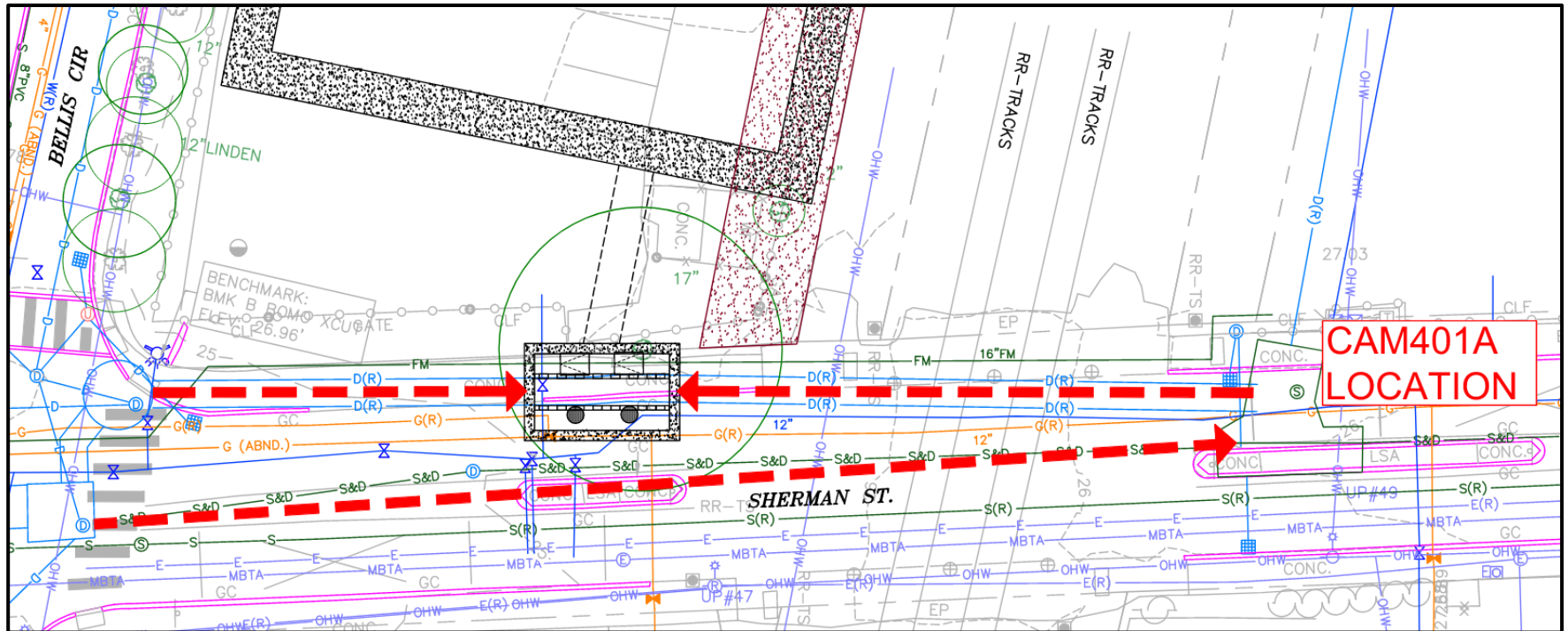


Figure 3-6. Diversion Structure Alternative 1 Flow Pattern

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

Additional locations were reviewed by shifting the vault south towards Bellis Circle. A studied location is shown in **Figure 3-7**, outside the 17-inch tree canopy. This location presents similar utility relocations including the stormwater force main from Bellis Tank, 12-inch Cast Iron water main, and 12-inch Eversource gas main. While the overall relocation of utilities is similar, shifting the vault too far south would introduce more conflicts with utilities at the Bellis Circle intersection and is undesirable. Despite the minor shift in this southern location, flow conveyance is negatively impacted with more head loss in the gravity combined sewer to be overcome and a reverse flow pattern (**Figure 3-8**). Due to the reverse and looping flow pattern, the diversion structure weir would need to be lowered and lengthened to maintain the CSO control performance required. These weir modifications ultimately increase tank activations and storage tank volume required, increasing O&M cost. Additionally, it places the diversion structure within the parking lot curb cut, obstructing vehicle access during maintenance activities and will experience repetitive vehicular loads over the access hatches; additional design considerations for rigorous access hatches would be required. This location also aligns associated tank operations in the southeast corner of the Site (e.g., bar rack maintenance, dewatering pumps/sump cleaning, grit capture tank maintenance), which is viewed less favorable to adjacent Bellis Circle residents.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

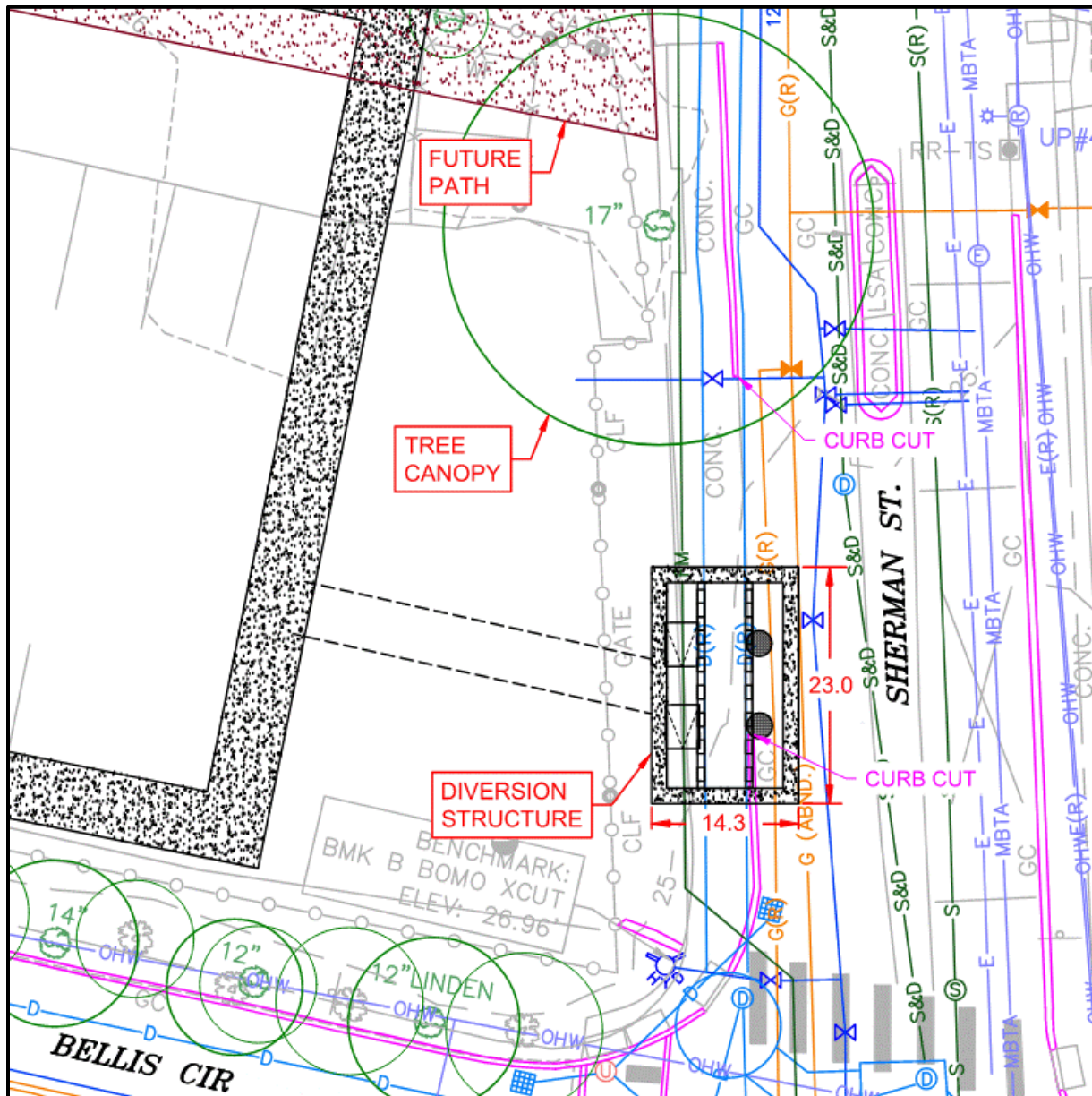


Figure 3-7. Diversion Structure Alternative 2



3.3 STORAGE TANK STRUCTURE EVALUATION

This section presents an evaluation of the primary tank dimensions and structure types with consideration of excavation support systems and excavation methods. An important variable for the tank confirmed by the City is that the area above it will only be used as a parking lot for DPW vehicles, with the possibility of heavier loads such as soil stockpiles removed from consideration.

3.3.1 Siting Overview

The tank's general configuration on the east side of the site as a rectangular concrete structure was selected during concept design. Recognizing the narrow geometry of the Site and the potential goal of a future building, the horizontal dimensions and position of the tank was evaluated further with goals to:

- maintain distance from the potential future conceived DPW building,
- comply with jurisdictional setbacks of the MBTA,
- protect trees identified for preservation,
- control for risks to adjacent utilities, buildings and structures,
- enable multiple areas for concrete mixing and pumping trucks to set up within the Site, and
- allow manageable operations and maintenance (O&M).

The original concept prioritized up to 20-ft construction setbacks to allow full access to each side of the tank. This setback intended to provide space for double-sided wall forms and movement of vehicles around the perimeter of the excavation, which included a temporary construction zone expanding beyond the curb lines of Bellis Circle and Sherman Street. During preliminary design, a new opportunity was identified regarding the temporary use of an abutting MBTA parcel to gain space for construction activities. Discussions with MBTA are constructive to-date, but it must be noted that use of the MBTA parcel is not formally accepted and requires formal permitting review. Refer to **Section 3.4** for additional discussion regarding this parcel in relation to truck hauling routes.

The depth of the structure was also examined. A major variable for constructing an underground storage tank is the groundwater elevation. Increasing tank depth below groundwater increases hydrostatic and buoyant forces on the normally empty structure that intensifies costs. This increase in cost is because the depth of the tank below groundwater may require additional buoyancy resistance that the empty tank weight and overlying fill will not counteract. Buoyancy resistance can be provided by rock anchors that only resist uplift forces or a deep foundation system that resists both uplift and gravity and lateral forces. While groundwater at the Site was recorded at two monitoring wells at a depth of 7 to 8-ft below grade, a more conservative fully saturated ground condition was assumed for preliminary structural analysis, based on the Cambridge Flood Viewer which indicates the parcel is impacted by precipitation flooding adjacent to the Site during the 100-year (1% frequency) storm event.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

Tank depth is also a consideration for manual tank cleaning, such as for the pump sump of the tank. During the CSO Storage Tank Options meeting on June 26, 2025, the City preferred a tank depth that is practical for vacuum truck cleaning. National Water Main and Inland Waters were both contacted and confirmed a maximum depth of 50-ft is achievable, yet inefficient, with their latest equipment. Therefore, a depth less than the maximum was targeted.

Taking into account these variables, three options were evaluated: (1) a conventional cast-in-place concrete structure, (2) a hybrid cast-in-place concrete structure, and (3) a prestressed concrete structure.

3.3.2 Conventional Cast-in-Place Concrete Structure

The conventional option is a steel reinforced cast-in-place concrete structure, and an example project is shown in **Figure 3-9** below. The conventional option provides the greatest flexibility for tank shape, custom structure arrangements, slab sloping, loadings, compartmentalization for storage volumes, future alterations, and ease of repair. Following shoring and dewatering of the excavation, the concrete base slab is placed. The concrete foundation would be a deep foundation dictated by site conditions and structural design requirements. The tank walls, top slab, and internal support columns are cast with free-standing formwork. Conventional cast-in-place concrete is constructed with control joints and embedded waterstops to maintain watertightness. The wall joints between adjacent concrete placements help control cracking by minimizing shrinkage cracks and directing any possible cracks to the planned joint locations. Considering the tank size and forces acting on the buried structure, thick and other large dimension placements may require “mass concrete” measures to cope with the generation of heat from cement hydration and prevent cracking.

A properly designed and constructed conventional cast-in-place structure has a service life in excess of 50 years (per the General Commentary of the ACI 350-06 building code) and is often in service for 100 years or longer with normal maintenance practices. Generally, repairs can be completed inside the tank. Factors ensuring the service life include design, construction practices, and material control.

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK



Figure 3-9. Conventional Cast-in-Place Concrete Tank Example (Stantec, 2007)

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

The conventional cast-in-place option assumed for concept design was first re-examined. This initial layout is shown in **Figure 3-10**. Structural evaluation of this layout found that wall thicknesses needed to increase significantly from conceived conceptual estimates, as presented in **Table 3-4** primarily due to an assumed fully saturated ground condition and resulting groundwater forces.

Table 3-4. Structural Evaluation of Conceived Cast-in-Place Wall Requirements

Reinforcement Option	Wall Thickness
With Shear Reinforcing	60-inch (6,000 PSI concrete) or 72-inch (5,000 PSI concrete) for the bottom 10-ft of wall, and 48-inch for the remaining height
With no Shear Reinforcing	90-inch with 6,000 PSI concrete or 96-inch with 5,000 PSI concrete for the bottom 10-ft of wall and 48-inch remaining height

Engineering the wall to vary in thickness would require successive vertical pours, and this sort of transition is not typical due to the added time and complexity to construct. Thus, the wall would likely be engineered as a consistent thickness from base slab to top slab, increasing concrete volume and cost. Taking into account these wall thicknesses, the tank depth from existing grade to pump sump was found to be approximately 48.5-ft (near the maximum 50.0-ft limit).

A similar tank layout was evaluated to decrease the depth by approximately 5-ft and enable more reliable maintenance by vactor truck. The structure was assumed to increase only in length and found to encroach upon the proposed building layout (**Figure 3-11**).

There are many possible permutations of the conventional cast-in-place option. Generally, to meet the goals established in **Section 3.3.1** (tree protection, MBTA jurisdiction, equipment access, etc.) and allowing for reduced separation between the potential future building and tank, the wet footprint of the tank must be reduced. Refer to **Figure 3-12** depicting the tank layout configuration, which results in the tank depth to increase to an undesirable 52.5-ft from existing grade to pump sump.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

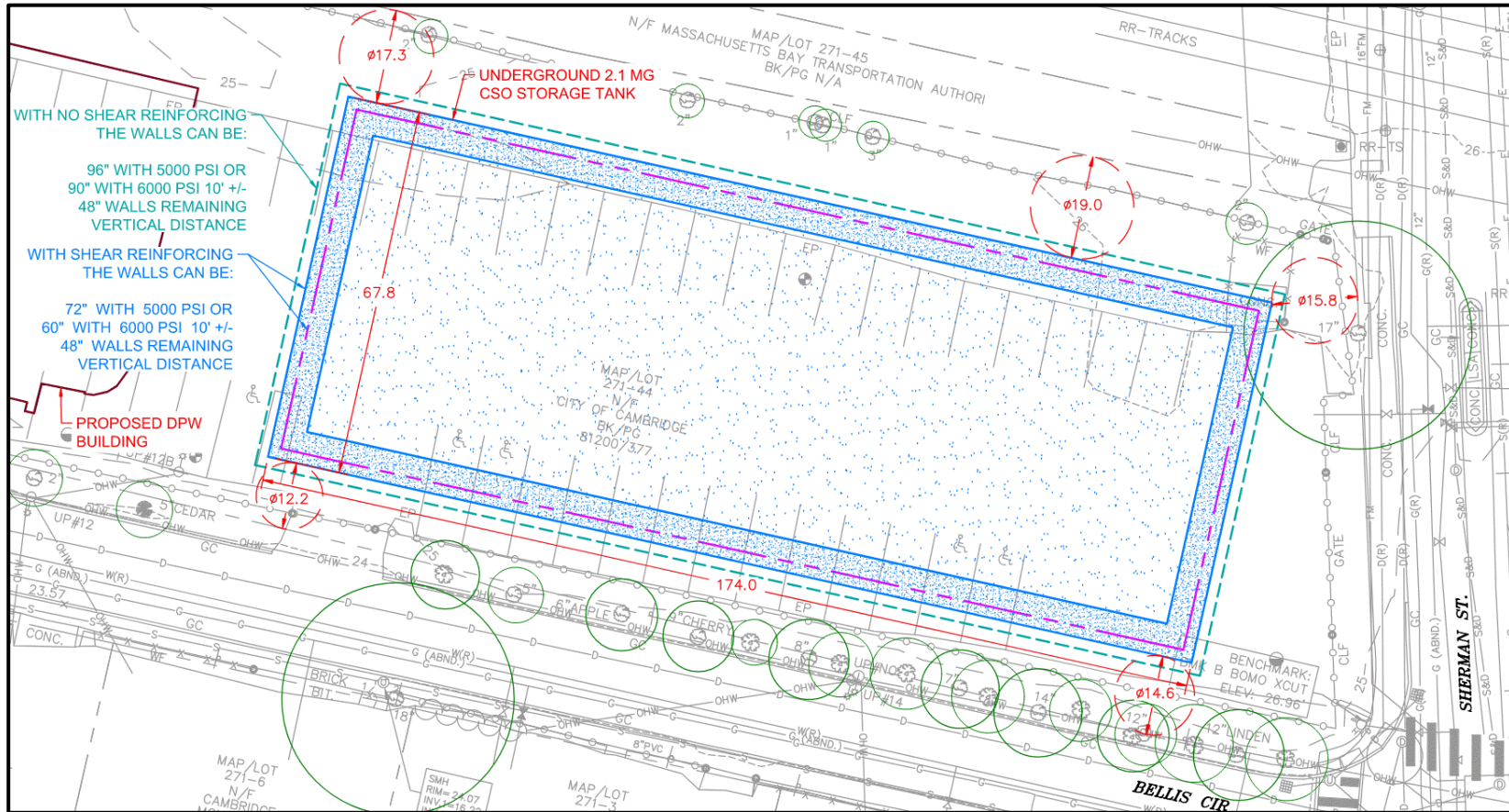


Figure 3-10. Conventional Cast-in-Place Layout – Initial Concept

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

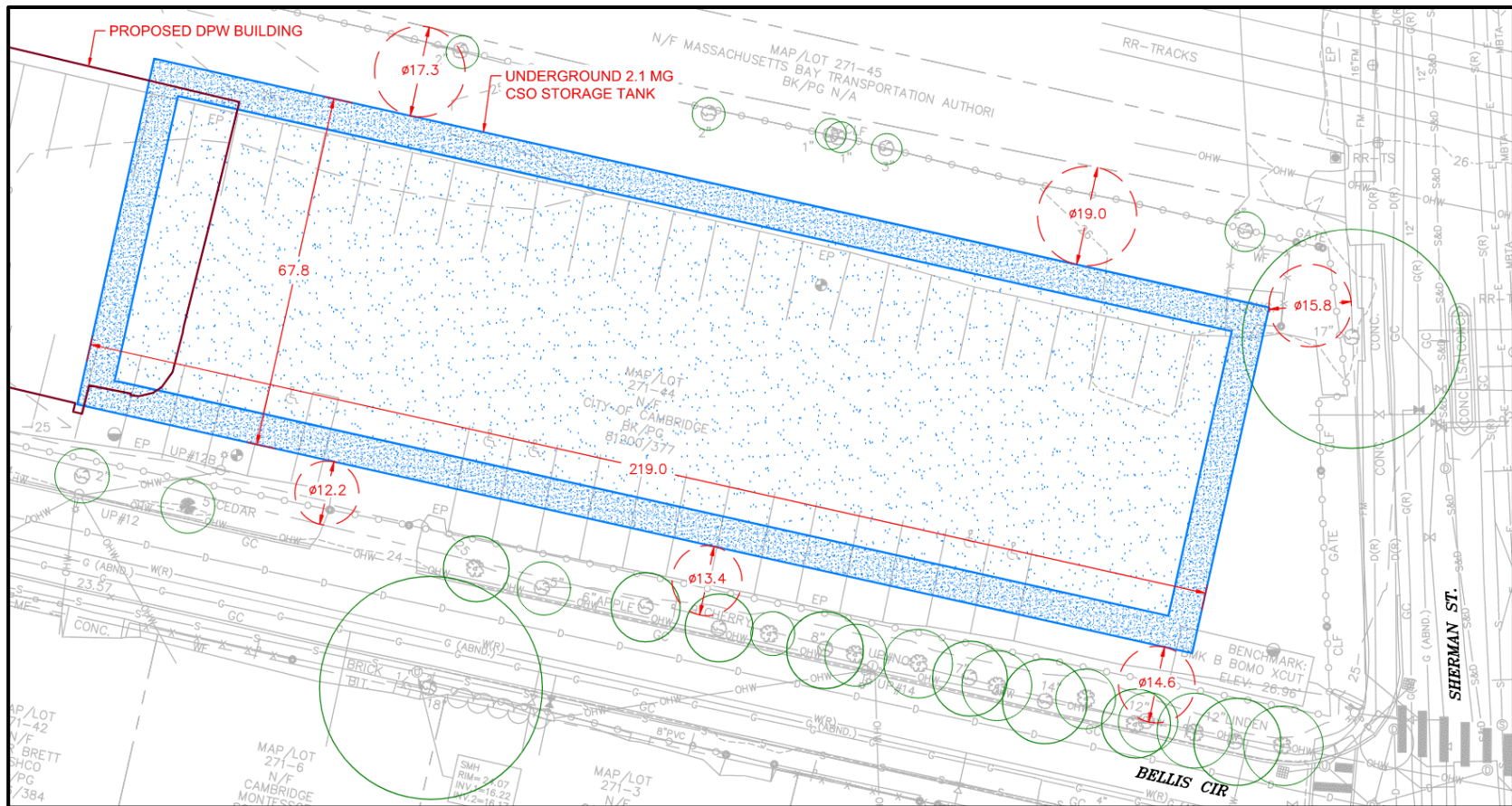


Figure 3-11. Conventional Cast-in-Place Layout – Reduced Depth



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

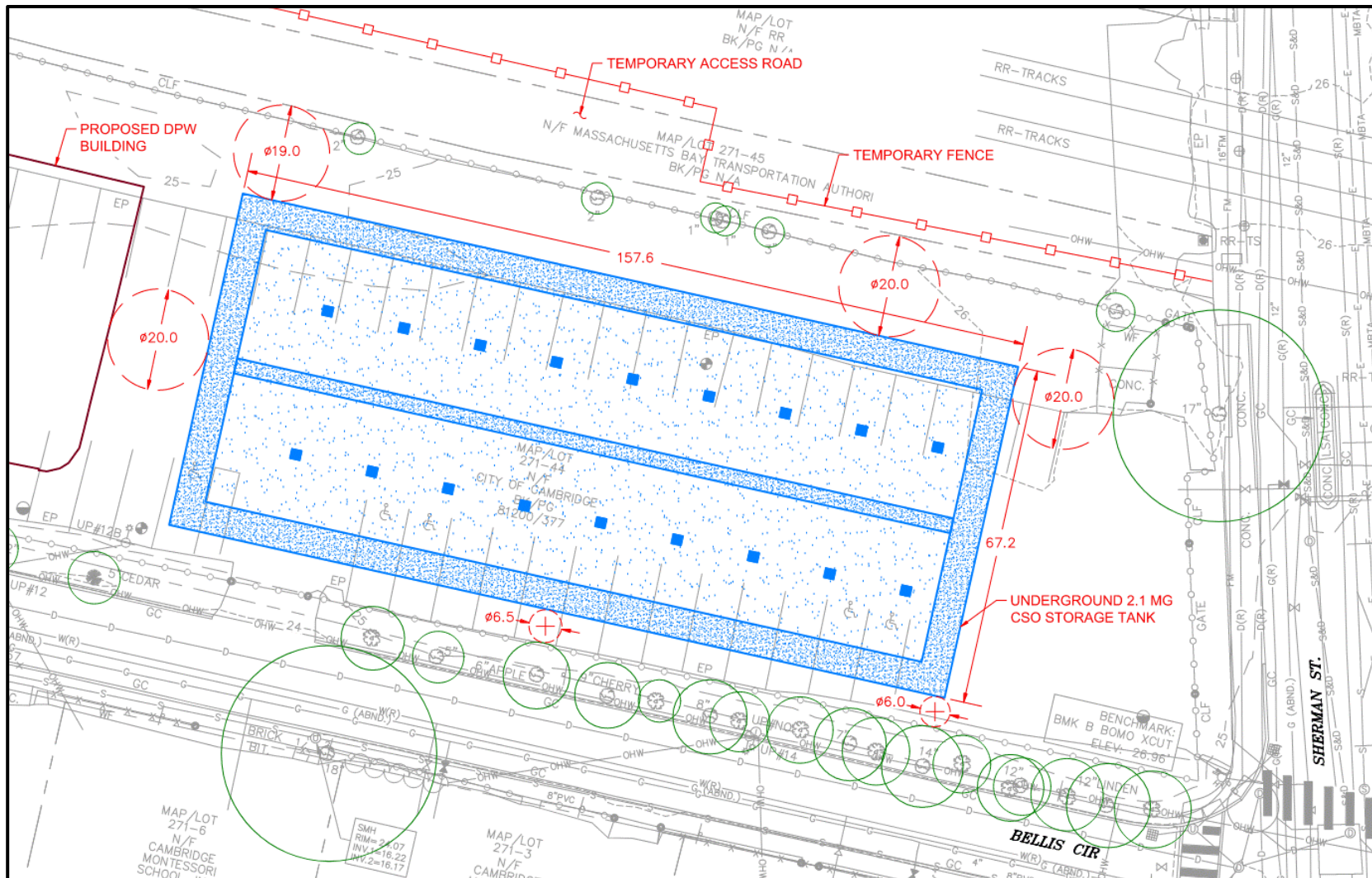


Figure 3-12. Conventional Cast-in-Place Layout – Goal Adjusted

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

Overall, the conventional cast-in-place option is a construction technique known by many reputable general contractors with the skills to successfully construct the tank to meet design requirements, specified materials, and constructability limitations. The project could expect a competitive bid market for most locations globally. However, due to site constraints, tree protections, and preferred tank depth, the conventional cast-in-place option was found less favorable unless accommodations are made for a reduced working area for tank construction. Until formal negotiations with MBTA are completed – a process likely to take several months – other structure types merit consideration.

3.3.3 Hybrid Cast-in-Place Concrete Structure

The hybrid option involves installing a permanent diaphragm wall or contiguous secant-pile wall as an excavation support system and groundwater cutoff. This wall is then integrated into the cast-in-place concrete tank structure as part of the exterior wall and foundation.

The initial diaphragm or contiguous secant-pile wall would be installed along the exterior footprint of the tank down into underlying clay or bedrock. Hydro mill trench cutters or drilling rigs install the initial wall consisting of concrete and steel reinforcement and key into the underlying clay or bedrock. This work is conducted at the surface without the need for dewatering. Examples of a deep circular wall being constructed are shown in **Figure 3-13** below.



Figure 3-13. Diaphragm Wall and Secant-Pile Wall Methods of Construction (Keller)

Excavation then occurs entirely within the initial wall down to the tank bottom elevation, illustrated in **Figure 3-14**. During excavation, tieback anchors or temporary bracing may be necessary to resist external soil and groundwater pressures.

Diaphragm walls and secant pile systems are considered water resistant but not watertight, and the type of concrete used during construction is generally not durable enough for long-term contact with sewage or stormwater (i.e., risk of chemical exposure and erosion of the concrete). For these reasons, the tank wall

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

is finished with a structural liner consisting of multiple layers of reinforcing steel doweled into the wall and placement of high-strength concrete using one-sided forming techniques. The tank bottom slab, interior columns, and top slab can then be constructed as conventional cast-in-place concrete.



Figure 3-14. Excavated Diaphragm Wall with Tieback Anchors (Keller)

The hybrid cast-in-place option offers a more compact excavation that reduces the overall work zone and requires less earthwork and soil management. It is an attractive option for tank sites very close to existing foundations and property lines. It is also ideal for site geologies that have challenging groundwater conditions and soil strata (boulder fields, thick glacial till with high blow counts) where steel sheeting is not feasible. The hybrid option is favorable for these challenging subsurface conditions due to the ability to “mine” through obstacles.

The walls for the hybrid option require additional concrete as extra thickness is required for the initial wall to ensure a minimum wall thickness, and there is a deviation from plumb in its installation requiring the structural liner to be designed thicker than necessary. The liner also involves one-sided forming which is more labor than free standing wall construction. Lastly, the construction method does not allow one to visually locate points of exterior leakage during hydrostatic testing. Overall, a hybrid option service life is considered similar to a conventional cast-in-place structure.

Due to the constrained Site conditions, identified tree protections (**Appendix A**), and assumed access to the abutting MBTA parcel, a hybrid tank layout was evaluated. The hybrid layout can be maximized in longitudinal and latitudinal directions while respecting MBTA jurisdiction and tree protection goals. For preliminary design, the tank limits were maximized in all directions to conceptualize the benefit on tank depth as shown in **Figure 3-15**. This approach facilitates support of excavation measures and wall forming to occur within Site limits. Overall, the approximate depth from existing grade to pump sump was calculated as 40.0-ft deep, with a 10-ft setback between the outer wall of the tank and the potential future conceived DPW building footprint.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

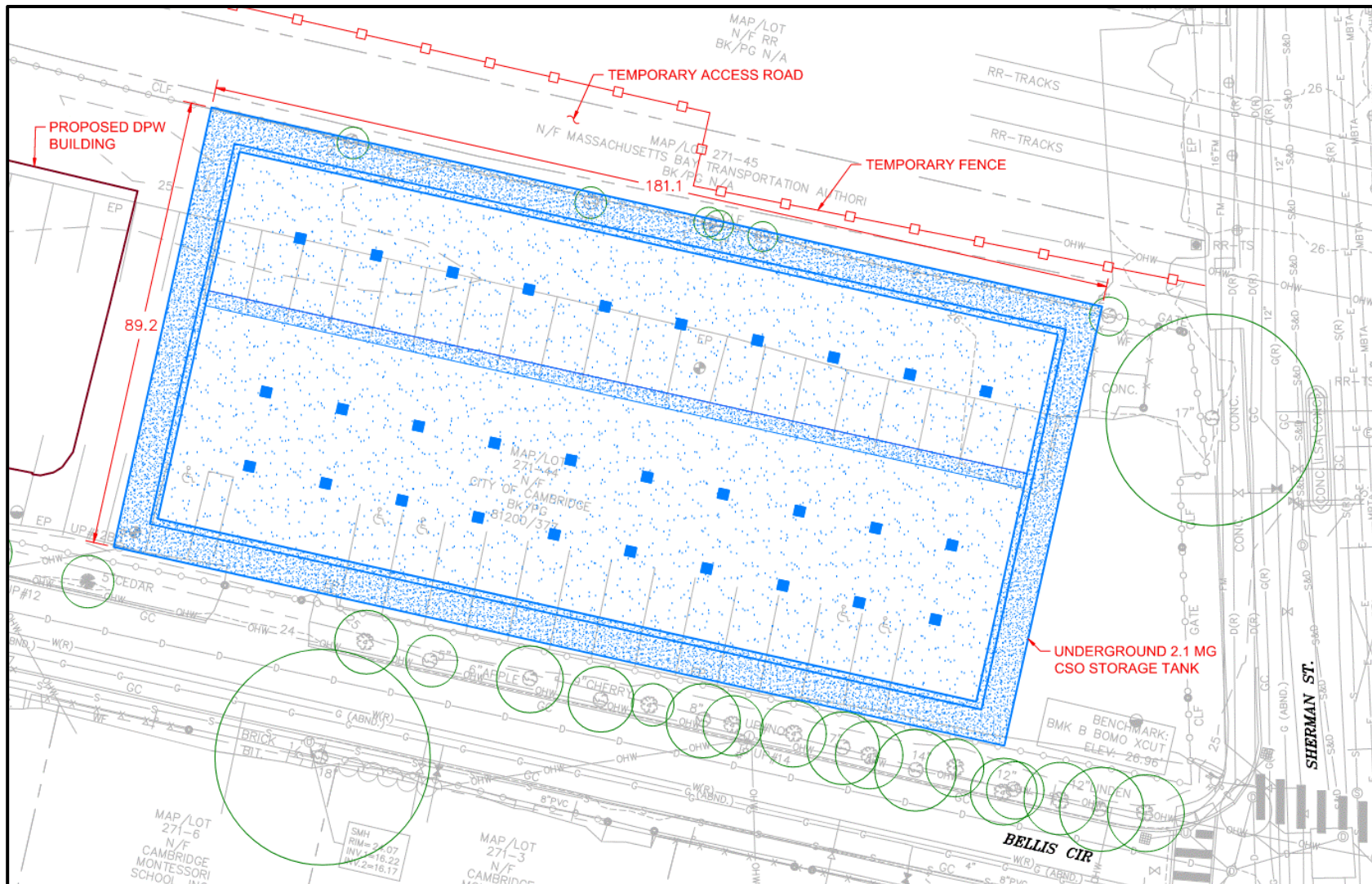


Figure 3-15. Hybrid Cast-in-Place Layout

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

While the hybrid option maximizes the longitudinal (short) dimension of the tank, it eliminates the excavation support technique of interlocking sheet piles that is relatively quick and economical to install. Yet this change has other advantages. The hybrid option limits ground vibrations compared to a traditional driven sheet pile approach, because the system is drilled or milled into the ground. It also has the advantage of reducing the volume and cost of excavation and soil management, which for this project constitutes approximately 3,500 cubic yards (CY) of soil left undisturbed on a site historically impacted by contamination.

3.3.4 AWWA D115 Tendon-Prestressed Concrete Water Tank

In 1996, the AWWA D115 standard for potable water storage tank design was developed. This system uses permanently tensioned steel tendons that are internal to the concrete members. The tendons maintain compression of the entire concrete cross-section under all load conditions, thereby reducing the volume of concrete and improving water tightness of the structure. The D115 standard has since evolved to include wastewater applications and is commonly used for rectangular tank shapes. A D115 tank design in summary incorporates:

1. Tendons are always internal to concrete members and encased in sealed grease and/or high-strength grout. This arrangement reduces the risk of tendon failure from exterior environmental factors, such as corrosive soils, H₂S corrosion, or de-icing chemicals present in stormwater. Design of prestressed concrete bridges follow this approach for similar reasons.
2. Most control joints (which prevent cracking) and construction joints (which are a source of leakage) can be eliminated. This approach allows concrete to be placed in fewer pours with fewer embedded waterstops and can yield time savings.
3. Diverse tank footprints are available. This flexibility allows installation within small/unusual parcels and setbacks.
4. Internal geometries and tank openings are readily customizable to have multiple chambers, differing levels, and different functions. This customization allows for configurations and system operation and maintenance to be tailored to Owner needs

An AWWA D115 tank can be engineered with precast wall assemblies, as depicted in **Figure 3-16**. However, a large rectangular underground tank with walls having a significant height and span subject to high groundwater pressures still requires a thick and heavy concrete cross section, making precast wall panels impractical to handle and ship. From past project experience, it is only viable for tendons to be engineered for cast-in-place construction on-site, as depicted in **Figure 3-17**. It is also common for D115 tanks to include ducts and tendons in the cast-in-place bottom slab which is integrated with the wall design. The service life for the D115 tank can range from 50 to 100 years depending on the construction method (e.g., precast or cast-in-place).



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK



Figure 3-16. AWWA D115 Tendon-Prestressed Precast Rectangular Tank



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK



Figure 3-17. AWWA D115 Tendon-Prestressed Cast-in-Place Circular Tank

AWWA D115 tanks use standard concrete techniques that local contractors can competitively bid and execute without specialized equipment. The major limitation is obtaining the specialization required to design and tension the tendons, of which there are few companies in the U.S. offering that service. Therefore, the overall structure must be engineered as a delegated design.

The D115 standard is suited for the conditions of the Sherman Street project. Structural Technologies, who is the major North American vendor for cast-in-place D115 tanks, was contacted to provide preliminary wall thicknesses for this project. Given an approximate 42-ft or 50-ft depth, the wall thickness was estimated to be 42-inch and 72-inch, respectively. There was a consistent relationship observed with wall thickness being higher than anticipated for the D115 option, primarily due to groundwater forces unique to this Site. The likelihood for support of excavation to require internal bracing was also noted by the vendor as a potential challenge, requiring additional analysis to verify that the structural integrity of the tendon system would not be compromised by temporary openings in the walls necessary for bracing to pass through during construction.

It appears the major advantage a D115 tank can offer in comparison to a conventional cast-in-place option – a reduction in wall thicknesses – is not likely to be realized. Additionally, tensioning of the

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

tendons requires a minimum clearance of approximately 4-ft all around the tank exterior, which is a dimensional requirement similar to the conventional cast-in-place option that limits the longitudinal (short) dimension of the tank and the associated wet footprint of the tank.

3.4 SOIL AND MATERIALS HAULING

At this stage in design, routes for hauling soil and construction materials are undergoing early evaluation. The proposed tank excavation will generate large quantities of soil that requires trucking the material to off-site disposal facilities. Because the Site is located within a residential area, additional due diligence is being conducted so that all reasonable routes for hauling soils are identified. Preliminary evaluation identified three primary approaches for hauling excavated material and delivering materials at the Site.

The first, and typical, approach would be for all trucking to occur in and out of Sherman Street and Bellis Circle and continue on to adjacent City streets. This provides direct access and operational flexibility for the contractor, but impacts the community in the form of increased traffic density, vehicle noise and dust, and safety concerns along the narrow Sherman Street corridor and at the MBTA railway crossing. Typical mitigation concepts, such as limiting major hauling activities to occur outside of typical commuting hours, are an option to balance community impact but could extend the duration of construction schedule.

A second approach involves establishing a hauling route along the northern edge of Danehy Park, and could involve utilizing a portion of the adjacent MBTA railway corridor that directs trucking in and out of the Site via New Street. This option depicted in **Figure 3-18** requires further coordination with the MBTA and may involve engagement with private property owners and different City departments to confirm access rights and operational constraints. Considerations include feasibility of one-way or two-way truck movements, maintaining active rail infrastructure, modifying and restoring MBTA's physical assets, necessary tree removals, and infringing upon regulatory buffer zones that may exist for the open water area at Danehy Park. While this alternative can reduce truck traffic on Sherman Street, it introduces additional permitting, increases railroad safety issues, and impacts the natural environment.

A third approach that was evaluated – but found to be unfeasible – involves utilizing the existing railroad tracks adjacent to the Site to directly load freight cars with soil for further transport and disposal. The design team engaged railway professionals and environmental soil brokers to determine feasibility of this option. There is a lack of rail routes from the Site to appropriate disposal locations, and the Fitchburg line presently does not have any freight locomotives running on the tracks. Additionally, a spur would need to be constructed for railway cars to be staged next to the parcel, which is an endeavor expected to take several years to coordinate. For these reasons, this approach has been discarded.

As the design progresses, these potential hauling methods will be refined, compared, and evaluated. The intent at this stage is to ensure options identified are examined with appropriate care, demonstrating the project team and City's commitment to thoughtful planning within a residential area.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

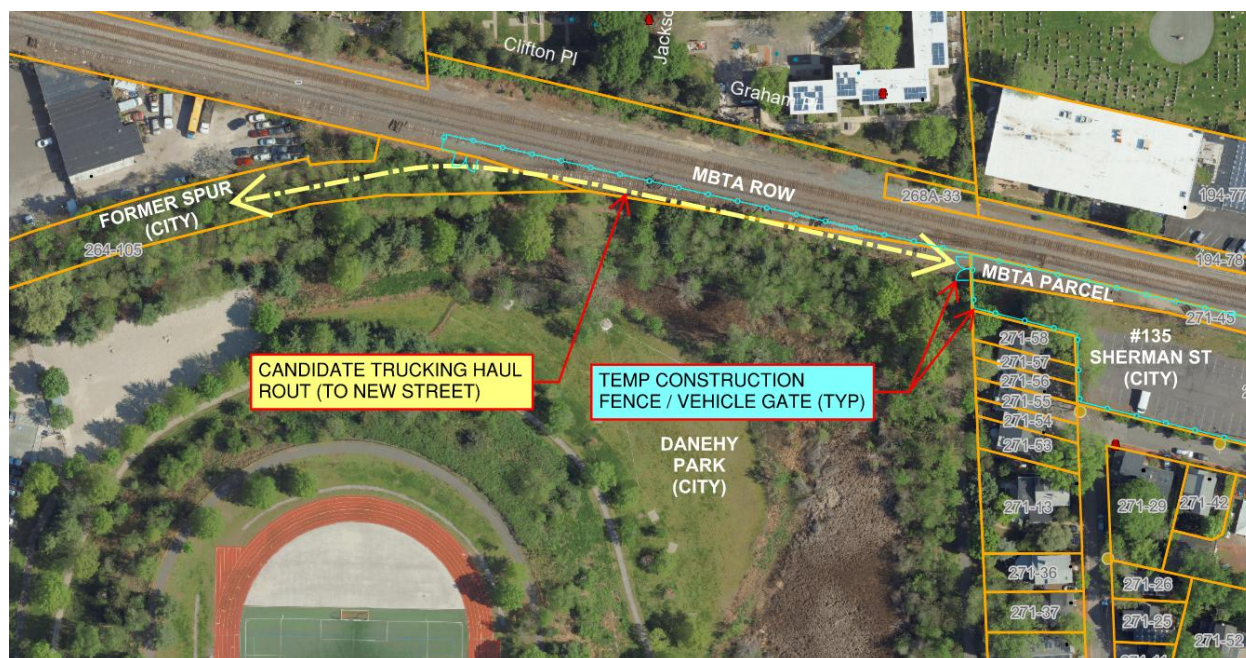


Figure 3-18. Candidate Haul Route to New Street

3.5 PROCESS EVALUATION

This section presents evaluations of key Process components for the operation of the CSO storage tank.

3.5.1 Odor Control System

The underground CSO storage tank is designed as a fully enclosed structure to isolate wet-weather flows and reduce overflows at CAM401A. However, the turbulence and air displacement generated during passive tank filling and the subsequent retention of combined sewage and/or residual organic solids remaining on the floor can generate odorous compounds. The primary odorous compounds include hydrogen sulfide (H_2S), reduced sulfur compounds, and volatile organic compounds (VOCs). Given the storage tank proximity to local receptors, including the Bellis Circle residences and the Cambridge Montessori School, a reliable odor control system for air purification is needed to mitigate potential air quality and community impacts.

3.5.1.1 Odor Mitigation Technologies

Different odor mitigation technologies were considered, including biofiltration, liquid chemical scrubbing, and dry media adsorption.

While biofilters offer favorable long-term operational cost profiles, their expansive spatial footprint directly conflicts with the tight parcel boundaries and overall site layout of the future DPW facility. Additionally,



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

biofilters require continuous, precise moisture control; any interruption to the water supply causes a rapid loss of microbial viability within the odor reducing microorganism. Biofilters also perform poorly under intermittent operating regimes; when shut down for a long period such as during dry weather, it can take them up to two weeks to come back to full operation. They are not suited for unmanned sites with intermittent odor control needs.

Liquid chemical scrubbers were eliminated, because they require onsite hazard chemical storage, high cost operation, and need regular operator oversight. They also require significant water demands.

Consequently, a dry media deep-bed activated carbon adsorption system is viewed as the optimal technology for this application. The media is highly effective at treating general sewage odors and volatile organic compounds (VOCs) typically associated with municipal collection systems, particularly under lower hydrogen sulfide (H₂S) loading conditions. Dry systems provide exceptional reliability, instant passive operation, and high removal efficiencies for intermittent or fluctuating contaminant loads. Also, the site layout for an activated carbon adsorption system is not extensive and aligns with project constraints.

3.5.1.2 System Configuration

There are several carbon filter configurations available. The main differences are height, footprint, and accessibility for maintenance. For this system, keeping the height to be as low as possible to reduce visual impact and ease of access for maintenance are governing criteria.

Two activated carbon filter systems were reviewed based on these criteria: a radial flow and a vertical tube system.

Alternative 1: Radial Flow

Description: Utilizes a cylindrical, vertical bed arrangement with a radial airflow distribution pattern. A representative unit is shown in **Figure 3-19**.

Key Characteristics:

Footprint: 14-ft (L) x 13-ft (W)

Height: 13.5-ft

Media Replacement: Top of cylinder

Table 3-5 lists the relative advantages and disadvantages.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

Table 3-5. Relative Advantages and Disadvantages for RF

Advantages	Disadvantages
• Smallest footprint	• Tallest profile • Smaller work platform for media replacement.

Alternative 2: Vertical Tube System

Description: Utilizes a horizontal rectangular vessel arrangement with horizontal airflow through multiple vertical chambers. A representative unit is shown in **Figure 3-20**.

Key Characteristics:

Footprint: 29.5-ft (L) x 11-ft (W)

Height: 10.5 ft:

Media Replacement: Top of rectangular vessel

Table 3-6 lists the relative advantages and disadvantages.

Table 3-6. Relative Advantages and Disadvantages for VTS

Advantages	Disadvantages
• Lowest profile • Largest work area for media replacement	• Larger footprint

Although the VTS system has a larger footprint, the lower profile and larger footprint provide a safe work area making this a favorable option.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

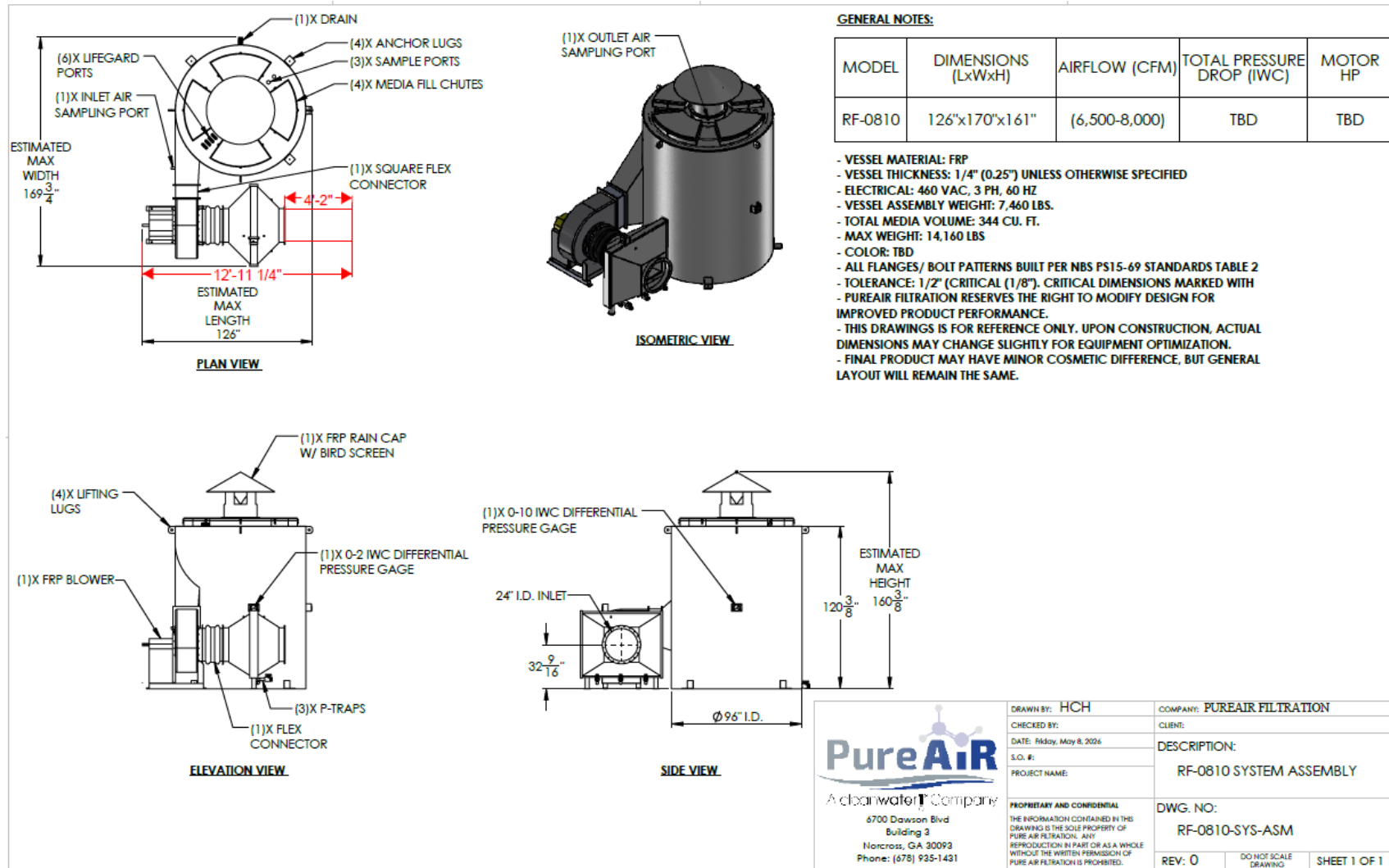


Figure 3-19. RF System

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

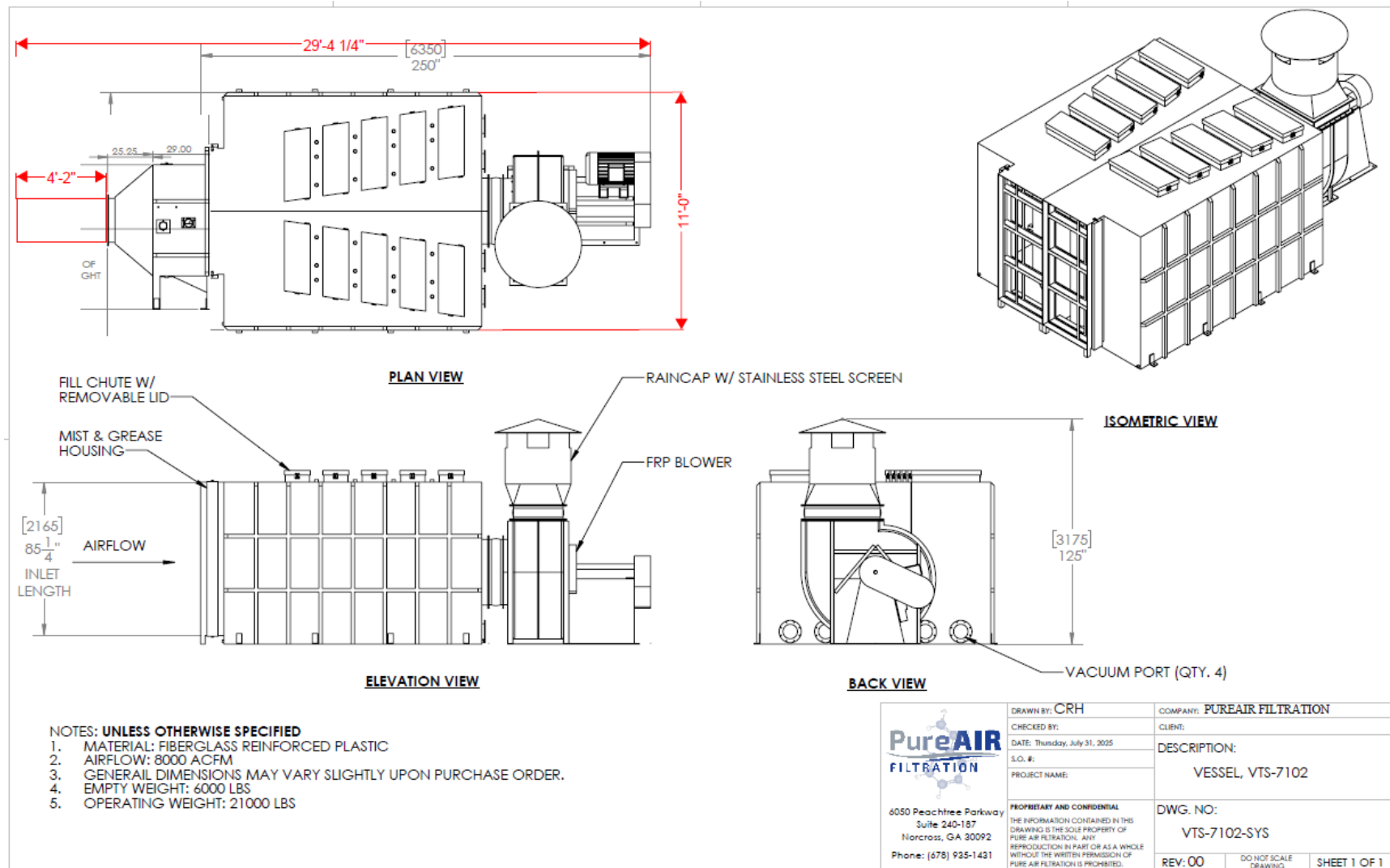


Figure 3-20. VTS System

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

3.5.1.3 Noise and Zoning Constraints

The Site is bounded by a C-1 Residential District with adjacent property owners and businesses, where the Cambridge Municipal Code (Chapter 8.16 Noise Control) establishes Maximum Allowable Octave Band Sound Pressure Levels down to 50 dB(A) at the property line. A baseline 7,000 cfm odor control exhaust fan expected for this project generates unmitigated acoustic levels of approximately 86 dB(A). For comparison, refer to **Figure 3-21** for environments typical of that noise level.

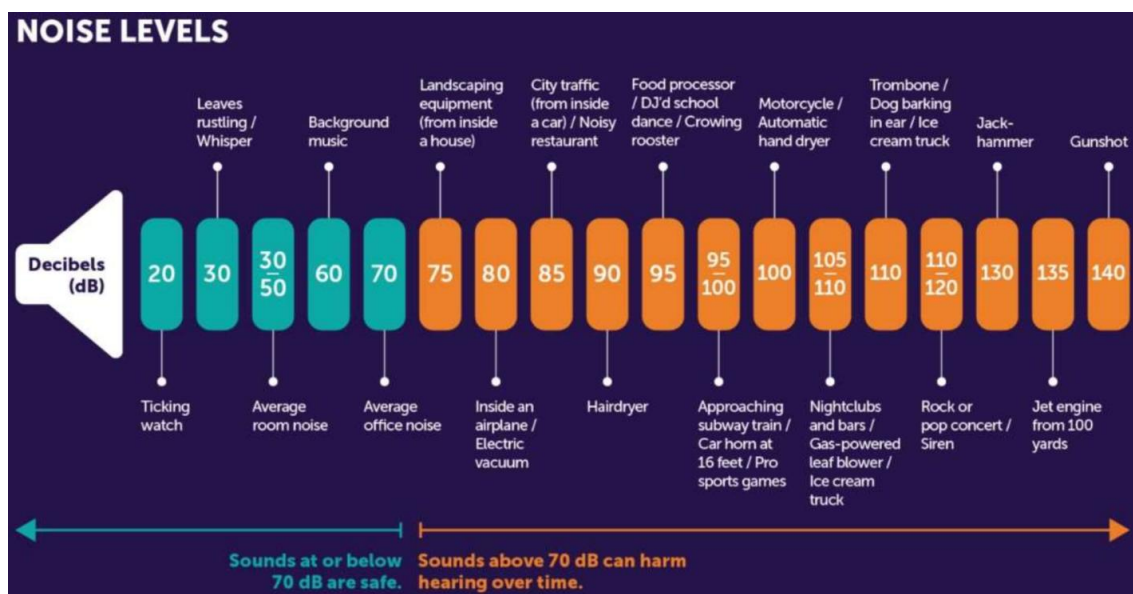


Figure 3-21. Typical Noise Levels and dB ratings

Under open-air, free-field conditions, the sound pressure level drops by approximately 6 dB for every doubling of the distance from a point noise source (governed by the inverse-square law). A passive reduction of no more than -18 dB is expected for the Site, meaning that noise attenuation is required. Two configurations for the odor control system were evaluated to achieve regulatory compliance:

- Alternative 1: Perimeter Acoustic Panel Enclosure (**Figure 3-22**)

Description: Installing a modular, sound-absorptive acoustic panel enclosure around the fan, motor, and drive assembly with an open-top design. This barrier configuration attenuates lateral noise transmission toward adjacent parcel boundaries while preserving unhindered overhead clearance for media replacement and routine equipment maintenance.

- Alternative 2: Dedicated Fan and Motor Acoustic Enclosure (**Figure 3-23**)

Description: Encapsulating the blower fan and motor within a dedicated, factory-engineered sound enclosure. This source-level mitigation isolates mechanical vibration and casing-radiated

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

noise at the origin without requiring a large structural fence around the broader equipment footprint.



Figure 3-22. Perimeter Acoustic Panel Enclosure Example



Figure 3-23. Dedicated Fan and Motor Acoustic Enclosure



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

To comply with municipal noise ordinances while optimizing life-cycle costs, a Perimeter Acoustic Panel Enclosure (Alternative 1) is favorable over a Localized Fan and Motor Enclosure (Alternative 2). Although the perimeter enclosure entails a higher initial capital cost, it yields significantly lower long-term operations and maintenance (O&M) expenses. The localized fan and motor enclosure severely restricts maintenance access, complicates heat dissipation, and requires ventilation which ultimately leads to elevated and ongoing O&M burdens. The open-top perimeter enclosure effectively attenuates lateral sound propagation toward sensitive boundaries while preserving unhindered overhead clearance for carbon media replacement, streamlining routine servicing, and ensuring reliable low-maintenance operation. In addition, it provides a static visual screen and a second security barrier.

3.5.1.4 Odor Equipment Siting Alternatives

Integrating the activated carbon adsorption equipment with the underground tank requires balancing ductwork routing, pressure drops, fan horsepower, and space planning for the site usage of a potential future DPW building. Two physical placement options were assessed:

- Alternative 1: Below-Grade Vault Configuration

Description: Positioning the entire odor control treatment train inside an underground structural vault to maximize surface land available for DPW vehicle staging.

Technical Factors: Requires a large structural vault with foundation. Heavy-duty, traffic-rated access hatches and/or removable concrete panels are needed that area large enough to clear the full physical dimensions of the treatment vessel. This necessitates a complex overhead structural framing system to support heavy traffic loads. Furthermore, an underground vault restricts access for maintenance activities such as monthly grease filter inspection and periodic carbon media replacement. Below-grade placement also introduces risks of groundwater infiltration and stormwater flooding, requiring a dedicated sump pump system and explosion-proof electrical equipment.

- Alternative 2: Above-Grade Surface Configuration

Description: Positioning the equipment at grade on a dedicated concrete pad above or adjacent to the tank.

Technical Factors: Provides direct vehicle drive-up access for maintenance and media replacement. It requires a permanent surface footprint that must be integrated into the paved lot, with bollards or other type of barrier systems to prevent vehicle strikes and dedicated clearances for maintenance access. It also presents as industrial equipment for residential sight lines.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

3.5.1.5 Community Environmental Safeguards and Air Quality Verification

Given the facility's proximity to dense residential and institutional zones, public stakeholder interest regarding local air quality is expected. To address community feedback and ensure operational harmony, the final design will incorporate dedicated frameworks for both pre- and post-construction air quality performance testing. The odor control system is designed to treat an average influent H₂S concentration of 5 ppm, achieving greater than 99% removal efficiency. Based on these average loading rates, the deep-bed activated carbon media is projected to have a service life of approximately two years before requiring replacement. Furthermore, to optimize operational efficiency, the odor treatment system can be normally operated during tank filling, dewatering and cleaning activities, and otherwise turned down or off during dormant dry weather conditions.

Air quality testing and odor performance validation can be executed through:

- Direct Source Sampling: Utilizing specialized Jerome meters or electrochemical cell sensors to directly monitor influent and H₂S concentrations at the odor control system discharge.
- Analytical Olfactometry: periodic collection of air samples from the odor treatment system exhaust which are analyzed by an independent, certified laboratory utilizing the Forced Choice Olfactometry Method in accordance with ASTM E-679.

Overall, a properly maintained and operating odor control system will ensure the public is not impacted by facility odors. As the design continues, additional review and planning can occur to further validate removal of pervasive odors. Furthermore, the odor control design parameters will be reviewed with the Cambridge Department of Health.

3.5.2 Tank Cleaning Technologies

Tank cleaning technologies were reviewed with the City on May 18, 2026 during the CSO Storage Tank Options Preliminary Design meeting (**Appendix E**). The tank cleaning alternatives discussion expanded on prior conceptual design options reviewed with the City including VacFlush, Scanjet spray nozzles, flushing gates, and tipping buckets as well as a new option the Acu-Drum. The following items summarize the topics discussed with the City and additional outreach and findings.

- Vacuum Flushing: The City did not express interest in the VacFlush system as the storage tank size and cell partitioning does not align with the optimal tank center flushing approach of a VacFlush system. This system is commonly utilized in Europe, but there are only a few installations in rectangular or circular tanks in North America. The agencies contacted in North America report occasional vacuum leaks with the concrete flushing basins and/or mechanical issues inhibiting operation. Overall, the VacFlush system is a cleaning approach best suited for Owners who desire this specific technology, are comfortable with overseas aftermarket support, and have favorable site conditions and quality-driven construction practices.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

- **Rotating Spray Nozzles:** The Scanjet SC-30T spray nozzle was also discussed but interest lessened from conceptual design due to it being uncommon for CSO tank cleaning and having blind spots and non-uniform distances within a column supported rectangular tank. While it is the preferred tank cleaning option for St. Louis Metropolitan Sewer District, further analysis and potentially site visits are required to affirm understanding for implementation. The Scanjet nozzle was noted as an attractive option to retain for future projects but undesired considering other options.
- **Flushing Gates:** The City expressed interest in flushing gate systems due to common use and successful performance. Within the City of Cambridge, flushing gate systems are familiar and a proven technology at locations within the City's sewer and drain collection systems. The City noted that after 20 years, there are no major issues with the hydraulic packs on the flushing gates installed; however, overtime the gates won't close due to debris build-up and/or gasket erosion preventing the gate from closing. Also, miscellaneous objects within a collection system can occasionally impede a gate from closing. Maintenance to address this requires physical entrance to the chamber by a technician, which has been manageable where sited in a shallow vault involving non-critical locations, but for a deep underground CSO storage tank the prospect of this maintenance is undesirable.
- **Tipping Buckets:** A commonly used technology that is favorable for rectangular tanks are tipping buckets. Tipping buckets are installed near the roof slab and can typically clean the same length of a flushing gate. Typically, potable water fills a tipping bucket and at a certain level the center of gravity shifts within the bucket causing it to rotate and spill down to the tank floor. Access to a tipping bucket for operation and maintenance activities is significantly less compared to flushing gates. Annual visual inspection from the ground surface, with infrequent greasing of bushings is expected. Access is common from above each bucket at locations such as hatches, removable concrete slabs, or an interior walkway can be included for direct manual inspection.
- **Tipping Drums:** One new alternative reviewed is the Acu-Drum manufactured by Grande based in Montreal, Canada. Similarly to flushing gates, the Acu-Drum sits near the tank floor and rotates forward to spill water as a tipping bucket would operate. It is commonly filled with the stored fluid vs. using an independent water supply. Grande noted the Acu-Drum integration is a niche design with a maximum lane length of 120-ft, ideally includes a floor slope greater than tipping buckets or flushing gates, and additional parameters Grande reviews to ensure proper cleaning.

Overall, tipping buckets were viewed as the favorable option due to a simplified operation compared to flushing gates and closure issues.

3.5.3 Dewatering Approach

A wet pit pumping station included within the tank was selected during conceptual design to reduce overall footprint of the installed structures vs. a separate pumping station. The storage tank floor will slope and direct flow towards a common pump zone. Submersible centrifugal pumps were reviewed for



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

comparison of options for the dewatering approach as they are likely to be the most available, economical, and durable pumps for a CSO application.

Two initial pumping options were reviewed based on fixed speed pumps having a past project precedence in the City of Cambridge and overall simplicity of electrical design:

- Option 1 reviewed Screw type impeller pumps to pass larger solids. Hidrostat was reviewed for this option although other comparable manufacturers for this pump style exist (e.g., Wemco and Hayward Gordon).

The Screw pumps had more broad pump curves available with less low end head as the curves were generally flatter with minimum head requirements of at least 20-ft to stay on the pump curve. Working with these pumps would likely require either inducing head on the pumps with an automated valve or operating a VFD. These pumps boasted a 5-inch solids passing diameter which could be an added benefit if items pass the 8-inch bar rack in the diversion structure.

- Option 2 considered more traditional non-clog semi open impeller submersible pumps with better rag handling capability and self-cleansing impeller technology. These pumps had a wider range of head with steeper pump curves that would allow for operating at a wider range on the pump curves without the need to automate valves to induce head as needed with the screw impeller pumps. Flygt pumps were evaluated for this option although other manufacturers such as Sulzer or KSB may have comparable options among others. Some of the Flygt pump models reviewed included an option of installing a cutting ring on the pump suction to transform it into a chopper pump which can be effective to prevent ragging. Typical solid passing diameter is around 2.5-inch.

Based on discussion with City operators and pump manufacturers, Option 2 (submersible impeller pumps) is viewed as the favorable option due to the City's experience with them in both sewer and stormwater applications and their operational success in those environments. Ragging was noted to be an occasional issue within Cambridge's sewage pumping stations, which are typically small size Flygt N impeller pumps. However the mid-size pumps required for this project would be less prone to that maintenance issue. Protecting these pumps from large debris is an important consideration. A coarse bar rack at the diversion structure is a planned option to prevent large debris from entering the tank.

The water surface elevation in the sanitary sewer will be monitored to sequence when the tank is dewatered after it activates. Once downstream interceptor flow levels subside, the pumps will activate and are sized to completely dewater the tank in 12 to 24 hours after a storm event. This dewatering time was selected to have the tank available for service again in a reasonable timeline as well as utilizing the available dry weather flow capacity in the sanitary sewer. **Table 3-5** provides the hydraulic parameters required of the pumps.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

Table 3-5. Pump Hydraulic Parameters

Design Flow Rate / Total Dynamic Head (TDH)	Low	High	Operational Maximum Speed Limited	Maximum
TDH range (ft)	33.7	22.8	13	15.7
Flow range (gpm)	1,907 (2.7 MGD)	3,743 (5.4 MGD)	4,350 (6.26 MGD)	4,766 (6.86 MGD)

3.5.4 Solids Management

The removal of solids from the tank was discussed with the City on May 18, 2026 during the CSO Storage Tank Options Preliminary Design meeting (**Appendix E**). The City noted that it routinely cleans and removes 6-inches or more of sediment from the combined sewer on Sherman Street, with concern that tank dewatering could exacerbate this problem if flow is directed there. The City identified the sanitary sewer as the preferred discharge outlet for tank dewatering, with flows ultimately conveyed to MWRA's regional treatment facility at Deer Island. Sediment deposition in the sanitary sewer is a concern, however, and two alternatives were reviewed to minimize this risk. Refer to **Table 3-6** for a summary comparison of the solid handling optimization options.

Option 1 – Underground Grit Capture Tank: A sediment capture tank was considered to centralize solids at one location to simplify removal. The storage tank will flush sediment to the pump sump and discharge valves will be automated to divert flow at a maximum of 1,962 gpm to a 10-ft Grit King® Compact grit capture tank rated for combined sewer applications. The Grit Separator includes a 14-inch inlet pipe from the dewatering pumps, an HDPE Hydrodynamic separator with no moving parts and a 30-inch diameter outlet pipe for final conveyance to the sanitary sewer on Sherman Street. The grit tank was sized to capture 95% of grit ≤125 micron at 1,962 gpm and 95% of grit ≤106 micron at 1,470 gpm which should be approximately 90% of the grit from the tank. The structure will have two access points for vacuum excavation, one within the center of the tank and one within the outer ring annulus. A 2-inch fluidizing line is offered to re-suspend the grit with water from a vacor truck for ease of removal. The grit tank is not specifically designed to capture floatables though they may remain in the tank and are to be vacuumed out if accumulated. Refer to **Figure 3-24** presenting a section view of the unit.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

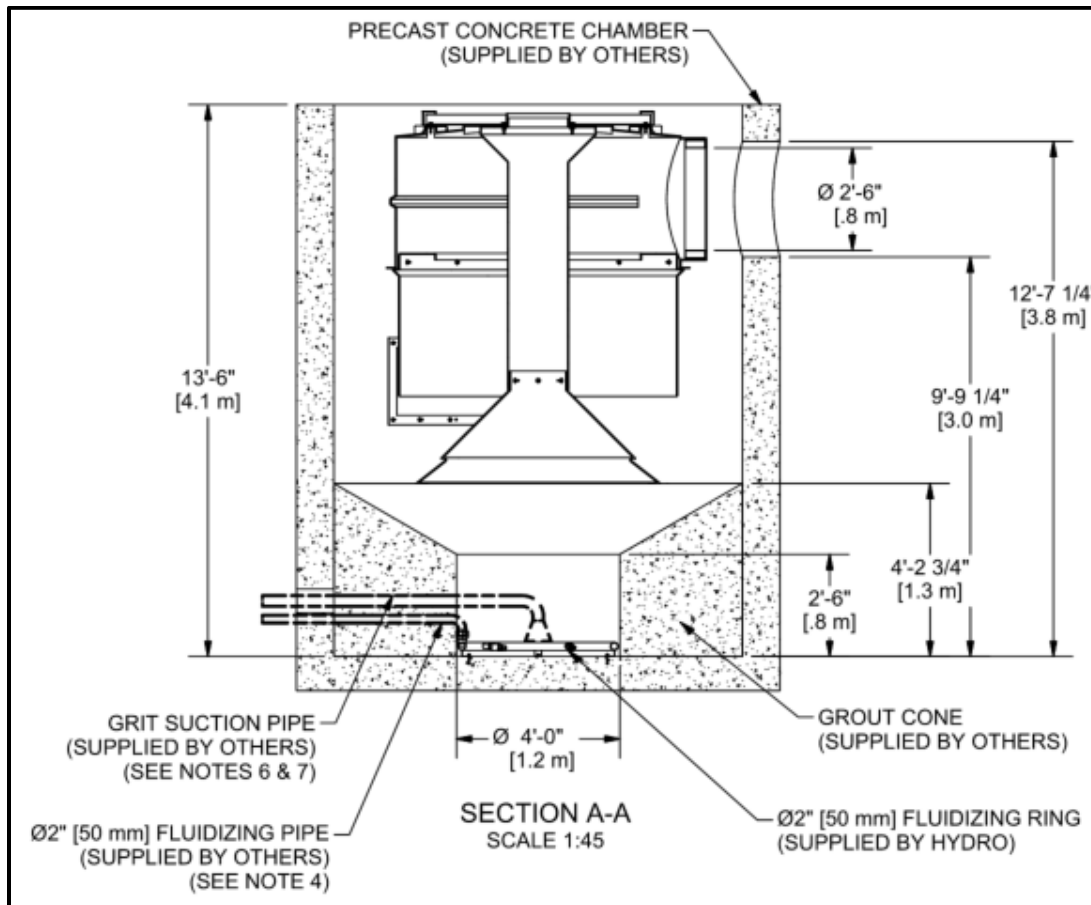


Figure 3-24. Grit Separator Tank

Option 2 – Upsized Pumps and Sewer Flush Vault: This option involves increasing the size of the tank dewatering pumps to discharge flow at a rate high enough to keep solids in suspension for approximately 1,000 linear feet along the 27-inch x 36-inch Brick sewer on Sherman Street. At this distance, suspended solids would approximately reach the Sherman Street and Rindge Avenue intersection and may settle at that location. To continue solids handling and prevent debris build-ups within the sanitary sewer, a sewer flush vault was conceived at the start of Montgomery Street (**Figure 3-25**). The sewer flush vault would release a rush of water to scour and remove remnants along the Montgomery Street sanitary sewer and convey them to the Alewife Linear Park siphon below the MBTA Red Line subway. This option does not eliminate the risk of sediment deposition, but conveys it to a location that already receives scheduled maintenance. Vector truck sewer cleaning would presumably be required quarterly throughout the year and could increase siphon maintenance issues.

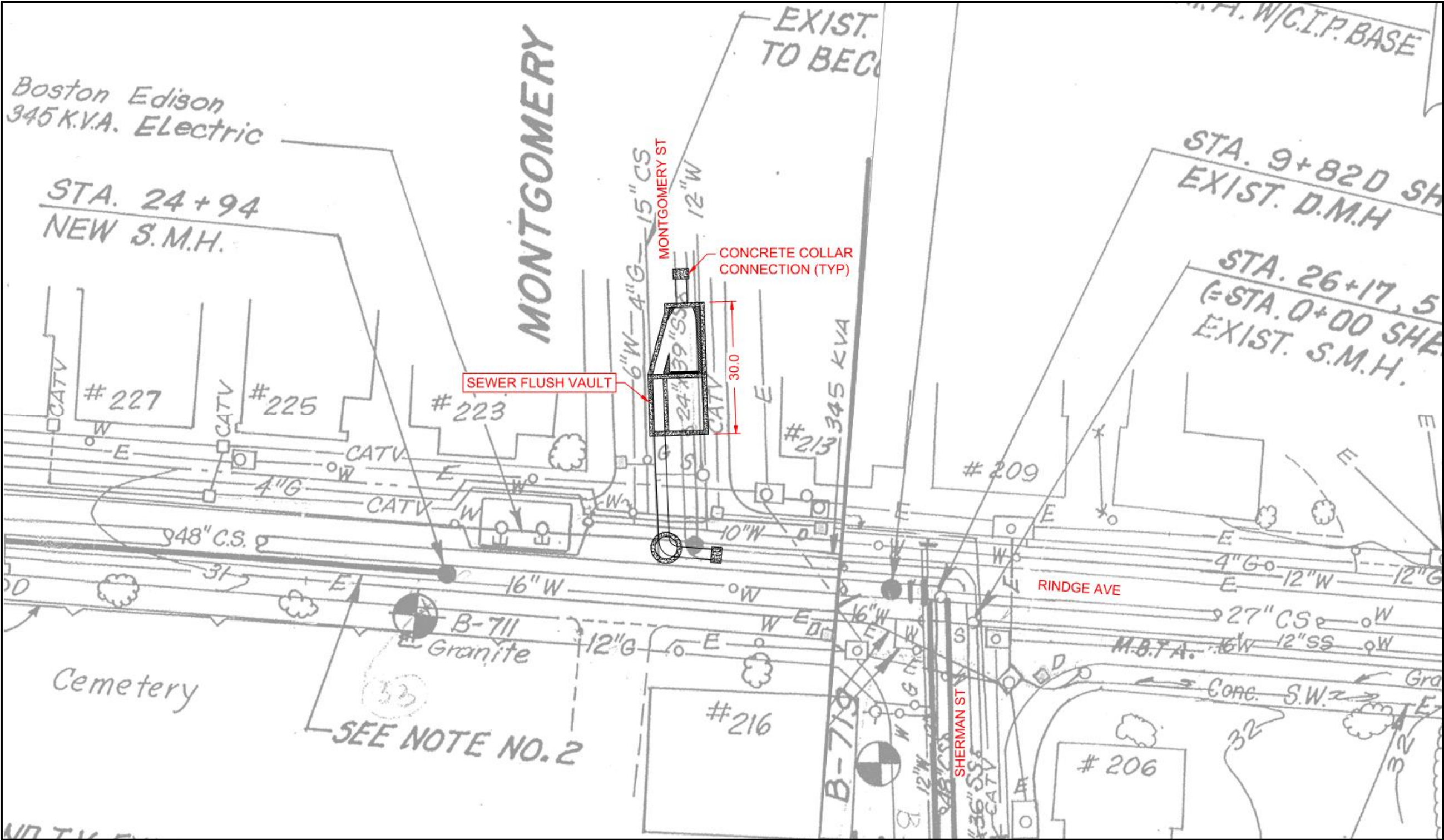


Figure 3-25. Sewer Flush Vault

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

Table 3-6. Sediment Handling Matrix

Option	Involves On-site Vactor Cleaning	Involves Sewer Cleaning	Involves Siphon Maintenance
1: Grit Capture Tank	Yes	No	No
2: Upsized Pumps & Sewer Flush Vault	No	Possible	Possible

Generally, these two options once constructed still involve manual cleaning. Maintenance of a grit capture tank involves vactor cleaning similar to routine catch basin maintenance that occurs across the City, whereas relying on systems to convey sediment downstream in the sanitary sewer promotes the need for mainline jet cleaning of sewers, which is also common in the City and occupies a roadway.

3.5.5 Electrical Transformer Evaluation

Stantec scheduled a meeting with Eversource Electric on June 11, 2026 to review anticipated electrical loads and required equipment on-site. The electrical load of the storage tank necessitates a pole-mounted transformer. However, the combined electrical load of a potential future DPW building with storage tank is expected to exceed 300kVA, whereby Eversource would require a utility-owned pad mounted transformer and three-bay switchgear on the Site. Considering that the City operates the parcel as a secure site, this equipment would necessitate its own 20-ft by 30-ft perimeter fence with a delegated lock for Eversource to access from the roadway.

An evaluation was performed to see if allocating space off of Sherman Street for a pad mounted transformer to serve a future building could be accommodated by the storage tank project. Two Site locations near the Sherman Street entrance were evaluated.

The southeast corner of the Site was evaluated but determined impractical given the planned prominent location for underground yard piping and possible vaults adjacent to the storage tank. The transformer and switch gear concrete pads would have to be placed directly over or adjacent to underground piping, which is not recommended. Additionally, this fenced-in area would conflict with planned truck turning radius in and out of the parcel (**Appendix F**) as shown in **Figure 3-26** and occupies a designated 25-ft turning radius and a DPW vehicle parking spot (**Figure 3-27**).



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

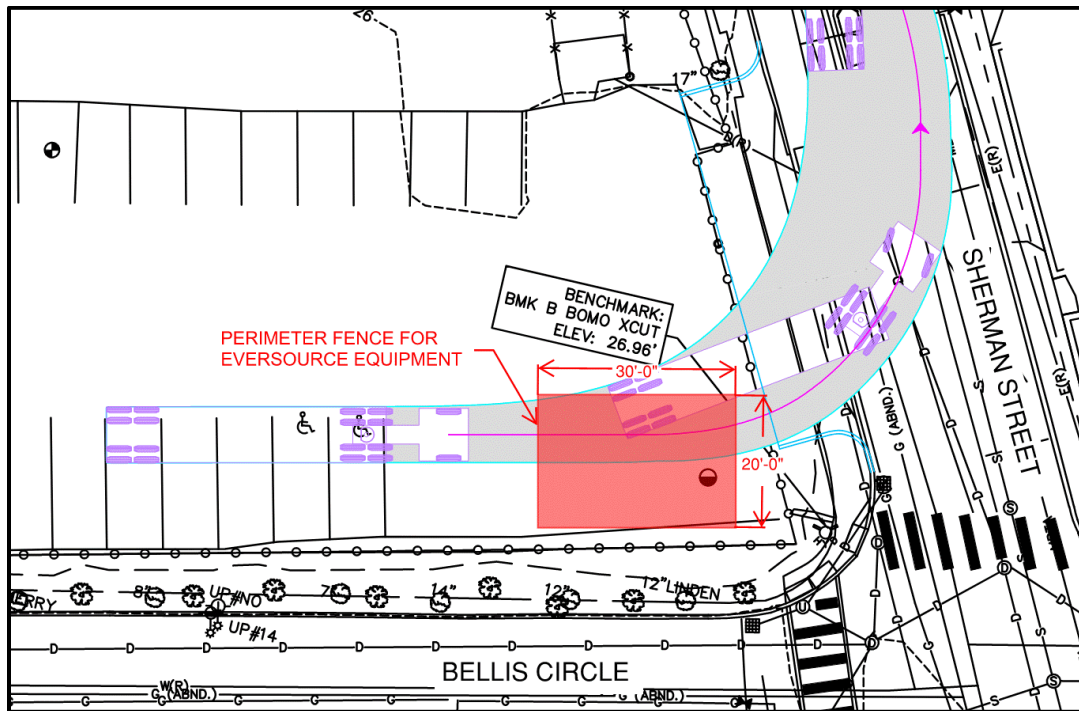


Figure 3-26. Pad-Mounted Transformer Concept 1 - Truck Turning Radius Conflict

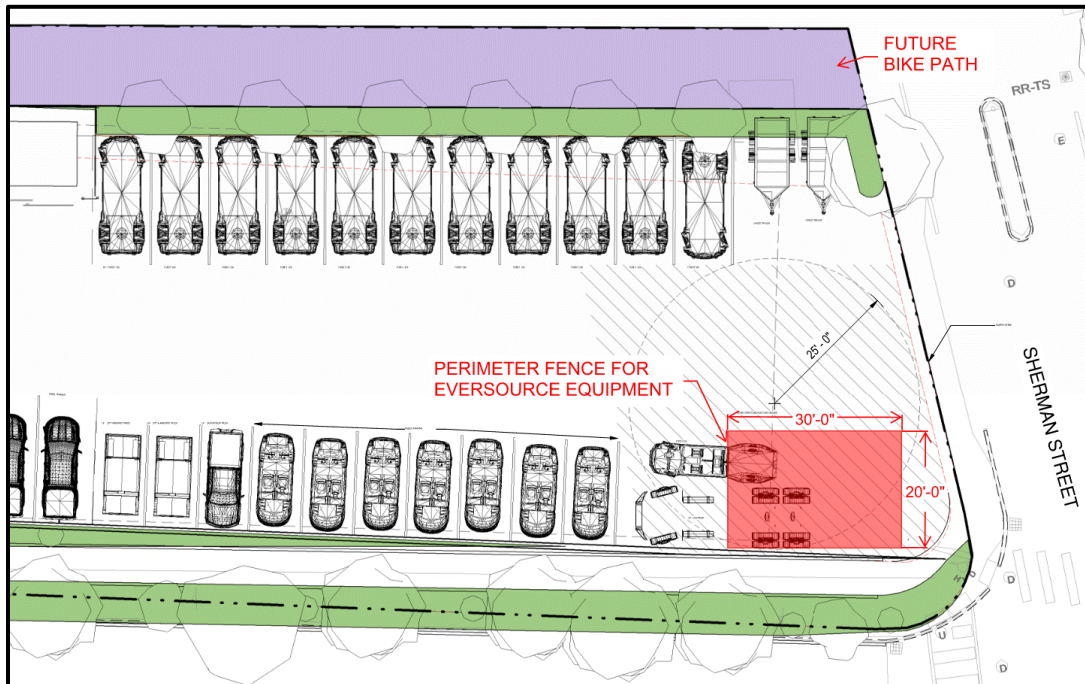


Figure 3-27. Pad-Mounted Transformer Concept 1 – Parking Space Conflict

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

Siting a transformer in the northeast corner was evaluated second and from a utility standpoint demonstrated a practical approach (**Figure 3-28**). However, the fenced area conflicts with truck turning radius in and out of the parcel (**Figure 3-29**) and occupies a designated 25-ft turning radius and three DPW parking spots (**Figure 3-30**).

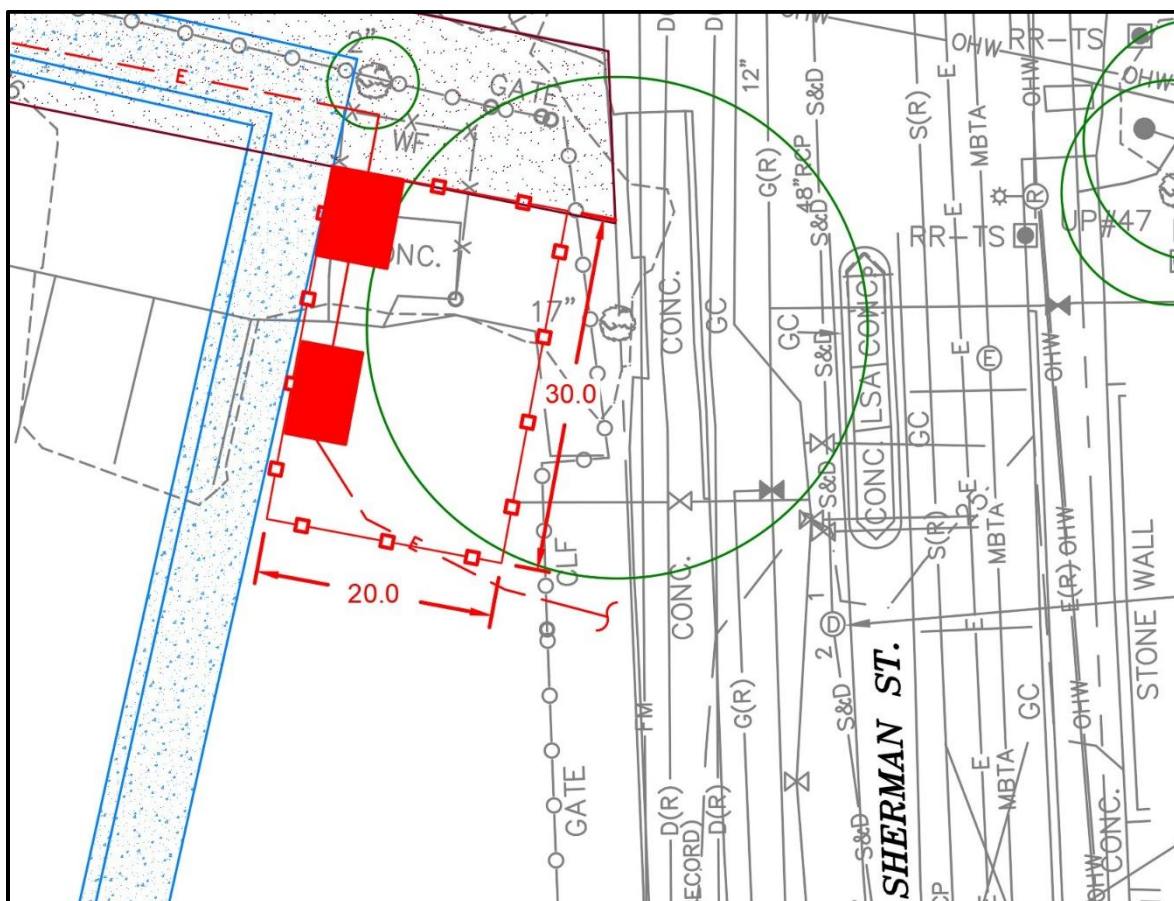


Figure 3-28. Electrical Equipment Concept 2 – Utility Layout

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

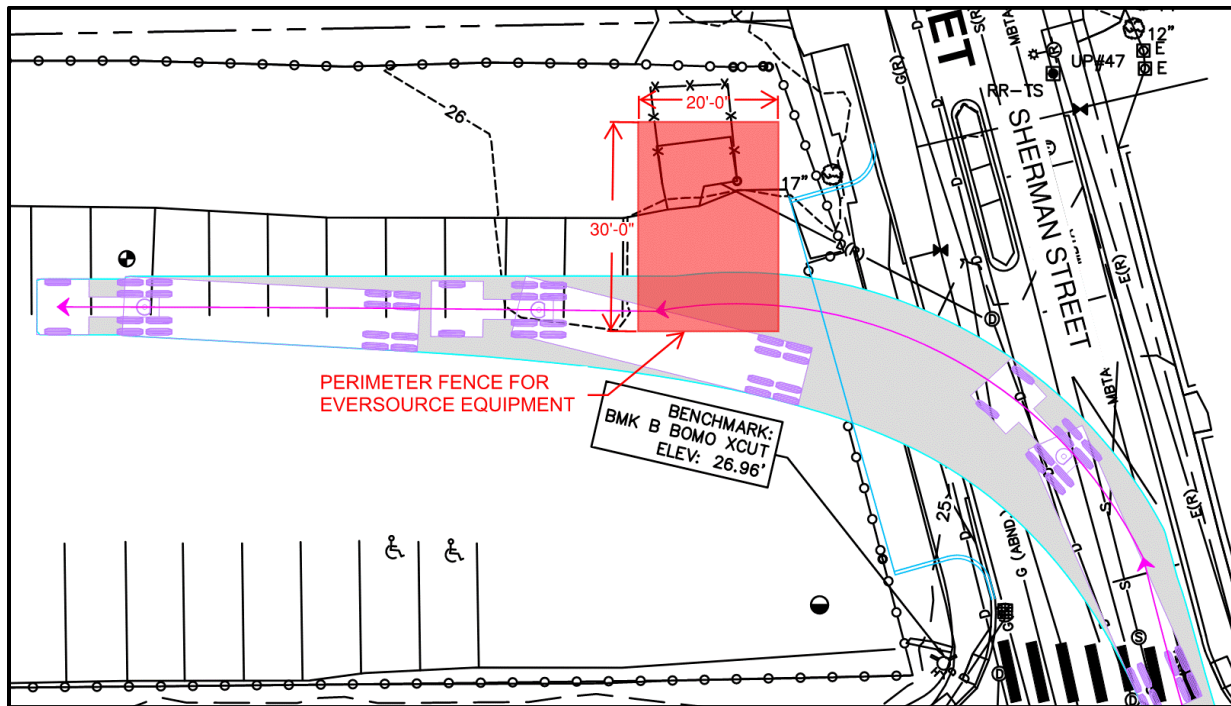


Figure 3-29. Pad-Mounted Transformer Concept 2 - Truck Turning Radius Conflict

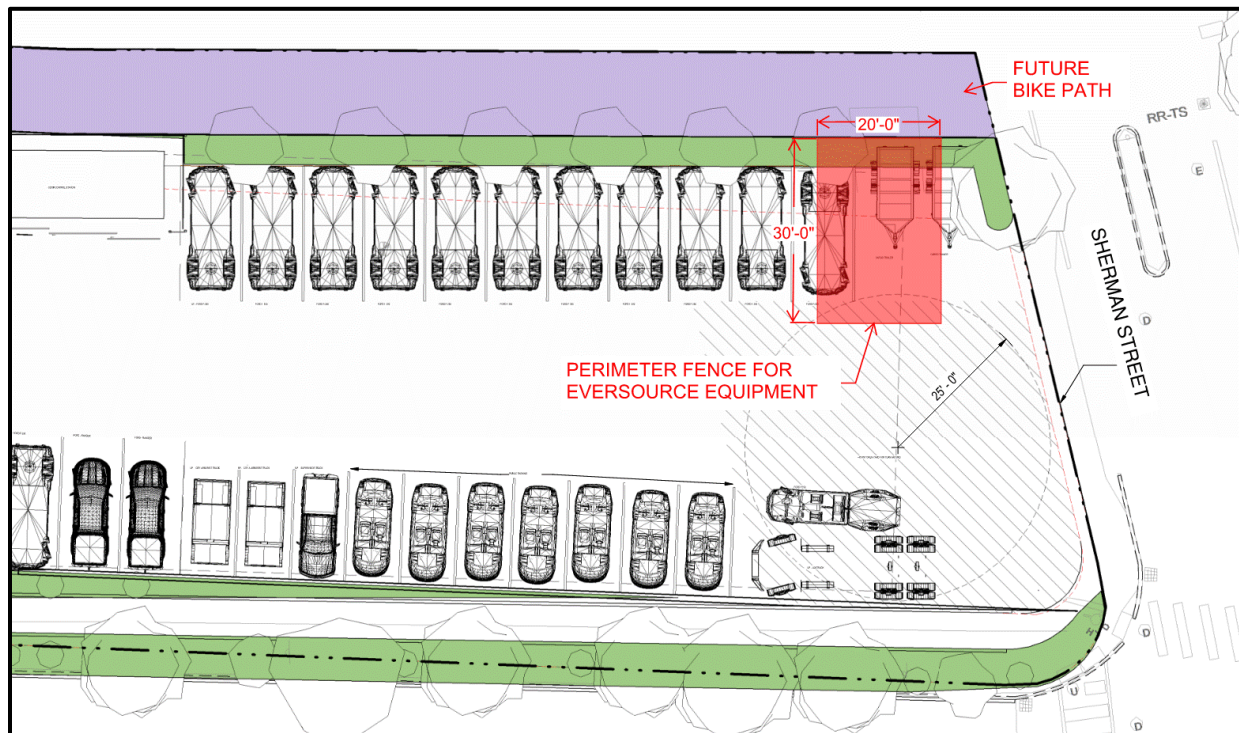


Figure 3-30. Pad-Mounted Transformer Concept 2 – Parking Space Conflict

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

Overall, due to truck turning constraints and planned parking lot operation, a pad mounted transformer would need to be sited west of the tank. Due to this location already being allocated for a future building, the City directed the design team to remove the building's electrical load from the storage tank preliminary design.

The smaller storage tank electrical load allows power to be supplied from a pole mounted transformer, with candidate locations being one of the existing utility poles along Bellis Circle. Storage tank electrical conduit and control panels can be designed to not affect truck turning radius or parking spaces associated with the potential future DPW building.

3.6 STORMWATER RUNOFF MANAGEMENT

In consideration of the planned multi-phase redevelopment of the entire Site, a wholistic on-site stormwater management approach was evaluated. Preliminary design of this first storage tank phase intends to size an on-site stormwater management system that handles all runoff from the storage tank improvement as well as the remaining phases to be constructed.

For the purposes of this analysis, the site redevelopment assumes construction of the CSO storage tank, the addition of concrete sidewalk along north edge of Bellis Circle, installation of the multi-use path, a future building per the conceptual design with added asphalt paving for vehicles, and areas of pervious landscaping. Runoff from all of these improved areas, as well as unchanged areas, was accounted for.

Stormwater management on the Site is subject to the Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Standards and the City of Cambridge Wastewater and Stormwater Management Guidance, including the 2026 Supplemental Directive. In accordance with the City's stormwater criteria, the proposed stormwater management system must provide sufficient on-site storage such that the post-development 25-year, 24-hour runoff does not exceed the pre-development 2-year, 24-hour runoff. Hydrologic analysis of the planned site redevelopment, based on final impervious and pervious/porous surface areas and hydrologic soil groups (HSG) A and C indicated by this project's geotechnical explorations, yielded an estimate of pre- and post-development runoff conditions to be met per **Table 3-7**.

Table 3-7. On-Site Stormwater Runoff Estimate

24-Hour 2070 Events	Pre-Development		Post-Development	
	Peak Rate (cfs)	Runoff Volume (af)	Peak Rate (cfs)	Runoff Volume (af)
2 year	2.50	0.169	0.00	0.000
10 year	5.15	0.360	0.28	0.059
25 year	6.89	0.490	2.43	0.169
100 year	10.17	0.740	9.96	0.412



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

To achieve the post-development runoff, various alternatives for stormwater management were considered including increased porous pavement, bio-swales/rain gardens, and subsurface infiltration systems. Given the expanse of the proposed storage tank and future building footprint, combined with a goal to protect perimeter trees and their underlying roots, the most viable alternative is a mix of subsurface infiltration system and porous asphalt along the multi-use path alignment with an approximate location as depicted in **Figure 3-31**.

The first component is an ADA compliant porous asphalt mixed pavement, which incorporates approximately 1.5-ft of crushed stone beneath. This approach ultimately acts as a large infiltration trench, allowing rainwater to permeate directly through the path surface instead of pooling or running off. Its use is only proposed in areas east and west of the tank footprint given the shallow bury of that structure. This option, though straightforward, can be vulnerable to sediment build-up eventually clogging (e.g., dirt, leaves, winter sand). To increase longevity, porous pavement must be vacuumed semi-annually to remove accumulated sediment and debris, which the City has experience with.

The second component is a subsurface infiltration system sited west of the tank and below the multi-use path to serve the remaining areas. To control drainage, the design requires sloping the proposed sidewalk and re-grading the eastern half of the paved lot above the storage tank so that surface runoff is directed to new area drains. Runoff would then be directed through drain pipes to one or more BMP catch basins (deep sump structures with hoods). The BMP catch basins would then direct flow towards the subsurface infiltration system, with secondary overflows to the City storm drain on Bellis Circle. There are pre-engineered modular systems backfilled with porous stone, and rated for minimum HS-20 traffic loads, that are common for subsurface infiltration, with candidates being HDPE linear chambers (Cultech) and stackable polypropylene modules (R-Tank) as depicted in **Figure 3-32**.

The use of a modular infiltration system allows components to be installed in tandem with each phase of construction. The strategy assumes two groups of modules, where the first group is installed with the tank phase, and the remaining group is installed with the multi-use path phase. Refer to **Section 4.4.3**, further discussing a recommended approach to meet City of Cambridge water quality requirements including Total Suspended Solids (TSS) and Total Phosphorus (TP) removal.



KLEINFELDER
Bright People. Right Solutions.

THE WORKS
CAMBRIDGE
DEPARTMENT
OF PUBLIC



Figure 3-32. Candidate Subsurface Infiltration System Products

4.0 RECOMMENDED FACILITIES

The following project elements are recommended to serve as a preliminary design baseline for cost estimating, City concurrence, and proceeding to final design. **Figure 4-1** illustrates the storage tank layout, encompassing the primary elements reviewed during preliminary design. Additional detail is provided in the form of 30% Design Drawings as **Appendix G** accompanied by a 30% Technical Specification Table of Contents as **Appendix J**, which can be referenced with the subsequent sections.

4.1 HYDRAULIC STRUCTURES

This section includes a summary of the primary hydraulic elements for the storage tank.

4.1.1 Diversion Structure and Pipeline

Hydraulic model analysis confirmed that the installation of a double weir diversion structure on the 48-inch combined sewer, along with a 60-inch diameter influent pipe from the diversion structure to the tank, can convey flow and adequately reduce CSOs at CAM401A for the 2050 Typical Year. The diversion structure location was reviewed approximately 40-ft south of the railroad tracks as depicted in **Figure 4-1**. This location was selected based on the proximity to CAM401A, keeping access hatches and maintenance outside the curb cut, and shifting tank components and maintenance (e.g., dewatering pumps, sump pump cleaning, grit capture tank) away from the Bellis Circle residents, as discussed in **Section 3.2**. Consequently, a 17-inch tree requires removal to accommodate the performance and operational benefits of the diversion structure at this location. Further City coordination will occur to discuss the advantages and disadvantages of the diversion structure location to support decision-making.

The double weir was favorably viewed because of the smaller footprint, therefore minimizing construction, pedestrian, and vehicular impacts. Additionally, the smaller footprint provides room for the required utility relocations. The double weir was designed with a 20-ft weir length which is longer than the modeling results of a 12.5-ft weir with 8-inch bar rack spacing. The increased weir length provides contingency for further refinement of the bar rack spacing during final design. Refer to **Table 4-1** for the Diversion Structure Design Parameters.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

Table 4-1. Diversion Structure Design Parameters

Item	Preliminary Design	
	Size (ft)	Elevation
		CCB
Existing Pipe	4 ft (Diameter)	14.77
Weir	20 ft (L)	16.05
Bar Spacing	8 in	-
Structure	25 ft (L) x 10 ft (W) x 12 ft (H)	-
Wall Thickness	16 in	-
Outlet to Tank	5 ft	10.9

The diversion structure placement is within Sherman Street and partially underlies the public sidewalk. Access hatches are proposed within sidewalk limits for internal maintenance or debris removal, and manhole covers are proposed within street limits. Refer to **Figure 4-2** depicting the diversion structure profile view



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

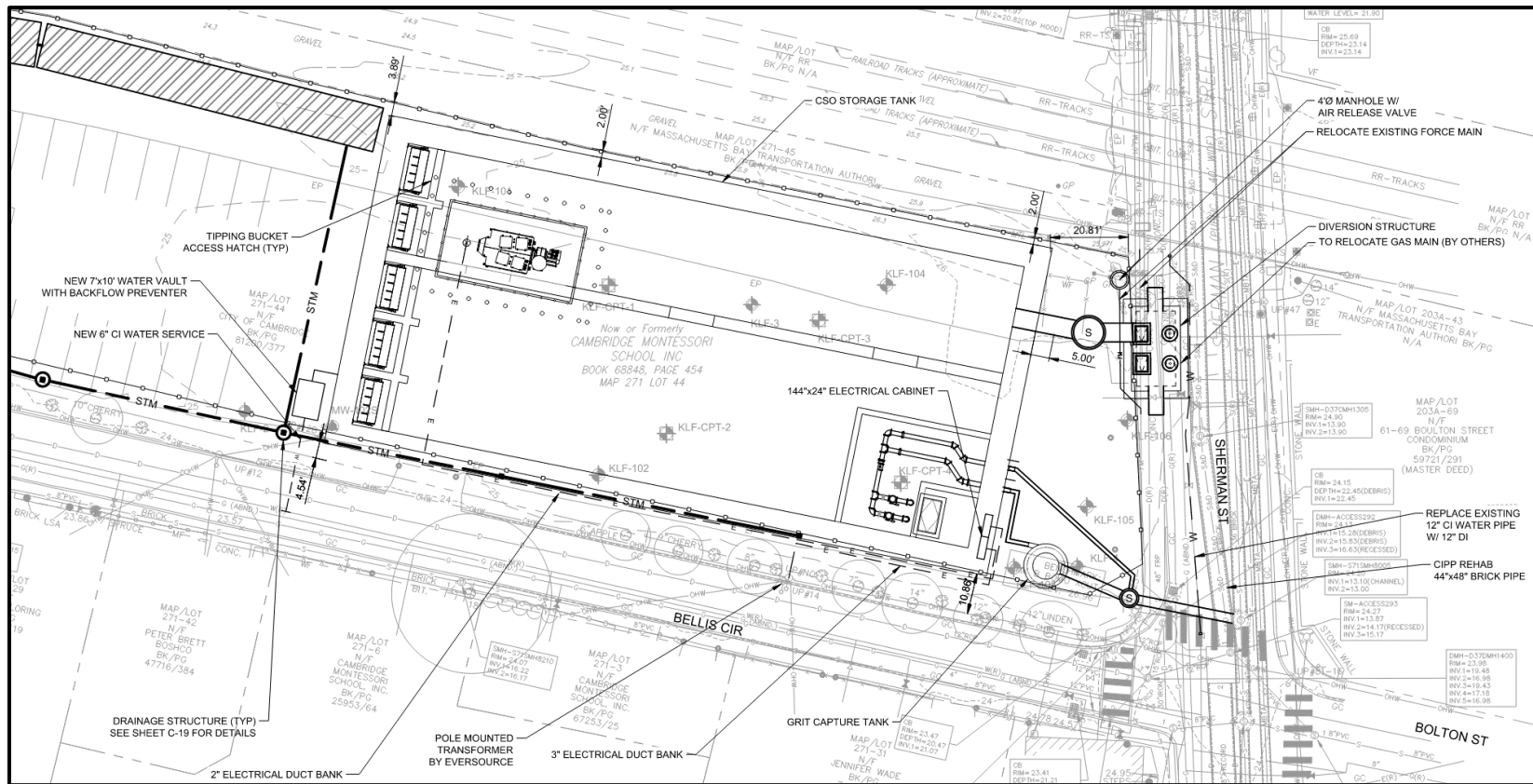


Figure 4-1. Storage Tank Facility



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

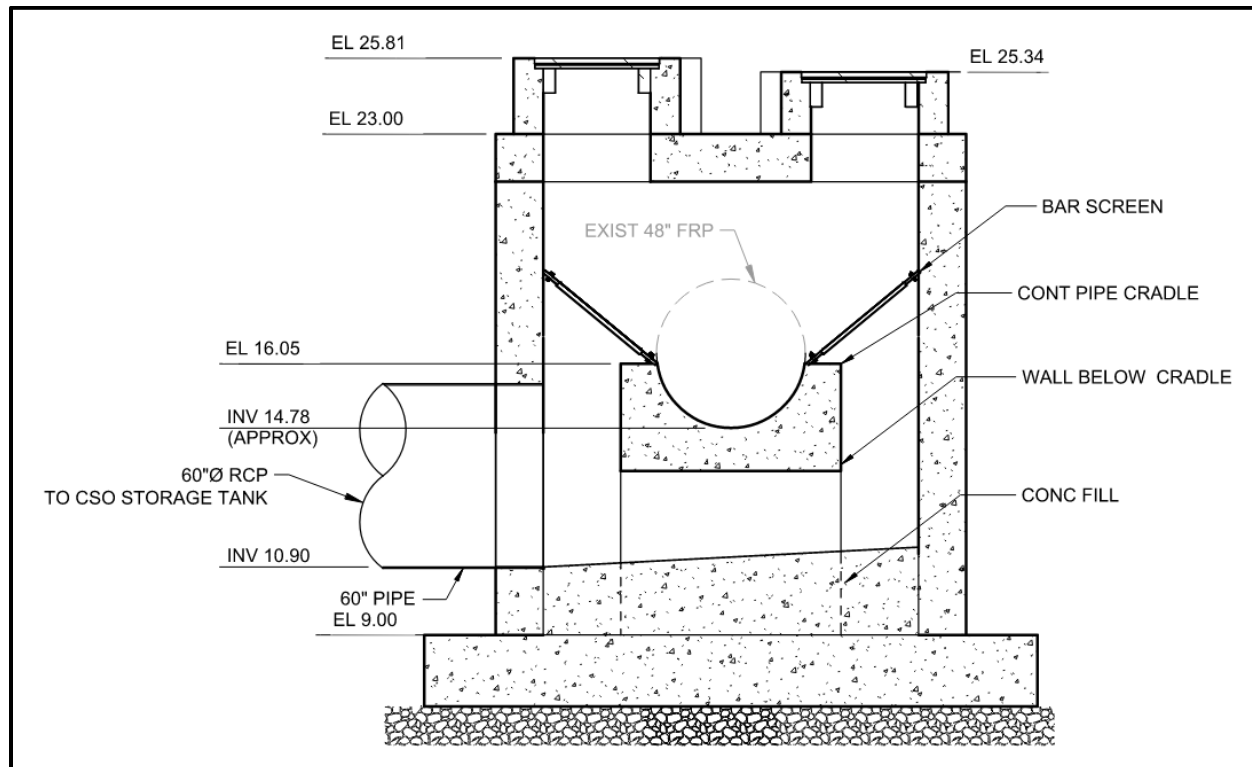


Figure 4-2. Diversion Structure Section

4.1.2 Storage Tank

For the purposes of preliminary design, a hybrid secant pile wall structure was selected to advance tank placement and design. Due to the narrow site conditions, tree protection requirements (**Appendix A**), area on the west side of the Site to be preserved for a potential future DPW building, and uncertainty on whether MBTA will approve temporary access within their parcel for the City's construction, a hybrid tank is an optimal solution. The hybrid tank maximizes the tank width (short dimension) without impacting adjacent trees and maintains reasonable setbacks for constructability, while also allowing a reduction in tank depth for ease of maintenance.

4.1.2.1 Hybrid Cast-In-Place Concrete Structure

The underground storage tank is designed to detain 2.1 MG. Given the site constraints and setbacks previously discussed in **Section 3.0**, the tank was designed in a rectangular shape. The basis of design for the tank wall is a secant pile perimeter wall used for excavation support and groundwater cutoff and then integrated with an interior reinforced concrete liner wall to provide a watertight tank. The alternative of a diaphragm wall will be retained as an option for a construction bid alternative. The secant pile or diaphragm wall provides an efficient means of excavation support and groundwater cutoff while also



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

serving as the permanent tank wall. Compared with alternative excavation support systems, this approach reduces construction staging requirements and excavation footprint, allowing the tank footprint to be maximized within the constrained site. The secant pile wall option is favored because it reduces the open excavation size during installation compared to a diaphragm wall, which will help limit deflections and risks to nearby structures and railway track, but if more costly there are ways to manage the risk in other ways. The tank foundation was assumed supported by a rock-socketed drilled shaft deep foundation system. The drilled shafts provide required axial compression capacity for gravity loads and tensile capacity to resist buoyancy-induced uplift force resulting from high groundwater conditions. Refer to **Table 4-2** for tank design parameters and **Figure 4-1** and **Figure 4-3** depicting a plan and profile view. Reference **Appendix G** for the drawing set and **Appendix H** for the structural design criteria.

Table 4-2. Tank Design Parameters

Item	Preliminary Design
	Size (ft)
Tank Exterior Dimensions	180.4 (L) x 89.2 (W)
Secant Pile Diameter	5
Interior Liner	1.33
Interior Wall Height	27.8 (min) - 38.1 (max)
Depth of Cover	3
Top Slab Thickness	1.5 with drop panels at columns
Column Size	2 (L) x 2 (W)
Column Grid Spacing	16 (L) x 15.25 (W)
Divider Wall Thickness	3
Max Depth to Base Slab	45.1
Base Slab Thickness	4
Rock-Socketed Drilled Shaft Diameter	3 (min) - 3.5 (max)

4.1.3 Constructability Considerations

4.1.3.1 Construction Monitoring

The final design will provide the instrumentation details, limits, and layouts of structural, geotechnical, and environmental monitoring required for tank construction. Structural and geotechnical monitoring will



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

include vibration monitoring, ground settlement and railway track monitoring, building and utility monitoring, and support of excavation monitoring points. Groundwater monitoring via observation wells will also be included. Environmental monitoring will include dust and noise monitoring at the Site perimeter and soil screening during soil disposal. The intent of this monitoring is to ensure the contractor maintains construction activities within required limits, to minimize disruptions, and to have mitigation steps ready if any monitoring aspect exceeds its threshold. Baseline monitoring will be completed prior to construction to establish appropriate thresholds, which will be included in the project specifications for construction.

4.1.3.2 Geotechnical Considerations

A hybrid geotechnical wall for support of excavation can be achieved by constructing either a diaphragm (reinforced slurry) wall or secant (tangential) pile wall in tandem with internal bracing. The design can be prepared for the construction contractor to select either system to meet the performance-based design criteria set forth in the project specifications by completing their own cost efficiency and risk assessments.

Dewatering will be necessary to allow for construction of the tank mat and dewatering plans will need to be designed to minimize impacts to adjacent structures by limiting drawdown. Given the use of a groundwater cutoff and experience working in Boston Blue Clay which constrains the movement of groundwater, dewatering operations are not expected to involve significant pumping equipment, although a groundwater frac tank may be necessary to remove turbidity. Dewatering discharge will require an MWRA Dewatering Permit given that the project lies in a combined sewer catchment.

The storage tank will require a deep foundation system (such as drilled shafts of reinforced concrete, or load bearing piles) that is socketed into rock to resist uplift forces. The deep foundation system will be structurally connected to the tank base mat to provide a continuous load path for transferring compression, uplift, and lateral forces from the tank structure into the surrounding soil and the competent bedrock. By extending into competent bedrock, the deep foundation system will reduce reliance on the compressible overburden soils and reduce the total and differential settlement of the tank structure. Further engineering of the primary tank structure is required before the type of foundation system is selected.



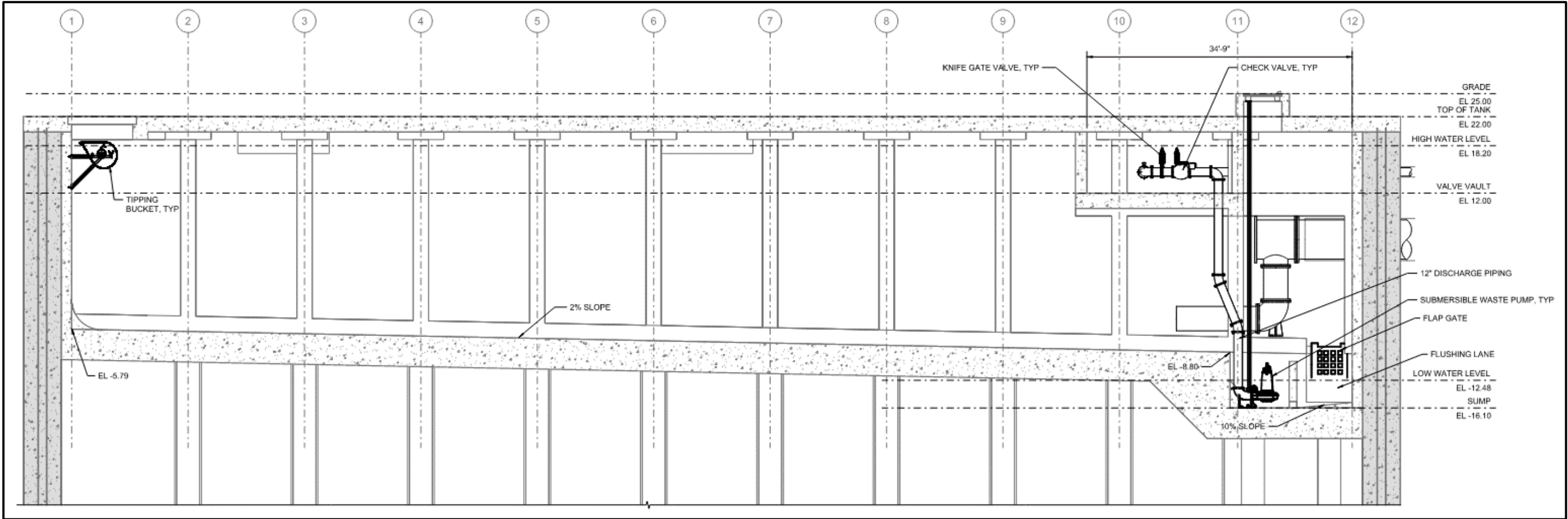


Figure 4-3. Storage Tank Profile View

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

4.1.3.3 Environmental Considerations

Samples were collected from shallow fill and native soil due to the likelihood of the presence of contamination from historical on-site sources, to provide recommendations for soil disposal during construction. **Results did not detect concentrations above MassDEP reporting thresholds for properties within 500 feet of a residential property. Concentrations detected below their respective MCP reporting thresholds are not considered to pose a significant risk to human health, public safety or the environment and no further assessment or remediation is required pursuant to the MCP.**

Soil samples of deeper soil were not collected, spanning the total depth of the planned excavation of the storage tank, however the underlying Boston Blue Clay is likely uncontaminated. During early storage tank construction, it is recommended that the contractor complete further characterization of soil at the Site to facilitate receiving facility approval to ensure timely off-site disposal of surplus soils at an appropriate, licensed facility. Further, based on estimates of the amount of surplus soil being transported for off-site disposal, one soil sample is recommended to be collected for every 500 cubic yards of surplus soil planned for off-site disposal. Soil samples should be collected for standard disposal characterization parameters including, but not limited to, VOCs, SVOCs, PCBs, TPH, MCP 14 metals, flashpoint, conductivity, reactivity and corrosivity.

4.1.3.4 Traffic Management Considerations

During construction of the CSO tank, Sherman Street is expected to maintain one travel lane in each direction to the extent practicable. The recommended traffic control measures are intended for typical weekday construction activities, Monday through Friday from 7:00 AM to 4:00 PM. Night work is not recommended because the work area is in the vicinity of a residential neighborhood.

During temporary traffic management setups on Sherman Street, a police detail is recommended at the railroad crossing gates to discourage vehicles from stopping on or within the railroad crossing. Bicycle and pedestrian accommodations will be provided through or around work zones, as appropriate.

Construction Access and Parking Restrictions

Construction vehicles are expected to access the Site initially from Sherman Street for site demolition and installation of the early excavation support systems. Once excavation for the tank commences, the Sherman Street entrance will not provide access to the western half of the Site, requiring construction vehicles to rely on Bellis Circle for access. This condition is expected to last a minimum of one year until the tank is backfilled. During the later tank fit-out and site restoration stages, access would resume from Sherman Street.

To support construction operations and maintain adequate circulation, on-street parking along Bellis Circle may be restricted during construction as needed to preserve access for emergency vehicles, school operations, and construction traffic.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

Sherman Street Utility Work

The existing median(s) at the Sherman Street railway crossing will likely need to be temporarily removed during excavations within the right-of-way. A temporary portable barrier is recommended to prevent motorists from driving around the railroad crossing gates. The design will call for the median(s) to be restored following backfill of the excavations and during pavement restoration.

During utility relocations and diversion structure installation within the Sherman Street southbound lane, it is recommended that southbound traffic be detoured via Rindge Avenue, Massachusetts Avenue, and Walden Street. A southbound detour was selected as it involves only right turns with less delay at intersections and traffic lights. Northbound traffic on Sherman Street can remain open. Refer to **Figure 4-4** for the proposed detour route.

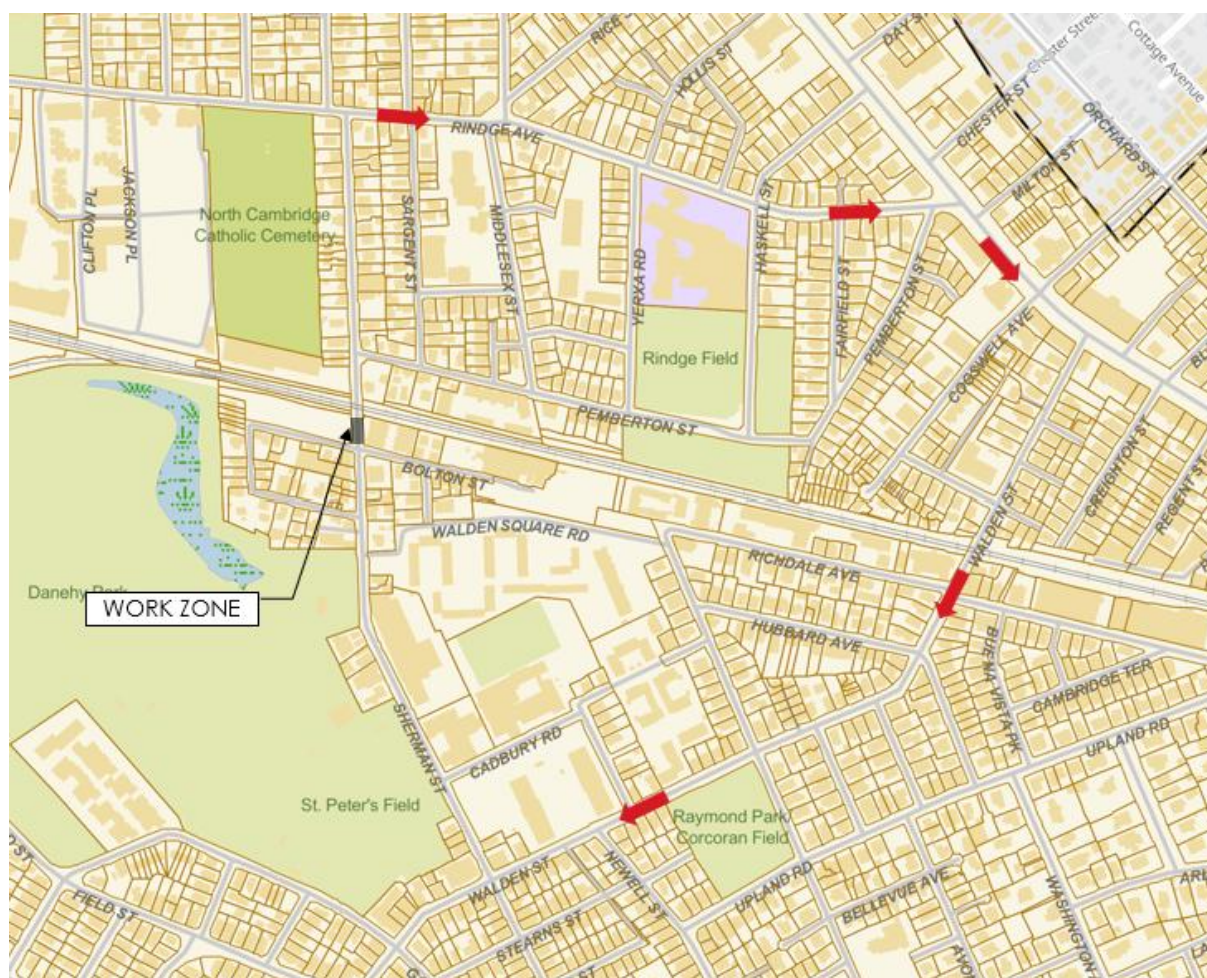


Figure 4-4. Sherman Street Southbound Detour

The detour would be implemented only during active work hours. During non-working hours, Sherman Street can be reopened to two-way traffic. This configuration is recommended because of the close

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

proximity of the at-grade railroad crossing located just north of the tank Site. The same traffic configuration also applies to modification of the CAM401A regulator on Sherman Street north of the railroad crossing.

Pedestrian access will be closed along Sherman Street's western sidewalk within the work zone. Pedestrians approaching from the north will be directed to the eastern sidewalk at the Pemberton Street intersection. Pedestrians approaching from the south will be directed to the eastern sidewalk at the Bolton Street/Bellis Circle intersection.

Full-Depth Reconstruction Paving

During full-depth reconstruction paving, southbound traffic on Sherman Street will be detoured. Refer to **Figure 4-4** for the detour route. During paving operations in the northbound lane, northbound traffic will be shifted to the southbound lane. Paving construction is expected to occur during normal work hours, unless other work hours are preferred in response to expected traffic patterns.

4.1.4 Dewatering Valve Vault

The storage tank pumps will discharge flow via piping that continues to a valve vault located in the headspace of the tank. The valve vault will house the required piping, check valves, discharge isolation valves, flow meter, and additional appurtenances, to convey water back to the sanitary sewer directly, or through the grit capture tank during cleaning operations. The valve vault was assumed to be a conventional cast-in-place structure. Refer to **Table 4-3** or **Appendix G** (Sheet M-5) for the valve vault layout.

Table 4-3. Valve Vault Details

Valve Vault Details	
Pipe Material	Schedule 10 - 304L SS
Pipe Size	12-inch, 14-inch grit capture discharge piping
Valve Vault Width	29.5-ft
Valve Vault Length	29.1-ft
Wall Thickness	8-inch
Check Valve Type	Swing Check 12-inch
Isolation Valve Type	Knife Gate 12-inch
Flow Meter Type	Magnetic Flow Meter 12-inch

4.1.5 CAM401A CSO Regulator Modification

Modifications to the CAM401A regulator are required to achieve the targeted reduction in CSOs. The CAM401A weir elevation and its accompanying rotating brush screen must be raised by 1.5-ft in response

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

to the proposed diversion structure that needs to overflow first to the storage tank. Removal of the brush screen is required to allow access to the weir wall. The weir wall will then be raised 1.5-ft, from an existing elevation of 17.0 (CCB) to elevation 18.5 (CCB) using cast-in-place concrete. The brush screen will then be reinstalled. While raising the weir would typically adversely impact water levels in the upstream combined sewer, with the potential to cause premature sewer backups and street flooding, the additional storage volume provided by the new tank offsets this effect.

Raising the weir wall and brush screen may require raising the interior vault ceiling height to accommodate the brush screen hydraulics. Internal inspection of CAM401A is scheduled in the Fall 2026 to confirm internal dimensions and structural condition. It is believed that the structure is precast, and it is expected that a new precast top slab with risers can be fabricated allowing it to be swapped out. This would allow the structure to remain in service during construction, eliminating the need for bypassing of the regulator. Removing the top of the structure also allows for easier construction activities within the vault. **Figure 4-5** shows the proposed work to the regulator.

Coordination with the brush screen manufacturer is ongoing. The original manufacturer, GNA Inc, was consulted and offered caution that this floatables control equipment is now 20+ years old and may not survive disassembly when it is removed from the vault. It may be possible to bid the work as two items – removal and reinstallation, plus an optional replacement – that would give the construction team incentive to remove the screen without damaging it.

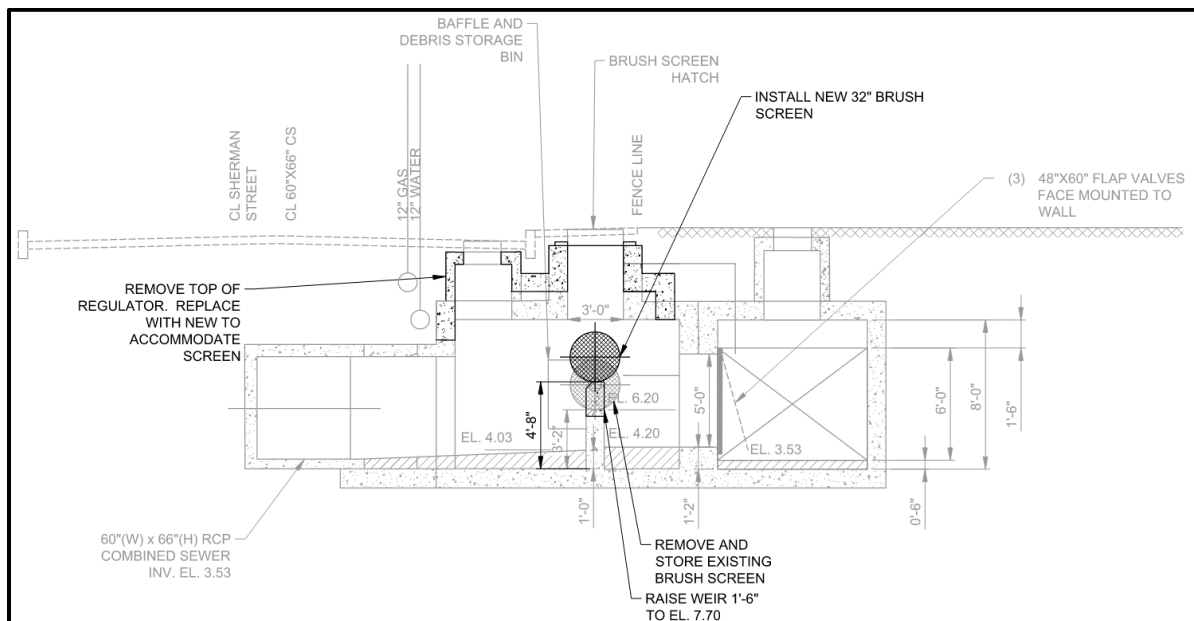


Figure 4-5. CAM401A Modifications

4.2 PROCESS MECHANICAL

4.2.1 Odor Control System

The odor control recommendation includes a complete, packaged, above-grade dry-media V-Bank Transition System (VTS) carbon adsorption unit as shown in **Figure 4-1**. The system is intended to treat foul air extracted from the storage tank headspace during tank filling, dewatering, and cleaning activities. The odor control system will ensure a negative pressure environment that prevents the escape of unconditioned air into the surrounding neighborhood.

4.2.1.1 Design Parameters and Sizing Criteria

To prevent the escape of fugitive odors, the storage tank headspace must be maintained under continuous negative pressure relative to the outside atmosphere by exhaust fans. From review of the 2050 Typical Year series peak storm event, the odor control design targets a peak flow of 75 MGD. This flow displaces air in the tank and requires a minimum ventilation capacity of 7,000 cubic feet per minute (cfm), which equates to approximately 1.5 air changes per hour (ACH) for the 2.1 MG storage tank volume which is reasonable for effective containment and continuous air treatment.

The VTS orientation facilitates top-entry gravity loading and direct overhead vector-assisted media evacuation, substantially simplifying routine carbon changeouts for service personnel. The design ensures that maintenance operations and support equipment can be positioned safely within the Site limits, avoiding operational encroachment into planned areas of the potential future DPW building vehicle fleet.

The system airflow rate of 7,000 cfm was established to exchange air in the headspace of the tank and maintain negative pressure during peak operating conditions. However, the recommended odor control unit can treat a maximum value of 10,500 cfm for additional redundancy. The design metrics for the odor control system are summarized in **Table 4-4**. Refer to **Appendix G** for the odor control unit location and cross section.

4.2.1.2 Noise Mitigation

Following a comprehensive evaluation of the logistical constraints specific to the Sherman Street Site, a perimeter acoustic panel enclosure is recommended to mitigate noise disturbance to adjacent abutters. The perimeter enclosure requires a 5-ft horizontal setback from the VTS equipment and interior wall, resulting in a 34.5-ft (L) by 16-ft (W) layout. The final height of the perimeter enclosure is subject to vendor review, but likely 10.5-ft based on industry guidelines.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

Table 4-4. Odor Control System

Parameter	Value	Comment
Required Ventilation Rate	7,000 cfm	Peak Fill Rate 75 MGD
H ₂ S Assumption	0-5 ppm	
Odor Control Technology	Activated Carbon Filter	
Filter Configuration	VTS	
Filter and Fan Material	FRP	
Minimum Empty Bed Residence Time	3 sec	
Maximum Face Velocity	60 ft/min	
System Head Loss	9-in water column	
Fan Power	20 HP	
Control Logic	Local Control Panel and City central SCADA system	Automatic ON when flow enters tank. Remote (manual) OFF
Backup Power	Portable Generator	
Noise limit	Daytime 60 dBA Nighttime 50 dBA	City of Cambridge C-1 Residential Zoning Requirement
Sound Attenuation	Acoustic Panels 10.5-ft Tall	Perimeter enclosure

4.2.2 Flushing Equipment Selection

Upon reviewing cleaning technologies with the City on May 18, 2026 during the CSO Storage Tank Options meeting, tipping buckets were most favorable to the City. The City is familiar with flushing gates and generally satisfied, however, miscellaneous objects impeding flushing gate closure is a persistent maintenance issue. The gate closure malfunction necessitates a confined space entry which introduces additional burden on maintenance staff and safety concerns. Tipping buckets were therefore selected to mitigate operational disruptions and safety concerns.

Grande Water Management Systems and Gabriel Novac and Associates (GNA) were contacted to obtain preliminary tipping bucket information. Both companies are considered reputable equipment suppliers in the CSO mitigation space. The design team's initial concern was if water submergence of a tipping bucket deters operation. The storage tank should reach a high water level (2.1 MG) 2-3 times per 2050 typical year storm results and completely fill (pressurize) during the worst case flooding 2050 10-year design storm. The responses and information received from both companies are presented in **Table 4-4**.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

Table 4-4. Tipping Bucket Information

Company	Information
Grande	Tipping bucket submergence is feasible but minimal to no submergence is the preferred scenario. The Grande tipping bucket is fabricated with stainless steel and uses grease lubricated waterproof bearings (extreme bearings SS-316 specialty seals) that were originally designed for the mussel industry and are widely used in the food industry in submerged conditions. Unit can be mounted to the tank back wall, side wall, or roof slab.
GNA	Tipping bucket submergence is feasible due to the grease lubricated waterproof bearing design (SKF double tapered roller bearings in a split cast iron housing). The unit is fabricated with 304 or 316 stainless steel. Unit can be mounted on the tank back wall, side wall, or roof slab.

Based on Grande and GNA responses, tipping buckets are a viable option. However, as with any equipment operation, anomalies occur and submergence of a tipping bucket may result in floated debris getting wrapped around a tipping bucket impeding operation, for example. The storage tank design and associated maximum fill elevation will progress further during 60% design, which ultimately determines the frequency of tipping bucket submergence (i.e., during the worst case 2050 10-year flooding event only). The heart of a tipping bucket relies solely on the two end bearings, which should be accessible regardless of water level submergence. The top slab design and access points, for inspection and/or to complete maintenance as required, will also progress during 60% design. Typically, maintenance for a tipping bucket should be minimal to none but access points are planned should the need arise. The top slab design can incorporate access hatches, removable top slabs, manhole openings, and/or incorporate an internal tank catwalk.

Additionally, five tipping buckets are anticipated based on preliminary tank column spacing, which should result in a cost savings compared to flushing gates. The industry rule of thumb (depending on stainless steel dollar amount) is with seven lanes or less tipping buckets should be cheaper as the stainless steel cost less than the associated flushing gate control system. Conversely, when there are eight or more flushing lanes, flushing gates tend to be cheaper as a flushing gate control system costs less than the additional cost of stainless steel for tipping buckets.

Overall, tipping buckets prove to be a practical alternative to the conventional flushing gate selection in the City of Cambridge. Tipping bucket design will be further progressed in conjunction with the storage tank during the next design phase. We also recommend scheduling a workshop with Grande and GNA to provide City personnel an opportunity to ask questions and gain further insight on the tipping bucket technology. **Figure 4-1** can be referenced for the preliminary tipping bucket layout and flushing lanes.

4.2.3 Dewatering Pump Selection and Configuration

The pumping configuration encompasses a wet pit approach by installing pumps within the storage tank. The storage tank floor will be sloped to direct flow to the pumps. Static head for the dewatering operation



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

fluctuates with the water elevation in the tank and the water elevation of the discharge force main high point.

With the tank full the water elevation is approximately 18.2-ft. The tank empty condition has a water level of -12.48-ft. With this wide range of static head conditions, the tank requires either having multiple pumps of different sizes and duty points on fixed speed motors with modulating valves to control flowrate or fewer pumps with variable speed capability operating at reduced speed to prevent flooding of the sanitary sewer system under the tank full scenario.

The maximum static head would occur at a very low water elevation in the tank and the highest water surface elevation downstream of the pumps. That would be a static head from -12.48-ft to 19.2-ft, or 31.7-ft. The minimum static head would occur when the water surface in the tank is at 18.2-ft and the downstream water surface elevation is at 21.4-ft. This creates a scenario where static head is 3.2-ft and friction losses are the majority of head loss which depends on the discharge flow rate.

Friction loss through the system is relative to the velocity of the flow through the discharge piping. 14-inch and 12-inch pipe options were reviewed for discharge piping over a range of discharge flows with tank full and empty scenarios at multiple pump speed conditions to test the most appropriate pipe selection for both the individual pump discharge piping and common force main. 12-inch diameter discharge piping provides reasonable velocities if the full tank is dewatered in 12 to 24 hours (4.3 feet per second [fps]) or if a full tank is dewatered in 12 hours (8.5 fps).

The total dynamic head for this system ranges from 15.7-ft to 33.7-ft. The flow rate to dewater the entire tank in 24 hours is 1,500 gallons per minute (gpm). Reducing the tank dewatering time to only 12 hours will increase the flow rate to 3,000 gpm.

After establishing self-cleaning, semi-open impeller-type submersible pumps as the preferred technology, the evaluation further considered whether to provide two large pumps or two smaller pumps and one large pump with capability of future conversion to a chopper pump impeller. This was based on a fixed speed operational restriction that was selected due to past project precedence in the City of Cambridge. Smaller pumps were necessary to limit the discharge in the tank full scenario if using fixed speed motors, but they weren't large enough to maintain high velocity at the tank empty scenario. Through discussion with City DPW staff, it was determined that issues at other pump stations leading to the preference for fixed speed pumps could be avoided through proper design with variable speed pumps. Variable speed pumps at other pump stations had ragging issues when operating at lower speeds, but it was determined that these were smaller pumps that have smaller suction and discharge diameters. Eliminating this constraint with the new tank design depth being shallower provided a better pump selection that can operate in a duty/standby configuration only requiring two pumps that have lower head impellers (LT vs MT trim) though the chopper impeller conversion is only available on the MT trim. If desired in the future, it would require replacement pumps. The selected pumps can operate at the entire tank depth from top to bottom with variable speed control. The decision to design around Flygt pumps as the design basis is the ability of the pumps to operate at all levels of the tank at multiple duty points on variable frequency drives,



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

with self-cleansing impellers that work well against ragging solids common in sewage. Alternate manufacturers will be reviewed for procurement to meet the performance of this design basis.

The 12-inch force main was preferred for the operating velocity range vs. the 14-inch diameter. The 12-inch pipe was preferred due to the ability to achieve or exceed the desired dewatering time when pushing it at higher velocities while maintaining higher cleansing velocities for grit and sediment transport while pumping at lower rates when the tank is near empty.

The tank can begin to be dewatered at a minimum rate of ~1,000 gpm – 2,400 gpm depending on the level in the tank by limiting pump speed when the capacity becomes available in the receiving sewer (i.e., the 2.1 MG tank can be dewatered in a maximum 24 hours). This would allow dewatering of the tank sooner than waiting for dry weather base flow after a storm event. The receiving sanitary sewer is 27-inch by 36-inch at 0.16% slope with a limited capacity of 8.2 MGD based on downstream conditions. Design flows for dewatering of the tank would aim to consume approximately 80% of this capacity or 6.56 MGD. Accounting for peak dry weather flow, which is approximately 1.2 MGD; the remaining capacity of the sewer would be approximately 5.4 MGD or 3,722 gpm. When the sewer capacity is entirely available for dewatering activity the tank will dewater at a design rate of 3,722 gpm to ~1,900 gpm through control feedback loops. Refer to **Section 4.6** for control philosophy. Pump Parameters are shown in **Table 4-5**. The preliminary pump selection is a 34HP premium efficiency motor, Flygt Model NP 3202 LT 619.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

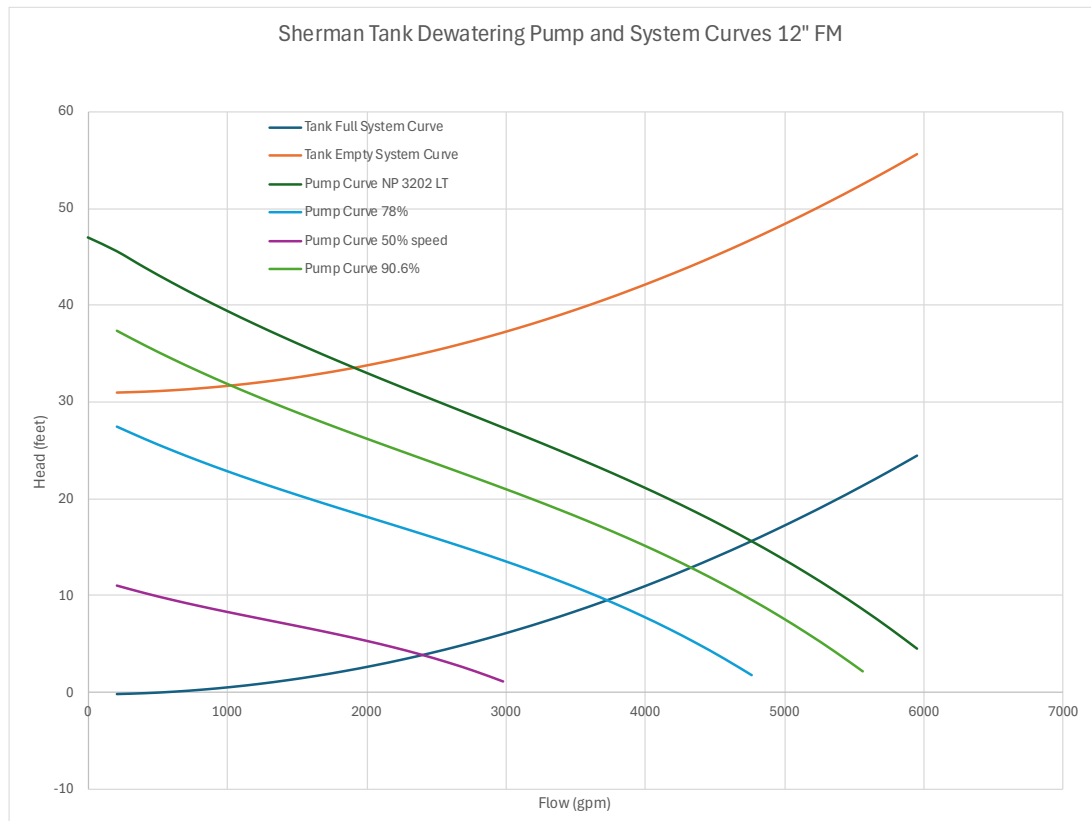


Figure 4-6. Dewatering System Curve with Pump Selection

The graph above shows the possibility of operational flow ranges with the tank full and tank empty system curves illustrating the capability to dewater at high or low rates depending on receiving sewer capacity.

Table 4-5. Pump Parameters

Design Flow Rate / Total Dynamic Head (TDH)	Low	High	Operational Maximum Speed Limited	Maximum
TDH range (ft)	33.7	22.8	13	15.7
Flow range (gpm)	1,907 (2.7 MGD)	3,743 (5.4 MGD)	4,350 (6.26)	4,766 (6.86 MGD)

4.2.4 Grit Capture Tank

The City noted that it routinely cleans and removes 6-inch or more of sediment from the combined sewer on Sherman Street, with concern that tank dewatering could exacerbate this problem if flow is directed



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

there. Based on sedimentation concerns and limited dry weather flow in the combined sewer, it was decided to dewater the storage tank to the 27-inch x 36-inch brick sanitary sewer on Sherman Street. The sanitary sewer has more consistent base flow to convey flushed material downstream. Given that the Sherman Street sanitary sewer is laid with minimal slope, has a history of sediment accumulation, and flows to a double-barrel siphon below the MBTA Red Line subway, exacerbating the maintenance of this pipeline is a concern. To prevent solids flushed from the tank being deposited in the sewer, a grit capture tank was selected to centralize solids capture.

The grit capture tank will receive tipping bucket flush wave volume during the cleaning dewater, before flow enters the sanitary sewer. The layout includes one precast 10-ft Grit King® Compact unit and **Table 4-6** presents design parameters.

This approach intends to centralize solids at one location and enable simple removal with a City vector truck. The grit capture tank is viewed as the lower maintenance option compared to jet cleaning and traffic management of sewers in the roadway. It's also the more economical option as discussed in **Section 3.5.4**. Scheduling a meeting with the vendor would give City personnel an opportunity to gain further insight and affirm maintenance requirements of the unit to ensure confidence in the decision to install and maintain the grit removal tank. Refer to **Figure 4-1** or **Appendix G** which illustrates the grit capture tank location and section.

Table 4-6. Grit Capture Tank Parameters

Parameter	Value	Comment
High Flow Rate	2.8 mgd (1,962 gpm)	Captures 95% of ≥ 125 micron grit (SG = 2.65); Headloss = 7 inches
Low Flow Rate	2.1 mgd (1,470 gpm)	Captures 95% of ≥ 106 micron grit (SG = 2.65); Headloss = 4 inches
Tank Diameter	10-ft	
Tank Depth	13-ft 6-inch	
Inlet Pipe Diameter	14-inch	
Outlet Pipe Diameter	30-inch	
Fluidizing Ring Requirements	2-inch quick disconnect coupling	50 gpm at 50 psi
Grit Suction Requirements	4 – 7 ft/s line velocity recommended	Two access cover locations for center of chamber and outer ring annulus maintenance.



4.3 CIVIL PIPELINES

4.3.1 Local Sewer and Drain Impacts

The proposed work along Sherman Street is not expected to conflict with the existing sanitary or combined sewers, as located by the preliminary survey. There is one conflict with an existing catch basin near the intersection of Bellis Circle and Sherman Street, and the catch basin will need to be relocated to accommodate storage tank dewatering discharge piping. Additionally, there is an existing 16-inch stormwater force main (Bellis Tank stormwater discharge) on Sherman Street which conflicts with the diversion structure and the storage tank influent pipe. The force main will be relocated west of the vault and above the influent pipe.

The diversion structure installation is in close vicinity to the existing 44-inch x 48-inch brick combined sewer. This pipe is old (1873) and, although the 2020 CCTV inspection indicates a good pipe condition, protection of this pipe is critical and it is recommended that this sewer be CIPP lined ahead of or during the early part of the project.

4.3.2 Local Water Main Impacts

There is expected relocation of 12-inch water main and associated services on Sherman Street due to the diversion structure location and storage tank discharge piping. The diversion structure has a large footprint, which conflicts with the adjacent 12-inch water main. The water main is anticipated to be relocated to the west to avoid the structure.

Additionally, the City may find it desirable to replace the existing cast iron water mains on Bellis Circle (6-inch Cast Iron installed 1938 and later lined in 1969 per City GIS) and Sherman Street (12-inch Cast Iron installed 1896 and later lined 1968 per City GIS) due to their age and assumed condition prior to any pavement restoration (refer to **Section 4.4.1**). Overall, the design team requests a decision prior to 60% kickoff as to whether or not the City would like to replace other water mains proactively or limit area utility improvements to only those necessary to accommodate the CSO storage tank work.

4.3.3 Private Utility Impacts

There are expected utility impacts on the privately owned 12-inch gas main and underground electric conduits along Sherman Street. The diversion structure conflicts with the 12-inch gas main owned by Eversource. It is recommended to engage the City's Eversource Gas field representative to coordinate relocation of this pipe. Additionally, the underground Eversource electrical conduit and MBTA conduit may be impacted. Ultimately, further review and information is required to confirm the impact specifically related to the MBTA utilities as described in **Section 6.2**.



4.4 SITE WORK AND LANDSCAPE IMPROVEMENTS

4.4.1 Paving

In regards to the parking lot, the storage tank project intends to restore the Site to match existing conditions except for a slight increase in impervious area to abut the potential future bike path. New pavement markings can be incorporated per City preference prior to the potential future DPW building. Additionally, the associated work on Sherman Street and truck access on Bellis Circle is anticipated to degrade the pavement condition over time due to heavy vehicle loadings and/or general construction activity. Final restoration efforts will include replacing the impacted pavement and road striping to existing conditions. Refer to **Appendix G** for the Site Materials Plan depicting restoration limits.

All walkways and paved surfaces will meet ADA accessibility requirements where applicable. Final paving limits will be refined as the design proceeds to update limits, preferences, and constraints coordinated by the City.

4.4.2 Plantings

The planting design prioritizes the preservation and protection of existing mature trees adjacent to the Site and along Bellis Circle to maintain canopy coverage, provide shade, and preserve Site character. New plantings will supplement the existing landscape with native and climate-adapted tree species selected to increase biodiversity, enhance ecological function, and improve long-term landscape resilience. Recommended canopy and understory tree species include Serviceberry (*Amelanchier spp.*), American Hornbeam (*Carpinus caroliniana*), American Hophornbeam (*Ostrya virginiana*), and Eastern Redbud (*Cercis canadensis*), all of which are on the recommended City of Cambridge Tree Species list, are well suited to the local climate and provide seasonal interest, habitat value, and ecological benefits. Native shrubs, grasses, and groundcovers can also be incorporated where appropriate to create a diverse understory that supports pollinators and wildlife habitat while reducing long-term maintenance and irrigation requirements. The recommended plant palette represents the basis of design and will be further refined as the design evolves based on detailed site conditions, planting area constraints, utility conflicts, and long-term maintenance considerations.

4.4.3 Stormwater Management

The proposed site redevelopment requires stormwater management measures to comply with City of Cambridge and MassDEP stormwater requirements. The recommended approach for the first tank phase consists of grading asphalt paving and sidewalk towards area drains, that then flow through deep sump hooded catch basins into a subsurface infiltration system. This alternative complies with the City's stormwater criteria such that the post-development 25-year, 24-hour runoff does not exceed the pre-development 2-year, 24-hour runoff, as presented in **Section 3.6**. Later during the multi-use path phase of construction, a second subsurface infiltration system combined with porous asphalt would be added to meet these same runoff requirements.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

This arrangement of stormwater components also serves as a treatment train for the runoff, and will comply with the City of Cambridge, MassDEP, and EPA TMDL water quality requirements. Stantec is currently preparing a comprehensive Stormwater Report for the entire parcel which will document water quality benefits. The requirement for work in Cambridge includes 65% TP removal and 80% TSS removal.

The recommendation presented herein establishes a baseline for the stormwater management design, to be refined during final grading and layout of site materials. Additionally, the 2070 – 1% Precip Flood Elevation 24.4 (CCB) will be reviewed integrally for flood resiliency.

4.4.4 Vehicle Access

Vehicle access to the Site will remain at the location of existing curb cuts on Sherman Street and Bellis Circle. The Truck Turn Feasibility Study (**Appendix F**) completed during concept design based on SU-30 vehicles remains valid for the restored Site condition.

4.5 ELECTRICAL

The following provides a summary of the preliminary electrical design.

4.5.1 Electrical Utility Service

Eversource Energy will provide a new 480V electrical service sized to power only the tank related loads as described in **Section 3.5.5**. The anticipated load for the proposed tank will not exceed 300kVA, which indicates a pole-mounted transformer and utility metering cabinet will be required. The utility metering cabinet will be located adjacent to the service distribution equipment.

4.5.2 Electrical Distribution System

The anticipated full-load ampacity of the storage tank, including submersible pumps, odor control system, and various valves and instruments is approximately 60A. An outdoor-rated 480V, 3-phase fused disconnect switch will be provided and will serve as the main service disconnect.

Distribution equipment for the tank and associated equipment will be housed within a NEMA 4X overall enclosure, containing all necessary variable frequency drives (VFD) and related control equipment for pump operation. Refer to **Appendix G**, Drawing C-5 (Utilities Plan) for enclosure location. The enclosure will accept a main 480V feed from the proposed switchboard and will provide 120/208V for ancillary devices using a control power transformer. The enclosure will also house a PLC and will be provided with adequate quantities of I/O to facilitate operation of the tank and associated equipment. Dimensions for this enclosure are estimated to be 84-inch tall, 72-inch wide, and 24-inch deep.

Electrical distribution will comply with 527 CMR 12.00 Massachusetts Electrical Code, which is based on the 2023 edition of the NFPA 70 National Electrical Code.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

4.5.3 Backup Power

A portable generator connection sized for only the odor control system will be incorporated into the manual transfer switch located at the service entrance to provide a means for standby power. The connections within the manual transfer switch will be sized specifically for the odor control system. Standby power is not required for the tank to capture flows for storage, since the tank is configured to fill passively by gravity. Tank dewatering and flushing operations can be delayed until power is restored.

4.5.4 Exterior Lighting

Exterior site lighting for the area occupied by the distribution equipment and pump control panels will comply with the Massachusetts Building Code 780 CMR Chapter 13. Exterior lighting will be LED, which will provide an efficient lighting solution for the outdoor areas.

4.6 INSTRUMENTATION AND CONTROL

The storage tank I&C design shall be modeled upon the City's recent PL6 Tank and Tobin Tank designs to ensure similarity of assets. A NEMA 4X, 316 Stainless Steel local Control Panel will be equipped with an Operator Interface Terminal (OIT) and cellular telemetry to the City's existing central SCADA System.

The storage tank Control System shall be Programmable Logic Controller (PLC) based and provide automatic and manual controls, local and remote monitoring, and remote collection of historical data. The main control panel shall monitor vendor provided and controlled odor control system and tank flushing system.

To enable pumping operations, level controls will be provided in the following locations:

- Storage Tank
 - Continuous level and back up level provided for pump control
- Receiving Sewer
 - Continuous level and back up level provided for pump inhibit on high sewer levels
- Grit capture tank
 - Continuous level provided for monitoring

4.6.1 I&C General: Design Standards

The control design will be in accordance with:

- NEC 2023 (NFPA 70-2023): National Electric Code
 - Massachusetts Electrical Code (527 CMR 12.00). The Massachusetts Electric Code has adopted the NEC 2023 with modifications. When conflict arises between the two, the more stringent requirement will be used.
- NFPA 820-2012 – Fire Protection in Wastewater Treatment and Collection Facilities
- Institute of Electrical and Electronics Engineers (IEEE) – C62.41, recommended practice on surge voltages in low-voltage AC power circuits.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

- National Electrical Manufacturers Association (NEMA), 250, Enclosures for Electrical Equipment (1000V max)

Instrumentation and Control equipment shall be listed by and shall bear the label of Underwriters' Laboratories, Inc. (UL). Specifically control panels shall be designed and constructed to UL-508A and IEC419.

4.6.2 Control System

The project includes the design and installation of a PLC for monitoring and control of the process equipment, pump motor starters, utility power status, levels, flow and other ancillary status and alarm conditions as required.

Control and monitoring of the storage tank will be available locally via an OIT located on the local Control Panel and remotely at the existing central SCADA System located at the DPW office.

A Process and Instrumentation Diagram (P&ID) will be developed to identify the process equipment, field instruments, local control panel, control system monitoring and control variables. Mounting/installation details will be developed for field devices as required. A control system network block diagram will show the project network configuration with the required communication medium, and network hardware.

The OIT will provide graphic screens for control and monitoring of the storage tank process and ancillary equipment. The existing central SCADA System will be modified to include new graphic screens and historical database as required by the project.

The Control System will be designed to provide 20% spare capacity for future equipment monitoring and control requirements.

4.6.3 Network Communications

The local Control Panel network segment shall employ EtherNet/IP protocol. A Rockwell Automation Stratix 2000, 5 port, RJ45 10/100 Ethernet Switch connects the PLC and OIT to the broadband access network device outlined below. The storage tank local Control Panel network communicates with existing City's central SCADA System site via a broadband access network cellular connection. A Cradlepoint s750C Router, mounted in the local Control Panel shall provide commercial grade cyber security, integrated router, firewall, terminal server, legacy-protocol conversion, and VPN functionality. Network transmission is by way of a hockey puck antenna and a whip antenna provided with the Encore security appliance and mounted on the local Control Panel. The cellular network shall be provided and maintained by Verizon.

4.6.4 PLC Panel Hardware

The storage tank Panel shall be a NEMA 4X, 316 Stainless Steel free standing, two-door, lockable, enclosure with brushed finish. The Control Panel shall accommodate a flange-mount 480 VAC, 3-phase



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

power disconnect and a panel dead front kit consisting of two white powder coated hinged inner door panels. Internal Control Panel components shall be mounted on removable steel mounting sub-plates. Thermostatically controlled circulation fans and heater will be provided to maintain the interior panel temperature. Control Panel exterior doors shall be fitted with intrusion alarm limit switches and intrusion alarm reset pushbuttons mounted on the panel sub-plates. A shelf for a laptop shall be provided on the OIT subpanel.

The OIT, pump mode selector switches, pump start/stop pushbuttons, pump running status indication and alarm indication are mounted on the panel dead front inside the storage tank Control Panel.

The storage tank PLC, mounted in the Control Panel shall be a Rockwell Automation CompactLogix Cat. #5069-L306ER with EtherNet/IP communications capability. The PLC shall include the following features:

- PLC shall be powered by 120 VAC.
- The PLC shall include the following I/O as a minimum:
 - Analog Input.
 - Digital Inputs, 120VAC.
 - Digital Outputs, Relay Output.
- The PLC layout shall provide space for expansion of a minimum of four (7) I/O modules.

The storage tank OIT shall be a panel mount, NEMA 4X, 10-inch touch screen, with an integral EtherNet/IP port, a USB port and a SD card slot. The OIT shall also support both an external keyboard and a mouse input. The OIT shall be an Allen Bradley PanelView Plus 7.

The Control Panel shall be furnished with a UPS sized to support the PLC including I/O modules, the OIT and all network hardware for a minimum of 30 minutes with a minimum UPS size no less than 350VA unit. The UPS shall include dry contacts for battery health/status monitoring. Control Panel UPS provisions shall include a dedicated input circuit breaker, and a dedicated 15 amp polarized simplex output receptacle.

Surge protection to protect Control Panel AC distribution circuits shall be provided installed in parallel on the main incoming utility power.

The panel shall contain LED lighting.

4.6.5 Programming Software

The storage tank PLC, OIT and the existing City's central SCADA System application programming will be provided under the project scope. The existing City's central SCADA system application software and licensing shall be provided by the City. The following software applications shall be used for project programming and configuration.

- PLC programming software: Rockwell Studio 5000 Logix Designer, version 36 or later.
- OIT programming software: Rockwell FactoryTalk View Studio Machine Edition Software
- Operating system software: Latest version of MS Windows.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

All signals monitored and derived by the storage tank PLC will be transmitted to the existing City's central SCADA System for remote monitoring, alarming and historical data collection.

4.6.6 Functional Description

The storage tank pumps, odor control system, and flushing system are all monitored and controlled via the storage tank control panel.

The two storage tank pumps are powered by Variable Speed Drives (VFD). Each pump is equipped with a hardwired Hand/Off/Auto mode selector switch, pump Start/Stop pushbuttons, Run status indicator light, an alarm/fault Reset pushbutton, pump elapse run time meter and a common alarm beacon located on the Control Panel.

In the Auto mode, the pumps operate in a Lead/Standby configuration as manually selected by the operator via the OIT graphic display control mode poke-point. Only one pump can occupy an operational mode at any one time.

The pumps are equipped with dedicated thermal and leakage detection sensors and panel mounted protection relays for alarming and pump shutdown. Reset pushbuttons located on the Control Panel resets the pumps thermal and leakage fault alarms. The pump thermal and leakage detection equipment shall be provided by the pump manufacturer.

The storage tank is fitted with a radar level transmitter to provide continuous level monitoring of the tank, to control pump start/stop functions and alarm CSO tank high-high level conditions, see setpoint in **Table 4-8** in the subsequent **Section 4.6.6.8**. The level increases as the tank fills and decreases as the pumps operate. Pump Lead/Standby mode operation is detailed in the Local Automatic Control description. Tipping ball-float level sensors shall provide backup level control.

Remote operation and monitoring of the storage tank Site is supported by the City's existing central SCADA System located at the DPW office. The storage tank Site communicates via cellular telemetry to the existing central SCADA System. Reference the **Section 4.6.1** for interface details.

4.6.6.1 Odor Control

The odor control system shall operate via a local vendor-provided control panel (VCP). The system shall operate continuously and shall be monitored for operational status and alarm conditions by the storage tank PLC. All operating statuses and alarm conditions shall be shown on the local OIT and transmitted to the remote existing city SCADA system.

4.6.6.2 Tank Flushing System

The tipping bucket controls shall be incorporated into the storage tank PLC. The controls arrangement and functionality shall be developed during the next design phase alongside the flushing system design.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

4.6.6.3 Pump Local Manual Control

When a pump's Hand/Off/Auto mode selector switch is in the Off position, the pump cannot be started and a running pump will be stopped. The OIT graphic display pump control mode poke-points are not active in the Off mode.

When the Hand/Off/Auto mode selector switch is in the Hand position, pump operation is controlled via the pump Start/Stop pushbuttons. Depressing the Start pushbutton starts the pump and depressing the Stop pushbutton stops the pump.

PLC pump run interlocks are not functional in the Hand mode however the PLC will monitor and alarm equipment and process status for the storage tank site. In the Hand mode, pump run interlocks and equipment protection are hardwired to the pump VFD.

4.6.6.4 Pump Local Automatic Control

When the pump Hand/Off/Auto mode selector switch is in the Auto position, a Lead/ Standby OIT graphic display control mode poke-point will be displayed for that unit.

When the Lead/ Standby mode poke-point is selected to the Lead mode, the pump will be the first to be called into service when the Sherman CSO tank level > the Lead pump start level sensor setpoint, and the receiving sewer level is < the pump inhibit setpoint. The pump will stop if the Sherman CSO tank level < the Lead pump stop level sensor setpoint or the receiving sewer level is > the pump inhibit setpoint.

The once called to operate the lead pump shall operate to meet a specific flow corresponding to a level within the storage tank.

When the pump Lead/ Standby mode poke-point is selected to the Standby mode, the pump will be placed into service when the Lead pump is in a fault condition. Should a Lead pump fault occur while selected for Auto mode operation, the pump selected as Standby shall change mode as required to the Lead mode and replace the faulted pump. Notification of the Standby pump to Lead mode change shall be displayed on the graphic displays.

If the radar level sensor fails the PLC will automatically start/stop the Lead pump based on the storage tank ball-float level sensor switches. The initial tank level start/stop time delays may be adjusted as required by the process conditions.

Table 4-7 contains an initial list of alarms. Detection of all alarms shall be delayed to prevent false or nuisance alarms.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

Table 4-7. List of Alarms

Alarm Description	Alarm Announced
ATS Utility/Generator Power Feed Status	Utility On (1) / Generator On (0)
Generator Common Alarm Status	Common Alarm
Panel Intrusion	Panel Intrusion Alarm
120 VAC Panel Power Status	120 VAC Panel Power Alarm
24 VDC Panel Power Status	24 VDC Panel Power Alarm
Pump No.1 Over-temperature	Pump Motor Winding Temp
Pump No.2 Over-temperature	Pump Motor Winding Temp
Pump No.1 Leakage	Detection Alarm
Pump No.2 Leakage	Detection Alarm
Pump No.1 VFD Fault	Pump Drive Fault Alarm
Pump No.2 VFD Fault	Pump Drive Fault Alarm
Panel UPS Battery Low	UPS Battery Low Alarm
Panel UPS Fail	UPS Fault Alarm

4.6.6.5 Remote Parameters Selection

In addition to the storage tank site remote monitoring and data collection, the existing central SCADA System allows remote adjustment of the following modes and parameters:

- Pump Lead/Standby control mode poke-point selection.
- Remote Pump Start/Stop function
- Remote Alarm Acknowledgement and reset
- Level setpoint and alarm time delays.
- Flow setpoints.

4.6.6.6 Pump Remote Manual Control

Remote Manual pump start/stop controls shall be available at the existing central SCADA System via the storage tank screen. An operator shall be able to select a pump HMI faceplate and select remote hand operation for each pump.

4.6.6.7 Remote Automatic Control

There are no Remote Automatic pump start/stop controls at the existing central SCADA System.



30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

4.6.6.8 Set Points and Alarms

All Sherman CSO Panel PLC I/O and internally derived points shall be indicated at the local OIT, and existing central SCADA System including pump run status, pump modes, fault status, equipment and process alarms, pump runtime and tank levels. The pump thermal and leakage faults shall be combined into a common pump fault alarm. Activation time-delay of all alarms shall be adjustable to prevent nuisance alarms.

Table 4-8. List of Setpoints

Setpoint Description	Setpoint (ft)	Alarm Announced
Storage Tank Level High High	34' 4"	High High Level Alarm
Storage Tank Level High	33'	Not Alarmed
Storage Tank Pumping Enabled Level	8' 6"	Not Alarmed
Storage Tank Pump Stop Level	6' 6"	Not Alarmed
Receiving Sewer Level High High	3' 3"	High High Level Alarm
Receiving Sewer Pumping Enabled Level	2' 4"	Not Alarmed
Receiving Sewer Pump Inhibit Level	2' 8"	Not Alarmed
Grit capture tank Level High High	6' 6"	High High Level Alarm



5.0 PERMITTING

Design-phase permitting is necessary prior to construction of the project. The project team is expected to prepare and administer the following permit applications. Other construction phase permits that are common to City utility and site development projects will be identified in the technical specifications for the construction contractor, and are not the focus of this chapter.

5.1 MBTA LICENSE FOR LAND SURVEY

As part of the preliminary design package, the property and right-of-way limits of the Site are based on GIS shapefiles and approximate. Because the MBTA owns a continuous parcel north of the Site for railroad operations, an MBTA License for Land Survey has been submitted for a surveyor to gain access to MBTA's adjacent parcel and the railway corridor to complete this property boundary survey. Additionally, there is a continuous chain link fence that meanders along the perimeter between the Site and MBTA property; the property boundary survey will allow this fence to be reset at verified property boundaries during construction.

The survey is expected to be completed during 60% Design. It is recommended for the surveyor to pick up additional detail for conditions north of the Site and Danehy Park. This survey will allow further definition of the alternative truck hauling route being considered in the westerly direction, plus utilities that need to be protected if temporary construction access is granted on the MBTA parcel.

5.2 MBTA LICENSE FOR CONSTRUCTION

The MBTA maintains rights to all areas adjacent and within close proximity (30-ft horizontal-plan dimension) to its property line, known as the Zone of Influence (ZOI). Due to the Site sharing a property line with MBTA, the following types of anticipated construction activities will necessitate applying for an MBTA License for Construction, which includes filing a Permit Set of drawings and specifications for MBTA review and approval.

- Site demolition activities such as tree removals that have potential to foul the track
- Site work along property lines, which may include security fencing
- Pile driving within 25-ft of MBTA structures and tracks
- Temporary construction access on MBTA property

The design team and City have begun consulting with the MBTA during preliminary design to confirm requirements for a future MBTA License for Construction application package. An application will be submitted to MBTA after 30% Design for review and to allow MBTA comments to be incorporated into final design and bid documents.

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

5.3 CITY ZONING

The site is currently zoned for Residence C-1. Discussions between City departments are ongoing to formalize the phased DPW infrastructure, building, and community path improvements on this parcel.

5.4 STORMWATER CONTROL PERMIT

The project is anticipated to require a more complex Stormwater Control Permit from the Cambridge DPW, due to the proposed Bellis Circle sidewalk improvements and stormwater management systems. The Stormwater Control Permit application will be in compliance with the City Wastewater and Stormwater Management Guidance, including the June 2021 Supplemental Directive, and other applicable local stormwater regulations.

Preparation of the Stormwater Control Permit application is anticipated to include a Stormwater Management Report documenting existing and proposed drainage conditions, hydrologic and hydraulic analyses, stormwater quantity and water quality compliance, and evaluation of the proposed stormwater management system. Additional supporting documentation is anticipated to include an Erosion and Sediment Control Plan and an Operation and Maintenance (O&M) Plan for the stormwater management systems.

5.5 TREE REMOVAL PERMIT

As documented in **Appendix A**, there are City shade trees identified for protection and others which are candidates for removal due to invasive, diseased and/or non-desirable species per the City Arborist. Should tree removals become warranted by the design, a permit subject to the rules and regulations set forth in the City of Cambridge Tree Protection Ordinance Title 8, Chapter 8.66 of the City's Municipal Code will need to be obtained.

5.6 CITY EXCAVATION AND TRENCH PERMIT

During the design phase, additional field investigation is planned that involves excavation, such as test pitting in the public right of way. To undertake this work, renewal of permit filings previously obtained by the design team will be required.



6.0 ADDITIONAL FIELD INVESTIGATIONS

Additional field investigations are necessary to inform the engineering of final design recommendations and assumptions stated in this report and to sufficiently characterize site conditions for contractors to accurately bid construction of the storage tank, thereby reducing the risk of costly unknowns that may be discovered during construction.

6.1 SEWER CONDITION ASSESSMENT

An initial inventory review of historical CCTV inspection data was completed in 2019 and 2020 for existing sewer and drainage networks in the vicinity of the Site. Results were shared with the City on June 6, 2026 and indicated almost all pertinent pipelines have an existing CCTV inspection with no identified video quality issues. However, there was a missing video for the 48-inch FRP combined sewer pipe where the diversion structure is proposed. To avoid the risk of a differing site condition, it is recommended the City inspect this pipe to confirm alignment and structural condition.

Additionally, the surveyed invert for the 48-inch FRP pipe indicates approximately 12-inch of debris in the pipe and its actual invert elevation is uncertain. It is recommended to jet clean this pipeline as soon as possible, re-measure the invert, and monitor for sediment re-accumulation, so that sediment loads are understood for operation of the diversion structure. For preliminary design, a record drawing invert elevation of this conduit has been used.

For the CCTV data obtained, there is a 2020 inspection for the 8-inch VCP sanitary sewer S71SMH8215_S71SMH8210 on Bellis Circle where a root ball lateral was observed at 111.4-ft (**Figure 6-1**). This root ball has likely increased in size and presents obstruction concerns. There is also a 2019 inspection for the 12-inch RCP storm drain D37DMH1410_D37DMH1400 where a crack multiple 9/10 at 61.4-ft was observed (**Figure 6-2**) and warrants future monitoring.

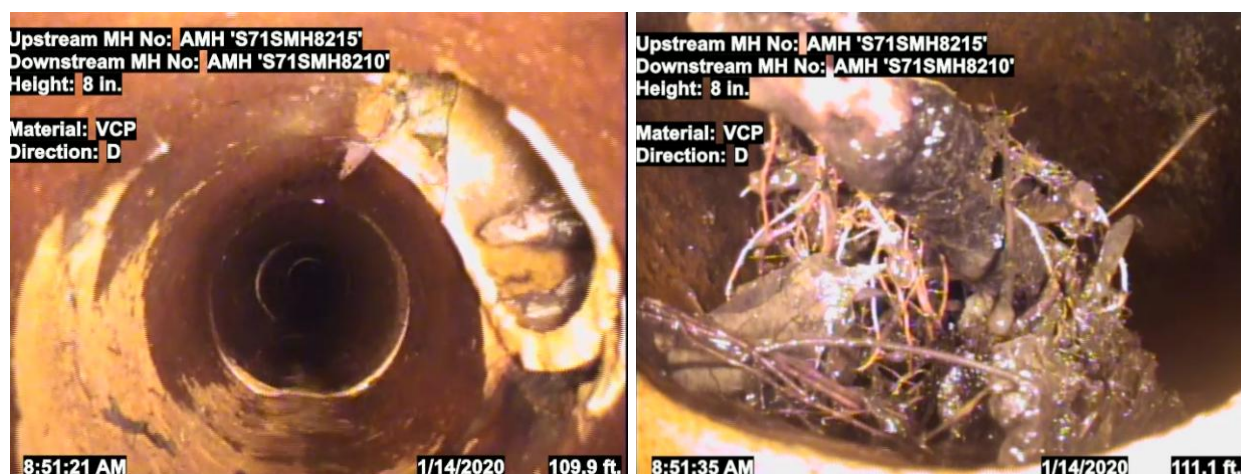


Figure 6-1. Root Ball Lateral

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

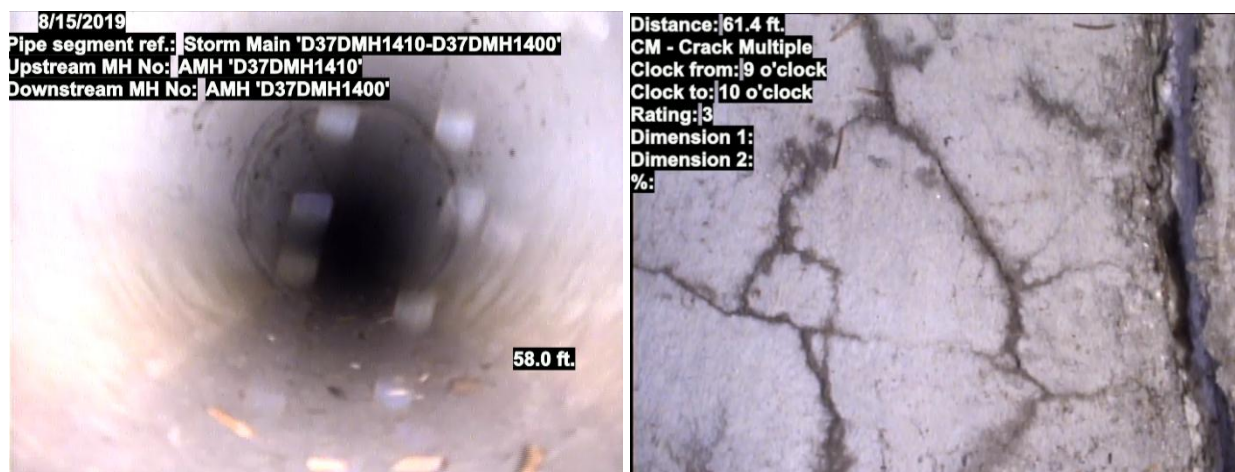


Figure 6-2. Crack Multiple

6.2 MBTA UTILITIES

Based on the 2025 WSP survey and the 2026 QL-B SUE investigations by BSIE, there is an assumed MBTA duct bank encasing 4-4" electrical conduit lines with one electrical manhole along the Sherman Street limit of work. To obtain utility record information for this underground MBTA infrastructure, the design team contacted MBTA records Archives staff who indicated that per MBTA policy, Archives does not provide construction documents to outside resources unless a project is on behalf of MBTA. The team was re-directed to contact the MBTA Public Request Portal for the Public Records Request Office, albeit with no responses to our request to date.

However, due to the Site abutting an MBTA parcel and a property boundary survey required, there is an opportunity to address this MBTA utility records request via the MBTA License for Land Survey application (refer to **Section 5.1**). Upon approval of the MBTA License for Land Survey, MBTA recommends engaging DigSafe with Keolis (MBTA's commuter rail operator) to mobilize and mark-out utilities alongside the design team's surveyor.

Overall, through submitting the MBTA License for Survey Agreement application and engaging Keolis, there will be opportunity to further evaluate the MBTA utilities within the Sherman Street limits and acquire additional information required to solidify utility locations.

6.3 SUBSURFACE UTILITY EXPLORATION

A subsurface utility exploration (SUE) commenced on April 13, 2026 by BSIE. The field investigations started with QL-B survey to horizontally locate underground utilities. The QL-B results were reviewed internally and referenced during preliminary design. Overall, the next steps include quality level A (QL-A) test pitting, which is anticipated to occur during 60% Design to definitively locate and confirm depth to specific utilities of interest.



6.4 TREE CONSIDERATIONS

As the design progresses, consideration will be given to both preservation of existing trees and successful establishment of proposed trees. Construction activities will be planned to avoid damaging tree roots, trunks, and canopy branches where possible. Damage to tree anatomy can compromise tree health, longevity, and structural stability. Tree perimeter fencing is typically installed to establish protection zones and keep heavy construction equipment, material storage, grading, and soil compaction at an appropriate distance. The City Arborist requests that excavation in unpaved areas be avoided below protected tree canopies to minimize root disturbance and assure long term tree health.

The proposed diversion structure on Sherman Street, new sidewalk along Bellis Circle, and on-site stormwater management practices for the #135 Sherman parcel pose challenges with tree protections. During 60% Design, a second site walk is recommended with the City Arborist to review the layout of proposed improvements. Review will include ground cover and exposed root conditions, and the possible impact of sidewalk and diversion structure construction.

In regard to replacement trees along Bellis Circle, the re-planted trees may not be in the same location unless the existing root masses can be adequately stump-ground and removed. Final tree removal and planting plans will be reviewed with the City Arborist for approval. There is also a Tree-of-Heaven proposed for removal and a licensed horticultural team should be consulted to properly treat and remove this invasive species to ensure it does not re-grow and overcome improvements on the Site.



7.0 COSTS AND SCHEDULE

An estimate of the construction costs and delivery schedule for the Sherman Street CSO storage tank facility is provided herein.

7.1 CLASS 4 CONSTRUCTION COST ESTIMATE

A preliminary 30% Engineer's Opinion of Probable Construction Cost (OPCC) was produced for the Sherman Tank Project, as described herein. The Class 4 Cost Estimate for the CSO Storage Tank project is estimated to be approximately \$35.8 million in capital cost. This value will be refined by cost estimating that will occur as the design progresses.

The cost estimate includes a 15% contingency (design and prime contractor's contingency) as well as a 5.25% annual escalation for the next twelve months, dropping to 5.2% thereafter. It is assumed construction will start in September 2027.

A breakdown of the major costs is presented as **Appendix K**, along with a description of the basis of the cost estimate and all assumptions.

For the purposes of preliminary design, the cost estimate assumes the scope of work as recommended in **Section 4.0** of this report. Project elements having the greatest potential for change that would result in a significant increase or decrease in cost include:

- Changing the volume and/or type of CSO storage tank.
- Conditions and/or disapprovals introduced by the MBTA.
- Discovery of contaminated soils or groundwater on the Site.
- Improvements to other existing infrastructure not considered in this report.

7.2 DELIVERY SCHEDULE

The project team's delivery schedule for Design, Bidding, and Construction phases is summarized in **Table 7-1**.

30% BASIS OF DESIGN REPORT – SHERMAN STREET CSO STORAGE TANK

Table 7-1. Delivery Schedule

Activity	Start Date
60% Design	September 2026
100% Design	January 2027
Bid Set	May 2027
Bidding	June 2027
Construction	September 2027

The start of bidding will depend on receipt of the MBTA Construction License Agreement, discussed in **Section 5.2**. While the design schedule allows more than 6 months to process this license application, the expected timeframe may be exceeded causing bidding and construction schedules to shift.

The storage tank construction duration is estimated to be 24 months once the contractor receives notice to proceed. An additional 6 months is expected for interim site restoration, start-up and/or punch list items.

END