United States Environmental Protection Agency

2014 GREEN INFRASTRUCTURE TECHNICAL ASSISTANCE PROGRAM
City of Fall River
Fall River, MA

Green Infrastructure Implementation in Fall River, Massachusetts

Reducing Stormwater Contributions to Combined Sewers through Tree Filter Retrofits, Rain Barrels, and Stormwater Credits to Homeowners

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About the Green Infrastructure Technical Assistance Program

Stormwater runoff is a major cause of water pollution in urban areas. When rain falls in undeveloped areas, soil and plants absorb and filter the water. When rain falls on our roofs, streets, and parking lots, however, the water cannot soak into the ground. In most urban areas, stormwater is drained through engineered collection systems (storm sewers) and discharged into nearby water bodies. The stormwater carries trash, bacteria, heavy metals, and other pollutants from the urban landscape, polluting the receiving waters. Higher flows also can cause erosion and flooding in urban streams, damaging habitat, property, and infrastructure.

Green infrastructure uses vegetation, soils, and natural processes to manage water and create healthier urban environments. At the scale of a city or county, *green infrastructure* refers to the patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water. At the scale of a neighborhood or site, green infrastructure refers to stormwater management systems that mimic nature by soaking up and storing water. Green infrastructure can be a cost-effective approach for improving water quality and helping communities stretch their infrastructure investments further by providing multiple environmental, economic, and community benefits. This multi-benefit approach creates sustainable and resilient water infrastructure that supports and revitalizes urban communities.

The U.S. Environmental Protection Agency (EPA) encourages communities to use green infrastructure to help manage stormwater runoff, reduce sewer overflows, and improve water quality. EPA recognizes the value of working collaboratively with communities to support broader adoption of green infrastructure approaches. Technical assistance is a key component to accelerating the implementation of green infrastructure across the nation and aligns with EPA's commitment to provide community focused outreach and support in the President's *Priority Agenda Enhancing the Climate Resilience of America's Natural Resources*. Creating more resilient systems will become increasingly important in the face of climate change. As more intense weather events or dwindling water supplies stress the performance of the nation's water infrastructure, green infrastructure offers an approach to increase resiliency and adaptability.

For more information, visit *http://www.epa.gov/greeninfrastructure*.

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1 Executive Summary

The City of Fall River is an historic waterfront community located at the mouth of the Taunton River along Mount Hope Bay in southeastern Massachusetts. Like many older industrial centers in the northeastern U.S., the City faces the challenge of degraded surface water quality associated with an aging combined sewer system. Through the implementation of several large sewer separation and storage infrastructure projects completed in recent years, the City has achieved significant reductions in the incidence of combined sewer overflows (CSOs). However, despite the successes of these conventional solutions, several areas of the City continue to exhibit frequent CSOs. These areas are generally not suitable for conventional infrastructure approaches due to resource limitations and significant implementation constraints.

This report documents the development of several green infrastructure elements that could be incorporated into the City's stormwater management program. First, much of the City relies on aging drainage infrastructure, primarily curb and street inlets subject to ongoing repair and replacement due to structural failure. To leverage an ongoing tree planting effort citywide, a low-cost standardized tree filter design was developed to replace these drainage elements as the City integrates green infrastructure in constrained street corridors and existing infrastructure. As part of a more focused tree filter pilot program, the Birch Street catchment area was studied, 12 specific retrofit locations were identified for future tree filter installation, and schematic designs were developed to guide pilot program implementation. Additionally, a fact sheet was developed to communicate the benefits of tree filters to City residents. In combination, the standardized design, the results of the pilot program (that uses the standard design), and the outreach materials will provide the City with the tools and experience it needs for widespread implementation of tree filters. Second, this report also explores the implementation of a citywide rain barrel program, including the adoption of a standard design for a rain barrel for residential use, the adoption of a citywide stormwater incentive program, and potential code revisions for administration of the incentives.

The adoption of tree filters in Fall River would serve three critical functions: (1) replacement of failing infrastructure, (2) reduction of stormwater contribution to combined sewers, and (3) facilitation of the installation of trees within street rights-of-way to support Fall River's urban tree initiatives. Rain barrels would capture a portion of runoff, providing small-scale irrigation and other benefits; developing an appropriate incentive program can increase participation and public awareness. Implementing the green infrastructure practices described in this report (tree filter retrofits in the pilot program and residential rain barrel distribution citywide) would demonstrate to residents, city staff, elected officials, and other stakeholders how green infrastructure functions and can provide multiple benefits to the community.

2 Introduction

The City of Fall River, Massachusetts is located in Bristol County along the eastern coast of Mount Hope Bay at the mouth of the Taunton River. Water bodies are an integral part of the City's culture, and there are several rivers, reservoirs, and a bay that border or lie within the City boundaries; Rhode Island borders Fall River to the south and also has substantial shoreline along Mount Hope Bay. In the eighteenth and nineteenth centuries, the Quequechan River, with waterfalls that gave the City its name, provided power for textile mills, allowing the City to be a major industrial center in New England during that time. Fall River is currently the tenth largest city in the state, with approximately 90,000 residents, including large populations of low income and non-English speaking residents.

Fall River was recently selected by the state of Massachusetts as one of three cities to implement a new energy-efficient tree-planting initiative (EETPI). The initiative seeks to plant up to 15,000 trees throughout these cities in areas where tree densities are generally low in order to reduce energy use in urban neighborhoods and lower heating and cooling costs for residents and businesses. In addition, a local nonprofit tree-planting organization, the Fall River Tree Committee, Inc., recently established one of the state's first urban tree nurseries and is supported by a strong group of volunteers who assist in planting and maintaining trees throughout the community.

In Fall River, however, the existing street network throughout the City has minimal space for tree planting due to paving widths and sidewalks on both sides of the streets that typically extend from back of curb to the right-of-way limit. To leverage ongoing urban tree-planting efforts, this report provides a framework for a green infrastructure pilot program for implementation of tree filters. The purpose of the pilot program, which focuses on a drainage area that experiences CSOs, is to evaluate the feasibility of implementing tree filters in the public right-of-way to provide stormwater control, while simultaneously creating opportunities to expand the urban tree canopy. This report also explores the potential installation of residential rain barrels, an economic incentive for City residents, and potential code revisions needed for administration of the incentives.

2.1 Water Quality Issues/Goals

Massachusetts Department of Environmental Protection (MassDEP) has classified Mount Hope Bay as a Class SB water[1] suitable for shellfish harvesting. Data from multiple sources indicate that the majority of the Bay consistently fails to meet water quality standards for bacteria. In addition to shellfishing, other designated uses in the Bay, such as primary and secondary contact recreational use, are affected by bacteria pollution (MassDEP 2010). Stormwater runoff from the City and other municipalities in both Rhode Island and Massachusetts also contribute to the observed impairments in the Bay.

In 2010, MassDEP, along with the U.S. Environmental Protection Agency (EPA), developed a total maximum daily load (TMDL) to address pathogens in Narragansett Bay and Mount Hope Bay. That same year, the Rhode Island Department of Environmental Management (RIDEM) developed a TMDL to address bacteria-related impairments in Mount Hope Bay and the Kickemuit River Estuary. Both TMDLs provide guidance for local governments and stakeholders to implement practices to meet bacteria water quality standards in the Bay and its tributaries.

CSOs from the City of Fall River are the largest source of fecal bacteria to Mount Hope Bay during wet weather (RIDEM 2010). The City has been under a Federal Court Order since 1992 to reduce CSO

[1] See 314 Code of Massachusetts Regulations at http://www.mass.gov/courts/case-legal-res/law-lib/laws-by-source/cmr/300-399cmr/314cmr.html.

discharges, and ongoing construction of facilities to store and treat the combined sewage have begun to mitigate the overflows. More than $178 million in capital improvements have been made to the Fall River collection system in recent years to address the CSO issue, including the completion of a deep rock tunnel storage system that began operation in 2005 (MassDEP 2010). These extensive upgrades to the collection and treatment systems at Fall River are expected to result in significant water quality improvements.

Fall River continues to experience CSO discharges from combined sewer outfalls along the City's shoreline during severe storm events, despite investments in gray infrastructure. The City wishes to expand its toolbox of CSO abatement methods to include green infrastructure to manage stormwater to improve water quality, while also providing additional benefits to the community (e.g., increasing tree canopy).

2.2 Overview and Goals

This report describes two parts of the City's green infrastructure initiatives. The first is the development of a pilot program to use green infrastructure—specifically tree filters—to reduce CSOs and to improve tree cover and aesthetics in a portion of Fall River. The pilot program would be one element of a multi-faceted municipal effort focused on integrating the state's EETPI with installation of tree filters to manage stormwater in a neighborhood setting, the installation of residential rain barrels, and an economic incentive program for City residents.

The pilot program targets the Birch Street catchment basin, which drains 94 acres and is connected to a 66-inch interceptor located along Mount Hope Bay shoreline. During significant rainfall events, the capacity of the interceptor is exceeded and combined sewer effluent is discharged directly to Mount Hope Bay. Based on continuous simulation modelling analysis of the City's combined sewer outfalls, the Birch Street basin is estimated to experience the greatest reduction in stormwater flows as a result of green infrastructure implementation (CDM 2012). Similarly, the basin is estimated to experience the greatest cost savings, as compared to conventional CSO reduction measures, when using green infrastructure practices to address stormwater flow reduction.

The pilot program would demonstrate the integration of green infrastructure with ongoing, citywide urban tree initiatives. The goals of the pilot program would be to:

- Develop a tree filter standard design that can be implemented in street rights-of-way across the City to replace failing catch basins.
- Develop concept schematics to retrofit up to 12 existing catch basins within the Birch Street pilot watershed with tree filters.

Consistent with the City's plan for CSO abatement, the new trees installed with the tree filter standard design would help the City meet its goals for reducing stormwater (and CSO) flows and would be demonstrated in 12 priority retrofit locations. Because the Birch Street subwatershed is also an area of focus for other tree planting efforts ongoing in the City, Fall River would be able to capitalize on a number of existing resources, including a dedicated non-profit, an urban tree nursery, and grants from the U.S. Forest Service and the state Department of Energy Resources. The neighborhood association in the basin has voiced strong support for plans to reduce CSO discharges. The City would also develop educational materials to distribute to residents to inform them about efforts to improve water quality, how tree filters work, and other related topics.

Second, the City seeks to develop a residential stormwater incentives program applicable to the entire city. The goals of the incentives program would be to:

- Identify a rain barrel standard design that can be adopted by the City and used by residents in order to capture a portion of stormwater flows, thereby reducing the potential for CSO events.
- Develop a process for the incentives program application and rain barrel distribution.
- Identify changes to city code to provide for administration of the incentives program.

2.3 Benefits

The City envisions two primary benefits from implementing these green infrastructure elements. The first is a reduction in the number of CSO events through improved control of stormwater. City officials estimate that the entire tree planting program (i.e., not just those installed as part of the pilot program) might reduce the citywide stormwater flows by 10–20 percent above the stated goal to meet the City's CSO plan. The second benefit is a beautification of the City by planting additional trees, which will also provide shade, reduce energy consumption, improve air quality, and engage local organizations.

2.4 Local Challenges

Fall River faces a long-standing problem with CSO discharges and has already spent a significant amount on conventional infrastructure. Despite these efforts, CSOs remain a concern and addressing these last outfalls will likely require large expenditures, a problem in a city with limited resources. Fall River's significant investments in gray infrastructure have started to reduce CSO discharges, but additional investment is needed to sufficiently reduce overflows. As such, the City is investigating opportunities to utilize green infrastructure to optimize performance and inform future stormwater decisions by considering the wide range of benefits achieved by implementing green infrastructure.

2.5 Site Conditions

The Birch Street catchment area is located in southwest Fall River along the eastern shore of Mount Hope Bay. Much of the development in this catchment occurred during the early twentieth century in response to the industrial growth of the City. The catchment drains 94 acres that include residential neighborhoods, parks, an elementary school, and several commercial businesses. The catchment area is roughly bounded by Slade Street to the north, South Main Street to the east, Pokross Street to the south, and Bay Street to the west. (See Figure 2-1.) The majority of the residences are single family homes, although portions of a large block of apartment buildings are located in the southwest corner of the catchment area.

Source: Tetra Tech, Inc.

Figure 2-1. The Birch Street catchment area

Prior to 2009, the Birch Street catchment area was somewhat larger, but construction of a 20-foot diameter CSO storage tunnel in 2009 resulted in the interception of a portion of the combined sewer for this catchment into the tunnel storage, effectively reducing the catchment area. Despite this reduction in contributing area, combined sewage flows still exceeds the capacity of the interceptor along the shore of Mount Hope Bay during larger storm events, resulting in direct discharge from the catchment area outfall at those times (Figure 2-2). A modeling analysis estimated that direct discharge to Mount Hope Bay occurs approximately 56 times in a typical year, resulting in 19 million gallons of combined sewage discharging directly to the Bay (CDM 2012).

Photo credit: Tetra Tech, Inc.

Figure 2-2. Birch Street outfall

The streets within the catchment are configured in a grid network with streets in a north-south or east-west orientation. The combined sewer system is exclusively located within the center of the road right-of-way with a main trunk along Bay Street connected to secondary feeder lines along the east-west oriented streets corresponding to the dominant slope direction. Houses are generally located close to the street with lawn space dedicated at the rear of the house within the center of the blocks. Street fronts exhibit limited presence of trees (Figure 2-3). Based on observations from a site visit, all stormwater runoff generated within the private parcels (including roof top runoff) is surface routed into the street right-of-way and eventually to the catch basin inlets along the curb.

Photo credit: Tetra Tech, Inc.

Figure 2-3. Typical street exhibiting limited trees along the right-of-way

2.6 Existing Catch Basin Characteristics

During the site visit, a review was conducted on the existing catch basins that collect stormwater runoff from the curb gutters and route it to the combined sewer. The review included collection of information on typical catch basin geometry, with a specific emphasis on characteristics important in the development of a tree filter standard design.

Catch basins within the Birch Street area are generally grouped around street intersections to capture runoff flowing along curb edges and prevent cross-street flow. Many intersections have multiple catch basins, while others have one or two, or depending on the slope, none. Catch basins are typically circular and constructed of brick or masonry block construction, depending on age. Historically brick was used, but masonry block is common for new construction and repairs. Catch basins are 5 to 6 feet in diameter with a depth of 5 to 6 feet. The connection to the combined sewer is provided by a cast iron pipe typically 2.5 to 3.5 feet below the top of the inlet. As a result, the catch basins incorporate a sump of 1.5 to 3.5 feet at the bottom to capture trash, floatables, and other debris. A hood, which serves as a debris shield, is typically installed on the sewer connection pipe to prevent floatables from entering the sewer system (Figure 2-4).

Photo credit: Tetra Tech, Inc.

Figure 2-4. Catch basin hood prevents debris from entering combined sewer

Catch basin inlets in Fall River generally are one of two configurations: curb and slotted grate inlets. Both configurations appear to be of consistent construction and dimensions below the ground surface as detailed above. Curb inlets, colloquially referred to as *Bradley Head* inlets (see Figure 2-5) consist of a concrete slab top integrated into the sidewalk incorporating a standard manhole ring frame and cover. Stormwater runoff is routed into the catch basin by means of a precast slot weir or throat integrated into the slab top at the curb edge and depressed or modified pavement surface to accommodate inflow. Curb inlets are sometimes located at the apex of intersections rather than along a straight section of curb. The curb inlet is the preferred style for new or replacement catch basin inlets.

Photo credit: Tetra Tech, Inc.

Figure 2-5. Catch basins with curb style inlet

Slotted grate catch basin inlets (see Figure 2-6) consist of a slotted cast iron drain (generally a cascade or bar grate) located within the curb gutter situated above the catch basin structure. These inlets do not include a dedicated manhole for access but rather rely on the grate for this purpose. Slotted grate catch basins appear to be somewhat more common within the Birch Street catchment area.

Photo credit: Tetra Tech, Inc.

Figure 2-6. Slotted grate inlet catch basin

2.7 Evaluation of Tree Filter Retrofit Locations

The Birch Street catchment area contains 58 catch basin inlets. Each catch basin inlet location was visually evaluated for the feasibility of retrofitting with a tree filter system. Feasibility considerations included a variety of factors related to conflicts with existing infrastructure and physical space requirements, such as:

- Overhead utility lines (low clearance height)
- Existing trees, utility poles, fire hydrants, or other vertical infrastructure
- Conflicts with adjacent structures on private property
- Presence of a cross-walk
- Sufficient sidewalk width to accommodate a tree and remain compliant with the Americans with Disabilities Act

Among the catch basins evaluated, 12 locations were identified as feasible for retrofit with a tree filter. The remaining 46 catch basins locations were excluded from consideration based on one or more of the issues noted above. The most common issues observed were presence of overhead utilities, and to a lesser extent, conflicting adjacent infrastructure.

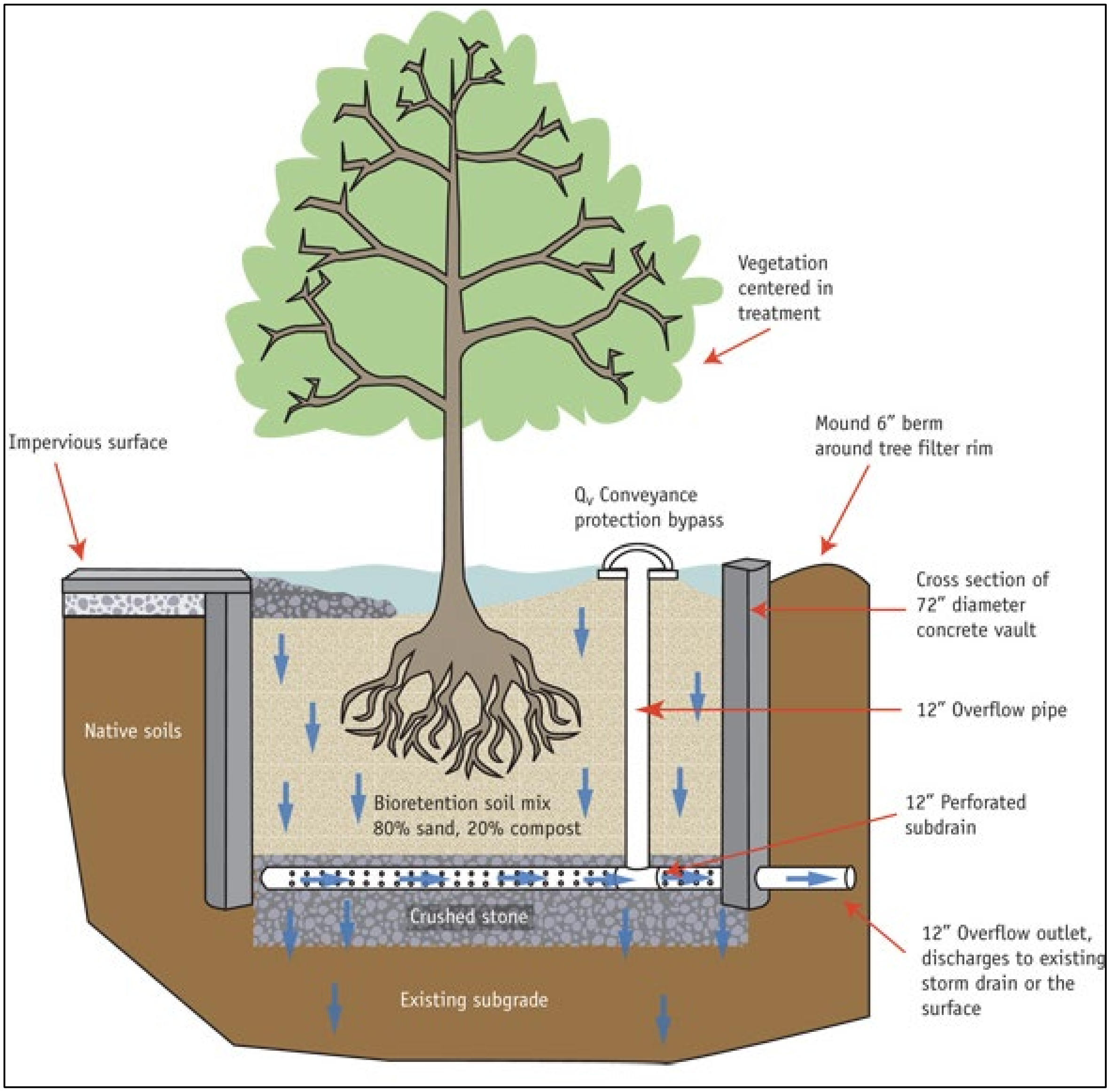
2.8 Soil Conditions

The Birch Street catchment area is classified using the U.S. Department of Agriculture's Web Soil Survey as *Urban-Land*, which has unknown parent material due to significant excavation or fill. According to the Web Soil Survey, the depth to a restrictive layer (water table or bedrock) exceeds 200 centimeters. Based on comments from City staff, much of Fall River overlays a shallow granite *dome* that is covered with a highly permeable glacial till material. Infrequent outcroppings of bedrock were observed during the site investigations, and City staff indicated that bedrock was sometimes encountered during installation of shallow infrastructure (such as new catch basins), requiring expensive bedrock removal. Interestingly, many homes in Fall River have full basements, and basement flooding does not appear to be a common issue within the community, perhaps indicative of high rates of permeability associated with the overlying soil material.

The presence of shallow underlying bedrock underscores the need for the standard tree filter design to emulate the depth and dimensions of the existing catch basins so that additional bedrock removal is limited. The high permeability rates associated with shallow soils also indicate that open bottom tree filters might be appropriate to enhance the reduction of runoff contribution to the combined sewer and allow the trees contained within them to access a larger rooting area.

3 Birch Street Tree Filter Pilot Program

Tree filters are structural elements typically installed along roadway curbs or in other ultra-urban settings. Sometimes referred to as tree box filters, they consist of a concrete *box* that contains a filter media suitable for plant growth in which a small tree is planted (Figure 3-1). Tree filters serve to function in much the same way that bioretention or bioswales do, but they are much more suitable to highly urban environments where pedestrian surfaces must be retained. Stormwater runoff is routed into the tree filter system via a curb opening, where it enters a storage zone directly above the filter media. Some designs also incorporate a pretreatment chamber upstream of the storage zone to capture debris and heavy sediment. Captured stormwater runoff slowly infiltrates through the filter media before exiting the tree filter, either through an underdrain connected to the storm or combined sewer system or directly into underlying soils. The filter media removes a portion of pollutants carried by the runoff and stores moisture for use by the tree.



Source: University of New Hampshire

Figure 3-1. Schematic view of typical tree filter

In support of the City's tree planting initiative, a standard tree filter design was developed to provide a simple, low-cost option that could be installed by the Community Utilities Department to replace failing catch basins on an as needed basis at locations throughout the City. The tree filters would serve three critical functions: (1) replace failing infrastructure, (2) reduce stormwater contribution to combined sewers, and (3) facilitate implementation of trees within the street right-of-way to support Fall River's tree programs. Additional design criteria for the tree filter, which are based on the existing geometries of the combined sewer catch basins and culverts (as described in Section 2.6), include:

- Fit within existing 6-foot to 8-foot wide sidewalk corridor (distance from curb to right-of-way limit)
- 6-foot maximum depth below grade
- Outlet invert 2.5 feet to 3.5 feet below grade
- 24-inch maximum outlet diameter
- Open bottom for infiltration
- Pretreatment option for floatables and solids control

Sections 4.1–4.4 below describe the development of the standard design (Appendix A). Section 4.5 describes the process of identifying specific retrofit sites for the tree filter pilot program in the Birch Street catchment (Appendix B). Lastly, Appendix C contains a fact sheet to distribute to the public that further describes tree filters and how they function.

3.1 Design Development

To facilitate a low-cost tree filter design that could be integrated into existing infrastructure while considering typical constraints inherent in a retrofit application, the design team worked with a local precast concrete manufacturer to develop a tree filter configuration that could be based on existing septic tank templates. As the basis for the design, a 2,000-gallon, traffic-rated septic tank was selected with outside dimensions of 6 feet wide, 10.5 feet long, and 6.25 feet high (including an 8-inch thick slab top). These dimensions maximize treatment volume while complying with the aforementioned site constraints and design criteria.

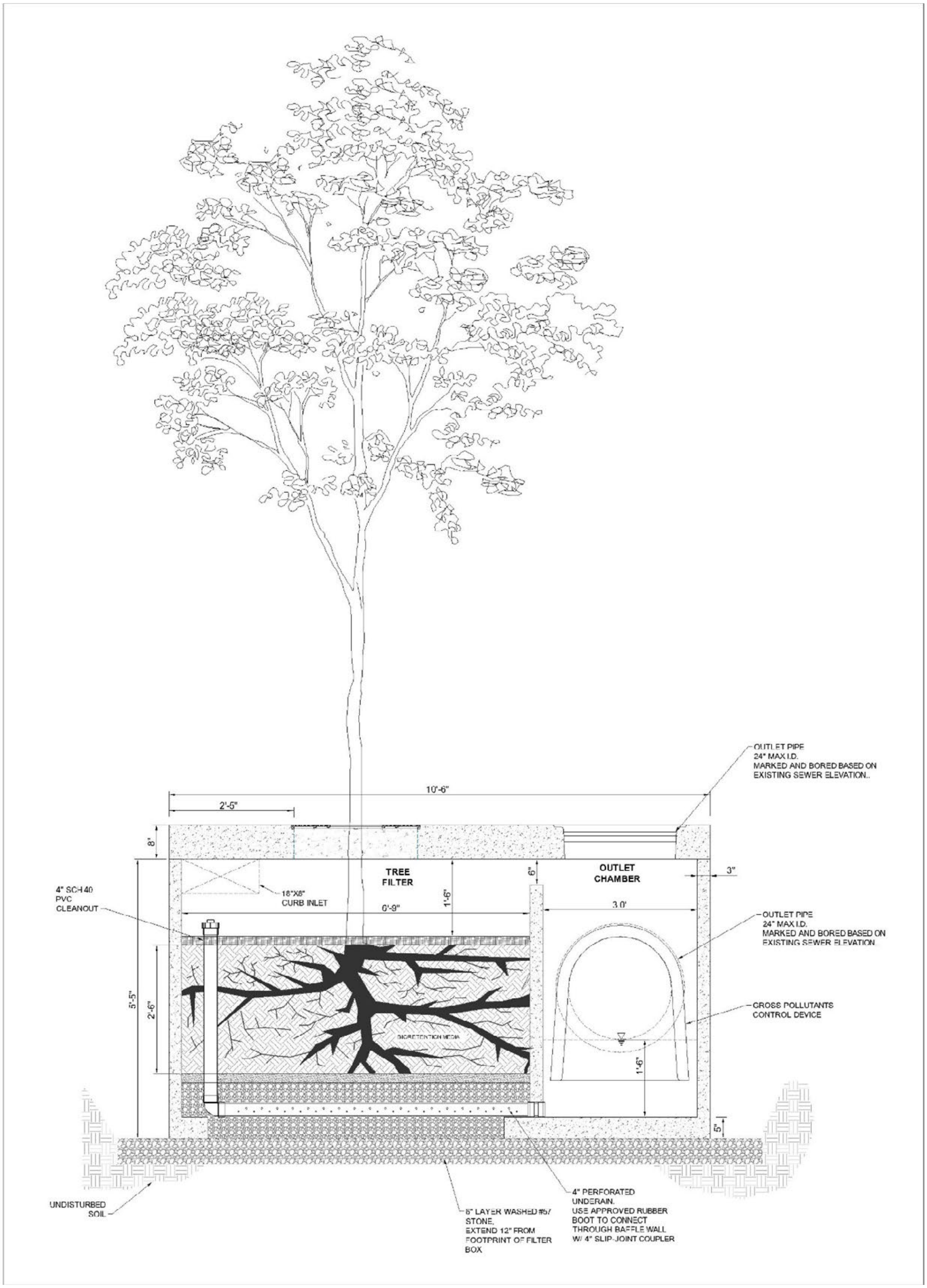
The single baffle wall in the septic tank form was retained for structural integrity and modified to provide separation between the two internal compartments: the tree filter and the outlet sump (with floatables control). The unit is designed so that stormwater enters the tree filter through a curb inlet at the top of the tree filter compartment (similar to the manner in which flow enters the curb inlet catch basins described previously), and it discharges from the system either through infiltration under the open-bottom tank or overflows through the culvert outlet. The baffle wall is designed to provide up to 12 inches of ponding depth over the tree filter during storm events. Stormwater inflows that exceed the infiltration capacity of the tree filter layers and the ponding volume will overflow to the outlet sump through the 6-inch tall opening between the top of the baffle wall and the slab top.

An underdrain is provided to drain the tree filter compartment into the outlet sump. Note that the tree filter tank will be constructed with a PVC coupler at the bottom of the baffle wall for quick underdrain connection in the field. During storm events, most of the initial infiltrated stormwater will bypass the underdrain and saturate the bedding layer through the bottom opening. Once inflow rates exceed the native soil infiltration rates, the underdrain layer will saturate and flow will begin discharging through the underdrain (and filling the sump compartment). The tree filter will then saturate to the depth of the outlet invert, which is based on the existing sewer depths. Regardless, at least 12–18 inches of the tree filter will freely drain and provide aerobic conditions immediately following the end of the storm event. After the storm event, the 18 inches of ponded sump water can slowly drain back through the underdrain and out the bottom of the tree filter based on the saturated infiltration rate of the native soil conditions. This underdrain configuration was provided to eliminate the nuisance of permanent standing water and anaerobic conditions in the sump compartment, although the underdrain component can be removed as a design alternative. Removal of the underdrain system from the standard design might be desirable as a means to reduce installation costs. This design alternative could also result in enhanced runoff reduction performance since the potential for discharge of filtered runoff into the combined sewer would be eliminated.

The surface opening for the tree trunk is located 2 feet 6 inches from the curb edge to allow a minimum of 3 feet of sidewalk width between the outer edge of the right-of-way and the tree trunk (assumes maximum trunk diameter of 12 inches and sidewalk corridor of 6 feet. The opening for the tree trunk uses a two-piece cast iron tree grate that can be replaced with various size openings as the tree grows.

As depicted in the section view below (Figure 3-2), other design components and features include the following (see Appendix A for a detailed design drawing):

1. **Filter Tank Components**
    a. 8-inch high x 18-inch wide curb inlet opening to tree filter
    b. 30-inch square tree grate with adjustable tree opening
    c. ASTM A48 manhole frame and cover
    d. Concrete baffle wall with overflow weir and underdrain coupler
    e. 24-inch maximum outlet opening (sited and cored by precast manufacturer) for site-specific culvert size and depth)
    f. Gross pollutants control device at outlet
2. **Bioretention Media Filter**
    a. Energy dissipation pad (salvaged concrete debris from catch basin demolition)
    b. 3-inch layer shredded hardwood mulch
    c. 2.5-foot bioretention media layer
    d. 2-inch washed sand “choking” layer (to prevent clogging of underdrain layer)
    e. 8-inch layer No. 8 drainage stone (with underdrain)
    f. 4-inch diameter perforated PVC underdrain (connected through baffle wall)
    g. 5-inch layer of No. 8 washed stone in open bottom
    h. 6-inch washed No. 57 stone bedding layer



Source: Tetra Tech, Inc.

Figure 3-2. Tree filter section view

3.2 Tree Selection

Conditions for tree establishment and growth within a tree filter are in many ways better than those experienced by trees elsewhere in urban areas, since the latter are often placed in areas of heavily compacted soil, constrained by subsurface infrastructure, or virtually covered by impervious surfaces. These conditions restrict the availability of space, nutrients, and water, all of which are necessary for tree vitality and growth. Tree filters, on the other hand, contain an engineered or customized media specifically tailored for plant growth as well as removal of stormwater pollutants. The routing of stormwater runoff into the tree filter similarly ensures the tree is provided with sufficient water and any entrained nutrients. As mentioned above, the media is designed to drain quickly so that anaerobic conditions within the root zone do not develop. Therefore, the primary limiting factors of tree filter systems are primarily spatial. Tree roots are constrained horizontally by the configuration of the filter area, approximately 5 feet by 6.5 feet, and might be limited vertically by the potential presence of underlying bedrock beneath the filter box.

The selection of tree species for incorporation into a tree filter must consider these conditions, as well as community preferences for urban trees. In addition, the selection of a tree species in a specific location should consider surrounding infrastructure and obstructions. These include adjacent structures, distance to signage, other trees, and, as commonly observed within the Birch Street catchment area, the presence of overhead utilities.

3.3 Stormwater Calculations

Instantaneous storage volumes were calculated for the standard tree filter design. Since the storage volume is fixed, the proportion of total drainage area water quality volume that is captured and treated by each tree filter will vary by site (although gross pollutants control will be provided for 100 percent of the runoff entering the tree filter). A more comprehensive and accurate estimate of runoff volume reduction will require in-situ soil infiltration data and long-term continuous simulation modeling using observed rainfall depths, durations, and frequencies. Such analysis could be provided as part of subsequent CSO mitigation efforts to evaluate the impact of the tree filter system relative to other CSO reduction methods.

The equation used to estimate the instantaneous storage volumes is based on the various media and aggregate volumes, assumed void ratios, and volume of surface ponding within the tree filter compartment. This is expressed by the equation below.

$$Storage\ Volume = \sum (V_r * V_m) * 7.48$$

Where storage volume is in gallons and:

V_r = voids ratio for each substrate

V_m = volume of each substrate (cubic feet)

Table 3-1 shows the calculated storage volumes for the standard tree filter design. Each tree filter system will provide nearly 750 gallons of hydraulic storage in a saturated fully utilized condition. This equates to almost 100 cubic feet of stormwater runoff for each tree filter system. The volume of storage is equivalent to the runoff expected from a 1,265-square foot (0.03-acre) impervious area during a 1-inch storm event, a widely accepted depth associated with water quality sizing.

Table 3-1. Instantaneous storage volumes for tree filter

Tree Filter Component	Depth (in)	Void Ratio	Storage Volume (gal)
Surface ponding	12	1.0	278
Bioretention media	30	0.25	174
Choking layer (ASTM C-33 sand)	2	0.50	23
Underdrain layer (No. 8 stone)	8	0.40	74
Open bottom fill (No. 8 stone)	5	0.40	31
Bedding layer (No. 57 stone)	6	0.45	168
Total Volume			**748**

3.4 Planning-Level Cost Estimate

Cost estimates for the standard tree filter design were assembled from quotes received from the precast manufacturer and product vendors, local bid summaries, and RSMeans estimates for standard materials (e.g., washed stone, concrete sand). Although it is anticipated the Community Utilities Department can perform the majority of tree filter installation, the cost estimate provided includes the labor, overhead, and material markup costs associated with installation by private contractors. Table 3-2 shows the itemized tree filter cost estimate, including the unit cost reference, material quantities, and overhead expenditures.

Table 3-2. Tree filter cost estimate

Item No.	Description	Reference	Quantity	Unit	Unit Cost	Total
Demolition/Earthwork						
1	Saw-cut cement sidewalk	Local bid summary[A]	12.0	LF	$4.80	$58
2	Saw-cut asphalt pavement	Local bid summary	22.5	LF	$3.20	$72
3	Remove curb and discard	Local bid summary	16.5	LF	$9.75	$161
4	Earth excavation	Local bid summary	36.7	CY	$21.50	$789
5	Backfill	Engineer’s opinion	20.4	CY	$8.50	$174
6	Bedding coarse (washed No. 57 stone)	RS Means	1.9	CY	$30.34	$56
7	Off-site hauling/disposal	Bid summary	18.0	TN	$83.50	$1,503
Precast Tank and Accessories						
8	10.5 ft x 6 ft x 5 ft Precast Tree Filter Tank[B]	Quote from J&R	1.0	EA	$2,800.00	$2,800
9	Custom coring for outlet pipe (12–24 in. dia.)	Quote from J&R	1.0	EA	$250.00	$250
10	26 in. x 4 in. manhole frame and cover	Quote from E.J.	1.0	EA	$331.46	$331
11	30" Square Tree Grate set w/ 16 in. dia. tree opening	Quote from E.J.	1.0	LS	$444.18	$444
12	Inner Tree Ring Grate Accessory (12–16 in. dia.)	Quote from E.J.	1.0	EA	$62.42	$62
13	30 in. Square Steel Tree Frame w/ anchor studs	Quote from E.J.	1.0	EA	$92.40	$92
14	Floatables control devices	Quote from E.J.	1.0	EA	$177.88	$178
Tree Filter						
11	Bioretention Media	RS Means	3.4	CY	$40.00	$138
12	No. 8 stone	RS Means	1.3	CY	$25.22	$33
13	Washed ASTM C-33 concrete sand	RS Means	0.2	CY	$68.29	$16
14	Washed No. 57 stone bedding for tank	RS Means	1.9	CY	$51.00	$94
15	4 in. SCH 40 perforated PVC	RS Means	6.0	LF	$13.76	$83
16	4 in. SCH 40 PVC	RS Means	4.0	LF	$6.00	$24
17	4 in. SCH 40 perforated PVC cleanout	Engineer’s opinion	1.0	EA	$100.00	$100
18	12–14 ft deciduous tree	Bid summary	1.0	EA	$800.00	$800
19	Triple shredded hardwood mulch	Engineer’s opinion	0.3	CY	$60.00	$21
Curb/Sidewalk/Asphalt Replacement						
20	Cement concrete sidewalk	Local bid summary	4.0	SY	$45.00	$180
21	Granite curb	Local bid summary	16.5	LF	$38.50	$635
22	Furnish and install aggregate base	Local bid summary	0.6	TN	$100.00	$60
23	Furnish and install aggregate sub-base	Local bid summary	1.2	TN	$120.00	$144
24	Furnish and install HMA 12.5 mm	Local bid summary	1.2	TN	$110.00	$132
Construction Subtotal						$9,429
25	Mobilization (5%)					$471
26	Bonds and Insurance (5%)					$471
27	Construction contingency (15%)					$1,414
Total Cost						**$11,786**

[A] unit costs based on summary of local bids provided by City

[B] Includes knockouts, underdrain pipe coupler, and delivery

3.5 Identified Catch Basin Retrofit Opportunities

As noted in Section 2.7, 12 existing catch basin locations were identified as priority candidates for replacement with the tree filter standard design. The 12 recommended retrofit locations and their respective drainage areas are shown in Figure 3-3. A detailed summary of locations is provided in Appendix B, including catchment and impervious area determination methods, sanitary sewer Node ID, adjacent street addresses, site map, and drainage area.

Source: Tetra Tech, Inc.

Figure 3-3. Recommended tree filter retrofit locations

The catch basins identified for retrofitting provide direct capture of over 16 acres of the Birch Street catchment area (i.e., 17 percent of the total 94-acre catchment). The drainage area to each of the 12 sites (Table 3-3) exceeds, in some cases by significant amounts, the drainage area that would result in complete utilization of the inherent storage volume of the filter during a 1-inch storm without overtopping or bypass. However, due to the dynamic nature of rainfall events, tree filter retrofits at these locations would likely provide reductions of flow rate during all storm events due to recharge through the filter bottom and detention storage inherent to the design. Likewise, during smaller storm events the tree filter would provide treatment and removal of stormwater contaminants through filtration of the media. In the event of future sewer separation, these practices would then serve to reduce pollutant loading from stormwater sources to Mount Hope Bay.

Table 3-3. Catch basin retrofit site characteristics

Site #	Drainage Area (ac)	Impervious Area (ac)	% Impervious
1	1.71	0.67	39.2
2	0.88	0.35	39.4
3	2.89	1.02	35.2
4	0.65	0.25	38.2
5	1.37	0.44	32.2
6	0.71	0.37	51.3
7	1.03	0.72	69.9
8	0.72	0.40	55.6
9	2.22	1.01	45.5
10	2.06	0.86	42.0
11	2.21	0.43	19.6
12	0.51	0.36	70.1
Total	**16.96**	**6.88**	**NA**

Additional information on specific catch basin geometries (e.g., outlet diameter and invert, bottom invert) and presence/location of utility service lines to adjacent residences was not available at the time of this report. As a result, more detailed conceptual design development was not possible for these retrofit locations. The standard tree filter design, however, has been developed to be suitable for the conditions observed at these sites. As additional site-specific information becomes available for these sites, the Fall River Community Utilities Department might further develop site specific implementation plans for the tree filters, including necessary utility relocations, infrastructure inverts, combined sewer tie-in conditions, and incorporation of sidewalk infrastructure.

3.6 Tree Filter Assessment Summary

Through adoption of a proposed tree filter standard design, the City of Fall River will add to its existing suite of tools for addressing the issue of continued CSOs to Mount Hope Bay. Prioritized implementation at the 12 identified retrofit locations within the pilot area will further provide the City with an example of how ongoing repair of existing infrastructure can incorporate green infrastructure principles to both meet local water quality needs and enhance ongoing tree initiatives. These efforts, when combined with other programmatic initiatives described below, will serve as a framework to expand green infrastructure efforts throughout the City.

4 Rain Barrel Incentive Program Options for Fall River

The City currently manages a stormwater service fee credit program to incentivize the reduction of stormwater. The current program only authorizes commercial properties to apply for credits, and credits cannot exceed 25 percent of the total fee ($140/2,800 square feet per year). The City requested a framework outlining the program revisions necessary to authorize a simple residential incentive program that would allow use of rain barrels to generate stormwater utility fee credits. City staff were only interested in incentivizing rain barrels to generate initial interest from residents. Additional credit options could be authorized in the future if there is adequate participation in the rain barrel program.

Based on input from City staff, the design team is proposing the following revisions to the City's existing stormwater credit incentive program. The proposed framework includes residential eligibility criteria, an application process, maintenance obligations, and code revisions necessary to authorize the rain barrel incentive program.

4.1 Proposed Rain Barrel Program Eligibility & Guidelines

- Eligibility is limited to residential homes only.
- Applicant must own the home and be in good financial standing with the City of Fall River.
- Rain barrels must be either the manufactured device preferred by the City or a similar model as approved by the City. See Table 4-1. for rain barrel options/types.
- Rain barrels must be installed prior to applying for the utility credit.
- Fifty percent of the property's roof drainage area must be connected to rain barrels and provide at least 50 gallons of storage per downspout.

4.2 Application Process

- The City will issue a credit of up to $75 per household. This credit will be applied to the first two quarters of utility fee after installation of the rain barrel.
- After the initial $75 installation credit, a credit of $2 per quarter will be earned as long as a rain barrel is on the property and functioning properly.
- Registration in the program will require the submittal of a simple application form and documentation that the barrel has been purchased and installed. A copy of the receipt for purchase and photo documentation of installation will be required.
- Completed applications must be submitted to the City of Fall River within 90 days of purchase of the rain barrel.
- The application form will include several statements to certify that:
    - The property owner will maintain the barrel properly.
    - The rain barrel will remain on the property for the life of the barrel and that if it fails to function it will be replaced in order to continue to get the credit.
    - The fee credit can be transferred to new property owners should the property be sold.
    - The owner must notify the City if the rain barrel is permanently disconnected for revocation of the credit.

Table 4-1. Rain barrel comparison matrix

Type	Price	Size	Installation	Use	Aesthetics	Shape	Warranty	Materials
Big Blue	$90	55 gal.; 35 in x 22.4 in	Moderate; does not include gutter diverter (sold separately). Must install spigot and overflow fittings.	Removable lid, but not screw top. One overflow or connector located halfway up barrel. Would not need stand if used middle valve for spigot.	Only comes in blue	Round	1 year	Food grade repurposed; brass spigot
FreeGarden RAIN **Enviro World Rain Barrel**	$80	55 gal.; 33 in x 24 in	Easy; must screw in spigot and screw on top with four screws.	Removable lid. Two overflow connectors or either side located at top of container. Do not need stand due to location of spigot	Only comes in white	Square to fit against house or in corner	1 year	Plastic, brass spigot
Barrel with Brass Spigot	$95	50 gal.	Easy; must screw in spigot and insert screen in top.	Unknown if lid removable. Two overflow connectors at top of barrel. Spigot located at bottom of barrel so would likely need a stand for proper flow.	Brown, looks like wooden barrel	Flat back to go against house	1 year	Polyethylene

4.3 Rain Barrel Distribution

Based on input from City staff, the preferred method of rain barrel distribution is requiring residents to independently purchase a rain barrel preferred by the City. However, if the City should decide in the future to implement a centralized rain barrel initiative and public education program, there are a number of organizations that can administer rain barrel sales for local governments (e.g., the Great American Rain Barrel Company (TGARB) located in Hyde Park, Massachusetts).

4.4 Code Revisions

The design team reviewed the City's municipal code and recommends several changes be made to authorize the proposed residential rain barrel program, as well as any similar incentive program which might be implemented in the future.

The existing regulations do not authorize residential property owners to qualify for a credit, they put a restriction on the amount of credit a property owner can receive, and they include confusing relevant definitions. The proposed revisions will allow for residential properties to earn the credit and allow for the credit to exceed 25 percent of the total charge (which will be the case for the first two quarters of the credit application). Further, the revisions remove the term *facility* from the definition of the term *credit*, as *stormwater facility* is defined later in the same section in a way that is not appropriate in understanding the term *credit*; the definition of *stormwater facility* includes combined sewers, catch basins, storm drains, drainage pipes, and a variety of other structures and stormwater control measures.

The following text provides the proposed underline/strikeout revisions proposed for the City's municipal code.

Section 74-140 Stormwater Fee

> (3) *Definitions*.
>
> …
>
> *Credit*. Credit shall mean a conditional reduction in the amount of the stormwater service fee to an individual property based on the provision and continuing presence of an effectively maintained and operational City-approved on-site stormwater management system ~~or facility~~ or other service or activity that reduces the stormwater management utility's cost of providing services.
>
> ~~Credits can be applied as follows at the discretion of the sewer commission: Credits shall not be eligible below the base ERU, meaning that any property that is subject to this fee shall be required to pay at least the cost of one ERU per quarter. As residential properties (single through eight family) pay the lowest possible cost credits are not available.~~
>
> ~~Credit shall not exceed 25 percent of the total charge.~~
>
> Credit requests filed after June 30 of any year shall not be applicable to the previous fiscal year(s).

5 Conclusion

Like many New England industrial cities with aging infrastructure and uncertain economies, the City of Fall River is faced with the challenge of maintaining existing utility services with limited resources. In addition, the City is under a Federal Court Order to reduce CSOs. Although the City has committed significant resources to address these issues, problem areas remain. Through the adoption of the green infrastructure program elements described above, however, the City can leverage existing programs and initiatives in a manner to mitigate some CSOs in the pilot Birch Street catchment area. Upon completion of potential future sewer separation projects currently planned for the Birch Street catchment, green infrastructure elements will then serve to further protect the water quality of Mount Hope Bay by reduction and treatment of stormwater prior to discharge directly to Mount Hope Bay. Furthermore, the adoption of tree filters in Fall River would serve three critical functions: (1) replace failing infrastructure, (2) reduce stormwater contribution to combined sewers, and (3) facilitate implementation of trees with street right-of-way to support Fall River's urban tree initiatives.

The Birch Street catchment area pilot program presents an opportunity to exhibit how green infrastructure practices can integrate into existing infrastructure. The pilot area is representative of typical residential neighborhoods and serves as a template for more widespread adoption in the other CSO areas throughout Fall River and elsewhere in the region. Implementation of the green infrastructure practices (tree filter retrofits in the pilot program and residential rain barrel distribution citywide) will demonstrate to residents, City staff, elected officials, and other interested stakeholders how green infrastructure functions and can provide multiple benefits to the community.

6 References

CDM Smith. 2012. CSO Abatement Program City of Fall River Massachusetts. CSO Control Plan and Program Update Report. Providence, RI.

MassDEP (Massachusetts Department of Environmental Protection). 2010. *Final Pathogen TMDL for the Narragansett/Mt. Hope Bay Watershed*. CN#351.0, Report #61 – TMDL -2. Massachusetts Department of Environmental Protection, Division of Watershed Management, Boston, MA. Available online at: *http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/narrmthb.pdf*.

RIDEM (Rhode Island Department of Environmental Management). 2010. *Total Maximum Daily Load Study for Bacteria: Mount Hope Bay and the Kickemuit River Estuary*. Rhode Island Department of Environmental Management, Office of Water Resources, Surface Water Protection Section, Providence, RI. Available online at:
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University of New Hampshire. 2007. *University of New Hampshire Stormwater Center: 2007 Annual Report*. University of New Hampshire, Durham, NH.

Appendix A: Tree Filter Standard Design

CITY/TOWN
STREET/ROUTE # OR NAME

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	4	X
PROJECT FILE NO. XXXXXX			

UTILITY SKETCH PLAN

Plotted on 10-Jun-2015 12:31 PM

TREE_FILTER_DETAIL_V3.DWG

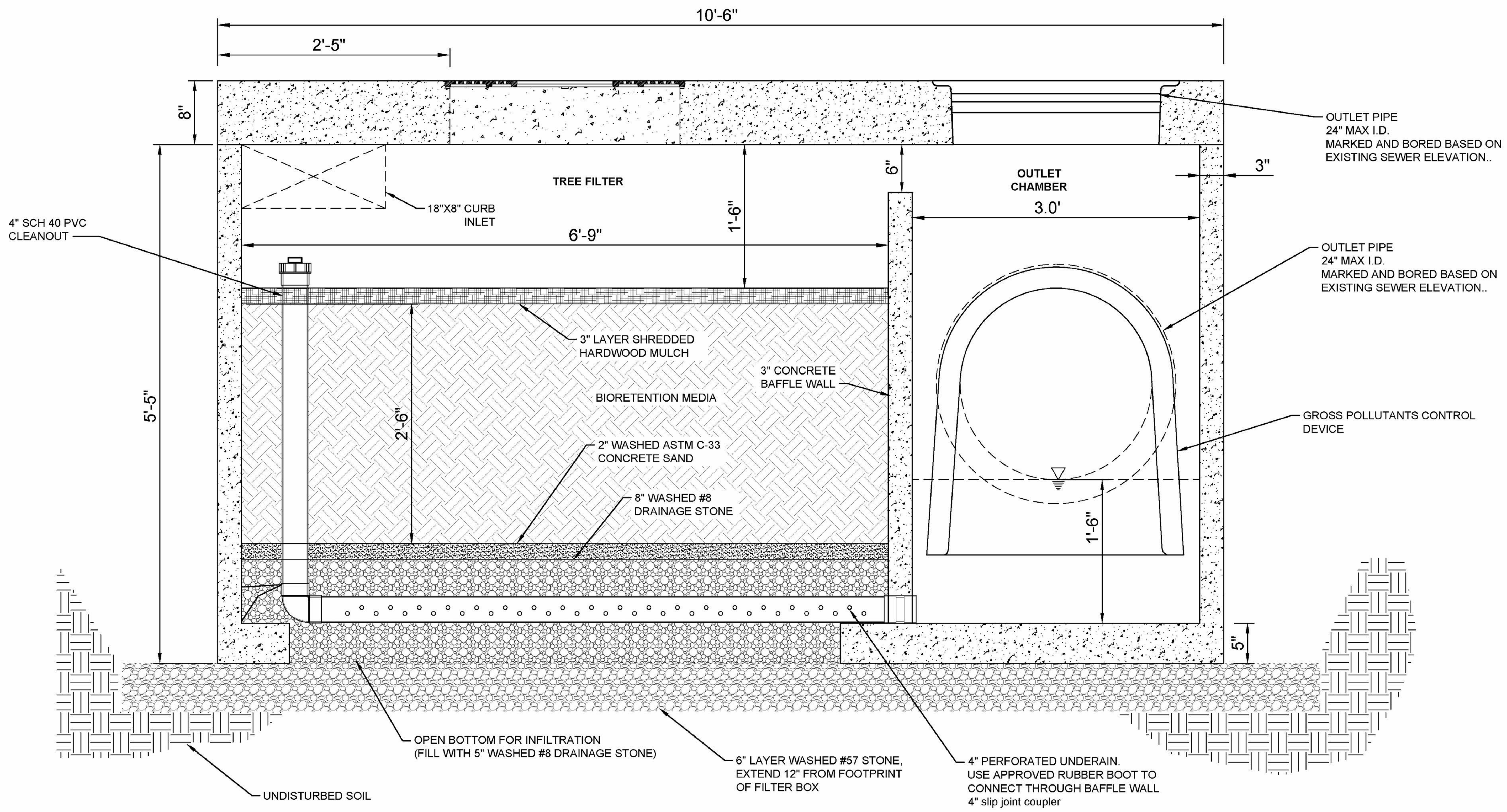
RECOMMENDED TREE LIST

Common Name	Botanical Name
Crabapple	*Malus spp.*
Dogwood	*Cornus spp.*
Hawthorn (thornless variety)	*Crataegus spp.*
Japanese Tree Lilac	*Syringa reticulate*
Cherry Plum	*Prunus cerasifera*
Serviceberry (single stem)	*Amelanchier spp.*

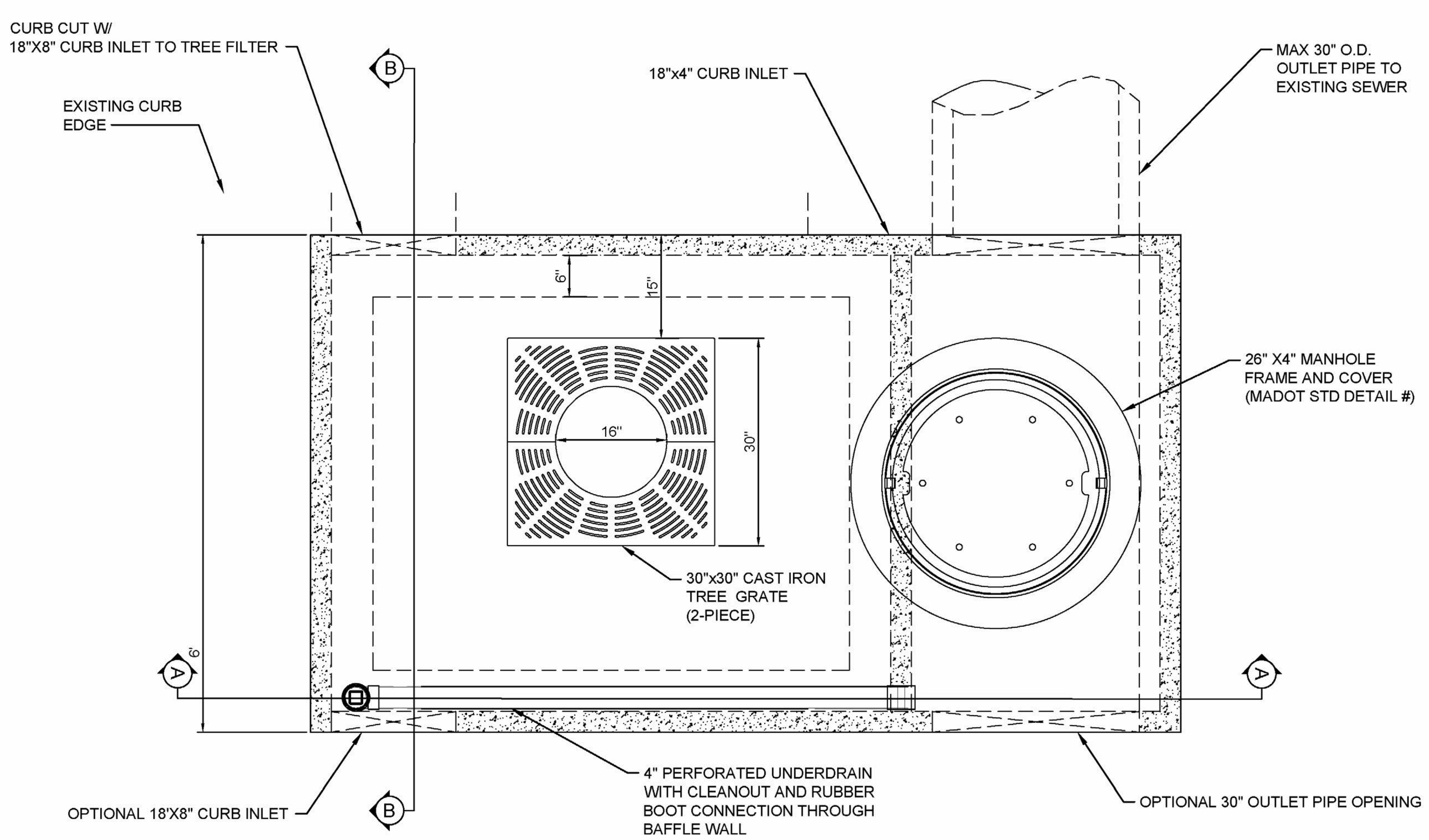
BIORETENTION MEDIA SPECIFICATION

BSM Composition	Sand	Sandy Loam			Compost
		Sand	Silt	Clay	
Volume	65%	20%			15%
Weight	75–80%		10% max.	3% max.	9% max.[1]

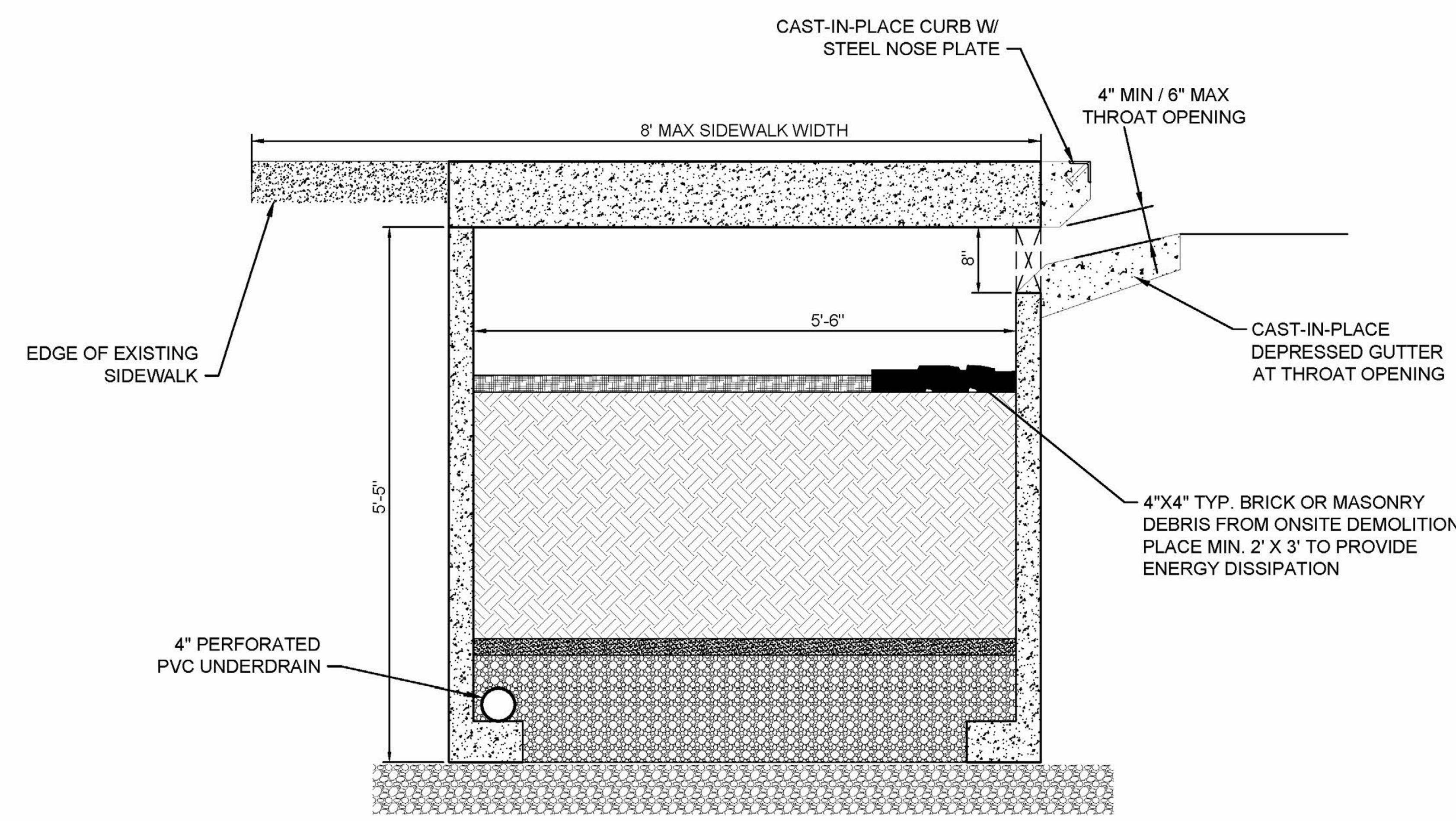
[1] compost by weight results in approximately 5% organic matter by weight.



SECTION A-A



PLAN VIEW



SECTION B-B

PREPARED BY:

REVISIONS		
REV.	COMMENTS	DATE

SCALE: XX FEET TO THE INCH

FILE NAME: TREE_FILTER_DETAIL_V3.DWG

FIELD BOOK. NO: XXXX

DISTRICT (X) UTILITY ENGINEER: XXXXXX

FIELD CHIEF: XXXXX PARS. NO: XXXXXXX

STREET/ROUTE # OR NAME

(TOWN/CITY NAME)

BASED OFF % SUBMISSION

PROJECT #

DATE: MONTH DD, YEAR

SHEET OF X

Appendix B: Tree Filter Retrofit Location Summary

Appendix B: Priority Tree Filter Retrofit Locations

1.1 Overview

During field investigations of the Birch Street catchment area, a feasibility determination was conducted on each of the 58 existing catch basins connected to the combined sewer system to assess whether a tree filter may be appropriate at a given basin. The field determination consisted of a physical site visit to each catch basin for visual evaluation of potential conflicts with replacement of the existing catch basin by the proposed tree filter structure. A variety of potential conflicts were observed and ranged from significant to minor. Significant conflicts included conditions that made a retrofit impossible or would carry significant costs. An example of a significant conflict is a catch basin immediately adjacent to a building or critical infrastructure that would likely be damaged during retrofit operations or require expensive relocation. Minor conflicts included those that would result in relatively small impacts to adjacent infrastructure or result in low-cost relocation. An example off a minor conflict is the presence of a street sign within the retrofit footprint. All 58 of the potential sites exhibited some form of potential conflict; some minor, some significant, or some a combination of the two.

1.2 Priority Tree Filter Retrofit Site Index

The project team conducted a review of the site evaluations and prioritized 12 catch basins in which conflicts were generally minor. These locations (shown in Figure B-1) are recommended for retrofit with the tree filter standard design in accordance with implementation schedule to be determined by Fall River.

Source: Tetra Tech, Inc.

Figure B-1. Prioritized tree filter retrofit locations within the Birch Street catchment area

Contributing drainage area for each priority retrofit site was approximated in ArcGIS using 2 foot contour data and aerial imagery. Summary information on the twelve prioritized tree filter retrofit locations is provided in Table B-1. The 12 sites are not presented in any specific order. It is understood that the City of Fall River wishes to retrofit tree filter systems as the existing catch basins require repair or replacement.

Table B-1. Summary of prioritized tree filter retrofit locations

Site Visit ID	Sanitary Sewer Node ID	Drainage Area (acres)	Adjacent Parcel ID	Adjacent Parcel Address
1	CB_242	1.71	B-11-1	455 Dwelly Street
2	CB_3202	0.88	H-15-35	185 Dwelly Street
3	CB_231	2.89	B-12-17	433 Slade Street
4	CB_34	0.65	A-1-2	King Philip Street
5	CB_16	1.37	A-1-2	King Philip Street
6	CB_12	0.71	A-2-43	199 King Philip Street
7	CB_3085	1.03	A-3-1	Bay Street
8	CB_3631	0.72	A-3-1	Bay Street
9	CB_18	2.22	A-1-17	450 Charles Street
10	CB_20	2.06	B-7-46	508 Bowen Street
11	CB_218	2.21	A-1-1	335 Birch Street
12	CB_241	0.51	H-14-38	425 Dwelly Street

1.2.1 Tree Filter Site 1

Source: Tetra Tech, Inc.

Figure B-2. Map of retrofit site 1 drainage area

Photo credit: Tetra Tech, Inc.

Figure B-3. Site 1 is located at the intersection of Dwelly and King Streets

Photo credit: Tetra Tech, Inc.

Figure B-4. Site 1 does not exhibit significant nearby structures or overhead utilities

Photo credit: Tetra Tech, Inc.

Figure B-5. The existing inlet type for site 1 is a Bradley

1.2.2 Tree Filter Site 2

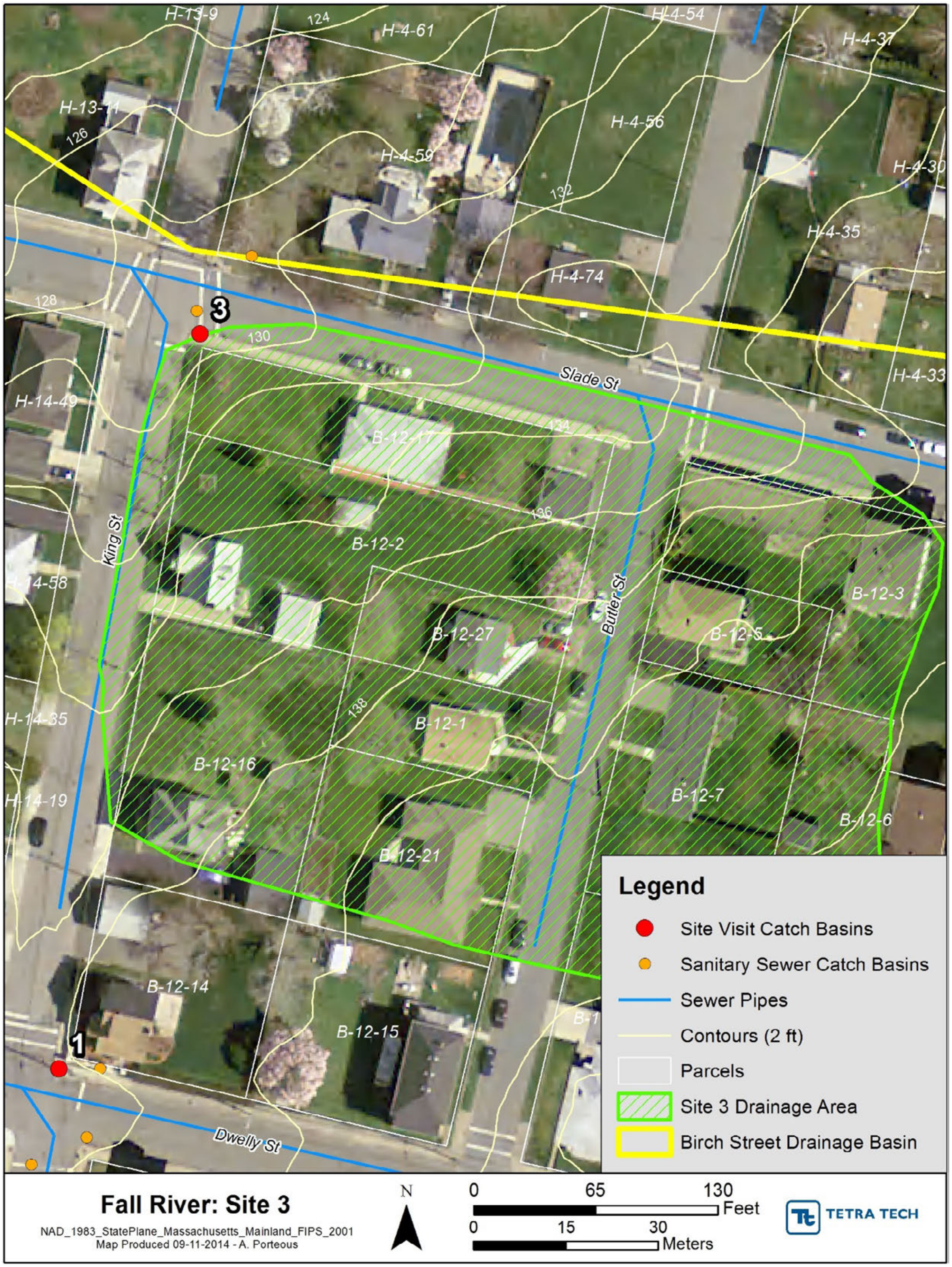
Source: Tetra Tech, Inc.

Figure B-6. Map of retrofit site 2 drainage area

Photo credit: Tetra Tech, Inc.

Figure B-7. Site 2 is located away from infrastructure and overhead utilities

1.2.3 Tree Filter Site 3



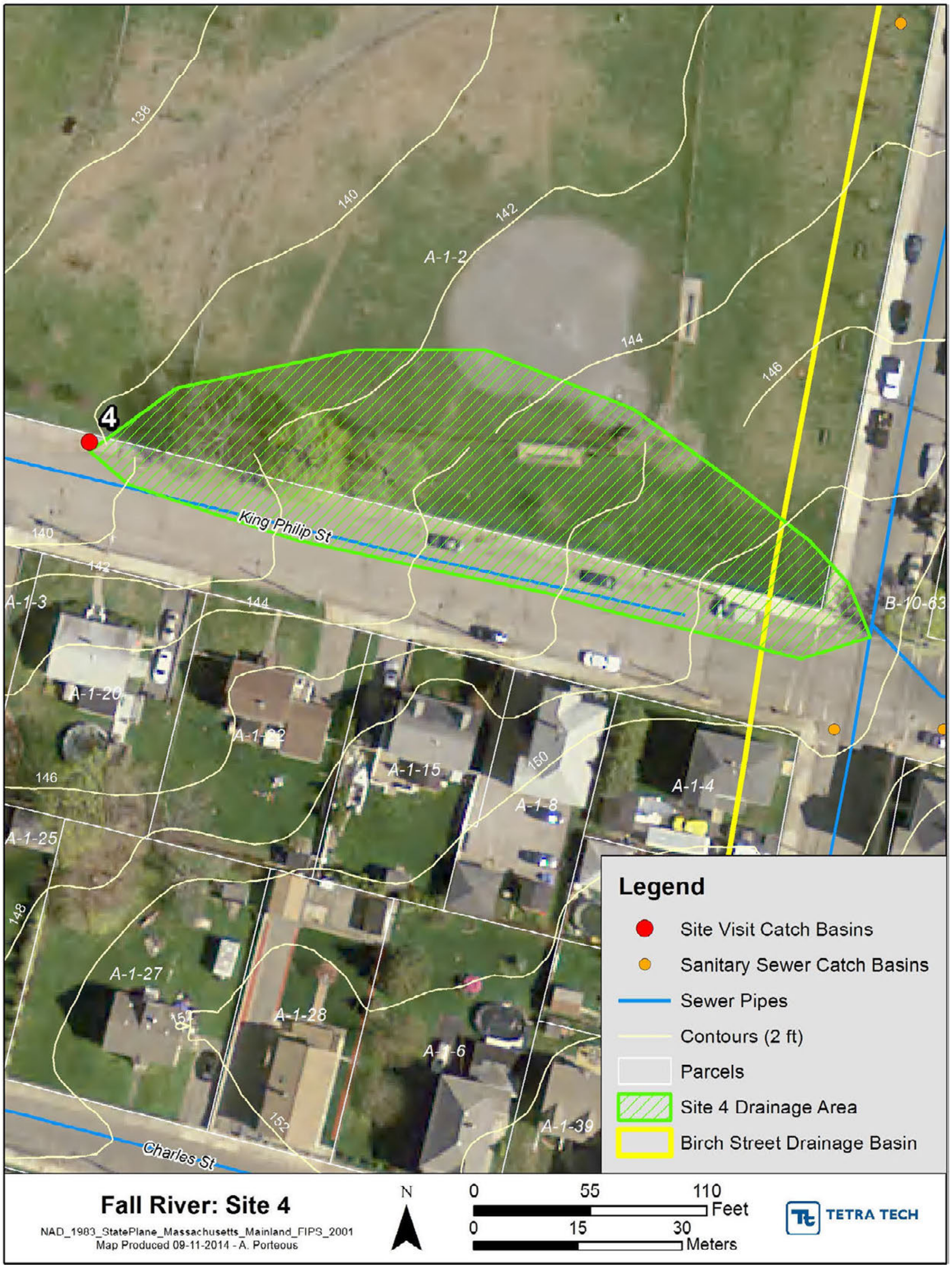
Source: Tetra Tech, Inc.

Figure B-8. Map of retrofit site 3 drainage area

Photo credit: Tetra Tech, Inc.

Figure B-9. Site 3 is located at the intersection of Slade and King Street

1.2.4 Tree Filter Site 4



Source: Tetra Tech, Inc.

Figure B-10. Map of retrofit site 4 drainage area

Photo credit: Tetra Tech, Inc.

Figure B-11. Site 4 is located adjacent to a large park

1.2.5 Tree Filter Site 5

Source: Tetra Tech, Inc.

Figure B-12. Map of retrofit site 5 drainage area

Photo credit: Tetra Tech, Inc.

Figure B-13. Site 5 is also located adjacent to a large park

1.2.6 Tree Filter Site 6

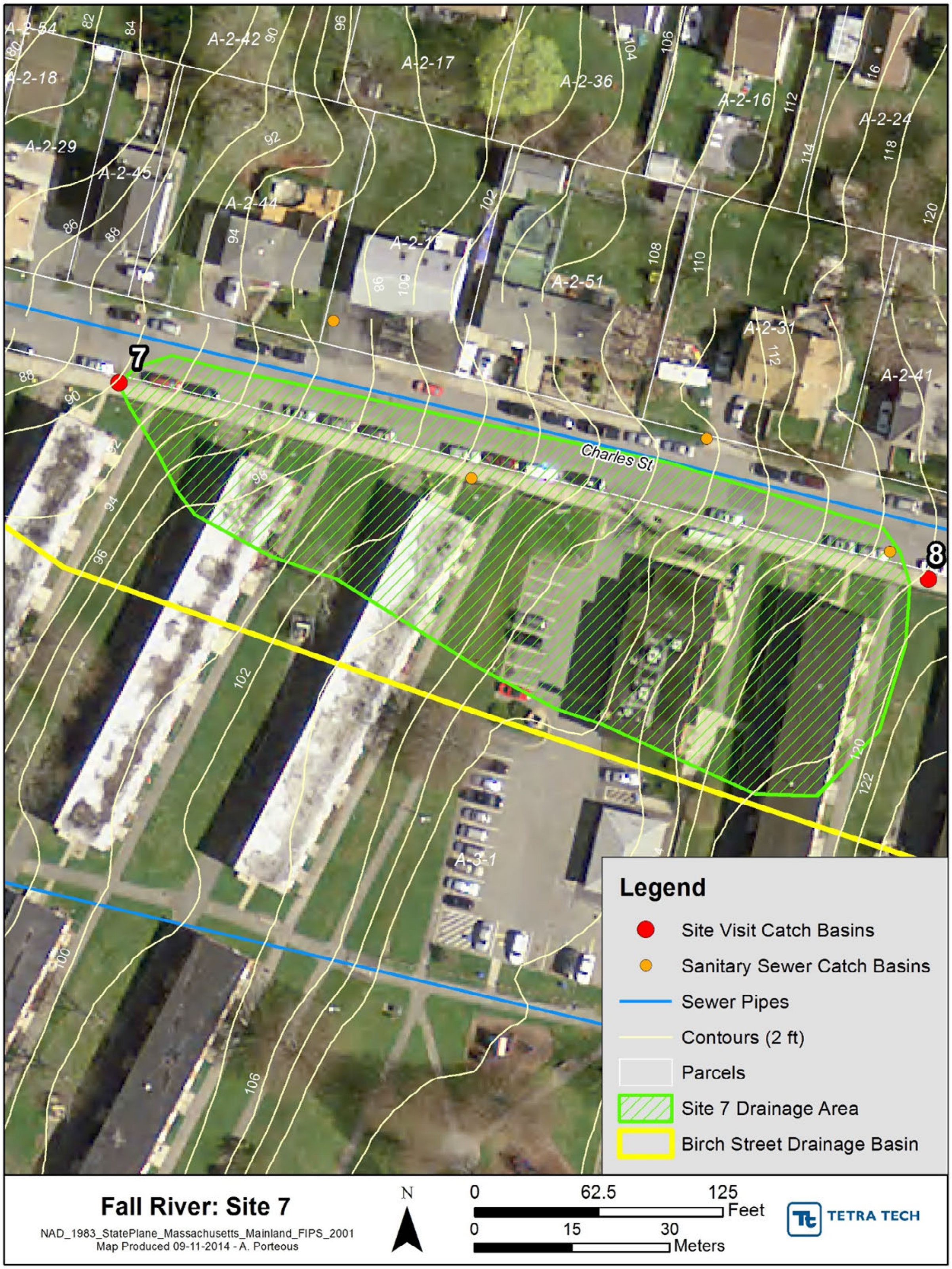
Source: Tetra Tech, Inc.

Figure B-14. Map of retrofit site 6 drainage area

Photo credit: Google Streetview

Figure B-15. Site 6 is located at the bottom of a slope along King Phillip Street

1.2.7 Tree Filter Site 7



Source: Tetra Tech, Inc.

Figure B-16. Map of retrofit site 7 drainage area

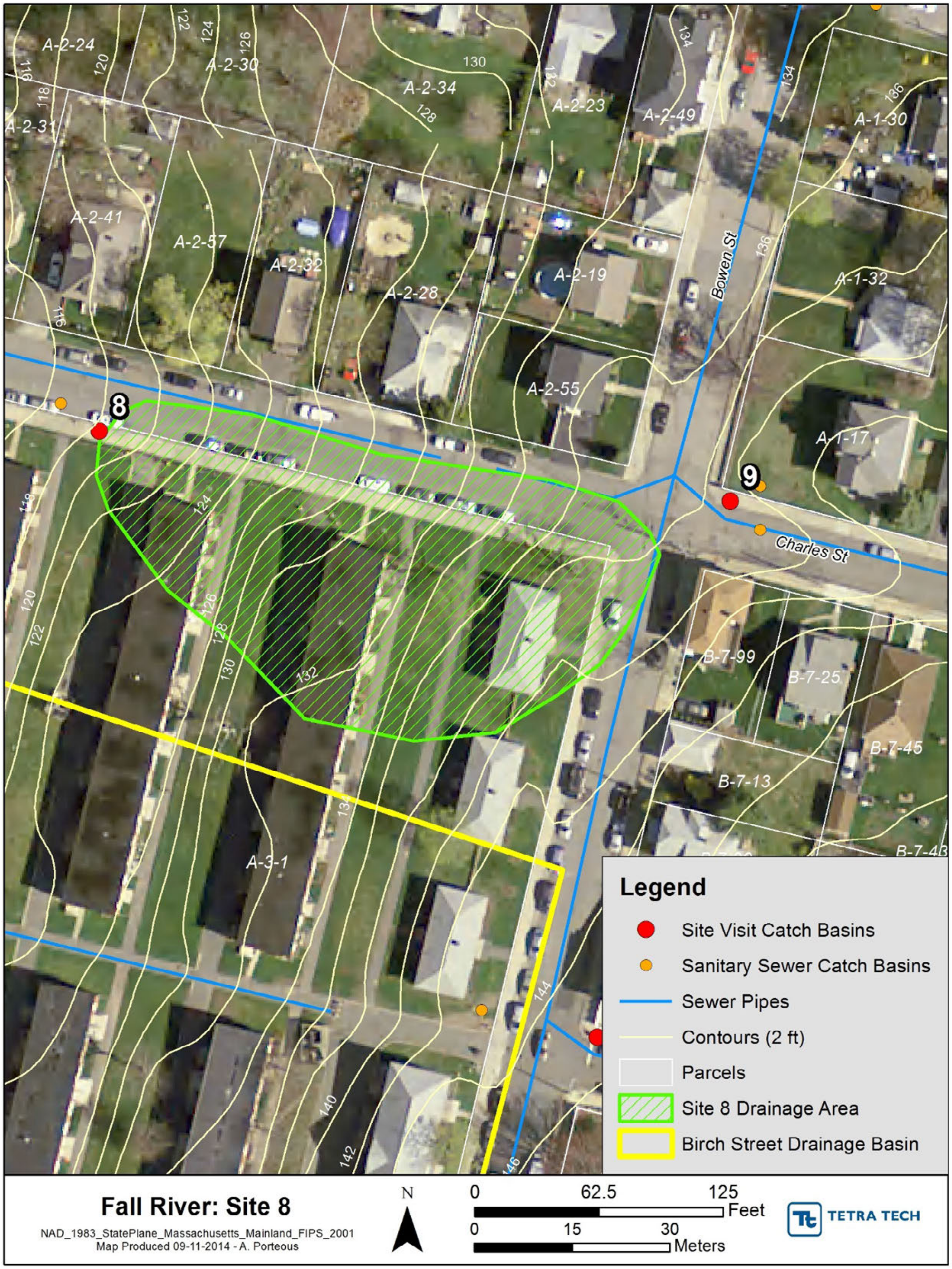
Photo credit: Tetra Tech, Inc.

Figure B-17. Crumbling sidewalk around site 7

Photo credit: Tetra Tech, Inc.

Figure B-18. Site 7 is located adjacent to multifamily housing

1.2.8 Tree Filter Site 8



Source: Tetra Tech, Inc.

Figure B-19. Map of retrofit site 8 drainage area

Photo credit: Tetra Tech, Inc.

Figure B-20. Crumbling sidewalk at site 8

Photo credit: Tetra Tech, Inc.

Figure B-21. No significant or minor conflicts at site 8

1.2.9 Tree Filter Site 9

Source: Tetra Tech, Inc.

Figure B-22. Map of retrofit site 9 drainage area

Photo credit: Tetra Tech, Inc.

Figure B-23. Site 9 is located at the intersection of Bowen and Charles Streets

Photo credit: Tetra Tech, Inc.

Figure B-24. Site 9 exhibits no adjacent structural conflicts

1.2.10 Tree Filter Site 10

Source: Tetra Tech, Inc.

Figure B-25. Map of retrofit site 10 drainage area

Photo credit: Tetra Tech, Inc.

Figure B-26. Site 10 is located at the intersection of Penn and Bowen Streets

Photo credit: Tetra Tech, Inc.

Figure B-27. An existing stop sign will need to be relocated

1.2.11 Tree Filter Site 11

Source: Tetra Tech, Inc.

Figure B-28. Map of retrofit site 11 drainage area

Photo credit: Tetra Tech, Inc.

Figure B-29. An aging tree at site 11 will need to be removed

1.2.12 Tree Filter Site 12

Source: Tetra Tech, Inc.

Figure B-30. Map of retrofit site 11 drainage area

Photo credit: Tetra Tech, Inc.

Figure B-31. This crosswalk at site 12 may need to be relocated

Appendix C: Tree Filter Fact Sheet

Stormwater Tree Filter

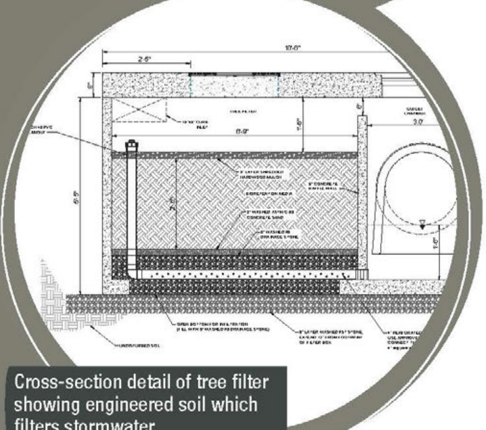
What is a Tree Filter?

Tree filters are stormwater catch basins which incorporate a planting chamber containing a specially engineered soil which filters stormwater runoff to remove pollutants. The chamber holding the soil is sized so that it can accommodate a tree or shrub enhancing the filtering of the soil while also improving street aesthetics and providing shade. Tree filters are an important tool for the City of Fall River to reduce the environmental impact of stormwater runoff and protect Mt. Hope Bay while incorporating trees along the roadways.

Artist's rendering of tree filter installation

How are they installed?

Tree filters are designed to fit within the existing street corridor specifically between the curb edge and the outer edge of the right of way replacing existing catch basins. During installation heavy equipment is used to remove the existing catch basin and portions of the existing sidewalk and street surface. Once a tree filter is installed these features are replaced retaining roadway and pedestrian functions.



Cross-section detail of tree filter showing engineered soil which filters stormwater

What trees can be planted?

Trees used in tree filters should be capable of thriving in the urban environment along city streets. They should be size limiting so that their root systems do not exceed the space available within the filter chamber and they should be hardy to the stormwater flow and pollutants which flow through the filter. The following is a list of trees which have been identified as meeting these criteria which are available in Fall River.

- Crabapple
- Dogwood
- Hawthorne
- Japanese Tree Lilac
- Cherry Plum
- Service Berry (single stem)

How are they maintained?

Like any landscape feature tree filters require ongoing maintenance to ensure that the tree is provided with a healthy growing. This includes checking the tree for illness or nutrient deficiencies and if needed pruning to remove dead of diseased limbs. Additionally since tree filters capture debris and sediment carried by stormwater runoff these items must be removed from time to time to ensure that the filters continue to function. This requires removal of the metal grate around the tree trunk and using a vacuum truck to remove collected debris. Additionally it may be necessary to replenish the layer of mulch on top of the engineered soil.