



EPA NPDES Permit Number # MAR0411132

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**TOWN OF
MEDWAY, MA**

**PHASE 1
PHOSPHORUS
CONTROL PLAN**

September 2023

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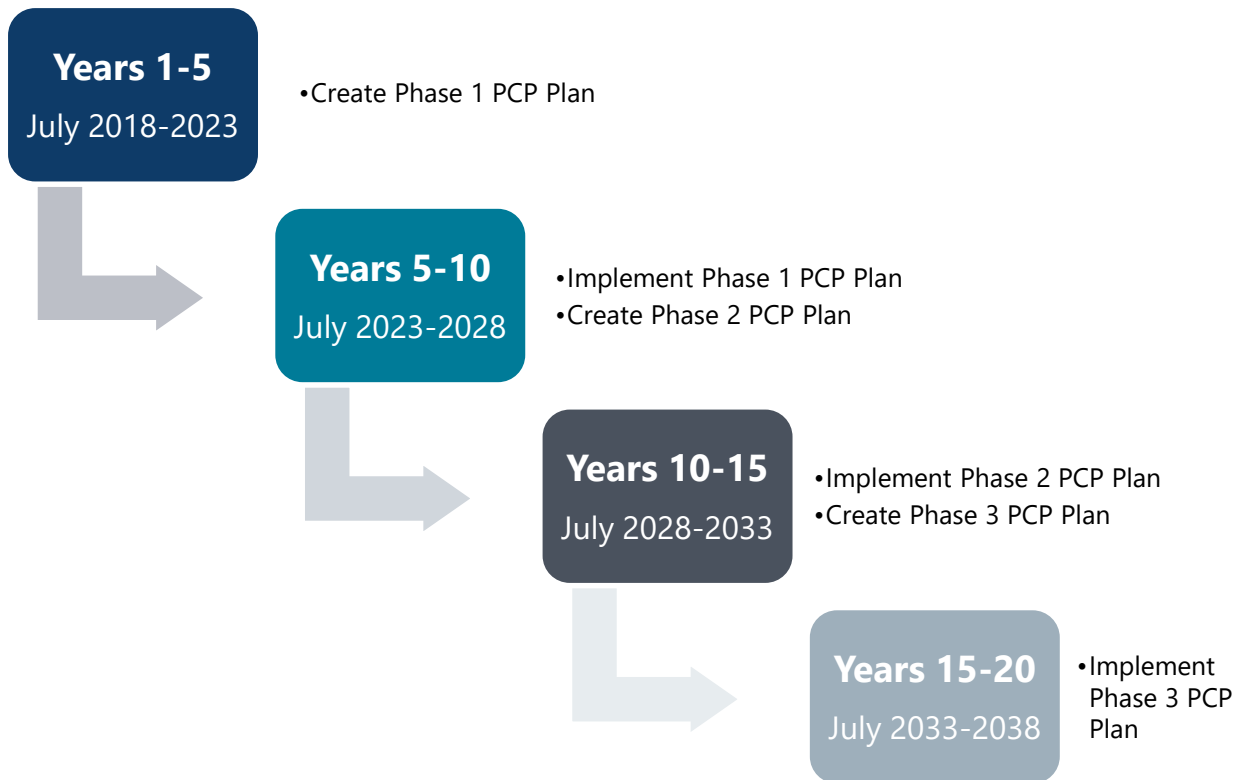
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1. INTRODUCTION

The Town of Medway, under the requirements of the United States Environmental Protection Agency (EPA), Municipal Separate Storm Sewer System (MS4) General Permit, is required to develop and execute a Phosphorus Control Plan (PCP) for its stormwater discharges into the Charles River watershed. The PCP will be implemented in three phases; this report is the Phase 1 PCP.

1.1 Required PCP Implementation Schedule

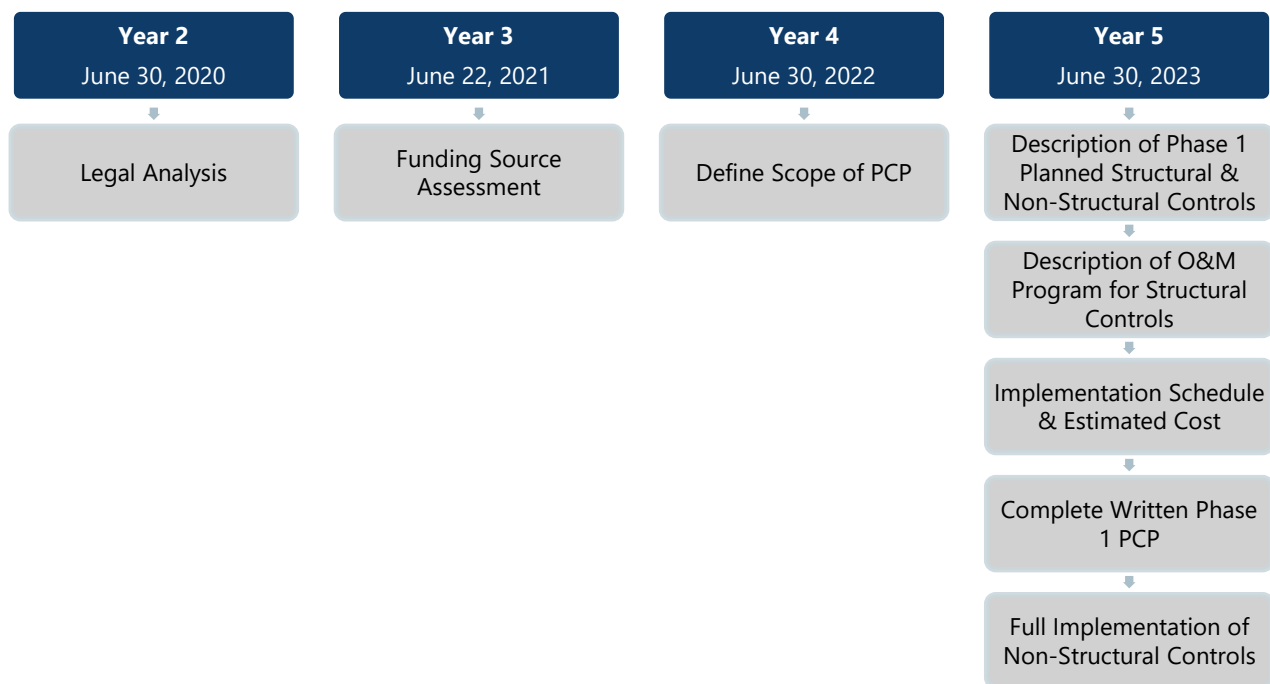
The MS4 General Permit (permit) PCP requirements are organized into three phases which are required to be implemented within a 20-year timeframe. The MS4 General Permit became effective July 1, 2018, and a modification to the MS4 General Permit became effective January 6, 2021. Graphic 1-1 below represents the schedule in 5-year MS4 General Permit-defined phases.



Graphic 1-1: MS4 General Permit-Defined Phases

1.2 Phase 1 of the PCP

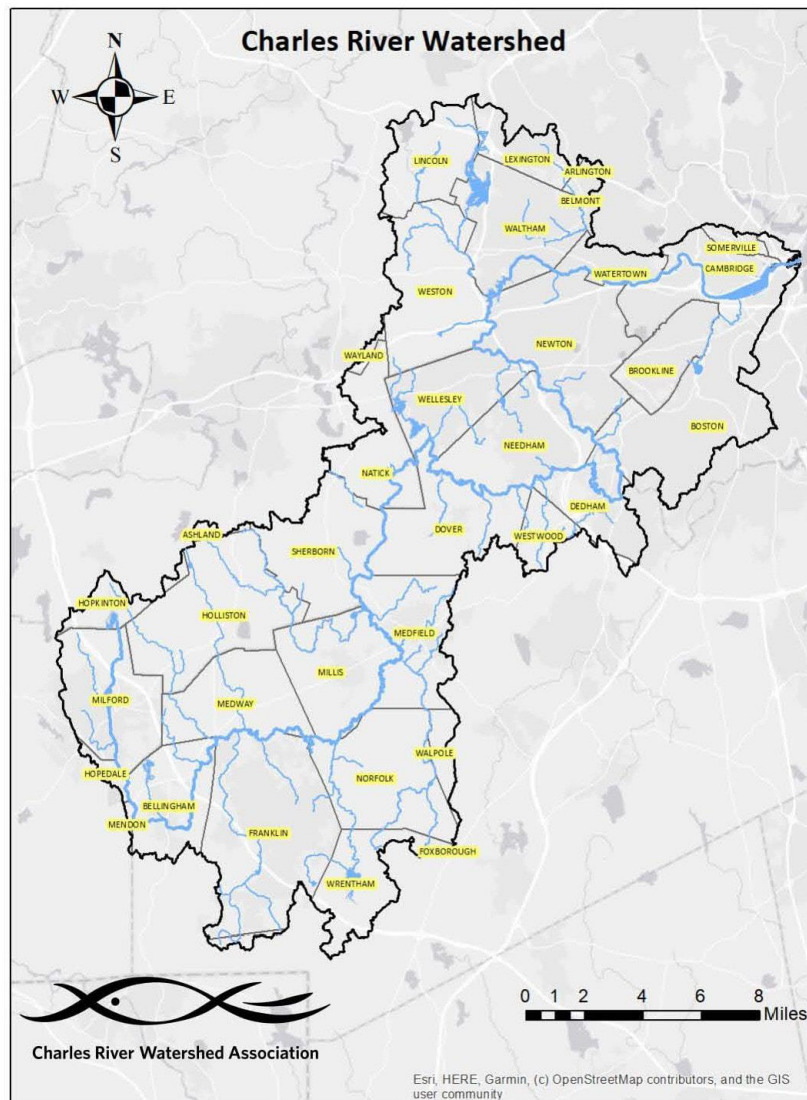
Phase 1 plan elements are outlined below in Graphic 1-2. This Phase 1 PCP (Plan) includes the elements outlined below through Year 5. This Plan provides a summary of stormwater-based phosphorus load reduction requirements, documents existing stormwater control measures and associated phosphorus load reduction credits, describes planned control measures to meet the Phase 1 Year 10 25% reduction requirement, outlines an operation and maintenance program for structural controls, and presents a Phase 1 implementation schedule and cost estimate.



Graphic 1-2: Phase 1 Plan Elements

2. WATERSHED AND COMMUNITY CHARACTERIZATION

The Charles River watershed consists of an approximate land area of 308 square miles. The river is approximately 80-miles long and spans from Echo Lake in Hopkinton to Boston Harbor. The river flows through 23 communities and the watershed includes 35 communities, as shown in Graphic 2-1 below. The Charles River watershed is home to over one million residents.



Graphic 2-1: Charles River Watershed Map by CRWA

*Map not to scale

As an urban river, it is impaired for multiple pollutants. Three total maximum daily loads (TMDLs) have been developed for the watershed, including two for nutrients and one for bacteria. A nearly five-decade cleanup effort has resulted in water quality improvements, primarily from elimination of industrial and municipal wastewater discharges and a significant reduction in untreated sewage overflows discharging into the river.

The primary challenge facing the river today is considered stormwater runoff. The nutrient phosphorus is transported to the river through stormwater runoff. In excessive quantities, phosphorus can lead to harmful algal blooms (HABs) and an associated reduction in river dissolved oxygen levels, which can impact aquatic life and create toxic cyanobacteria outbreaks. Stormwater-based phosphorus sources in the urban environment typically consist of organic materials (leaves, grass clippings, etc.) washed off impervious areas during rain and snowmelt, sediments eroded from construction sites, wash off from winter sand application, and runoff containing phosphorus-based fertilizers.

The Town of Medway (the Town) is a suburban community located southwest of Boston between interstates 495 and 95 and bisected by route 109 (Main Street). The Town occupies a land area of approximately 11.5 square miles and is bordered by Holliston, Millis, Franklin, Bellingham, and Milford. As of 2020, the Town had a population of 13,115. The town's history as an agricultural community is still present today with several working farms occupying nearly 400 acres of land. The Charles River defines the southern border of town, and evidence of its industrial past is present through the Sanford Mill and Dam as well as the Village Street Dam. Per the Town's 2022 *Master Plan Update*, the Town is zoned approximately 55% residential, 9% commercial/industrial, 5% institutional, 23% open space, and 7% as other.

Medway is located entirely within the Charles River watershed. Excessive stormwater runoff is easily generated by the built environment within the Town which, without control measures in place, can contribute stormwater-based pollutants to the Charles River watershed. Reducing stormwater runoff and phosphorus in the Town's stormwater discharges are essential for the long-term sustainability and recovery of the Charles River.

2.1 Medway Characteristics

2.1.1 Hydrography

Medway contains multiple waterbodies, some impaired with one or more pollutants. Figure 1 identifies the waterbodies in town and Table 2-1 outlines the major receiving waterbodies with impairments as presented in the Draft Massachusetts Integrated List of Waters for the Clean Water Act 2022 Reporting Cycle.

Table 2-1: Medway's Impaired Waterbodies

Waterbody Segment	Impairments
Charles River (MA 72-04)	Flow Regime Modification, Ambient Bioassays - Chronic Aquatic Toxicity Chlordane in Fish Tissue DDT in Fish Tissue Escherichia (E. Coli) Fish Bioassessments Mercury in Fish Tissue Nutrient/Eutrophication Biological Indicators Phosphorus, Total Temperature
Charles River (MA 72-05)	Fanwort Water Chestnut Algae Benthic Macroinvertebrates Chlordane in Fish Tissue DDT in Fish Tissue Dissolved Oxygen Dissolved Oxygen Supersaturation Mercury in Fish Tissue Nutrient/Eutrophication Biological indicators Phosphorus, Total Turbidity
Chicken Brook (MA 72-34)	E.coli
Hopping Brook (MA 72-35)	E.coli

2.1.2 Land Cover

Impervious surfaces can contribute to increased stormwater runoff, route surface pollutants quickly to receiving waters, and restrict the recharge of groundwater. Pervious areas allow the infiltration of precipitation to recharge shallow and deep groundwater and preserve the hydrologic integrity of a watershed. Most impervious cover is made up of buildings, parking lots, driveways, and roads. The percentage of impervious cover in a watershed can indicate the probable health of the watershed and associated waterbody. Extensive literature sources indicate that watersheds with greater than 10% of their land area covered by impervious surfaces exhibit various signs of impairment due to stormwater runoff. Medway consists of approximately 974 acres of impervious area, which is approximately 13% of the total land area.

2.1.3 Land Use

Land use is also an important factor when evaluating a watershed for sources of stormwater-based runoff pollution. In most cases, commercial, industrial, high- and medium-density residential, and highway land uses generate higher concentrations of pollutants in stormwater runoff than undeveloped or rural areas. Land use distribution per the MassGIS 2005 Land Cover/Land Use dataset is illustrated in Figure 2 in Appendix A.

Table 2-2 summarizes the area distribution within each land use category, Table 2-3 summarizes the percent of total impervious cover by land use category. This data was presented in an EPA Region 1 memorandum dated April 22, 2014, with the subject *Overview of Methodology to Calculate Baseline Stormwater Phosphorus Loads and Phosphorus Load Reduction Requirements for Charles River Watershed* and is based on the MassGIS 2005 Land Use dataset. As demonstrated in Table 2-3, commercial, industrial, high-density residential, and highway areas in the Town have higher percent impervious cover than other land use types. This results in higher concentrations of pollutants in stormwater runoff from these land uses. Additionally, the Town's overall percent total impervious area cover of approximately 13% is 1.3 times higher than the 10% impervious surface indicator for impairments due to stormwater runoff. Finally, Table 2-2 demonstrates that the Watershed consists primarily of forest, medium-density residential, and commercial land use.

Table 2-2: Area of Aggregate Land Use (acres)

Community	Commercial	Industrial	High Density Residential	Medium Density Residential	Low Density Residential	Highway	Open Land	Agriculture	Forest	Total Area
Medway	191.33	132.25	266.04	399.17	1,816.75	11.6	423.67	370.14	3,812.36	7,466.14

Table 2-3: Percent Impervious Area of Aggregate Land Use Categories

Community	Commercial	Industrial	High Density Residential	Medium Density Residential	Low Density Residential	Highway	Open Land	Agriculture	Forest	Overall % IA
Medway	65%	58%	33%	26%	22%	37%	14%	8%	2%	13%

2.1.4 Soils

Based on data from the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), Medway consists primarily of hydrologic soil group (HSG) B soils (37.4 %), followed by HSG A (27.7%), HSG C/D (18.8%), HSG C (11.4%) and HSG D (4.7%) soils. HSG A generally has the lowest runoff potential and HSG D the greatest. Understanding watershed soils aids stormwater runoff mitigation decision making, since stormwater control measures are more effective on HSG A and B soils due to their high infiltration capacity. Figure 3 illustrates the locations of each hydrologic soil group in the Watershed.

2.2 Water Infrastructure

Stormwater runoff in Medway is either captured and conveyed via an existing closed conduit drainage system or is conveyed via overland flow to waterbodies. The Town's drain and sewer are separated. Roughly 2,900 properties are connected to the sewer system, with the remainder utilizing septic systems.

2.3 Historic Stormwater Management Approach

Under the MS4 General Permit, the Town is required to implement a stormwater management program (SWMP) intended to reduce pollutants in stormwater. The Town's latest SWMP, dated June 2023, outlines

the activities and measures that the Town implements to meet the terms and conditions of the MS4 General Permit. The six minimum control measures, or main elements of the SWMP, include public education and outreach, public participation, illicit discharge detection and elimination (IDDE), management of construction site runoff, management of post-construction site runoff, and good housekeeping in municipal operations.

To ensure that stormwater from development projects is adequately controlled, the Town has developed requirements for stormwater design and drainage management that are applicable for the following:

1. Any activity that results in a land disturbance greater than 20,000 square feet of land; or
2. Any removal, disturbance, alteration, or addition of 10,000 square feet of more of impervious cover; or
3. Any development project that:
 - a. Requires a special permit, site plan review, or subdivision review; or
 - b. Requires a permit from the Conservation Commission.

In addition to the requirements outline above, the Town of Medway also regulates connections to the MS4 regardless of whether the connection was permitted in the past.

2.4 Economic Development Activity

Medway developed from a historically agricultural and industrial community. Factories utilized the Charles River and its tributaries for its hydropower which helped build Medway. The Town also has strong roots in its agricultural past and there are still several working farms. Industrial development has moved away from the rivers and are located in two zoned areas on the outskirts of town. Medway has no defined downtown area and is known as a "bedroom community" with the majority of its residents leaving town to work elsewhere. This this has led to the suburban sprawl we see in countless communities across the country.

Stormwater should continue to be an important aspect of the planning and economic development process. Redevelopment of commercial properties presents a cost-effective opportunity for the Town to reduce the phosphorus load to the Charles River.

3. PHOSPHORUS LOAD REDUCTION TARGETS

3.1 PCP Area

The Town of Medway has the option to implement its PCP across the entire town or just within the MS4-regulated urbanized area. The extent of the MS4-regulated urban area encompasses nearly the entire town (151 acres non-urban and 12 acres owned by MassDOT), as shown in Figure 4 in Appendix A. Therefore, Medway is opting to implement the PCP within our community boundaries because the planned practices/approaches will be implemented at the municipal scale and we want to “take credit” for all the non-structural and structural stormwater practices being implemented.

3.2 Baseline Load

The following table summarizes the annual baseline and allowable phosphorus load and required load reduction for the Town’s stormwater discharges in the Charles River watershed as described in the MS4 General Permit and are based on 2005 land use information.

Table 3-1: Annual Stormwater Phosphorus Load Reduction (2005)

Annual Load (kg / lbs)			
Baseline Phosphorus Load (Permit - 2005)	Allowable Phosphorus Load	Phosphorus Load Reduction Requirement	Percent Reduction in Phosphorus Load
1,063 / 2,343	662 / 1,459	400 / 882	38%

3.3 Change in Baseline Load Since 2005

The baseline load displayed in Table 3-1 above was calculated by EPA using land use and land cover data from 2005. Land use and cover changes have occurred since 2005 that will likely increase the 2005 baseline load. As such, permittees are required to reflect and mitigate for increases in phosphorus load due to development since 2005. The current load reduction requirement is being used as the target management goal.

During Year 6 and Year 7, the change in load due to development since 2005 is required to be reported as a part of the Phase I Performance Evaluation. With funding from the MassDEP MS4 Technical Assistance Grant, the Charles River Watershed Association and the University of Vermont are partnering to help the watershed communities update their land use and impervious surface GIS data to 2021. This will assist the Town with recalculating the phosphorus load reductions.

4. LEGAL ANALYSIS

The MS4 General Permit describes the scope of the required legal analysis as a document that identifies existing regulatory mechanisms available to the Town, such as bylaws and ordinances, and describes changes to regulatory mechanisms that may be necessary to effectively implement all phases of the PCP.

The intent of the preliminary legal analysis is to provide guidance for the Town to consider how to best manage stormwater across the public and private sectors to meet the MS4 General Permit total phosphorus reduction requirements.

The town considers the approval of the Stormwater Management and Land Disturbance Bylaw at the May 2020 Town Meeting and the Massachusetts Attorney General as an example of the legal analysis completed to date. Considering that there was no Phosphorus Control Plan for Town Counsel to review until the end of Year 5, a more comprehensive legal analysis will occur in the follow phases of implementation.

5. FUNDING SOURCE ASSESSMENT

The town funds the stormwater management program through a dedicated stormwater expense account and stormwater consulting expense account. Larger projects may use capital funding which needs Town Meeting approval. Grant funding is another option the town is pursuing.

Possible funding entities include:

- Massachusetts Department of Environmental Protection State Revolving Fund Loan,
- Massachusetts Municipal Vulnerability Preparedness Action Grant,
- Section 604(b) Water Quality Management Program,
- Section 319 Water Quality Management Planning Grant Program,
- Metropolitan Area Planning Council's Accelerating Climate Resiliency Grant,
- Massachusetts Division of Ecological Restoration's Restoration and Revitalization Priority Projects Program, and
- Congressional Directed Spending.

It is anticipated that financing of the PCP will evolve as the MS4 General Permit term progresses and specific planned stormwater controls are designed and implemented.

6. EXISTING STORMWATER CONTROLS

6.1 Non-Structural

Non-structural pollution prevention practices prevent or reduce stormwater related runoff pollution by reducing the exposure and generation of pollutants that can be washed off during precipitation events. Non-structural management approaches can also include public education and outreach, or new or refined regulatory policies that minimizes creation or impact of land development, septic systems or other sources of stormwater and groundwater pollution. Non-structural management practices typically refer to stormwater runoff management that do not require extensive engineering design and construction efforts, hence the term non-structural. Non-structural controls can be the most cost-effective stormwater attenuation strategies for any given watershed but require careful planning and organization of labor resources, enforcement or incentives, education, and outreach, and may require specialized equipment.

The MS4 General Permit currently allows credit for three non-structural control measures: enhanced sweeping, catch basin cleaning, and organic waste and leaf litter collection. The following operational standards were used to estimate phosphorus reduction credits for current Town operations.

Table 6-1: Existing Non-Structural Control Standards

Non-Structural Control	Operational Standard	Reduction Factor
Sweeping	Semi-annual sweeping of municipally owned roadways, parking lots or other municipally operated impervious surfaces using a mechanical broom sweeper from March through November.	1% annual reduction, prorated by 0.75 for a period between March and November.
Catch Basin Cleaning	Annual cleaning of municipally owned catch basins within municipally owned and maintained roadways, parking areas and properties	1% annual reduction
Organic Waste and Leaf Litter Collection	Annual cleaning of municipal roadways, parks, and municipal facilities.	5% annual reduction

Implementing these non-structural controls on municipal properties represent a phosphorus reduction of 13.6 pounds per year, as noted in the table below.

Table 6-2: Existing Non-Structural Controls Load Reduction

	Land Cover (acres)			Load Reduction (lbs/year)		
	All Roadways & Parking lots	Impervious Catch Basin Drainage Area	Enhanced Sweeping	Catch Basin Cleaning	Organic Waste/ Leaf Litter Collection	Total
	285.09	491.59	4.01	9.59	0.0	13.6

Calculations supporting this estimate are included in Appendix B. The roadway jurisdiction is appended as Figure 5 in Appendix A, and a figure showing MAPC catchment areas for catch basins is appended as Figure 6.

6.2 Structural

Structural BMPs are permanent structures and/or facilities constructed and operated to reduce the discharge of pollutants in stormwater by treating runoff via filtration, infiltration, and/or biological processes. A structural BMP is creditable towards the Town's total phosphorus reduction requirement if it meets the design requirements outlined by EPA in the MS4 General Permit and is currently functioning as it was designed to. Medway organizes its structural BMPs into three categories: "town-owned," "town-managed," and "private."

Town-owned BMPs are structures located on town-owned properties. There are five town properties that treat all on-site impervious cover: Choate Park, Thayer Homestead, Oakland Park, Department of Public Works, and Medway High School. The Burke-Memorial Elementary School was retrofitted with a rain garden in 2019 to treat runoff from a portion of the parking lot, playground, and basketball court. The Medway Police Station also has a detention basin that treats roof and parking lot run off; however, there are no supporting stormwater calculations for this structure.

Most town-managed BMPs were built between the 1990s and 2010s as a part of residential subdivisions. Typically, the Town accepted these roads, and therefore; all infrastructure maintenance falls under the jurisdiction of the Department of Public Works (DPW). Some earlier subdivisions did not include drainage easements for maintenance access, but in later years, the Planning Board began requiring easements in the definitive plans. Other town-managed BMPs are located in the town's right-of-way, and therefore, fall under the DPW for maintenance.

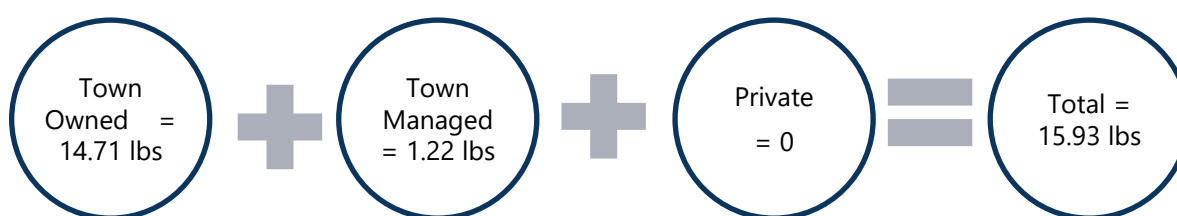
Private BMPs are structures outside of the jurisdiction of the Department of Public Works for maintenance. These are typically commercial, industrial, and institutional properties, or developments with homeowners' association to manage the property.

Using permitting and planning documentation provided Community and Economic Development Department, Board of Health, Building Department, and DPW, the Town identified existing structural stormwater control measures across town as seen in Table 6-3 below.

Table 6-3: Existing Structural Controls

Town-Owned	Town-Managed	Private	Total
31	72	89	192

As previously stated, structures are only creditable if they meet the EPA requirements and are functioning as they were designed. Over the years, many BMPs were not maintained in accordance with the operations and maintenance manuals. However, Medway is in the process of restoring these BMPs and will claim phosphorus reduction credits. Phosphorus reduction was calculated using EPA's Best Management Practice Accounting and Tracking Tool (BMP-BATT), which is a spreadsheet-based tool that provides accounting, tracking, and reporting for pollutant load reduction. The credit estimated for 15 Town-Owned, 1 Town-Managed, and zero privately managed BMPs is summarized in Graphic 6-1. Privately owned BMPs may be creditable; however, the town does not have reports documenting maintenance and functionality. The existing structural control credit calculations are included in Appendix C.1.



Graphic 6-1: Structural Controls Reduction (lbs/year)

Each BMP was inspected during 2022 by the DPW Highway Superintendent, Right of Way Supervisor, and Compliance Coordinator. The inspection form was based off criteria needed for the BATT tool as well as a BMP maintenance bid sheet shared by the Town of Tewksbury, MA. As DPW staff completed the initial inspections, additional information was collected to assist with prioritizing maintenance. For example, we included whether or not there was a drainage easement, and if so, was the easement obstructed making maintenance access a challenge. The inspection form is included in Appendix C.2. The locations of all structural BMPs are illustrated in a figure provided in Appendix C.3.

The total credit presented in this section is anticipated to be updated and refined as additional documentation is reviewed. It is also important to note that the date of last completed maintenance is required to take credit for each BMP. Certification that all BMPs are being inspected and maintained according to the O&M program specified in this PCP (Section 8) is also required. Certification requirements are listed in Appendix F.

6.3 Phosphorus Load Reduction Gap

Table 6-4 below summarizes Medway's anticipated stormwater phosphorus load reduction gap estimated by crediting existing non-structural and structural controls as outlined above.

Table 6-4: Estimated Existing Phosphorus Load Reduction Gap (lbs/year)

Required Phosphorus Load Reduction (lbs)	Estimated Reduction Achieved			Estimated Load Reduction Gap
	Non-Structural	Structural	Total Non-Structural and Structural Reduction	
882	13.6	15.93	29.53	852.47

The MS4 General Permit requires that municipalities achieve reduction targets in a phased approach. Under Phase 1 of the PCP implementation, the Town of Medway is obligated to meet 20% of the reduction target at the end of Permit Year 8 (June 2026) and 25% of this target at the end of Permit Year 10 (June 2028), as summarized in Table 6-5.

Table 6-5: Anticipated Phosphorus Load Reduction Gap for Phase 1

Target Milestones	Reduction Required	Reduction Provided by Existing Structural and Non-Structural Controls	Estimated Load Reduction Gap
Phase 1-Year 8 Reduction Requirement June 2026	20% (176 lbs./year)	3.3% (29.53 lbs./year)	83.3% (146.47 lbs./year)
Phase 1-Year 10 Reduction Requirement June 2028	25% (220 lbs./year)	3.3% (29.53 lbs./year)	86.6% (190.47 lbs./year)
Total 20-Year Permit Reduction Requirement June 2038	100% (882 lbs./year)	3.3% (29.53 lbs./year)	96.7% (852.47 lbs./year)

Section 7 of this plan summarizes planned controls to meet the Phase 1 reduction target of 25% by Year 10 (2028). It should be noted that the required phosphorus load reduction is anticipated to increase due to development since 2005, as discussed in Section 3.3.

7. PLANNED CONTROLS

7.1 Non-Structural

Per the MS4 General Permit, the permittee shall describe the non-structural stormwater control measures necessary to support achievement of the phosphorus export milestones in Table F-1 (MS4 General Permit Appendix F). The description of non-structural controls shall include the planned measures, the areas where the measures will be implemented, and the annual phosphorus reductions that are expected to result from their implementation in units of lbs/yr. Annual phosphorus reduction from non-structural BMPs shall be calculated consistent with Attachment 2 to Appendix F of the MS4 General Permit.

Table 7-1: Planned Non-Structural Controls Load Reduction

	Land Cover (acres)		Load Reduction (lbs/year)			
	All Roadways and Parking Areas	Impervious Catch Basin Drainage Area	Enhanced Sweeping	Catch Basin Cleaning	Organic Waste/ Leaf Litter Collection	Total
Town-Owned and Town-Managed Properties & Roadways	285.09	491.59	12.02	19.17	8.31	39.5

Calculations supporting the planned non-structural controls estimate are included in Appendix D.

7.2 Structural

Planned structural controls have been assessed to meet the Town's load reduction gap for Year 8 and 10. Phase 1 planned structural controls will be located on town owned and managed parcels, as well as roadways. Increased oversight and management of existing privately owned BMPs will also be part of Phase I implementation.

7.2.1 Municipal Structures

There are 128 municipally owned parcels in Medway, however, many properties that would be considered one site are actually comprised of multiple parcels. For example, the Town's high school is broken up into 6 different parcels but is considered one property.

In 2020, the Town partnered with the Charles River Watershed Association (CRWA) to conduct an infiltration feasibility assessment of town-owned parcels for their potential to treat stormwater onsite. Factors such as soil conditions, depth to ground water, wetland resource areas, and impervious cover were assessed through GIS analysis and soil assessments. Of the 128 municipal parcels, 77 have some portion of impervious cover with no single parcel having more than ~25% impervious cover. In total, 97 parcels were identified as having viable retrofit and infiltration potential. The results of the infiltration feasibility assessment have served as a basis for continued evaluation of town properties.

For example, Oakland Park was identified as a town parcel with opportunity for infiltration. As a member of the Charles River Climate Compact and participant in the Charles River Flood Model project, Medway's Oakland Park was selected as an opportunity for additional flood storage and green infrastructure. In 2023, the Town collaborated with the CRWA and Horsley Witten Group to further develop concept plans for 10 additional town sites and 25% engineered plans for the Medway Middle School and High School. The Medway Middle School project includes 4 new rain gardens and a subsurface infiltration basin. The High School project includes tree trenches and additional rain gardens.

Through the process of evaluating town sites, it was realized that incorporating offsite drainage onto larger town parcels with conducive soils a higher phosphorus reduction and infiltration capacity could be achieved. The Medway Middle School project will accommodate stormwater from Kelley Street and Holliston Street, which abut the school. An additional study was conducted on the lower section of Holliston Street, which will include enhanced biofiltration along the streetscape.

Lastly, there is an opportunity to retrofit existing structural controls to increase infiltration capacity and water quality treatment. For example, the existing detention basin at the Police Station can be retrofitted to incorporate stormwater from Village Street and Campbell Street, promoting additional infiltration and treatment. The High School also poses an opportunity to retrofit two existing basins with additional infiltration capacity. The Winter Street structural control has potential to collect stormwater from much of the Village Residential and Village Commercial Zoning Districts.

Table 7-2 below summarizes each retrofit's estimated phosphorus load reduction, estimated cost, and estimated cost per pound of phosphorus removed. These should be considered estimated implementation costs; they do not include inspection or maintenance for continued performance throughout the BMP's life.

Table 7-2: Town-Owned Parcel Retrofit Summary

Structure Location	BMP Type	Load Reduction (lbs/year)	Estimated Cost	Approximate Cost/Pound Removed (\$/lb)
Middle School	Rain Garden 1 (Bioretention)	0.5	\$66,600	\$133,200
	Rain Garden 2 (Bioretention)	0.42	\$41,200	\$98,095
	Rain Gardens 3 & 4 (Bioretention)	3.39	\$175,000	\$51,622
	Infiltration Basin	17.44	\$154,400	\$8,853
Oakland Park	Bioswales	1.22	\$61,000	\$50,000
	Infiltration Basin	11.44	\$101,278.32	\$8,853
Fire Station #1	4 Infiltration rain gardens	2.1	\$105,000	\$50,000
Public Library	1 Infiltration rain garden	0.1	\$5,000	\$50,000
1 Mechanic St	1 infiltration rain garden	0.17	\$8,500	\$50,000
Burke-Memorial Elementary School	5 Infiltration rain gardens	9.6	\$480,000	\$50,000
0 North Street	1 Infiltration rain garden	0.4	\$20,000	\$50,000
Cassidy Field Parking Lot	1 infiltration rain garden	1.2	\$60,000	\$50,000
Jacob Ide House (158 Main Street)	2 infiltration rain gardens	0.3	\$15,000	\$50,000
Highway Barn	2 infiltration rain gardens	3.9	\$195,000	\$50,000

McGovern Elementary School	3 Rain Gardens	3.4	\$170,000	\$50,000
Police Station	3 Infiltration rain gardens	1	\$50,000	\$50,000
High School	2 infiltration basins	6.04	\$60,400	\$10,000
Holliston Street (Lower)	enhanced biofiltration	6.18	\$309,000.00	\$50,000.00
Winter Street	Infiltration basins, and bioretention basins	20.08	\$200,800	\$10,000
Total		88.88	\$2,278,178	\$25,632

7.2.2 Roadways and Town-Managed Parcel Retrofit Summary

There are over 100 miles of municipally owned roadways in Medway, and stormwater runoff from impervious cover outside of the municipal right-of-way may also be captured by municipal catch basins and treated. Due to limitations in available space within municipal right-of-way, not all traditional BMPs are viable for roadway retrofits as they may be for a regional retrofit facility or a larger available municipal parcel. Therefore, existing BMPs within subdivisions, which were originally designed to treat roadway runoff, roof runoff, etc., are prioritized for retrofit or restoration during the first phase of the PCP. For the purposes of this plan, a retrofitted BMP involves reengineered designs for an existing BMP, whereas a restoration BMP involves reconstructing an existing BMP to its original design.

The roadways and sites listed in this phase of the PCP were selected after reviewing the Department of Public Works 5 Year Roadway Improvement Plan and determining which streets were scheduled for repaving. Retrofitting within these selected roadways provides an opportunity for the Town to address phosphorus removal credits as part of a broader roadway rehabilitation project. New BMP opportunities were identified on 6 roadway improvement areas.

Each BMPs' estimated phosphorus load reduction, estimated cost, and estimated cost per pound of phosphorus removed is summarized in Table 7-3 below. These should be considered estimated implementation costs; they do not include inspection or maintenance for continued performance throughout the BMP's life.

Table 7-3: Roadways and Town-Managed Parcel Retrofit Summary

Structure Location	Action	BMP Type	Load Reduction (lbs/year)	Estimated Cost	Approximate Cost/Pound Removed (\$/lb)
Grapevine Way	Restoration	Infiltration basin	0.19	\$5,000	\$5,000
Hickory Lane	Restoration	wet basin	4.87	\$ 24,395	\$5,000
Broad Acres Farm Road	Restoration	wet basin	4.17	\$ 20,865	\$5,000
Broad Acres Farm Road	Restoration	wet basin	5.68	\$28,445	\$5,000
Lantern Lane & Pine Meadow	Restoration	Infiltration	0.42	\$30,000.00	\$5,000.00
Newton Lane	Restoration	detention basins	0.33	\$5,000.00	\$5,000.00
Blueberry Hill Road	Restoration	wet basin/created wetland	6.52	\$15,000.00	\$5,000.00
Fairway Lane	Restoration	enhanced biofiltration	3.18	\$159,400	\$50,000
Daffodil Drive	Restoration	infiltration basin	1.28	\$6,415	\$5,000
Daffodil Lane	Retrofit	enhanced biofiltration	1.38	\$69,350.00	\$50,000.00
Tulip Way	Retrofit	enhanced biofiltration	2.24	\$112,250.00	\$50,000.00
Tulip Way	Retrofit	enhanced biofiltration	0.48	\$ 24,200.00	\$50,000.00

Temple Street	Retrofit	enhanced biofiltration	4.85	\$242,950.00	\$50,000.00
Applegate	Retrofit	infiltration basin	8.82	\$88,230.00	\$10,000.00
Alder Street	Retrofit	infiltration basin	1.23	\$12,300.00	\$10,000.00
Ash Lane	Retrofit	enhanced biofiltration	5.42	\$271,450.00	\$50,000.00
Independence Lane & Freedom Trail	Retrofit/ Restoration	enhanced biofiltration	3.25	\$162,550.00	\$50,000.00
Diane Drive, Kimberly Drive, Stephanie Road (Country View Estates)	New	2 infiltration basins	5.64	\$56,480	\$10,000
Shaw St, Samoset St	New	enhanced biofiltration	8.04	\$402,000	\$ 50,000
Claybrook Farm Road	New	enhanced biofiltration	3.97	\$198,700	\$50,000
Cedar Farm Road	New	enhanced biofiltration	1.86	\$93,300	\$50,000
Castle Road/Granite Street	New	infiltration basin	1.72	\$17,250	\$10,000
Laurelwood Lane	New	enhanced biofiltration	1.75	\$87,700.00	\$50,000.00
TOTAL			77.4	\$2,133,230	\$27,560

7.3 Phosphorus Load Reduction Gap

Table 7-4 and 7-5 below summarize Medway's anticipated stormwater phosphorus load reduction gap estimated by crediting existing and planned non-structural and structural controls.

Table 7-4: Estimated Planned Phosphorus Load Reduction Gap (lbs/year)

Required Phosphorus Load Reduction	Estimated Reduction Achieved				Estimated Load Reduction Gap
	Existing Structural & Non-Structural	Planned Non-Structural	Planned Structural	Total Existing and Planned	
882	29.53	39.5	166.28	221.71	-1.71

Table 7-5: Anticipated Phosphorus Load Reduction Gap for Phase 1

Target Milestones	Reduction Required	Reduction Provided by Existing and Planned Controls	Estimated Load Reduction Gap
Phase 1-Year 8 Reduction Requirement July 2026	20% (176 lbs/year)	20.2% (177.88 lbs/year)	0% (0 lbs/year)
Phase 1-Year 10 Reduction Requirement July 2028	25% (220 lbs/year)	25.1% (221.71 lbs/year)	0% (0 lbs/year)
Total 20-Year Permit Reduction Requirement July 2038	100% (882 lbs/year)	25.1% (221.71 lbs/year)	74.9% (660.29lbs/year)

It should be noted that the required phosphorus load reduction is anticipated to increase due to development since 2005, as discussed in Section 3.3.

Calculations for planned structural controls and concept plans are included in Appendix E.

8. OPERATION AND MAINTENANCE PROGRAM FOR STRUCTURAL CONTROLS

Per the MS4 General Permit, the permittee shall establish an Operation and Maintenance Program for all structural BMPs being claimed for phosphorus reduction credit as part of Phase 1 of the PCP. This includes BMPs implemented to date as well as BMPs to be implemented during Phase 1 of the PCP.

The Operation and Maintenance Plan (O&M) for existing and planned structural controls will follow the O&M Plans associated with the approved plans for individual sites and subdivisions. The Department of Public Works complied as-builts or the equivalent, stormwater reports, long term O&M plans, and Orders of Conditions for all town-owned, town-managed, and privately owned sites with BMPs in Medway. These documents are stored in a shared online drive for interdepartmental review as well as in hard copies in individual binders for DPW Highway Division Staff to implement in the field. Sites and subdivisions with specific O&M Plans and log sheets are used when they exist; otherwise, a standard BMP inspection sheet is provided in the binders.

Inspections of town-owned and town-managed sites are the responsibility of the DPW Highway Division, which oversees stormwater drainage infrastructure. When maintenance such as mowing or tree removal is required, the DPW Parks Division partners with the DPW Highway Division to complete the required maintenance. As inspection sheets are completed, they are recorded in the DPW work order system.

Privately owned structural BMPs fall within the DPW Sustainability Coordinator and Conservation Agent's jurisdiction. Reports will be submitted annually to both parties by the owner of the property or property manager.

The EPA self-certification program will be explored during Phase 1 of the PCP. In accordance with MS4 Permit Part 2.3.7.a. iii, "all permittee-owned stormwater treatment structures (excluding catch basins) shall be inspected annually at a minimum."

9. PHASE 1 IMPLEMENTATION

9.1 Schedule

The Town has created a schedule for implementation of all planned Phase 1 BMPs, including, as appropriate: obtaining funding, training, purchasing, construction, inspections, monitoring, operation and maintenance activities, and other assessment and evaluation components of implementation. Implementation of planned BMPs must begin upon completion of the Phase 1 Plan, and all non-structural BMPs shall be fully implemented within 6 years of the MS4 General Permit effective date. Structural BMPs shall be designed and constructed to ensure the permittee will comply with the Year 8 and Year 10 phosphorus load milestones established in Table F-1 (MS4 General Permit Appendix F). The Phase 1 plan shall be fully implemented as soon as possible, but no later than 10 years after the effective date of MS4 General Permit.

The implementation schedule is outlined in Table 9-1 below.

9.2 Estimated Cost

The estimated costs of implementing the phase 1 structural controls are based on a few factors including prior actual costs incurred for restoring BMPs and construction cost estimates from engineers for bioretention basins and subsurface infiltrators. Based on these factors the cost estimates were reasonably deduced.

Per prior experience, new structural controls typically have engineering and design costs of approximately \$100,000 to receive bid ready construction plans. Retrofit BMPs not incorporating a wider drainage area may cost roughly \$30,000. Costs incurred for the restoration BMPs will be funded through the stormwater operations budget. Non-structural controls will be funded through the stormwater operations budget as well.

The estimated design cost for the new and retrofitted BMPs is approximately \$1,504,000. Construction cost for all new, retrofitted, and restored BMPs is approximately \$4,393,000. Therefore, the total estimated implementation cost is \$5,897,000 by Year 10. This yields a \$26,600 cost per pound of phosphorus removal.

Table 9-1 outlines the Phase 1 structural and non-structural controls schedule and costs.

Table 9-1: Phase 1 Implementation Schedule and Estimated Costs

Description	Location	Type	Phosphorus Removal	Construction Cost	Design Costs	Cost Estimate Source	FY24 (Year 6)	FY25 (Year 7)	FY26 (Year 8)	FY27 (Year 9)	FY28 (Year 10)
restoration	Lantern Lane & Pine Meadow	Infiltration	0.428	\$30,000	n/a	DPW	DPW perform maintenance, Engineer confirm calcs				
restoration	Newton Lane	detention basins	0.335	\$5,000	n/a	DPW	DPW perform maintenance, Engineer confirm calcs				
restoration	Blueberry Hill Road	wet basin/created wetland	6.521	\$15,000	n/a	DPW	DPW perform maintenance, Engineer confirm calcs				
restoration	Grapevine Way	Infiltration	0.191	\$5,000	n/a	DPW	DPW perform maintenance, Engineer confirm calcs				
restoration	Hickory Lane	wet basin	4.879	\$24,395	n/a	DPW	DPW perform maintenance, Engineer confirm calcs and determine retrofit opportunity	Retrofit or restore			
restoration	Broad Acres Farm Road	wet basin	4.173	\$20,865	n/a	DPW	DPW perform maintenance, Engineer confirm calcs and determine retrofit opportunity	Retrofit or restore			
restoration	Broad Acres Farm Road	wet basin	5.689	\$28,445	n/a	DPW	DPW perform maintenance, Engineer confirm calcs and determine retrofit opportunity	Retrofit or restore			
restoration	Fairway Lane	enhanced biofiltration	3.188	\$159,400	n/a	DPW	DPW perform maintenance, Engineer confirm calcs and determine retrofit opportunity	Retrofit or restore			
new	Diane Drive, Kimberly Drive, Stephanie Road (Country View Estates)	2 infiltration basins	5.648	\$56,480	\$100,000	DPW	Concept design plans	100% Design plans with cost estimates	Construction		
new	Shaw St, Samoset St	enhanced biofiltration	8.04	\$402,000	\$100,000	DPW	Concept design plans	100% Design plans with cost estimates	Construction		
new	Claybrook Farm Road	enhanced biofiltration	3.974	\$198,700	\$100,000	DPW	Concept design plans	100% Design plans with cost estimates	Construction		
new	Cedar Farm Road	enhanced biofiltration	1.866	\$93,300	\$100,000	DPW	Concept design plans	100% Design plans with cost estimates	Construction		

new	Castle Road/Granite Street	infiltration basin	1.725	\$17,250	\$100,000	DPW	Concept design plans	100% Design plans with cost estimates	Construction		
new	Laurelwood Lane	enhanced biofiltration	1.754	\$87,700	\$100,000	DPW	Concept design plans	100% Design plans with cost estimates	Construction		
restoration	Daffodil Lane	infiltration basin	1.283	\$6,415	\$100,000	DPW	DPW perform maintenance, Engineer confirm calcs and determine retrofit opportunity	100% Design plans with cost estimates	Retrofit or restore		
retrofit	Daffodil Lane	enhanced biofiltration	1.387	\$69,350							
retrofit	Tulip Way	enhanced biofiltration	2.245	\$112,250							
		enhanced biofiltration	0.484	\$24,200							
retrofit	Temple Street	enhanced biofiltration	4.859	\$242,950	\$30,000	DPW	DPW perform maintenance, Engineer confirm calcs and determine retrofit opportunity	100% Design plans with cost estimates	Retrofit or restore		
new	Oakland Park	Bioswales	1.22	\$61,000	\$60,000	CRWA	Concept design plans	100% Design plans with cost estimates	construction		
		Infiltration Basin	11.44	\$101,278							
new	Middle School	Rain Garden 1 (Bioretention)	0.5	\$66,600	\$60,000	Horsley Witten	100% Design plans with cost estimates		Construction		
		Rain Garden 2 (Bioretention)	0.42	\$41,200							
		Rain Gardens 3 & 4 *bioretention	3.39	\$175,000							
		Infiltration Basin	17.44	\$154,400							
new	Cassidy Field Parking Lot	1 infiltration basin	1.2	\$60,000	n/a	CRWA	100% Design plans with cost estimates		Construction		
new	McGovern Elementary School	3 Rain Gardens	3.4	\$170,000	\$30,000	CRWA	Concept design plans	100% Design plans with cost estimates	Construction		
retrofit	High School	2 infiltration basins	6.04	\$60,400	\$30,000	DPW	DPW perform maintenance, Engineer confirm calcs and determine retrofit opportunity	100% Design plans with cost estimates	retrofit		
retrofit	Applegate	infiltration basin	8.823	\$88,230	\$30,000	DPW	DPW perform maintenance, Engineer confirm calcs and determine retrofit opportunity	100% Design plans with cost estimates	retrofit		
retrofit	Alder Street	infiltration basin	1.23	\$12,300	\$30,000	DPW	DPW perform maintenance, Engineer confirm calcs and determine retrofit opportunity	100% Design plans with cost estimates	retrofit		
retrofit	Ash Lane	enhanced biofiltration	5.429	\$271,450	\$30,000	DPW	DPW perform maintenance, Engineer confirm calcs and determine retrofit opportunity	100% Design plans with cost estimates	retrofit		

retrofit/rest oration	Independence Lane &Freedom Trail	enhanced biofiltration	3.251	\$162,550	\$30,000	DPW	DPW perform maintenance, Engineer confirm calcs and determine retrofit opportunity	100% Design plans with cost estimates	retrofit		
new	Holliston Street (lower)	enhanced biofiltration	6.18	\$309,000	\$84,000	DPW	Concept design plans		100% Design plans with cost estimates		Construction
retrofit	Police Station	3 Infiltration rain gardens	1	\$50,000	n/a	CRWA	Concept design plans		engineered plans	100% Design plans with cost estimates	retrofit
retrofit	Winter Street	1 Infiltration basin, 1 bioretention basin	20.08	\$200,800	\$100,000	DPW	DPW perform maintenance, Engineer confirm calcs and determine retrofit opportunity		100% Design plans with cost estimates		retrofit
new	Fire Station #1	4 Infiltration rain gardens	2.1	\$105,000	n/a	CRWA	Concept design plans			100% Design plans with cost estimates	Construction
new	Public Library	1 Infiltration rain garden	0.1	\$5,000	\$30,000	CRWA	Concept design plans			100% Design plans with cost estimates	Construction
new	1 Mechanic St	1 infiltration rain garden	0.17	\$8,500	\$30,000	CRWA	Concept design plans			100% Design plans with cost estimates	Construction
new	Burke-Memorial Elementary School	5 Infiltration rain gardens	9.6	\$480,000	\$30,000	CRWA	Concept design plans			100% Design plans with cost estimates	Construction
new	0 North Street	1 Infiltration rain garden	0.4	\$20,000	\$100,000	CRWA	Concept design plans			100% Design plans with cost estimates	Construction
new	158 Main Street	2 infiltration rain gardens	0.3	\$15,000	\$30,000	CRWA	Concept design plans			100% Design plans with cost estimates	Construction
new	Highway Barn	2 infiltration rain gardens	3.9	\$195,000	\$100,000	CRWA	Concept design plans			100% Design plans with cost estimates	Construction
		EXISTING STRUCTURAL	15.93								
		PLANNED NON-STRUCTURAL	39.5								
TOTAL			221.712	\$4,393,778	\$1,504,000						
Grand Total			\$5,897,778								
Total \$/lbs Phosphorus removal			\$26,601								

APPENDIX A: WATERSHED FIGURES

Figure 1: Hydrology

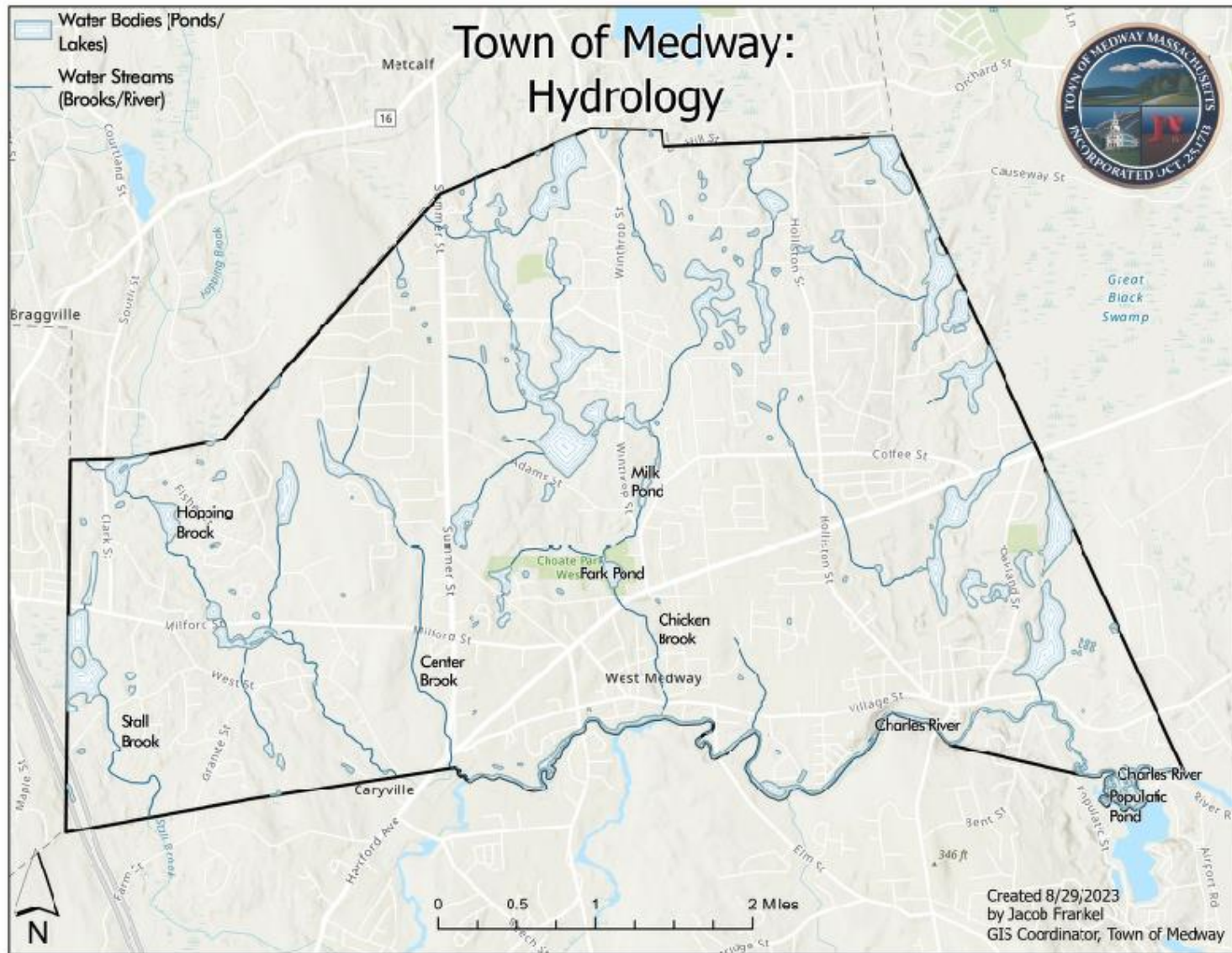


Figure 2: 2005 Land Use and Land Cover

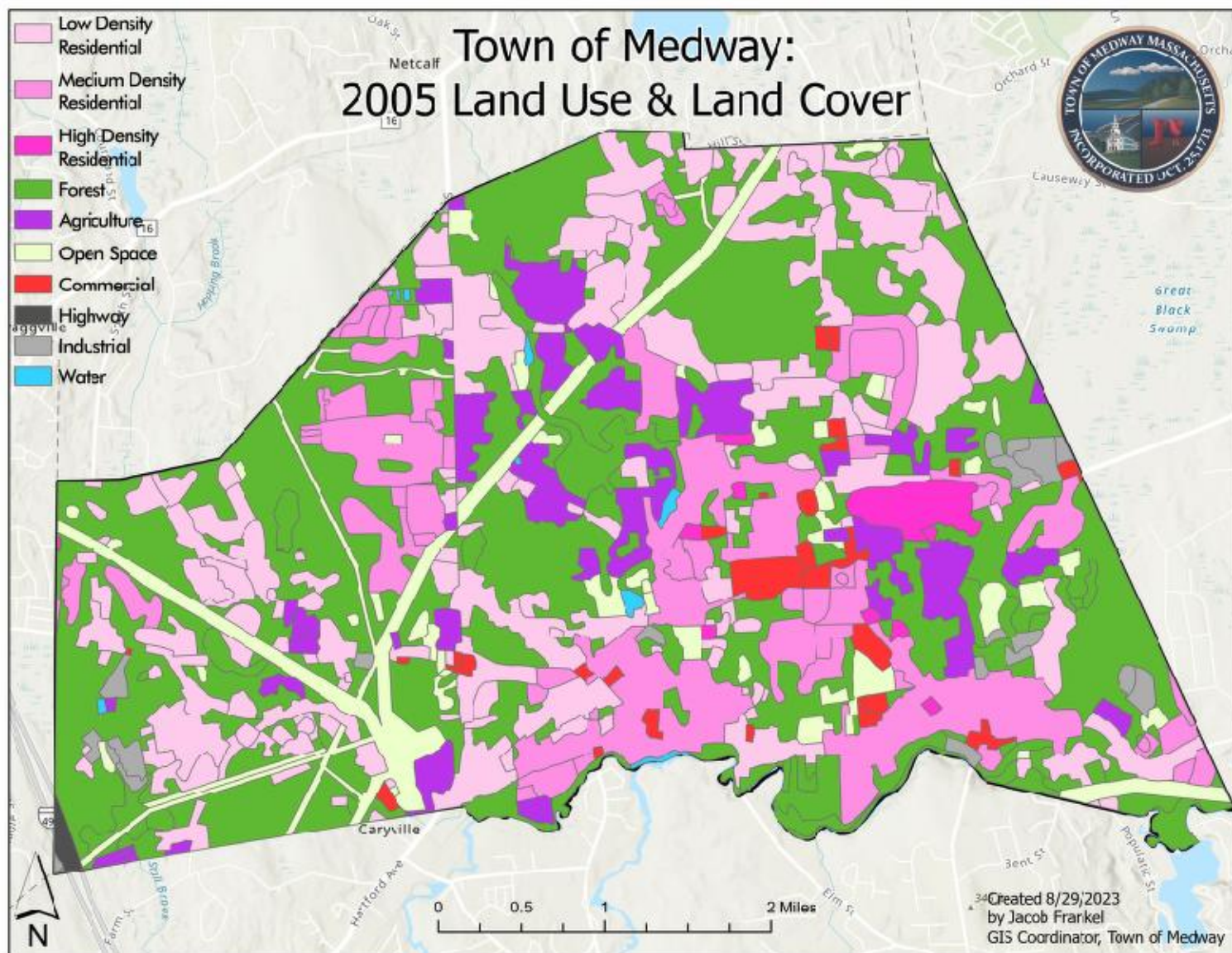


Figure 3: Hydrologic Soil Groups

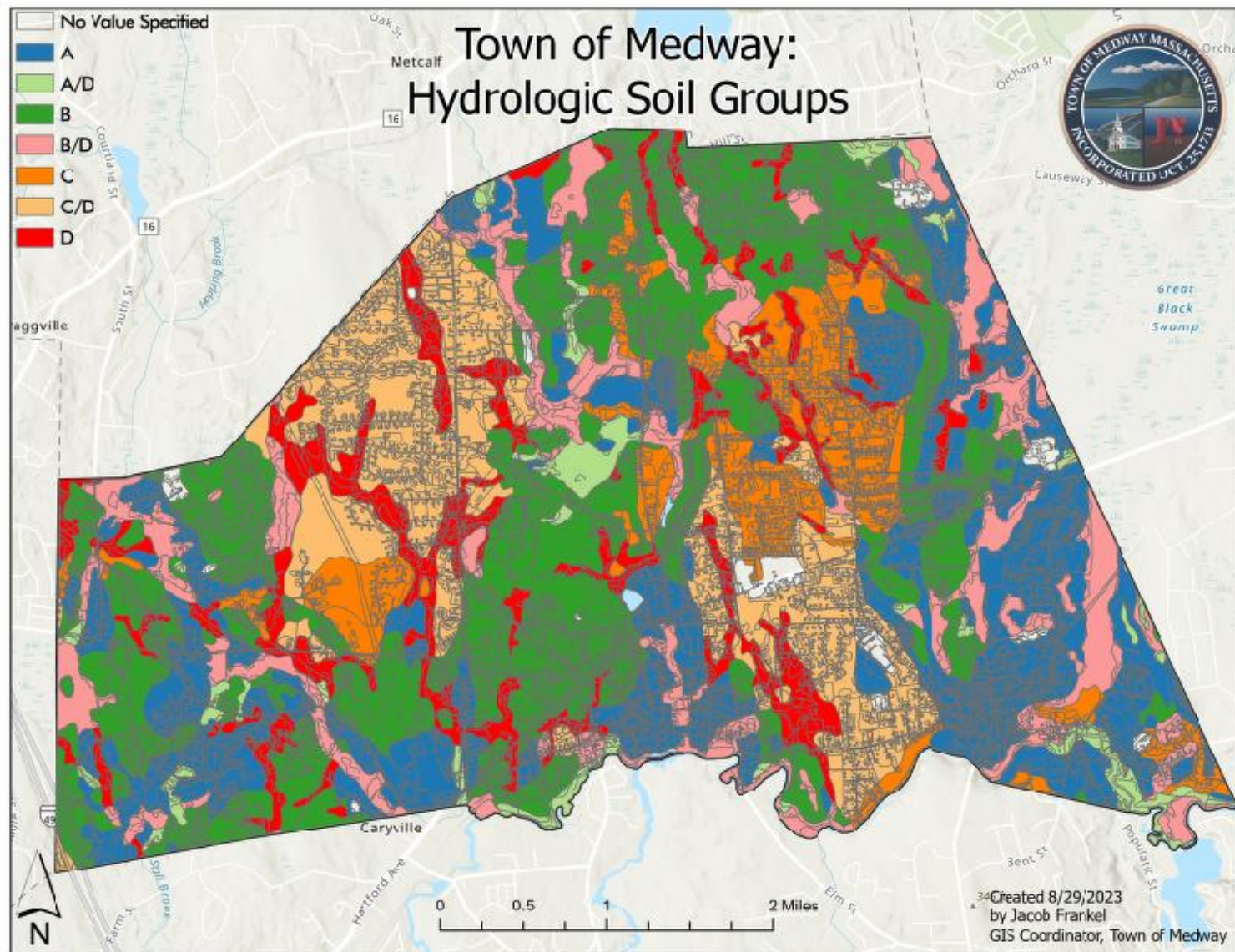
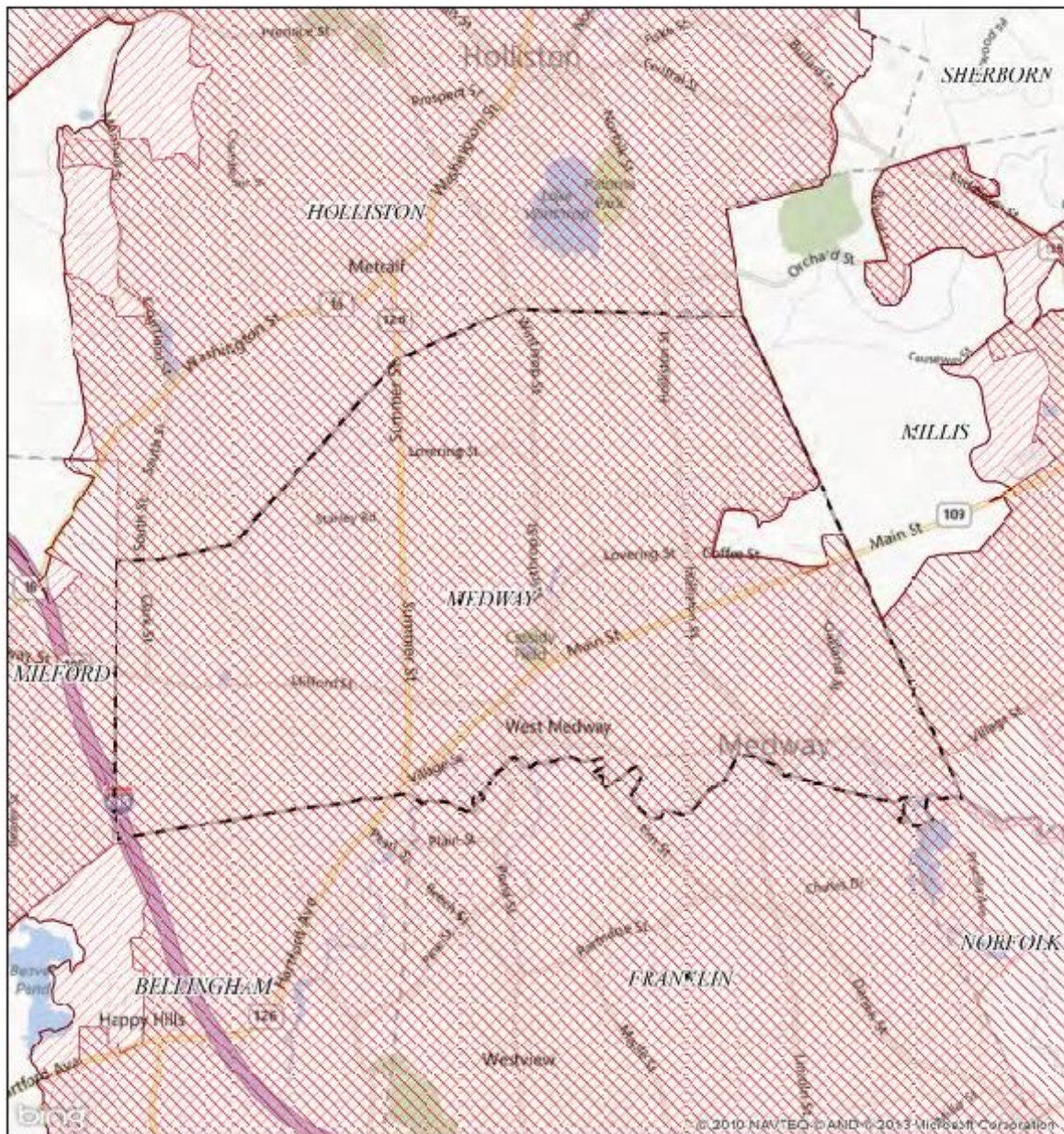


Figure 4: Urbanized Area



**NPDES Phase II Stormwater Program
Automatically Designated MS4 Areas
Medway MA**

Regulated Area:



Town Population: 12752
Regulated Population: 12714
(Populations estimated from 2010 Census)



Urbanized Areas, Town Boundaries:
US Census (2000, 2010)
Base map © 2013 Microsoft Corporation
and its data suppliers

US EPA Region 1 GIS Center Map #8824, 8/9/2013

Figure 5: Roadway Jurisdiction

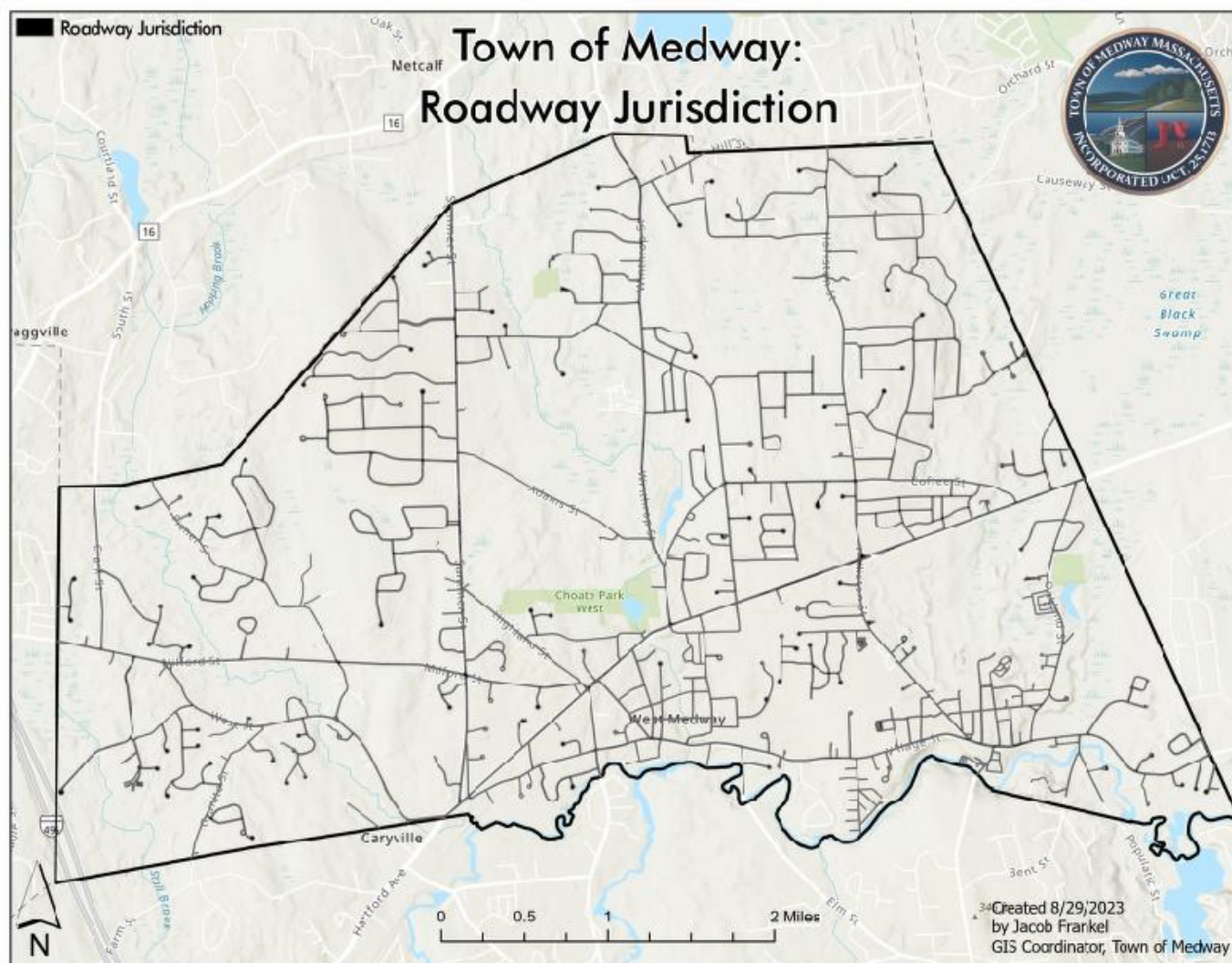
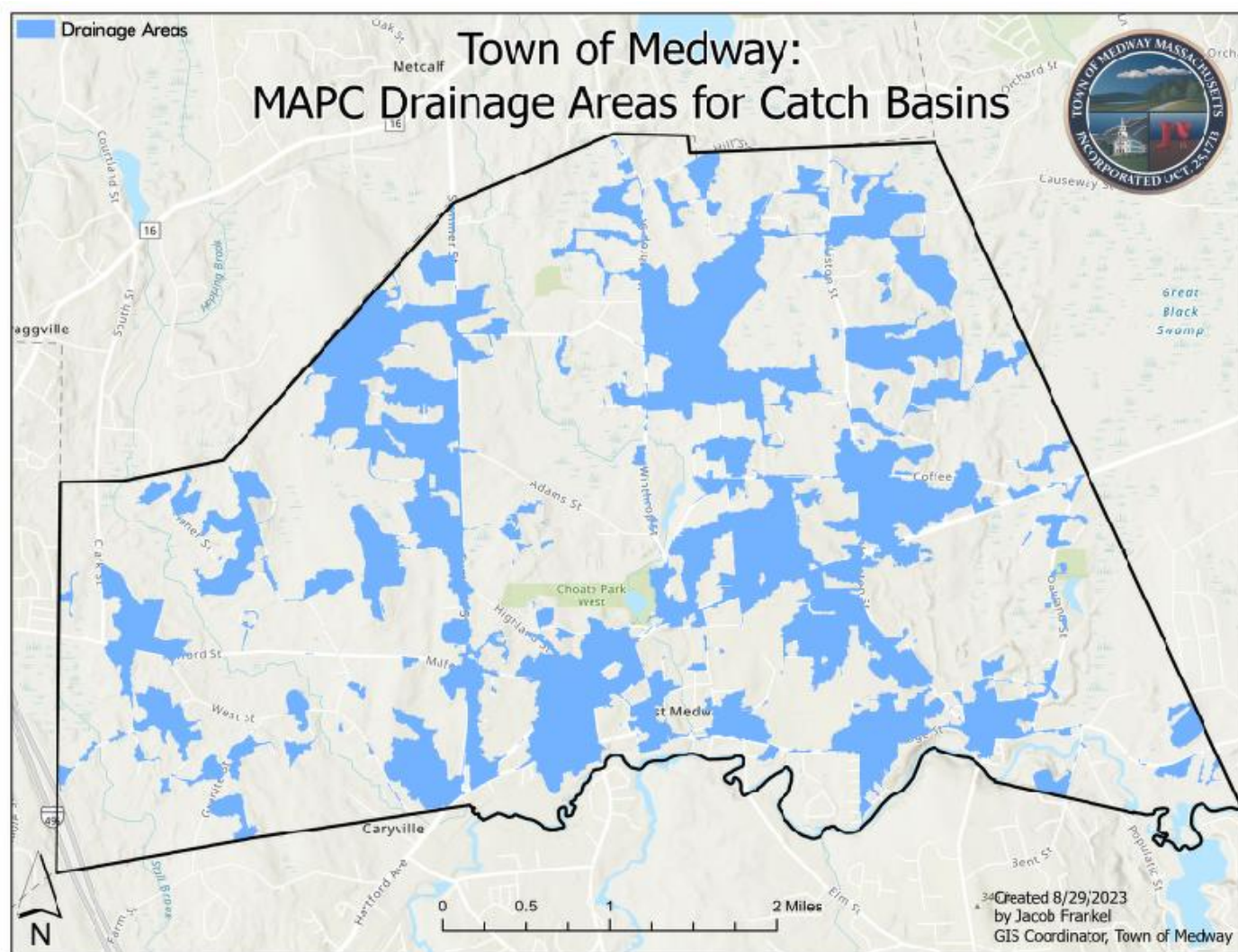


Figure 6: MAPC Drainage Areas for Catch Basins



APPENDIX B: EXISTING NON-STRUCTURAL CONTROLS

B.1: Enhanced Street Sweeping

The Town continues to gather and refine its data as well as expand its suite of analytic and tracking tools. However, during the time of these calculations it is important to note some data gaps. Currently, the town GIS roadway layer does not distinguish between private and public roadways or parking lots. Having a polygon layer that separates these features will help the town define its jurisdiction and more accurately identify phosphorus load removal.

Through GIS analysis, the town calculated the acreage of roadway in each land use type and its impervious and pervious coverage. Per the US EPA's land use land cover guidance titled, "2016 Massachusetts Small MS4 Permit Pollutant Loading Export Rates applied to the 2016 Massachusetts Land Use/Land Cover GIS Dataset," the town used the weighted average phosphorus loading rates of 1.95lbs P/ac/yr for all land use types except forest and agricultural lands.

Medway's sweeping operations occurs annually in the spring and fall using our mechanical broom sweeper. These operations begin in March and end by December.

We calculated the following phosphorus removal using Equation 2-1 provided in Appendix F of the MS4 General permit:

Equation 2-1: Phosphorus Credit
$$p_{\text{sweeping}} = IA_{\text{swept}} \times PLER_{\text{IC-land use}} \times PRF_{\text{sweeping}} \times AF$$

IA_{swept} = Area of impervious cover swept

$PLER_{\text{IC-land use}}$ = Phosphorus load export rate for impervious cover and specified land use (lb/acre/yr)

PRF_{sweeping} = Phosphorus reduction factor for sweeping based on sweeper type and frequency

AF = Annual frequency of sweeping

Agricultural

IA_{swept} = 6.52 acres

$PLER$ = 1.52 lbs/acre/year

PRF = 0.01

AF = 0.75

$$\begin{aligned} \text{Agricultural Credit } p_{\text{sweeping}} &= 6.52 \text{ acres} \times 1.52 \text{ lbs/acre/year} \times 0.01 \times 0.75 \\ &= \mathbf{0.07 \text{ lbs/year}} \end{aligned}$$

Commercial

IA swept = 12.25 acres
PLER = 1.95 lbs/acre/year
PRF = 0.01
AF = 0.75

$$\text{Commercial Credit}_{p \text{ sweeping}} = 12.25 \text{ acres} \times 1.95 \text{ lbs/acre/year} \times 0.01 \times 0.75 \\ = \mathbf{0.18 \text{ lbs/year}}$$

Forest

IA swept = 44.00 acres
PLER = 1.52 lbs/acre/year
PRF = 0.01
AF = 0.75

$$\text{Credit}_{p \text{ sweeping}} = 44.00 \text{ acres} \times 1.52 \text{ lbs/acre/year} \times 0.01 \times 0.75 \\ = \mathbf{0.50 \text{ lbs/year}}$$

High Density Residential

IA swept = 27.01 acres
PLER = 1.95 lbs/acre/year
PRF = 0.01
AF = 0.75

$$\text{HDR Credit}_{p \text{ sweeping}} = 27.01 \text{ acres} \times 1.95 \text{ lbs/acre/year} \times 0.01 \times 0.75 \\ = \mathbf{0.40 \text{ lbs/year}}$$

Industrial

IA swept = 7.68 acres
PLER = 1.95 lbs/acre/year
PRF = 0.01
AF = 0.75

$$\text{Industrial Credit}_{p \text{ sweeping}} = 7.68 \text{ acres} \times 1.95 \text{ lbs/acre/year} \times 0.01 \times 0.75 \\ = \mathbf{0.11 \text{ lbs/year}}$$

Low Density Residential

IA swept = 139.15 acres
PLER = 1.95 lbs/acre/year
PRF = 0.01
AF = 0.75

$$\text{LDR Credit}_{p \text{ sweeping}} = 139.15 \text{ acres} \times 1.95 \text{ lbs/acre/year} \times 0.01 \times 0.75 \\ = \mathbf{2.04 \text{ lbs/year}}$$

Medium Density Residential

IA swept	= 38.71 acres
PLER	= 1.95 lbs/acre/year
PRF	= 0.01
AF	= 0.75

$$\text{MDR Credit}_{p \text{ sweeping}} = 38.71 \text{ acres} \times 1.95 \text{ lbs/acre/year} \times 0.01 \times 0.75 \\ = \mathbf{0.57 \text{ lbs/year}}$$

Open Land

IA swept	= 9.76 acres
PLER	= 1.95 lbs/acre/year
PRF	= 0.01
AF	= 0.75

$$\text{Open Land Credit}_{p \text{ sweeping}} = 9.76 \text{ acres} \times 1.95 \text{ lbs./acre/year} \times 0.01 \times 0.75 \\ = \mathbf{0.14 \text{ lbs/year}}$$

Total phosphorus removal for all impervious cover land uses = 4.01 lbs./year

B.2: Catch Basin Cleaning

The Town utilized the Metropolitan Area Planning Council (MAPC) "Catchment Delineation Toolbox" to determine the drainage area contributing to each catch basin. Using GIS analysis, we were able to overlay land use, land cover, and soil types for each catch basin drainage area. Additionally, per the US EPA's land use land cover guidance titled, "2016 Massachusetts Small MS4 Permit Pollutant Loading Export Rates applied to the 2016 Massachusetts Land Use/Land Cover GIS Dataset," the town used the weighted average phosphorus loading rates of 1.95lbs P/ac/yr for all land use types.

Medway cleans all town owned catch basins annually. Catch basins that need attention before the annual spring cleaning are addressed as needed. At this time, the town's data does not distinguish between public and privately owned catch basins. Further delineation in the data is needed to better define the phosphorus load removal and town jurisdiction.

Each of the 2430 catch basin drainage areas were analyzed for their impervious cover and their total phosphorus load per land use type. We used the Equation 2-3 per the MS4 General Permit Appendix F to determine the pounds of phosphorus removed through our catch basin cleaning program. We used a phosphorus reduction factor of 0.01 because we clean our basins annually and not semi-annually. The excel spreadsheet includes the analysis for each basin. Below are three examples demonstrating how each catch basin phosphorus removal was calculated.

Equation 2-3: Credit_{P CB} = IA_{CB} × PLER_{IC-land use} × PRF_{CB}

IA_{CB} = Area of impervious cover swept

PLER_{IC-land use} = Phosphorus load export rate for impervious cover and specified land use (lb/acre/yr)
PRF_{CB} = Phosphorus reduction factor for catch basin cleaning

Example 1: CB-1 = 0.24acres X 0.421lbs/acre/year x 0.01
= **0.001lbs/year**

Example 2: CB-969 = 4.27acres X 7.69lbs/acre/year X 0.01
= **0.34lbs/year**

Example 3: CB-1000 = 0.774acres x 1.176lbs/acres/yeas x 0.01
= **0.009lbs/year**

The total phosphorus removal from catch basin cleaning is 9.59lbs/year.

B.3: Enhanced Organic Waste and Leaf Litter Collection Program

The Town of Medway collects leaf litter and organics from parks across town, and the street sweeper is used daily in the fall. However, we do not have the capacity to sweep every street or every parking lot weekly. Therefore, the Town is not claiming phosphorus removal credit for this non-structural control.

The total phosphorus removal from leaf litter collection is 0.0lbs/year.

APPENDIX C: EXISTING STRUCTURAL CONTROLS

C.1: Credit Calculations

State	MASSACHUSETTS
Municipality	MEDWAY
Permit Type	MS4
Permit Number	
Major Watershed	CHARLES
TP Load Reduction Target	N/A
TN Load Reduction Target	N/A
TSS Load Reduction Target	N/A

Table 1. Project Summary Credit for MEDWAY, MASSACHUSETTS

Project Type	Removed Phosphorus Load (lb/yr)	Removed Nitrogen Load (lb/yr)	Removed Sediment Load (lb/yr)
Structural	15.93	125.93	5499.38
Non-Structural	0	0	0
Land Use Conversion	0	0	0
Total	15.93	125.93	5499.38

Table 2. Structural Project Summary for MEDWAY, MASSACHUSETTS

Project ID	BMP Type	BMP Storage Capacity (ft³)/ Filter Depth (in.)	Phosphorus BMP Efficiency (%)	Nitrogen BMP Efficiency (%)	Sediment BMP Efficiency (%)	Removed Phosphorus Load (lb/yr)	Removed Nitrogen Load (lb/yr)	Removed Sediment Load (lb/yr)	Impervious Area Treated (ac)	Run off Depth (in.)

BMP-51-1	WET POND/CREATED WETLAND	750	8.96	5.76	19.19	0.53	2.92	243.92	3.23	0.06
BMP-51-2	INFILTRATION BASIN	19640	100	100	100	4.14	35.13	880.75	2.26	1.9
BMP-48-8	INFILTRATION BASIN	1724	99.25	100	100	1.11	8.37	476.71	0.73	0.65
BMP-48-7	INFILTRATION BASIN	2407	100	100	100	0.57	4.28	239.04	0.36	1.42
BMP-48-2	INFILTRATION BASIN	20956	100	100	100	3.74	31.73	795.66	2.03	2.14
BMP-47-12	INFILTRATION TRENCH	308	96.36	99.12	100	0.12	0.9	51.96	0.08	1.06
BMP-48-1	EXTENDED DRY DETENTION POND	1008	12.55	16.04	46.55	0.04	0.4	66.55	0.218	1.27
BMP-48-3	INFILTRATION TRENCH	210	52.6	81.02	74.95	0.2	2.29	118.38	0.238	0.24
BMP-48-5	EXTENDED DRY DETENTION POND	3393	14	23.13	49	0.08	0.98	113.3	0.343	2.27
BMP-42-2	INFILTRATION BASIN	44930	98.8	100	100	1.87	14.13	800.61	1.22	10.15
BMP-42-5	GRASS SWALE (CONVEYANCE)	1708	15.26	10.08	73.39	0.15	0.76	315.75	0.66	0.71
BMP-59-5	BIOFILTRATION	3544	56.8	35.8	99.76	0.66	3.59	250.15	0.615	1.2
BMP-37-1	EXTENDED DRY DETENTION POND	4072	14	23.13	49	0.08	1.07	56.73	0.287	3.17
BMP-29-2	EXTENDED DRY DETENTION POND	65017	14	23.13	49	1.16	16.72	885.71	4.282	2.91
BMP-29-3	EXTENDED DRY DETENTION POND	5065	12.39	15.11	46.39	0.26	2.66	204.15	1.166	1.2
BMP-62-8	EXTENDED DRY	53750	14	23.13	49	1.219	19.981	1226.997	4.05	

	DETENTION POND									
--	-------------------	--	--	--	--	--	--	--	--	--

**Table 3. Non-Structural Project Summary for MEDWAY,
MASSACHUSETTS**

There are no non-structural
BMPs.

**Table 4. Land Use Conversion Project Summary for
MEDWAY, MASSACHUSETTS**

There are no land use
conversion projects.

TOWN OWNED STORMWATER STRUCTURE Inventory Field Sheet

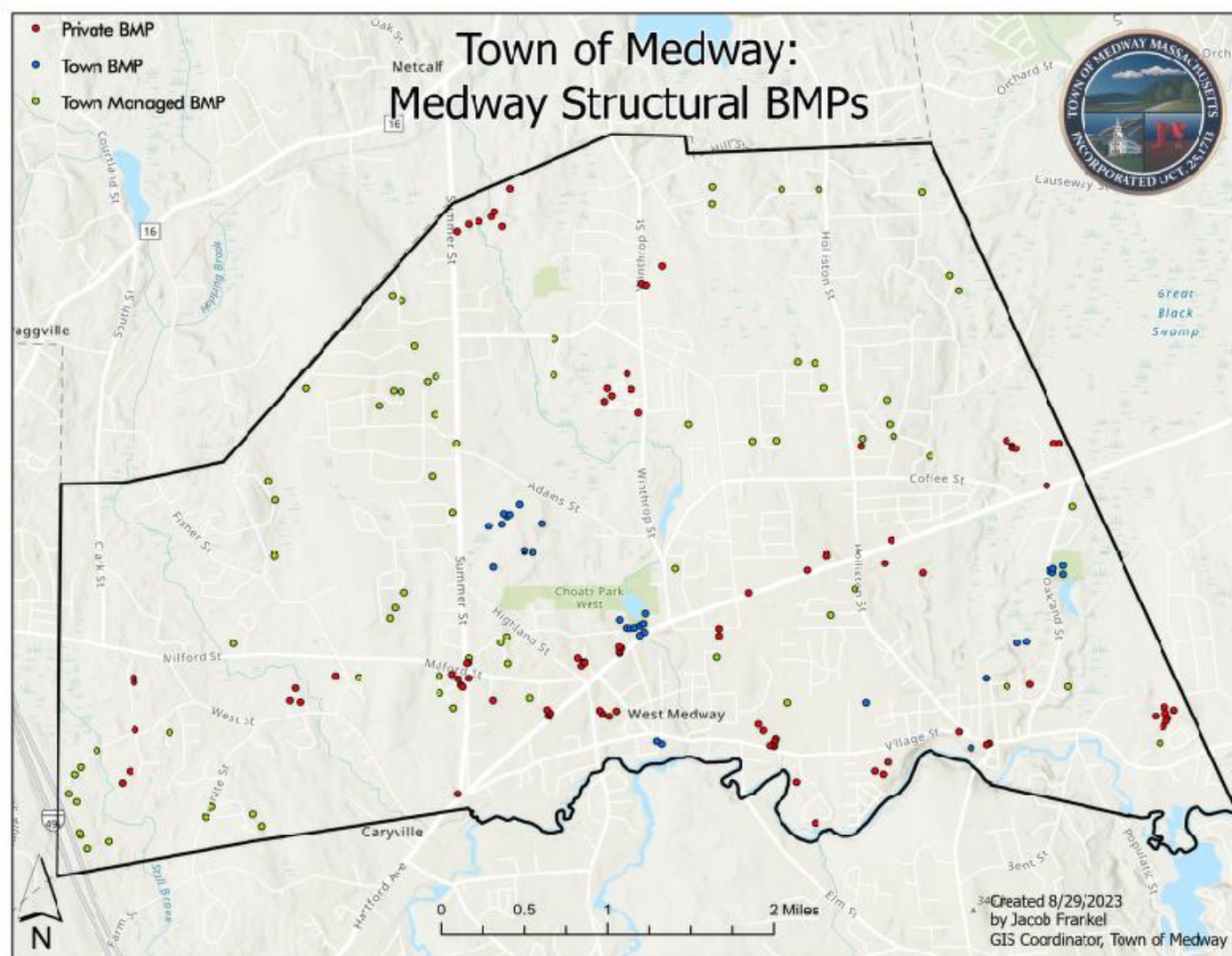
Section 4: Maintenance

	CHECK if Needed	RELATIVE SEVERITY INDEX (1-3)			COMMENTS
Mowing	☐	☐ 1 – Minimal	☐ 2 – Moderate	☐ 3 – Substantial	
Trim Vegetation	☐	☐ 1 – Minimal	☐ 2 – Moderate	☐ 3 – Substantial	
Tree Removal & Stump (<u>less</u> than 9")	☐	Number:			
Tree Removal & Stump (<u>greater</u> than 9")	☐	Number:			
Litter	☐	☐ 1 – Minimal	☐ 2 – Moderate	☐ 3 – Substantial	
Grass, Brush, Leaf Dumping	☐	☐ 1 – Minimal	☐ 2 – Moderate	☐ 3 – Substantial	
New Stone/Rip Rap	☐	☐ 1 – Minimal	☐ 2 – Moderate	☐ 3 – Substantial	
Mulch	☐	☐ 1 – Minimal	☐ 2 – Moderate	☐ 3 – Substantial	
Excavating	☐	☐ 1 – Minimal	☐ 2 – Moderate	☐ 3 – Substantial	
New Plantings	☐	☐ 1 – Minimal	☐ 2 – Moderate	☐ 3 – Substantial	
Invasive Species	☐	☐ 1 – Minimal	☐ 2 – Moderate	☐ 3 – Substantial	
Jet Line	☐	☐ 1 – Minimal	☐ 2 – Moderate	☐ 3 – Substantial	
Camera Investigation	☐				
Clean Sump	☐	☐ 1 – Minimal	☐ 2 – Moderate	☐ 3 – Substantial	

Section 5: Additional Comments

|

C.3: Structural BMP Locations



APPENDIX D: PLANNED NON-STRUCTURAL CONTROLS

D.1: Enhanced Street Sweeping

The town used the same method described in Appendix A to calculate the phosphorus removal credits.

Due to incompatible weather conditions in the winter (i.e., mechanical broom sweeper can cause ice on the roads), Medway will continue the sweeping frequency from March through December. Additionally, the town will continue using the mechanical broom sweeper for town wide sweeping. The update to our sweeping program will be to increase sweeping activities to monthly as opposed to twice per year.

We calculated the following phosphorus removal using Equation 2-1 provided in Appendix F of the MS4 General permit:

Equation 2-1: Phosphorus Credit
$$p_{\text{sweeping}} = IA_{\text{swept}} \times PLER_{\text{IC-land use}} \times PRF_{\text{sweeping}} \times AF$$

IA_{swept} = Area of impervious cover swept

$PLER_{\text{IC-land use}}$ = Phosphorus load export rate for impervious cover and specified land use (lb/acre/yr)

PRF_{sweeping} = Phosphorus reduction factor for sweeping based on sweeper type and frequency

AF = Annual frequency of sweeping

Agricultural

IA_{swept} = 6.52 acres

$PLER$ = 1.52 lbs/acre/year

PRF = 0.03

AF = 0.75

$$\begin{aligned} \text{Agricultural Credit } p_{\text{sweeping}} &= 6.52 \text{ acres} \times 1.52 \text{ lbs/acre/year} \times 0.03 \times 0.75 \\ &= \mathbf{0.22 \text{ lbs/year}} \end{aligned}$$

Commercial

IA_{swept} = 12.25 acres

$PLER$ = 1.95 lbs/acre/year

PRF = 0.03

AF = 0.75

$$\begin{aligned} \text{Commercial Credit } p_{\text{sweeping}} &= 12.25 \text{ acres} \times 1.95 \text{ lbs/acre/year} \times 0.03 \times 0.75 \\ &= \mathbf{0.54 \text{ lbs/year}} \end{aligned}$$

Forest

IA swept = 44.00 acres
PLER = 1.52 lbs/acre/year
PRF = 0.03
AF = 0.75

$$\text{Credit}_{p \text{ sweeping}} = 44.00 \text{ acres} \times 1.52 \text{ lbs/acre/year} \times 0.03 \times 0.75 \\ = \mathbf{1.50 \text{ lbs/year}}$$

High Density Residential

IA swept = 27.01 acres
PLER = 1.95 lbs/acre/year
PRF = 0.03
AF = 0.75

$$\text{HDR Credit}_{p \text{ sweeping}} = 27.01 \text{ acres} \times 1.95 \text{ lbs/acre/year} \times 0.03 \times 0.75 \\ = \mathbf{1.19 \text{ lbs/year}}$$

Industrial

IA swept = 7.68 acres
PLER = 1.95 lbs/acre/year
PRF = 0.03
AF = 0.75

$$\text{Industrial Credit}_{p \text{ sweeping}} = 7.68 \text{ acres} \times 1.95 \text{ lbs/acre/year} \times 0.03 \times 0.75 \\ = \mathbf{0.34 \text{ lbs/year}}$$

Low Density Residential

IA swept = 139.15 acres
PLER = 1.95 lbs/acre/year
PRF = 0.03
AF = 0.75

$$\text{LDR Credit}_{p \text{ sweeping}} = 139.15 \text{ acres} \times 1.95 \text{ lbs/acre/year} \times 0.03 \times 0.75 \\ = \mathbf{6.11 \text{ lbs/year}}$$

Medium Density Residential

IA swept = 38.71 acres
PLER = 1.95 lbs/acre/year
PRF = 0.03
AF = 0.75

$$\text{MDR Credit}_{p \text{ sweeping}} = 38.71 \text{ acres} \times 1.95 \text{ lbs/acre/year} \times 0.03 \times 0.75 \\ = \mathbf{1.7 \text{ lbs/year}}$$

Open Land

IA swept	= 9.76acres
PLER	= 1.95 lbs/acre/year
PRF	= 0.03
AF	= 0.75

$$\text{Open Land Credit}_{p \text{ sweeping}} = 9.76\text{acres} \times 1.95 \text{ lbs./acre/year} \times 0.03 \times 0.75 \\ = \mathbf{0.43 \text{ lbs/year}}$$

Total phosphorus removal for all impervious cover land uses = 12.2 lbs./year

D.2: Catch Basin Cleaning

The town used the same methods to calculate the phosphorus removal credits described in Appendix B.

After incorporating a new data collection and management system for catch basin cleaning, we can more accurately track which catch basins require more frequent cleaning. Therefore, the town will continue with its town wide annual catch basin cleaning operations; however, we will increase the frequency of cleaning for basins that accumulate more sediment. We will use a phosphorus reduction factor of 0.02 to accommodate the increased frequency of cleaning. Below are three examples demonstrating how each catch basin phosphorus removal was calculated.

Equation 2-3: Credit P_{CB} = $IA_{CB} \times PLER_{IC\text{-land use}} \times PRF_{CB}$

IA_{CB}	= Area of impervious cover swept
$PLER_{IC\text{-land use}}$	= Phosphorus load export rate for impervious cover and specified land use (lb/acre/yr)
PRF_{CB}	= Phosphorus reduction factor for catch basin cleaning

Example 1: CB-1 = 0.24acres X 0.421lbs/acre/year x 0.02
= **0.002lbs/year**

Example 2: CB-969 = 4.27acres X 7.69lbs/acre/year X 0.02
= **0.65lbs/year**

Example 3: CB-1000 = 0.774acres x 1.176lbs/acres/yeas x 0.02
= **0.0118lbs/year**

The total phosphorus removal from catch basin cleaning is 19.17lbs/year.

D.2: Enhance Organic Waste and Leaf Litter Collection Program

The Town of Medway plans to increase sweeping and leaf litter collection in high density residential areas, commercial areas, open space and forested areas between September 1 and December 1.

Equation 2-5: Credit_{p leaf litter} = IA_{leaf litter} × PLER_{IC-land use} × (0.05)

IA_{Leaf Litter} = Impervious area in applicable watersheds are subject to enhanced organic waste and leaf litter collection program

PLER_{IC-land use} = Phosphorus load export rate for impervious cover and specified land use (lb/acre/yr)

(0.05) = 5% nutrient reduction factor for organic waste and leaf litter collection program

High Density Residential

IA swept = 27.01 acres
PLER = 2.32 lbs/acre/year
(0.05)

$$\text{HDR Credit}_{p \text{ leaf litter}} = 27.01 \text{ acres} \times 2.32 \text{ lbs/acre/year} \times 0.05 \\ = \mathbf{3.13 \text{ lbs/year}}$$

Commercial

IA swept = 12.25 acres
PLER = 1.78 lbs/acre/year
(0.05)

$$\text{Commercial Credit}_{p \text{ leaf litter}} = 12.25 \text{ acres} \times 1.78 \text{ lbs/acre/year} \times 0.05 \\ = \mathbf{1.09 \text{ lbs/year}}$$

Forest

IA swept = 44.00 acres
PLER = 1.52 lbs/acre/year
(0.05)

$$\text{Credit}_{p \text{ leaf litter}} = 44.00 \text{ acres} \times 1.52 \text{ lbs/acre/year} \times 0.05 \\ = \mathbf{3.34 \text{ lbs/year}}$$

Open Land

IA swept = 9.76 acres
PLER = 1.52 lbs/acre/year
(0.05)

Open Land Credit_{p leaf litter} = 9.76 acres x 1.52 lbs./acre/year x 0.05
= **0.74 lbs/year**

The total phosphorus removal from enhanced leaf litter cleaning is 8.31lbs/year.

APPENDIX E: PLANNED STRUCTURAL CONTROLS

E.1: Structural Control Retrofit Fact Sheets and BATT Calculations

Calculations based on Existing Plans and MAPC Catchment Area Analysis.

State	MASSACHUSETTS
Municipality	MEDWAY
Permit Type	MS4
Permit Number	
Major Watershed	CHARLES
TP Load Reduction Target	N/A
TN Load Reduction Target	N/A
TSS Load Reduction Target	N/A

Table 1. Project Summary Credit for MEDWAY, MASSACHUSETTS

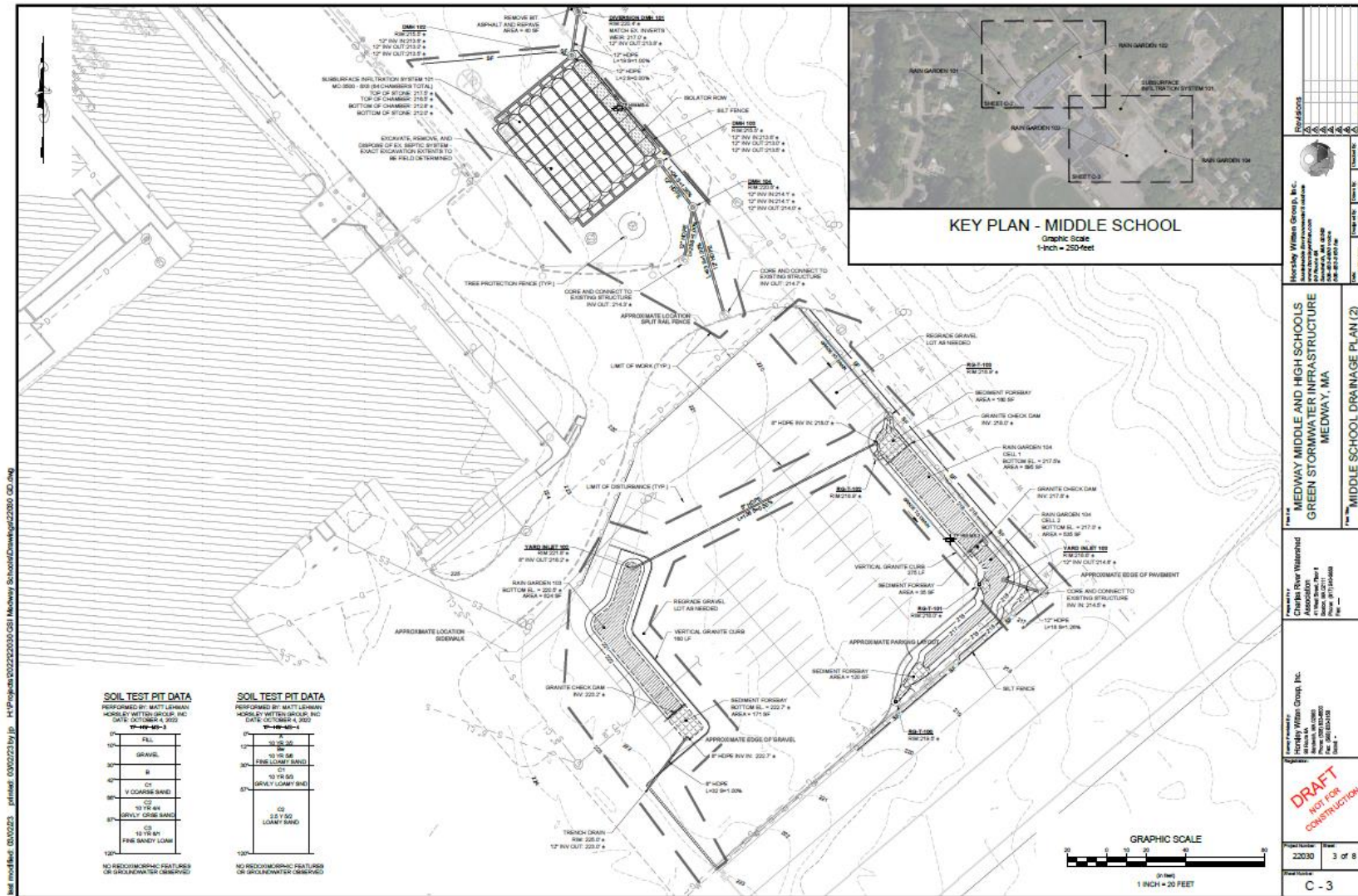
Project Type	Removed Phosphorus Load (lb/yr)	Removed Nitrogen Load (lb/yr)	Removed Sediment Load (lb/yr)
Structural	103.52		
Non-Structural	0	0	0
Land Use Conversion	0	0	0
Total	103.52		

Table 2. Structural Project Summary for MEDWAY, MASSACHUSETTS

Project ID	BMP Type	Land Use	Impervious Area Treated (ac)	Pervious Area	Soil type	Infiltration Rate	BMP Storage Capacity (ft ³)/Filter Depth (in.)	Removed Phosphorus Load (lb/yr)
------------	----------	----------	------------------------------	---------------	-----------	-------------------	--	---------------------------------

High School (BMP-37-2)	Infiltratio n Basin	Commerc ial	1.874	4.945	B	1.02	22,901	3.78
High School (BMP-38-1)	Infiltratio n Basin	Commerc ial			B	1.02	57,600	2.26
Winter Street (BMP-30-3)	Infiltratio n basin	HDR	11.73	18.01	B	1.02	510,95 8	20.08
Diane Drive (OF-7-1)	Infiltratio n basin	LDR	1.947	2.959	B	1.02	4,500	2.987
Kimberly Drive (OF-7-2)	Infiltratio n basin	LDR	1.66	3.58	B	1.02	1125	2.661
Shaw Street (OF-68-1) (OF-58-4) Samoset (OF-69-2) (OF-69-1)	Enhance biofiltrati on	LDR	5.73	18.214	B		25,000	8.04
Fairway Lane (OF-9-5) (OF-9-4) (OF-9-3) (OF-9-1)	Enhanced Biofiltrati on	LDR	2.003	4.483	B		25,000	3.188
Hickory Drive (BMP-10-1)	Wet Basin	LDR	3.941	14.621	B		149,01 9	4.879
Broad Acres Farm Road (BMP-19-1))	Wet Basin	LDR	2.631	9.051	C/D		132,01 8	4.173
Broad Acres Farm Road (BMP-18-1)	Wet Basin	LDR	4.01	10.12	C/D		132,01 8	5.689
Claybrook Farm Road (OF-12-16)	Enhanced Biofiltrati on	LDR	1.92	5.83	C/D		12,000	3.974
Temple Street (BMP-39-2)	Enhanced Biofiltrati on	MDR	2.647	9.03	A		140,72 1	4.859
Cedar Farm Road (OF-26-2)	Enhanced Biofiltrati on	LDR	1.145	2.964	B		12,000	1.866
Granite Street/ Castle Road (OF-55-1)	Infiltratio n Basin	LDR	1.01	7.02	A	2.41	20,000	1.725
Daffodil Lane (BMP-64-2)	Infiltratio n Basin	LDR	0.813	2.089	A	2.41	53,685	1.283
Daffodil Lane (BMP-64-1)	Infiltratio n Basin	LDR	0.888	1.8	A	2.41	120,00 0	1.387
Tulip Way (BMP-65-1)	Enhanced Biofiltrati on	LDR	1.567	4.68	B		241,24 5	2.245

Tulip Way (BMP-65-2)	Enhanced Biofiltrati on	LDR	0.348	0.504	B		120,33 6	0.484
Laurelwood Lane (OF-34-4)	Enhanced Biofiltrati on	MDR	0.985	1.321	A		19,500	1.754
Applegate Road (BMP-32-1)	Infiltratio n Basin	LDR	5.484	19.804	A	2.41	145,56 6	8.823
Alder Street (BMP-53-1)	Infiltratio n Basin	Industrial	0.689	0.609	A	2.41	26,460	1.23
Ash Lane (BMP-21-4)	Enhanced Biofiltrati on	LDR	2.898	14.125	B	1.02	137,57 4	5.429
Lantern Lane (BMP-45-1)	Infiltratio n Basin	LDR	0.128	2.085	B	1.02	142,35 2	0.428
Independence Lane (BMP-47-1) (BMP-47-2)	Enhanced Biofiltrati on	LDR	0.856	1.049	B		122,55 8	1.27
Freedom Trail (BMP-46-3)	Enhanced Biofiltrati on	LDR	1.352	1.427	B		43,208	1.981
Newton Lane (BMP-19-3) (BMP-19-4) (BMP-19-5)	Enhanced Biofiltrati on	LDR	1.02	4.833	C/D		61,912	0.335
Blueberry Hill Road (BMP-19-7)	Wet Basin	LDR	3.517	17.261	C/D		240,00 0	6.521
Grapevine Way (BMP-61-1)	Infiltratio n Basin	LDR	0.118	0.459	A	2.41	7,545	0.191



Total Phosphorus Load Reduction

Horsley Witten Group

Sustainable Environmental Solutions
90 Route 6A • Unit 1 • Sandwich, MA 02563
508-833-8800 • horsleywitten.com



Project Name: Medway Schools GSI
Project Location: Medway, MA
Date: 3/7/2023
Calculated By: JMP
Checked By: SS

Existing Total Phosphorus Load

Drainage Area ID	Land Use	Land Cover within Use	TP Load Export Rate (lb/ac/year)	Area (acres)	TP Load (lb/yr)
Middle School Surface (Total)	Commercial	Impervious	1.78	2.961	5.27
		Pervious (HSG D)	0.37	0.900	0.33
Holliston (Street and Neighborhood)	Medium Family Residential	Impervious	1.96	7.190	14.09
		Pervious (HSG C/D)	0.29	2.397	0.69
Courtyard (Building)	Commercial	Impervious	1.96	2.162	4.24
		Pervious (HSG D)	0.37	0.143	0.05
High School (Total)	Commercial	Impervious	1.78	1.138	2.03
		Pervious (HSG B)	0.12	0.335	0.04
Total Existing Load					26.75

Proposed Total Phosphorus Load (without reductions from SCMs)

Drainage Area ID	Land Use	Land Cover within Use	TP Load Export Rate (lb/ac/year)	Area (acres)	TP Load (lb/yr)
MS1	Commercial	Impervious	1.78	0.207	0.37
		Pervious (HSG D)	0.37	0.388	0.14
MS2	Commercial	Impervious	1.78	0.195	0.35
		Pervious (HSG D)	0.37	0.222	0.08
MS3 (A&B)	Commercial	Impervious	1.78	0.641	1.14
		Pervious (HSG D)	0.37	0.164	0.06
MS4 (A&B)	Commercial	Impervious	1.78	1.918	3.41
		Pervious (HSG D)	0.37	0.126	0.05
Holliston	Medium Family Residential	Impervious	1.96	7.190	14.09
		Pervious (HSG C/D)	0.29	2.397	0.69
Courtyard	Commercial	Impervious	1.96	2.162	4.24
		Pervious (HSG D)	0.37	0.143	0.05
HS1	Commercial	Impervious	1.78	0.416	0.74
		Pervious (HSG B)	0.12	0.106	0.01
HS2	Commercial	Impervious	1.78	0.577	1.03
		Pervious (HSG B)	0.12	0.140	0.02
HS3	Commercial	Impervious	1.78	0.145	0.26
		Pervious (HSG B)	0.12	0.089	0.01
Total Proposed Load (without SCMs)					26.75

Proposed SCM Phosphorus Reduction

Drainage Area ID	SCM	Applicable Performance Curve	Treated Runoff Depth from Impervious Area (in)	TP Percent Reduction	TP Load to SCM (lb/yr)	TP Load after SCM (lb/yr)
MS1	Rain Garden 101	Infiltration Basin	1.0	98%	0.51	0.01
MS2	Rain Garden 102	Infiltration Basin	1.0	98%	0.43	0.01
MS3 (A&B)	Infiltration Chambers 101	Infiltration Trench	0.5	86%	1.20	0.17
MS4 (A&B)	Rain Gardens 103 and 104	Infiltration Basin	1.0	98%	3.46	0.07
Holliston + Courtyard	Infiltration Chambers 101	Infiltration Trench	0.5	86%	19.08	2.67
HS1	Rain Garden 201	Infiltration Basin	1.0	98%	0.75	0.02
HS2	Tree Trench 201	Infiltration Trench	1.0	98%	1.04	0.02
HS3	Rain Garden 202	Infiltration Basin	1.0	98%	0.27	0.01
Total Proposal Load (with SCMs)						2.97
Load Reduction from Existing to Proposed Conditions						23.78

Note: Methodology based on Massachusetts MS4 General Permit (as modified January 6, 2021), Appendix F, Attachment 3.

Abbreviations:

SCM = Stormwater Control Measure

TP = Total Phosphorus

The following town owned and right of way parcels have been identified as opportunities for stormwater structural best management practice (BMP) in the Town of Medway by the Charles River Watershed Association and the Town staff. The sites are listed in order of priority. This document contains proposed BMP design characteristics, and maps for each site.

- A. Fire Station
- B. Medway Public Library
- C. Medway Police Department
- D. 1 Mechanic St
- E. Burke Memorial Elementary School
- F. 0 North St
- G. 11 Winthrop St
- H. Highway Barn
- I. 158 Main St
- J. McGovern Elementary School

ID# 46-53: FIRE STATION 1 (44 MILFORD ST)



BMP sizing and design

- Drainage Area : 2.04 acres
- Existing load: 2.4 lbs
- Proposed reduction: 2.1 lbs (90%)
- Sub-drainages: 4
- BMP type: Infiltration rain garden
- Depth: 1 ft

ID	Drainage area (acre)	Percent Impervious	BMP water quality volume (cf)	P- Load Reduction (lb/yr)
#1 (A)	0.85	56%	1,289	0.8
#2 (B)	0.74	70%	1,372	0.9
#3 (C)	0.28	68%	505	0.3
#4 (D)	0.17	61%	278	0.2

ID#57-44: MEDWAY PUBLIC LIBRARY (26 HIGH ST)



BMP sizing and design

- Drainage Area : 0.29 acres
- Existing load: 0.38 lbs
- Proposed reduction: 0.3 lbs (90%)
- Sub-drainages: 1
- BMP type: Infiltration rain garden
- Depth: 1 ft

ID	Drainage area (acre)	Percent Impervious	BMP water quality volume (cf)	P- Load Reduction (lb/yr)
#5	0.29	72%	556	0.3

ID# 58-27: MEDWAY POLICE DEPARTMENT (315 VILLAGE ST)

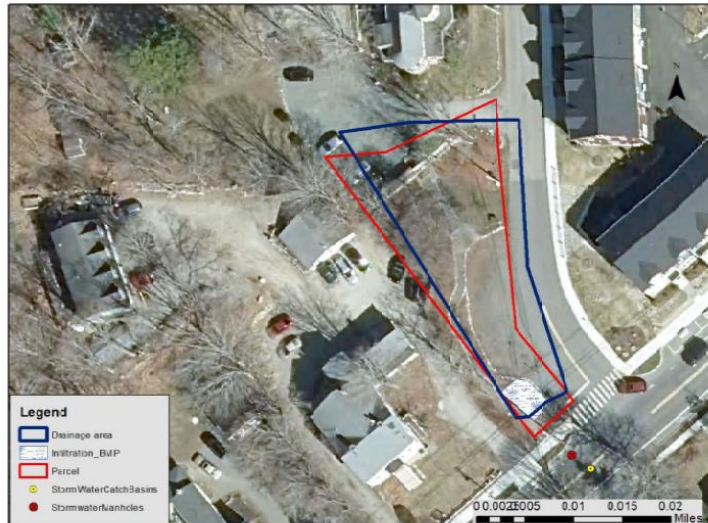


BMP sizing and design

- Drainage Area : 1.2 acres
- Existing load: 1.16 lbs
- Proposed reduction: 1 lbs (90%)
- Sub-drainages: 3
- BMP type: Infiltration rain garden
- Depth: 1 ft

ID	Drainage area (acre)	Percent Impervious	BMP water quality volume (cf)	P- Load Reduction (lb/yr)
#6 (A)	0.67	70%	1,038	0.8
#7 (B)	0.29	21%	147	0.1
#8 (C)	0.25	32%	225	0.1

ID# 47-58: 1 MECHANIC ST



BMP sizing and design

- Drainage Area : 0.22 acres
- Existing load: 0.2 lbs
- Proposed reduction: 0.17 lbs (90%)
- Sub-drainages: 1
- BMP type: Infiltration rain garden
- Depth: 1 ft

ID	Drainage area (acre)	Percent Impervious	BMP water quality volume (cf)	P- Load Reduction (lb/yr)
#9	0.22	45%	273	0.17

ID# 59-39: BURKE ELEMENTARY SCHOOL (16 CASSIDY LN)



BMP sizing and design

- Drainage Area : 3.7 acres
- Existing load: 5.1 lbs
- Proposed reduction: 4.6 lbs (90%)
- Sub-drainages: 4
- BMP type: Infiltration rain garden
- Depth: 1 ft

ID	Drainage area (acre)	Percent Impervious	BMP water quality volume (cf)	P- Load Reduction (lb/yr)
#10 (A)	1.7	83%	4,737	2.3
#11 (B)	0.37	100%	1,209	0.6
#12 (C)	0.9	66%	2,094	1
#13 (D)	0.7	62%	1,435	0.7

ID# 60-37: 0 NORTH ST



BMP sizing and design

- Drainage Area : 1.4 acres
- Existing load: 0.5lbs
- Proposed reduction: 0.4lbs (90%)
- Sub-drainages: 1
- BMP type: Infiltration rain garden
- Depth: 1 ft

ID	Drainage area (acre)	Percent Impervious	BMP water quality volume (cf)	P- Load Reduction (lb/yr)
#14	1.4	21%	512	0.4

ID# 39-79: 11 WINTHROP ST



BMP sizing and design

- Drainage Area : 1.6 acres
- Existing load: 1.3 lbs
- Proposed reduction: 1.2 lbs (90%)
- Sub-drainages: 1
- BMP type: Infiltration rain garden
- Depth: 1 ft

ID	Drainage area (acre)	Percent Impervious	BMP water quality volume (cf)	P- Load Reduction (lb/yr)
#15	1.6	44%	1,263	1.2

ID# 48-67: 158 MAIN ST



BMP sizing and design

- Drainage Area : 1.1 acres
- Existing load: 0.4 lbs
- Proposed reduction: 0.3 lbs (90%)
- Sub-drainages: 2
- BMP type: Infiltration rain garden
- Depth: 1 ft

ID	Drainage area (acre)	Percent Impervious	BMP water quality volume (cf)	P- Load Reduction (lb/yr)
#16 (A)	0.96	3%	53	0.1
#17 (B)	0.18	89%	285	0.3

ID# 50-74: HIGHWAY BARN (46 BROAD ST)



BMP sizing and design

- Drainage Area : 2.5 acres
- Existing load: 4.3 lbs
- Proposed reduction: 3.9 lb(90%)
- Sub-drainages: 2
- BMP type: Infiltration rain garden
- Depth: 1 ft

ID	Drainage area (acre)	Percent Impervious	BMP Water Quality Volume (cf)	P- Load Reduction (lb/yr)
#18 (A)	1.9	94%	4,690	3
#19 (B)	0.6	100%	1,594	1

ID# 31-96: McGovern (9 Lovering St)



BMP sizing and design

- Drainage Area : 6.4 acres
- Existing load: 3.8 lbs
- Proposed reduction: 3.4 lbs (90%)
- Sub-drainages: 3
- BMP type: Infiltration rain garden
- Depth: 1 ft

ID	Drainage area (acre)	Percent Impervious	BMP Water Quality Volume (cf)	P- Load Reduction (lb/yr)
#20 (A)	0.55	100%	1,797	0.9
#21 (B)	0.57	67%	1,314	0.6
#22 (C)	1.7	67%	3,311	1.9

E.3: CRWA and Weston & Sampson Concept Plans and Calculations



Figure 3.6 Medway Oakland Park/Friends of the Elders COA concepts

Appendix 5

Phosphorus Loading and Reduction Calculations

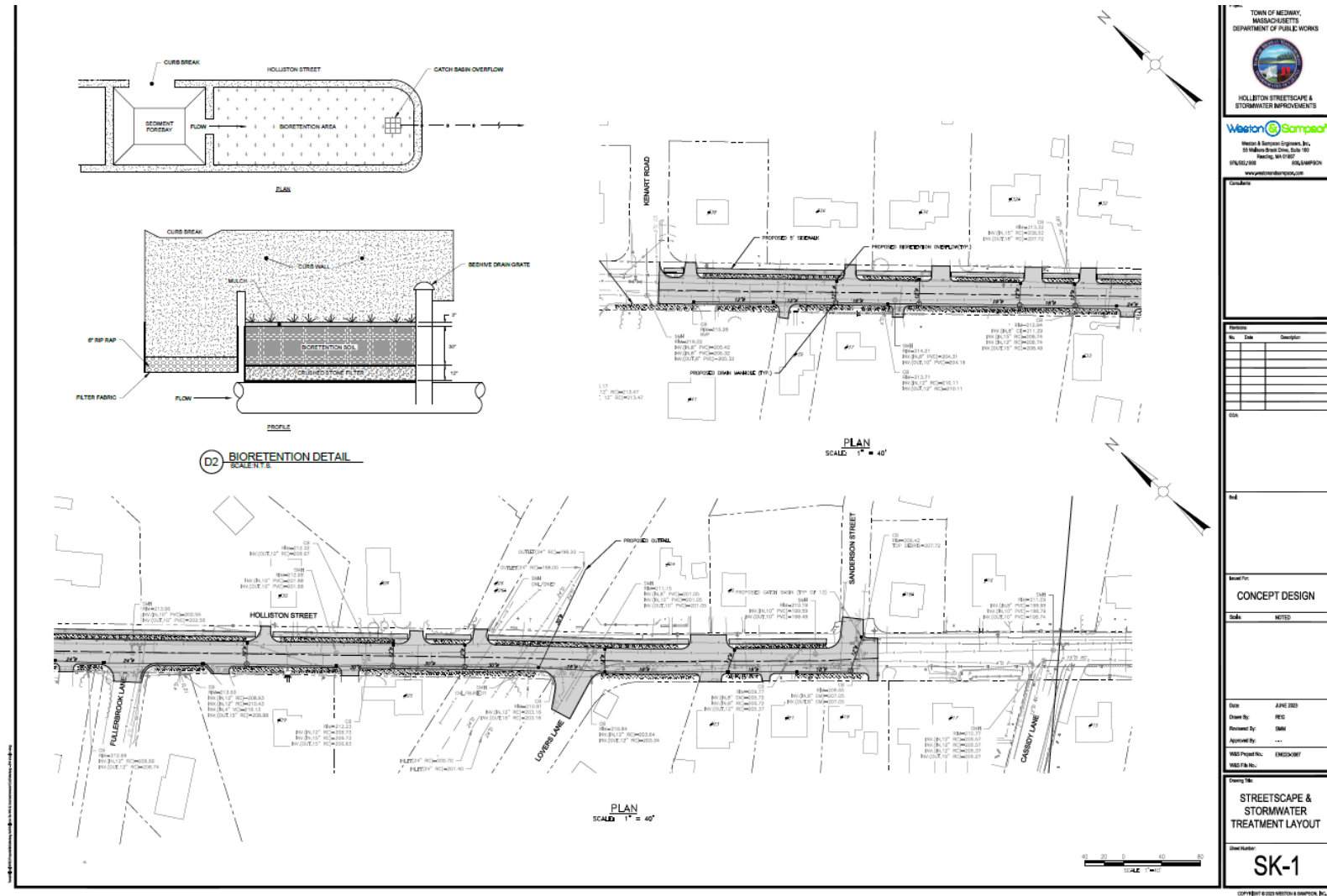
City/Town	BMP Location	BMP Type	BMP Type NS4 Permit (Ref 1)	BMP Size (sf)	Total Drainage Area (sf) (Ref 2)	Total Drainage (Acres)	Land Use (Ref 3)	Land Use (Ref 4)	Impervious % (Ref 5)	Pervious %	Impervious Area (acres)	Pervious area (acres)	Loading Rate - (lbs/acre/year) Impervious (Ref 6)	Soils Type (Majority) (Ref 7)	Load Rate - (lb/acre/year) Pervious (Ref 6)	Total Load (lbs/year)	BMP Percent Reduction (Ref 8)	Load Reduction (lbs/year)
Waltham	Three along Lakeview Ave, 2 along Shore Rd	Bioretention (no underdrain)	Biofiltration	10,750	77,400 ¹	1.78	High Density Residential	High Density Residential	39%	61%	0.69	1.08	2.32	A	0.03	1.64	53%	0.87
Waltham	One in Lazazero Playground	Bioretention (no underdrain)	Biofiltration	1,950	14,040 ¹	0.32	Participation Recreation	Open Space	100%	0%	0.32	0.00	1.52	A	0	0.49	53%	0.26
Newton	Bioswales along Cheesecake Brook	Bioretention (no underdrain)	Biofiltration	18,125	166,750 ²	3.83	Participation Recreation	Open Space	100%	0%	3.83	0.00	1.52	A	0	5.82	53%	3.08
Newton	Bioswales in Park	Bioretention (no underdrain)	Biofiltration	33,395	307,234 ²	7.05	Participation Recreation	Open Space	45%	55%	3.17	3.88	1.52	A	0.03	4.94	53%	2.62
Newton	Subsurface Infiltration	Subsurface Infiltration	Infiltration Trench	138,000	993,600 ¹	22.81	Medium Density Residential	Medium Density Residential	45%	55%	10.26	12.55	1.96	A	0.03	20.49	98% ³	20.08
Newton	Roof Rain Harvesting	N/A not available			-											0.00		
Medway	Bioswales in Park	Bioretention (no underdrain)	Biofiltration	35,750	328,900 ²	7.55	Participation Recreation	Open Space	30%	70%	2.27	5.29	1.52	A	0.03	3.60	53%	1.91
Medway	Subsurface Infiltration	Subsurface Infiltration	Infiltration Trench	116,000	835,200 ¹	19.17	Medium Density Residential	Medium Density Residential	30%	70%	5.75	13.42	1.96	A	0.03	11.68	98% ³	11.44
Medway	Roof Rain Harvesting	N/A not available																

¹Drainage area calculated assuming 0.5 ft ponding and 1.5 in WQV. Assumes 1 ft² bioretention area or subsurface infiltration area can capture stormwater from 7.2 ft² of drainage area. See Reference 2 for detailed calculations.

²Drainage area calculated assuming 0.75 ft ponding and 1.5 in WQV. Assumes 1 ft² bioretention area can capture stormwater from 9.2 ft² of drainage area. See Reference 2 for detailed calculations.

³Assumes 2.41 in/hr, 98% removal. See Reference 8 for additional details.

E.4: Holliston Street Structural Controls



State	MASSACHUSETTS
Municipality	MEDWAY
Permit Type	Other
Permit Number	
Major Watershed	CHARLES
TP Load Reduction Target	N/A
TN Load Reduction Target	N/A
TSS Load Reduction Target	N/A

Table 1. Project Summary Credit for MEDWAY, MASSACHUSETTS

Project Type	Removed Phosphorus Load (lb/yr)	Removed Nitrogen Load (lb/yr)	Removed Sediment Load (lb/yr)
Structural	6.18	31.65	2294.55
Non-Structural	0	0	0
Land Use Conversion	0	0	0
Total	6.18	31.65	2294.55

Table 2. Structural Project Summary for MEDWAY, MASSACHUSETTS

Project ID	BMP Type	BMP Storage Capacity (ft³)/ Filter Depth (in.)	Phosphorus BMP Efficiency (%)	Nitrogen BMP Efficiency (%)	Sediment BMP Efficiency (%)	Removed Phosphorus Load (lb/yr)	Removed Nitrogen Load (lb/yr)	Removed Sediment Load (lb/yr)	Impervious Area Treated (ac)	Runoff Depth (in.)
curbside bio	BIOFILTRATION	14610	63	40	100	6.18	31.65	2294.55	3.652	0.65

APPENDIX F: CERTIFICATIONS

F.1: Inspection/Maintenance for Structural BMPs

F.2: Municipal Turf Fertilizer Management

F.1: Inspection/Maintenance for Structural BMPs

Per the MS4 General Permit: Certification that all structural BMPs are being inspected and maintained according to the O&M program specified as part of the PCP. The certification statement shall be:

I certify under penalty of law that all source control and treatment Best Management Practices being claimed for phosphorus reduction credit have been inspected, maintained, and repaired in accordance with manufacturer or design specification. I certify that, to the best of my knowledge, all Best Management Practices being claimed for a phosphorus reduction credit are performing as originally designed.

H.2: Municipal Turf Fertilizer Management

Per the MS4 General Permit: Certification that all municipally owned and maintained turf grass areas are being managed in accordance with Massachusetts Regulation 331 CMR 31 pertaining to proper use of fertilizers on turf grasses.



**Woodard
& Curran**

