Needham MA

Watershed No. 2

Walker Pond Area

September 2023

WATERSHED ANALYSIS REPORT

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WATERSHED ANALYSIS REPORT

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Prepared for: Town of Needham

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1.0 PURPOSE

The Town has developed a watershed management program outlined in the ***2018 Watershed Management Plan*** (***WMP***) focusing on the development and implementation of stormwater improvement projects to address water quality, manage stormwater flows and maintain the Town's stormwater system. The program follows both general and subwatershed specific methodology and is used in capital improvements planning and to meet the requirements of the 2016 Massachusetts Municipal Separate Storm Sewer System (MS4) Permit, "the Permit", effective July 1, 2018. As required to meet the terms and conditions of the Permit, a Stormwater Management Plan (SWMP) was developed with the following minimum control measures:

1) A public education program in order to change public behavior causing stormwater pollution,
2) An opportunity for the public to participate in and provide comments on the stormwater program,
3) A program to effectively find and eliminate illicit discharges within the MS4,
4) A program to effectively control construction site stormwater discharges to the MS4,
5) A program to ensure that stormwater from development projects entering the MS4 is adequately controlled by the construction of stormwater controls, and
6) A good housekeeping program to ensure that stormwater pollution sources on municipal properties and from municipal operations are minimized.

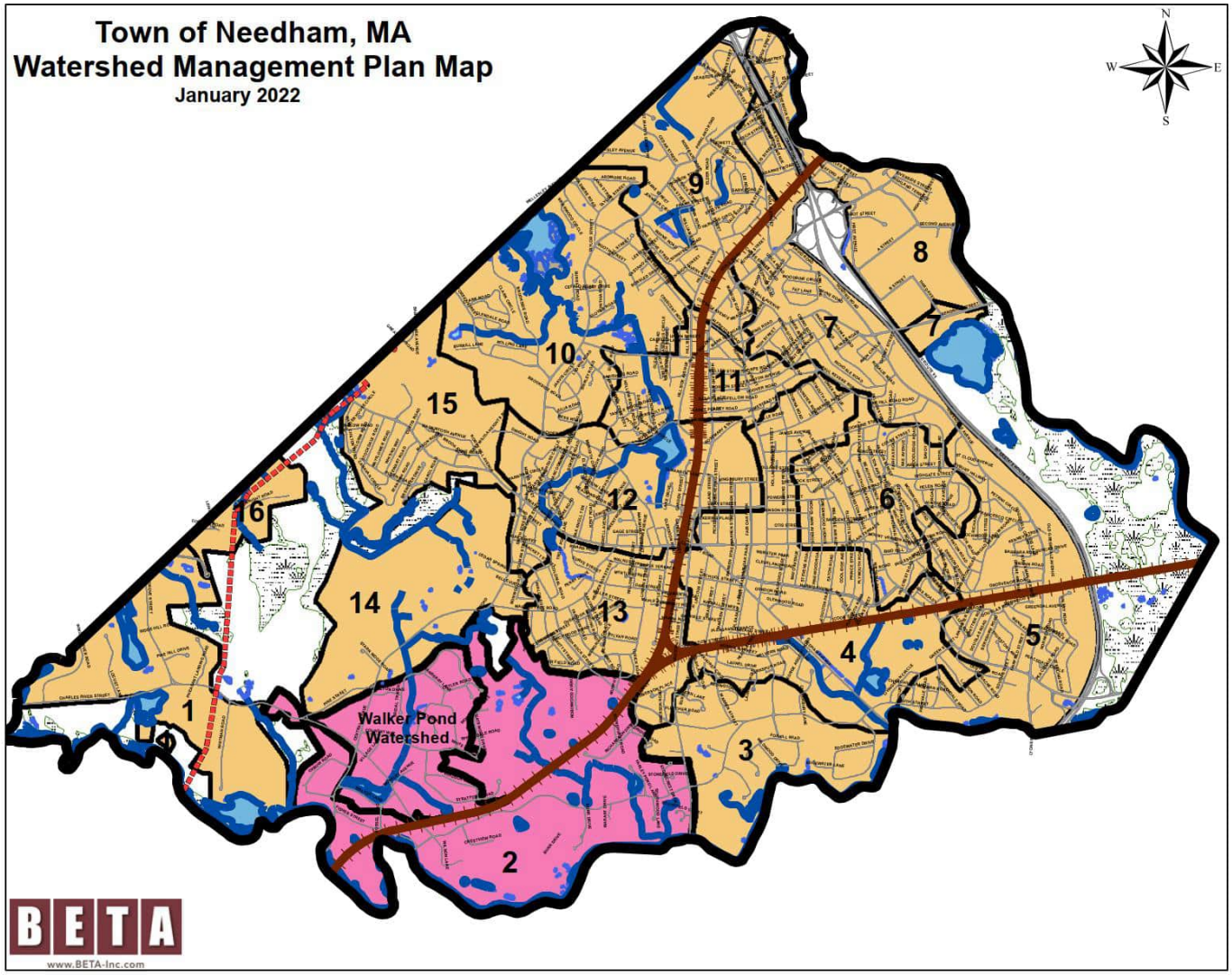
In addition to these six elements, the entire Town is within the Charles River Watershed which adds a requirement for development of a Phosphorus Control Plan (PCP), including: evaluating the sources of phosphorus, recommending the inclusion of best management practices (BMPs), and documenting the required reduction of phosphorus loads to the Charles River.

The goal of the Town's watershed management program is to tailor the requirements of the Permit and watershed management techniques to individual watersheds. The purpose of this report is to summarize watershed specific analysis and recommendations for Watershed No. 2 in Needham's Watershed Management Plan.

2.0 INTRODUCTION

The ***2018 WMP*** divided the Town into 16 watersheds based on topographic and drainage infrastructure delineation and prioritized the watersheds based on several metrics. This analysis focuses on Watershed No 2 which is located in the south of Needham along the Charles River. The watershed is approximately 954 acres with over 110 acres of impervious area including buildings, driveways, streets and parking lots. The watershed is primarily low density residential and is bi-sected by the Bay Colony Rail Trail. The neighborhoods have piped stormwater infrastructure including more than 460 catch basins and over 33,800 feet of storm drain pipe. Other than residential, the area has a significant amount of floodplain (134 acres) and wetlands (112 acres). Notable land use includes Walker Pond and Walker Gordon Fields, Farley Pond Reservation and the Town Forest. NRCS soils mapping identified less than half of the watershed area with well-draining soils conducive for infiltration. **Figure 2-1** is a map of the Town's watershed areas with Watershed No. 2 highlighted. A detailed map of Watershed No. 2 highlighting characteristics for analysis can be found in **Appendix A**.

Figure 2-1: Needham's Watersheds



3.0 LOCAL DRAINAGE/FLOODING ISSUES

3.1 HISTORY OF FLOODING

The ***2018 WMP*** identified two areas in Watershed No. 2 as having a history of flooding: Oxbow Road neighborhood and a short section of Country Way opposite Scott Road.

3.1.1 OXBOW ROAD NEIGHBORHOOD

As part of the 2002 Stormwater Master Plan, the Oxbow Road neighborhood drainage system was modeled. The conclusion was that the system was of sufficient size relative to its drainage area. However, Walker Gordon Pond outlet flow is routed through this system and flooding occurs in locations where there is surcharge from the combined flows. Past reports found the outlet structure typically becomes clogged with debris which causes the pond to fill beyond the design elevation. The overflow of the pond causes flooding at Walker Pond and at adjacent properties and roadways. It also negatively impacts the Oxbow Road drainage system.

Consistent with the 2002 report, BETA recommends retro fitting and/or constructing a new outlet control structure with a trash rack and providing a direct piped connection to the Charles River, bypassing the Oxbow Road neighborhood.

3.1.2 COUNTRY WAY AT SCOTT ROAD

Properties within Watershed No. 2 identified in the inventory of *September 1, 2013 Flash Flood/List of Impacted* compiled by the Town included 150 Country Way. The flooding, as reported, impacted the yard and small portion of garage due to water runoff from the neighbor's property (156 Country Way).

The homeowner of 150 Country Way was advised to re-grade the backyard to prevent ponding and to allow the water to flow naturally toward the wetland area. The Town also proposed to raise the driveway apron two (2) inches and install a double catch basin between the two driveways.

BETA has field verified the two catch basins on Scott Road connect to the catch basins in front of 156 Country Way. BETA also confirmed that between 150 and 156 Country Way, there is a single catch basin. If there is still additional flooding from street runoff, BETA recommends that the Town install the double catch basin as was recommended in the 2013 report.

4.0 PUBLIC EDUCATION

4.1 OBJECTIVE AND REQUIREMENTS

The objective of the education program is to increase the public's knowledge on stormwater issues of significance, with the goal to change their behavior to reduce the pollutants in stormwater.

The Town-wide education program to meet the requirements of the MS4 permit includes the following messages that will reach audiences within Watershed No. 2:

1. Educational stormwater messages focused on topics most relevant to the community, a minimum of twice over the five (5) year permit term to each of the following audiences:
    a. Residents;
    b. Businesses, institutions (churches, hospitals), and commercial facilities;
    c. Developers (construction);
    d. Industrial facilities.

4.2 WATERSHED SPECIFIC EDUCATION MESSAGES

The land use for Watershed No. 2 is almost entirely residential or open space. The Charles River (Segment MA72-06) is the receiving water for this watershed and is impaired by nutrients including a total maximum daily load (TMDL) for phosphorus. The following messages have been developed to target this audience and impairment.

4.2.1 PAMPHLETS

Three messages were generated to provide education to local residents and businesses:

1. A tri-fold educational pamphlet was developed and distributed by mail in January 2022 to residents of the Walker Pond Watershed. A copy of the pamphlet can be found in **Appendix B**. The pamphlet includes information on phosphorus in stormwater and its effects on ponds, specifically Walker Pond. It discusses ways that residents can help reduce phosphorus contributions including lawn care do's and don'ts, rain gardens and pond buffers to encourage infiltration, proper pet waste disposal and septic system maintenance. Lastly, it introduces the Town's Walker Pond Improvement Pilot Project anticipated for construction in Spring 2022. This provides a basis for ongoing messaging to make the residents aware of what the Town is doing in their neighborhoods to address stormwater and the effects on Walker Pond. Future messages will follow-up on construction progress and include education about public involvement and participation opportunities discussed in **Section 5**, such as the catch basin marking program.
2. A news article was developed with similar information as the above-mentioned pamphlet, with a Town-wide audience target. The article will be published town wide. The article introduces the stormwater program to the public and provides a basis for a series of stormwater program communications to keep the public up to speed on what the Town is doing through its watershed and stormwater management program, and how they can be engaged. The article can be found in **Appendix B**.
3. The primary audience of Watershed No. 2 is single-family homeowners. When they decide to build, renovate, or take on small scale construction projects at their property, they are most likely not aware of the consideration that should be given to erosion control best management practices. Education materials outlining practices to provide erosion and sediment controls for construction and development projects have been created by various entities including EPA, Neponset Stormwater Group, and Think Blue Massachusetts. A sample of these materials that can be used and modified as needed are included in **Appendix C**. This educational material should be distributed during the building permit application process for all construction projects, including single-family homes. **Sections 7 & 8** provide more information on how these materials can be distributed through the Town's construction, new and redevelopment permitting process.

4.2.2 NEIGHBORHOOD SIGNAGE

Signage is an efficient method to increase awareness of the impacts of pollutants in stormwater runoff and what can be done to prevent it. Signage can be installed strategically within the watershed to educate the public about ongoing issues, improvements, and ways they can participate. The following signage opportunities have been identified within this watershed:

1. Installing signage on catch basins is a great way to make people aware that dumping into a catch basin is not allowed. This educational tool reminds people of the connection between storm drains and local waterways such as Walker Pond or the Charles River. There are approximately 290 catch basin markers being installed as part of the Walker Pond Improvement Project. As

described in **Section 5.2**, the installation will be completed as part of a public involvement and participation volunteer effort.

The Town of Wellesley developed a *Guide to Storm Drain Markings* which can be found in **Appendix D**. The guide outlines how to run the volunteer program and discusses the different options for markers that can be installed: stenciling, glue-on or self-adhesive markers, and pre-cast markings. BETA spoke with a representative from the Charles River Watershed Association (CWRA), who gave input on the three different types of markers.

- Stencils last longer, but the stencil templates break after overuse and the images are usually large.
- Glue-on markers are easier to apply and more obvious to the public, but usually last a few years and may fall down the storm drain.
- Catch basin grates with pre-cast markers are aesthetically pleasing and the longest lasting, but are expensive and need to be installed by the Town or contractor.

The CWRA also sent along the Town of Salem's approach, which was to have street artists paint the catch basin and surrounding areas. The following is a link to view Salem's project website: Drain SmART Salem Mural Project — Creative Salem (squarespace.com)

BETA recommends using the glue-on markings for existing structures and requiring pre-cast markers for any new or replacement catch basins in the future. There are multiple options for generic markers, or they can be customized to identify a specific waterbody for additional cost and manufacturing time.

2. Walker-Gordon Field is a good location for signage to remind the public of simple tips and tricks to help reduce pollution. A sign board that can be updated with information applicable to the season or highlighting current stormwater improvements and pond water quality status could be of interest to those who frequent the park. Currently around the field there are a few signs reminding dog owners to clean up after their pets. There is also a wooden sign board reminding users to keep the park litter free, keep dogs leashed on perimeter and clean up after them, and to park legally (see photo next page). The board belongs to the Needham Park & Recreation. This board is dated and can be replaced with a sign board that can be updated as needed.

3. A sign board was proposed as part of the Walker Pond Improvements Project and has been installed at the Walker-Gordon Field property adjacent to the pond. This board will be used to educate residents on the impacts of high phosphorus loads on the Pond. It will explain the function of the vegetated filter strip and infiltration trench, and the benefits of the Stormwater Improvement Project to reduce the total phosphorus load to the Pond and ultimately to the Charles River.

5.0 PUBLIC INVOLVEMENT AND PARTICIPATION

5.1 OBJECTIVE AND REQUIREMENTS

The main objective of this control measure is for the Town to provide opportunities to engage the public to participate in the review and implementation of the Town's Stormwater Management Program (SWMP). The Permit requires opportunities be provided annually. The Public participation opportunities may include but are not limited to: websites, hotlines, clean-up teams, monitoring teams, or an advisory committee. The Town has a Stormwater webpage where it posts the Town's SWMP and other educational materials. In addition, there are opportunities for public involvement specific to stormwater improvements proposed for this watershed that should be capitalized on and reported on in the MS4 annual reports.

5.2 ONGOING AND RECOMMENDED PARTICIPATION OPPORTUNITIES

Along with review and comment on the Town's SWMP, the following public participation opportunities are applicable to Watershed No. 2.

5.2.1 VEGETATED FILTER STRIPS

A community committee participated in the generation of the idea to encourage residents to install vegetated filter strips on their properties. Education materials were developed by the committee to introduce the filter strip concept and design to homeowners and to aid in the installation on private properties. The vegetated filter strips are beneficial to phosphorus reduction in the watershed and include New England Wildflower Seed Mix Species to attract pollinators for added environmental benefit. BETA recommends the Town make the seed mix available to homeowners, should homeowners decide to install the vegetated filter strips at their properties. Since the vegetated filter strip and infiltration trench BMP has been installed along Walker Lane it can be referenced as a demonstration project for application in other areas.

5.2.2 CATCH BASIN MARKERS

As described in **Section 4.2.2**, catch basin markings can help reduce debris and pollutants from entering the storm drain system and ultimately water resources. As part of the Walker Pond Improvements Project, the Town will facilitate an opportunity for volunteers to assist with installation of these catch basin markers in Watershed No. 2. A *Guide to Storm Drain Markings* developed by the Town of Wellesley, which can be found in **Appendix D**, outlines how to run the volunteer program.

6.0 Illicit Discharge Detection and Elimination (IDDE) Program

6.1 Objective and Requirements

The main objective of this control measure is to systematically find and eliminate sources of illicit non-stormwater discharge to its municipal storm sewer system and implement procedures to prevent such discharges.

6.2 Outfall Screening and Sampling

The first phase of Needham's IDDE plan was to conduct dry weather screening and sampling of all its outfalls and interconnections. This was completed in June 2021 and a summary report issued with the results. BETA screened a total of 285 outfalls and interconnections; of that total, 184 are Town-owned MS4 outfalls, 11 are MS4 interconnections, 90 are non-MS4 outfalls. Within Watershed No. 2, this effort consisted of 57 outfalls (42 MS4 outfalls, 15 non-MS4 outfalls). Under dry weather conditions, none of the outfalls in Watershed No. 2 exhibited indicators of concern for potential illicit discharges or the MS4 Permit criteria for likely sanitary sewer input:

- Olfactory or visual evidence of sewage,
- Ammonia ≥ 0.5 mg/L, surfactants ≥ 0.25 mg/L, and bacteria levels greater than the water quality criteria applicable to the receiving water, or
- Ammonia ≥ 0.5 mg/L, surfactants ≥ 0.25 mg/L, and detectable levels of chlorine.

Outfall screening and sampling in Watershed No. 2 was conducted by BETA in 2021 and 2022 during wet weather conditions. 21 of the 42 MS4 outfalls have been sampled during wet weather: 14 were not flowing given 1 visit attempt, 4 were not flowing at 2 visit attempts, 2 need a police detail to access, and 1 did not exist. The Non-MS4 outfalls (15 in total) were not visited during wet weather conditions. Of the 21 wet weather sampled outfalls in the watershed, eleven (11) tested positive for E. Coli along with indicators of free chlorine and/or surfactants.

Table 6-1 lists these outfalls with sampling results and summarizes catchment area characteristics based on field site walks and records research. **Appendix F** includes a map of Watershed No. 2 with these outfall locations highlighted, along with their individual catchment maps.

Table 6-1: Watershed No. 2 IDDE Investigation Wet Weather Results

Outfall	System Length (ft)	Location	Date Sampled	Pollutant Sampling Results	BETA Field Observations & Recommendations	Records of Sewer or Septic in the Area	Previous I/I Investigation Recommendations
02-01	1350	Chestnut Street	9/10/2021	E. Coli & Surfactants & Chlorine detected below level of concern	12/28/2021 - Three catch basins were filled with debris, water, and mud. *Recommendations: Clean drainage system and perform CCTV.*	Area mostly supported by sewer. 1 parcel in catchment area on septic built 1986.	No Data
02-04	340	South Street near Farley Pond Lane	6/14/2021	E. Coli (109,500 MPN/100mL) Surfactants, Chlorine detected at levels of concern	11/15/2021 - Catch basins leading to outfalls were clear of debris, pet waste bags, and had no visible pollutants. This outfall is located near Farley Pond area, which may have some wildlife habitats that could contribute to the bacteria. 8/9/2023 – BETA accompanied the Town for CCTV inspection of this catchment system. Investigation found no evidence of illicit discharge in the system (See Memo to Town dated 8/16/23). *Recommendations: Clean catch basins and drainpipes and re-sample during wet weather to confirm issue is resolved.*	No septic systems record in the catchment area.	No Data
02-07	225	Richardson Drive	7/9/2021	E. Coli (4,810 MPN/100mL) Surfactants, Chlorine detected below level of concern	11/15/2021 - No pet waste bags observed in catch basins. One of the three catch basins in the system (CB D098-030) was located in a ditch in the sidewalk. The catch basin was covered with a pile of leaves and heavily flowing during dry weather. BETA opened the catch basin and discovered three (3) inlets to the catch basin coming from towards the railroad tracks/powerlines. 11/21/2021 - BETA sampled the inlets of CB D098-030 in the outfall 02-07 system. Although the inlets had slightly elevated surfactants levels, they did not have reportable levels of E. Coli, ammonia, or free chlorine. *Recommendations: Perform CCTV.*	Richardson Drive has a sewer system.	CCTV Completed in 2018 SMH S58-003 to S58-001: camera blocked by debris. Recommend dig and replace the section. SMH S58-003 to S58-002: Infiltration at capped WYE and at Service. Recommend dig and replace the section.
02-11	310	South Street Easement	6/9/2022	E.Coli, Surfactants, Chlorine detected below level of concern	Note: Water main replacement project completed in late June 2023. Water main fall 2022 with repavement completed in June 2023. 8/9/2023 – BETA accompanied the Town for CCTV inspection of this catchment system. Much of the system was inaccessible due to brush overgrowth and blockages in pipes. System connectivity is unclear (See memo to Town dated 8/16/23). *Recommendations: Research town records for abandoned pipes/cbs. Restore access and clean catch basins and drainpipe and re-sample during wet weather to confirm issue is resolved.*	South Street parcels may use septic, built in 2009, 1832, and 2016.	No Data
02-13	50	South Street	6/9/2022	E. Coli (30,759 MPN/100mL) Surfactants, Chlorine detected below level of concern	Note: Water main replacement project completed in late June 2023. Water main fall 2022 with repavement completed in June 2023. 8/9/2023 – BETA accompanied the Town for CCTV inspection of this catchment system. Investigation found no evidence of illicit discharge in the system (See Memo to Town dated 8/16/23). *Recommendations: Clean catch basins and drainpipes and re-sample during wet weather to confirm issue is resolved.*	South Street parcels may use septic, built in 1981, 1914 (major renovation 2015), and 1900.	No Data
02-17	1180	Crestview Road	5/10/2021	E. Coli & Surfactants detected below level of concern	11/15/2021 - Catch basins leading to outfalls were clear of debris, pet waste bags, and had no visible pollutants. *Recommendations: Perform CCTV.*	Crestview Road parcels all have septic systems built between 1919-2008 (based on GIS data).	No Data
02-31	1750	92 Country Way	7/9/2021	E. Coli (15,531.2 MPN/100mL) Surfactants detected at levels of concern	11/15/2021 - Along Country Way, the catch basins were covered with leaves. There were some visible leaves in the catch basins along the visible water, but no signs of clogging or pet waste bags present. There were multiple landscaping companies working along Country Way. *Recommendations: Educate residents and landscaping companies about proper leaf disposal. Observe structures during a different season to see if any debris besides leaves and perform CCTV.*	Country Way has a sewer system; catchment area includes 7 parcels that may still use septic, built in 1904, 1952 (2), 1961, 1968, 1970, 2010.	No Data
02-34	530	Country Way	7/9/2021	E. Coli & Surfactants detected below level of concern	12/28/2021 - Catch basins leading to outfalls were clear of debris, pet waste bags, and had no visible pollutants. *Recommendations: Perform CCTV.*	Country Way has a sewer system. 2 parcels may still use septic, built in 1960, 1961.	No Data
02-43	280	Bridle Trail Road	9/9/2021	E. Coli & Surfactants detected below level of concern	12/28/2021 - Catch basins leading to outfalls were clear of debris, pet waste bags, and had no visible pollutants. *Recommendations: Perform CCTV.*	Catchment area on Bridle Trail Road has sewer system.	No Data
02-48	510	Murphy Road	9/10/2021	E. Coli & Surfactants detected below level of concern	12/28/2021 - Catch basins leading to outfalls were clear of debris, pet waste bags, and had no visible pollutants. *Recommendations: Perform CCTV.*	Murphy Road and High Rock Street have a sewer system.	CCTV Completed in 2014 SMH S49-057 to S49-058: moderate leak in service. Recommend lateral grout up to 5 feet.

Outfall	System Length (ft)	Location	Date Sampled	Pollutant Sampling Results	BETA Field Observations & Recommendations	Records of Sewer or Septic in the Area	Previous I/I Investigation Recommendations
02-51	750	Robinwood Avenue	7/9/2021	E. Coli (34,432 MPN/100mL) Chlorine detected at levels of concern	11/15/2021 - This outfall is located at the entrance of the Bay Colony Rail Trail. The drainage system in the trailhead area may be susceptible to garbage from hikers or pet waste, although there was no evidence of this at the time. There were no visible dumpsters or dog waste stations. *Recommendations: Perform CCTV.*	Robinwood Avenue has a sewer system. 1 parcel may still use septic, built in 1956.	CCTV Completed in 2014 SMH S49-026 to S49-027: heavy leak at joint to sealed chimney service. Fine roots at joint to chimney service. Recommend point repair up to 4 feet.

6.3 CATCHMENT INVESTIGATION AND RECOMMENDATIONS

Sampling and catchment investigation work had been conducted in Watershed No. 2 as part of the 2003 Storm Water Management Plan. At that time, it was determined that Watershed No. 2's bacteria hits were related to high amounts of geese in the area. BETA conducted a site walk on November 15th, 2021 and on December 28th, 2021 at the affected outfalls and throughout their catchment areas. The catchments were all observed to be low density residential neighborhoods with well-manicured, possibly fertilized, lawns and roads contributing to the drainage system. There were no obvious indications of animal waste such as geese in the watershed or pet waste bags in the drainage system catch basins at that time. Low levels of surfactants found at the outfalls during wet weather may indicate improper disposal of household detergents. **Table 6-1** summarizes the catchment investigations and characteristics.

The bacteria levels found during wet weather screening and sampling may be attributed to normal wet weather conditions. There are natural, non-fecal sources of fecal indicator bacteria, including plants, sand, soils, and sediments, that contribute to a certain background level in ambient waters and vary based on local environmental and weather conditions. Bacteria can grow and live on surfaces, especially storm structures, and during wet weather conditions, bacteria is more likely to travel along with the storm flow. A study posted by EPA indicated that E. coli levels lower than 2,400 MPN/100 mL were observed in stormwater samples in areas that could not possibly be contaminated with sanitary sewerage (Shergill, 2004). Four of the nine outfalls with bacteria hits had E. coli levels greater than 2,400 MPN/100mL, as indicated in **Table 6-1**.

Following the Town's IDDE program approach to catchment investigations, all nine drainage catchment areas are recommended as a priority for CCTV inspection of the drainage infrastructure. The four outfalls with E. Coli detected at levels of concern should be a high priority for CCTV and follow-up investigation. If CCTV results identify a potential illicit connection to the drainage system, then further investigation to confirm an illicit connection may be recommended and removal be required. This could include but is not limited to additional dry and wet weather sampling; smoke testing; or dye testing to trace the source of the potential discharge. If CCTV does not find defects or indicators of illicit connections, then the catchment will be cleared and investigation complete.

As noted in **Table 6-1**, five of the nine drainage catchment areas are in proximity to old septic systems that were built between 1938 and 1992 and three coincide with areas where sewer rehabilitation was recommended as part of the Town's sanitary sewer infiltration and inflow program**.** Potential defects in the septic system coupled with high groundwater levels may allow bacteria to migrate into the drainage system. CCTV will help determine if there are any defects in the storm drainpipe allowing potentially contaminated groundwater to enter, particularly in locations where sanitary sewer CCTV indicates system defect in the sanitary sewer. If defects are found, they need to be addressed.

6.4 ONGOING MONITORING

Throughout the 16 watersheds in Needham, locations were determined as the most downstream point(s) of stormwater flow for routine dry and wet weather sampling. These ongoing screening and sampling efforts will follow the procedures outlined in the Town's IDDE Plan to provide a composite sampling result for each watershed.

Within Watershed No. 2, BETA suggests conducting screening and sampling at four (4) monitoring locations biannually (in Spring and Fall), under both dry and wet weather conditions. Dry weather conditions are defined in the MS4 Permit as conditions in which no more than 0.1 inches of rainfall has

occurred in the previous 24-hour period and no significant snow melt is occurring. Conditions are considered wet weather with more than 0.1 inches of rainfall in the previous 24-hour period. If flow is observed under either of these conditions, a sample is required.

The monitoring locations can be found on the site map in **Appendix A** (labeled as ML-#) and are summarized in **Table 6-2**. BETA has confirmed during a site visit that all suggested locations are relatively accessible and are feasible locations for sampling.

Table 6-2: Proposed Sampling Monitoring Locations in Watershed No. 2

Street	Sample ID & Structure	Procedure
South Street	ML-1 Farley Pond Culvert	• Sample collected at the upstream of mouth of the culvert in the middle of the pipe, in the center of flow.
Charles River Street	ML-2 Walker Pond Inlet	• Sample collected in stream near Charles River Street.
Walker Lane	ML-3 Walker Pond Weir Outlet	• Location: Northern side of the precast concrete structure. • Position the sample cup 2' below the top of the precast concrete basin, 6" inward from the East edge of the precast concrete basin. • Move the sample cup towards the flow at a constant elevation until the sample is received. *Note: Flow entering the precast concrete basin will vary based on amount of debris against the grate where the water enters the structure.*
Oxbow Road	ML-4 Outfall 02-27	• Sample collected at center of flow.

The following screening data should be recorded at each sampling visit: surrounding land use; receiving land or water type; date of inspection, pipe size, shape, and material; outfall type, material, and condition; presence of scouring, algae growth, sediment buildup; discharge quantity; and presence of indicators of potential non-stormwater discharges (stressed vegetation, staining, odor, color, turbidity, floatables, and oil sheen).

All samples are to be analyzed for the following using a field test kit: ammonia, chlorine, specific conductivity, salinity, surfactants, temperature, and pH. Samples will also be sent to the Alpha Analytical in Westborough, MA to be tested for E. Coli (freshwater receiving waters) and Total Phosphorus. Total phosphorus must be tested due to the total phosphorus TMDL for the Charles River. Initial screening and sampling of these locations were completed in 2021 to serve as a baseline set of data; the results are included in **Appendix G**.

The four locations within Watershed No. 2 were chosen due to their advantageous positions in the stormwater system before the final discharge into the Charles River (MA72-06). The proposed outfall collect stormwater from relatively large catchment areas within the watershed. The two ponds collect stormwater from various residential neighborhoods and play an important role in local phosphorus cycling and storage. The following paragraphs detail each location more specifically.

South Street, Farley Pond Culvert: Stormwater outfalls from residential neighborhoods north/northeast of Farley Pond discharge into the wetlands and streams that lead to the pond. Sampling upstream of the

culvert under South Street would help gather water quality data from the pond that ultimately discharges into the Charles River.

Walker Lane, Walker Pond Weir Outlet: Walker Pond collects stormwater from many neighborhoods within Watershed No. 2. By sampling at the discharge point of the pond, water quality data would help to monitor the health of the pond and indicate how well the pond works to manage stormwater pollutants before discharging towards the Charles River.

Charles River Street, Walker Pond Inlet: Walker Pond collects stormwater from many neighborhoods within Watershed No. 2. By sampling the water coming from the stream into the pond, water quality data will be better able to determine the source of phosphorus loading into the pond which ultimately discharges towards the Charles River.

Oxbow Road, Outfall 02-27: Sampling outfall 02-27 would be beneficial in creating a profile of the stormwater quality from the Oxbow Road residential neighborhood that directly discharges into the Charles River.

7.0 Construction Site Stormwater Runoff Control

7.1 Objective and Requirements

The objective of the construction stormwater runoff control program is to minimize or eliminate erosion and maintain sediments on site so that it is not transported in stormwater and allowed to discharge to a water of the U.S through the Town's MS4.

7.2 Current Implementation

The Town of Needham Stormwater Bylaw (Town of Needham General Bylaw Article 7) was enacted on February 15, 2019 to address illicit discharges and construction site stormwater runoff controls. The Town continues to implement requirements of this minimum control measure in Watershed No. 2 and all areas of Town through its Stormwater Bylaw. Per the Bylaw, all persons required to obtain a Building Permit for new construction, reconstruction, alteration, repair, removal, demolition, and/or additions greater than 25% of the existing building footprint are subject to the requirements of the Bylaw. The State Building Code also requires a permit for any change of use of a building or structure, and/or the installation or alteration of any regulated equipment. Stormwater Management and Erosion Control plans are required to be submitted as part of the Building Plot Plan or independently with an application for a Building Permit, Planning Board Application, Zoning Board of Appeals application Conservation Commission application, and/or prior to any development activity.

Site plan review and enforcement included the following elements for sediment and erosion control:

1. Regulatory mechanism that requires the use of sediment and erosion control practices at construction sites, including controls for other wastes on construction sites.
2. Written procedures for site inspection and enforcement.
3. Sediment and erosion control requirements for construction site operators performing land disturbance activities.
4. Requirements to control waste from construction sites.
5. Written procedures for site plan review and inspection and enforcement.

The Director of Public Works or his/her designee is responsible for day-to-day administration and enforcement of the bylaw and its regulations, including authority to investigate and suspend illicit

discharges and to require elimination of illicit discharges. The permitting authority is the municipal board issuing permits for construction (Building Department, Planning Board, Zoning Board of Appeals, and Conservation Commission) and is responsible for determining compliance with the bylaw for any application to them.

7.3 RECOMMENDATIONS

The Town's Bylaw offers additional protection to its water resources from construction site stormwater runoff by lowering the threshold of applicability required by the MS4 permit from over one acre of disturbance to instead include all construction requiring a building permit, regardless of the disturbance area. However, there are projects that may occur in Town that cause land disturbance but do not require a building permit. For example, extensive landscaping work or tree clearing to create lawn area or fields changes stormwater runoff patterns and groundcover conditions and can result in erosion and sediment issues during and after the activities occur. Driveway and roadway installation or expansion are other instances where a building permit is not required but stormwater and erosion control impacts are likely to occur if not designed and constructed properly. BETA recommends the Bylaw should be expanded to include applicability for projects that do not require a building permit but propose an acre or more of land disturbance to meet the minimum requirement of the MS4 permit. The Town may consider lowering the threshold to less than an acre for additional protection of receiving waters.

In March 2020, the Building Department moved to an online permitting system. The Guided Process outlines requirements for various types of construction projects, identifies other Town Department requirements to consider, and provides a list of requirements for permit applications. The Guided Process should specifically identify and link applicants to the Town's Stormwater Bylaw and provide educational information on erosion and sediment controls and considerations that are expected to be used on all projects. This information is especially important to provide for single family homeowners, such as the audience in Watershed No. 2, who may not be as familiar as a contractor is with the process and erosion control best management practices. As discussed in **Section 4.2**, template materials for construction erosion and sediment controls are included in **Appendix C**.

8.0 STORMWATER MANAGEMENT IN NEW AND REDEVELOPMENT

8.1 OBJECTIVE AND REQUIREMENTS

The objective of an effective post-construction stormwater management program is to reduce the discharge of pollutants found in stormwater to the MS4 through the retention or treatment of stormwater after construction on new or redeveloped sites, and to ensure proper maintenance of installed stormwater controls.

8.2 CURRENT IMPLEMENTATION

As discussed in **Section 7.0**, the Town continues to implement requirements of this minimum control measure in Watershed No. 2 and all areas of Town through its Stormwater Bylaw. Per the Bylaw, all persons required to obtain a Building Permit for new construction and/or additions greater than 25% of the existing building footprint are subject to the requirements of the Bylaw. As part of the Stormwater Management and Erosion Control Plan requirement, provisions must be made for post-construction measures to provide a minimum combined volumetric capacity to recharge a minimum of one inch of rainfall depth over the total impervious area of the property. The purpose being to prevent or minimize increases in stormwater volumes and flows to the MS4 and to reduce pollutant loading to the MS4 and receiving waters. For single-family home lots with 4,000 sf or less of impervious surface on the property,

which make up the majority of Watershed No. 2, the option to satisfy this requirement is to use the Standard Infiltration Method (SIM) developed by the Town. SIM is installing drywells at one or more corners of the main dwelling/building to collect the roof runoff from the structure. The map in **Appendix A** identifies the areas of Watershed No. 2 anticipated to have soils with good infiltration rates where the SIM can be applied. The Town should continue to implement and enforce this program in these areas of Watershed No. 2 and in areas where infiltration is not possible due to soil or groundwater constraints, the property owner should contribute funds to construct communal infiltration systems on Town property as defined in the Stormwater Bylaw. As of June 2021, there are 856 buildings in Watershed No. 2, and 34 of those (approximately 4%) have submitted building permit applications. Following the building permit requirements, those 34 buildings have infiltration implemented with construction.

As a requirement of the Permit, the Town is developed a report assessing current street design and parking lot guidelines and other local requirements that affect the creation of impervious cover. Watershed No. 2 is primarily built out without any large parcels where subdivisions or roadway extensions would likely be proposed or with properties where large commercial or institutional uses may develop parking lots. The Town is also required to develop a report assessing existing local regulation to determine if green infrastructures are allowable when appropriate site conditions exist. As discussed, the Town's stormwater bylaw enables, encourages, and requires green infrastructure whenever appropriate. It is not anticipated that either of these assessment reports will impact Watershed No. 2.

In the Town's Watershed Plan and Stormwater Management Plan, facilities have been identified that could be modified or retrofitted with BMPs to develop the communal infiltration systems. None of the these previously identified facilities lie within Watershed No. 2, however, the following open space and recreation areas identified in this effort in Watershed No. 2 may be considered for addition to the list and can be found on the map in **Appendix A**:

- Open Space around Walker Pond
- Walker Gordon Field (additional measures)
- Conservation Land on the east side of Charles River Street south of Walker Lane
- Various locations within the right-of-way

Open Space evaluated but not suitable

- Town Forest – Soils are not feasible for improvements
- Farley Pond Reservation – Soils are not feasible for improvements
- Bay Colony Rail Trail – owned by the MBTA and is elevated, no realistic BMP
- DCR Redwing Bay – owned by DCR, private property

8.3 RECOMMENDATIONS

The same recommendation from **Section 7.0** applies to this section; the Bylaw should be expanded to include applicability for projects that do not require a building permit but propose an acre or more of land disturbance to meet the minimum requirement of the MS4 permit. The permitting authorities for new and redevelopment projects should be diligent in using the Bylaw to require installation of a BMP for any new and redevelopment happening in the watershed, particularly within the good soil areas. When reviewing Stormwater Management Plans, the permitting authority should request calculations for treatment volumes and phosphorus removal to track the benefit of BMP implementation on private property which should be included in MS4 annual reporting.

9.0 GOOD HOUSEKEEPING

9.1 OBJECTIVE AND REQUIREMENTS

The Town will implement an operations and maintenance (O&M) program for permittee-owned operations that has a goal of preventing or reducing pollutant runoff and protecting water quality from all permittee-owned operations. The Town-wide O&M program has been developed and includes inventory, routine inspections, cleaning, and maintenance of all Permittee-Owned Facilities, Streets, Parking lots, and Stormwater Infrastructure. The program includes the Watershed No. 2 area, specifically the facilities and infrastructure identified in the following sections.

9.2 TOWN FACILITIES

In December 2020, BETA inspected the 38 Town-owned properties and 12 MS4 infrastructure BMPs included in the Town-wide O&M program. BETA compiled the results from these inspections into action items, as noted in the *December 2020 Observations* column of **Table 9-1**. Follow-up information is included in the *Most Recent Observations*.

Table 9-1: Town Facility BMPs

BMP from Town-Wide O&M		December 2020 Observations	Most Recent Observations
Town Forest	Central Ave near Marked Tree Rd, 200+ acres of forest with trails	Regrade parking lot and eliminate parking lot sediment to nearby pond.	None.
Walker-Gordon Fields	174 Charles River Street, Infiltration System (ID 37)	Add infiltration trench along parking lot to inspections and map.	Infiltration trench has been installed at Walker-Gordon Field along the parking lot.
Water Quality Tank ID 101	Chestnut Street near Charles River Street	Unable to locate in the field.	Sedimentation tank manholes are buried under sediment and vegetation. Sediment was seen in the manhole directly upstream. BETA recommends clearing vegetation and performing annual inspection and cleaning.
Water Quality Tank ID 102	Near Willow Street Bridge on South Street	Unable to locate in the field.	Field verified this does not exist. Remove BMP from inventory.
Water Quality Tank ID 103	South Street at Chestnut Street	Proprietary structure that discharges to the drainage system on South Street.	Sedimentation tank was installed, sedimentation visible in all three manholes. BETA recommends annual inspection and cleaning.
Infiltration Catch Basin ID 108	Pine Street at Charles River Street	Clean per regular catch basin schedule.	Clean per regular catch basin schedule.

Maps and inspection logs of these facilities and structures have been revised to incorporate the findings of this analysis: the parking lot was added to the Town Forest inspection log and called out on its respective map, and the infiltration trench was added to the Walker-Gordon Field inspection log and map. These are included in **Appendix H** and should be used to update the Town-wide O&M Plan. The Town-wide O&M plan will also need to be updated when new BMPs proposed under **Section 9.4** are installed. The BMP maintenance guide in **Appendix H** has been updated to include the types of BMPs recommended in this report.

9.3 Infrastructure Maintenance

9.3.1 Enhanced Street Sweeping

Street sweeping for the entire Town area and associated phosphorus credit is detailed further in the Phosphorus Control Plan.

9.3.2 Catch Basin Cleaning

Catch Basin Cleaning for the entire Town area and associated phosphorus credit is detailed further in the Phosphorus Control Plan.

9.3.3 Snow Storage Areas

Potential locations for Town snow storage in Watershed No. 2 were considered, however, no suitable locations were identified. The majority of the area is residential which generally does not generate need for additional snow removal outside of the roadway shoulders.

10.0 Phosphorus Control Plan

10.1 Objective and Requirements

Needham's stormwater system discharges to six (6) receiving waterbodies identified in MassDEP's Integrated List of Waters. A previously identified, the Charles River (Segment MA72-06) is the receiving water for Watershed No. 2 and is impaired by nutrients including a total maximum daily load (TMDL) for phosphorus.

A portion of the watershed flows through Walker Pond prior to discharging to the Charles River. A study entitled *Walker Pond Lake Management 2017 Final Report* prepared by ESS Group, indicated that Walker Pond is shallow in depth (2.4 feet average), approximately six acres in size, and is inundated with aquatic plant growth. High nutrient (phosphorus and nitrogen) and low dissolved oxygen levels were recorded as well. ESS Group found the high phosphorus levels are due primarily to stormwater runoff.

The 2016 Municipal Separate Storm Sewer Systems (MS4) Permit requires the Town of Needham to reduce phosphorus loads from their drainage systems to the Charles River by 55% by 2036. To address the discharge of phosphorus from its MS4, the Town has developed a Phosphorus Control Plan (PCP) designed to reduce the amount of phosphorus in stormwater (SW) discharges from its MS4 to the Charles River and its tributaries. The PCP will be completed in phases. The Town will add it as an attachment to its written SWMP upon completion and report its progress in annual reports pursuant to Part 4.4 of the Permit toward achieving its Phosphorus Reduction Requirement. The PCP will be developed and fully implemented as soon as possible, but no later than 20 years after the Permit.

The following is an analysis of the watershed that includes three calculations: (1) the 2005 phosphorus load, (2) EPA required reduction and (3) existing and proposed BMPs to meet the requirement.

10.2 Determine Phosphorus Load Export and Reduction Required

The watershed was analyzed to determine the phosphorus load for stormwater runoff routed through the Town drainage system (MS4). Refer to the maps in **Appendix J and K** to see the data and sub-watershed delineations used for analysis and discussed in this section.

10.2.1 Data

The calculation was completed using the following data:

- MassGIS Soils, Topography, and Land Use Data
- Town of Needham roadway, driveway and building surface and drainage system mapping
- Google Maps, street view to verify curbing
- Site visits to verify drainage system mapping
- 2016 MS4 Permit Appendix F including the three attachments – modified in December 2020

10.2.2 METHODOLOGY

The load for Watershed 2 was determined using the same data and methodology outlined in the "Phosphorus Baseline Load Calculations Methodology" memo submitted with GIS layers via email to EPA on April 28, 2023, and further outlined in the Phosphorus Control Plan. However, the layers were clipped to the watershed boundary instead of the Town boundary.

10.2.3 REQUIRED PHOSPHORUS REDUCTION

The modified 2016 MS4 Permit requires the Town of Needham to reduce the phosphorous load by 55%, which was calculated to be a reduction of 974 kg/yr (2,147 lbs./yr) by Year 2036. It also requires inclusion of BMPs to meet 20% reduction by Year 8 and 25% reduction by Year 10.

The total phosphorus load for Watershed 2 was calculated to be 243.0 lbs./yr. and for Walker Pond 87.2 lbs./yr. The required phosphorus removal for Watershed 2 is 133.7 lbs./yr. and for Walker Pond is 48.0 lbs./yr.

Calculations for all BMPs discussed in this section can be found in **Appendix I**, with a summary in **Table 10-1**.

10.3 BEST MANAGEMENT PRACTICES (BMPS) TO MEET REQUIREMENTS

The Town proposes to meet and exceed this requirement through utilization of several non-structural and structural BMPs, which include but are not limited to:

1. Disconnecting/removal of impervious surfaces.
2. Enhanced pavement sweeping.
3. Catch basin cleaning.
4. BMP retrofits for redevelopments including:
    a. Roof infiltration systems
    b. Infiltration trenches
    c. Drywells & subsurface infiltration systems.

The Town also requires residents upgrading their property and seeking a building permit to provide groundwater recharge on their property.

10.4 NON-STRUCTURAL BMPS

10.4.1 DISCONNECTING/REMOVAL OF IMPERVIOUS SURFACES

The Town will evaluate regulations relative to impervious surface requirements including street widths, sidewalks, parking space numbers and sizes, driveways, etc. The Town will also encourage low impact development (LID) techniques including disconnection of impervious surfaces with country drainage, vegetated filter strips, rain gardens, and infiltration systems.

BETA evaluated the watershed to find potential areas to reduce pavement within Town right-of-way. The following streets were evaluated due to them being dead end streets:

1. Crestview Road
2. Wilson Lane
3. Burr Drive
4. Marant Drive
5. Farley Pond Lane
6. Southwood Lane
7. Stonecrest Drive
8. Walker Lane

After investigation, the majority of these listed streets are not feasible for pavement reduction. The streets are currently at the Town required widths, and because there are either no sidewalks or sidewalks are only on one side of the street, pavement reduction cannot be done. Walker Lane is the only potential area for pavement reduction, and this has been incorporated into the Walker Pond Improvements Project. Pavement reduction at this location will include narrowing the street width along Walker Lane, removing pavement at the intersection of Walker Lane with Russell Road and removing the roadway past the driveway for 43 Walker Lane.

10.4.2 ENHANCED STREET SWEEPING

As mentioned in **Section 9.3.1**, the Town will provide required street sweeping for all roads a minimum of twice per year.

10.4.3 CATCH BASIN CLEANING

As mentioned in **Section 9.3.2**, the Town will provide catch basin cleaning such that a minimum sump storage capacity of 50% is maintained throughout the year.

10.5 SEMI-STRUCTURAL BMPS

As they worked to identify potential locations for BMPs, the Town of Needham encountered several "natural basins" within their analyzed watersheds. Typically, these basins are a natural depression in A or B rated soils that have adequate volume to retain and infiltrate stormwater with no outlet or overflow. These natural basins will continue to be documented as they are encountered while the town pursues areas to implement public BMPs..

These areas will be added to the annual BMP inspections for an initial investigation to confirm drainage. Once this is completed these natural basins will be added to the list of current structural BMPs. They will be added to the BMP inspection list to confirm that the topography has not been modified and they continue to function as infiltration basins.

As future watersheds are investigated, these natural basins will continue to be added in this manner.

10.6 STRUCTURAL BMPS

The most cost-effective method for removal of phosphorus from stormwater runoff is through infiltration. Therefore, the initial evaluation of opportunities included identifying subwatersheds that outlet at or near soils with high infiltration rates (typically soils with a hydrologic group rating of A or B). The following sections describe potential opportunities to implement infiltration throughout the watershed. A number of these concepts were developed by Needham's *Total Watershed Management Working Group* and have been further evaluated and refined in this analysis.

10.6.1 ROOF INFILTRATION

The Town requires those who apply for a building permit to retrofit the property to provide groundwater recharge of roof runoff – if soils are suitable.

Existing GIS and Town data was analyzed, assuming approximately 100 building permits per year Town-wide (5 in Watershed No. 2) with average roof area of 2300 sq. ft over the remaining 16 years Permit period. This will be taken into consideration as the Town pursues credit for private BMPs over the course of implementing their Phosphorus Control Plan.

10.6.2 SITE SPECIFIC RETROFITS

10.6.2.1 VEGETATED FILTER STRIP & INFILTRATION TRENCH

The *Total Watershed Management Working Group* developed a concept to install 8-foot-wide vegetated filter strips (VFS) utilizing pollinator seed mix throughout the Walker Pond watershed to provide treatment of stormwater runoff from primarily residential lots.

Using research found from the Metropolitan Area Planning Council (Fact Sheet: Grass Filter Strips – MAPC), the design requirements for vegetated filter strips are as follows:

- The limiting design factor for filter strips is not total drainage area but rather the length of flow contributing to it. Because sheet flow runoff becomes concentrated flow as distance increases, the contributing area to a vegetated buffer should be no more than 60-feet for impervious surfaces, and 100-feet for pervious surfaces.
- Slopes should be between 1% and 15%, though slopes less than 5% are preferred. The top and toe of the slope should be as flat as possible.
- The filter strip should be at least 20' long (downhill length) to provide water quality treatment. Minimum width is 8' or 0.2 X length of flow over the impervious surface upstream of the filter strip.

- Depth of sheet flow should be less than 0.5" for the design storm. Depending on the pollutant removal required, residence time should be at least 5 minutes, preferably 9 minutes or more.
- Use Manning's equation to calculate velocity, assuming hydraulic radius equals depth, with n values of 0.20 for mowed grass slope and 0.24 for infrequently mowed grass slope. Normal velocity should be <1.0 feet/second for design flow, with maximum permissible velocity of 3.0 feet/second for peak discharge during 10-year storm.
- Use a cement level spreader or pea gravel diaphragm at the top of the slope.
- Filter strips can be designed with a pervious berm of sand and gravel at the toe of the slope. This feature provides an area for shallow ponding at the bottom of the filter strip. Runoff ponds behind the berm and gradually flows through outlet pipes in the berm. The volume ponded behind the berm should be equal to the water quality volume.
- Designers should choose a grass that can withstand calculated flow velocities, and both wet and dry periods. Also consider depth to groundwater and choose facultative wetland species if appropriate.
- If filter strip will be used for snow storage, use salt tolerant vegetation (e.g., creeping bentgrass).
- During construction, divert runoff from unstable areas away from filter strips.
- Protect the underlying soil from compaction to the extent possible: work from outside the boundaries of the filter strip or use oversized tires and lightweight equipment.
- Disturbed areas steeper than 4:1 should be protected during establishment with erosion control blankets.

Using these design factors, BETA conducted field visits to review potential VFSs locations. The following limiting factors were found at many locations:

- Existing Soil: Most of the soils in the watershed have a hydrologic soil group rating of A (high infiltration rate) and B (moderate infiltration rate). Little runoff is generated or conveyed over open (grass and woodland) areas. Therefore, converting lawns or open space to VFSs does not produce significant improvement in water quality.
- Tree canopy: Some locations are shown under substantial tree canopy which may make it difficult to maintain required vegetated cover to achieve treatment goals.
- Special Site Grading: As previously noted, runoff needs to flow evenly from pavements to and across VFSs. These requirements may not be applicable and/or suitable for many locations.
- Private Properties: Most of the property in the area is private and would rely on homeowners for installation and maintenance. The town can encourage but cannot depend on installation or maintenance in these location to meet permit requirements for stormwater quality. Consider incentive programs for homeowner BMPs such as VFSs and reducing impervious areas.

As part of the Walker Pond Improvements Project, BETA designed for the installation of a 300-foot-long by 8-foot-wide vegetated filter strip, along with a 400-foot infiltration trench with infiltration pipe system to provide groundwater recharge and phosphorous removal along the north side of Walker Lane on Town-owned land. This system will provide a net phosphorus load reduction of 1.5 lbs./yr. This design may be replicated by homeowners on their own properties if they are amenable to it. Details of the design are provided in **Appendix E**.

10.6.2.2 SUBSURFACE INFILTRATION SYSTEM

BETA recommends providing stormwater treatment for portions of Charles River Street, Village Lane, and Central Avenue (23.1± ac) with a subsurface infiltration system, consisting of HDPE chambers set in stone

below the Walker-Gordon Field gravel parking area. Storm drain infrastructure exists in the roadway in this area and could be routed to an offline system under the parking area prior to the outfall to Walker Pond.

10.6.2.3 Surface Infiltration Basins

Surface infiltration basins are designed to capture stormwater, allowing solids to settle, and removing soluble pollutants. There is a Town conservation property on the east side of Charles River Street which currently has no drainage infrastructure, between house numbers 89 and 109. This is a potential location for an infiltration basin or other BMP.

10.6.2.4 Sump Manholes and Leaching Basins

The *Total Watershed Management Working Group* identified locations for installing large 6-foot diameter manholes with (deep) 4-foot sump at various locations to capture pollutants prior to discharge to resource areas. To achieve phosphorus removal, these structures would need to be fitted with filter systems or modified to provide infiltration. BETA recommends installing leaching manholes surrounded by stone with a solid 4-foot sump in series connected with perforated pipe surrounded by stone to facilitate sediment and phosphorus removal. Two of these structures are incorporated into the Walker Pond Improvements Project on Walker Lane. Details of the design are provided in **Appendix E**. **Appendix I** also includes details on leaching manhole and basin designs along with phosphorus removal calculations.

Other potential locations to explore further for leaching manholes based on soils and drainage infrastructure include 80 Country Way and 370 Country Way.

10.6.2.5 Drywell or Other BMP Retrofits

There is potential to retrofit private homes with roof runoff drywells as well as the Town's stormwater management systems to include infiltration practices where site conditions include available space, "good" soils, and where seasonal high groundwater elevations would allow. Some of these practices applied to the Town's infrastructure may be located on private properties and require an easement for maintenance. A Land Use map is included in **Appendix J** and soils map in **Appendix K** to assist in identifying these areas. Refer to **Appendix I** for typical drywell retrofit example design and phosphorus removal calculations.

Also, in some situations, runoff from pavement areas could be directed to an infiltration swale with a stone trench to provide groundwater recharge and phosphorus load reductions. To prevent pavement/roadway damage, this would only be recommended in areas where there are confirmed hydrologic group A or B soils as shown in **Appendix K**, Watershed 2 Soils Map.

Currently a leaching catchbasin on Pine Street and stone trench installed Gordon field provide a net phosphorus reduction of 0.9 lbs./yr.

10.7 Phosphorus Reduction Summary

The calculated phosphorus load for watershed tributary to the MS4 systems is 243.0 lbs./yr. At the required rate of removal of 55%, the required removal is 133.7 lbs./yr. As indicated in **Table 10-1**, and if BMPs can be constructed in all the subwatersheds as listed, they will only provide a maximum removal of 65.6 lbs./yr.

This is due to the fact that 19 of the 45 subwatersheds are located within NRCS listed hydrologic group rated "D" soils (very low infiltration) making infiltration BMPs infeasible. Since filter BMPs are less financially feasible, based on the cost of construction and maintenance requirements, it is recommended

that the final balance (currently calculated at 8.9 lbs./yr) be accommodated in more suitable areas in other watersheds throughout the Town.

Table 10-1: Phosphorus Load Reduction Summary

Current Phosphorus Reduction (Since 2005)					**Removal**
	Best Management Practice				(lbs./yr.)
	Roof Infiltration				2.25
	Walker-Gordon Field Stone Trench				0.48
	Pine Street Leaching Catch Basin				0.39
	Total				**3.12**
Projected Phosphorus Reduction					
	Natural Basins (Semi-Structural BMPs)				3.66
	Enhanced Street Sweeping				0.51
	Catch Basin Cleaning				0.73
	Walker Lane Planting Strip/LMH/Infiltration Trench				1.47
	Total				**6.37**
Potential BMP Retrofits Based on "Good" Soils (assume 90% removal)					
	Subwatershed ID - Address	(lbs./yr)		Subwatershed ID - Address	(lbs./yr.)
	CRS1 - 0 Charles River Street	1.00		CRS15 - Morse Street	2.08
	CRS2 - 0 Charles River Street	0.65		FS16 - 43 Fisher Street	0.62
	CRS4 - Walker-Gordon Field	5.18		SS17 - South Street at Charles	1.63
	OR5 - 147 Oxbow Road	7.15		SR27 - 103-111 Stratford Rd	3.46
	BTR6 - 54-68 Bridal Trail Road	1.47		SR28 - 143-157 Stratford Rd	3.18
	BTR7 - 14 Bridal Trail Road	1.73		SR29 - 245 Stratford Rd	2.13
	CW8 - 81 Country Way	2.60		SS30 - 5 Crestview Road	1.26
	WL9 - Walker Lane (Private)	2.98		CR31 - 0 Charles River Street	2.99
	CA10 - 1885 Central Ave	1.26		SS32 - 1220 South Street	0.41
	CA11 - 1885 Central Ave	1.24		RA39 – Robinwood Ave	1.11
	FS12 - 142 Fisher Street	3.75		CS46 - Chestnut St (at Charles)	2.78
	Total				**51.32**
Potential BMP Retrofits Based on "Mixed" Soils (assume 50% removal)					
	SS33-1150 South Street	0.36			
	SS38-898 South Street	1.71			
	Total				**2.07**
Total Existing, Projected and Potential Phosphorus Removal					**62.88**
	Required Phosphorus Removal				133.7
	Additional Phosphorus Load to be removed in other watersheds				70.82

11.0 SUMMARY OF RECOMMENDATIONS

- Flooding
  - Oxbow Road: Consistent with the 2002 report, BETA recommends retro fitting and/or constructing a new outlet control structure with a trash rack and providing a direct piped connection to the Charles River, bypassing the Oxbow Road neighborhood.
  - Country Way at Scott Road: BETA recommends that the Town install the double catch basin as was recommended in the 2013 report, *Flash Flood/List of Impacted*.
- Education Messages
  - Provide erosion and sediment controls education material with building permit applications.
  - Install drainage structure markers on existing catch basins and require pre-cast markers for any new or replacement catch basins.
  - Replace the existing wooden sign board at Walker-Gordon field and include stormwater education on the new sign board.
- Public Involvement
  - Involve community volunteers in a catch basin marking program.
- IDDE Program
  - Perform CCTV inspection of storm drains for high priority identified catchments.
  - Conduct routine screening and sampling at four (4) monitoring locations biannually (in March and November), under both dry and wet weather conditions.
- Construction Site Stormwater Runoff Control & Stormwater Management in New and Redevelopment
  - In the stormwater bylaw, consider adding review for land disturbance projects instead of depending only on building permits.
  - When reviewing Stormwater Management Plans, the permitting authority should require calculations for treatment volumes and phosphorus removal to track the benefit of BMP implementation on private property.
  - Update the online permitting system used by the Building Department to specifically identify and link applicants to the Town's Stormwater Bylaw and provide educational information on erosion and sediment controls and considerations that are expected to be used on all projects.
- Good Housekeeping
  - Perform cleaning and maintenance at Town facility BMPs identified in Table 9-1.
  - Update Town-wide O&M Plan with Appendix H.
- Phosphorus Control and BMPs
  - Install a subsurface infiltration system below the Walker-Gordon Field gravel parking area to treat drainage flows from Charles River Street, Village Lane, and Central Avenue (23.1± ac) prior to discharge to Walker Pond.
  - Install drainage and an infiltration BMP on Town property on the east side of Charles River Street, between house numbers 89 and 109.
  - BETA recommends designing and installing drywell or other infiltration BMP retrofits within the Town's stormwater management systems to achieve removal rates by sub-watersheds identified in Table 10-1.

12.0 REFERENCES

General Permits for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems in Massachusetts (as modified). 2016 Massachusetts Small MS4 General Permit. US EPA. Boston, MA. Signed April 4, 2016, modified December 7, 2020.

MassGIS Data. Massachusetts Bureau of Geographic Information. Boston, MA. Downloaded 2021.

Shergill, S. Quantification of Escherichia Coli and Enterococci Levels in Wet Weather and Dry Weather Flows. Masters thesis, Department of Civil and Environmental Engineering, the University of Alabama. Tuscaloosa, AL. May 2004.

Soils Data with Hydrologic Group Rating. Web Soil Survey. USDA Natural Resources Conservation Service (NRCS). Amherst, MA. Downloaded 2021.

APPENDIX A

- **Site Map**

Town of Needham, MA
Watershed No. 2 Analysis Map
March 2022

WATERSHED 2 ANALYSIS INFILTRATION AND TREATMENT OPPORTUNITIES	
COMPLETED	
ID	**Location**
C-1	Walker-Gordon Field Infiltration Trench
C-2	Pine Street Leaching Catch Basin
PROPOSED	
ID	**Location**
P-1	Walker-Gordon Field Parking Lot Infiltration System
P-2	Charles River Street Infiltration BMP
P-3	Walker Lane Stormwater Improvements Project (VFS + Trench)
P-4	Pavement Reduction
P-5	Leaching Manhole at 80 Country Way
P-6	Leaching Manhole at 370 Country Way

Legend

- Monitoring Location
- House using Septic System
- Flow Redirection Opportunities
- Railroad
- Drainage Issues
- Town-Owned Parcel
- Sewer Manhole
- Sewer Pipe
- Drain Outfall
- Drain Manhole
- Drain Inlet
- Drain Culvert
- Drain Catch Basin
- Drain Pipe

Walker Pond Sub-Watershed

Town Forest

Farley Pond Reservation

Conservation Land

Walker Gordon Field

Walker Pond

Bay Colony Rail Trail

DCR Redwing Bay

Charles River

ML-1 ML-2 ML-3 ML-4

C-1 C-2 P-1 P-2 P-3 P-4 P-5 P-6

BRIDLE TRAIL ROAD · CRANBERRY LANE · OUTLER ROAD · WOODS END DRIVE · SPRINGDALE ROAD · PINE STREET · CARLETON DRIVE · CENTRAL AVENUE · CHARLES RIVER STREET · COUNTRY WAY · SCOTT ROAD · WHITE PINE ROAD · CLIFFWOOD DRIVE · STRATFORD ROAD · WINDSOR ROAD · VILLAGE LANE · WALKER LANE · GREEN ROAD · RUSSELL ROAD · ROBBINS STREET · FISHER STREET · WILSON LANE · CRESTVIEW ROAD · SOUTH STREET · HIGH ROCK STREET · MURPHY ROAD · YURICK ROAD · FOREWOOD AVENUE · RICHARDSON DRIVE · ALDRIDGE ROAD · STONEBRIDGE DRIVE · STONEFIELD COURT · SOUTHWOOD LANE · FARLEY POND LANE · RIVER DRIVE · MALVERN LANE · CHESTNUT STREET · SOUTHFIELD COURT

N W E S

1 inch = 250 feet

0 0.045 0.09 0.18 0.27 0.36 Miles

Hydrologic Soils Groups

High Infiltration Rate: Group A or B
- Sand/Gravel (based on soil testing)
- A or B

Unknown Infiltration Rate
- A/D, B/D

Poor Infiltration Rate: Group C, D, or Rock
- C, D, or Rock
- Wetlands

APPENDIX B

- **Educational Brochure for Watershed Residents**

Protecting Needham's Ponds, Lakes, and Streams from Stormwater Pollution

Have you heard about Walker Pond?

In 2021, the Select Board approved the Walker Pond Improvement Project with implementation of the pilot program anticipated in Spring 2022. The project consists of three phases to begin the process of addressing water quality issues at Walker Pond. The first phase is a pilot project to address stormwater entering the pond. The project includes analysis of the watershed area, design and installation of pollinator infiltration strips to slow down and treat stormwater flow, installation of drainage manholes with sumps to address sediment and litter, and a catch basin marking program.

The Stormwater Effect

The health of any body of water is a direct reflection of what is happening in its surrounding watershed. When stormwater flows throughout the watershed it does not observe property lines. It picks up pollutants and carries them to wherever the water flows - typically to storm drains and then, without any treatment, into nearby streams and lakes. In Needham, a particular pollutant of concern in our waterbodies is phosphorus. Sources of phosphorus in urban runoff include plant and leaf litter, soil particles, pet waste, road salt, and fertilizers. Lawns and roads are the largest contributors. Excessive levels of phosphorus in waterbodies can cause algae and plants to grow faster than the ecosystem can handle, negatively impacting recreational use (fishing, swimming, and boating) and degrading wildlife habitat.

Since 1996, the Town has been actively working to address stormwater quality issues through a number of strategies including illicit connection removal, adding treatment structures to the Town's drainage system, and requiring environmentally sensitive site design and infiltration of stormwater on private new and redevelopment projects. These efforts are ongoing through the Town's Watershed Master Plan and Stormwater Management Plan.

What can you do?

Preventing and reducing stormwater pollution is much cheaper and easier than trying to remove it. The following are simple ways you can have a positive impact on the Town's valuable water resources.

- Lawn Care: Use the smallest amount of chemicals necessary and always follow directions. Do not overwater lawns and gardens. Do not dump or store yard waste near waterways; instead, bring it to the Recycling & Transfer Station.
- Smart Landscaping: Plant native plants, shrubs, and trees to help soak up rainwater. Allow native plants to grow as a buffer along waterways to absorb and filter out pollutants from stormwater. Divert roof runoff to drywells where water can seep into the ground rather than towards driveways and roadways.
- Be a Responsible Pet Owner: Pick up after your pet in your yard and if you're on a walk. Dispose of it in a trash can – never throw the waste down a storm drain.
- Septic System Maintenance: Phosphorus from waste decomposition in septic systems can also leach into waterways, so it is important to perform routine pumping and maintenance on septic systems.

Every little bit helps! For more tools, resources and information on stormwater best management visit the Town's website: https://www.needhamma.gov

Walker Pond

Water samples taken from the pond indicate low dissolved oxygen levels, likely due to excessive algal growth, and high phosphorus levels.

Samples taken at the inlet to the pond had high phosphorus levels, an indicator that stormwater runoff is a major source of phosphorus input to Walker Pond.

Stormwater Runoff

During a rain storm, water may run over nearby surfaces and into Walker Pond or it may go down storm drains that lead to Walker Pond. This water picks up pollutants and nutrients like phosphorus along its way.

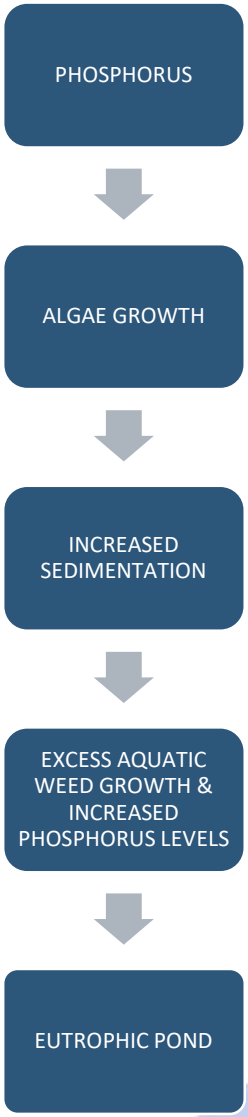
Phosphorus in the Pond

Increased levels of phosphorus cause algae to grow faster than the ecosystem can handle.

Large growths of algae are called algal blooms, which seriously reduce or eliminate oxygen in the water, leading to illnesses and death in fish.

The algae decays and eventually dies, sinking to the bottom of the pond, using up more oxygen to decompose. As it breaks down, the sediment releases more phosphorus into the pond.

The pond becomes ***eutrophic***, meaning shallow and enriched with nutrients. The water is usually green with algae, and the pond bottom mucky.



Stormwater information can be found on the Town website:
https://www.needhamma.gov

Questions? Contact Town of Needham Engineering Dept 781-455-7550

PROTECTING WALKER POND FROM STORMWATER POLLUTION:

EDUCATION FOR WATERSHED RESIDENTS

Town of Needham Incorporated 1711

How can you help?

Lawn Care Do's

- Use organic fertilizer whenever possible. Organic or slow-release fertilizer causes less harm to water. Be sure to use fertilizer with no or low phosphorus.
- Limit the use of lawn chemicals and always follow directions. Use the smallest amount necessary.
- Aerate your lawn annually.
- Properly store unused fertilizers and properly dispose of empty containers.
- Utilize the yard waste area at the Recycling & Transfer Station to dispose of leaves and grass clippings.

Lawn Care Don'ts

- Do not apply fertilizer before windy or rainy days.
- Do not overwater lawns and gardens. Use a soaker (porous) hose that releases water directly to the ground.
- Do not keep adding chemicals if you have continuing problems with your grass. Have your soil tested.
- Do not dump or store leaves, grass clippings or yard waste near waterways.

This information and more can be found at: https://www.epa.gov/nutrientpollution/what-you-can-do-your-yard

Rain Gardens

Rain gardens utilize natural processes to manage stormwater runoff and reduce its impact on water quality.

- Plant native plants, shrubs, and trees to reduce the amount of fertilizer needed and provide a way for water to soak into the ground.

Pond Buffers

Buffers intercept and slow stormwater runoff from yards, while absorbing and filtering out pollutants.

- Allow native plants to create a buffer strip along shoreline.

A Town project was approved to design and install filter strips and infiltration. Construction at Walker Pond is anticipated in Spring 2022.

Image: GoogleMaps, Street View

Pet Waste

Pet waste left in yards and communities can have adverse effects on the environment. Stormwater runoff can carry the nutrients in waste to the pond, encouraging weed and algae growth.

- Pick up after your pet in your yard.
- On a walk? Bring a plastic bag with you.
- Dispose of it by placing in a trash can. *Never throw waste down a storm drain.*

Septic Systems

Phosphorus from waste decomposition in septic systems can leach into the pond.

- Perform routine pumping and maintenance on septic systems.

The Town completed a sewer extension project this past year in Walker Lane to decommission septic systems that were directly adjacent to the pond.

APPENDIX C

- **Educational Materials for Homeowner Construction Projects**

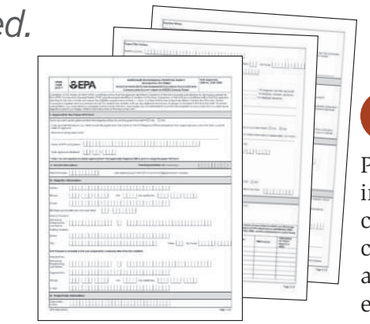
EPA 830-F-15-001
December 2015

EPA United States Environmental Protection Agency

Stormwater Pollution Prevention for Small Residential Construction Sites

10 Steps to Stormwater Pollution Prevention on Small Residential Construction Sites

Stormwater management on small residential construction sites need not be complicated.



1 Protect Any Areas Reserved for Vegetation or Infiltration and Preserve Existing Trees

If you will be installing infiltration-based features such as rain gardens or bioswales, make sure these areas are designated as off limits to avoid compaction.

Save time and money by preserving existing mature trees during construction. Preserving mature trees minimizes the amount of soil that needs to be stabilized once construction is complete, and minimizes the amount of runoff during and after construction activity.

2 Stockpile Your Soil

EPA's CGP requires operators to preserve native topsoil on site unless infeasible and protect all soil storage piles from run-on and runoff. For smaller stockpiles, covering the entire pile with a tarp may be sufficient.

3 Protect Construction Materials from Run-On and Runoff

At the end of every workday and during precipitation events, provide cover for materials that could leach pollutants.

4 Designate Waste Disposal Areas

Clearly identify separate waste disposal areas on site for hazardous waste, construction waste, and domestic waste by designating with signage, and protect from run-on and runoff.

5 Install Perimeter Controls on Downhill Lot Line

Install perimeter controls such as sediment filter logs or silt fences around the downhill boundaries of your site.

6 Install Inlet Controls

Sediment control logs, gravel barriers, and sand or rock bags are options for effective inlet controls. Make sure to remove accumulated sediment whenever it has reached halfway up the control.

7 Install a Concrete/Stucco Washout Basin

Designate a leak-proof basin lined with plastic for washing out used concrete and stucco containers. Never wash excess stucco or concrete residue down a storm drain or into a stream!

8 Maintain a Stabilized Exit Pad

Minimize sediment track-out from vehicles exiting your site by maintaining an exit pad made of crushed rock spread over geotextile fabric. If sediment track-out occurs, remove deposited sediment by the end of the same work day.

9 Post Your NOI and Keep an Up-to-Date Copy of Your SWPPP on Site

Post a sign or other notice of your permit coverage, including your NPDES tracking number and site contact information. Also, keep a copy of your complete and up-to-date SWPPP on site and easily accessible, including site maps showing where each BMP is or will be installed.

10 Site Stabilization

Immediately stabilize exposed portions of the site whenever construction work will stop for 14 or more days, even if work is only temporarily stopped. Remember, final stabilization is required prior to terminating permit coverage.

EPA's Construction General Permit (CGP) Small Residential Lot Stormwater Pollution Prevention Plan (SWPPP) Template

Who needs to seek coverage under the EPA CGP?

Stormwater discharges from construction activities that disturb one or more acres, or smaller sites disturbing less than one acre that are part of a common plan of development or sale, are regulated under the National Pollutant Discharge Elimination System (NPDES) stormwater permitting program. Prior to the start of construction, construction operators must obtain coverage under an NPDES permit, which is administered either by the state (if it is authorized to operate the NPDES program) or EPA. Where EPA is the permitting authority, operators may seek coverage under the EPA CGP. The CGP requires operators of construction sites to meet effluent limits (i.e., through the implementation of erosion and sediment controls) and requires operators to develop a SWPPP detailing erosion and sediment controls and pollution prevention measures that will be implemented to meet the requirements of the CGP.

What is the Small Residential Lot SWPPP Template?

The Small Residential Lot SWPPP Template is designed to help operators of small residential sites develop a streamlined SWPPP that meets the minimum requirements of EPA's CGP. This simplified template does not change, relax, or modify any existing conditions in the CGP, including the requirement to submit a Notice of Intent (NOI) for permit coverage.

How does it work?

Think of the Small Residential Lot SWPPP Template as a 1040EZ tax form for small construction sites. All of the same requirements apply, but compliance options are focused on only those controls that apply to small residential lot construction, and they are presented in a simplified, user-friendly format.

The Small Residential Lot SWPPP Template streamlines SWPPP development by providing a simplified menu of erosion and sediment control and pollution prevention practices that operators can select from to complete a SWPPP consistent with the minimum requirements in the CGP.

Easy to Use BMP Menu

The Small Residential Lot SWPPP Template provides operators with a walk-through menu of typical erosion and sediment control and pollution prevention practices (i.e., Best Management Practices or BMPs) appropriate for small construction sites.

Illustrated Appendix with Pull-Out BMP Spec Sheets

Clear, step-by-step BMP spec sheets for each practice you choose are provided in an illustrated appendix that you may edit based on your site-specific conditions.

Does my project qualify for EPA's Small Residential Lot SWPPP Template?

In order to use EPA's streamlined template, your site must meet a series of criteria, including:

- ✔ Projects must disturb less than one acre of land;
- ✔ Projects must be located outside of sensitive areas (areas with endangered species concerns, historic preservation issues, wetlands, etc.);
- ✔ Projects must not cause disturbance within 50 ft of a water of the U.S.;
- ✔ Projects must not require the use of chemical treatment for stormwater; and
- ✔ Projects must not disturb steep slopes.

To access EPA's streamlined Small Residential Lot SWPPP Template, visit:
www.epa.gov/national-pollutant-discharge-elimination-system-npdes/stormwater-discharges-construction-activities

Stormwater Pollution Prevention Guide

FOR CONSTRUCTION INDUSTRY

Protect your business, your clients and your reputation by installing and maintaining construction site stormwater best management practices (BMPs) properly.

You'll not only avoid fines and work stoppages, you'll be protecting the waterways your community depends on, and earning a well deserved reputation.

For more information visit:
www.neponsetstormwater.org

Stormwater and the Construction Industry

Protect Natural Features

Bad

Good

- Minimize Clearing.
- Minimize the amount of exposed soil.
- Identify and protect areas where existing vegetation, such as trees, will not be disturbed by construction activity.
- Protect streams, stream buffers, wild woodlands, wetlands.or other sensitive areas from any disturbance or construction activity by fencing or otherwise clearly marlking these areas.

Construction Phasing

Bad

Good

- Sequence construction activities so that the soil is not exposed forlong periods of time.
- Schedule or limit grading to small areas.
- Install key sediment control practices before site grading begins.
- Schedule site stabilization, such as landscaping, to be completed immediately after the land has been graded to its final contour.

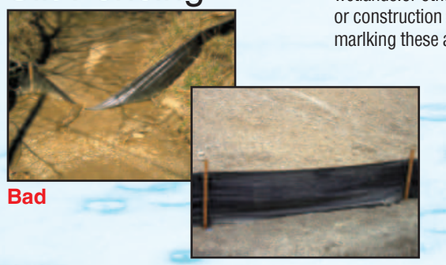
Vegetative Buffers

Bad

Good

- Protect and install vegetative buffers along water-bodies to slow and filter stormwater runoff.
- Maintain buffers by mowing or replanting periodi-cally to ensure their effectiveness.

Silt Fencing



Bad

Good

- Inspect and maintain silt fences after each rainstorm.
- Make sure the bottom of the silt fence is buried in the ground.
- Securely attach the material to the stakes.
- Don't place silt fences in the middle of a waterway or use them as a check dam.
- Make sure stormwater is not flowing around the silt fence.

Maintain your BMPs!

www.neponsetstormwater.org

Site Stabilization

Bad

Good

- Vegetate, mulch, or otherwise stabilize all exposed areas as soon as land alterations have been com-pleted.

Construction Entrances

Bad

Good

- Remove mud and dirt from the tires of construction vehicles before they enter a paved roadway.
- Properly size entrance BMPs for all anticipated vehicles.
- Make sure that the construction entrance does not become buried in soil.

Slopes

Bad

Good

- Rough grade or terrace slopes.
- Break up long slopes with sediment barriers, or under drain, or divert stormwater away from slopes.

Dirt Stockplies

Bad

Good

- Cover or seed all dirt stockpiles.

Storm Drain Inlet Protection

Bad

Good

- Use rock or other appropriate material to cover the storm drain inlet to filter out trash and debris.
- Make sure the rock size is appropriate (usually 1 to 2 inches in diameter).
- If you use inlet filters, maintain them regularly.

Brought to you by the Neponset Stormwater Partnership, a joint effort of the Metropolitan Area Planning Council, the Neponset River Watershed Association, and the municipalities of Boston, Canton, Dedham, Foxboro, Medfield, Milton, Norwood, Sharon, Stoughton, Randolph, Walpole and Westwood.

Construction

Stormwater Pollution Prevention Guide

Stormwater pollution is the bacteria, chemicals, metals, nutrients and other contaminants that wash down stormdrains and into waterways.

Place
Stamp
Here

neponset stormwater partnership

Many folks don't make the connection that storm drains and waterways are connected. Every time something gets washed down a stormdrain, it can affect the cleanliness and health of the water that we rely on for drinking and recreation.

Common stormwater pollutants include: Antifreeze, Detergents, Fertilizers, Gasoline, Household Chemicals, Motor Oil, Paints, Pesticides, Pet Waste, Road Salt, Solvents, Yard Waste

You can help to protect local waterways from contaminants by eliminating practices that contribute to stormwater pollution. Picking up after pets and disposing of waste in a trash can is a great start!

Preventing storm water pollution helps to keep our waterways clean for future generations. **Consider your actions and do your part for clean water.**

Learn more about preventing stormwater pollution:
www.neponsetstormwater.org

Construction

The federal EPA will soon be imposing requirements on municipal stormwater systems, which may be very costly for towns to implement.

Minimizing the pollutants that run off of your worksite and into stormdrains may reduce the need for towns to raise revenue to comply with these new federal rules.

Taking low cost actions now may result in significant future savings for you in the future.

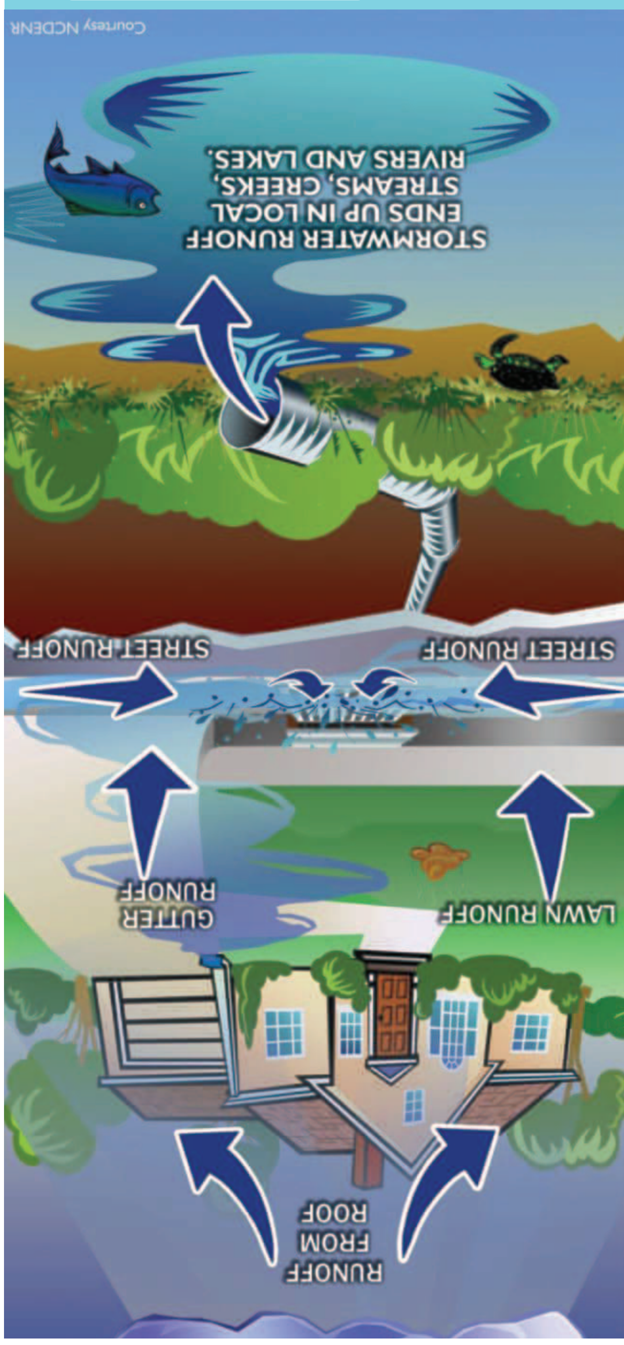
Stormwater runoff from construction activities is regulated because it can have a significant impact on water quality by contributing sediment and other pollutants to creeks, streams, lakes, etc.

In order to discharge stormwater from a construction site, all construction projects that disturb one acre or more of land must have either:

- an individual stormwater permit, or
- coverage under US EPA's general permit

Disturbance includes, but is not limited to soil disturbance, clearing, grading, and excavation. Operators of sites disturbing less than one acre are also required to obtain a permit if their activity is part of a "larger common plan of development or sale" with a planned disturbance of one acre or greater.

In addition to these statewide rules, you may be required to meet additional local stormwater and erosion control regulations. **Check with your city or county government to determine if additional local rules apply to your construction project.**



We're working with your town to reduce stormwater pollution.

Learn more by visiting **www.neponsetstormwater.org**

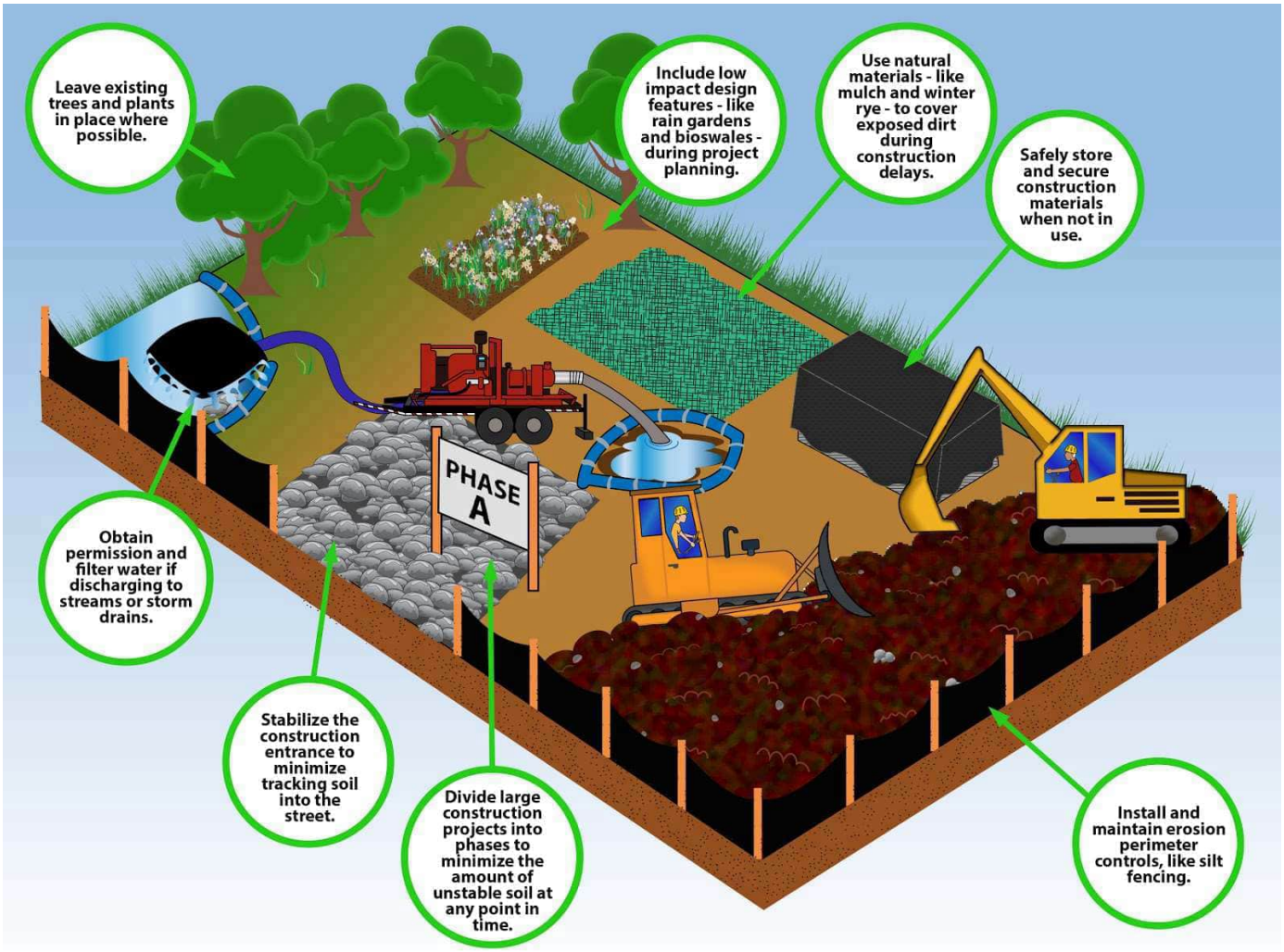
neponset stormwater partnership

YOUR LOGO HERE

THINK BLUE MASSACHUSETTS

Plan Ahead to Prevent Pollution:

Tips to Reduce Stormwater Runoff During Construction



Contact EPA and your municipality to make sure you have the proper permits before beginning construction.

Construction companies can do their part to keep Massachusetts' waterways clean.

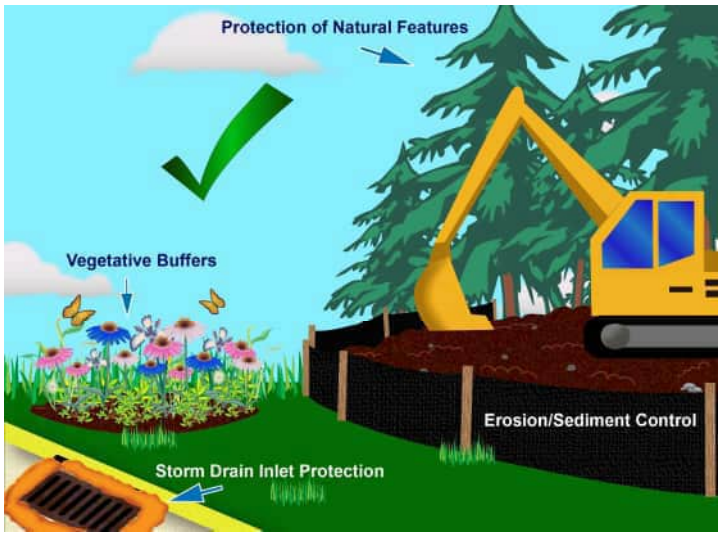
Find more tips like these at www.ThinkBlueMassachusetts.org.

THINK BLUE MASSACHUSETTS

Developers

Stop Erosion in its Tracks to Keep Our Waters Clean

DO



DON'T

What can you do?

- Find out if you need a Construction General Permit.
- Visit NAME OF TOWN's conservation commission before you disturb the soil.
- Pick a combination of erosion and sediment controls that work for your site.
- This includes practices that protect natural landscape features, like streams and wetlands, and stabilize soil.
- You will also need to use practices to protect and maintain silt fences, storm drain inlets, and construction entrances.

Why is this necessary?

- Water that falls on your construction site either soaks into the ground or runs off into storm drains.
- Water and pollution that goes into storm drains eventually ends up in lakes, rivers, and streams.
- Once these pollutants reach waterways, they can harm fish and other wildlife. They can even make our water unsafe to drink.
- Most importantly, allowing polluted runoff to leave your site and enter a storm drain or waterway is against the law.

Learn more at: www.ThinkBlueMassachusetts.org

Adapted from materials provided by Neponset Stormwater Coalition and US EPA.

THINK BLUE MASSACHUSETTS

APPENDIX D

- ***Guide to Storm Drain Markings*, Town of Wellesley**

NEW

GUIDE TO STORM DRAIN MARKING

TOWN OF WELLESLEY, DPW

ENGINEERING DIVISION

November 25, 2020

Table of Contents

Introduction

The purpose of this guide is to provide a how-to instruction for the Town residents and volunteers interested in assisting the Town of Wellesley Department of Public Works (DPW) with the Storm Drain Marking Program, which has been encouraged by the Environmental Protection Agency (EPA) to reduce debris and pollutants from entering waterways. The EPA has assisted with the implementation of Storm Drain Marking Programs throughout the country and this guide is a compilation of those programs and how-to guides.

This guide does not represent a complete or exhaustive approach of marking programs nor is the Town endorsing one program over another. Our hope is to provide schools, civic groups, such as the boys and girls scouts, tools to help implement a successful citizen-education program to reduce dumping and pollutants from entering our local waterways.

What is Nonpoint Source?

Nonpoint Source (NPS) pollution is triggered when rainfall and snowmelt carries debris and pollutants over land to waterways such as streams, rivers, ponds and wetland areas and eventually to the Charles River. We all contribute to NPS many times without meaning to. NPS pollution may consist of fertilizers, grease, oil, gasoline, antifreeze, road salt, paint solvents, animal waste and even grass clippings and fallen leaves. NPS may also consist of atmospheric deposition, sediment and erosion control and seepage of sewerage from septic systems.

Many states have reported that the leading cause of water quality issues are a result of NPS. NPS may effect drinking water supplies, recreation, fisheries and wildlife. For more information, please refer to the follow website form the EPA: https://www.epa.gov/nps/basic-information-about-nonpoint-source-nps-pollution

What is a Storm Drain?

The most common route of NPS is through a storm drain system. Storm drainage systems are networks of catch basins, drain manholes, drain pipes, and outlets that are built under roadways, parking lots, fields or any place were stormwater collects and could cause flooding. Other terms that are used in the storm drainage system are curbs, gutters, channels, ditches, pipes or culverts.

Here are some examples of the basic components of a drainage system.

Catch Basin

Drain Manholes

Why be Concerned with What Enters a Storm Drain System?

A drainage system is designed to receive stormwater runoff from pavement, sidewalks, lawn areas into the drainage system via catch basins which discharge to nearby waterbodies. A drainage system is separate from a sanitary sewer system that collects sewerage and discharges to a treatment plant. NPS has the potential to harm the Town's streams, rivers, ponds and wetland areas because the drainage system typically does not pretreat stormwater prior to discharging to our waterways.

Why Mark Storm Drains?

Marking storm drains is a great way to make people aware that dumping into a catch basin is not allowed because the stormwater drains from the catch basin to the Charles River. The storm drain marking is an educational tool to remind people of the connection between the storm drain and local waterways.

Labeling Storm Drains

One of the first visible signs of the program will be the placement of markings on or behind a catch basin. There are three marking options used in the industry; stenciling, glue-on or self-adhesive markers and permanent pre-cast markings. The Town uses a 4" diameter curb marker that is glued-on at behind catch basins. These markers are easily visible from the roadway or sidewalk.

The storm marking program consists of gluing storm drain markers to curbing behind a catch basin. Other drain markers include cast iron metal plaques. Following are two examples of drain markers that are used in Wellesley.

Drain marker behind catch basin

Fig.1

Cast iron plaque

Fig.2

Provided in Appendix A is a copy of the instructions for installing curb markers with an adhesive, which is the type of storm drain marker that the Town of Wellesley uses. The drain marking brand we use is found at the following website. www.dasmanufacturing.com.

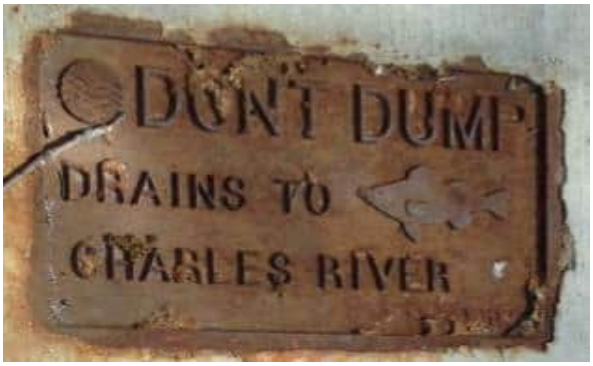
The cost for a 4" drain marker is $4.55 each per 50-249 and the glue costs $8.75. These prices are as of the date of this guide and subject to change by the manufacturer. Additional vendors and sources of information pertaining to storm drain marking may also be available through other sources.

Types of Messages

The purpose of drain markers is to prevent deliberate dumping into the storm drain. The Town's focus is "drains to Charles River" because our main tributary is the Charles River. Many of our brooks such as Fuller Brook drain to the Charles River. Lake Waban and Morse's Pond also drain to the Charles River.

Decal

Cast Iron Marker



The placement of the marker is positioned behind a catch basin, as shown on the figure 1 &2. The markers are placed on granite or asphalt curbing directly behind the catch basin, centered on the catch basin. It is our hope that the message will deter littering, dumping chemicals, oils, solvents, paints and other practices that contribute to NPS.

Municipalities Role

The role of the Town of Wellesley DPW is to coordinate the volunteer marking projects. Coordination is as follows:

- Provide marking kits containing all the materials and tools needed to carry out the marking project;
- Provide GIS mapping of the locations identifying catch basins to be marked;
- Train the volunteers of the safety requirements which may include the following equipment: traffic cones, safety vests, masks/goggles and gloves;
- Provide incentives and rewards for volunteer work such as T-shirts, certificates, etc.

Planning Your Marking Project

Before Marking:

- Organizing Volunteers: Volunteers should sign a liability waiver. A sample copy is provided in Appendix B. Make sure the Police Department is informed prior to start of the work.
- Map the neighborhood: Use a GIS map to identify areas were storm drain marking is scheduled to be performed, including those already marked.
- Keep weather in mind: The drain marking project is better performed during dry and warm weather, above 50°. Cold, rainy days will not work due to the glue not properly adhering.
- Notify the Neighborhood: The neighborhood should be notified a week before marking the drains. Flyers may be the best way to notify the neighborhood, explaining the storm drain program and request that people avoid parking cars within 20 feet of a storm drain that is planned to be marked.

Day of the Event:

- Check the weather: If inclement weather exists, consider having an alternative rain date.
- Collect all liability wavers.
- Review all safety procedures: See Appendix C.
- Divide volunteers into working groups: One or two adults should be assigned to supervise each group. A group should consist of four to six people.
- Distribute supplies to each work group.
- Assign work sections to each group: Provide a GIS map for each group.
- Mark: Stenciling and curbing instructions in Appendix A.
- Check for missed drains: Have volunteers from each group check that all the storm drains in the group's area have been marked.
- Clean up: Clean up the work site after completing the markings.
- Celebrate: Thank the volunteers for a job well done. Hand out recognition certificates.

Remember

Mailboxes are only to be used for mail bearing postage. It is illegal to put anything in the mailbox that has not been delivered by the U.S. Postal Service. Do not place any of your educational materials in a mailbox!

On-Line Resources

Vendors

- https://www.berntsen.com/Parks-Recreation/Storm-Drain-Markers
- http://www.dasmanufacturing.com/
- https://www.almetek.com/storm-drain-markers/

CASTINGS

- https://www.ejco.com/am/en/about-us/locations

USEPA

https://www.epa.gov/nps
https://cfpub.epa.gov/npstbx/index.html
https://www.epa.gov/nps/resources-students-and-educators-about-nonpoint-source-nps-pollution

What You Can Do to Reduce Nonpoint Source Pollution

NOTE: Feel free to use any of the following USEPA information for articles in your municipal or township newsletter!

Household Chemicals

- Be aware that many chemicals commonly used around the home are toxic. Select less toxic alternatives. Use non-toxic substitutes wherever possible.
- Buy chemicals only in the amount you expect to use, and apply them only as directed. More is not better.
- Take unwanted household chemicals to hazardous waste collection centers; do not pour them down the drain. Pouring chemicals down the drain may disrupt your septic system or else contaminate treatment plant sludge.
- Never pour unwanted chemicals on the ground. Soil cannot purify most chemicals, and they may eventually contaminate runoff.
- Use low-phosphate or phosphate-free detergents.
- Use water-based products whenever possible.
- Leftover household pesticide? Do not indiscriminately spray pesticides, either indoors or outdoors, where a pest problem has not been identified. Dispose of excess pesticides at hazardous waste collection centers.

Landscaping and gardening

- When landscaping your yard, select plants that have low requirements for water, fertilizers, and pesticides.
- Cultivate plants that discourage pests. Minimize grassed areas which require high maintenance.
- Preserve existing trees, and plant trees and shrubs to help prevent erosion and promote infiltration of water into the soil.
- Use landscaping techniques such as grass swales (low areas in the lawn) or porous walkways to increase infiltration and decrease runoff.
- Leave lawn clippings on your lawn so that nutrients in the clippings are recycled and less yard waste goes to landfills.
- If you elect to use a professional lawn care service, select a company that employs trained technicians and follows practices designed to minimize the use of fertilizers and pesticides.
- Compost your yard trimmings. Compost is a valuable soil conditioner which gradually releases nutrients to your lawn and garden. (Using compost will also decrease the amount of fertilizer you need to apply.) In addition, compost retains moisture in the soil and thus helps you conserve water.
- Spread mulch on bare ground to help prevent erosion and runoff.
- Test your soil before applying fertilizers. Overfertilization is a common problem, and the excess can leach into ground water or contaminate rivers or lakes. Also, avoid using fertilizers near surface waters. Use slow- release fertilizers on areas where the potential for water contamination is high, such as sandy soils, steep slopes, compacted soils, and verges of water bodies. Select the proper season to apply fertilizers: Incorrect timing may encourage weeds or stress grasses. Do not apply pesticides or fertilizers before or during rain due to the strong likelihood of runoff.
- Calibrate your applicator before applying pesticides or fertilizers. As equipment ages, annual adjustments may be needed.
- Keep storm gutters and drains clean of leaves and yard trimmings. (Decomposing vegetative matter leaches nutrients and can clog storm systems and result in flooding.)

Septic Systems

- Improperly maintained septic systems can contaminate ground water and surface water with nutrients and pathogens. By following the recommendations below, you can help ensure that your system continues to function properly.
- Inspect your septic system annually.
- Pump out your septic system regularly. (Pumping out every three to five years is recommended for a three-bedroom house with a 1,000-gallon tank; smaller tanks should be pumped more often.)
- Do not use septic system additives. There is no scientific evidence that biological and chemical additives aid or accelerate decomposition in septic tanks; some additives may in fact be detrimental to the septic system or contaminate ground water.
- Do not divert storm drains or basement pumps into septic systems.
- Avoid or reduce the use of your garbage disposal. (Garbage disposals contribute unnecessary solids to your septic system and can also increase the frequency your tank needs to be pumped.)
- Don’t use toilets as trash cans! Excess solids may clog your drain field and necessitate more frequent pumping.

Source: EPA Journal article, November/December 1991

Water Conservation

Homeowners can significantly reduce the volume of wastewater discharged to home septic systems and sewage treatment plants by conserving water. If you have a septic system, by decreasing your water usage, you can help prevent your system from overloading and contaminating ground water and surface water. (Seventy-five percent of drain field failures are due to hydraulic overloading.)

- Use low-flow faucets, shower heads, reduced-flow toilet flushing equipment, and water saving appliances such as dish and clothes washers. (See table on water savings possible with conservation devices.)
- Repair leaking faucets, toilets, and pumps.
- Use dishwashers and clothes washers only when fully loaded.
- Take short showers instead of baths and avoid letting faucets run unnecessarily.
- Wash your car only when necessary; use a bucket to save water. Alternatively, go to a commercial carwash that uses water efficiently and disposes of runoff properly.
- Do not over-water your lawn or garden. Overwatering may increase leaching of fertilizers to ground water.
- When your lawn or garden needs watering, use slow watering techniques such as trickle irrigation or soaker hoses. (Such devices reduce runoff and are 20percent more effective than sprinklers.)

Other Areas Where You Can Make a Difference • Clean up after your pets. Pet waste contains nutrients and pathogens that can contaminate surface water.

- Drive only when necessary. Driving less reduces the amount of pollution your automobile generates. Automobiles emit tremendous amounts of airborne pollutants, which increase acid rain; they also deposit toxic metals and petroleum byproducts into the environment. Regular tune-ups and inspections can help keep automotive waste and byproducts from contaminating runoff. Clean up any spilled automobile fluids.
- Recycle used oil and antifreeze by taking them to service stations and other recycling centers. Never put used oil or other chemicals down stormdrains or in drainage ditches. (One quart of oil can contaminate up to two million gallons of drinking water!)

Community Action

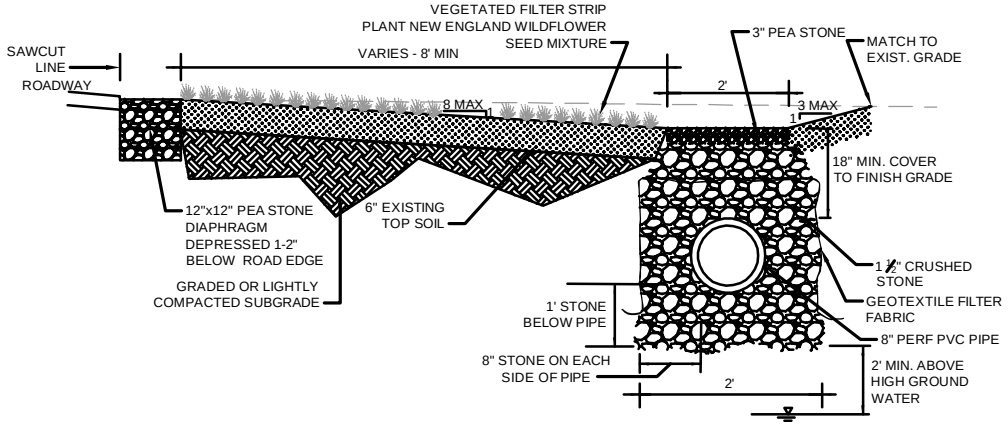
- Participate in clean-up activities in your neighborhood.
- Write or call your elected representatives to inform them about your concerns and encourage legislation to protect water resources.
- Get involved in local planning and zoning decisions and encourage your local officials to develop erosion and sediment control ordinances.
- Promote environmental education. Help educate people in your community about ways in which they can help protect water quality. Get your community groups involved.

Source: Village of Lincolnshire

Source: EPA Journal article, November/December 1991

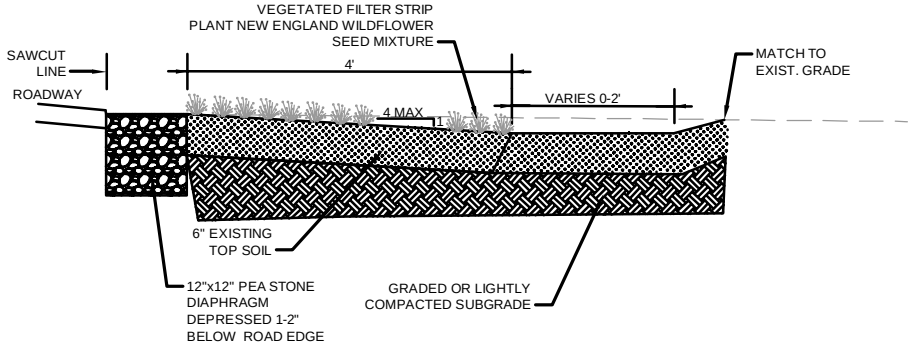
APPENDIX E

- **BMP Details**



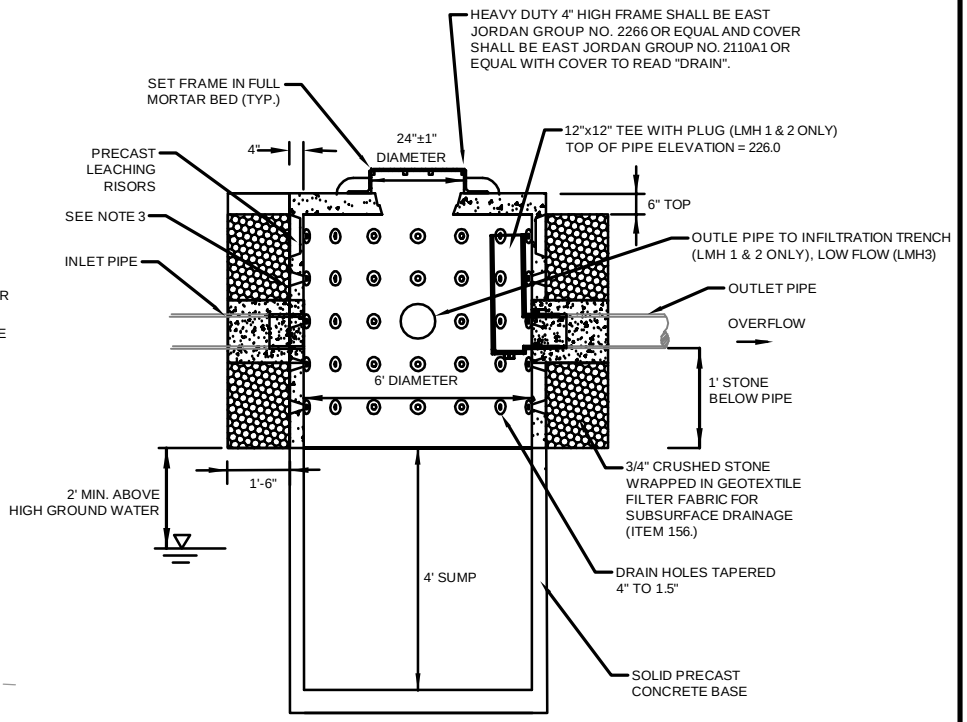
VEGETATED FILTER STRIP WITH INFILTRATION TRENCH

NOT TO SCALE



VEGETATED FILTER STRIP WITH SWALE

NOT TO SCALE



NOTES:
1. CONCRETE: 4,000 PSI MINIMUM AFTER 28 DAYS.
2. STRUCTURE TO ACCOMODATE H-20 LOADING.
3. PROVIDE GALVANIZED WIRE SCREEN AROUND BASIN TO PREVENT MIGRATION OF STONE.

LEACHING MANHOLE WITH SUMP (LMH)

NOT TO SCALE

BETA

WATERSHED NO. 2 ANALYSIS

APPENDIX E - BMP DETAILS

VEGETATED FILTER STRIP
INFILTRATION SWALE/TRENCH/LMH SYSTEM

Figure No. 1

Scale = NOT TO SCALE

APPENDIX F

- **Maps of Bacteria Hits**

Town of Needham, MA
Watershed No. 2
Bacteria Hits

Outfall 02-43
Wet Weather
E. Coli (MPN/100mL) = 920.84
Surfactants (mg/L) = 0.25-0.50

Outfall 02-34
Wet Weather
E. Coli (MPN/100mL) = 261.25
Surfactants (mg/L) = 0.25

Outfall 02-51
Wet Weather
E. Coli (MPN/100mL) = 34,432
Chlorine (mg/L) = 0.04

Outfall 02-48
Wet Weather
E. Coli (MPN/100mL) = 579.43
Surfactants (mg/L) = 0.25-0.50

Outfall 02-07
Wet Weather
E. Coli (MPN/100mL) = 4,810
Chlorine (mg/L) = 0.04
Surfactants (mg/L) = 0.25

Outfall 02-31
Wet Weather
E. Coli (MPN/100mL) = 15,531.2
Surfactants (mg/L) = 0.50

Outfall 02-04
Wet Weather
E. Coli (MPN/100mL) = 109,500
Chlorine (mg/L) = 0.04
Surfactants (mg/L) = 0.25-0.50

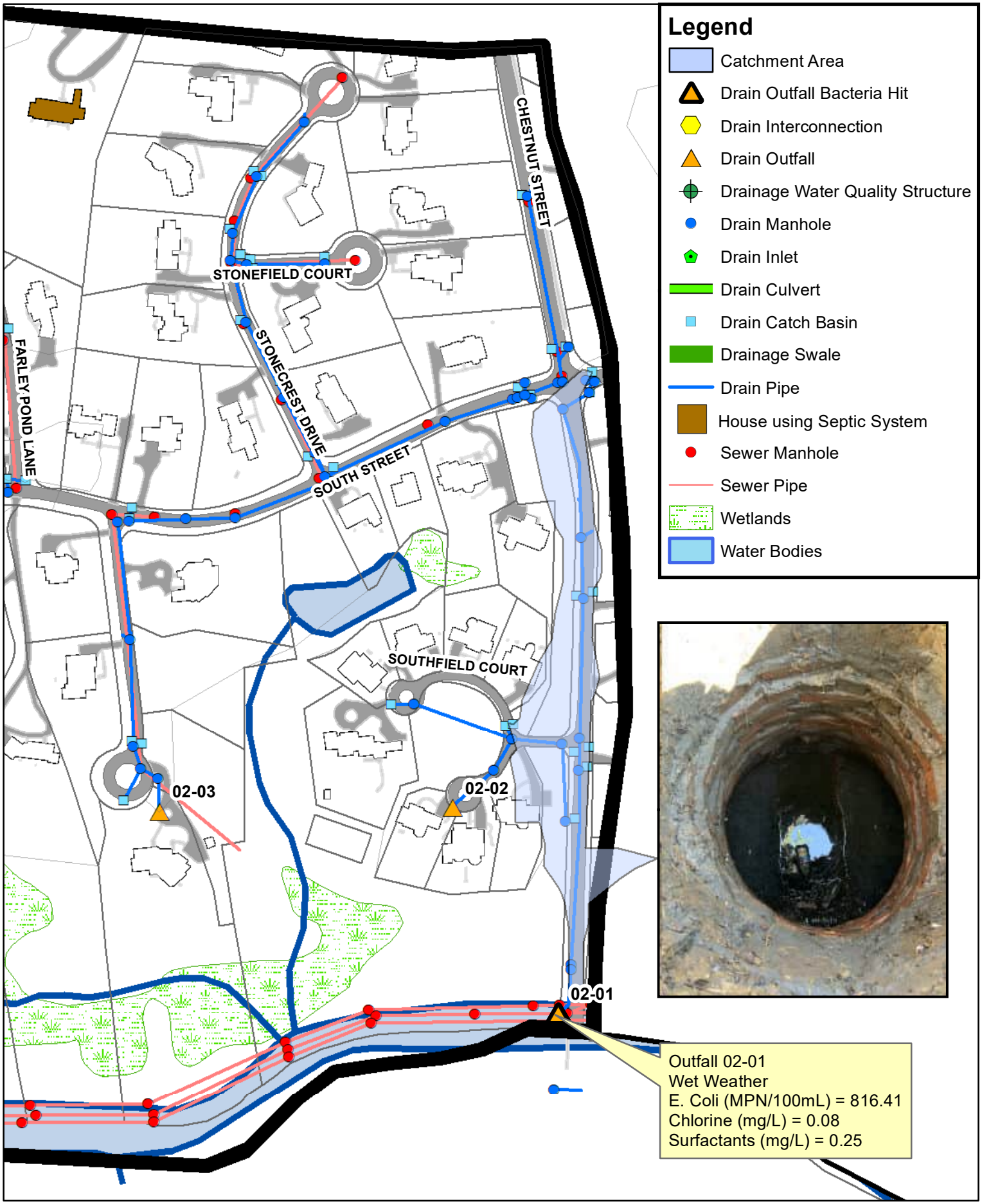
Outfall 02-01
Wet Weather
E. Coli (MPN/100mL) = 816.41
Chlorine (mg/L) = 0.08
Surfactants (mg/L) = 0.25

Outfall 02-17
Wet Weather
E. Coli (MPN/100mL) = 240
Surfactants (mg/L) = 0.25

Legend

- Drain Outfall Bacteria Hit
- Drain Interconnection
- Drain Outfall
- Drainage Water Quality Structure
- Drain Manhole
- Drain Inlet
- Drain Culvert
- Drain Catch Basin
- Drainage Swale
- Drain Pipe
- Sewer Manhole
- Sewer Pipe
- Wetlands
- Water Bodies
- House using Septic System

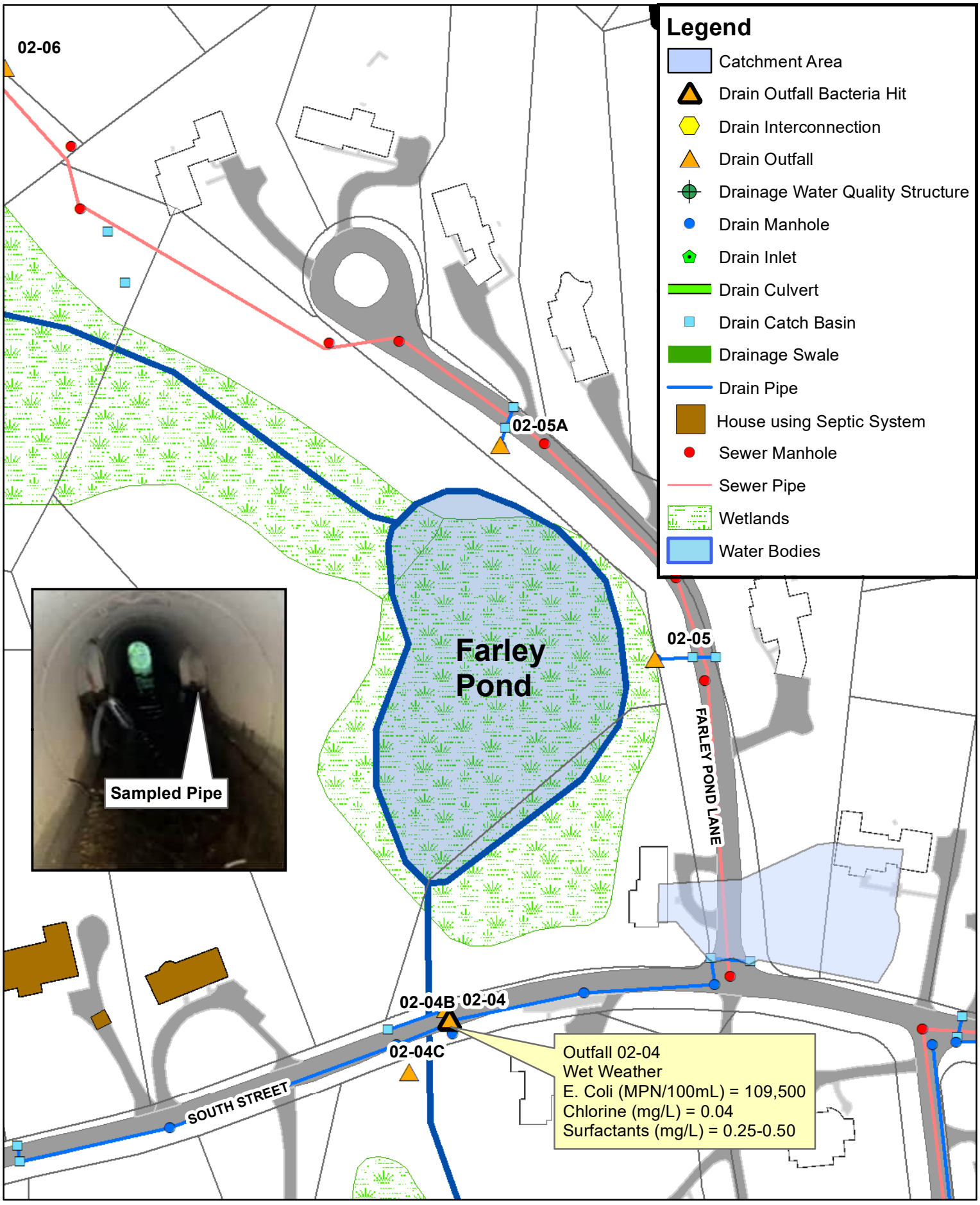
BETA
www.BETA-Inc.com
1 inch = 500 feet
320 160 0 320 Feet



1 inch = 250 feet

Town of Needham, MA
Watershed No. 2
Outfall 02-01

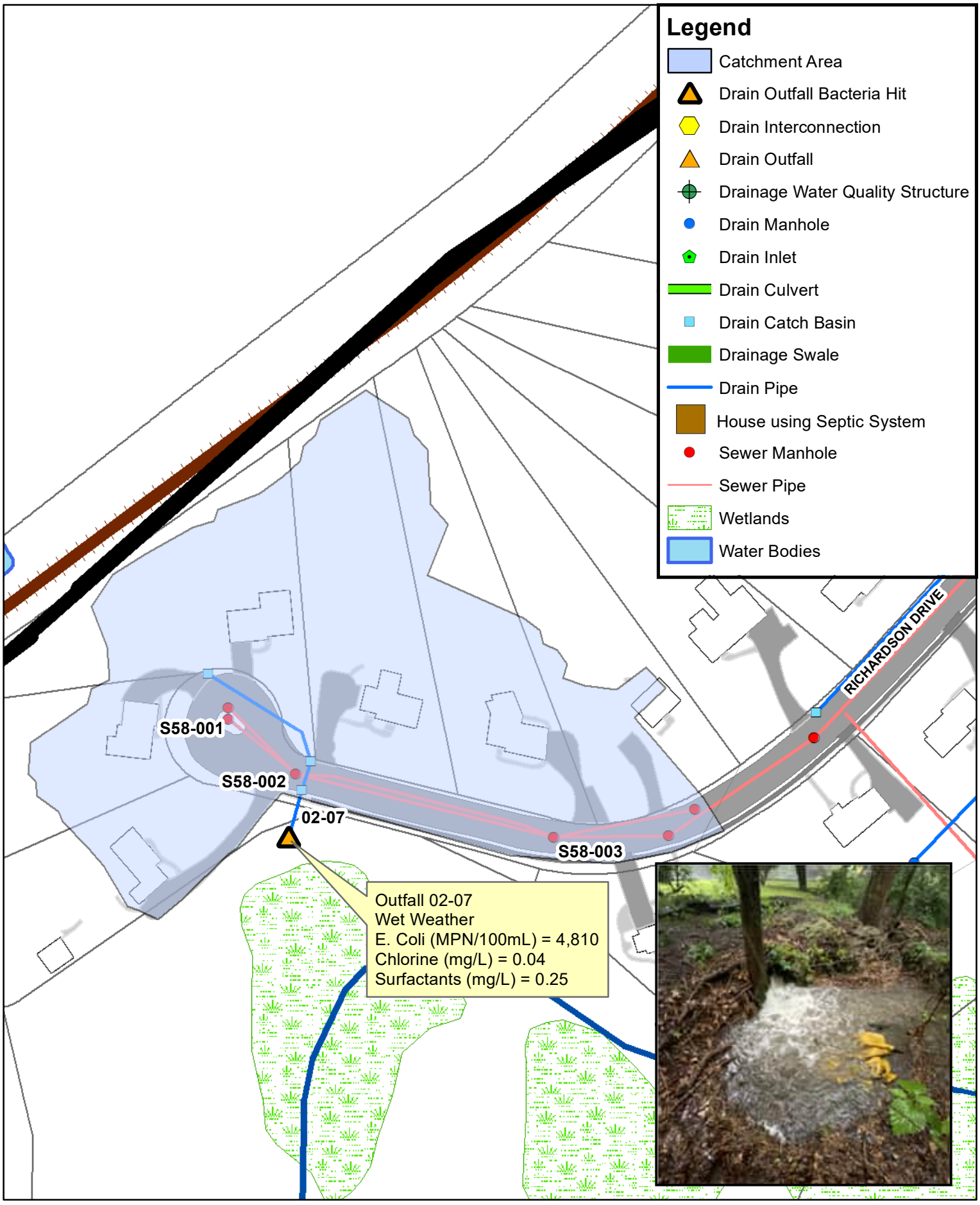
BETA
www.BETA-Inc.com



1 inch = 125 feet

Town of Needham, MA
Watershed No. 2
Outfall 02-04

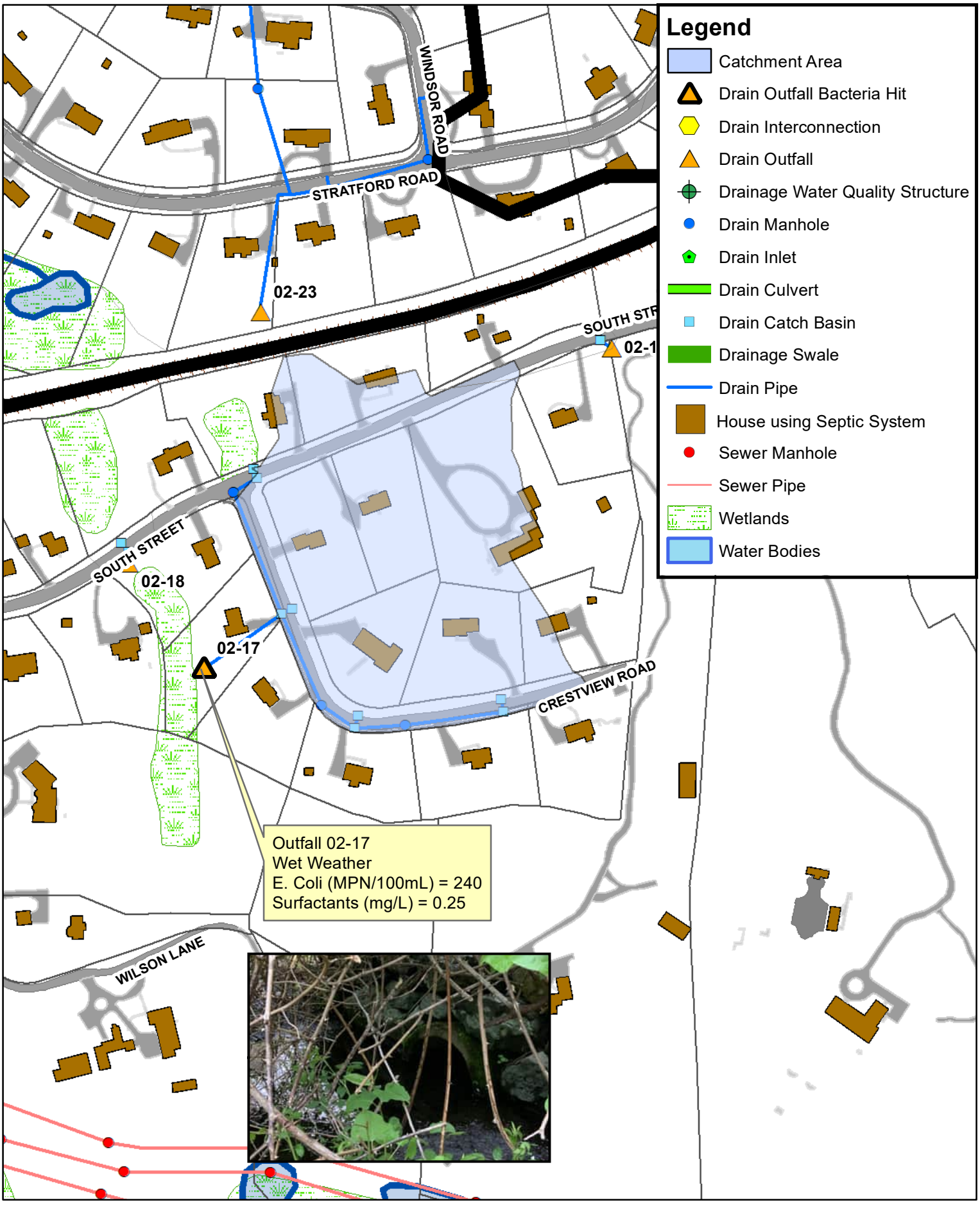
BETA
www.BETA-Inc.com



1 inch = 125 feet

Town of Needham, MA
Watershed No. 2
Outfall 02-07

BETA
www.BETA-Inc.com



1 inch = 250 feet

Town of Needham, MA
Watershed No. 2
Outfall 02-17

BETA
www.BETA-Inc.com

Legend

- Catchment Area
- Drain Outfall Bacteria Hit
- Drain Interconnection
- Drain Outfall
- Drainage Water Quality Structure
- Drain Manhole
- Drain Inlet
- Drain Culvert
- Drain Catch Basin
- Drainage Swale
- Drain Pipe
- House using Septic System
- Sewer Manhole
- Sewer Pipe
- Wetlands
- Water Bodies

02-38

CARLETON DRIVE

BRIDLE TRAIL ROAD

02-36

02-34

02-33

SCOTT ROAD

02-32

CENTRAL AVENUE

Note: Stream enters drainage system and outlets at outfall location.

COUNTRY WAY

VILLAGE LANE

Outfall 02-31
Wet Weather
E. Coli (MPN/100mL) = 15,531.2
Surfactants (mg/L) = 0.50

02-31

CHARLES RIVER STREET

COUNTRY WAY

STRATFORD ROAD

1 inch = 300 feet

Town of Needham, MA
Watershed No. 2
Outfall 02-31

BETA
www.BETA-Inc.com

Outfall 02-34
Wet Weather
E. Coli (MPN/100mL) = 261.25
Surfactants (mg/L) = 0.25

02-41
02-39
02-40
02-37
02-35
02-34
02-36
02-33
02-32
02-31

CRANBERRY LANE
COUNTRY WAY
SCOTT ROAD
COUNTRY WAY
COUNTRY WAY
WHITE PINE ROAD

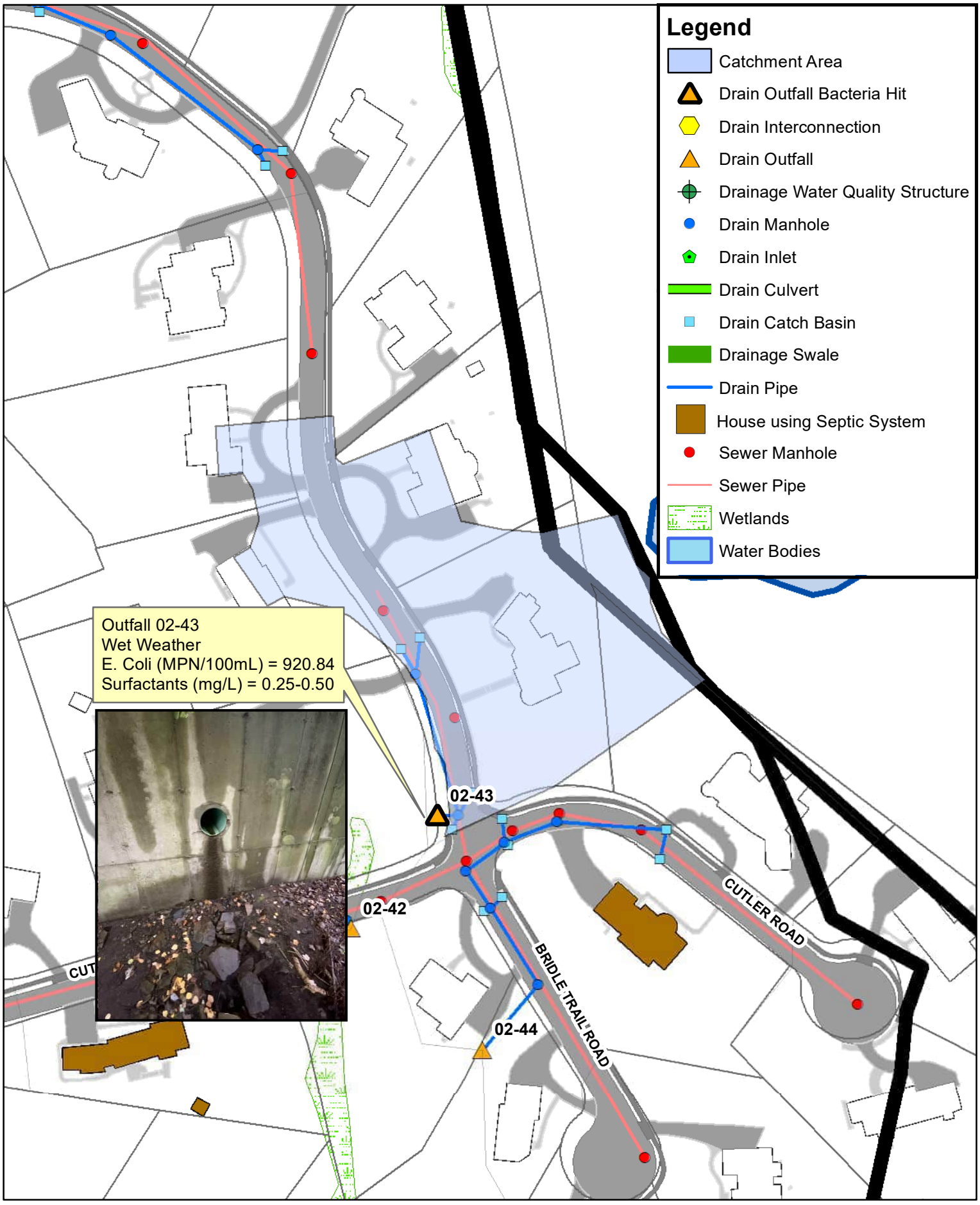
Legend

- Catchment Area
- Drain Outfall Bacteria Hit
- Drain Interconnection
- Drain Outfall
- Drainage Water Quality Structure
- Drain Manhole
- Drain Inlet
- Drain Culvert
- Drain Catch Basin
- Drainage Swale
- Drain Pipe
- House using Septic System
- Sewer Manhole
- Sewer Pipe
- Wetlands
- Water Bodies

1 inch = 250 feet

Town of Needham, MA
Watershed No. 2
Outfall 02-34

BETA
www.BETA-Inc.com



1 inch = 125 feet

Town of Needham, MA
Watershed No. 2
Outfall 02-43

BETA
www.BETA-Inc.com

Legend

- Catchment Area
- Drain Outfall Bacteria Hit
- Drain Interconnection
- Drain Outfall
- Drainage Water Quality Structure
- Drain Manhole
- Drain Inlet
- Drain Culvert
- Drain Catch Basin
- Drainage Swale
- Drain Pipe
- House using Septic System
- Sewer Manhole
- Sewer Pipe
- Wetlands
- Water Bodies

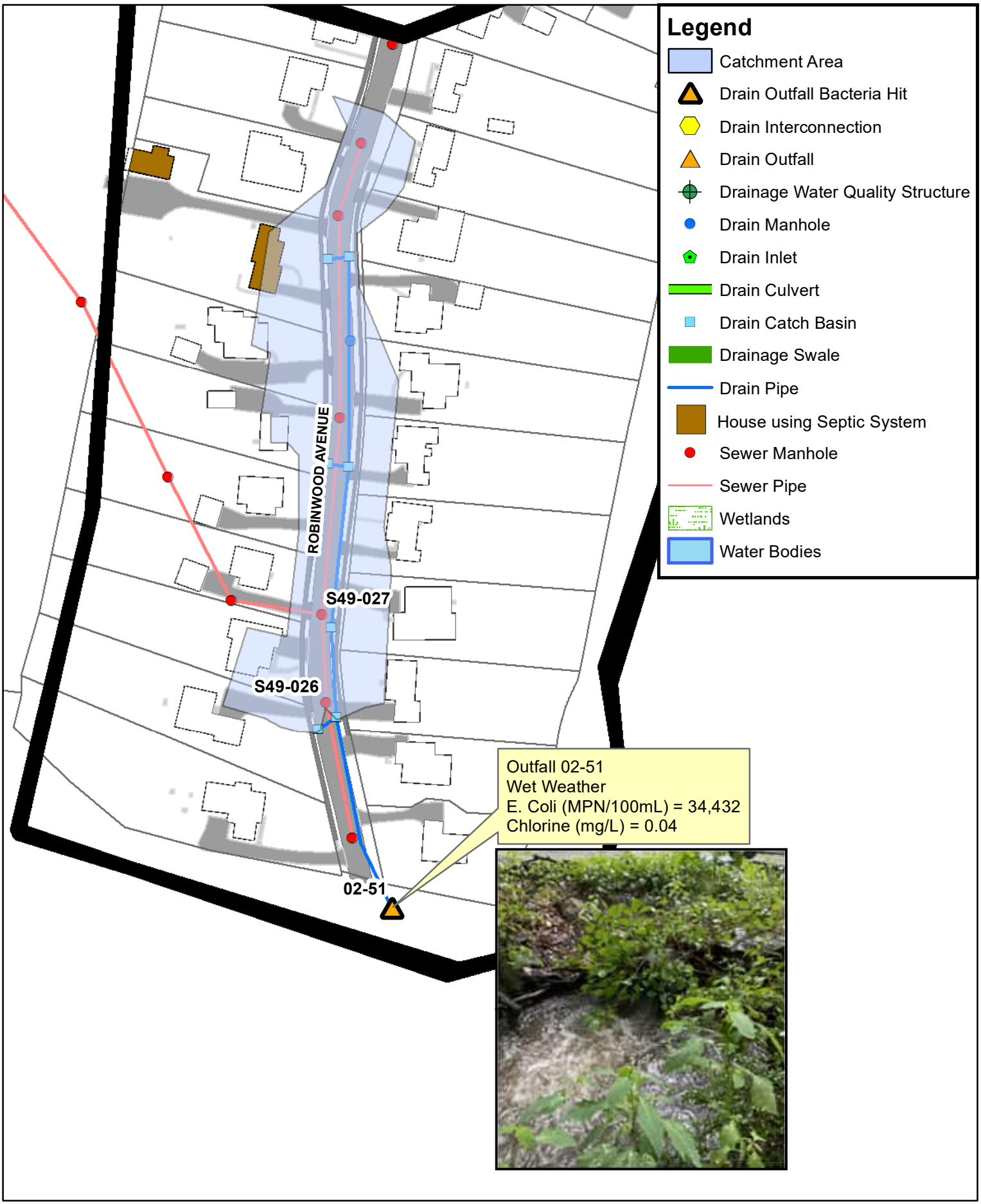
S49-058
YURICK ROAD
HIGH ROCK STREET
MURPHY ROAD
02-50
Outfall 02-48
Wet Weather
E. Coli (MPN/100mL) = 579.43
Surfactants (mg/L) = 0.25-0.50

S49-057
02-49
02-48
HIGH ROCK STREET

1 inch = 160 feet

Town of Needham, MA
Watershed No. 2
Outfall 02-48

BETA
www.BETA-Inc.com



1 inch = 125 feet

Town of Needham, MA
Watershed No. 2
Outfall 02-51

BETA
www.BETA-Inc.com

APPENDIX G

- **Monitoring Locations Baseline Data Table**

Monitoring Locations in Subwatershed No. 2 - Baseline Data						ammonia (mg/L)	free (residual) chlorine (mg/L)	conductivity (µS/cm)	salinity (ppt)	pH	surfactant (mg/L)	temperature (°C)	e. coli (MPN/100mL)	total phosphorus (mg/L)	Olfactory or visual evidence of sewage	Notes
Sample ID	Sample Structure	Street Name	Sampling Date	Weather Condition (Dry / Wet)	Sampled Structure ID											
					Indicator Threshold	≥ 0.5	≥ 0	See note 1	See note 2	See note 3	≥ 0.25		≥ 235 [4]	≥ 0.100 [5]	See note 6	
					Test Type	field test	field test	field instrument	field instrument	field instrument	field test	field instrument	Lab	Lab	Field Observation	
					Equipment/glassware	Hach NI-SA	Hach CN-80	YSI556	YSI556	YSI556	Chemetrics K-9400	YSI556				
ML-1	Farley Pond Culvert	South Street	12/28/2021	Dry	Culvert Outlet	0	0	151	0.07	7.07	0.25-0.5	1.96	85.74	0.023	None	Substantial Flow
ML-2	Walker Pond Inlet	Charles River Street	n/a	n/a	No Flow	-	-	-	-	-	-	-	-	-	None	To be sampled as part of Walker Pond Study
			n/a	n/a	No Flow	-	-	-	-	-	-	-	-	-	None	To be sampled as part of Walker Pond Study
ML-3	Walker Pond Weir Outlet	Walker Lane	11/5/2021	Dry	Weir Outlet	0.2	0-0.04	145	0.10	6.93	0.25-0.5	8.33	1	-	None	Substantial Flow
			12/28/2021	Dry	Weir Outlet	0	0	338	0.16	7.32	0.25-0.5	3.14	<1	0.077	None	Substantial Flow
ML-4	Outfall 02-27	Oxbow Road	5/10/2021	Wet	DMH: D107-025	0	0.4	316.7	0.19	7.36	0.25	14.1	62	0.033	None	Substantial Flow
			5/24/2021	Dry	DMH: D107-025	0	0.2	422.9	0.23	7.12	0.25	18.9	5	0.045	None	Moderate Flow
			12/28/2021	Dry	DMH: D107-025	0	0	381	0.18	7.32	0.25-0.5	4.87	2.01	0.031	None	Trickle Flow

Color Key

Exceeds Indicator Threshold

Notes:

1. Distilled water has a conductivity in the range of 0.5 to 3 µmhos/cm. The conductivity of rivers in the United States generally ranges from 50 to 1500 µmhos/cm. Studies of inland fresh waters indicate that streams supporting good mixed fisheries have a range between 150 and 500 µhos/cm. Conductivity outside this range could indicate that the water is not suitable for certain species of fish or
2. Samples with marine influence were determined by salinity testing. Samples with less than 2ppt had no influence, between 2ppt and 12ppt had some influence, greater than 12ppt had major influence. Tidal inflow tested at around 18ppt.
3. In general, a water with a pH < 7 is considered acidic and with a pH > 7 is considered basic. The normal range for pH in surface water systems is 6.5 to 8.5 and for groundwater systems 6 to 8.5.
4. Massachusett Department of Public Health beach reporting limits for E. Coli is 235 cfu/100mL in freshwater. *MPN/100 mL = CFU/100mL (difference in method, units equivalent).*
5. US EPA acceptable range for Total Phosphorus in streams or other flowing waters not discharging directly to lakes or impoundments is < 0.100 mg/L.
6. Likely sewer input indicators are any of the following:
    * Olfactory or visual evidence of sewage
    * Ammonia ≥ 0.5 mg/L, surfactants ≥ 0.25 mg/L, and bacteria levels greater than the water quality criteria applicable to the receiving water, or
    * Ammonia ≥ 0.5 mg/L, surfactants ≥ 0.25 mg/L, and detectable levels of chlorine.

APPENDIX H

- **Maps & Inspection Logs for Town-owned Facilities and Structures in Watershed No. 2**

O&M MAP 36 TOWN FOREST							
		Inspection			Maintenance		
BMP Description	Required Action	Initials	Date	Follow-up Required	Action	Date	Notes
Wooded Area	Remove debris & yard waste						
	Erosion & vegetation						
Parking Lot	Sweep						
	Remove sediments & debris						

Note: Inspections to be completed in accordance with Needham's O&M Plan.

TOWN FOREST
BMP MAP iV

Scale: 1" = 160'

160 0 160 320

PARKING LOT

TOWN FOREST

O&M MAP 36

O&M MAP 37 WALKER GORDON FIELD - 174 Charles River Street							
		Inspection			Maintenance		
BMP Description	Required Action	Initials	Date	Follow-up Required	Action	Date	Notes
Open Field	Remove debris & yard waste						
	Mow grass						
	Re-seed as necessary						
Infiltration Trench	Inspect the trench 24 hours or several days after a rain event						
	Re-seed as necessary						
	Mow top of trench						
	Remove sediments & debris						

Note: Inspections to be completed in accordance with Needham's O&M Plan.

T:\Engineering\DPW Eng Branches\CAD-Drafting\Needham Town Maps\BMP-SWPP Plans\SWPP Plans-Maint-DPW-RTS and DeFazio Maps.dwg, Walker Gordon Field, 9/8/2017 2:03:33 PM, tsarno

WALKER GORDON FIELD
BMP MAP iV

Scale: 1" = 40'

40 0 40 80

WALKER GORDON FIELD

Infiltration trench along parking lot

MOSELEY AVENUE

LANE

WALKER

LANE

RIVER

120

160

O&M MAP 37

Town of Needham, MA
BMP Maintenance Guide

BMP Description	Required Action	Required Action Frequency
Water Quality Unit (Oil/Grit Separator)	Remove accumulated oils, grease, and sediments	Annually
Proprietary Structure	Inspect and clean units in accordance with manufacturers' recommendations	Annually
	Remove sediments & debris	
Deep Sump Catch Basin	Remove sediments & debris	4 times per year
Leaching Catch Basin or Manhole	Remove sediments & debris	Annually
	Rehabilitate the basin if it fails due to clogging	
Bioretention Areas & Rain Garden	Remove sediments & debris	Annually
	Mow and/or mulch	
	Replace vegetation if needed	
	Remove invasive species as needed	
Extended Dry Detention Basin	Inspect outlets	Annually
	Mow upper stage, side slopes, embankment, & spillway	
	Remove trash and debris	
	Remove sediments from basin	
Water Quality Swale	Make sure vegetation is adequate and slopes are not eroding, check for rilling and gullying, ponding and sedimentation	Annually
	Mow 3" - 6"	
	Remove sediments & debris	
	Repair eroded areas if needed	
	Re-seed as necesssary	
Infiltration Basin	Inspection for settlement, erosion, tree growth on embankments, condition of riprap and turf, ponding, and sedimentation	Annually
	Mow the buffer area, side slopes, and basin bottom if grassed floor	
	Inspect and clean pretreatment devices associated with the basin	
	Remove sediments & debris	
Infiltration Trench	Inspect the trench 24 hours or several days after a rain event	Annually
	Mow top of trench if it is grassed	
	Inspect and clean pretreatment BMPs - check inlets and outlets for clogging	
	Remove sediments & debris	
Infiltration Chamber	Inspect inlets	2 times per year
	Remove sediment from pretreatment BMPs	
	Remove sediments & debris	
Porous Pavement	Vacuum sweep	Annually
	Power wash surface	
Wooded Area	Remove debris & yard waste	Annually
	Erosion & vegetation	
Stone Chips	Remove debris & trash	Annually
	Add stone chips where needed	
Parking Lot	Sweep	2 times per year
	Remove sediments & debris	
Vegetated Filter Strip	Inspect level spreader for sediment buildup and signs of erosion, bare spots, and overall health	Annually
	Mow grass	
	Remove sediment from toe of slope or level spreader	
	Re-seed as necesssary	

Note: Inspections to be completed in accordance with Needham's O&M Plan.

Town of Needham, MA
MS4 Infrastructure BMP Inspection Log

Map ID	Location	BMP Description	Inspection		Follow-up Required	Maintenance		Notes
			Initials	Date		Action	Date	
101	Chestnut St near Charles River Street	Water Quality Tank						
103	South Street at Chestnut Street	Water Quality Tank						
104	Chestnut Street at High Rock Street	Water Quality Tank						
105	Off of Lake Drive	Plunge Pool & Trap Rock						
106	Chestnut Street at Carriage Lane	Water Quality Tank						
107	Perry Drive	Water Quality Tank						
		Plunge Pool						
108	Pine Street at Charles River Street	Leaching Catch Basin						
109	32 Canterbury Lane	Infiltration						
110	Central Avenue / Elliot Street (Bridge)	Water Quality Tanks						
		Sediment Forebay						
		Water Quality Swale						
111	Greendale at Hunting Road (Relief Drain	Sediment Forebay @ Outlet						
		Swale with Checkdams						
112	Downtown Improvements	Outfall						

Note: Inspections to be completed in accordance with BMP Maintenance Schedule and Needham's O&M Plan.

APPENDIX I

- **Phosphorus Reduction Calculations**

Phosphorus Reduction Summary in Watershed 2

Total Phosphorous Reduction requird by the MS4 Permit	65% =	974 kg/yr		2,147	lb/yr
Watershed 2 (from phosphorus load calculation)				77.5	lb/yr
Walker Pond (from phosphorus load calculation)				37.2	lb/yr

Current Phosphorus Reduction

Roof Infiltration to Date	2.25	lb/yr			
Walker Field Infiltration Trench	0.48	lb/yr			
Pine Street Leaching CatchBasin	0.39	lb/yr	Total	3.12	lb/yr

Projected Phosphorus Reduction

Enhanced Street Sweeping (non-structural)	0.51	lb/yr			
Catchbasin Cleaning (non-structural)	0.73	lb/yr			
Roof Infiltration (thru 2038)	6.42	lb/yr			
Walker Lane Trench/LMH System (Prop. installation 2022)	3.36	lb/yr	Total	10.51	lb/yr

Potential Infiltration Retrofits (A or B Soils) - Assume 90% removal

Watersed ID	P Load (lbs/yr)	Reduced (lbs/yr)	Watersed ID	P Load (lbs/yr)	Reduced (lbs/yr)			
CRS1	1.11	1.00	FS16	0.69	0.62			
CRS2	0.73	0.65	SS17	1.81	1.63			
CRS4	5.76	5.18	SR27	3.84	3.46			
OR5	2.93	2.64	SR28	3.54	3.18			
BTR6	1.64	1.47	SR29	2.36	2.13			
BTR7	1.93	1.73	SS30	1.40	1.26			
CW8	2.89	2.60	CR31	3.32	2.99			
WL9	3.31	2.98	SS32	0.46	0.41			
CA10	1.39	1.26	SS33	0.71	0.64			
CA11	1.38	1.24	CS46	3.09	2.78			
FS12	4.17	3.75				Total	43.61	lbs/yr

Potential Infiltration Retrofits (Mixed Soils) - Assume 50% removal

Watersed ID	P Load (lbs/yr)	Reduced (lbs/yr)			
SS33	0.71	0.355			
SS38	3.42	1.71			
RA39	1.23	0.615	Total	2.68	lbs/yr

Watershed Total Load Reduction (exist & proposed)	59.92	lbs/yr
Phosphorus Load to be remove in other watersheds	17.58	lbs/yr

Outfall ID	Water-shed ID	Total Area (sq ft)	Road1 (ft) W	Road1 (ft) L	Road2 (ft) W	Road2 (ft) L	Road3 (ft) W	Road3 (ft) L	cul.de.sac A (sqft)	Total Road	Driveways 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total Dr/Pave	Roof Areas (sq ft) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total Roof	OPEN AREAS (%) A	B	C	D	Total Open	P Load	Outlet Address	HSG
D094-030	CRS1	224,165	21	650	0	0	0	0		13,650	4,268	2,530	0	0	0	0	0	0	0	0	0	0	0	0	0	6,798	2,242	925	4,268	0	0	0	0	0	0	0	0	0	0	0	0	0	7,435	100%	0%	0%	0%	196,283	0.14	0 Charles River St	A
D095-020	CRS2	44,903	26	450	21	370	0	0		19,470	521	337	0	0	0	0	0	0	0	0	0	0	0	0	0	858	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100%		0%	0%	24,575	0.02	0 Charles River St	A
	PS3	60,250	430	21	0	0	0	0		9,030	7367	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7,367	2,304	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,304	100%		0%	0%	41,550	0.03	Pine St	A
D108-023a	CRS4	1,006,811	21	2519	26	1357	24	433		98,573	2,509	4,885	1,034	4,777	2,000	1,062	8,778	3,275	3,312	3,028	2,152	3,002	1,014	2,697	1,820		1,051	2,304	2,704	2,071	3,124	3,685	3,395	3,521	3,356	2,151	2,380	1,098	1,950	1,353	2,041	2,628	2,264								
											2,076	2,467	728													50,616	2,178	3,440	3,849													50,541	100%		0%	0%	807,082	0.56	10 Moseley Ave	B
D107-025	OR5	1,579,224	29	2284	13	1360	0	0		83,916	1,349	1,686	3,833	4,341	5,841	2,177	2,267	2,190	3,121	5,080	2,492	4,128	2,040	1,895	2,523		1,442	1,098	5,158	3,900	4,252	3,802	3,836	1,372	1,768	2,358	2,042	2,871	2,033	5,202	3,000	2,924	3,241								
											2,495	2,229	2,839	9,595	5,698	2,589	3,722	2,348	1,870	1,480	2,071	1,283	1,935	1,398		86,514	2,937	2,971	2,421	4,399	3,486	4,358	4,988	2,667	2,392	1,625	1,416	929	1,269	830	3,126	1,023		91,134	60%		0%	40%	1,317,660	5.02	147 Oxbow Road	B/D
D083-057a	BTR6	162,698	27	506	23	690	0	0		29,532	1,423	1,794	1,484	2,117	0	0	0	0	0	0	0	0	0	0	0	6,817	1,002	3,336	1,948	1,357	633	0	0	0	0	0	0	0	0	0	0	0	8,275	100%		0%	0%	118,074	0.08	54-68 Bridle Trail Rd	A
D096-049	BTR7	223,609	27	319	0	0	0	0	5100	13,713	2,117	4,412	4,867	3,701	1,069	0	0	0	0	0	0	0	0	0	0	16,165	5,316	1,131	1,948	4,667	3,355	3,811	1,671	0	0	0	0	0	0	0	0	0	21,899	100%		0%	0%	171,832	0.12	14 Bridle Trail Rd	A
D096-040	CW8	753,866	27	3064	0	0	0	0		82,728	3,504	3,037	1,386	4,152	1,071	1,325	2,887	2,745	402	692	2,511	2,101	1,907	1,551	4,931		3,541	1,570	1,176	2,368	4,860	590	3,021	1,297	1,346	696	1,555	1,765	3,511	2,649	3,333	2,319	3,352								
															5,239	2,603	1,969									44,012	2,881	578	1,358	1,111												44,873	85%	15%	0%	0%	582,253	0.58	81 Country Way	A
D107-025	WL9	276,757	16	1143	11	1367	0	0		33,325	3,640	2,005	2,082	1,901	1,453	1,826	3,061	0	0	0	0	0	0	0	0	15,968	2,565	2,863	2,266	2,480	2,084	1,919	1,242	0	0	0	0	0	0	0	0	0	15,419	45%		0%	55%	212,046	1.06	Walker Pond	A
D107-034	CA10	141,468	25	780	0	0	0	0		19,500	7,444	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7,444	377	2,977	1,234	1,437	0	0	0	0	0	0	0	0	0	0	0	0	6,025	80%		0%	20%	108,500	0.24	1885 Central Ave	A/D
D115-002	CA11	131,509	25	788						19,700	6,967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6,967	2,158	2,468	376	1,437	0	0	0	0	0	0	0	0	0	0	0	0	6,438	80%			20%	98,404	0.22	1885 Central Ave	A/D
D116-015	FS12	589,293	18	1337	28	438	0	0		36,330	1,308	4,726	2,734	2,961	2,289	2,196	3,472	3,968	3,002	1,461	0	0	0	0	0	28,117	1,558	2,168	1,583	1,894	1,917	225	2,190	2,176	2,873	1,198	2,192	156	115	2,394	0	0	22,638	80%		0%	20%	502,208	1.13	142 Fisher St	A
D108-028	WL13	36,850	28	108	29	154	0	0		7,490	1,905	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,905	1,532	998	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,530	100%		0%	0%	24,925	0.02	Walker Pond	A
D108-031	WL14	140,738	28	379	0	0	0	0		10,612	3,217	2,657	0	0	0	0	0	0	0	0	0	0	0	0	0	5,874	1,629	1,422	2,911	123	155	636	0	0	0	0	0	0	0	0	0	0	6,876	100%		0%	0%	117,376	0.08	Walker Pond	A
	CRS15	171,224	25	1028	21	61	0	0		26,981	563	918	2,771	2,751	3,889	703	2,979	3,213	0	0	0	0	0	0	0	17,787	882	1,356	404	1,846	543	279	451	1,044	2,121	890	1,430	312	964	0	0	0	12,521	100%		0%	0%	113,935	0.08	10 Moseley Ave	B
D166-019	FS16	186,360	24	393	0	0	0	0		9,432	2,453	603	0	0	0	0	0	0	0	0	0	0	0	0	0	3,056	1,880	485	1,351	314	0	0	0	0	0	0	0	0	0	0	0	0	4,030	100%		0%	0%	169,842	0.12	Charles River (43 Fisher St)	A
D116-026	SS17	136,507	33	516	22	409	0	0		26,026	743	764	1,644	786	1,653	4,565	0	0	0	0	0	0	0	0	0	10,155	2,016	110	1,428	847	1,333	7,122	408	242	181	439	0	0	0	0	0	0	14,126	100%		0%	0%	86,201	0.06	Charles River (South St)	A
D083-036a/040a	BTR18	791,218	28	1985	28	757	27	331		85,713	1,763	2,516	3,307	4,340	2,473	2,585	1,901	909	2,793	1,693	2,506	4,833	2,544	3,754	1,845		798	2,070	2,022	3,918	4,388	4,873	2,308	2,918	4,934	5,241	4,524	3,810	4,163	4,660	4,144	3,171	3,202								
															5,053	2,505	1,387	3,478	1,155							53,339	1,034	5,215	130	1,820	2,731											72,072			0%	100%	580,094	4.93	98 Bridle Trail Rd	D
D096-030	CW19	132,943	28	409	28	281	0	0		19,320	598	1,000	527	0	0	0	0	0	0	0	0	0	0	0	0	2,125	1,820	107	1,808	674	0	0	0	0	0	0	0	0	0	0	0	0	4,409			0%	100%	107,090	0.91	160 Country Way	D
D096-022	CW20	463,125	29	1408	30	418	0	0		53,372	557	5,204	11,001	1,905	3,564	2,661	644	1,442	1,288	1,817	86	2,195	0	0	0	32,364	1,587	1,431	3,630	875	3,850	2,348	2,396	3,286	2,195	743	517	2,345	86	103	0	0	0	25,391			0%	100%	351,999	2.99	160 Country Way	D
D096-022	CW21	310,551	56	1044	13	143	0	0	3925	35,126	3,012	15,294	5,315	3,570	1,975	0	0	0	0	0	0	0	0	0	0	29,166	2,914	4,889	3,407	3,507	1,519	588	109	232	0	0	0	0	0	0	0	0	17,166			0%	100%	814,889	6.92	160 Country Way	D
D096-027	CW22	21,808	27	178	0	0	0	0		4,806	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,665	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,665			0%	100%	15,337	0.13	128 Country Way	D
D083-080	BTR23	294,933	28	786	28	649	0	0	12134	52,314	1,818	4,192	1,306	2,198	1,990	2,308	2,210	917	1,535	941	2,483	0	0	0	0	21,898	973	2,379	1,034	5,180	3,219	1,484	291	3,330	967	725	0	0	0	0	0	0	19,581			0%	100%	201,140	1.71	276 Bridle Trail Road	D
D097-021	WED24	45,784	21	133	0	0	0	0		2,793	536	0	0	0	0	0	0	0	0	0	0	0	0	0	0	536	1,259	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,259			0%	100%	41,196	0.35	Woods End Dr	D
D097-017	WED25	85,783	21	569	0	0	0	0		11,949	2,888	2,103	632	164	0	0	0	0	0	0	0	0	0	0	0	5,787	1,259	3,924	134	0	0	0	0	0	0	0	0	0	0	0	0	0	5,317			0%	100%	62,730	0.53	Woods End Dr	D
D097-007	GD26	165,114	24	625	0	0	0	0		15,000	2,371	1,839	1,974	1,624	1,901	1,336	0	0	0	0	0	0	0	0	0	11,045	1,761	3,371	2,304	922	1,635	0	0	0	0	0	0	0	0	0	0	0	9,993			0%	100%	129,077	1.10	Springdale Rd	D
D108-020	SR27	440,355	30	1388	27	375	0	0		51,765	3,227	1,644	1,864	2,351	3,657	1,691	2,987	1,036	0	0	0	0	0	0	0	18,457	2,354	2,987	413	4,115	3,157	3,029	2,212	193	126	125	3,299	3,336	87	0	0	0	25,433	90%		0%	10%	344,700	0.51	103-111 Straford Rd	A
D108-008	SR28	295,727	28	1242	28	618	0	0		52,080	1,569	2,203	2,990	2,313	4,508	1,328	1,708	2,215	2,100	2,004	3,108	1,728	0	0	0	27,773	3,719	1,322	2,717	2,744	219	2,604	110	2,392	1,425	300	0	0	0	0	0	0	17,552	100%		0%	0%	198,322	0.14	143-157 Straford Rd	A
D108-010	SR29	249,352	28	693	0	0	0	0	9230	28,634	2,687	1,232	2,041	2,602	1,965	4,520	936	2,215	0	0	0	0	0	0	0	18,198	439	1,895	2,193	3,014	4,423	40	1,709	1,222	1,092	1,209	0	0	0	0	0	0	17,235	100%		0%	0%	185,286	0.13	103-111 Straford Rd	A
D116-007	SS30	101,601	27	830	0	0	0	0		22,410	1,291	699	1,273	2,582	909	226	0	0	0	0	0	0	0	0	0	6,979	1,413	1,294	1,144	1,221	313	114	0	0	0	0	0	0	0	0	0	0	5,499		100%	0%	0%	66,713	0.18	5 Crestview Rd	B
D166-003	CR31	375,929	21	607	28	1010	0	0		41,027	2,387	2,373	9,843	3,010	1,077	3,198	3,221	0	0	0	0	0	0	0	0	25,109	1,785	2,287	85	3,017	1,667	1,776	396	4,082	2,099	986	0	0	0	0	0	0	18,179	70%	30%	0%	0%	291,614	0.38	17 Crestview Rd	B
D109-019a	SS32	59,389	21	417	0	0	0	0		8,757	1,385	1,138	0	0	0	0	0	0	0	0	0	0	0	0	0	2,523	840	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	840	100%		0%	0%	47,269	0.03	1220 South St	A
D109-021	SS33	34,856	21	620	0	0	0	0		13,020	1,946	577	0	0	0	0	0	0	0	0	0	0	0	0	0	2,524	2,127	640	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,767	50%		0%	50%	16,546	0.08	1150 South St	D
D109-014a/016a	SS34	39,553	21	327	0	0	0	0		6,867	2,931	1,923	0	0	0	0	0	0	0	0	0	0	0	0	0	4,854	922	608	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,529			0%	100%	26,303	0.22	1150 South St	D
D109-031	SS35	65,407	21	377	0	0	0	0		7,917	2,470	2,395	3,246	1,330	0	0	0	0	0	0	0	0	0	0	0	9,440	2,022	1,675	330	0	0	0	0	0	0	0	0	0	0	0	0	0	4,027			0%	100%	44,023	0.37	0 South St	D
D110-010	SS36	58,543	21	854	0	0	0	0		17,934	2,346	998	0	0	0	0	0	0	0	0	0	0	0	0	0	3,344	628	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	628			0%	100%	36,638	0.31	0 South St	D
D118-004	BD37	366,301	18	1178	21	442	0	0	3836	34,322	3,100	2,998	3,903	2,430	5,087	2,833	3,554	2,590	6,053	0	0	0	0	0	0	32,548	3,486	3,653	3,322	1,915	3,810	3,564	4,854	2,636	0	0	0	0	0	0	0	0	27,240			0%	100%	272,191	2.31	33 Bur Dr	D
D110-064a/064b	SS38	262,586	21	1374	23	87	0	0		30,855	5,147	4,092	3,753	5,781	847	0	0	0	0	0	0	0	0	0	0	19,619	2,456	445	1,714	3,600	2,109	571	1,116	0	0	0	0	0	0	0	0	0	12,011		40%	0%	60%	200,101	1.24	898 South St	D
D098-037	RA39	66,121	32	609	0	0	0	0		19,488	500	520	1,085	754	2,685	503	500	233	598	1,318	418	742	1,565	448	0	11,870	800	507	243	1,805	0	0	0	0	0	0	0	0	0	0	0	0	3,355	100%		0%	0%	31,409	0.02	Town Forest (Robinwood Ave)	D
D085-112/-93	HRS40	286,683	41	1151	22	417	22	370		64,505	610	700	644	737	442	373	353	458	1,425	442	504	445	1,136	249	363		1,347	1,340	940	1,419	929	1,223	113	81	112	81	1,006	703	1,203	848	896	827	1,098								D
											487	668													10,036	1,124	1,103	176													16,569			0%	100%	195,574	1.66	Town Forest (High Rock St)	D
D098-014	RD41	185,671	38	441	0	0	0	0	8617	25,375	3,358	1,950	709	2,561	2,717	1,495	0	0	0	0	0	0	0	0	0	12,790	2,415	1,816	2,382	2,132	2,749	2,084	0	0	0	0	0	0	0	0	0	0	13,578			0%	100%	133,929	1.14	Farley Bond (Richardson Dr)	D
D098-010	RD42	628,144	37	1344	26	480	0	0	1904	64,112	2,212	1,182	1,984	1,994	1,313	2,665	2,734	2,085	2,547	2,111	2,080	2,905	1,914	0	0	27,726	2,253	2,422	2,096	2,225	1,793	479	2,593	3,313	695	1,157	2,504	1,996	1,856	2,884	198	2,345	0	30,809			0%	100%	505,497	4.29	100 Richardson Dr	D
D110-019	FPR43	130,817	23	135	0	0	0	0	11389	14,494	2,843	2,863	873	0	0	0	0	0	0	0	0	0	0	0	0	6,579	2,576	2,881	2,779	772	0	0	0	0	0	0	0	0	0	0	0	0	9,008			0%	100%	100,737	0.86	Farley Pond (Richardson Dr)	D
D110-016	FPR44	325,200	23	555	0	0	0	0		12,765	2,922	2,806	423	5,160	0	0	0	0	0	0	0	0	0	0	0	11,312	2,316	4,508	1,860	1,702	2,212	1,927	2,632	4,763	0	0	0	0	0	0	0	0	21,920			0%	100%	279,204	2.37	Farley Pond (Richardson Dr)	D
D110-037	SL45	726,645	25	963	21	492	21	1021	27364	83,212	1,021	4,028	2,508	2,530	3,901	2,125	2,548	3,030	3,283	3,054	3,128	2,897	2,678	2,867	3,683		1,938	1,111	4,317	5,426	2,632	5,063	3,854	4,963	4,604	2,212	4,149	4,485	4,303	4,021	2,391	3,199	1,201								
											2,997	3,874	1,684	4,882											56,718	568													60,436			0%	100%	526,279	4.47	47 Southwood Ln	D
D111-075	CS46	179,786	39	1872	17	118	0	0		75,014	2,878	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,878	2,766	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,766		100%	0%	0%	99,128	0.27	Charles River (Chestnut St)	B

Water-shed ID	Area (ac)					Land Use	HSG	Phophorus Load (lb/yr)			Outlet		Comments
	Total	Paved	Roof	Tot.	Open			Imperv	Perv	Total	Address	HSG	
CRS1	5.15	0.47	0.17	0.64	4.51	LDR	A	0.97	0.14	1.11	0 Charles River St	A	Outfall > 300' to W
CRS2	1.03	0.47	0.00	0.47	0.56	LDR	A	0.71	0.02	0.73	0 Charles River St	A	Outfall to woods
PS3	1.38	0.38	0.05	0.43	0.95	LDR	A	0.65	0.03	0.68	Pine St	A	Ex. Leaching CB
CRS4	23.11	2.26	1.16	3.42	18.53	LDR	A	5.20	0.56	5.76	10 Moseley Ave	B	Gordon Fld BMP
OR5	36.25	1.93	0.00	1.93	0.00	LDR	A	2.93	0.00	2.93	147 Oxbow Road	B/D	Scatter BMPs
BTR6	3.74	0.83	0.19	1.02	2.71	LDR	A	1.56	0.08	1.64	54-68 Bridle Trail Rd	A	Pot. Inf. BMP
BTR7	5.13	0.69	0.50	1.19	3.94	LDR	A	1.81	0.12	1.93	14 Bridle Trail Rd	A	Pot. Inf. BMP
CW8	17.31	1.90	0.00	1.90	0.00	LDR	A	2.89	0.00	2.89	81 Country Way	A	Scatter BMPs
WL9	6.35	1.13	0.35	1.49	4.87	LDR	A	2.26	1.06	3.31	Walker Pond	A	Walker Ln BMPs
CA10	3.25	0.62	0.14	0.76	2.49	LDR	A	1.15	0.24	1.39	1885 Central Ave	A/D	Pot. Inf. BMP
CA11	3.02	0.61	0.15	0.76	2.26	LDR	A	1.16	0.22	1.38	1885 Central Ave	A/D	Pot. Inf. BMP
FS12	13.53	1.48	0.52	2.00	11.53	LDR	A	3.04	1.13	4.17	142 Fisher St	A	may not outlet
WL13	0.85	0.22	0.06	0.27	0.57	LDR	A	0.42	0.02	0.43	Walker Pond	A	Walker Pond
WL14	3.23	0.38	0.16	0.54	2.69	LDR	A	0.82	0.08	0.90	Walker Pond	A	Improvments
CRS15	3.93	1.03	0.29	1.32	2.62	LDR	A	2.00	0.08	2.08	10 Moseley Ave	B	Project
FS16	4.28	0.29	0.09	0.38	3.90	LDR	A	0.58	0.12	0.69	Charles River (43 Fisher St)	A	Pot. Inf. BMP
SS17	3.13	0.83	0.32	1.15	1.98	LDR	A	1.76	0.06	1.81	Charles River (South St)	A	Pot. Inf. BMP
BTR18	18.16	1.97	0.00	1.97	0.00	LDR	D	2.99	0.00	2.99	98 Bridle Trail Rd	D	Poor Soils - all
CW19	3.05	0.49	0.10	0.59	2.46	LDR	D	0.90	0.91	1.81	160 Country Way	D	Poor Soils - all
CW20	10.63	1.97	0.58	2.55	8.08	LDR	D	3.88	2.99	6.87	160 Country Way	D	Poor Soils
CW21	7.13	1.48	0.39	1.87	18.71	LDR	D	2.84	6.92	9.76	160 Country Way	D	Poor Soils - all
CW22	0.50	0.11	0.04	0.15	0.35	LDR	D	0.23	0.13	0.36	128 Country Way	D	Poor Soils - all
BTR23	6.77	1.70	0.45	2.15	4.62	LDR	D	3.27	1.71	4.98	276 Bridle Trail Road	D	Poor Soils - all
WED24	1.05	0.08	0.03	0.11	0.95	LDR	D	0.16	0.35	0.51	Woods End Dr	D	Poor Soils - all
WED25	1.97	0.41	0.12	0.53	1.44	LDR	D	0.80	0.53	1.34	Woods End Dr	D	Poor Soils - all
GD26	3.79	0.60	0.23	0.83	2.96	LDR	D	1.26	1.10	2.35	Springdale Rd	D	Poor Soils - all
SR27	10.11	1.61	0.58	2.20	7.91	LDR	A	3.34	0.51	3.84	103-111 Straford Rd	A	Pot. Inf. BMP
SR28	6.79	1.83	0.40	2.24	4.55	LDR	A	3.40	0.14	3.54	143-157 Straford Rd	A	Pot. Inf. BMP
SR29	5.72	1.08	0.40	1.47	4.25	LDR	A	2.24	0.13	2.36	103-111 Straford Rd	A	Pot. Inf. BMP
SS30	2.33	0.67	0.13	0.80	1.53	LDR	B	1.22	0.18	1.40	5 Crestview Rd	B	Pot. Inf. BMP
CR31	8.63	1.52	0.42	1.94	6.69	LDR	A	2.94	0.38	3.32	17 Crestview Rd	B	Pot. Inf. BMP

Water-shed ID	Area (ac)					Land Use	HSG	Phophorus Load (lb/yr)			Outlet		Comments
	Total	Paved	Roof	Tot.	Open			Imperv	Perv	Total	Address	HSG	
SS32	1.36	0.26	0.02	0.28	1.09	LDR	A	0.42	0.03	0.46	1220 South St	A	Outfall > 300' to W
SS33	0.80	0.36	0.06	0.42	0.38	LDR	A/D	0.64	0.08	0.71	1150 South St	D	Inf. BMP upgrad?
SS34	0.91	0.27	0.04	0.30	0.60	LDR	D	0.46	0.22	0.69	1150 South St	D	Poor Soils - all
SS35	1.50	0.40	0.09	0.49	1.01	LDR	D	0.75	0.37	1.12	0 South St	D	Poor Soils - all
SS36	1.34	0.49	0.01	0.50	0.84	LDR	D	0.76	0.31	1.08	0 South St	D	Poor Soils - all
BD37	8.41	1.54	0.63	2.16	6.25	LDR	D	3.28	2.31	5.60	33 Bur Dr	D	Poor Soils - all
SS38	6.03	1.16	0.28	1.43	4.59	LDR	D	2.18	1.24	3.42	898 South St	D	Inf. BMP upgrad?
RA39	1.52	0.72	0.08	0.80	0.72	LDR	A	1.21	0.02	1.23	Town Forest (Robinwood Ave)	D	Inf. BMP upgrad?
HRS40	6.58	1.48	0.00	1.48	0.00	LDR	D	2.25	0.00	2.25	Town Forest (High Rock St)	D	Poor Soils - all
RD41	4.26	0.88	0.31	1.19	3.07	LDR	D	1.81	1.14	2.94	Farley Bond (Richardson Dr)	D	Poor Soils - all
RD42	14.42	2.11	0.71	2.82	11.60	LDR	D	4.28	4.29	8.57	100 Richardson Dr	D	Poor Soils - all
FPR43	3.00	0.48	0.21	0.69	2.31	LDR	D	1.05	0.86	1.91	Farley Bond (Richardson Dr)	D	Poor Soils - all
FPR44	7.47	0.55	0.50	1.06	6.41	LDR	D	1.61	2.37	3.98	Farley Bond (Richardson Dr)	D	Poor Soils - all
SL45	16.68	1.91	0.00	1.91	0.00	LDR	D	2.90	0.00	2.90	47 Southwood Ln	D	Poor Soils - all
CS46	4.13	1.79	0.06	1.85	2.28	LDR	B	2.81	0.27	3.09	Charles River (Chestnut St)	B	Pot. Inf. BMP
Total	299.73	45.40	11.02	56.43	169.79			85.77	33.44	119.20			
Walker Pond	139.33	21.76	6.04	27.80	92.22			42.25	17.40	57.28			

Required Reduction 65% Total Watershed 77.48 lbs/yr Walker Pond 37.23 lbs/yr

P Loads in "Good Soils" = 53.78 bs/yr Assuming installing systems for 90% removal = 48.4 lbs/yr

-29.08

= Subwatershed Areas Tributary to Walker Pond D = Poor soils for infiltration practices = Potential high groundwater

Table 3-1: Average annual distinct phosphorus (P) load export rates for use in estimating P load reduction credits in the MA MS4 Permit

Phosphorus Source Category by Land Use	Land Surface Cover	P Load Export Rate, lbs./acre/year	P Load Export Rate, kg/ha/yr.
Commercial (COM) and Industrial (IND)	Directly connected impervious	1.78	2.0
	Pervious	See* DevPERV	See* DevPERV
Multi-Family (MFR) and High-Density Residential (HDR)	Directly connected impervious	2.32	2.6
	Pervious	See* DevPERV	See* DevPERV
Medium -Density Residential (MDR)	Directly connected impervious	1.96	2.2
	Pervious	See* DevPERV	See* DevPERV
Low Density Residential (LDR) - "Rural"	Directly connected impervious	1.52	1.7
	Pervious	See* DevPERV	See* DevPERV
Highway (HWY)	Directly connected impervious	1.34	1.5
	Pervious	See* DevPERV	See* DevPERV
Forest (FOR)	Directly connected impervious	1.52	1.7
	Pervious	0.13	0.13
Open Land (OPEN)	Directly connected impervious	1.52	1.7
	Pervious	See* DevPERV	See* DevPERV
Agriculture (AG)	Directly connected impervious	1.52	1.7
	Pervious	0.45	0.5
*Developed Land Pervious (DevPERV) – HSG A	Pervious	0.03	0.03
*Developed Land Pervious (DevPERV) – HSG B	Pervious	0.12	0.13
*Developed Land Pervious (DevPERV) – HSG C	Pervious	0.21	0.24
*Developed Land Pervious (DevPERV) – HSG C/D	Pervious	0.29	0.33
*Developed Land Pervious (DevPERV) – HSG D	Pervious	0.37	0.41

Taken from 2016 MS4 Pemit (Modified) - Appendix F Attachment 3

CODE	MA GIS ABBREV	EPA Code	CATEGORY	DEFINITION
1	AC	AG	Cropland	Intensive agriculture
2	AP	AG	Pasture	Extensive agriculture
3	F	For	Forest	Forest
4	FW	For	Wetland	Nonforested freshwater wetland
5	M	Ind/Com	Mining	Sand; gravel & rock
6	O/PL	Open	Open Land	Abandoned agriculture; power lines; areas of no vegetatio
7	RP/RG	Open	Participation Recreation	Golf; tennis; Playgrounds; skiing
8	RS	Open	Spectator Recreation	Stadiums; racetracks; Fairgrounds; drive ins
9	RW/RM	Open	Water Based Recreation	Beaches; marinas; Swimming pools
10	R0	HDR	Residential	Multi family
11	R1	HDR	Residential	Smaller than 1/4 acre lots
12	R2	MDR	Residential	1/4 -- 1/2 acre lots
13	R3	LDR	Residential	Larger than 1/2 acre lots
14	SW	Water	Salt Wetland	Salt marsh
15	UC	Ind/Com	Commercial	General urban; shopping center
16	UI	Ind/Com	Industrial	Light & heavy industry
17	UO/UP/ H/CM	Open	Urban Open	Parks; cemeteries; public & institutional greenspace; also
18	UT/TF	HWY	Transportation	Airports; docks; divided highway; freight; storage; railroad
19	UW	Ind/Com	Waste Disposal	Landfills; sewage lagoons
20	W	Water	Water	Fresh water; coastal embayment
21	WP/CB/ OR/N	Ag	Woody Perennial	Orchard; nursery; cranberry bog

Phosphorus Load Removal - Building Constrution/Roof Infiltration

Total Phosphorous Reduction requird by the MS4 Permit 974 kg/yr = 2,147 lb/yr

Bylaws require Infiltration of roof runoff for all new building permits

Projected Retrofits

	Town	Watershed 2		2019	2020	2021
Total Buildings	11,494	856	Total Building Permits	38	13	107
Total Infiltrating	246	28	Watershed 2 Permits	1	0	5
Total Roof Area	26,385,827 sq ft	1,926,560 sq ft				
	2300 ave roof/ bldg		Ave (Say)	100 bldg/yr (Town)		
				5 bldg/yr (watershed 2)		

Current Phosphorous Load Reduction from Roof Infiltrations

Land Use = Low Density Residential (LDR) = 1.52 lb/ac/yr =

856 bldg x	2300	sf/bldg/43,560 sf/ac x	1.52 lb/ac/yr =	68.7 lb/yr	(Town)
28 bldg x	2300	sf/bldg/43,560 sf/ac x	1.52 lb/ac/yr =	2.2 lb/yr	(Watershed 2)

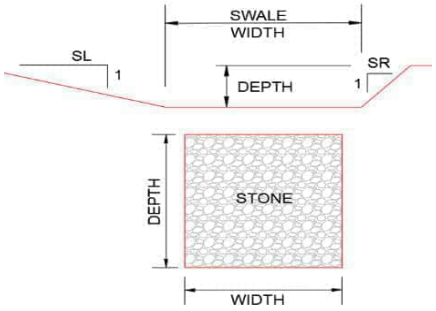
Projected Phosphorous Load Reduction from Roof Infiltrations over 20 years

16 yr x 100 bldg/yr x	2300	sf/bldg/43,560 sf/ac x	1.52 lb/ac/yr =	128 lb/yr	(Town)
16 yr x 5 bldg/yr x	2300	sf/bldg/43,560 sf/ac x	1.52 lb/ac/yr =	6.4 lb/yr	(Watershed 2)

Phosphorus Load Removal - Walker Gordon Field Stone Trench

Land Use =	Open		P Load Export Rate =	1.52 lb/ac/yr	Impervious
Soil Type =	Loamy Sand	A	P Load Export Rate =	0.03 lb/ac/yr	Pervious
Infiltration Rate =		2.41 in/hr	Infiltration Rate =	0.03 cfs	Pervious

Surface	AREA	P Load Rate		P Load
Impervious (Gravel Parking Area)	0.3 ac	1.52	lb/ac/yr	0.46 lb/yr
Open (grass)	1.0 ac	0.03	lb/ac/yr	0.03 lb/yr
				0.49 lb/yr



	Input		Storage		Surface Area	
Stone	Stone Width	5 ft	Stone	3.50 cf/ft	5	sf/ft
	Stone Depth	2 ft				
	Stone Void Ratio	0.35	Total	3.50 cf/ft		
Swale Length		105 ft.	368	cf.	5	sf.
		System Storage	368	cf	525	sf.
		System Infiltration Rate	0.029	cfs		

Depth of Flow Treated (from HydroCAD) = 1.3 inch
P Load Reduction (from Table) = 98%

Phosphorus Load Reduction 0.48 lb/yr

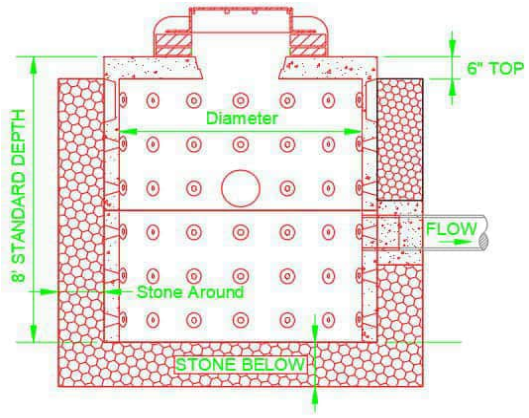
Phosphorus Load Removal - Existing Pine Street Leaching Catchbasin

Land Use =	Low Density Residential	LDR	P Load Export Rate =	1.52 lb/ac/yr	Impervious
Soil Type =	Loamy Sand	A	Infiltration Rate =	0.03 lb/ac/yr	Pervious
Infiltration Rate =	2.41 in/hr				

Impervious Surface = 0.38 ac

Phosphorus Load = 0.58

Existing 4 ft dia LCB 8 ft deep



Input			Storage		Surface Area
LMH Diameter	4	ft	Structure	101 cf	
Storage Depth	8	ft			
Stone Void Ratio	40%				
Stone Below	1	ft	Below	5 cf	28.3 sf
Stone Side	2	ft	Side	161 cf	170 sf
				266 cf	198 sf

From HydroCAD 0.35 inch infiltration for system

68% Phosphorus Removal

Phosphorus Load Reduction 0.39 lb/yr

Projected Phosphorus Load Removal - Enhanced Street Sweeping

$Credit_{Sweeping} = IA_{swept} \times PLE_{IC\text{-}land\ use} \times PRF_{sweeping} \times AF$

Where:

$Credit_{Sweeping}$	=	Phosporus load removed by enhanced sweeping (lb/yr)
IA_{swept}	=	Impervious Area Swept (acres)
$PLE_{IC\text{-}land\ use\backslash}$	=	Phosphorus Load Export Rate of Impervous surface per land use (lb/ac/yr)
$PRF_{sweeping}$	=	Phosporus Reduction Factor per types of sweeper & frequency
AF	=	Annual Frequency of Sweeping (no months/12)

IA_{swept}	=	33.8	acres	
$PLE_{IC\text{-}land\ use\backslash}$	=	1.52	lb/ac/yr	Land Use = Low Density Residential (LDR)
$PRF_{sweeping}$	=	0.01		
AF	=	1		

$Credit_{Sweeping}$ = 33.8 ac X 1.52 lb/ac/yr X 0.01 X 1 = **0.51 lbs/yr**

Projected Phosphorus Load Removal - Catchbasin Cleaning

$Credit_{CB} = IA_{CB} \times PLE_{IC\text{-}land\ use} \times PRF_{CB}$

Where:

$Credit_{CB}$	=	Phosporus load removed by enhanced sweeping (lb/yr)
IA_{CB}	=	Impervious Area Swept (acres)
$PLE_{IC\text{-}land\ use\backslash}$	=	Phosphorus Load Export Rate of Impervous surface per land use (lb/ac/yr)
PRF_{CB}	=	Phosporus Reduction Factor per typs of sweeper & frequency

IA_{CB}	=	24	acres	
$PLE_{IC\text{-}land\ use\backslash}$	=	1.52	lb/ac/yr	Land Use = Low Density Residential (LDR)
PRF_{CB}	=	0.02		

$Credit_{Sweeping}$ = 24 ac X 1.52 lb/ac/yr X 0.02 = **0.73 lbs/yr**

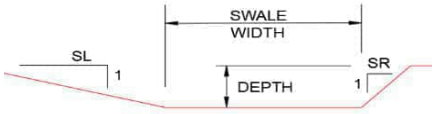
Phosphorus Load Removal - Walker Lane Planst Strip / LMHs / Infiltration

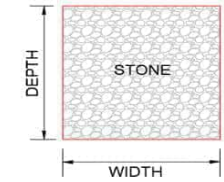
Subwatershed Information WL-1, WL-2 & CRS-1

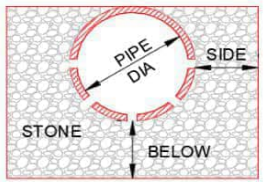
Land Use = Low Density Residential LDR
Soil Type = Loamy Sand A
Infiltration Rate = 2.41 in/hr

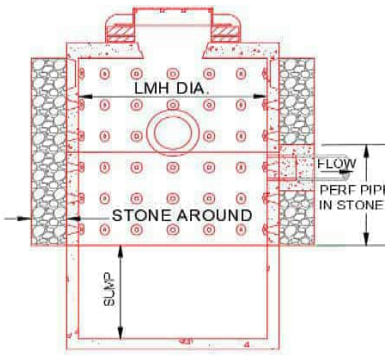
P Load Export Rate = 1.52 lb/ac/yr Impervious
Infiltration Rate = 0.03 lb/ac/yr Pervious

ID	Area (ac)					Land Use	HSG	Phophorus Load (lb/yr)		
	Total	Paved	Roof	Imperv	Open			Imperv	Pervious	Total
CRS15	3.93	1.03	0.29	1.32	2.61	LDR	A	2.01	0.08	2.08
WL13	0.85	0.22	0.06	0.28	0.57	LDR	A	0.43	0.02	0.44
WL14	3.23	0.38	0.16	0.54	2.69	LDR	A	0.82	0.08	0.90
				2.140	5.870					3.43









	Input			Storage			Surface Area
Swale	Swale Width	3	ft	Swale	2.75	cf/ft	5.5 sf/ft
	Swale Depth	0.5	ft				
	Slope SL	4	in.				
	Slope SR	1					
Stone	Stone Width	3	ft	Stone	1.05	cf/ft	3 sf/ft
	Stone Depth	1	ft				
	Stone Void Ratio	0.35		Total	3.80	cf/ft	
Pipe	Pipe Diameter	12	in.	Pipe	0.79	cf/ft	7 sf/ft
	Stone Below	12	in.	Stone	1.83	cf/ft	
	Stone Side	12	in.	Total	2.61	cf/ft	
LMH	LMH Diameter	6	ft.	LMH	85	cf/ea	113 sf/ea
	Stone Around	1.5	ft.	Stone	37	cf/ea	
	Sump (leach)	2	ft.	Total	122	cf/ea	

Swale Length	400	ft.	1520	cf.	2200 sf.
Leaching Pipe Length	400	ft.	1044	cf.	2800 sf.
Number of LMH	4	ea.	488	cf	452 sf.
		System Storage	3052	cf	4352 sf.
		System Infiltration Rate	0.243	cfs	

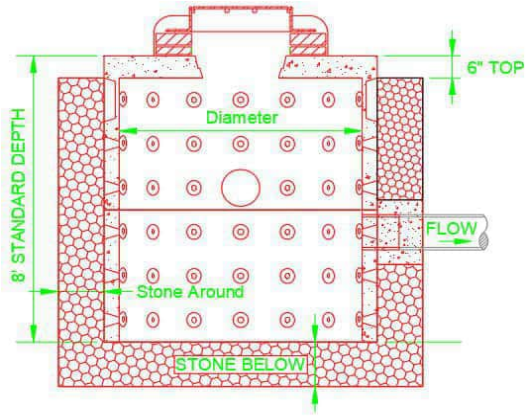
Depth of Flow Treated (from HydroCAD) = 1.3 inch
P Load Reduction (from Table) = 98%

Phosphorus Load Reduction 3.36 lb/yr

Phosphorus Load Removal - Typical 8' Dia. Drywell Retrofit

Land Use =	Low Density Residential	LDR	P Load Export Rate =	1.52 lb/ac/yr	Impervious
Soil Type =	Loamy Sand	A	Infiltration Rate =	0.03 lb/ac/yr	Pervious
Infiltration Rate =	2.41 in/hr				

Try 8 ft dia Drywell 6 ft deep



Input			Storage		Surface Area
LMH Diameter	8	ft	Structure	302 cf	
Storage Depth	6	ft			
Stone Void Ratio	40%				
Stone Below	1	ft	Below	20 cf	78.5 sf
Stone Side	2	ft	Side	151 cf	220 sf
				472 cf	298 sf

From HydroCAD 0.6 inch per system 0.5 ac Pavement 91% Phosphorus Removal = **0.69 lbs**

Order of Magnitude Construction Cost

	Item	Quant	Unit	Cost	Item Cost
120.	Excavation	30	cy	$ 40	$ 1,200
156.	Stone	16	cy	$ 50	$ 800
698.2	Filter Fabic	34	sy	$ 6	$ 204
	8' Dia LMH & Cover	1	ea	$ 8,000	$ 8,000
	Pipe Connect	1	ea	$ 500	$ 500
	Outlet Control	1	ea	$ 500	$ 500
	Loam and Seed	70	sy	$ 10	$ 700
					$ 11,904
	Contingency	20%			$ 2,381
					$ 14,285
	Engineering	10%			$ 1,428
					$ 15,713
				Say	$ 32,000 /ac pavement

$ 22,000 /lb phosphorus in Watershed 2

APPENDIX J

- **Watershed No. 2 Land Use Map**

Town of Needham, MA
Watershed No. 2
Land Use Map
March 2022

Legend

- Low Density Residential
- Medium Density Residential
- High Density Residential
- Other Use
- Subcatchment Area Outline
- Flow Direction Arrow
- Drain Outfall
- Drain Catch Basin
- Drain Manhole
- Drain Inlet
- Drain Pipe
- Drain Culvert

Town Forest
Walker Pond
Walker Gordon Field
Conservation Land
Bay Colony Rail Trail
DCR Redwing Bay
Farley Pond Reservation
Charles River

N
W E
S

1 inch = 250 feet

0 0.045 0.09 0.18 0.27 0.36 Miles

APPENDIX K

- **Watershed No. 2 Soils Map**

Town of Needham, MA
Watershed No. 2
Soils Map
March 2022

Legend

- Subcatchment Area Outline
- Flow Direction Arrow

Hydrologic Soils Groups

High Infiltration Rate: Group A or B

- A
- B

Unknown Infiltration Rate

- A/D, B/D

Poor Infiltration Rate: Group C, D, or Rock

- C, D, or Rock
- Wetlands

Town Forest
Walker Gordon Field
Walker Pond
Conservation Land
Bay Colony Rail Trail
DCR Redwing Bay
Farley Pond Reservation
Charles River

N
W E
S

1 inch = 250 feet

0 0.045 0.09 0.18 0.27 0.36 Miles