

Pine Knoll Shores Drainage Study - Baboosic Lake Merrimack, NH

Stakeholder Meeting/Project Wrap-up

November 17, 2022



Introduction and Acknowledgement

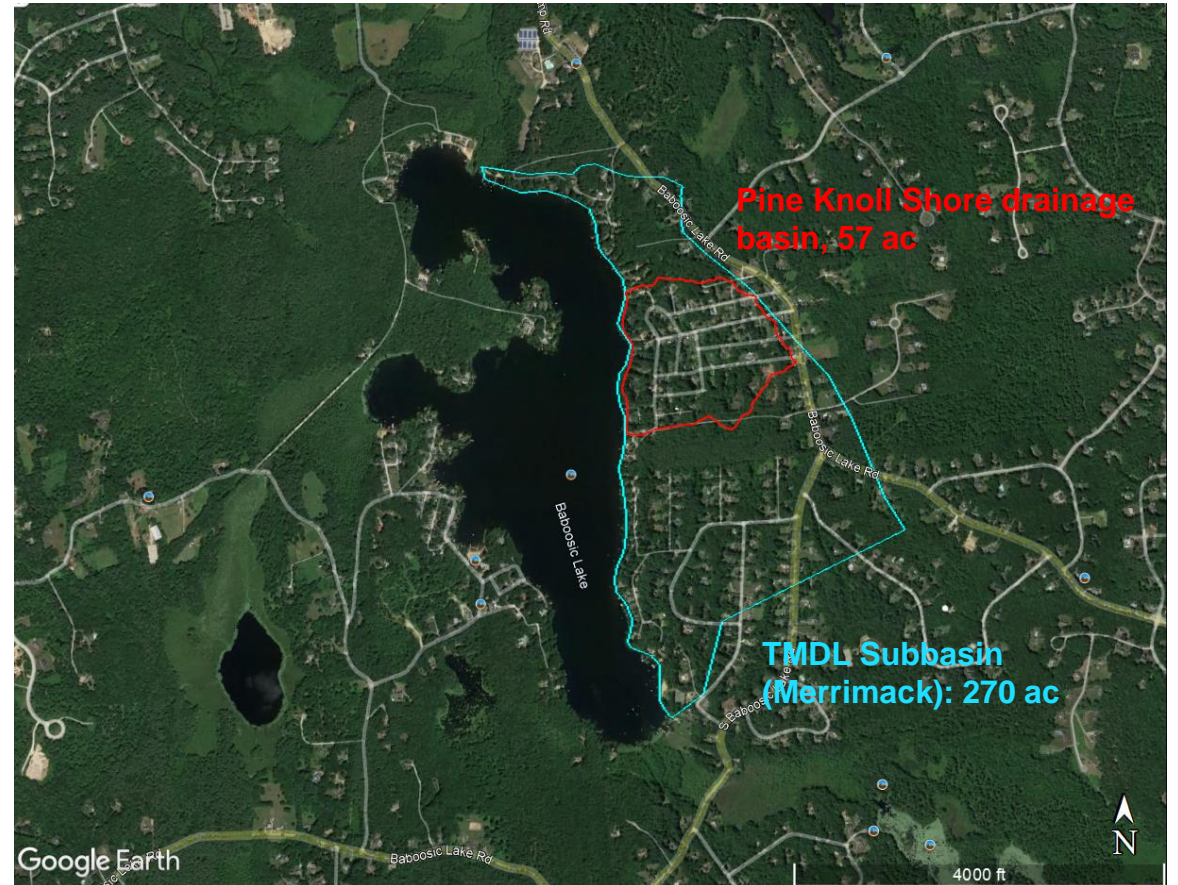
The Baboosic Lake (Pine Knoll Shores Subdivision) Drainage Study funded by New Hampshire Department of Environmental Services (NHDES) Clean Water State Revolving Fund (CWSRF) with Principal Forgiveness.

Project Team

Town of Merrimack, Department of Public Works	NH Department of Environmental Service	AECOM
Kyle Fox, PE, Director	Deborah Loiselle, Stormwater Coordinator	Yan Zhang, PHD, PE, Project Manager
Dawn Tuomala, PE, DPW Deputy Director/Town Engineer	Jeff Marcoux, Watershed Supervisor	Craig Drennan, EIT
	Dennis Greene, PE, Design Review Engineer	David Carbonneau, PE
		Hancock Associates (Survey)

Agenda

- Project Background
- Approach and Findings
- Improvement Design Concepts
 - Step-wise approach to BMP concept development
 - Description of selected projects
 - Pollutant reduction
- Implementation Recommendations



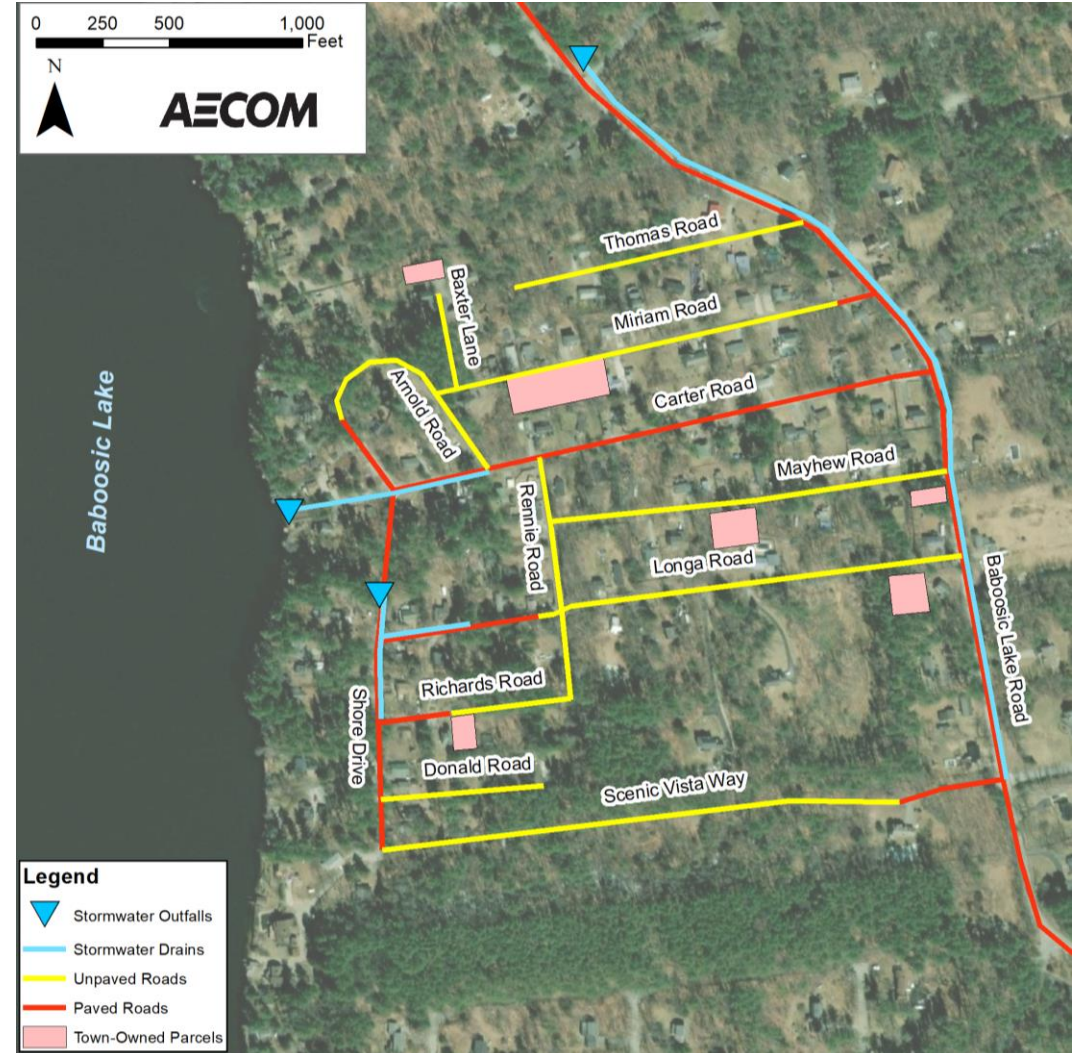
Project Meetings

Meetings	Date	Location
Kickoff Meeting	April 6, 2022	Merrimack DPW
Mid-Level Meeting	July 14, 2022	NHDES, Concord
Design Review Meeting	August 23, 2022	Merrimack DPW
Work Session Meeting	September 22, 2022	Virtual
Stakeholder Meeting/Wrap-up	November 17, 2022	Merrimack Town Council

Final Report to be published following comments obtained during the Nov 17 Meeting; time frame December 9.

Project Background

- Baboosic Lake TMDL (Total Maximum Daily Loads) (EPA, 2011) - Baboosic Lake is listed as impaired for primary-contact recreation due to hepatotoxic cyanobacteria (phosphorous).
- Pine Knoll Shores Subdivision lies wholly within the Baboosic Lake Watershed, contributing phosphorus carried by TSS in stormwater runoff
- Subdivision watershed is ~20% the size of the TMDL watershed, but holds 40-50% the population
- Major pollutant contributors: gravel / unpaved road runoff, sediments in stormwater runoff; septic systems, etc.
- Merrimack's **NH MS4** (Municipal Separate Stormwater Sewer System) Requirements.
(<https://www.merrimacknh.gov/stormwater>)



Projective Objectives

The objective of this study was to propose stormwater conveyance and treatment improvements for the Subdivision that, when implemented, will result in tangible water quality benefits to Baboosic Lake.

- ❑ Develop BMPs within Town's right-of-way/properties in the subdivision to reduce TSS and phosphorus loading to Baboosic Lake
- ❑ Seek opportunities in the DPW's roadway paving and rehabilitation plan
- ❑ Engage stakeholder and minimize abutter impacts



Project Approach

1

Existing Condition Characterization

- Site survey
- Engineering field visit & site evaluations
- Soil & geotechnical review

2

Evaluations

- Hydrologic, hydraulic, water quality modelling
- Stormwater collection, treatment alternative review
- Roadway rehabilitation alternatives
- Abutter impacts

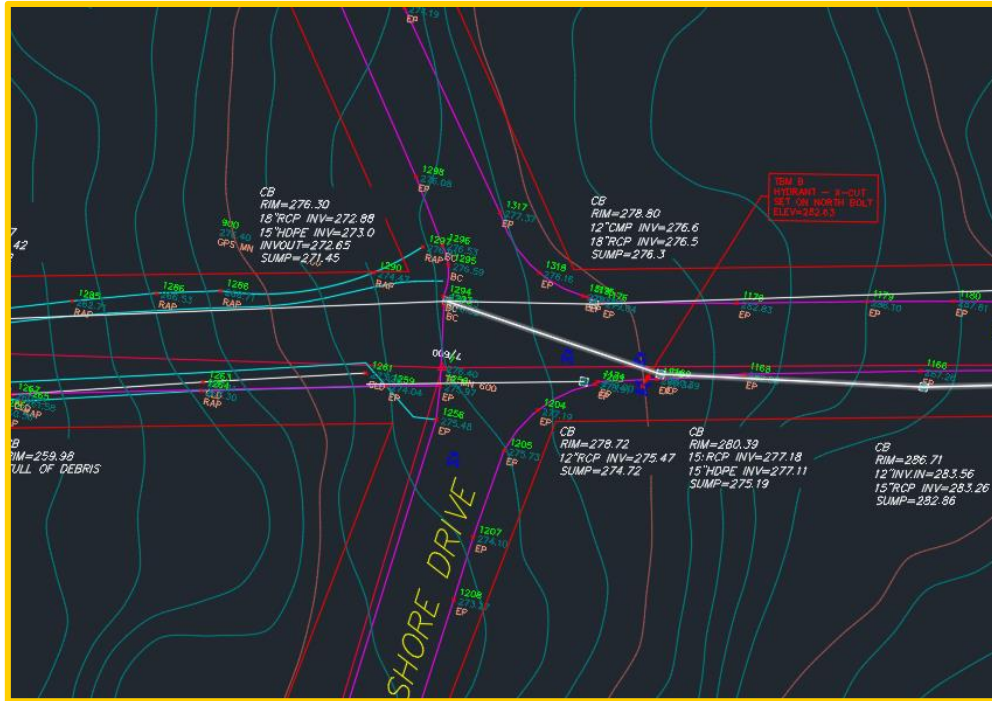
3

Engineering Report & Conceptual Design

- Engineering report
- Up to 30% engineering design plan set
- Implementation recommendations

Existing Condition Evaluation

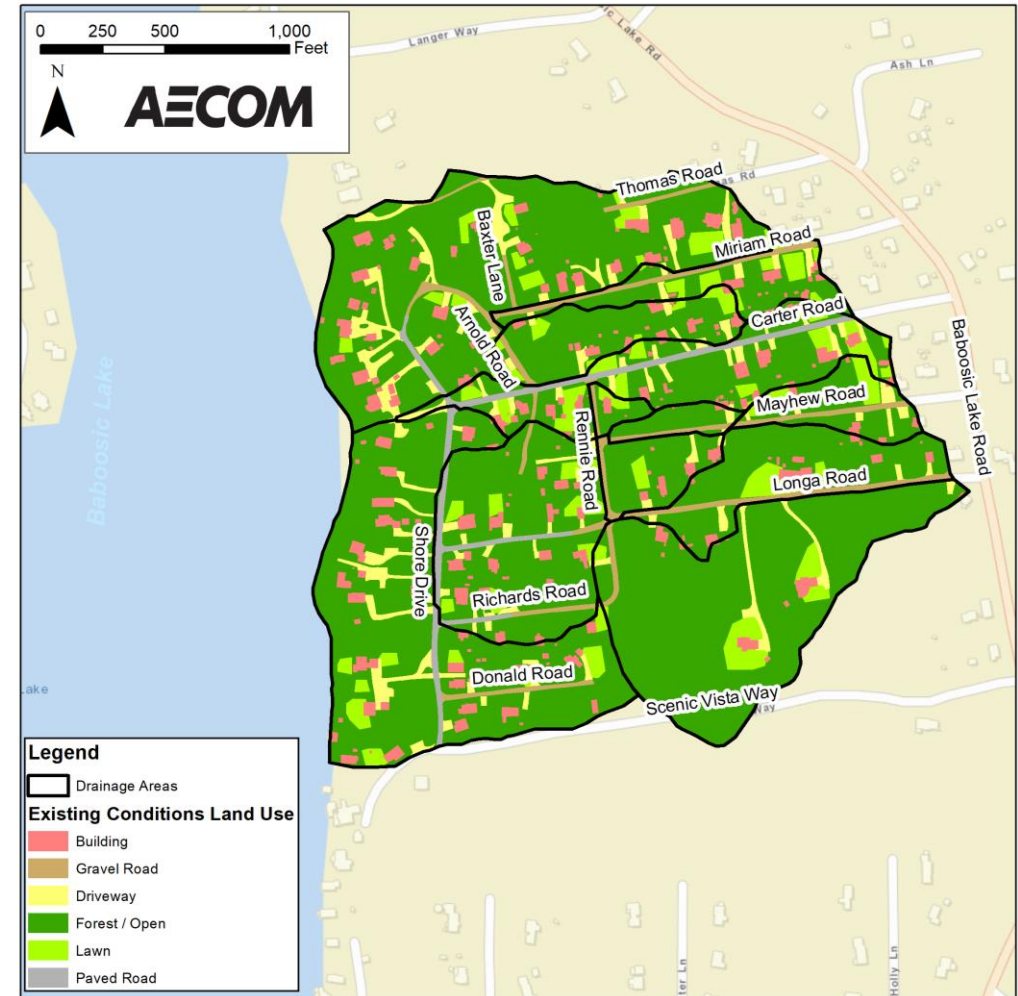
- Field survey performed May-June 2022: topography, drainage structure attributes, property and ROW, edge of roads, etc.
- Field reconnaissance April 2022



Evaluations – Pollutant Washoff Modeling

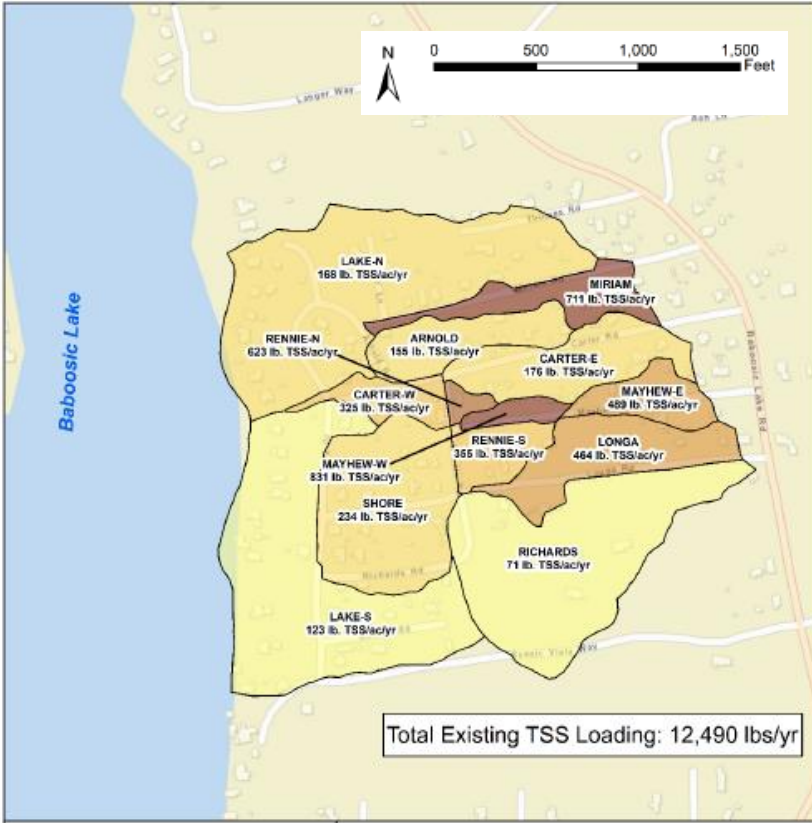
- NHDES Simple Model: Land use-based washoff analysis that links land use in a watershed to a pollutant EMC (event mean concentration)
- Annualized based on average annual rainfall to determine annual mass of pollutant contributed by each watershed, in lbs
- Load reduction by BMPs (best management practices) can be accounted
- Compare to TMDL TP (total phosphorous) Load

Drainage Basin	Area, Ac.	Annual TP Load, lb
TMDL- Merrimack	270	38
Pine Knoll Shores (2022)	57	21.1



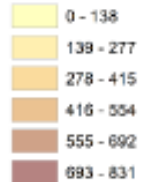
Existing Conditions Washoff Modeling Results

Total Suspended Solids

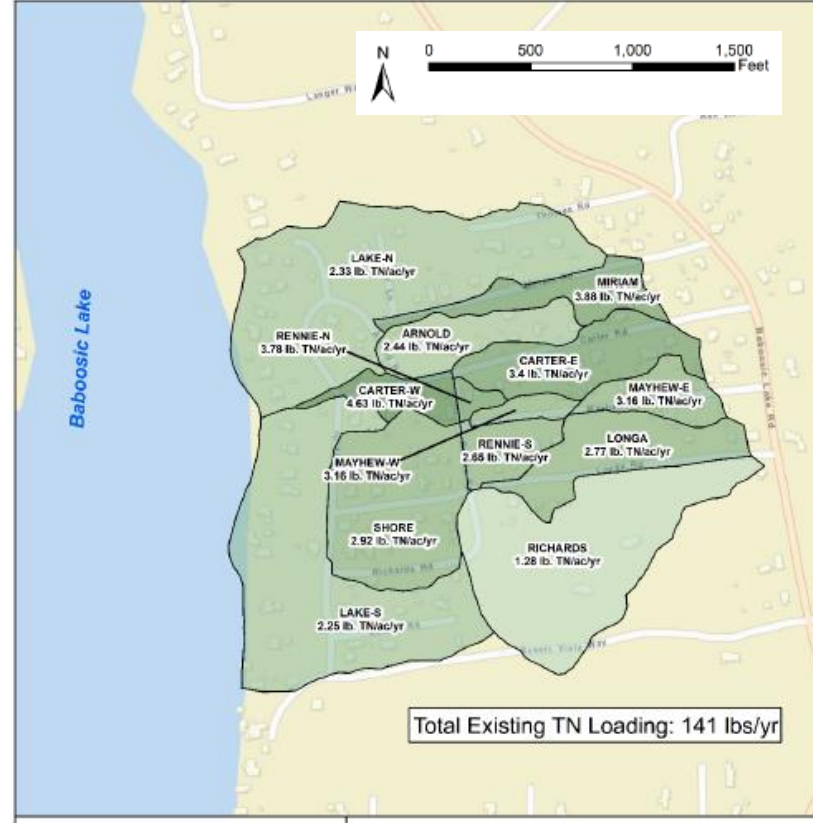


Legend

Existing TSS Loading, lb./ac/yr

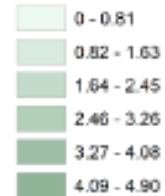


Total Nitrogen

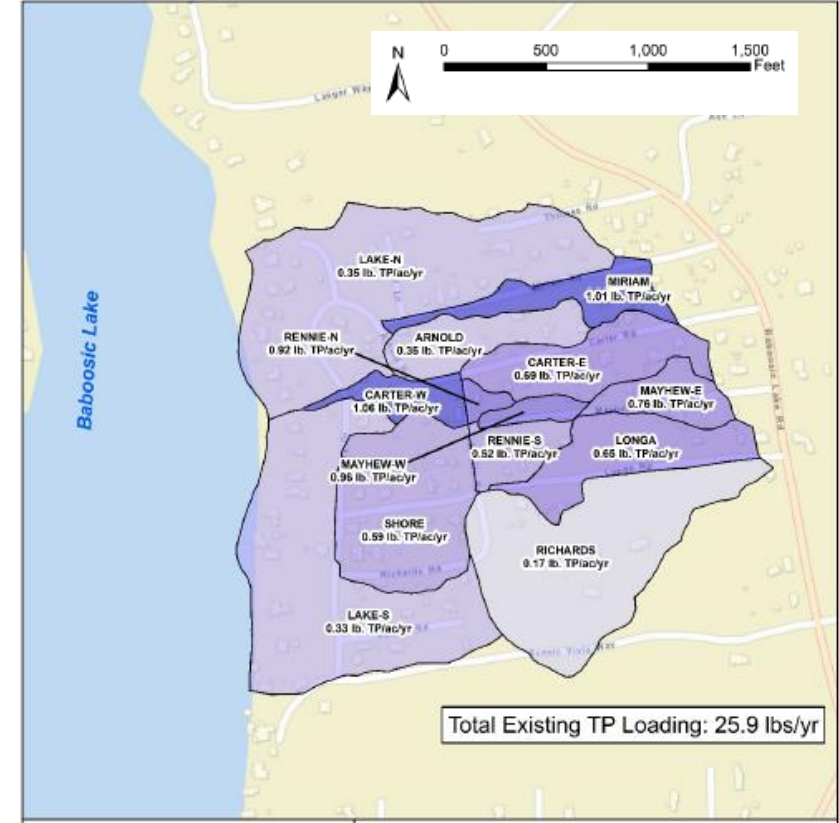


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Existing TN Loading, lb./ac/yr

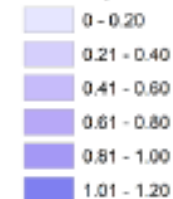


Total Phosphorous



Legend

Existing TP Loading, lb./ac/yr

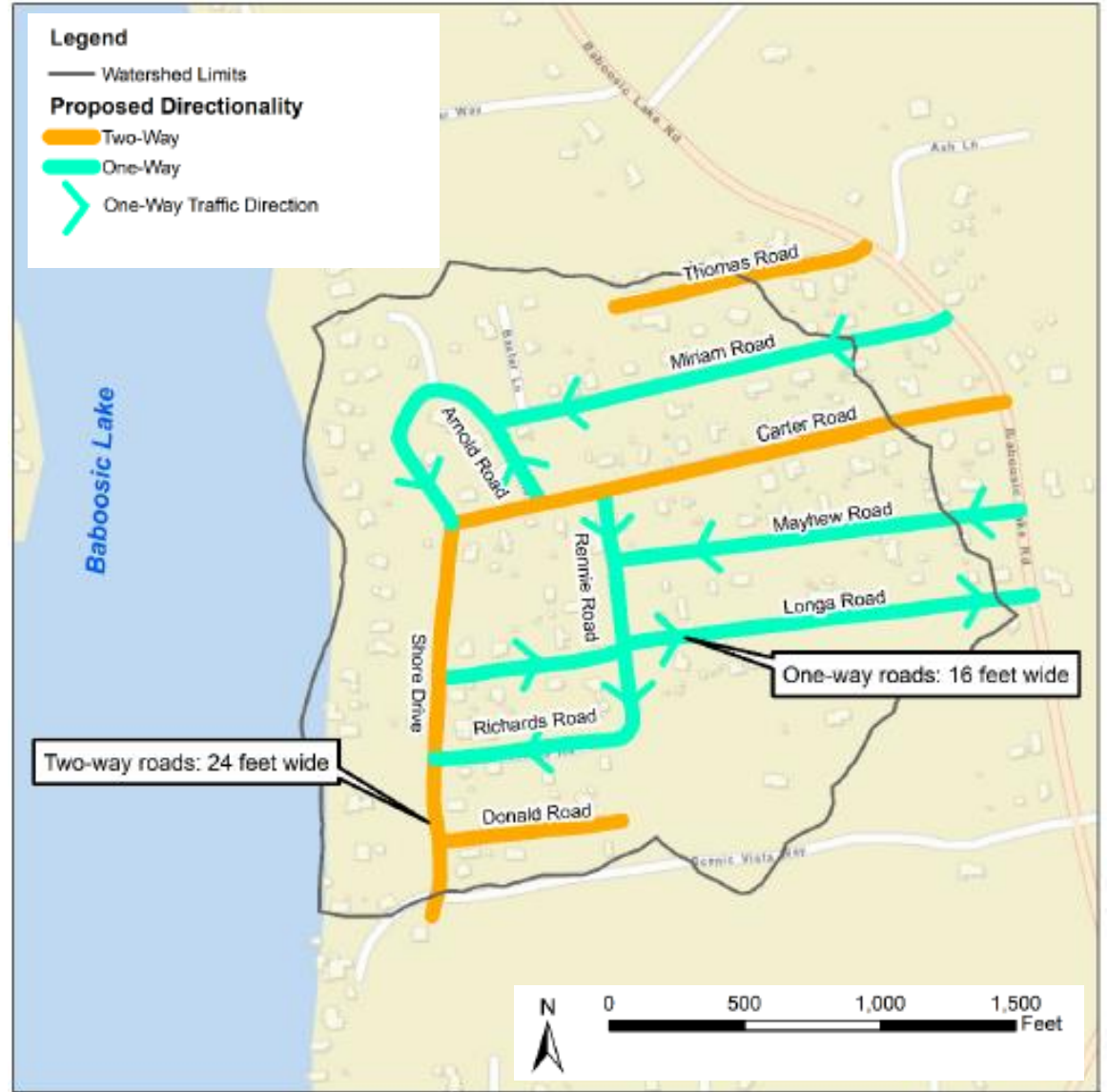


Development of Improvement Project Concepts

1. **Pave** the older and unpaved roadways.
2. **Drain** the newly paved surfaces through the addition of stormwater infrastructure.
3. **Treat** the stormwater runoff to further reduce TSS & nutrient loading to the lake.

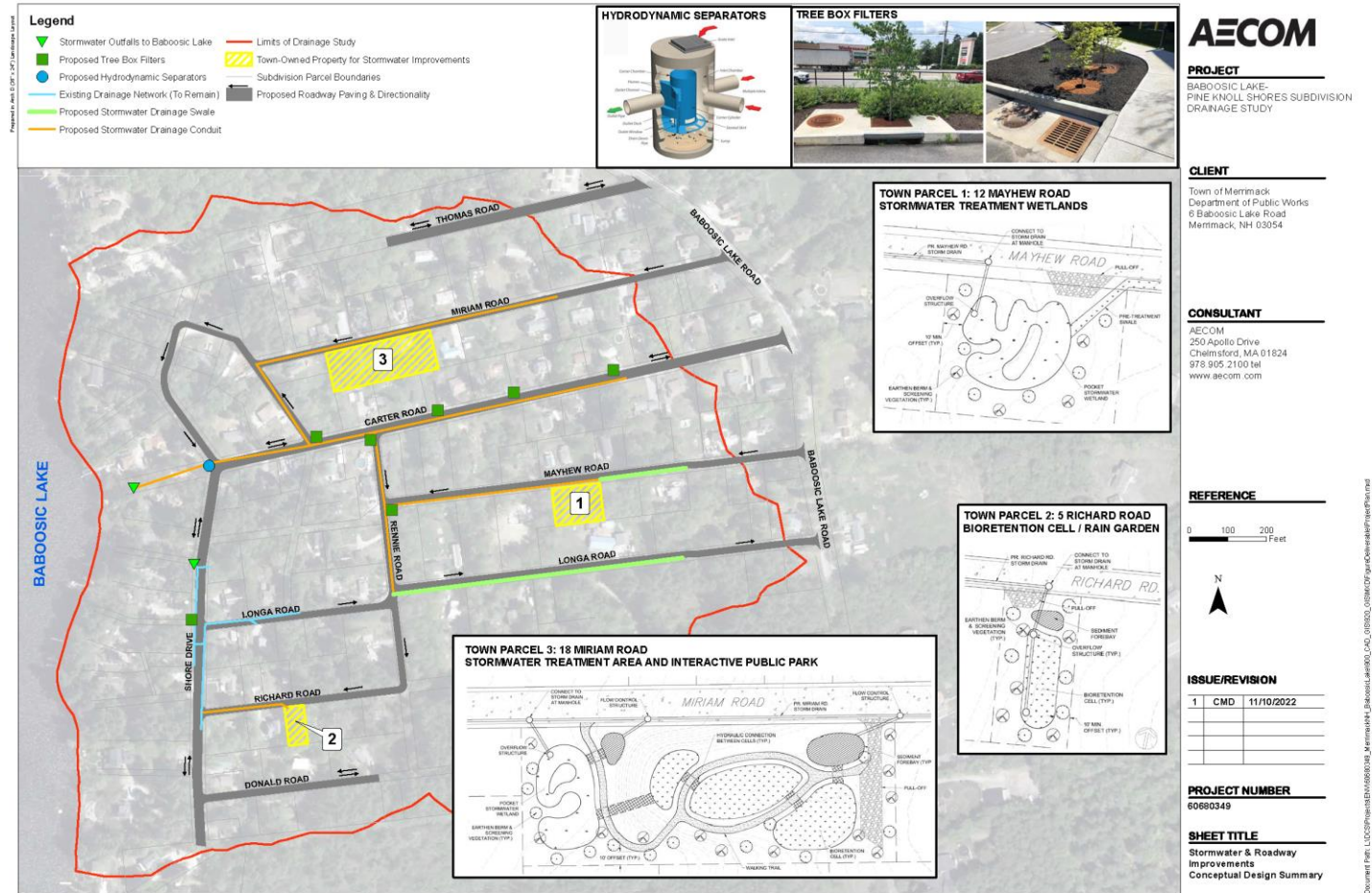
Work within Town ROW & land to limit abutter impact.

Maximize treatment to the extent practicable.



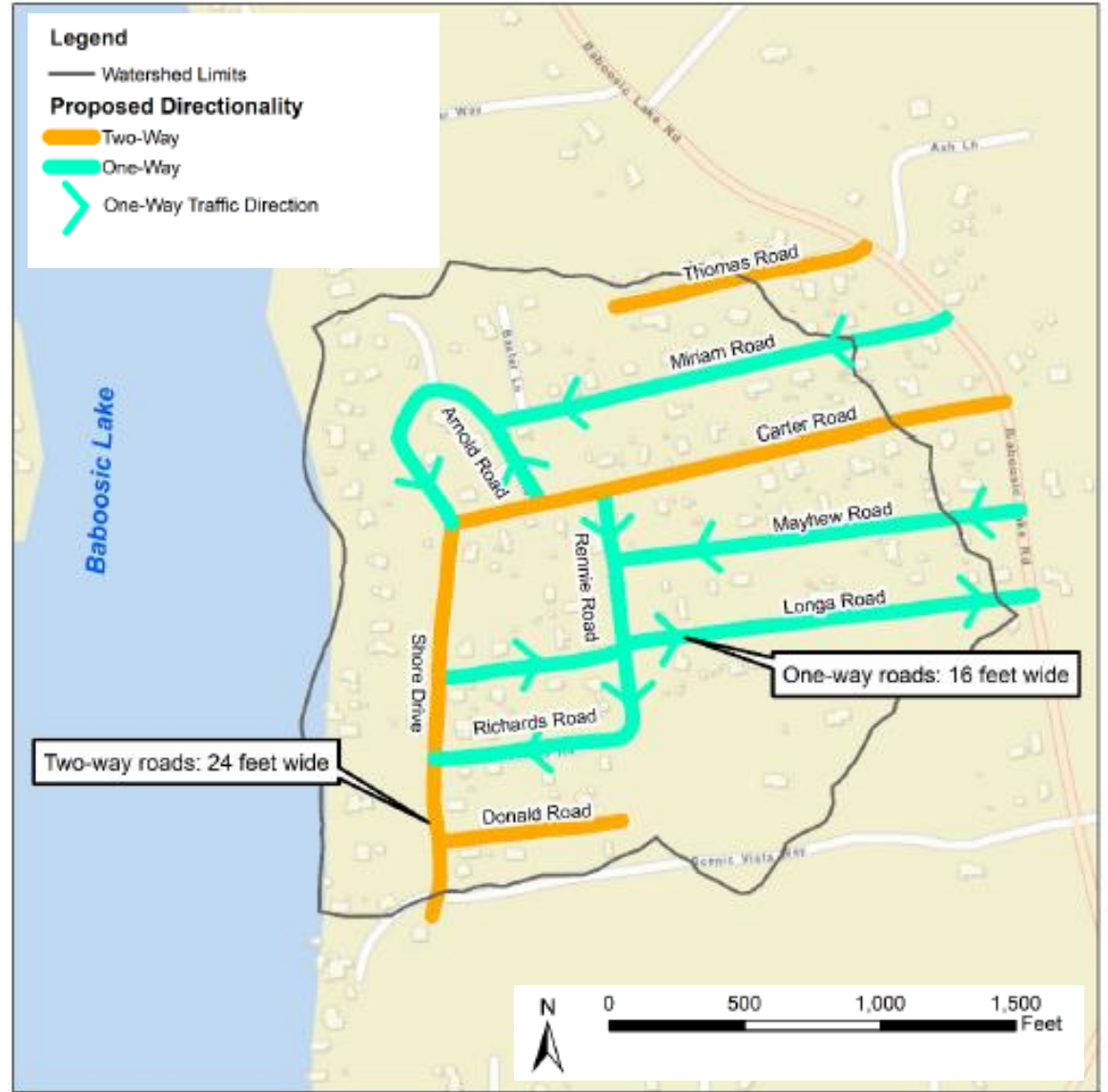
Recommended Projects

1. Roadway Paving & Drainage Improvement (All Subdivision Roads)
2. Tree Box Filter Installation (Carter Road, Rennie Road, and Shore Drive)
3. Hydrodynamic Separator Installation (at Carter Road and Shore Drive)
4. Bioretention Cell (rain garden) (Town Land: Richards Road)
5. Stormwater Wetland (Town Land: Mayhew Road)
6. Stormwater Treatment Park (Town Land: Miriam Road)



Proposed Project 1: Roadway Paving & Drainage Improvement

- Pave unpaved roads; reconstruct & repave existing paved roads
 - Two-way: 5,140 LF
 - One-way: 4,510 LF
- Add curbing & drainage infrastructure to convey stormwater runoff
- Roadway directionality based on ROW widths, abutter impacts, and sight distance safety
- Approximate cost to repave / reconstruct all roads (including drainage): \$2.3M
- Expected pollutant reduction: TSS 4,500 lb/yr or 38%



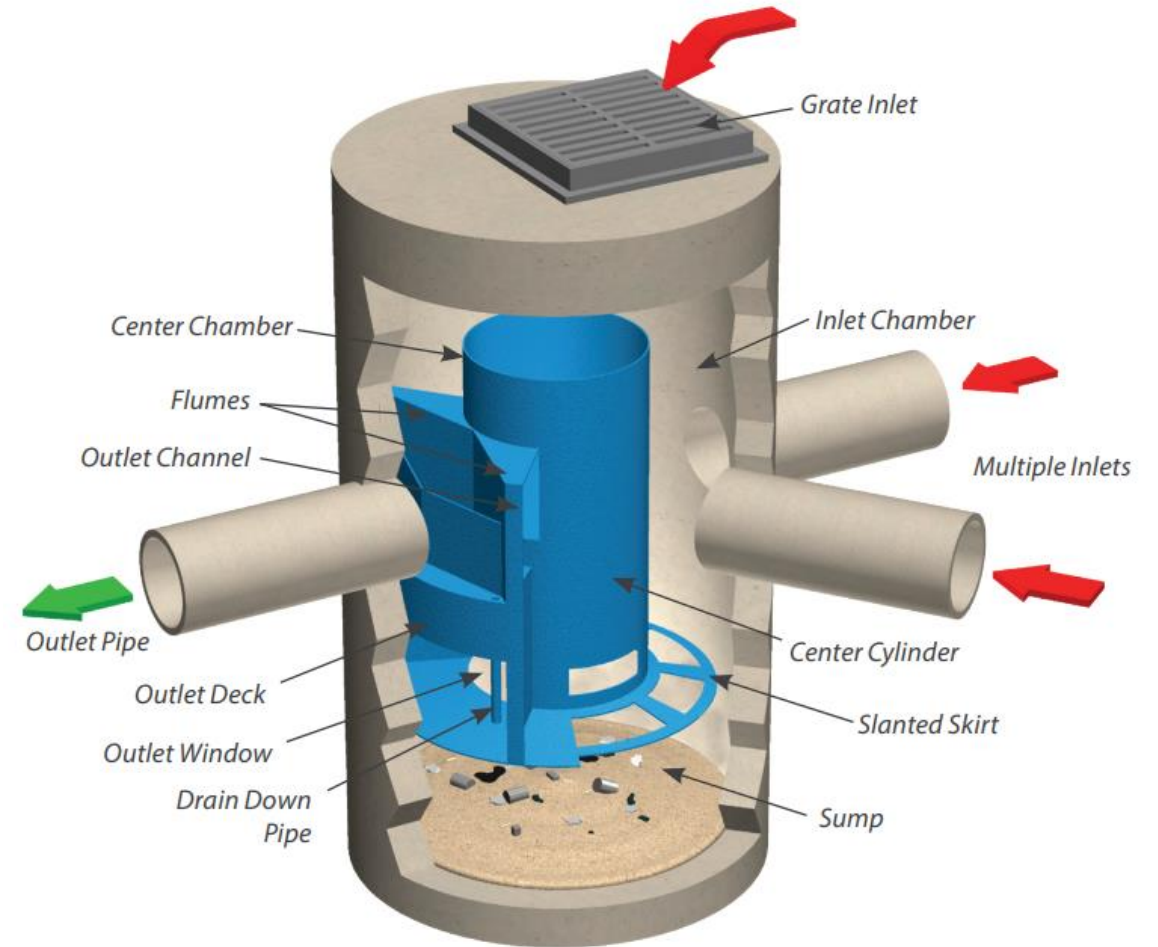
Proposed Project 2: Tree Box Filters Installation on Carter Road, Rennie Road, and Shore Drive

- Provide roadside stormwater treatment with limited footprint (ideal for ROW applications)
- Can be used to provide / return tree cover & vegetation in areas where trees will be removed
- Manufactured by Contech Engineered Systems
- # Units Proposed: 5 along Carter; 1 each on Rennie & Shore
- Unit cost (including install): \$25K-\$30K
- Expected pollutant reductions from current (assuming roads paved):
 - TSS: 1,240 lb/yr or 10%
 - TP: 1.6 lb/yr or 6.7%
 - TN: 16 lb/yr or 12.2%



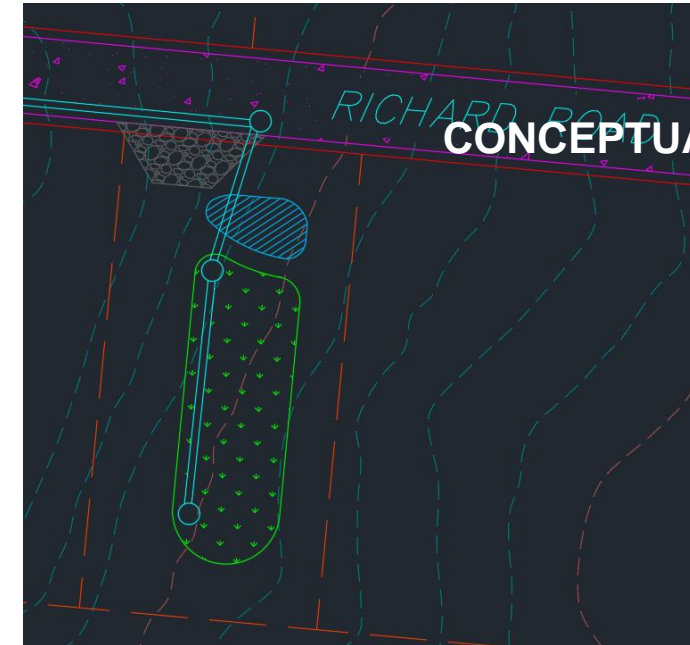
Proposed Project 3: Hydrodynamic Separators on Carter Road and Shore Drive

- Target higher-TSS areas (primarily provides sediment removal – no nutrient treatment)
- In-line treatment system; uses large manhole structure to provide stormwater treatment
- Manufactured by third-party vendors
- # Units Proposed: 1 on Carter Road
- Unit cost (including install): \$15K-\$20K
- Expected pollutant reduction:
 - TSS: 400 lb/yr or 3.4%



Proposed Project 4: Bioretention Cell (Rain Garden) on Richards Road

- Utilize Town-owned property to install a rain garden / bioretention cell along Richards Road
 - Accept curbside runoff from Richards; discharge to drain system; Relatively small contributing drainage area (due to location of parcel)
 - Functions: groundwater infiltration; runoff volume reduction; nutrient removal
- Pollutant reductions from current (assuming roads paved):
 - TSS: 62 lb/yr (0.5%)
 - TP: 0.08 lb/yr (0.3%)
 - TN: .42 lb/yr (0.3%)



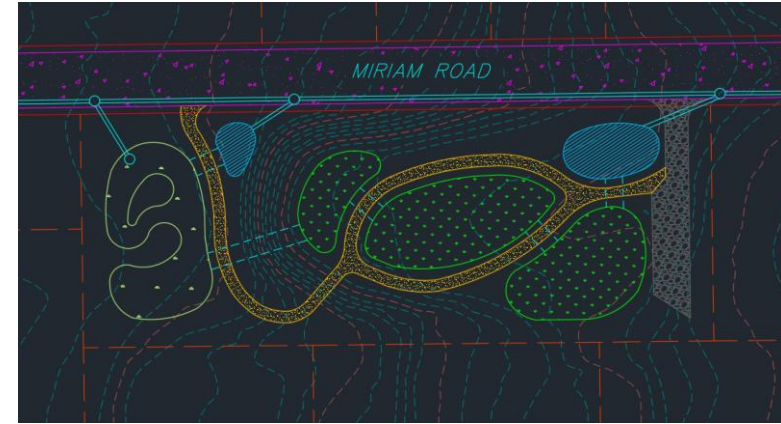
Proposed Project 5: Stormwater Wetlands on Mayhew Road

- Utilize Town-owned property to install a pocket stormwater wetland system along Mayhew Road
 - Accept runoff from Mayhew via pre-treatment swale; discharge to drain system; Terraced construction to meld wetlands area into existing topography
 - Functions: groundwater infiltration; runoff volume reduction; nutrient removal through biologic uptake
- Pollutant reductions from current (assuming roads paved):
 - TSS: 265 lb/yr (2.2%)
 - TP: 0.7 lb/yr (2.9%)
 - TN: 2.5 lb/yr (1.9%)



Proposed Project 6: Stormwater Treatment Park on Miriam Road

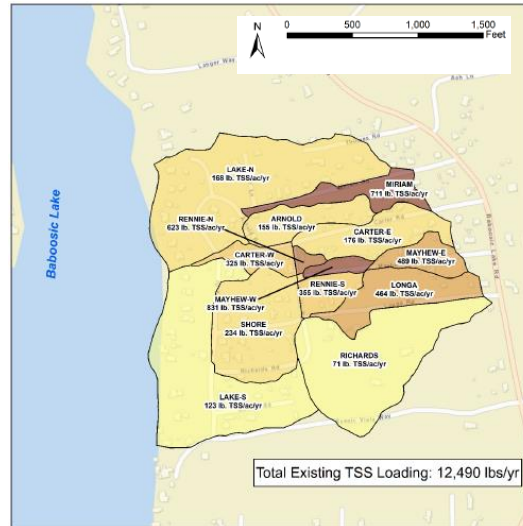
- Utilize largest Town-owned property in subdivision to create a stormwater management demonstration project
 - Hydraulically divert water quality volume to park for treatment; high flows bypass and discharge thru drainage system
 - Pretreatment provided onsite through forebays
 - Bioretention cells in upland area and stormwater wetland in lowland area
 - Walking trails connections
 - Educational signage
- Expected pollutant reductions from current (assuming roads paved):
 - TSS: 644.9 lb/yr or 5.4%
 - TP: 1.7 lb/yr or 7.1%
 - TN: 6.2 lb/yr or 4.7%



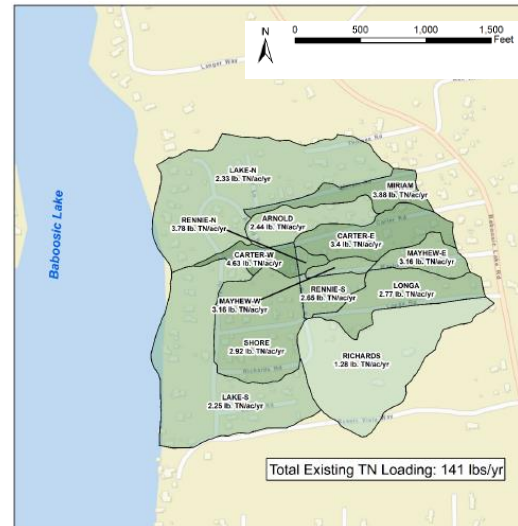
Predicted Pollutant Reduction for all Phases (1-3) of Proposed Projects

Existing

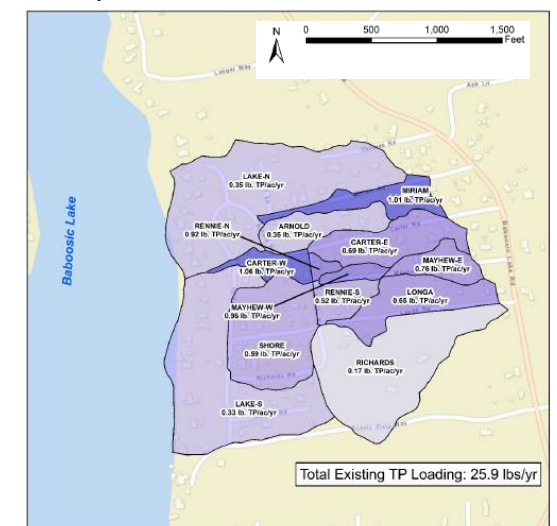
TSS (63%)



TP (12%)



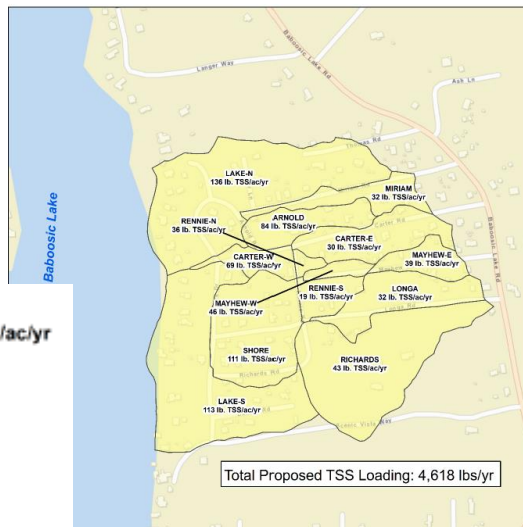
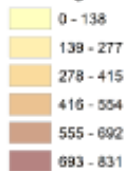
TN (18%)



Future

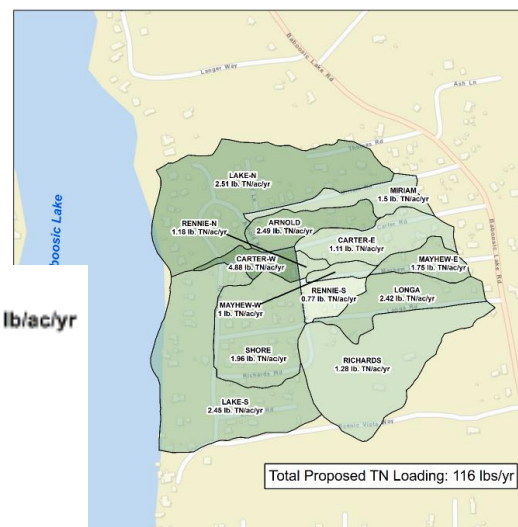
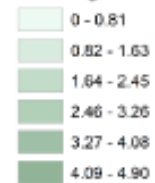
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Existing TSS Loading, lb/ac/yr



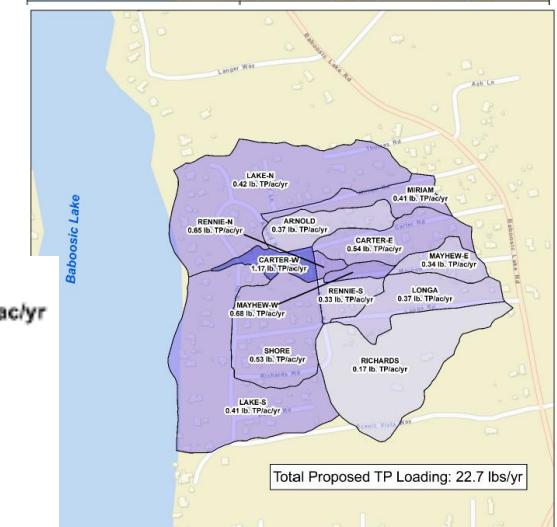
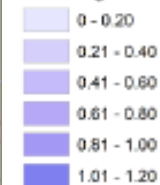
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Existing TN Loading, lb/ac/yr



Legend

Existing TP Loading, lb/ac/yr



* TN and TP percent reduction not accounting pollutants attached to sediments.

Project Summary Matrix

Project	Pollutant Removal			Cost	Abutter Impact	Community Benefit	Maintenance	External Funding Eligibility
	TSS	TP	TN					
Roadway Paving & Drainage Improvements	●	◐	◐	●	◐	●	●	○
Tree Box Filters	●	●	●	●	◐	◐	◐	●
Hydrodynamic Separators	◐	X	X	◐	●	○	◐	◐
Bioretention at 5 Richard Road	○	○	○	◐	◐	○	○	●
Stormwater Wetlands at 12 Mayhew Road	◐	◐	◐	◐	○	○	○	●
Stormwater Park at 18 Miriam Road	◐	●	◐	○	○	●	◐	●

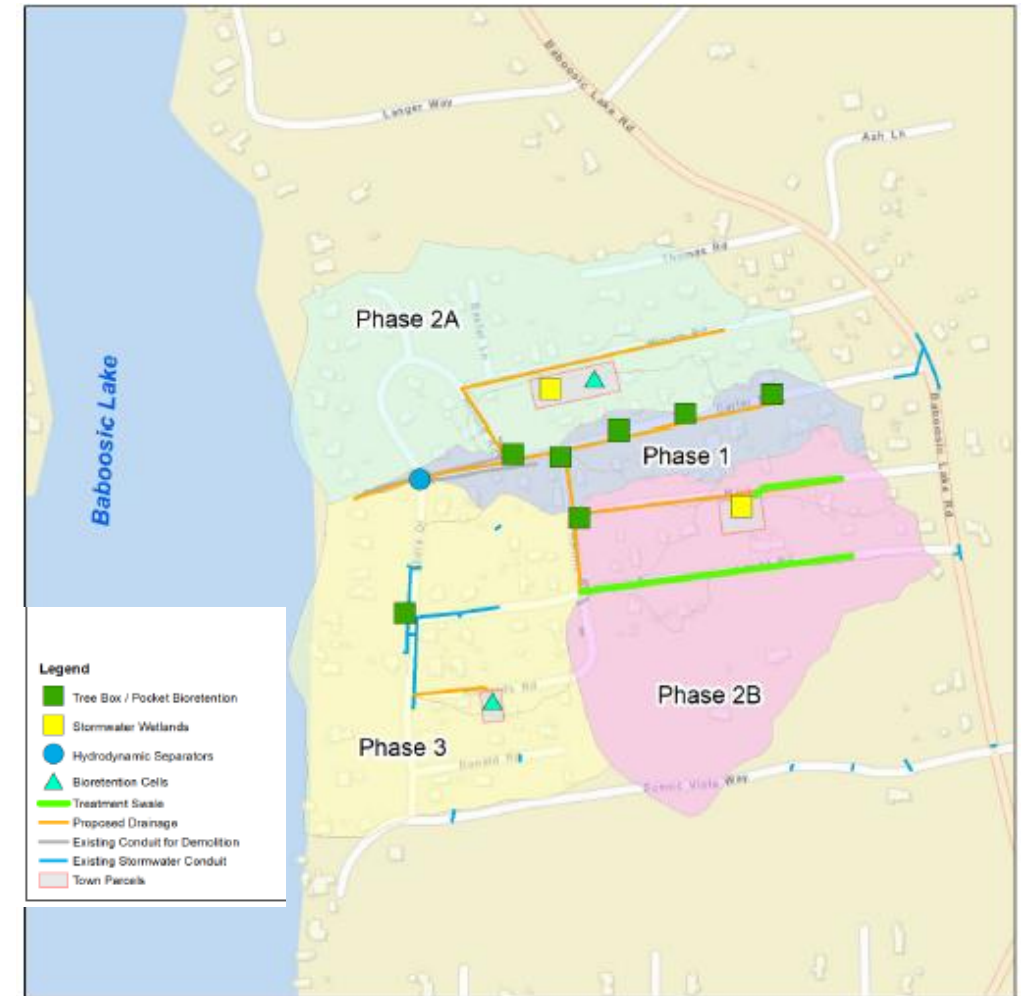
KEY: Excellent Very Good Good Fair Poor NA

 ● ◐ ○ ◑ ● X

Implementation Phasing and Cost

Phase #	Description of Projects
1	Carter Road and Rennie (north) Hydrodynamic separator, tree boxes (4), outfall stabilization
2A	Miriam, Thomas, and Arnold Roads Stormwater park on Miriam Road, Tree Box (1)
2B	Mayhew, Longa (east), and Rennie Road (south) Stormwater wetland on Mayhew Road, Tree Box (1)
3	Longa, Richards, Donald Roads, and Shore Drive (north) Bioretention on Richard Road, Tree Box (1)

Implementation Phase	Estimated Cost*	Annual TSS Loading Reduction, lb/yr	Annual TP Loading Reduction, lb/yr	Annual TN Loading Reduction, lb/yr
Phase 1	\$926,937	1,098	0.5	9.0
Phase 2A	\$560,513	2,234	0.9	4.4
Phase 2B	\$655,331	3,366	2.2	8.0
Phase 3	\$777,769	905	-0.4	4.0
Total	\$2,920,550	7,603	3.2	25.4



Summary

- Design concepts developed using a holistic watershed approach
- Reduce pollutant loading to Baboosic Lake
- Project implementation qualifies for external funding
- Subdivision roadway pavement to improve quality of life for residents
- Public education function on stormwater management
- Maintenance can be incorporated into current DPW O&M programs
- Support Merrimack NH MS4 compliance
- Fulfill NHDES *CWSRF* requirements

Questions?

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