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Phosphorus Source Identification And Potential Structural BMPs Report

Prepared for
Town of Concord

REPORT UPDATED BY THE TOWN OF CONCORD ENGINEERING DIVISION
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Introduction

1.1 Overview

The Town of Concord (the Town) is in central Massachusetts at the intersection of the Assabet, Sudbury, and Concord River watersheds. The Assabet River, Sudbury River, and the Concord Rivers have various water quality impairments. Most notably, and the focus of this report, is the Assabet River's impairment and Total Maximum Daily Load (TMDL) for total phosphorus.

The Assabet River runs through the south-western side of Town into the middle of the Town, where it intersects the Concord and Sudbury rivers. The Town of Concord also owns and operates its municipal separate storm sewer system (MS4), which contains 99 outfalls that discharge to the Assabet River. In operating the MS4, the Town is obligated to adhere to the requirements of EPA's 2016 MS4 Permit (the Permit). Since the Assabet River has a phosphorus water quality impairment, the Town is required to compete the requirements In Part II of Appendix H to the Permit. One key component of this includes completing a Phosphorus Source Identification Report and Potential Structural BMPs Report. This document satisfies this Permit requirement.

1.2 Purpose of Document

The MS4 Permit requires that the Town's Phosphorus Source Identification Report and Potential Structural BMPs Report include the following:

- Calculation of total MS4 area draining to the Assabet River and associated outfall catchments,
- Incorporation of screening and monitoring results from the Town's IDDE Plan,
- Calculation of impervious area and directly connected impervious area (DCIA) for target catchments,
- Identification, delineation, and prioritization of potential catchments with high phosphorus loading,
- Identification of potential retrofit opportunities for installation of structural BMPs within the Assabet River watershed on town-owned parcels.
- Track and document the metrics for each of the BMPs installed within the Town's regulated area.

Phosphorus Load Summary

The first step in identifying methods for phosphorus reduction is to calculate the phosphorus loads within the watershed. This section reviews the methodology and results of this phosphorus baseline load calculation, which is calculated for each outfall catchment in the watershed.

2.1 Data Sources

Phosphorus loads are calculated following the methodologies presented in Attachment 1 to Appendix F of the MS4 Permit. This land-use approach requires data such as land use type and soil types to estimate corresponding loads for each area based on derived phosphorus export rates. Table 1 lists out the data sources used for this assessment.

Table 1. Data Sources to Calculate Phosphorus Loads

Parameter	Data Source	Notes
Land Use	2005 Land Use, MassGIS	Used 2005 land use to match MS4 Permit methodology.
Impervious Cover	2005 Impervious Surface, MassGIS	
Soils	NRCS Web Soil Survey	
Outfall Catchments	Town of Concord Stormwater GIS	Catchments are being continuously refined through ongoing IDDE and other stormwater field work.

BC delineated the outfall catchments in GIS using a desktop analysis of the Town's drainage system, topography, and an analysis of how overland flow will travel towards each outfall. Based on a review of the 99 outfalls within the Assabet River watershed, we determined that multiple outfalls are either culverts or should be combined based on flow accumulation, thus resulting in a total of 95 catchments used for this assessment. Through ongoing field investigations during the Permit term, the Town will continue to refine its stormwater infrastructure inventory, resulting in continually refined and updated catchments.

2.2 Methodology

Attachment 1 to Appendix F of the Permit outlines the phosphorus load calculation methodology in the following steps:

1. Determine the total area (acres) associated with the impaired watershed;
2. Sort the total area associated with the watershed into land use categories;
3. Calculate the annual phosphorus load associated with each land use category by multiplying the total area of land use by the appropriate land use-based composite phosphorus loading export rate (PLER);
4. Determine the baseline phosphorus load by summing the land use loads.

In addition to these steps reported in the Permit, we calculated the phosphorus loads for each of the outfall catchments, which means that these steps were applied to the catchment level, not for the entire watershed. For each catchment, BC calculated the impervious area, DCIA, and impervious

cover, and pervious cover areas by land use type. The PLERs used to calculate the resulting phosphorus loads varied by land use are detailed in Table 2.

Table 2. Phosphorus Export Loading Rates from MS4 Permit

Phosphorus Land Use Code Description	Phosphorus Loading Export Rate (lb/ac/yr)					
	DCIA	Pervious Area Soil Type				
		HSG A	HSG B	HSG C	HSG C/D	HSG D
Commercial	1.78	0.04	0.18	0.36	0.46	0.54
Industrial	1.78	0.04	0.18	0.36	0.46	0.54
High-Density Residential	2.32	0.04	0.18	0.36	0.46	0.54
Medium-Density Residential	1.96	0.04	0.18	0.36	0.46	0.54
Low-Density Residential	1.52	0.04	0.18	0.36	0.46	0.54
Highway	1.34	0.04	0.18	0.36	0.46	0.54
Forest	1.52	0.11	0.14	0.19	0.21	0.23
Open Land	1.52	0.04	0.18	0.36	0.46	0.54
Agriculture	1.52	0.07	0.29	0.60	0.76	0.91

The DCIA for each catchment was estimated using the Sutherland Equation. The Sutherland Equation is an empirical formula that can be used to estimate directly connected impervious area based on the land use type and amount of total impervious area, and this methodology was used by EPA to calculate phosphorus load baselines in other watersheds.[1] Eq.1 shows the Sutherland Equation, and the coefficients used are shown in Table 3.

$$Percent\ DCIA = A * \left(\left(Percent\ Impervious \frac{Area}{100}\right)\right)^{B} \qquad Eq.1$$

Table 3. Sutherland Equation Coefficients[2]

Phosphorus Land Use Group	A	B
Commercial	0.4	1.2
Industrial	0.4	1.2
Multi-Family	0.4	1.2
High-Density Residential	0.4	1.2
Medium-Density Residential	0.1	1.5
Low-Density Residential	0.1	1.5
Highway	0.1	1.5
Forest	0.01	2

[1] https://www3.epa.gov/region1/npdes/stormwater/ma/IA-DCIA-Calculation-Methodology.pdf

[2] M. Voorhees, *Overview of Methodology to Calculate Baseline Stormwater Phosphorus Loads and Phosphorus Load Reduction Requirements for Charles River Watershed – Final MA MS4 Permit.* EPA, 2016.

Open Land	0.1	1.5
Agricultural	0.01	2

With the areas in each category, DCIA, and PLERs summarized here, BC calculated the phosphorus loads associated with each catchment. These results are presented in the next section.

2.3 Results

The Assabet River watershed comprises approximately 2,880 acres within the Town of Concord. Of this area, approximately 1,110 acres are contained within the Town's MS4 outfall catchments, based on preliminary catchment delineations. These catchments, and the watershed boundary within the Town, are shown in Figure 1.

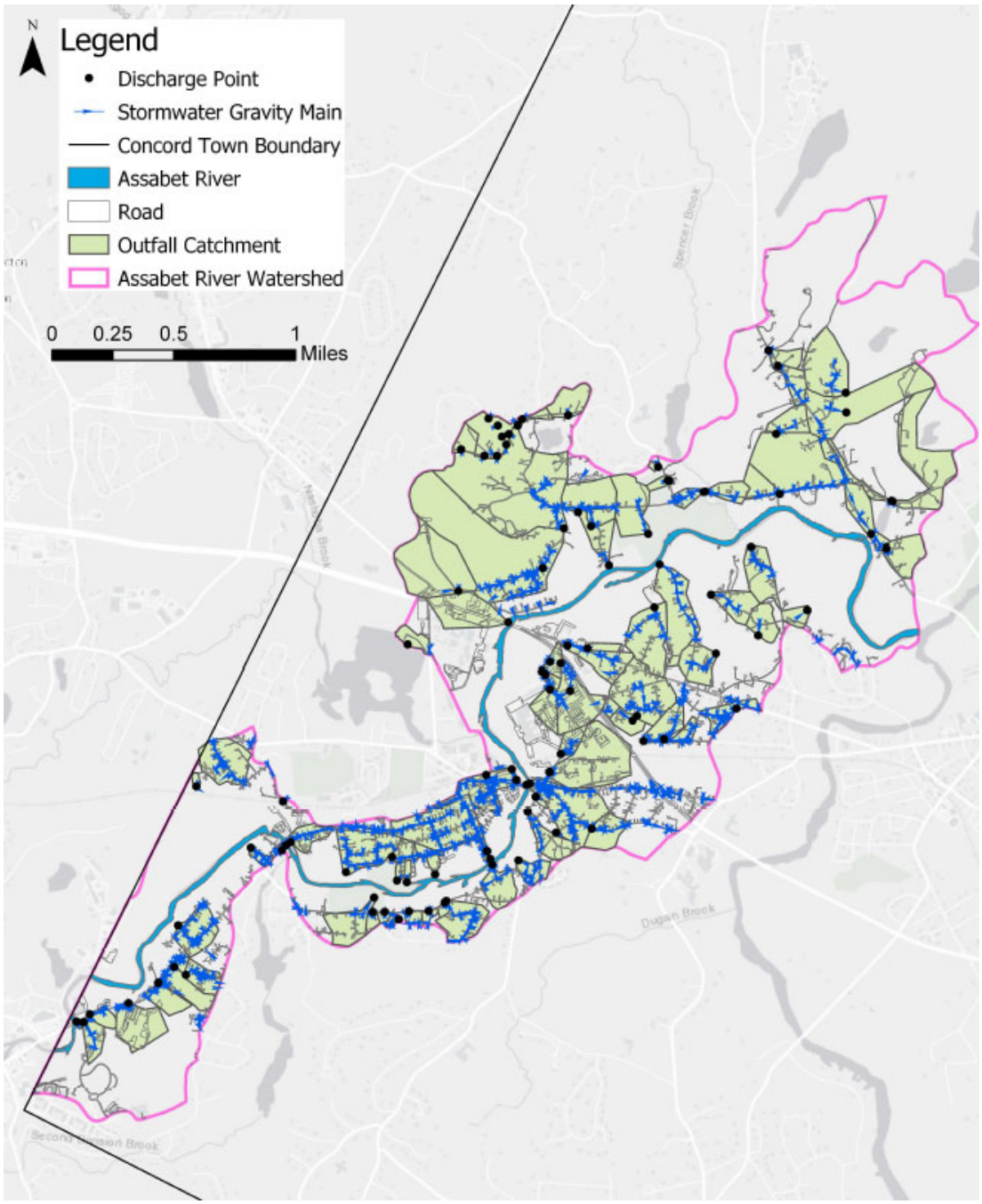

Figure 1. Concord Stormwater Outfall Catchments within the Assabet River Watershed

The impervious area, DCIA, and total phosphorus loads for each of the 95 catchments are presented in Appendix A, as required by the Permit.

The catchment sizes and resultant phosphorus loads vary greatly across the 95 catchments. As shown in Figure 1, the catchments in the northern part of the watershed are larger, on the average, compared to catchments in the central and southern parts of the watershed. The phosphorus loads vary greatly across all the catchments, too. While some contribute less than 1 pound of phosphorus

per year, others generate around 20 pounds. In general, larger catchments contribute larger loads, and so the highest loading areas will generally be the larger catchments. Figure 2 symbolizes the catchments based on the phosphorus load.

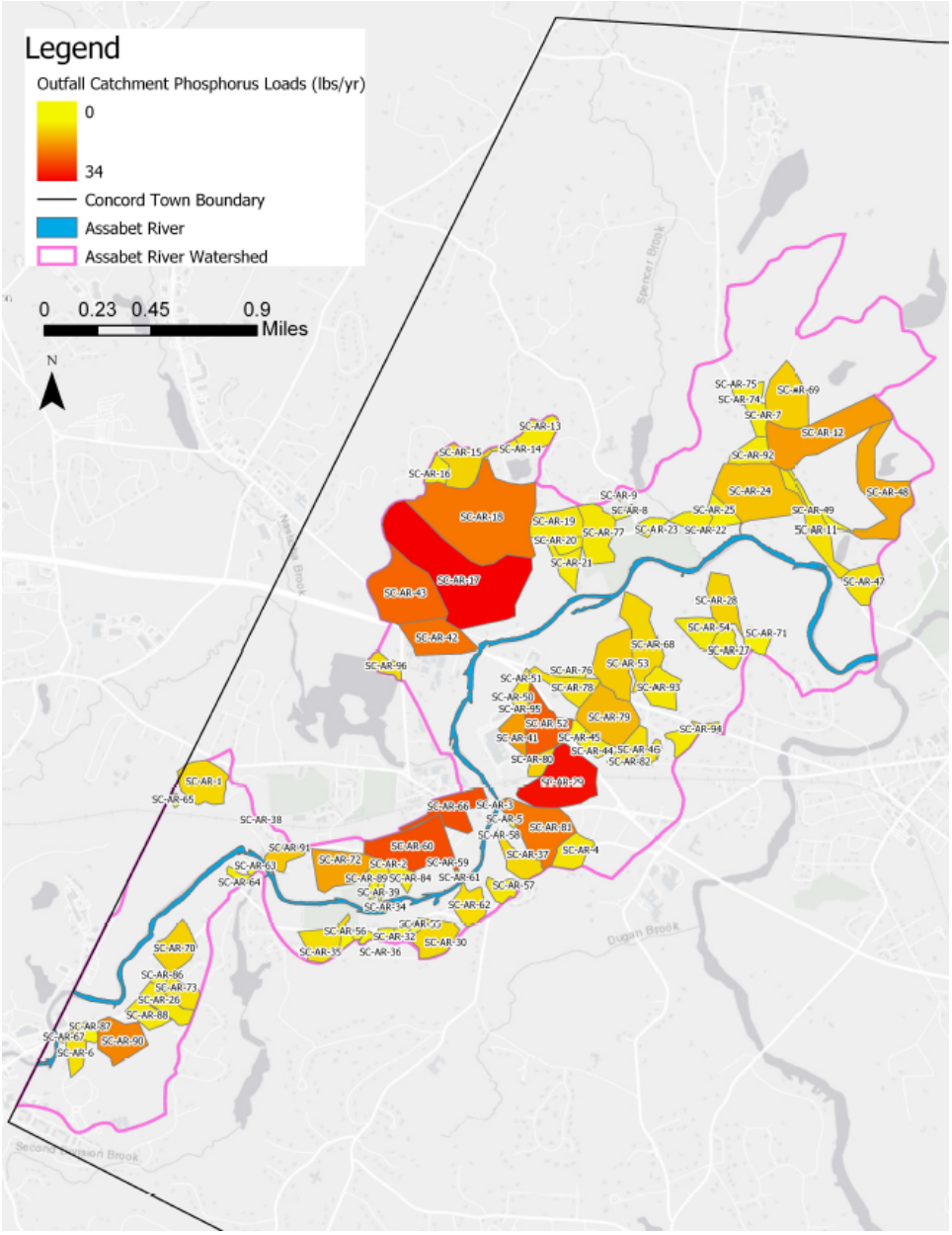

Figure 2. Catchment Phosphorus Loads (lb/year)

There are some instances where smaller or medium-sized catchments contribute relatively large loads, and this is generally due to high levels of impervious cover and high-loading land uses in those areas. To understand where the most concentrated phosphorus loads are coming from, we normalized the loading rates based on the contributing catchment area. While Figure 2 is based on the phosphorus load (pounds phosphorus per year), Figure 3 normalizes this to a unit basis (pounds

phosphorus *per acre* per year) to illustrate where the most concentrated phosphorus loads are coming from.

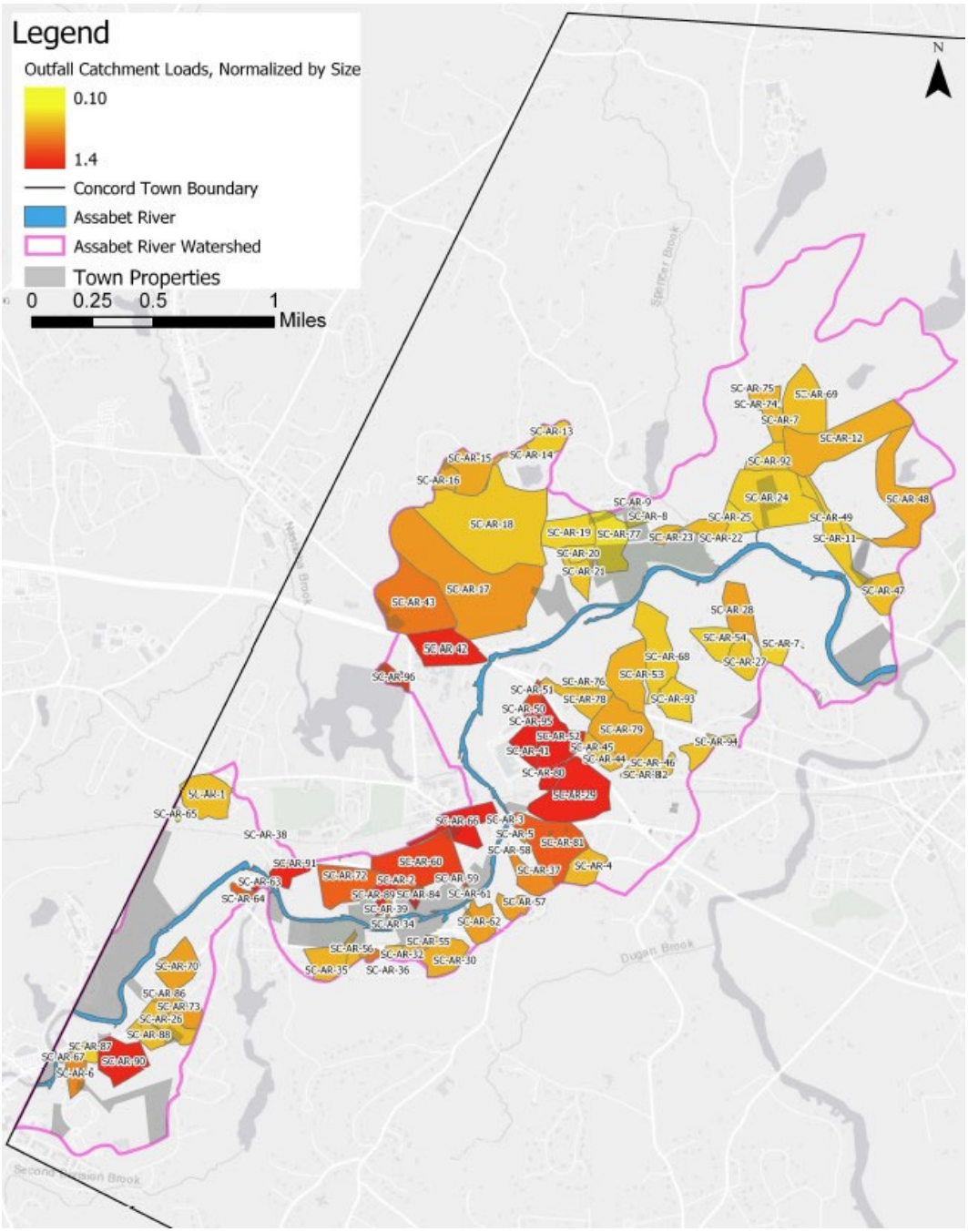

Figure 3. Catchment Phosphorus Loads, Normalized by Area (lb/acre/year)

While many of the highest loading areas are similar between these two figures, there are some key differences:

- The large catchments in the northern part of the watershed do not have as high normalized loading rates. The high loads there are mostly driven by the catchment size.

- The large northeastern catchments have varying loading rates, some driven by size and some driven by land use.
- The catchments in the middle of the watershed exhibit the highest loading rates, and these areas correspond to more highly urbanized parts of the watershed.

Catchment Conditions and Prioritization

To address the impairments of the Assabet River and meet MS4 Permit requirements, Concord and other MS4s Permitees discharging to the river will be required to reduce phosphorus loads from stormwater runoff. The catchments with high loads shown in Section 2.3 inform where there is the highest potential to reduce stormwater phosphorus loading; however, since phosphorus reduction can be an expensive undertaking, the Town is incorporating multiple considerations to prioritize projects that reduce phosphorus loads. This prioritization will be done in multiple steps. Through the efforts documented in this report, the Town is first incorporating two criteria for prioritizing projects with structural stormwater best management practices (BMPs): the results of IDDE investigations, and an evaluation of upcoming projects on municipal properties.

In the future, the Town may further refine these BMP opportunities by also considering broad benefits of stormwater BMP installation as part of the ongoing development of their Integrated Water Resource Plan (IWRP). The findings from this evaluation may be used to prioritize and sequence projects with stormwater BMPs. This is notable because the Town is subject to multiple permit requirements, and stormwater BMPs may provide an opportunity to reduce nuisance flooding, infiltrate stormwater to replenish groundwater, and meet other community goals.

The screening as described in the sections below enables the Town to identify high priority municipal retrofit sites as required by the MS4 Permit. Through the ongoing IWRP process, the Town intends to further prioritize and sequence projects over time, and through this process, will evaluate retrofit costs and engineering and regulatory feasibility of redevelopment or retrofit BMPs.

3.1 Outfall Prioritization from IDDE

The Town owns MS4 outfalls throughout the entire Town, 99 of which fall within the Assabet River watershed. Additionally, seven (7) of the Town's interconnections discharge to the Assabet River. Only 13 of these 99 outfalls in the Assabet River watershed discharge directly to the Assabet River.

The Town completed its outfall screening and sampling in 2022 in accordance with the IDDE requirements of the MS4 Permit. Based on the results, only two of the outfalls discharging directly to the Assabet were flowing and sampled for phosphorus. Due to the lack of outfalls with dry weather flow and associated phosphorus sampling data, this information will only play a minor role in determining priority catchments for phosphorus reduction. The outfall and catchment characteristics from the IDDE Plan are summarized in Table 4.

Table 4. Phosphorus IDDE Sampling Results

Discharge Type	Total Count	In Assabet Watershed	Direct Discharges to Assabet	Dry Weather Flow Observed	Dry Weather Flow Phosphorus Results (identifier, mg/L)	
Outfalls	145	99	13	2	OF-5	0

Discharge Type	Total Count	In Assabet Watershed	Direct Discharges to Assabet	Dry Weather Flow Observed	Dry Weather Flow Phosphorus Results (identifier, mg/L)	
					OF-355	0.57
Interconnections	14	7	7	0	0	

Upon inspection, OF-5, which drains one of the higher-loading catchments, SC-AR-81**Error! Reference source not found.**, was observed with flow, but the phosphorus concentration was below analytical detection limits. Conversely, OF-355 (catchment SC-AR-68**Error! Reference source not found.**) contained phosphorus in the sample, but it has a lower corresponding catchment load. Therefore, at this time, the IDDE sampling results will not have a large impact on the prioritization of catchments.

3.2 Municipal Properties

The Town owns the rights-of-way and is working to systematically improve both the roadway surface and implement green infrastructure and other stormwater BMPs through its pavement management plan. The Town's pavement management plan currently has over 60 roadway segments that are planned for upcoming improvements in FY2022-FY2025. Through implementation of this pavement management plan, the Town is incorporating BMPs such as deep sump catch basins and tree boxes for enhanced phosphorus removal.

BC evaluated this plan to identify which projects are located within the Assabet River watershed, and which are located within or near the catchments with high phosphorus loads and should therefore be prioritized for phosphorus removal BMPs. Each roadway segment within the Assabet at least partially intersects with one or more of the stormwater catchments. These planned projects constitute the Town's inventory for retrofit opportunities throughout the Town. The Town shall complete further screening during the design phase of each project to identify which projects will include stormwater BMPs. Table 5 summarizes the opportunities for BMPs associated with the Town's pavement management plan.

Table 5. Pavement Management Plan Opportunity Projects

Street Name
Assabet Ave
Central St
Coburn Hill Rd
College Rd
Hayes Rd
Hildreth Ln
Issac Davis Rd
Lanes End
Lapham Rd
Lee Dr
North Branch Rd
Pine St
Pond View Ln
Winslow St

While the roadway segments largely intersect the catchments, they are not consistently located within the catchments with the highest loads. Therefore, we also evaluated where municipally owned properties intersect these catchment areas and may provide opportunity for significant phosphorus load reduction. It is important to note that while the Town does not currently have a facility upgrade or capital improvement plan associated with the municipal properties, and this analysis therefore is based solely on proximity to high phosphorus load catchments. The municipal properties and planned roadway improvement projects are shown, overlaid with the catchments, in Figure 4.

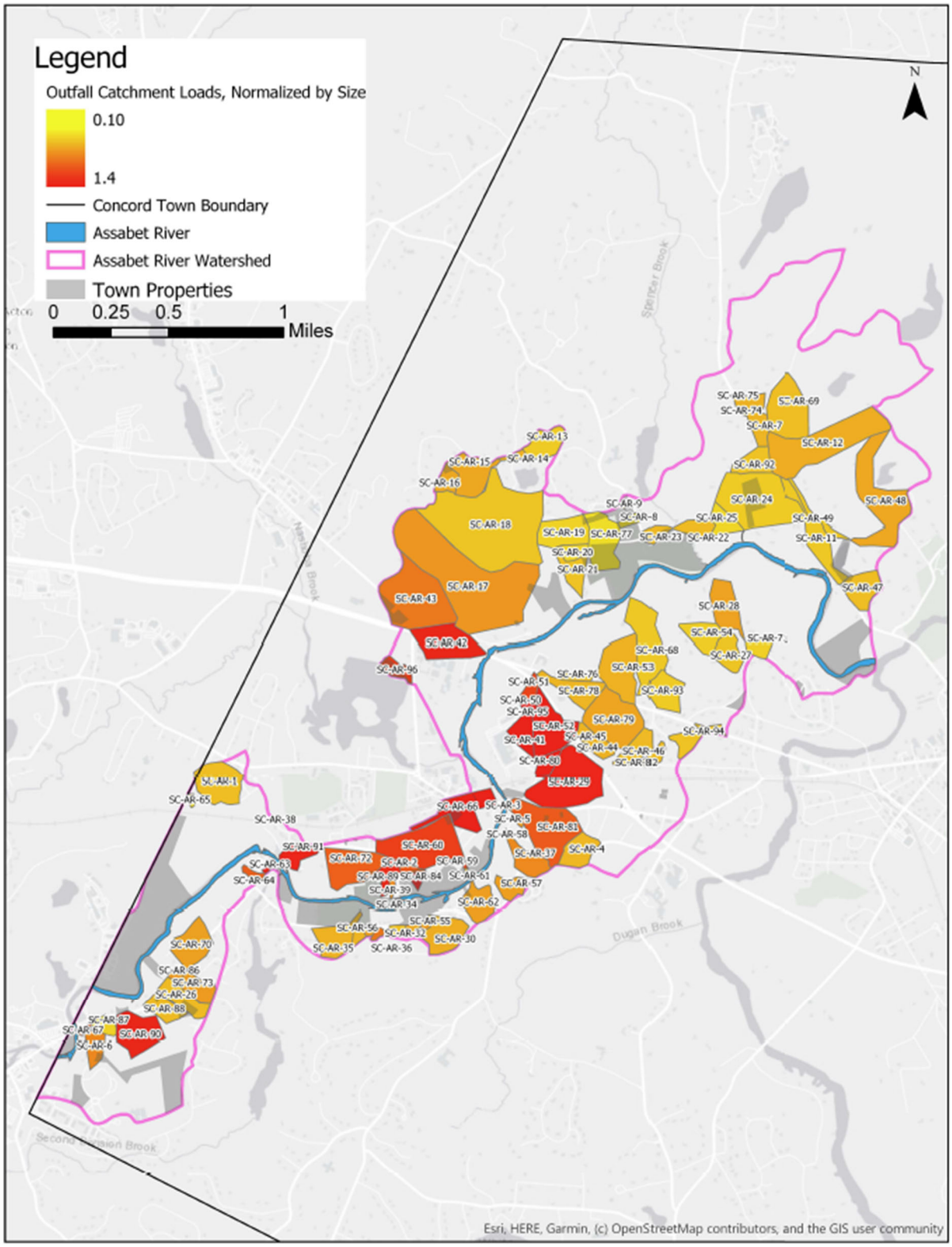

Figure 4. Area-Normalized Phosphorus Loads Overlaid with Municipal Retrofit Opportunities

3.3 Priority Catchments with BMP Opportunity

Sections 2.3 and 3.2 provided a basis of understanding on where there are high phosphorus loading areas within the Assabet River watershed, and where there is public land available to implement structural BMPs to mitigate this phosphorus. This section lays out where there are ongoing projects and municipal opportunity sites that can be leveraged for phosphorus retrofits as required by Appendix H part II.1.b.i.5 of the Permit. Planned projects that can be updated for phosphorus control retrofits represent a cost-effective way to target phosphorus reduction in alignment with ongoing Town priorities and goals.

Most of the roadway improvement projects are small relative to the catchments; while there are immediate opportunities here, the reductions on the roads currently planned for upgrades will likely be small relative to the phosphorus loads. Therefore, to maximize phosphorus removal, another method that should be employed by the Town is to focus on retrofitting phosphorus removal BMPs onto other municipally owned properties. There are many properties located within the Assabet River watershed; however, the high load catchments along highways MA-62 and MA-2 abut multiple municipal properties, including Thoreau Elementary School, and are very close to the Assabet River. These properties represent high priority locations for phosphorus removal stormwater BMP retrofits, as they would target a large portion of the phosphorus loads generated throughout the MS4. Figure 5 illustrates a detailed map of these high-priority catchments, along with the nearby municipal properties that represent high priority retrofit opportunities identified through this GIS screening.

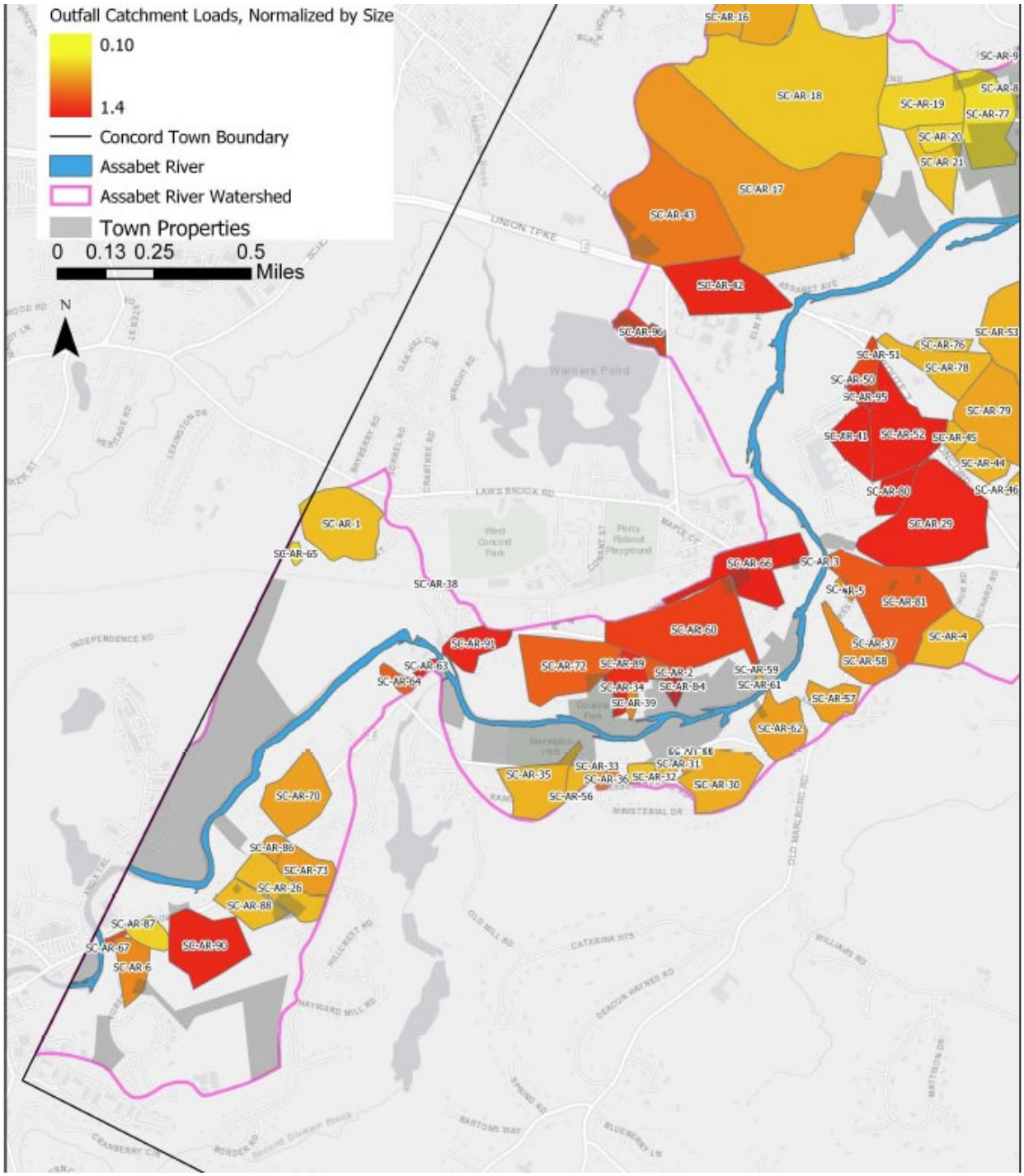

Figure 5. High Priority Catchments with Municipal Retrofit Opportunities

The highest priority catchments, based on the area-normalized loads and associated municipal property retrofit opportunities, along with the associated total phosphorus load for each catchment, are summarized in Table 6.

Table 6. Phosphorus Loads for High Priority Catchments

Catchment ID	Phosphorus Load (lb/year)	Normalized Phosphorus Load (lb/acre/year)
SC-AR-2	1.40	0.58
SC-AR-3	0.04	0.69
SC-AR-4	2.58	0.24
SC-AR-5	0.30	0.37
SC-AR-29	31.57	0.84
SC-AR-34	1.38	0.81
SC-AR-37	0.12	0.27
SC-AR-39	0.56	0.41
SC-AR-40	0.04	0.75
SC-AR-41	12.29	1.44
SC-AR-44	1.55	0.26
SC-AR-45	0.58	0.25
SC-AR-50	0.16	0.77
SC-AR-51	2.58	0.67
SC-AR-52	20.87	0.97
SC-AR-57	2.03	0.32
SC-AR-58	4.21	0.40
SC-AR-59	0.03	0.23
SC-AR-60	23.11	0.69
SC-AR-61	0.09	0.24
SC-AR-62	3.56	0.32
SC-AR-63	0.84	0.96
SC-AR-64	1.28	0.56
SC-AR-66	22.98	1.25
SC-AR-72	11.55	0.55
SC-AR-76	0.60	0.21
SC-AR-78	3.02	0.27
SC-AR-79	8.52	0.30
SC-AR-80	5.11	0.98
SC-AR-81	17.64	0.57
SC-AR-84	1.64	0.89
SC-AR-85	0.00	0.11

Catchment ID	Phosphorus Load (lb/year)	Normalized Phosphorus Load (lb/acre/year)
SC-AR-89	3.71	0.78
SC-AR-91	6.52	0.85
SC-AR-95	2.68	1.31
SC-AR-96	3.76	0.70

The Town of Concord has identified potential retrofit opportunities for the installation of structural BMPs of municipally-owned properties during redevelopment, including the removal of impervious cover (IC) area.

Appendix B contains the prioritized list of town-owned parcels with consideration of multiple factors including:

1. Prioritized list of town-owned parcels with highest total phosphorus pollutant loads and;
2. A number of factors from section 2.3.6d that are used to determine the potential of each parcel to be retrofitted with a stormwater BMP.

A focus on town-owned properties is a priority for the Town of Concord in order to prepare for the Year 5 requirement which states, “Within five years of the permit effective date, the permittee shall evaluate all permittee-owned properties identified as presenting retrofit opportunities or areas for structural BMPs installation…”

Potential Structural BMPs and Metrics (Year 5)

4.1 Potential Structural BMPs

The purpose of this section of the document is to meet the requirements in **Appendix H Part II.1.c.i** to evaluate all permittee-owned properties for potential BMPs to reduce stormwater pollutants including phosphorus, **Part II.1.c.ii** to provide a list of BMP(s) that have been installed on permittee-owned properties, and **Part II.1.c.iii** to track and document the metrics for each of the BMPs installed within the permittees regulated area. The permittee-owned properties that are used in this evaluation are taken directly from Section 3.3 of this document.

4.2 Town-Owned Properties Retrofit Evaluation

The Town of Concord has evaluated all permittee-owned properties identified as presenting retrofit opportunities or areas for structural BMP installation under permit Part 2.3.6.d. or identified in Section 3.3 that are within the drainage area of the impaired water or its tributaries. The evaluation included:

1. The next planned infrastructure, resurfacing or redevelopment activity planned for the property (if applicable) OR planned retrofit date;

2. The estimated cost of redevelopment or retrofit BMPs; and

3. The engineering and regulatory feasibility of redevelopment or retrofit BMPs.

Table 7. Permittee-Owned Properties Retrofit Evaluation

Parcel	Next Planned Infrastructure Improvement	Estimated Cost	Engineering and Regulatory Feasibility of Redevelopment or Retrofit
2158	Estimated 2024	$267,000	See Attachment B
2476	none	$209,000	See Attachment B
2447	none	$148,000	See Attachment B
2322	none	$94,000	See Attachment B
2498-1	none	$46,000	See Attachment B
2710	none	$35,000	See Attachment B
2456	none	$25,000	See Attachment B
2971-3	none	$22,000	See Attachment B
2712	none	$7,000	See Attachment B
3789	none	$4,000	See Attachment B

The Town of Concord is considering a Stormwater Utility Enterprise Fund. The fees collected will be used to comply with permit requirements including retrofit of Town-owned properties. The Town expects the Stormwater Fee to be in effect in Year 7 of the permit, at which time a detailed schedule for planned infrastructure improvements will be developed.

4.3 Planned Structural BMPs

The Town of Concord has provided a listing of planned structural BMPs and a plan and schedule for implementation in the table above.

The Town is planning to install the following project within the drainage area of the water quality limited water or its tributaries in Year 6 (2023/2024). The Town will install the remainder of the structural BMPs in accordance with the plan and schedule above. This plan will be evaluated annually and will be adjusted accordingly.

Table 8. Permittee-Owned Properties Retrofit Evaluation

Planned or Estimated for Year 6 (2023/2024)

Parcel	Next Planned Infrastructure Improvement for Year 6 (2023/2024)	Estimated Cost	Engineering and Regulatory Feasibility of Redevelopment or Retrofit
2158	2023/2024, estimated	$267,000	See Attachment B

4.4 BMP Tracking Metrics

The Town of Concord's tracking and accounting elements associated with Part II.1.c.iii of Appendix H of the Massachusetts MS4 permit are consistent with Attachment 3 of Appendix F of the MS4 permit. The tracking information for each of the structural BMPs installed by the Town in its regulated area can be found in the table below. The Town will provide the tracking metrics for all of the BMPs installed in its regulated area in the Year 5 Annual Report.

Table 9. Located Within the Regulated Area Tracking Metrics

Date BMP was Implemented	Location	Type of BMP	Total Area Treated by the BMP (Acres)	Design Storage Volume of the BMP (ft^3)	Estimated Mass of Phosphorus Removed by the BMP Per Year (lbs/yr)
2013	Baker Ave	Biofiltration	0.58	4798	0.72
2013	Nashoba Rd and Wilson Rd	Biofiltration	0.12	2948	0.15
2012	Finigan Way Basin #2	Biofiltration	0.11	2537	0.14
2012	Finigan Way Basin #3	Biofiltration	0.14	5086	0.17
2012	Finigan Way Basin #1	Biofiltration	0.41	10657	0.51

APPENDIX A

ASSABET RIVER WATERSHED CATCHMENT LOADING AND AREA SUMMARY

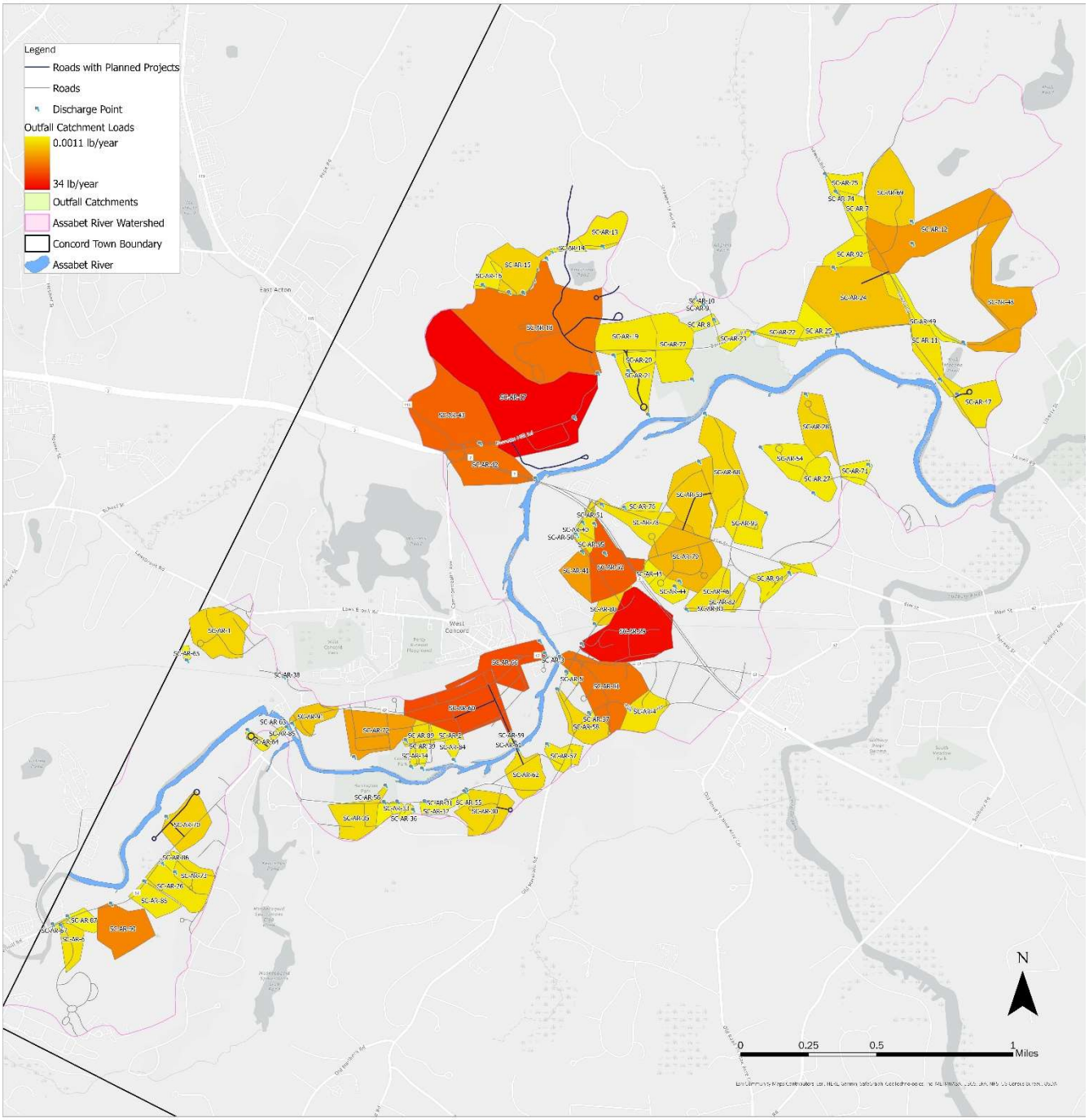

Figure 1 Phosphorus Loading Rates for catchments in the Town of Concord and Assabet watershed

Table 1 Phosphorus Loading Rates for catchments in the Town of Concord and Assabet watershed

Catchment ID	Impervious Area (acres)	DCIA (acres)	Phosphorus Load (lb/year)
SC-AR-1	3.72	1.61	4.18
SC-AR-10	0.01	0.00	0.01
SC-AR-11	2.74	1.09	2.83
SC-AR-12	3.55	1.22	12.30
SC-AR-13	0.86	0.23	1.80
SC-AR-14	0.58	0.24	0.52
SC-AR-15	2.91	0.86	4.65
SC-AR-16	0.81	0.29	1.53
SC-AR-17	11.23	4.91	33.76
SC-AR-18	8.06	3.06	17.67
SC-AR-19	1.87	0.75	2.27
SC-AR-2	0.91	0.68	1.40
SC-AR-20	0.69	0.27	0.60
SC-AR-21	1.65	0.74	1.79
SC-AR-22	1.16	0.46	1.53
SC-AR-23	0.91	0.34	0.97
SC-AR-24	2.78	1.01	7.12
SC-AR-25	0.67	0.27	0.96
SC-AR-26	1.15	0.55	2.45
SC-AR-27	1.04	0.34	1.76
SC-AR-28	2.01	0.77	4.58
SC-AR-29	14.43	12.20	31.57
SC-AR-3	0.02	0.02	0.04
SC-AR-30	3.29	1.66	4.10
SC-AR-31	0.37	0.17	0.49
SC-AR-32	0.31	0.11	0.42
SC-AR-33	0.25	0.12	0.41
SC-AR-34	0.68	0.57	1.38
SC-AR-35	2.88	1.43	3.45
SC-AR-36	0.44	0.23	0.59
SC-AR-37	0.09	0.05	0.12

Catchment ID	Impervious Area (acres)	DCIA (acres)	Phosphorus Load (lb/year)
SC-AR-38	0.03	0.01	0.02
SC-AR-39	0.30	0.22	0.56
SC-AR-4	1.36	0.77	2.58
SC-AR-40	0.03	0.02	0.04
SC-AR-41	6.81	6.59	12.29
SC-AR-42	9.57	7.90	17.97
SC-AR-43	5.77	2.48	19.68
SC-AR-44	0.87	0.53	1.55
SC-AR-45	0.61	0.31	0.58
SC-AR-46	2.50	1.19	2.89
SC-AR-47	1.61	0.53	2.75
SC-AR-48	3.11	0.69	10.59
SC-AR-49	0.91	0.39	0.82
SC-AR-5	0.17	0.12	0.30
SC-AR-50	0.10	0.07	0.16
SC-AR-51	1.78	1.27	2.58
SC-AR-52	12.18	10.75	20.87
SC-AR-53	4.60	2.35	5.93
SC-AR-54	1.17	0.39	1.64
SC-AR-55	0.30	0.16	0.44
SC-AR-56	0.51	0.25	0.57
SC-AR-57	1.35	0.71	2.03
SC-AR-58	2.80	1.70	4.21
SC-AR-59	0.03	0.01	0.03
SC-AR-6	2.00	1.36	2.93
SC-AR-60	13.28	10.10	23.11
SC-AR-61	0.08	0.02	0.09
SC-AR-62	2.62	1.39	3.56
SC-AR-63	0.55	0.45	0.84
SC-AR-64	0.95	0.61	1.28
SC-AR-65	0.01	0.01	0.12
SC-AR-66	12.09	11.09	22.98
SC-AR-67	0.37	0.27	0.48

Catchment ID	Impervious Area (acres)	DCIA (acres)	Phosphorus Load (lb/year)
SC-AR-68	4.09	1.74	4.38
SC-AR-69	2.10	0.68	5.22
SC-AR-7	1.20	0.45	1.67
SC-AR-70	3.79	1.99	4.76
SC-AR-71	0.48	0.21	0.69
SC-AR-72	6.42	4.77	11.55
SC-AR-73	2.22	1.24	2.86
SC-AR-74	0.16	0.05	0.14
SC-AR-75	0.65	0.17	1.42
SC-AR-76	0.29	0.20	0.60
SC-AR-77	1.35	0.40	2.01
SC-AR-78	2.35	1.20	3.02
SC-AR-79	6.78	3.57	8.52
SC-AR-8	0.22	0.07	0.27
SC-AR-80	3.10	2.81	5.11
SC-AR-81	9.82	7.31	17.64
SC-AR-82	0.01	0.01	0.01
SC-AR-83	0.01	0.01	0.01
SC-AR-84	1.25	1.05	1.64
SC-AR-85	0.00	0.00	0.00
SC-AR-86	0.57	0.31	0.73
SC-AR-87	0.47	0.09	0.59
SC-AR-88	0.82	0.45	1.84
SC-AR-89	1.97	1.59	3.71
SC-AR-9	0.11	0.02	0.10
SC-AR-90	8.95	7.96	15.30
SC-AR-91	3.28	2.66	6.52
SC-AR-92	1.74	0.70	1.83
SC-AR-93	2.06	0.86	2.16
SC-AR-94	1.94	0.66	1.73
SC-AR-95	1.48	1.39	2.68
SC-AR-96	2.23	2.18	3.76

APPENDIX B

POTENTIAL STRUCTURAL BMP EVALUATION

Concord identification of potential retrofit opportunities or opportunities for the installation of structural BMPs during redevelopment

Scoring Criteria						Impervious Cover (IC) Area Score 0-2 Acres IC = 5 2.1-5 Acres IC = 10 5.1-10 Acres IC = 15 10.1-20 Acres IC = 20 20.1+ Acres IC = 25	Is the site easy to access for maintenance purposes? Yes = 10 Possibly = 5 No = 0	Is the subsurface geology appropriate for a stormwater BMP? Yes = 10 Possibly = 5 No = 0	Is the depth to the water table appropriate for a stormwater BMP? Yes = 10 Possibly = 5 No = 0	Is the site slope appropriate for a stormwater BMP? <5% slope = 10 5-10% slope Possibly = 5 >15% slope = 0	Is the site elevation appropriate for a stormwater BMP? Yes = 10 Possibly =5 No = 0	Is the proximity to surrounding aquifers appropriate for a stormwater BMP? >1000 feet = 10 500-100 feet = 5 <500 feet = 0	Is the proximity to subsurface infrastructure including sanitary sewers and septic systems appropriate for a stormwater BMP? Yes = 10 Possibly = 5 No = 0	What is the risk to public safety? Low Risk = 10 Medium Risk = 5 High Risk = 0	Capital Improvements Plan (CIP) for storm and/or sanitary sewer infrastructure and paving projects - is the BMP area located within an area scheduled for construction? <1 year = 15 1-3 years = 10 >3 = 5 Not scheduled or in CIP = 0	What is the current storm sewer level of service? Stormwater collection system present = 10 Stormwater collection system nearby = 5 No stormwater collection system present = 0	Does the area discharge to impaired waters? Yes = 10 Possibly = 5 No = 0	Does the area discharge to first or second order streams? Yes = 10 Possibly = 5 No = 0	Does the area discharge to critical receiving waters? Yes = 10 Possibly = 5 No = 0	What is the complexity and cost of implementation? Low = 10 Medium = 5 High = 0	Is the site appropriate for public use? Yes = 10 Possibly = 5 No = 0	Is there an opportunity for public education at the site? Yes = 10 Possibly = 5 No = 0	Is there an opportunity for general public education? Yes = 10 Possibly = 5 No = 0	Would a nitrogen reduction BMP be appropriate in this area? Yes = 10 Possibly = 5 No = 0	Would a stormwater infiltration BMP be appropriate in this area? Yes = 10 Possibly = 5 No = 0	*Are drainage easements or other permissions needed to install and maintain the BMP?* Yes = 0 Possibly = 5 No = 10	*Current use or intended future development for the municipality?* Developed = 25 Possible Plan for development = 10 Undeveloped = 5 No future plan for development = 0	Score
Street Address	Parcel ID	Impervious Cover Area (Acres)	Total Phosphorus Load (lb/year)	Estimated Total Phosphorus Load Reduction with 0.8- inch in-sising (lb/yr)	Estimated Costs of 0.8-inch sizing ($)																								
376 COMMONWEALTH AVE	2158	2.90	4.46	3.17	$ 247,000.00	10	10	5	5	10	10	5	5	10	15	5	10	5	0	0	10	10	10	0	10	10	25	267180
29 PRAIRIE ST	2476	2.30	4.09	2.91	$ 209,000.00	10	10	5	5	10	10	5	5	10	0	10	10	5	0	0	10	10	10	0	10	10	25	209170
1276 MAIN ST	2447	1.63	2.90	2.06	$ 148,000.00	5	10	5	5	10	10	5	5	10	0	10	10	5	0	0	10	5	5	0	10	10	25	148131
2149 MAIN ST	2322	1.03	2.01	1.43	$ 94,000.00	5	10	5	5	10	5	5	5	10	0	10	10	5	0	0	10	5	5	0	10	10	25	94150
8A BROWN ST	2498-1	0.50	0.99	0.70	$ 46,000.00	5	5	5	5	10	5	5	5	10	0	10	10	5	0	5	5	5	5	0	10	10	0	46120
169 HARRINGTON	2730	0.38	0.58	0.41	$ 35,000.00	5	10	5	5	10	5	5	5	10	0	0	10	5	0	5	5	5	5	0	10	10	25	35140
1201 MAIN ST	2456	0.27	0.48	0.34	$ 25,000.00	5	10	5	5	10	5	5	5	10	0	5	10	5	0	5	5	5	5	0	10	10	25	25145
150 FOREST RIDGE RD	2971-3	0.22	0.43	0.31	$ 22,000.00	5	10	5	5	10	5	5	5	10	0	5	10	5	0	5	10	5	5	0	10	10	25	22150
249 HARRINGTON AVE	2729	0.07	0.11	0.08	$ 7,000.00	5	10	5	5	10	5	5	5	10	0	10	10	5	0	10	10	5	5	0	10	10	25	7155
1149 MAIN ST	3789	0.04	0.09	0.06	$ 4,000.00	5	10	5	5	10	5	5	5	10	0	5	10	5	0	10	10	5	5	0	10	10	25	4155

APPENDIX C

BMP TRACKING METRICS CALCULATIONS

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

Table 1. Project Summary Credit for CONCORD, MASSACHUSETTS

Project Type	Removed Phosphorus Load (lb/yr)	Removed Nitrogen Load (lb/yr)	Removed Sediment Load (lb/yr)
Structural	0.81	3.72	289.71
Non-Structural	0	0	0
Land Use Conversion	0	0	0
Total	0.81	3.72	289.71

Table 2. Structural Project Summary for CONCORD, MASSACHUSETTS

Project ID	BMP Type	BMP Storage Capacity (ft^3)/ 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.)
Infiltration Basin #2	BIOFILTRATION	2537	63	40	100	0.14	0.62	48.28	0.11	6.35
Infiltration Basin #3	BIOFILTRATION	5086	63	40	100	0.17	0.79	61.45	0.14	10.01
Infiltration Basin #1	BIOFILTRATION	10657	63	40	100	0.51	2.31	179.97	0.41	7.16

Table 3. Non-Structural Project Summary for CONCORD, MASSACHUSETTS

There are no non-structural BMPs.

Table 4. Land Use Conversion Project Summary for CONCORD, MASSACHUSETTS

There are no land use conversion projects.

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

Table 1. Project Summary Credit for CONCORD, MASSACHUSETTS

Project Type	Removed Phosphorus Load (lb/yr)	Removed Nitrogen Load (lb/yr)	Removed Sediment Load (lb/yr)
Structural	0.15	0.68	52.67
Non-Structural	0	0	0
Land Use Conversion	0	0	0
Total	0.15	0.68	52.67

Table 2. Structural Project Summary for CONCORD, MASSACHUSETTS

Project ID	BMP Type	BMP Storage Capacity (ft^3)/ 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.)
Nashoba&Wilson	BIOFILTRATION	2948	63	40	100	0.15	0.68	52.67	0.12	6.77

Table 3. Non-Structural Project Summary for CONCORD, MASSACHUSETTS

There are no non-structural BMPs.

Table 4. Land Use Conversion Project Summary for CONCORD, MASSACHUSETTS

There are no land use conversion projects.