Lake Warren Watershed Management Plan Implementation Phase 1

Final Report Submitted to New Hampshire Department of Environmental Services

Submitted by
Southwest Region Planning Commission

Funding for this project was provided in part by a Watershed Assistance Grant from the NH Department of Environmental Services with Clean Water Act Section 319 funds from the U.S. Environmental Protection Agency

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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Executive Summary

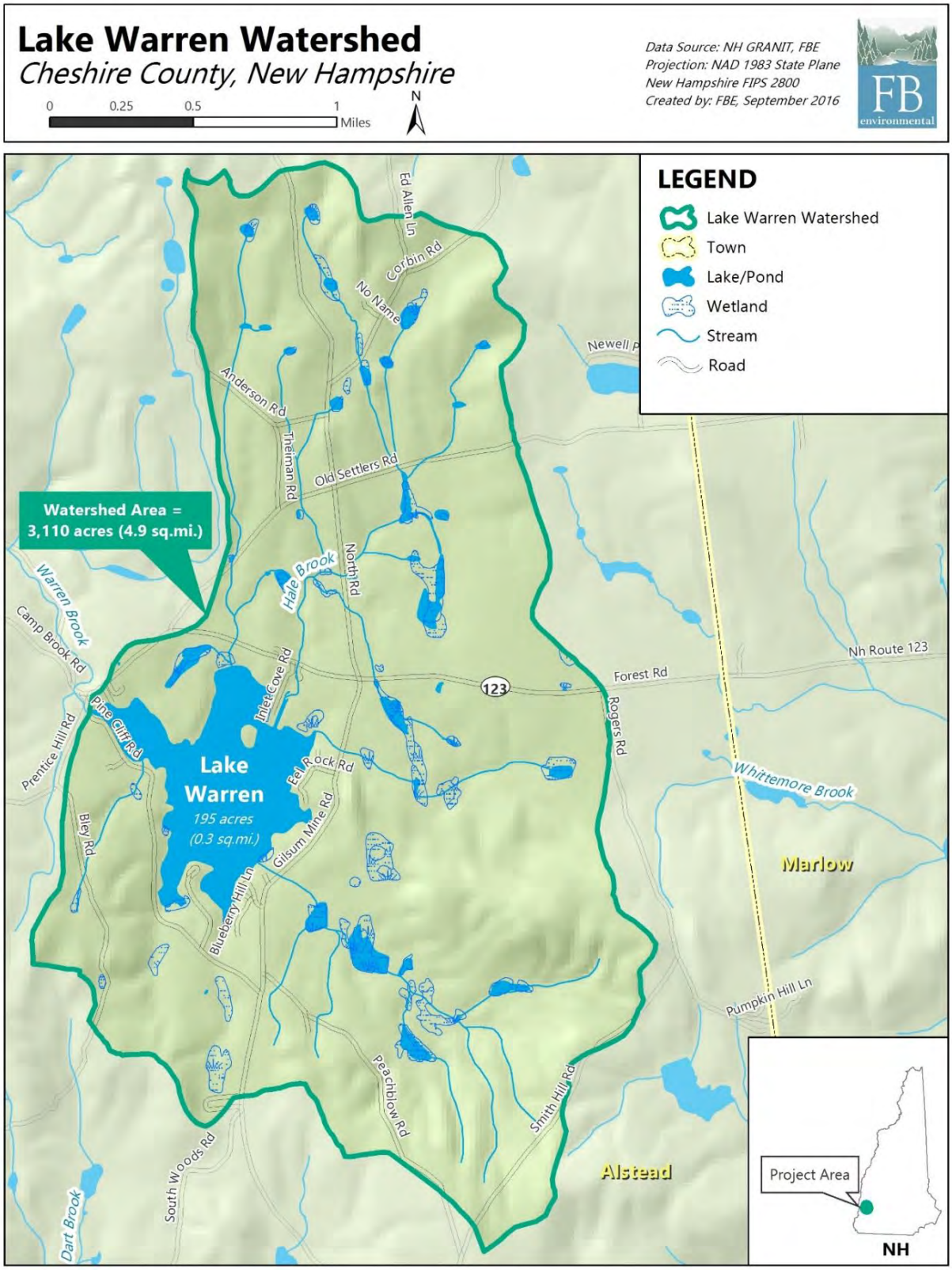
The Lake Warren Watershed Management Plan was developed in 2016 in response to declining water quality in Lake Warren. The lake is currently listed as impaired for Aquatic Life Use (ALU) due to high levels of Chlorophyll-a (Chl-a) and total phosphorus (TP), and low pH (NHDES, 2014b). Excess TP can stimulate algae growth, which typically results in a decrease in Secchi disk transparency (SDT; i.e., a decrease in water clarity) due to the additional algae. The comprehensive watershed plan, developed in collaboration with New Hampshire Department of Environmental Services (NHDES), the Southwest Region Planning Commission (SWRPC), and the Lake Warren Association (LWA) provides a roadmap for preserving the water quality of Lake Warren, and provides a mechanism for procuring funding (i.e., Section 319 grants) to secure action needed to achieve water quality goals.

The Lake Warren Watershed Management Plan set a goal of a 25% reduction (97 lbs P/year) in phosphorus loading to Lake Warren. The goal was designed to meet the mesotrophic Aquatic Life Use standards, but approach the oligotrophic standards. To reduce nutrient loading to the lake, the project funded the conceptual design and implementation of stormwater controls on private and municipal properties in the Lake Warren watershed. The project involved stakeholders and/or cash and in-kind funding sources from, NHDES, the Lake Warren Association, engineers/consultants, municipal officials/staff from Alstead, and landowners. The project was originally planned to include stormwater improvements on Arbor Way, the installation of BMPs at 3-6 Town-owned or residential sites, a conceptual design for improvements to Pine Cliff Road, and an outreach campaign to educate property owners and lake users on methods of protecting the lake and watershed.

Overall, the project resulted in the installation of structural Best Management Practices (BMPs) at eight locations to reduce nitrogen by 2.3 lbs N/year, phosphorus by 0.27 lbs P/year, and sediment by 0.21 tons per year. In addition, a conceptual design for Pine Cliff Road, a primary source of phosphorus to the lake identified in the Watershed Management Plan, was developed and presented to the Board of Selectmen. Additional sites were identified for further BMP installations in future phases.

Some challenges with this project were landowner commitment and communication. Multiple sites originally identified for this project were on shared private driveways and issues with who would be responsible for Operations and Maintenance and providing the up-front costs for the projects made installation at these sites infeasible for this phase. All homeowners on these two roads (Arbor Way and Eel Rock Road) have since been engaged and these projects are worth revisiting in future phases as conceptual designs have been developed.

Image 1: Lake Warren Watershed Map



Introduction

Geographic Location and Profile

Lake Warren is located in the Southwestern portion of New Hampshire in the Town of Alstead, in Cheshire County. The population of Alstead is 1,937 according to the 2010 Census data. The Town has an area of 39.7 square miles of land and .4 square miles of inland waters. The Cold River and Warren Brook flow through the northern part of Alstead and join together east of the village center. The two largest ponds are Lake Warren (also known as Warren Lake) in the east and Caldwell Pond in the south. Lake Warren is accessible from NH 123. It is 185.5 acres and is a relatively shallow lake with a maximum depth of 13.8 feet and a mean depth of 7.2 feet. The entire watershed for Lake Warren lies within the Town of Alstead. It is located within HUC 010801070203.

The project was the third project since 2011 to gather information to develop a plan, implement ways to improve the water quality, and ultimately have the lake removed from the NH DES List of Impaired Lakes. The lake is currently listed as impaired for aquatic life due to high levels of total phosphorus (TP), Chlorophyll-a (Chl-a) and low pH.

Previous studies

A water quality report was developed by the Cold River Local Advisory Committee that identified areas of concern for the health of the lake. Trends observed relative to long-term total phosphorous (TP), chlorophyll and transparency suggest that the overall water quality in the lake is declining at a rate that is much faster than the natural progression of New Hampshire lakes and ponds of its size. This led to the first of three funding rounds through the USEPA Clean Water Act.

In 2011, through a 604b grant, the Comprehensive Lake Inventory and Management Plan was developed. This was recommended as a first step to exploring the causes of contaminants to the lake. In 2013, another grant was pursued to provide funding for the development of a Nutrient Loading Study to identify pollutant load reductions and methods of achieving the levels necessary to improve the classification from Mesotrophic to Oligotrophic and remove it from the "impaired" status. Through that study, it was determined that a 28% reduction in phosphorus loading to Lake Warren was needed to restore water quality.

The 2014 Lake Warren Modeling Report completed under that grant has shown that stormwater runoff and septic systems are the largest contributors of phosphorus to Lake Warren. Through a watershed survey conducted in the summer 2013, Pine Cliff Road and the Town Boat Launch were identified as primary areas of concern. Both locations had obvious signs of erosion directly impacting the lake and were prioritized for remediation under the Lake Warren Action Plan completed in June 2014.

In 2017, through a 319 Implementation grant, the Lake Warren Implementation Phase II project included the development of a watershed-based management plan and two demonstration projects as a first step in reducing non-point sources of stormwater runoff and erosion to Lake Warren.

The two demonstration projects sites were selected by the Lake Warren Steering Committee during the early phase of this project. Both sites have high public visibility, and were areas that needed restoration to reduce the stormwater runoff from entering the lake.

Project Objectives

The goal of the Lake Warren WMP is to improve the water quality of Lake Warren. The project implemented Objective 2 of the Lake Warren WMP by reducing the total phosphorus load to the lake.

Objectives and associated deliverables specific to the project are provided in Table 1, along with an evaluation of how well each objective was achieved. Achieving the objectives for this project helped control NPS pollution from reaching Lake Warren by reducing the total phosphorus load to the lake through the implementation of BMPs (see Project Outcomes & Measurable Results).

Table 1. List of objectives and associated deliverables for the project, as well as an evaluation of how well each objective was achieved.

Objective #	Objective Description	Objective Deliverable	Success Evaluation
Objective 1:	Complete project management and administration for grant execution.	Executed contract between consulting firm and SWRPC; semi-annual progress reports, pollutants-controlled reports (PCR), and a final report submitted to NHDES.	After review of the responses to the RFQ, SWRPC selected Comprehensive Environmental, Inc. (CEI) as the technical consultant to carry out the project. The subcontract agreement was signed on May 20, 2021. SWRPC submitted to NHDES semi-annual progress reports (4), pollutants-controlled reports, and a final report in December 2022.
Objective 2:	Develop a Site-Specific Project Plan (SSPP).	Draft and final SSPP approved by NHDES.	A final approved SSPP was signed by all parties on August 11, 2021.
Objective 3:	Conduct technical site visits and develop conceptual designs for sites selected.	Copies of the approved conceptual BMP designs and material cost estimates sent to NHDES and landowners.	Site visits to five properties were completed on 8/30/21. Technical Assistance Reports detailing the conceptual designs and cost estimates were drafted and finalized by 5/26/22.

Objective #	Objective Description	Objective Deliverable	Success Evaluation
Objective 4:	Meet procedural requirements and secure the legal authority to implement the proposed activities.	Copies of all necessary permits, cost-share agreements, and O&M plans submitted to the Town of Alstead, NHDES, and landowners.	No permits were required for the project sites. CSAs and O&Ms were signed by the participating properties and submitted to NHDES.
Objective 5:	Improve the quality of Lake Warren through implementation of BMPs at project sites.	NPS Site Reports and Pollutants Controlled Reports submitted to NHDES.	Implementation BMPs were completed.
Objective 6:	Develop a design for Pine Cliff Road that will create a larger buffer and walkway between the edge of the road and the shoreline.	Five options for Pine Cliff Road were developed and presented to the Lake Warren Work Group and later to the Alstead Board of Selectmen at a public meeting.	The Alstead Board of Selectmen liked the designs and decided to hold a larger public meeting for input from residents after Town Meeting.
Objective 7:	Hold three outreach/educational public events.	Events were held on 7/7/22, 8/6/22 and 8/11/22.	All three events were well attended with a range of 22 to 38 people in attendance per event.
Objective 8:	Complete required submittals, create Work Group, invoices, and final report.	The Lake Warren Work Group was created; semi-annual reports and invoices submitted.	All project deliverables were completed and submitted to NHDES.

Project Outcomes and Measurable Results

The Lake Warren Watershed Management Plan set a goal of a 25% reduction (97 lbs P/year) in phosphorus loading to Lake Warren. Though this project only reduced 0.27 lbs P/year, the development of multiple options and conceptual designs to address phosphorus from Pine Cliff Road is a major milestone to move this reduction goal forward. The Lake Warren Watershed Management Plan identified Pine Cliff Road as a major contributor to phosphorus (49 lbs P/year). This project also included the engagement of the Alstead Road Agent and Board of Selectmen to begin to determine the right course of action to address this phosphorus source.

The outcome of the project was measured as pollutant load reduction estimates using the Massachusetts Watershed Based Plan tool, following steps described in the SSPP, which included taking before and after measurements of the BMP installation sites. Measurements included the dimensions of the BMP itself

and the treatment drainage area. Percent reduction efficiencies were selected from the literature that matched closely to the installed BMP.

Overall, the project was successful in meeting the anticipated pollutant load reductions given the fewer and smaller projects installed. A portion of the nutrient load from stormwater runoff to Lake Warren was alleviated because of the improvements completed under this project.

Analysis of water quality data as a measure of success would not be appropriate since the BMPs were installed in the Summer of 2022, leaving little opportunity for adequate "after" sampling of the lake's water quality. Additional monitoring years would be needed to determine success through water quality data.

Another achievement was the support from the Alstead Board of Selectmen at their meeting on June 21, 2022 to move forward with a larger public forum to determine the preferred design option for the unpaved portion of Pine Cliff Road. The Selectmen also requested that a traffic study of that area be conducted to determine the traffic volume, speed and vehicle type to help quantify the overall usage of the road. The traffic study was completed by SWRPC and the results have been added to the Appendix of this report. The findings of the study support the Pine Cliff designs to narrow the road and create a safer area for pedestrians.

The outreach and educational component of this project included three very well attended events with presentations from professionals at NHDES. The topics included maintaining a healthy lake, cyanobacteria, and a Soak Up the Rain presentation. A self-assessment survey was made available to the Lake Warren Association to distribute to members during their next annual meeting. It is anticipated that a guest speaker will be invited to present the survey and provide background information to its content.

Conclusions and Recommendations

As mentioned previously, the Lake Warren Watershed Management Plan set a goal of a 25% reduction (97 lbs P/year) in phosphorus loading to Lake Warren. The project ultimately reduced the phosphorus load by 0.27 lbs P/year with the installation of eight structural stormwater BMPs. However, the project also included the development of multiple options and conceptual designs to address phosphorus from Pine Cliff Road. The Lake Warren Watershed Management Plan identified Pine Cliff Road as a major contributor to phosphorus (49 lbs P/year). This project provided an important first step in implementing this action as it included the engagement of the Alstead Road Agent and Board of Selectmen to begin to determine the right course of action to address this phosphorus source.

Image 2: Surveying Pine Cliff Road

Overall, the project was successful in meeting the anticipated pollutant load reductions given the fewer and smaller projects installed. A portion of the nutrient load from stormwater runoff to Lake Warren was alleviated because of the improvements completed under this project.

Image 3: Proximity of Pine Cliff Road to the lake

There were some challenges with this project primarily with landowner commitment and communication. Two sites originally identified for this project were on shared private driveways. Issues with who would be responsible for Operations and Maintenance and providing the up-front costs for the projects made installation at these sites unfeasible for this phase. All homeowners on these two roads (Arbor Way and Eel Rock Road) have since been engaged and these projects are worth revisiting in future phases as conceptual designs have been developed.

Achieving the ultimate desired environmental outcome will require multiple phases of implementation efforts, including both structural and non-structural BMPs. Future phases will include the implementation of the Pine Cliff Road re-design and structural BMPs which will effectively reduce the phosphorus load to the lake. Future phases will also continue to educate watershed residents, implement stormwater improvements (both large-scale and small-scale), and improve water quality protections in municipal ordinances for smarter development in the watershed - all based on specific recommendations made in the Lake Warren Watershed Management Plan.

Appendix

SITE SPECIFIC PROJECT PLAN FOR:

LAKE WARREN WATERSHED MANAGEMENT PLAN IMPLEMENTATION PHASE I: PINE CLIFF, ARBOR WAY, AND PROPERTY OWNER STORMWATER BEST MANAGEMENT PRACTICES

NHDES Project #RI-20-CT-05
Under the:
New Hampshire Department of Environmental Services
New Hampshire Nonpoint Source Management Program QAPP
August 27, 2020
RFA# 20097

&

Field Assessments and Analysis in support of Bantam Lake Watershed Based Plan QAPP
January 17, 2020
RFA# 20027

August 3, 2021

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Approval Signatures:

Project Manager: _____
Signature/Date
Lisa Murphy, Southwest Region Planning Commission

CEI Task Order Manager/Quality Assurance Coordinator: Emily DiFranco 8/13/2021
Signature/Date
Emily DiFranco, Comprehensive Environmental Inc.

NHDES NPS Program Project Manager: Jeffrey Marcoux 08/11/2021
Signature/Date
Jeffrey Marcoux, NHDES

NHDES NPS Program Quality Assurance Coordinator: 08/12/2021
Signature/Date
Stephen Landry, NHDES

NHDES Quality Assurance Manager: Vincent R. Perelli 08/11/2021
Signature/Date
Vincent Perelli, NHDES

For Receipt:
U.S. EPA Nonpoint Source Project Manager: _____
Signature/Date
Erik Beck, U.S. EPA New England

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1 - DISTRIBUTION LIST

Table 1 lists people who will receive copies of the approved Site Specific Project Plan (SSPP) for the *Lake Warren Watershed Management Plan Implementation Phase I: Pine Cliff, Arbor Way, and Property Owner Stormwater Best Management Practices ("the Project") under* the *New Hampshire Nonpoint Source Management Program Quality Assurance Program Plan* dated August 27, 2020.

Table 1. SSPP Distribution List

Name	Project Role	Organization	Phone/E-mail
Lisa Murphy	Project Manager	SWRPC	603-357-0557 lmurphy@swrpc.org
Emily DiFranco	Task Order Manager / QA Coordinator	CEI	603-343-6311 edifranco@ceiengineers.com
Matt Lundsted	Engineering Lead	CEI	800-725-2550 ext. 305 mlundsted@ceiengineers.com
Dave Roman	Pollutant Load Reduction Lead	CEI	401-864-4020 droman@ceiengineers.com
Josephine Hatton	GIS Support	CEI	800-725-2550 jhatton@ceiengineers.com
Jeffrey Marcoux	NPS Program Project Manager	NHDES	603-271-8862 jeffrey.d.marcoux@des.nh.gov
Stephen Landry	NPS Program QA Coordinator	NHDES	603-271-2969 stephen.c.landry@des.nh.gov
Vincent Perelli	QA Manager	NHDES	603-271-8989 vincent.r.perelli@des.nh.gov
Erik Beck	Project Manager	USEPANE	617-918-1606 beck.erik@epa.gov
SWRPC = Southwest Region Planning Commission. CEI = Comprehensive Environmental, Inc., USEPANE = United States Environmental Protection Agency, Region 1, New England. NHDES = New Hampshire Department of Environmental Services.			

2 - PROJECT ORGANIZATION

Figure 1 outlines the organizational structure of project personnel. Table 2 identifies their specific roles and responsibilities. Lisa Murphy, Project Manager, will oversee and communicate project progress to the New Hampshire Department of Environmental Services (NHDES), partners, and stakeholders, with help from Comprehensive Environmental, Inc (CEI). Principal data users include the SWRPC, the Lake Warren Work Group, Comprehensive Environmental, Inc. (CEI), and NHDES, who will use the data to assist in the load reduction calculations for the Project.

Figure 1. Project Organizational Chart

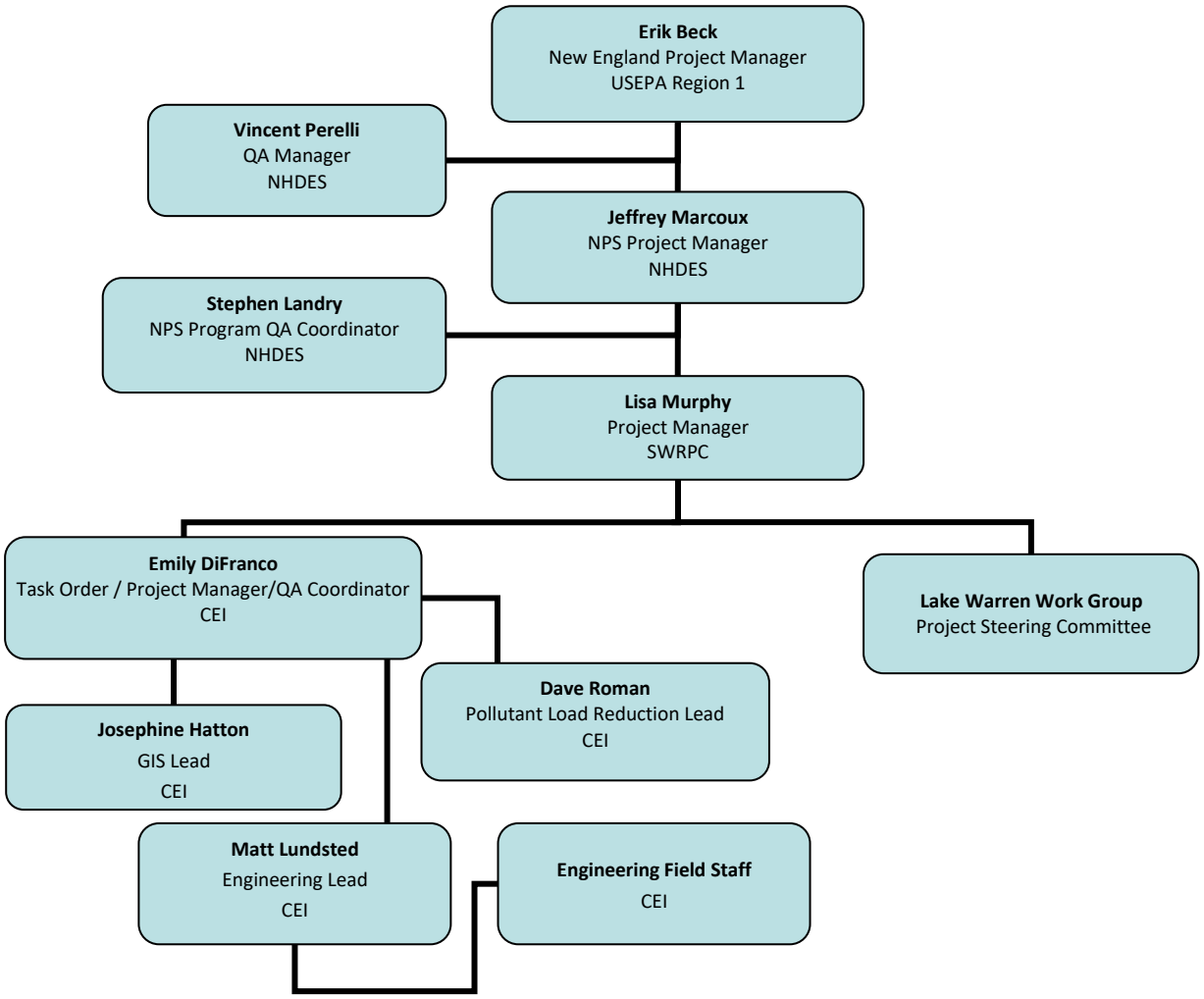


Table 2. Personnel Roles and Responsibilities of Key Project Personnel

SWRPC	Lisa Murphy is the Senior Planner for the Southwest Regional Planning Commission (SWRPC). The SWRPC is the recipient of the Section 319 Watershed Assistance Grant from NHDES to implement the Plan for Lake Warren. Ms. Murphy will review all project deliverables to ensure contract adherence from consultants, approve payment requests, and process all grant requirements. She will also facilitate project coordination between all project partners.
Lake Warren Work Group	The Lake Warren Work Group is the name of the project's Steering Committee. This group represents various stakeholders throughout the watershed who are committed to providing expertise, professional experience, collaborative goal-setting, and decision making during the development of the Plan.
NHDES	Steve Landry (NHDES) is the Nonpoint Source (NPS) Management Program Coordinator and Quality Assurance Program Coordinator for NPS projects. He is responsible for reviewing Site Specific Project Plans (SSPPs) and Quality Assurance Project Plans (QAPPs).
	Jeffrey Marcoux (NHDES) is the Nonpoint Source Management Program Project Manager for this Watershed Assistance Grant project. Mr. Marcoux will assist the SWRPC with contract management requirements relative to Section 319 USEPA Clean Water Act requirements and review project deliverables developed by contractors to ensure technical quality and contract adherence.
	Vincent Perelli (NHDES) is the agency's Quality Assurance Manager, and will be responsible for reviewing and approving this SSPP. Mr. Perelli will consult on any SSPP amendments requested during the contract period but remain independent from the project.
CEI	Emily DiFranco (CEI) is the Task Order/Project Manager/Quality Assurance Coordinator. She is responsible for overall management of the CEI contract team, including overseeing CEI staff and facilitating coordination with SWRPC and project partners. She will also perform monitoring of quality control (QC) activities to determine conformance with quality assurance and quality control requirements within this SSPP.
	Matt Lundsted (CEI) is the Engineering Lead. He will prepare and conduct the conceptual and final designs and associated project deliverables in collaboration with CEI Engineering Field Staff.
	Dave Roman (CEI) is the Pollutant Load Reduction Analysis Lead and will develop analysis input data sets, perform the analysis, and prepare project deliverables. Mr. Roman will implement the QA/QC program related to load reduction analysis tasks.
	Josephine Hatton (CEI) is the GIS lead at CEI and will assist in the development of all watershed-specific maps in coordination with SWRPC.
USEPANE	Erik Beck (USEPANE) is Project Manager for the New Hampshire Nonpoint Source Management Program and he oversees and approves work plans and projects funded through Section 319 and 604(b) of the Clean Water Act.

3 - SITE INFORMATION

Lake Warren, a relatively shallow lake located off of Route 123 in Alstead, New Hampshire is approximately 195 acres in size. The Lake is dammed at the outlet and forms the headwaters of Warren Brook in the northwest corner of the Lake. The Lake Warren watershed is located entirely within the Town of Alstead and encompasses 3,111 acres or 4.9 square miles. The watershed is predominately forested (75%). Agricultural land uses occupy approximately 10.5% of the watershed. Developed land comprises approximately 7% of the watershed and is located primarily along the lake shoreline and transportation corridors.

Lake Warren is currently listed on the 2018 New Hampshire 305(b)/303(d) Assessment Report as impaired for Aquatic Life Integrity due to high levels of Chlorophyll-*a* (Chl-*a*) and total phosphorus (TP), and low pH. Excess TP can stimulate algae growth, which typically results in a decrease in Secchi disk transparency (SDT; *i.e.,* a decrease in water clarity) due to the additional algae. This is evident in Lake Warren, where TP and Chl-*a* have increased since 1980, while Secchi disk transparency has decreased.

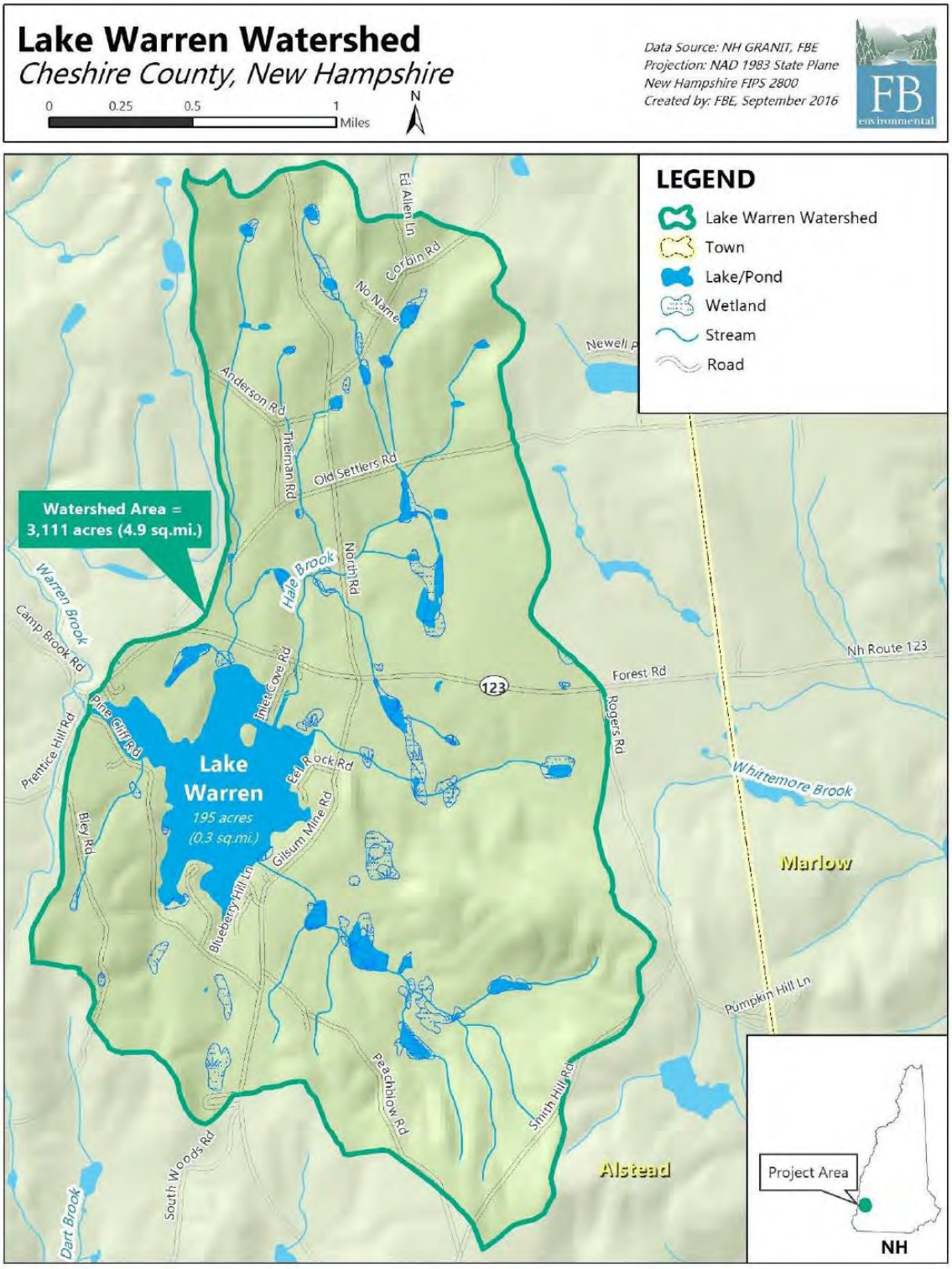
The Lake Warren Watershed Management Plan was completed in December 2016. This Plan determined that the watershed accounted for 77% of the total phosphorus loading to Lake Warren. To reach the target 25% reduction in total phosphorus for Lake Warren, a range of structural and non-structural best management practices (BMPs) were identified throughout the watershed. A field investigation conducted for the development of the Plan identified specific locations throughout the watershed to implement structural BMPs to address the watershed pollutant load to the Lake.

Priority locations include various shoreline properties, Arbor Way, and Pine Cliff Road. Pine Cliff Road is a town-owned road that runs along the western shoreline of Lake Warren near the dammed outlet. Much of this road is unpaved and generates excessive amounts of “road dust” that impacts the adjacent lake.

4 - PROJECT RATIONALE

As noted, Lake Warren is currently listed as impaired for Aquatic Life Integrity due to high levels of Chlorophyll-*a* and total phosphorus, and low pH. As part of the watershed management plan for Lake Warren completed in December 2016, Pine Cliff Road, Arbor Way, and properties along the lake shore were identified as areas with high potential pollutant loads to Lake Warren. In 2021, the SWRPC received a Watershed Assistance Grant to implement the structural BMPs in the specific locations recommended in the Plan.

Figure 2. Lake Warren Watershed, Alstead, New Hampshire
(figure from the Lake Warren Watershed Management Plan, 2016)



5 - PROJECT DESCRIPTION

This project will provide design and permitting for structural BMPs to remedy water quality threats associated with erosion, sedimentation and excessive nutrient loading caused by stormwater and drainage issues at previously identified pollutant sources within the Lake Warren watershed. The project goal is to protect the lake from potential in-fill, sedimentation, turbidity and algal blooms associated with stormwater runoff and nonpoint source pollution generated on Arbor Way, at homeowner sites, and along Pine Cliff Road, an unpaved road adjacent to the lake.

Under this project, the CEI Engineering Lead and field staff will collect primary data along Pine Cliff Road, Arbor Way, and identified homeowner sites to support initial evaluations, to confirm problem areas, and to perform calculations for BMP design. The CEI Project Manager and Engineering Lead will plan, perform and document field work using the Watershed Assessment template (Appendix A). This template is incorporated in this SSPP under the Quality Assurance Project Plan (QAPP) for Field Assessments and Analysis in support of Bantam Lake Watershed Based Plan Appendix – RFA Number 20027, dated January 17, 2020. The QAPP was prepared by Comprehensive Environmental Inc. for EPA Region 1 New England.

CEI will dedicate one day of field assessment conducted by a two-person field team consisting of a New Hampshire-licensed Professional Engineer (P.E.) and supporting staff engineer. For the technical site visit, field measurements such as the approximate BMP drainage area, primary soil type, and confirmation of land uses will be collected to allow for the calculation of pollutant load reduction estimates. BMP sizing, costing, and treated phosphorus and sediment load will be calculated from the BMP Selector Tool from Massachusetts's Department of Environmental Protection's (MassDEP) Watershed Based Plan Tool (WBPT) for applicable BMPs. The parameters output by the WBPT (i.e., potential size, cost, and load reduction) have been previously reviewed and approved by EPA Region 1. Output parameters for BMPs not currently included in the WBPT will be calculated as feasible based on published information and professional judgement. The WBPT is incorporated into this SSPP under the Quality Assurance Project Plan (QAPP) for Field Assessments and Analysis in support of Bantam Lake Watershed Based Plan Appendix – RFA Number 20027, dated January 17, 2020. The QAPP was prepared by Comprehensive Environmental Inc. for EPA Region 1 New England.

Secondary data will include GIS layers from NH GRANIT including topographic contours, soil type, and aerial photographs. These data will be used to create GIS maps of each specific site and to verify drainage areas and soil type. CEI will prepare conceptual (example in Appendix B) and final designs for sites on Arbor Way, homeowner sites, and Pine Cliff Road after the technical site visit described above. Conceptual designs will be submitted to SWRPC, the Lake Warren Work Group, NHDES, and the property owner for review with estimated pollutant load reductions and cost estimates for implementation. Comments received will be incorporated by CEI into the final design.

6 - HISTORICAL DATA INFORMATION

BMP locations have been previously identified in the 2016 Lake Warren Watershed Management Plan. Section 9 provides a more detailed description of secondary data quality objectives and acceptance criteria.

7 - ESTABLISHING WATER QUALITY GOALS

This section is not applicable to this Project as it is only a requirement for projects developing watershed management plans.

8 - LOADING MODELS

The MassDEP WBPT will be used to calculate load reduction estimates for BMP treatment-scale watershed sites. These watershed sites were identified during the watershed planning process as catchment-level areas of the watershed that are shown to contribute substantial amounts of phosphorus to Lake Warren. The WBPT is an established empirical model that estimates nutrient or pollutant export amount from smaller, BMP treatment-scale watershed sites based on drainage area, precipitation patterns, land use, and known concentrations of pollutants. This model is appropriate for the smaller, BMP treatment areas identified during watershed investigations.

Load reduction estimates will be calculated by Dave Roman of CEI and reviewed by Matt Lundsted of CEI for completeness and rationality. Data will be evaluated using the best professional judgment of qualified staff and comparisons to load reduction estimates generated from similar watershed analyses in New Hampshire.

CEI will estimate load reductions and cost estimates for the identified BMPs. Potential sizing, costs, and pollutant load reductions will be calculated for each recommended structural BMP by using the WBPT. Required inputs include BMP type, design storm size, drainage area, and land use. Outputs include anticipated BMP footprint based on a typical cross section; estimated construction cost; and estimated load reduction for Total Suspended Solids (TSS), and Total Phosphorus (TP). Outputs from the WBPT have been previously reviewed and approved by USEPA Region 1.

The WBPT has been configured for a subset of common structural BMPs. Output parameters for BMPs not currently included in the WBPT were calculated by CEI as feasible based on published information and professional judgment. CEI included these work products and supplements to the WBPT in the USEPA-approved *QAPP for Field Assessments and Analysis in support of Bantam Lake Watershed Based Plan Appendix* (2020). Specific methods for this BMP pollutant loading estimate analysis are as follows:

- **Delineate drainage area and determine land use information:** Where applicable, the drainage area to proposed BMP features will be delineated by CEI staff using one-foot contours obtained from existing site surveys, field survey, aerial imagery, and best professional judgment. The land use/cover type within each delineated drainage area will be estimated based on data from the National Land Cover Database (NLCD).
- **Perform sizing:** A general design objective is to size each BMP to treat and potentially infiltrate the water quality volume (WQV) to the maximum extent practicable. The WQV is the minimum amount of stormwater runoff from a rainfall event that should be captured and treated to remove the majority of stormwater pollutants on an average annual basis. The WQV is defined by CEI as the volume of runoff generated by the first one-inch of rainfall. However, each proposed BMP should be designed to get the most treatment that is practical given the size and constraints of each site. Applicable BMPs (*e.g.,* bioretention cells) were sized using the WBPT based on a one-inch design storm.
- **Estimate costs:** The construction costs for each potential structural BMP will be estimated by CEI using output from the WBPT, then adjusted based on best professional judgment relative to overall site size and complexity (*i.e.,* inflated upwards for conservatism). BMPs not supported by the WBPT will be estimated using inflation adjusted unit pricing from past projects in the region. Once construction costs are calculated, engineering and design costs will be calculated at 30-percent of the estimated construction cost. Engineering and design costs represent approximate costs for engineering design and analysis, survey, design drawing preparation, and permitting. The 30-percent estimate may vary on a site-specific basis. An overall capital cost for each

structural BMP will then be estimated by summing estimated construction and engineering costs. A contingency factor of roughly 20-percent will be applied to provide a cost estimate range. Cost estimates will not include engineering services related to building and construction quality assurance.

- **Calculate potential pollutant load reductions:** Pollutant loading estimates associated with applicable structural BMPs will be calculated based on the WBPT. Structural BMPs not supported by the WBPT (*e.g.,* bank stabilization) will be calculated based upon the USEPA Region 5 Spreadsheet Model for Estimating Load Reductions included in the *New Hampshire Department of Environmental Services Nonpoint Source Management Program QAPP-RFA#20097* (2020).

9 - QUALITY OBJECTIVES AND CRITERIA

The WBPT and USEPA Region 5 Spreadsheet Model for Estimating Load Reductions will be used to calculate pollutant load reductions for this project. These models are both included in USEPA-approved QAPPs as described in the sections above. Both methods are spreadsheet-based methods with built-in guidance on model input requirements. Some site-specific information is required to be collected in the field including proposed BMP type, percent impervious cover in the BMP drainage area, and contributing/drainage area by land use type. The approval and endorsement of this model by the USEPA ensures that the right type, quantity, and quality of data are collected for this project.

The QA process for this project consists of using data of acceptable quality, data analysis procedures, pollutant load reduction calculation methodology, administrative procedures, and technical reviews. Project quality objectives and criteria for data will be addressed by: (1) evaluating the quality of the data used, and (2) assessing the results of pollutant load reduction calculations. Dave Roman and Emily DiFranco will perform these tasks.

Measurement Data Acceptance Criteria

Pollutant load reduction calculations for this project will be accomplished using secondary data from qualified sources, including governmental agencies. Data of known and documented quality are essential components of the success of the pollutant load reduction calculations to be conducted under this project because the model will generate data to be used to determine the estimated load reductions that may be acquired with the installation of the BMPs. Table 3 summarizes the acceptance criteria for secondary data that will be used in the setup and calibration of the model.

The organizations generating the secondary data that may be used in this project typically apply their own review and verification procedures to evaluate a dataset's integrity and conformance to QA/QC requirements. The quality of the data will be judged using information in source documents, from websites of origin, or directly from the authors. If the quality of the data can be adequately determined, the data will be used. If it is determined that no quality requirements exist or can be established for a dataset that must be used for this task, a case-by-case basis determination will be made and documented regarding the use of the data. Data of unknown quality will not be used (and the decisions documented) if the use of such data is believed to have a significant or disproportionate impact on the model and project results.

Secondary data will be assembled, reviewed, and formatted in an Excel spreadsheet format ready for calculation of pollutant load reductions by the CEI team. Data that are outside of typical ranges for a given parameter will be flagged for exclusion during model setup, calibration, and validation. Flagged data will only be excluded if they are determined to be erroneous (*e.g.,* pH >14).

Table 3. Data Acceptance Criteria for Secondary Data

Quality Criterion	Description
Reasonableness	Datasets will be reviewed to identify anomalous values that may represent data entry or analytical errors. Such values will not be used without clarification from the agency providing the data.
Completeness	Datasets will be reviewed to determine the extent of gaps in space and time. It is likely that some data gaps will be evident. These gaps and the methods used to fill the gaps will be discussed in project deliverables.
Comparability	Datasets from different sources will be compared by checking the methods used to collect the data and that the units of reporting are standardized.
Representativeness	Datasets will be evaluated to ensure that the reported variable and its spatial and temporal resolution are appropriate for the project. For example, datasets must be able to be reasonably aggregated (or disaggregated) to represent conditions in the model and must be representative of conditions during the simulation periods. The goal is for data and information to reflect present day conditions. Where possible, data from the past 10 years will be used.
Relevance	Data specific to the study site will be used. If needed, regional data and information that most closely represent the study site will be used.
Reliability	Sources of data and information will be considered reliable if they meet at least one of the following acceptance criteria: • The information or data are from a peer-reviewed, government, industry-specified source. • The source is published. • The author is engaged in a relevant field such that competent knowledge is expected (*i.e.,* the author writes for an industry trade association publication versus a general newspaper). • The information was presented in a technical conference where it is subject to review by other industry experts. • The information or data are from a lake association/watershed group, deemed credible by NHDES. • Sources of data that use unknown collection and data review procedures are considered less reliable, and will be used only if necessary to fill data gaps and following discussion with and approval by NHDES.

EPA's *Guidance for Quality Assurance Project Plans for Modeling* (EPA QA/G-5M) discusses the importance of using performance criteria as the basis by which judgments are made on whether the model results are adequate to support the decisions required to address the study objectives. A "weight of evidence" approach that embodies the following principles will be adopted for all model calibration in this project (Donigian 2002):

Given that models are approximations of natural systems; exact duplication of observed data is not a performance criterion. The model calibration process will measure, through comparability goals, the ability of the model to simulate observed data.

No single procedure or statistic is widely accepted as measuring, or capable of establishing, acceptable model performance. Thus, both quantitative (error statistics) and qualitative (graphical) comparisons of observed data and model results will be used to provide sufficient evidence to weight the decision of model acceptance or rejection.

All model and observed data comparisons must recognize, either qualitatively or quantitatively, the inherent errors and uncertainty in both the model and the measurements of the observed data sets.

10 - QUALITY CONTROL

Quality control checks will be performed by CEI Task Manager/QA Coordinator, Emily DiFranco to ensure that information collected for the project is accurately entered in spreadsheets. QA/QC checks will be conducted on all spreadsheets for inconsistencies. If errors are identified, CEI Task Manager/QA Coordinator, Emily DiFranco, will review the input values and correct the error to ensure that no incorrect information is used in any calculation. In addition, CEI Task Manager/QA Coordinator, Emily DiFranco, will review all pollutant load reduction calculations for QA/QC. All QA/QC issues identified will be properly documented, along with the appropriate steps taken to resolve the issues, in the final pollutant load reduction spreadsheet.

11- FINAL PRODUCTS AND REPORTING/SCHEDULE

The Watershed Assistance Grant for this project was approved in May of 2021. Table 4 summarizes the project tasks to be completed by CEI and the anticipated project schedule.

Table 4. Project Tasks and Schedule

Activity	Approximate Initiation Date	Approximate Completion Date	Product
Task 7: Technical site visits to proposed BMP locations and collection of primary data on the size and sources of stormwater issues.	8/1/2021	8/31/2021	Support documents for initial assessments.
Task 8: Selection of BMP locations	9/1/2021	9/30/2021	Technical report for each site
Task 10: Complete final BMP designs for Arbor Way and homeowner sites.	10/1/2021	12/31/2021	Draft and final designs
Task 11: Develop permit applications	1/1/2022	2/29/2022	Assist with permit applications
Task 12: Respond to changes in the permitting process and update design as necessary.	3/1/2022	3/31/2022	Permit application comments
Task 13: Develop cost-share agreements.	4/1/2022	4/30/2022	Cost-share agreements
Task 14: Develop Operations and Maintenance Plans	4/1/2022	4/30/2022	O&M Plans
Task 17: Conceptual design for Pine Cliff Road	10/1/2021	5/31/2022	Conceptual design
Task 18: Attend Alstead BOS Meeting and complete final design for Pine Cliff Road.	6/1/2022	7/31/2022	Attendance at meeting and final design
Task 15: Coordinate implementation of BMPs.	5/1/2022	9/30/2022	Implementation of BMPs
Task 16: Develop NPS site reports and PCRs for each BMP.	10/1/2022	10/31/2022	NPS Site Reports and PCRs
Task 25: Assist SWRPC with final report.	11/1/2022	11/30/2022	Load reduction estimates, photo-documentation, and all other technical information required

APPENDIX A

Watershed Assessment Field Data Form (page 1)

Watershed / Subwatershed Name: _____ Field Crew: _____
Site # _____ Date: _____ Site Ownership (if known): _____
Weather Conditions: _____ Rain in last 48 hours (approx. total) _____
Location (*town, road name, house#, intersection)* _____
GPS Coordinates: _____ Photos Taken? _____

General Site Description: circle one in each category

Land use/activity:

State Road	*Driveway*	*Boat Access*
Municipal Road	*Residential*	*Agriculture*
Private Road	*Commercial*	*Construction Site*
Trail/Path	*Municipal/Public*	*Other:* _____

Description of Problems/Improvement Opportunities: *circle ALL that apply*

Problem Type	**Description (circle)**	**Notes/Description of Problem**	**Approx. Size** (length x width)
Surface Erosion	*Slight* *Moderate* *Severe*		
Road Shoulder Erosion	*Slight* *Moderate* *Severe*		
Soil	*Bare* *Uncovered Pile* *Winter Sand*		
Culvert	*Unstable Inlet/Outlet* *Clogged* *Crushed/Broken* *Undersized*		
Ditch	*Slight Erosion* *Moderate Erosion* *Severe Erosion* *Bank Failure* *Undersized*		
Parking Lot	*Drains Directly to Waterbody* *Evidence of Concentrated Flow*		
Shoreline	*Undercut* *Lack of Shoreline Vegetation* *Erosion* *Unstable Access*		
Agriculture	*Livestock Access to Waterbody* *Tilled Eroding Fields* *Manure Washing Off-Site* *Inadequate Buffer*		
Other (*e.g.,* area to improve stormwater treatment)			

Watershed Assessment Field Data Form (page 2)

Recommended BMP(s): *circle all that apply*

Vegetated Filter Strip
Bioretention
Detention Basin
Retention Basin
Infiltration Basin
Infiltration Trench
Gravel Wetland
Sand Filter
Grassed Swale
Other: _____

Subsurface Structure
Deep Sump Catch Basin
Leaching Catch Basin
Hydrodynamic Separator
Establish Buffer
Enhance Buffer
Add New Surface Material
Bank Armoring
Bank Stabilization

Divert Runoff
Armor Inlet/Outlet (Culvert)
Replace Culvert
Enlarge Culvert
Plunge Pool
Conservation Tillage
Crop Nutrient Management
Livestock Access Limitation
Pet Waste Station

Description of Recommendation(s):

Potential Site Constraints: *circle all that apply*

Limited Space
Utilities
Private Property
Crosses Property Lines
Permitting Issues (e.g., wetlands)
Steep Slope
Difficult Access
May Interfere with Snow Plowing
Other: _____

Sketch of Site / Potential BMP(s):

APPENDIX B

Site 1: Boat Launch

Location: 123 Smith Street **Source Type**: Boat Launch/Parking Lot

Owner: Town of Townington **Priority**: High

Example Conceptual BMP Design (Page 1 of 2)

Site Description

The Boat Launch and parking lot are located on Palmer Road. The parking lot is relatively flat and unpaved and drains as surface runoff down the boat launch into the Lake. The Boat Ramp is cracked and is in poor condition. There are no known underground utilities or site access constraints at this site. Underlying soils are Sandy Loam (Hydrologic Soil Group B) and are expected to provide effective infiltration.

Proposed Improvements

1. Install approximately 60’ by 30’ bioretention cell in existing grassed area to east of boat ramp with curb inlet to capture sediment / debris from up gradient gravel parking lot. Install riprap overflow to discharge to Bantam Lake.
2. Replace paved boat ramp with articulated block ramp (approximately 30’ wide by 30’ long). Install trench drain at the top of boat launch ramp (approximately 46 ‘ wide) and direct flow to east of ramp to bioretention cell.

See **Figures Below** for an overview of proposed improvements, including a typical design detail for a bioretention cell.

Existing Boat Launch Parking Area.

Existing Boat Launch

Estimated Costs: $78,000 - $117,000

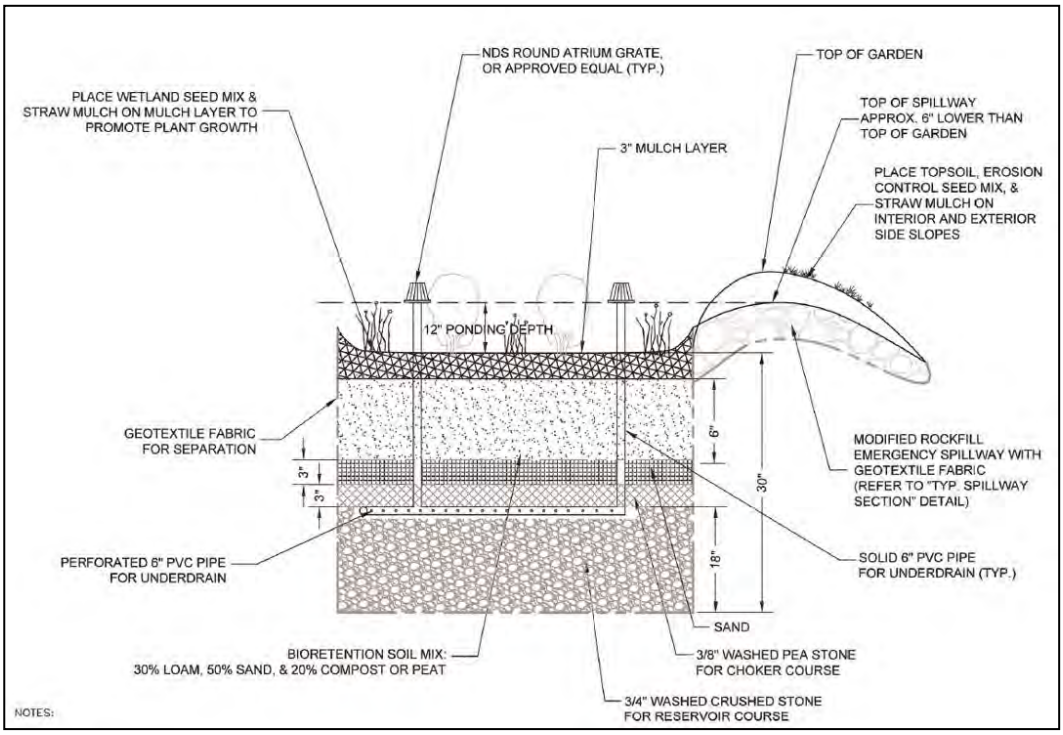
Estimated Nutrient Load Reduction:

- Total Suspended Solids: 0.4 ton/yr
- Total Phosphorus: 2.1 lb/yr
- Total Nitrogen: 12.2 lb/yr

Anticipated Permits: Municipal Inland Wetland Permit, 401 Water Quality Cert.

Example Conceptual BMP Design (Page 2 of 2)

Proposed Parking Lot and Boat Launch Improvements.



Typical Bioretention Cell Cross Section with Underdrain and Overflow

MEMORANDUM

To: Lisa Murphy, Southwest Region Planning Commission

From: Emily DiFranco, Comprehensive Environmental Inc. (CEI)

Re: Lake Warren Technical Site Visit

Date: September 30, 2021

CEI conducted a technical site visit to the Lake Warren watershed on August 30, 2021 to identify locations where structural BMPs and other restoration practices could be implemented to reduce pollutant loads within the watershed. These sites had been identified during the field investigation for the development of the Lake Warren Watershed Management Plan in 2013. Priority sites for the technical site visit were provided to CEI by the SWRPC prior to the site visit.

A summary of the sites visited on August 30, 2021 is provided in Table 1, including:

- Location of the site from the original watershed plan;
- Property ownership;
- A description of the site issue identified in the 2013 plan;
- Observations from the 2021 site visit; and
- Next steps.

The potential structural BMP locations described in the sections below are not intended to be an all-inclusive listing of potential structural retrofit improvements possible within the watershed. Many of the sites visited during the field investigation appeared to have been addressed in the years since the original plan was written. These sites are indicated in the table as requiring Operation and Maintenance only.

As shown in the table, several sites were chosen for conceptual design. These designs are provided in this report. Each conceptual design includes a description of the site, the type of BMP proposed, estimated materials, estimated costs, and estimated labor hours. Some of the sites are beyond the scope of the funding available for this project and should be addressed in an additional phase of the project or through other means.

Sites highlighted in blue in Table 1 are recommended for installation during this phase of the project.

Table 1: Proposed Best Management Projects for the Lake Warren Implementation Project (sites highlighted in blue are recommended for this project)

Location Designation	Ownership	Previously Cited Issue	Observations at Site Visit	Next Steps
1-02: Dirt portion of Pine Cliff Rd	Town	Dust; Soil and roadway sedimentation	Soil and roadway sedimentation	**Full Design**; Later phase of project
1-02: Portion of Lake Warren bank across from 51 Pine Cliff Rd	Town	N/A	Bank eroding around drainage pipes, beginning to undermine road	**Conceptual Design;** Stabilize bank with stacked, vegetated coir logs or similar product
1-03: Communal Gravel Driveway at Arbor Way	Residential	Driveway erosion	Erosion on driveway, pooling at bottom	**Conceptual Design;** install water diverter to direct water to outlet grate
4-02: Hale Brook inlet to Lake warren at the end of Fred Carmen Ln	Residential	Sedimentation from upstream, excessive deposits in inlet reducing water depth	Substantially reduced water level in inlet, attributed to recent storms and land disturbances upstream in Hale Brook	**Conceptual Design;** Seek funding from outside sources for full Design & Build - Monitor for future degradation
HB7-02: Bank of Hale Brook east of N Rd	N/A	Vegetate with tress/shrubs to stabilize bank	Bank has stabilized since previous investigation	**Operation & Maintenance;** problem resolved by unknown; - Monitor for future degradation
3-04: Residence at 110 Gilsum Mine Rd	Residential	Install Runoff Diverter	New stormwater control outlet installed at the end of the culvert from the eastern side of the road, stormwater discharges from spillway in quantities to cause channelizing along property. Flow continues overland through the woods to the Lake	**Conceptual Design;** Implement velocity reduction techniques, water diverters, and larger diameter channel protection
4-06: At the intersection on Hale Brook and Forest Rd	Town	Sedimentation accumulating on edge of road in westbound lane, flushing towards brook. Bank of Brook eroding	Armored manmade drainage channel exists, collects sediment; Brook bank has been reinforced with large stones	**Operation & Maintenance;** work already completed; -Remove Sediment - Monitor for future degradation
4-07, Residential Property: Lake Warren island	Residential	Install vegetated buffer near the high erosion areas	Unfeasible to construct or install by barge or small boat; No access	**Operation & Maintenance;** No viable access at low cost; - Monitor for future degradation

Location Designation	Ownership	Previously Cited Issue	Observations at Site Visit	Next Steps
5-07B: East of 211 Old Settlers Rd	Town	Riprap and reshape ditch; remove grader/plow berms.	Minor sedimentation from roadway, primarily though vegetated strip; minor sediment accumulation	**Operation & Maintenance;** work already completed; - Remove sediment. - Monitor for future degradation
3-06: Eel Rock Rd driveway	Residential	Install vegetated buffer; armor with stone; install turnouts; building foundation threatened (may require engineering)	Install water diverters at intervals along driveway; armor and create entry of stormwater to wetland at location of water diverters	**Conceptual Design;** Direct stormwater off driveway into adjacent wetland at periodic intervals
5-03: Undersized culvert north of 70 N Rd	Town	Enlarge culvert; vegetate road shoulder; riprap ditches; discontinue plowing snow into wetland area	Flooding during a storm this summer caused damage downstream of culvert. Culvert and road shoulder were emergency repaired. Enlarge culvert to handle flow from upstream wetland	**Out of Budget;** Seek funding from outside sources
5-10: Ditch and Culvert on southbound lane of N Rd; intersection of N Rd and Old Settlers Rd	Town	Riprap ditch; remove culvert clog; install check dams	Riprap installed and culvert appears to have been unclogged	**Operation & Maintenance;** work already completed; - Remove Sediment - Monitor for future degradation

CONCEPTUAL DESIGN 1; Site 1-02: Bank Stabilization

Location: Drainage culvert outlets across from 51 Pine Cliff Rd

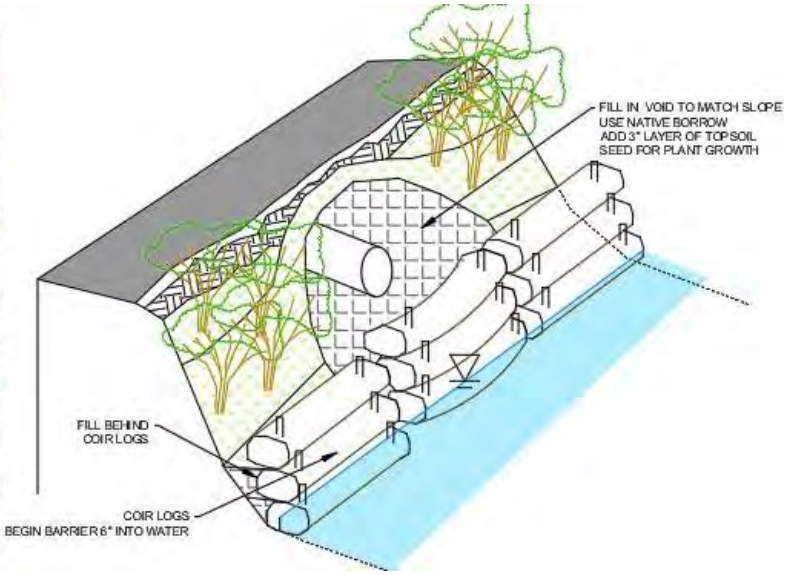
BMP Type: Coir Log Slope Stabilization

Owner: Town of Alstead, NH

Effort Level: High

Site Description

The bank of Lake Warren, across from # 51 Pine Cliff Rd is undergoing erosion and it is beginning to undercut the roadway. The erosion is localized around the outlets of culverts that drain from the opposite side of Pine Cliff Rd. The entire combined stretch of eroded bank is roughly 40 ft wide. Vegetation is currently holding the bank together but will soon be stressed by the eroding soil. Portions of the bank in other areas have already undergone heavy erosion and have been repaired with riprap.



Proposed Improvements

1. Cut woody vegetation in the area of work no more than 3 days prior to the work. Do not pull out or otherwise disturb the roots.
2. Install coir logs along bank up to a foot below the road surface (approx. 6 ft). Fill with Native borrow fill behind each coir log as it is installed. Overlap the previous log by 6" horizontally with each successive log. Cut one log to make an opening for the existing pipe to allow discharge. Stake at each end with Hardwood stake (may have to hammer a pilot hole with metal stake).
3. Once the logs are installed, backfill the remaining void space around each culvert. Grade the new fill to match existing slope of the bank. Seed with native plants or approved wetland seed mix.

Estimated Material Quantities:	28 X 10ft by 12" dia. Coir Logs	1.5 X Cu. Yards of Native Borrow
	3 X Bags of Seed	
Total Estimated Cost:	$4,000 – $4,500	
Estimated Man-Hours	**Labor**	**Equipment**
16 hours (2 days)	2 X Laborers	Shovel, Hammer, Truck/wheelbarrow

CONCEPTUAL DESIGN 2; Site 1-03: Common Driveway Improvements

Location: Arbor Way

BMP Type: Water Diverters

Owner: Residents of the Neighborhood

Effort Level: Medium

Site Description

Arbor Way is a private road that has issues with rapid deterioration of the road surface from erosion. The erosion has not made it directly to the lake, however it pools at the intersection with Pine Cliff Rd and has filled up a catch basin at that spot with sediment. The catch basin drains to the lake via a culvert under Pine Cliff. The private road has been partially resurfaced recently to fix erosion issues.

Proposed Improvements (Two Options)

1. (**Low Cost**) create an upstream plunge pool and riprap around existing catch basin to capture sediment. Open and remove/dispose sediment within catch basin.
1. (**Higher Cost**) Install two water Diverters (Void Trench), one diverting water to the North into the existing lawn channel area already used to attenuate stormwater in this area. The second, diverting water South just after the existing yard drain. Void Trenches shall be 24” deep by 12” wide by 12’ long, and the excavation shall be lined with Filter Fabric. Larger stone (Rip Rap) shall be used for this road because of its physical condition.
2. On the Southern side of the road, manually excavate a 6” deep depression that wraps around the telephone pole to the existing catch basin. Install two stone check dams along its length.
3. Open existing catch basin and remove/dispose of sediment.

Estimated Material Quantities:	**3** X Cu. Yards Rip Rap **1** X Equipment Rental (Optional)	**6** X Sq. Yards Non-Woven Filter Fabric **1** X Stone Delivery (service)
Total Estimated Cost:	$750 – $1,250	

Estimated Man-Hours (w/ Excavator)	**Labor**	**Equipment**
8 hours (1 day)	1 X Laborer/Operator	Shovel, Mini Excavator, Pickaxe
Estimated Man-Hours (w/o Excavator)	**Labor**	**Equipment**
8 hours (1 day)	2 X Laborer	Shovel, Wheelbarrow, Pickaxe

CONCEPTUAL DESIGN 3; Site 4-02: Hale Brook Outlet to Lake Warren

Location: The property at the end of Fred Carmen Lane

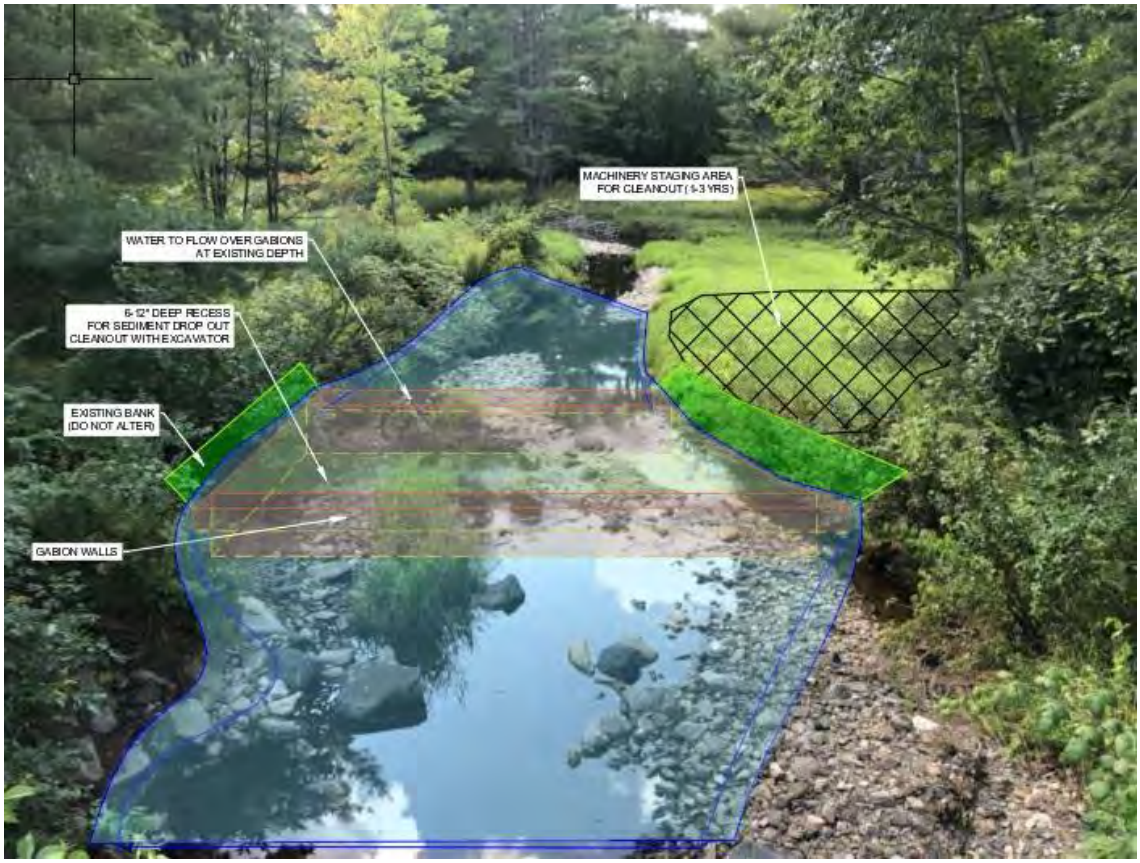
BMP Type: Submerged Gabion Drop Inlet

Owner: Joyce Curll

Effort Level: Very High

Site Description

Hale Brook outlets to Lake Warren after passing under an existing bridge/culvert that gives access to Joyce Curll's Property. Anecdotal testimony from two of the surrounding residents described large amounts of sediment, as well as stones greater than 6", being transported downstream during particularly heavy rain events. The sediment to either side of the water in the picture below was apparently transferred during 2-3 major storms. The subsequent stretch of lake is a man-made channel that has been decreasing in depth of the last decade.



Proposed Improvements

1. Dam and Divert Hale Brook around extents of work (40ft L x 30ft W). Establish erosion controls and Staging area as indicated on the drawing above. Move excavation machinery into place and prepare gabions.
2. Excavate and place gabions from bank to bank (~30ft). Repeat process 40 ft downriver. Excavate 12" below existing river bed between both gabion walls. Remove river soil and truck to a suitable disposal area.
3. Remove dam and diversion of Hale Brook and let the brook resume natural river flow. Repair any damage to bank and remove staging area erosion controls.

Design:	$7,500 - $10,000
Permitting:	$7,500 - $10,000
Brook Damming & Diversion:	$15,000
Materials:	$10,000 - $15,000
Overhead and Labor:	$10,000
Total Estimated Cost:	$50,000 – $60,000

CONCEPTUAL DESIGN 4; Site 3-04: Channelization and Velocity Reduction

Location: 110 Gilsum Mine Rd

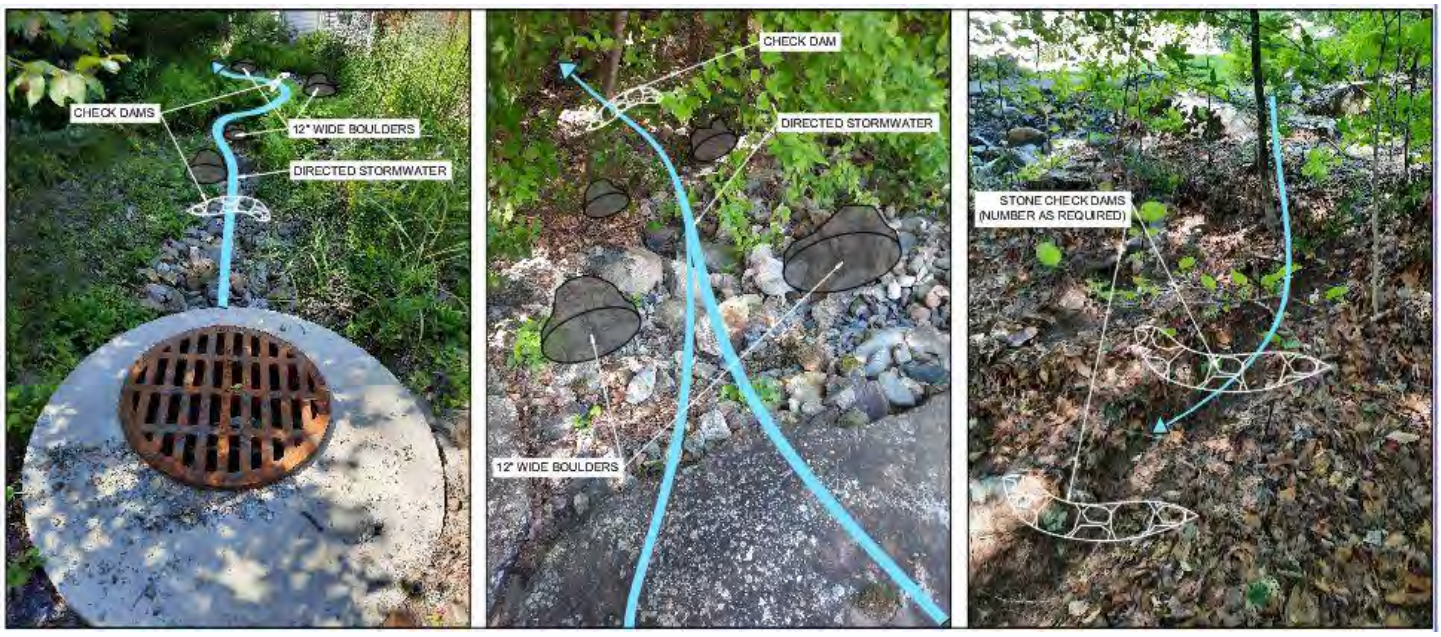
BMP Type: Channel Reinforcement

Owner: Lisa Tusveld

Effort Level: Low

Site Description

The Southern edge of the property has historically received heavy runoff from the road and the wetland on the opposite side of the road. An attempt to attenuate the runoff using an outlet control device installed by others after the assessment project does not reduce runoff from large storms. Excessive channelization at further points down the slope has caused damage to existing stonework in the resident's yard and pushed sediment toward the lake. Future additional channelization will promote erosion of sediment into the lake.



Proposed Improvements

1. Embed 12" boulder into the existing channel after the outlet control device. Leave roughly 2/3 of the boulders exposed.
2. Install check dams of loose stone of roughly 6-inch diameter along the path of the existing channels in the slope after the resident's yard, as shown on the drawing above. Monitor for stone migration from check dams and repair when required after storms.

Estimated Material Quantities:	**10-20** X 12" dia. Boulders	**1** X Cu. Yards of Stone
	1 X Stone Delivery (service)	
Total Estimated Cost:	$500 – $1,000	
Estimated Man-Hours	**Labor**	**Equipment**
12 hours (1.5 days)	1 X Laborer	Shovel, wheelbarrow

CONCEPTUAL DESIGN 5; Site 3-06: Water Diverters

Location: Eel Rock Rd

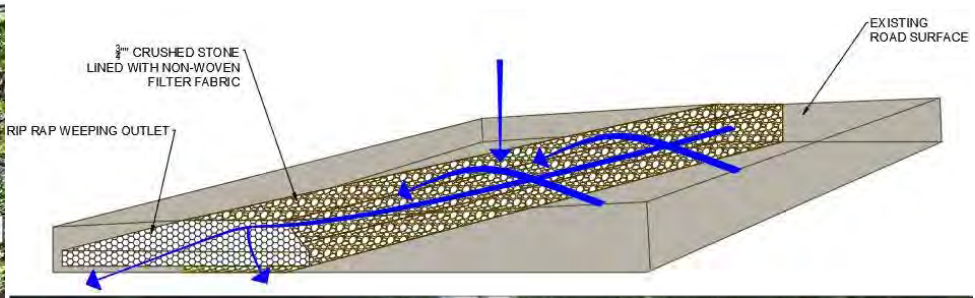
BMP Type: Water Diverters

Owner: Residents of the Neighborhood

Effort Level: Medium

Site Description

Eel Rock Rd is a private road that has a history of stormwater runoff coming from the main road (Gilsum Mind Rd) as well as the stormwater accumulating and running off of the private road itself. Eel Rock Rd has been resurfaced at least two times over it's lifetime which illustrates the existing and potential sediment transfer in the future.



Proposed Improvements

1. Place Water diverters in the form stone trench (Void Trench) which will capture water and direct it perpendicular to the road. The outlet of the void trench will be comprised of rip rap to encourage the water to flow in that direction, eventually outletting to an adjacent wetland.
2. Prior to installation of the 24" deep by 24" wide by 15' long void trench, filter fabric will be installed within the excavation to separate the stone and limit its migration into the surrounding gravel. Periodic maintenance can be done to regenerate the available void space within the stone that may be filled with silt.

Estimated Material Quantities:	**9** X Cu. Yards ¾" Crushed Stone	**1** X Cu. Yards of Rip Rap
40 X Sq. Yards Non-Woven Filter Fabric	**1** X Equipment Rental (Optional)	**1** X Stone Delivery (service)
Total Estimated Cost:	$1500 – $2,000	

Estimated Man-Hours (w/ Excavator)	**Labor**	**Equipment**
12 hours (1.5 days)	1 X Laborer	Shovel, Wheelbarrow, Pickaxe
	1 X operator	Mini-Excavator
Estimated Man-Hours (w/o Excavator)	**Labor**	**Equipment**
16 hours (2 days)	2 X Laborer	Shovel, Wheelbarrow, Pickaxe

CONSTRUCTION GUIDANCE 1; Site 1-02: Bank Stabilization

Location: Drainage culvert outlets on Lake Warren bank 50-56 Pine Cliff Road

Owner: Town of Alstead, NH

Site Preparation and Planning

At the location of the work, take measurements to verify material estimates and adjust quantities noted below as needed. Obtain all the materials specified (if the updated measurements are larger, use those). Notify abutters and residents to alert them of the proposed work. Establish safe working conditions according to the recommendations of the Alstead Highway Department at the site across from #50 Pine Cliff Road. Use hand labor to trim vegetation and clear the immediate area for work. Do not remove the roots.

Construction Instructions and Sequencing

1. Make preparations for all the biologs to be stored on site with easy accessibility. Make additional preparations to receive native borrow backfill via truck capable of either hand spreading or dumping from a wheel barrow. Organize the backfill delivery to coincide with step 4.

2. Begin constructing the biolog wall by placing the first 10ft log section so that one end is aligned directly under the end of the exposed culvert. Orient it so that the log is perpendicular to the flow direction of the culvert. Place the log in the water so that the water level is just about halfway to the top of the log. Stake it in place at four points, approximately every 2-1/2 feet of biolog using hardwood stakes. Repeat this process with an additional biolog with its end also aligned with the center of the exposed culvert butting against the end of the previous placed biolog. Add two additional biologs to the ends of both biologs so that there are 4 biologs perpendicular to the flow of the culvert and the biologs extend at least 20 feet to either side of the culvert. If this length is not adequate to address the entire length of the erosion add additional logs.

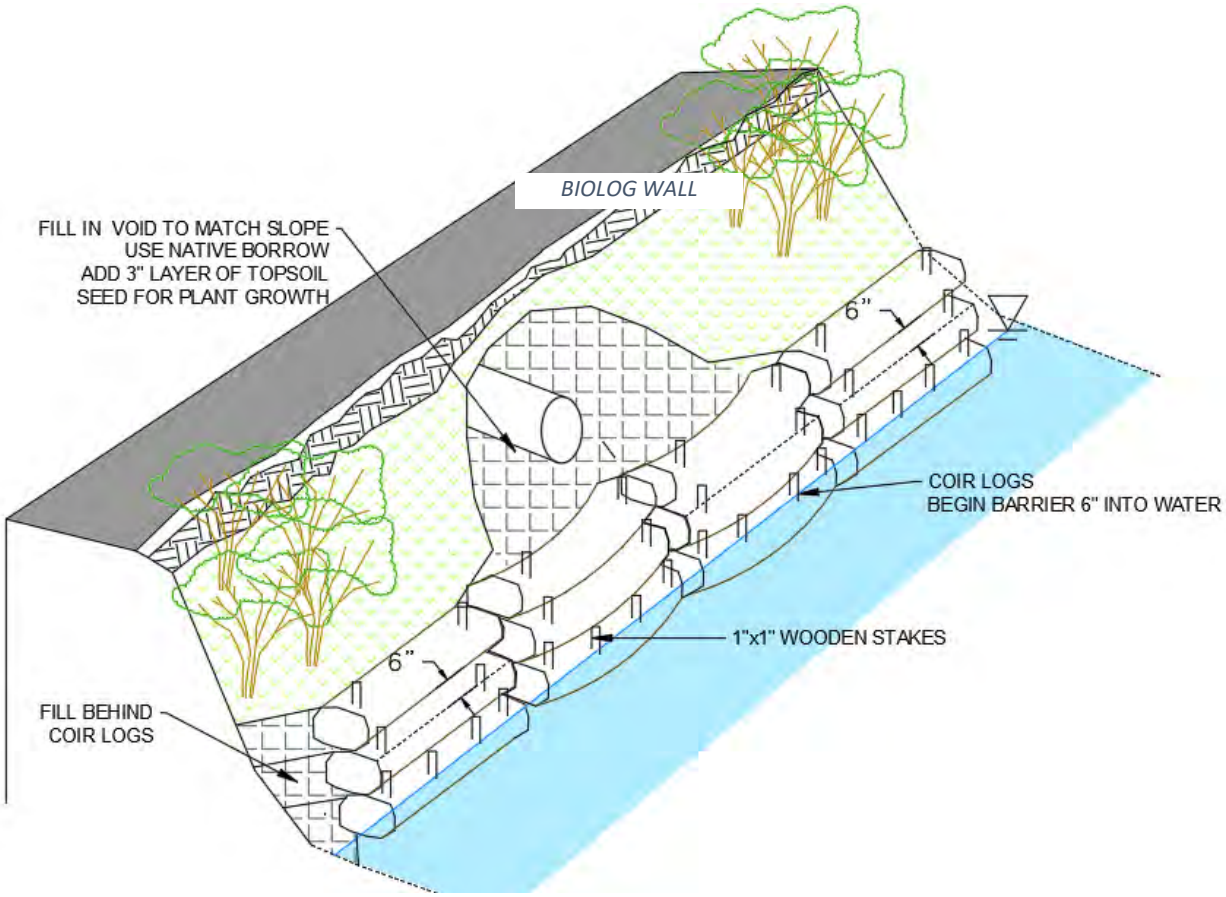
3. Fill the gap between the bottom row biolog and the eroded slope with soil so that it is almost flat with the top of the log. Hand compact only. Stack a second layer of biologs on top of the first. Offset the second layer so that the biolog is parallel to the first, but offset 6-inches into the bank and from the face of the underlying row. Stake this log two times, one stake 2-1/2 ft in from either end. Repeat this process for all three of the bottom row biologs.

4. Repeat step 3 going up the bank until you have reached a height. Take care to not leave the biolog wall unsupported by fill. Organize fill delivery so that as the gaps are filled behind each biolog and the natural slope. More fill may be needed as the biologs reach the height of the undermined portion of the culvert.

5. Once the biowall is complete, seed all areas with the specified seed mix. Revisit the site every two weeks or after every significant rainstorm and reseed as necessary to ensure stabilization. If soil has migrated due to a rain event, repair as needed.

Construction Plans and Materials

Estimated Material Quantities:	**28** X 10ft by 12” dia. Coir Logs	**1.5** X Cu. Yards of Native Borrow
	3 X Bags of Seed	
Estimated Material Cost:	$4,000-$5,000	
Estimated Man-Hours	**Labor**	**Equipment**
16 hours (2 days)	2 X Laborers	Shovel, Hammer, Truck/wheelbarrow



CONCEPTUAL DESIGN 2; Site 1-03: Common Driveway Improvements

Location: Arbor Way **Owner:** Residents of the Neighborhood

Site Preparation and Planning

At the location of the work, take measurements to verify material estimates and adjust quantities noted below as needed. Obtain all the materials specified (if the updated measurements are larger, use those). Notify neighbors/abutters of the proposed work on their driveway and what days and hours it will occur on. Give at least one weeks' notice so that access or alternate parking can be established and maintained. Informally close the road and request that residents park at the end to allow for completion of the work.

Construction Instructions and Sequencing

1. Make preparations for all the material to be stored on site with easy accessibility. Make sure the material is stored so that traffic can access the road after work hours.

2. At the location shown on the plan, place a marker indicating the beginning of the trench. The trench will be approximately 12 feet long and will have a 20 degree slant down slope towards the existing stormwater convenance shown on the diagram on the property of #10 Arbor Way. To accomplish this, place a marker at one side of the road, walk 4 feet down the length of the road, cut perpendicular across the road, and put a marker down.

3. Begin excavation for the void trench. Dig a trench 24" deep and 12" wide going in a straight line from marker to marker across Arbor Way. It will be helpful to have a board or other straight edge to keep your trench roughly even at 24" deep.

4. Unroll the standard non-woven filter fabric to a length of 12 feet and cut. Place the filter fabric in the trench and use a weight or pins to keep the sides from falling in the trench. The trench should be lined on all three sides with the filter fabric.

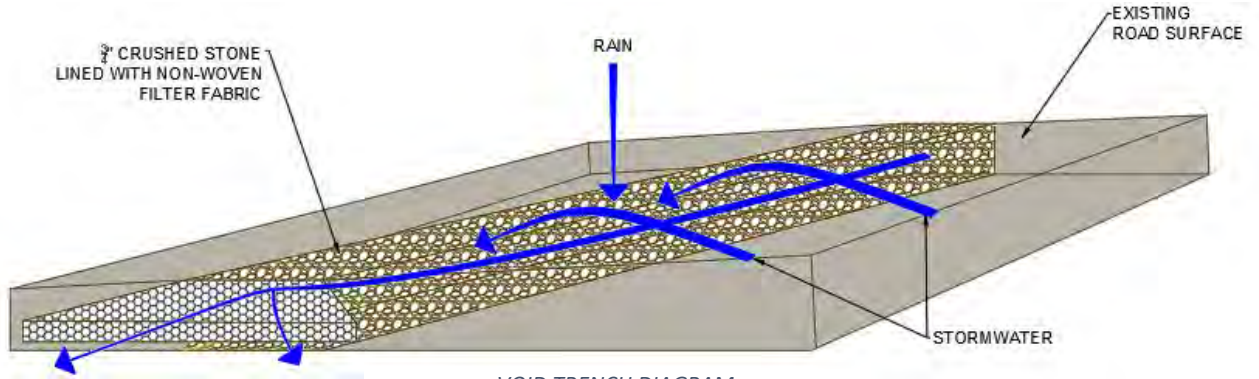
5. Fill the trench with crushed stone until it is approximately 3" from the road surface (roughly 3/4 of the trench). Unpin the fabric and lay it over the stone in the trench. It does not need to overlap. Fill in the remainder of the trench with crushed stone until it meets the existing grade of the road.

6. Repeat steps 3-5 beginning for the second trench beginning at the outlet of the yard drain as indicated on the plan.

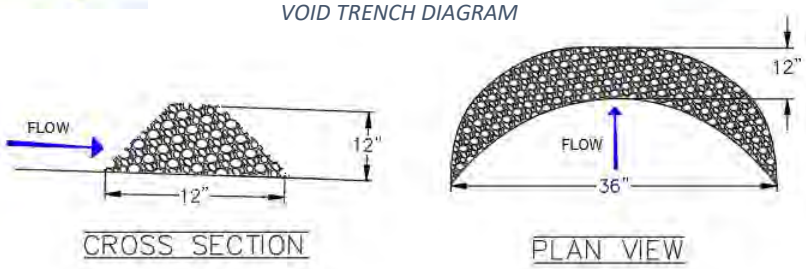
7. Measure 20 feet after the end of the second void trench along the grassy shoulder headed downhill on Arbor ay. Use the stone to create a 12" tall by 36" wide check dam. Repeat 20 feet further downhill until you are within 20 feet of the existing catch basin.

8. In the area immediately around the existing catch basin, excavate down 6" , 2 feet wide around the perimeter on all sides of the catch basin. Fill the depression with stone thoroughly to just below the elevation of the top of the grate (1/2").

Construction Plans and Materials



VOID TRENCH DIAGRAM



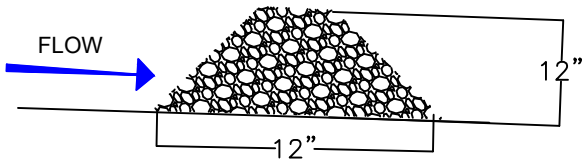
CHECK DAM DIAGRAM

Estimated Material Quantities:	**3** X Cu. Yards 1" dia. Stone	**6** X Sq. Yards Non-Woven Filter Fabric
	1 X Equipment Rental (Optional)	**1** X Stone Delivery (service)
Estimate Material Cost:	$750-$1,250	
Estimated Man-Hours (w/ Excavator)	**Labor**	**Equipment**
8 hours (1 day)	1 X Laborer/Operator	Shovel, Mini Excavator, Pickaxe
Estimated Man-Hours (w/o Excavator)	**Labor**	**Equipment**
8 hours (1 day)	2 X Laborer	Shovel, Wheelbarrow, Pickaxe

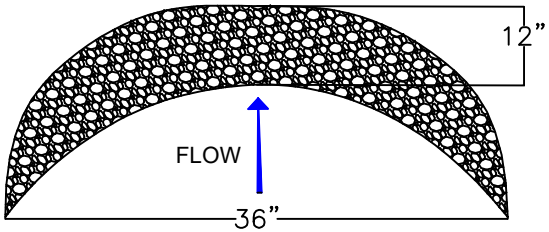

#56 PINE CLIFF ROAD
PINE CLIFF ROAD
VOID TRENCH
STONE
CONNECTNG
TRENCH
#10 ARBOR WAY
EXISTING
TOWN OWNED
CATCH BASIN
6" DEEP GRASSED
SWALE WITH CHECK
DAMS (2)
VOID TRENCH
90'
ARBOR WAY
#5 ARBOR WAY
#9 ARBOR WAY


WATER DIVERTER
(VOID TRENCH)
STONE
CONNECTING
TRENCH


WATER DIVERTERS
(VOID TRENCH)
CREATE 6" GRASSED SWALE
DIRECT TO EXISTING GRATE
AT END OF ARBOR LN
STONE
CONNECTING TRENCH
CHECK DAMS
CLEAR PLANT DEBRIS AND
CLEAN OUT GRATE (DPW)

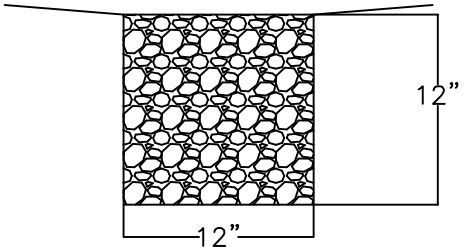


CROSS SECTION



PLAN VIEW

STONE TRENCH DETAIL



CROSS SECTION

CONCEPTUAL DESIGN 4; Site 3-04: Channelization and Velocity Reduction

Location: 110 Gilsum Mine Rd **Owner:** Lisa Tusveld

Site Preparation and Planning

At the location of the work,take measurements to verify material estimates and adjust quantities listed below as needed. Obtain all the materials specified (if the updated measurements are larger, use those). Plan the work for a day where the weather will be free of precipitation for at least 3 days after the completion of the work to avoid washout.

Construction Instructions and Sequencing

1. Make preparations for all the material to be stored on site with easy accessibility.

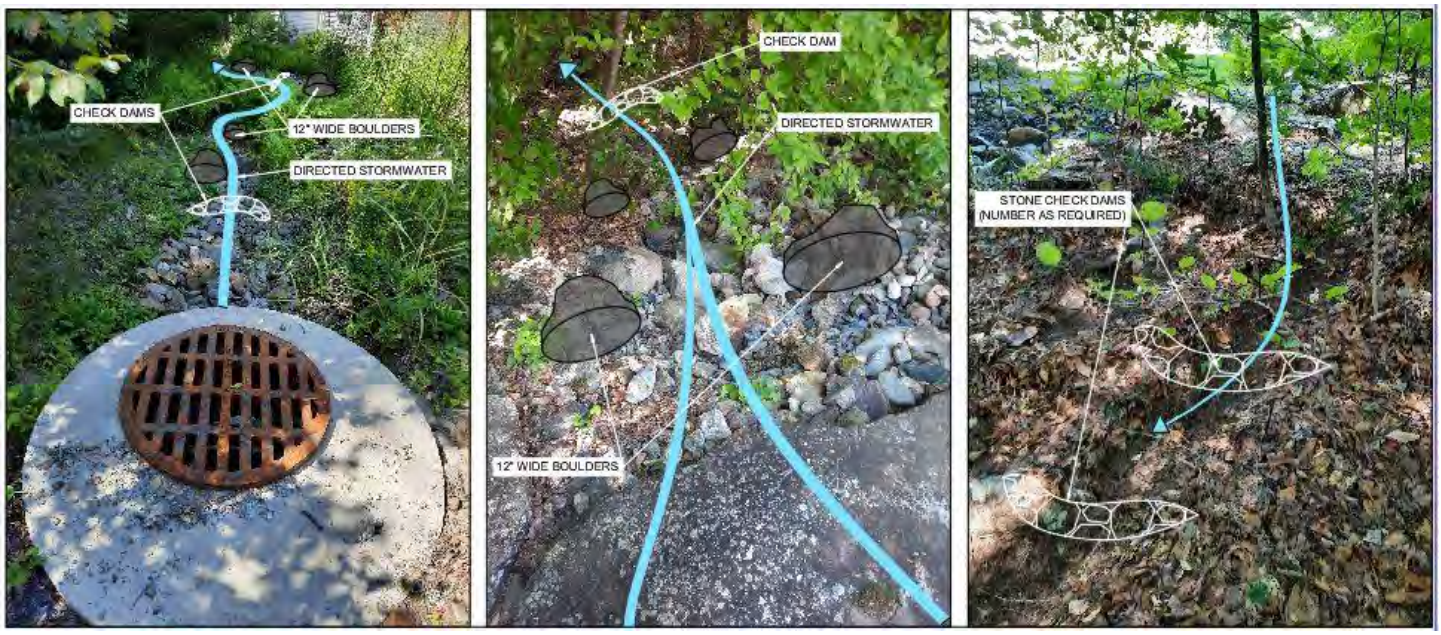
2. Begin by measuring a distance 15 feet from the existing municipal outlet. Measure parallel to the meandering stream as shown in the plan below. Use the 6” diameter stone to create a 12” tall by 36” wide check dam. Make sure the top of the check dam is even and level across the top to avoid “short circuiting” and concentration of flow at one point.

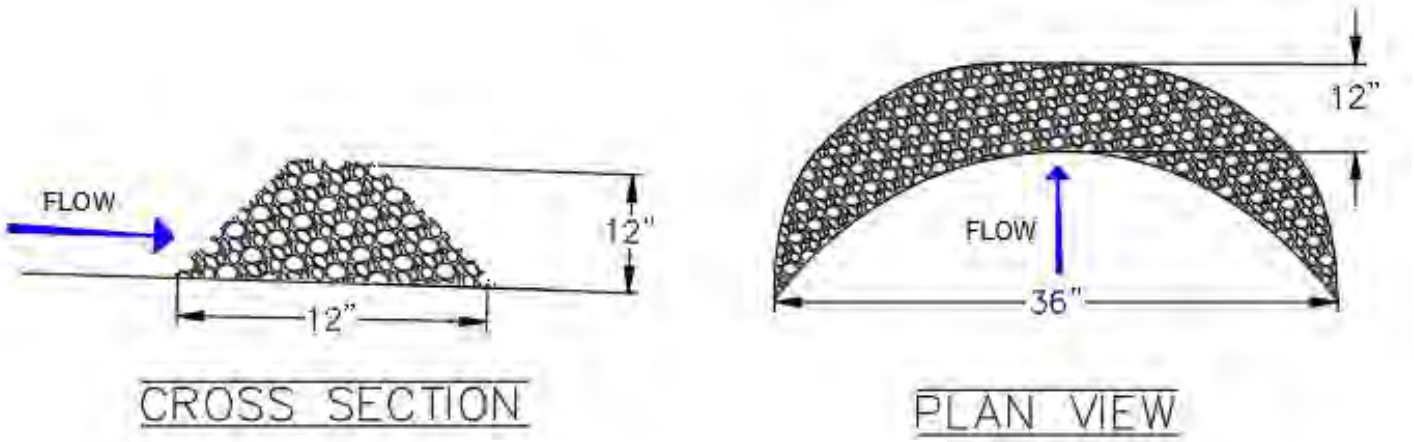
3. Repeat step 2, 15 feet downstream from the previous check dam. Make sure to follow the existing stormwater path. Establish the check dam and repeat the process until you have established two check dams past the edge of the forest.

4. At the existing municipal outlet along Gilsum Road install larger diameter stone. Between each set of check dams, dig one or two small depressions into the ground (approximately 3”). Arrange in a way that splits the stormwater flow. Place one or two 12” stone directly into the depressions and fill in soil so there are no gaps. Hand compact soil as much as possible.

5. Repeat step 6 until either all of the 12” stones are used up, or there are no more spaces between check dams.

Construction Plans and Materials





CHECK DAM DIAGRAM

Estimated Material Quantities:	**10-20** X 12" dia. Boulders	**1** X Cu. Yards of 6" dia. Stone
	1 X Stone Delivery (service)	
Estimated Material Cost:	$500 - $1,000	
Estimated Man-Hours	**Labor**	**Equipment**
12 hours (1.5 days)	1 X Laborer	Shovel, wheelbarrow

CONCEPTUAL DESIGN 5; Site 3-06: Water Diverters

Location: Eel Rock Rd **Owner:** Residents of the Neighborhood

Site Preparation and Planning

At the location of the work, take measurements to verify material estimates and adjust quantities noted below as needed. Obtain all the materials specified (if the updated measurements are larger, use those). Make the neighbors/abutters aware of the work on their driveway and what days and hours it will occur on. Give at least one weeks' notice so access or alternate parking can be established and maintained. Informally close the road and request that residents park at the end to allow for completion of the work.

Proposed Improvements

1. Make preparations for all the material to be stored on site with easy accessibility. Make sure the material is stored so that traffic can still access the road after work hours.

2. Measure 75 feet from the entrance to Eel Rock Road towards the lake. At the end of the 75 feet, place a marker indicating the beginning of the trench, The trench will be 15 feet long and will have a 20-degree slant down slope towards the existing stormwater convenance shown on the plan as the blue line. To accomplish this, place a marker at one side of the road, walk 4-3/4 feet down the length of the road, cut perpendicular across the road, and put a marker down.

3. Begin excavation for the void trench. Dig a trench 24" deep and 24" wide going in a straight line from marker to marker across arbor way. It will be helpful to have a board or straight edge to keep your trench roughly even at 24" deep.

4. Unroll the standard non-woven filter fabric to a length of 15 feet and cut. Do this twice. Place one length of filter fabric on one half of the trench lengthwise, and use a weight or pins to keep the side from falling in the trench. Do this again for the other half of the trench. The trench should be lined on all three sides with the filter fabric.

5. Fill the trench with crushed stone until it is approximately 3" from the road surface (roughly 3/4 of the trench). Unpin the fabric and lay it over the stone in the trench. It does not need to overlap. Fill in the remainder of the trench with stone until it meets the grade of the road.

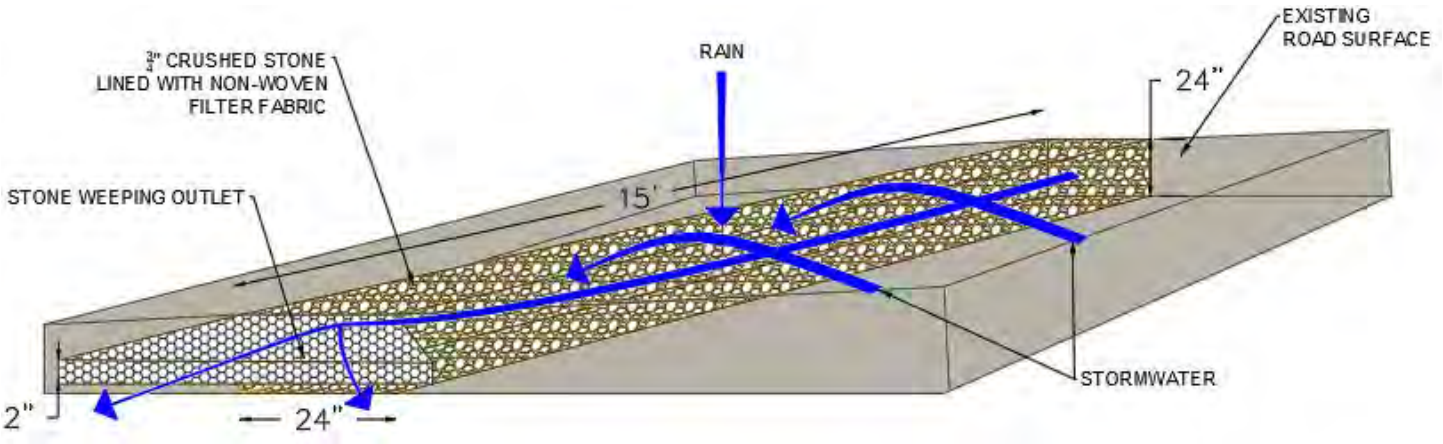
6. Repeat steps 3-5 beginning for the remainder of the trenches (4 in total). Each trench will be separated from each other by 75 feet measured down the center line of Eel Rock Road.

7. Return to the first trench and measure a distance 2-ft towards the channel from the end of the void trench. Excavate a 2-in deep trapezoid between the end of the void trench and the channel, using your 2-ft measurement as the base of the trapezoid. See diagram below for further explanation. Fill in the 2-in depression with placed rip rap. It is OK if the stones protrude higher than the existing ground immediately around them, this will help slow down the flow.

8. Repeat step seven until all void trenches have stone weeping outlets.

Construction Plans and Materials

EEL ROCK ROAD VOID TRENCH PLACEMENT



Estimated Material Quantities:

9 X Cu. Yards ¾" Crushed Stone

1 X Cu. Yards of Rip Rap

40 X Sq. Yards Non-Woven Filter Fabric

1 X Equipment Rental (Optional)

1 X Stone Delivery (service)

Estimated Material Cost: **$1,500-$2,000**

Estimated Man-Hours (w/ Excavator)	**Labor**	**Equipment**
12 hours (1.5 days)	1 X Laborer	Shovel, Wheelbarrow, Pickaxe
	1 X operator	Mini-Excavator
Estimated Man-Hours (w/o Excavator)	**Labor**	**Equipment**
16 hours (2 days)	2 X Laborer	Shovel, Wheelbarrow, Pickaxe

OPERATION & MAINTENANCE PLAN AGREEMENT

The type and location of stormwater control(s) (hereafter, management practice) are described in the design and specifications provided as a separate document accompanying this Agreement.

Management practices implemented under this Agreement and with funds awarded under the NH 319 Watershed Assistance Grants Program shall be properly operated and maintained for the intended purposes during the life span of the project (10 years) or for as long as the homeowner owns the property.

Please note that the management practice is likely to continue providing water quality benefits for a longer period than the agreed upon project life span. NHDES and CEI/SWRPC recommend that the management practice be operated and maintained for as long as it is needed to protect water quality.

Operation includes the administration, management, and performance of non-maintenance actions needed to keep the complete practice safe and functioning as intended. Maintenance includes work to prevent deterioration of the practice, repair of any damage, or replacement of the practice to its original condition if one or more components fail. The maintenance requirements for this project are:

Check Dam:

A check dam is a small, constructed dam, across a swale or drainage ditch deigned to slow the flow of stormwater and limit erosion and sediment transportation.

1. Annual inspections should be completed after installation to ensure the proper operation of the void trench. An inspection should be conducted after every heavy rain event within the first year of installation.
2. Any trash, sediment accumulation or debris accumulation (i.e. leaves and sticks) within or near the check dam should be removed in order to prevent clogging of the system.
3. At any point during an inspection, stone from the check dam is observed to be displaced, the displaced stone should be reset into the check dam.

I understand and consent to the terms of this Agreement.

Lisa Tusveld 7-21-22

Property Owner LISA TUSVELD Date

F. Endorsements

The undersigned hereby agree to the terms of this Project Work Agreement.

Lisa Tusveld
110 Gilsum Mine Road

Lisa Tusveld
(Signature)

LISA TUSVELD
(Print)

Date: July 21, 2022

Comprehensive Environmental Inc.

_____
(Signature)

_____
(Print)

Date: _____, 2022

OPERATION & MAINTENANCE PLAN AGREEMENT

The type and location of stormwater control(s) (hereafter, management practice) are shown on the plan provided as a separate document accompanying this Agreement.

Management practices implemented under this Agreement and with funds awarded under the NH 319 Watershed Assistance Grants Program shall be properly operated and maintained for the intended purposes during the life span of the project. The agreed upon life span for this project is 10 years. Please note that the management practice is likely to continue providing water quality benefits for a longer period than the agreed upon project life span. NHDES and CEI/SWRPC recommend that the management practice be operated and maintained for as long as it is needed to protect water quality.

Operation includes the administration, management, and performance of non-maintenance actions needed to keep the complete practice safe and functioning as intended. Maintenance includes work to prevent deterioration of the practice, repair of any damage, or replacement of the practice to its original condition if one or more components fail. The maintenance requirements for this project are:

Catch Basin Stone Lined Sediment Traps:

1. During rainy months (March-December), monthly visual inspections should be completed after installation to ensure the proper operation of the sediment traps. In addition, an inspection should be conducted after every heavy rain event.
2. Accumulated sediment should be removed once it reaches the rim elevation of the catch basin grate ("effective overflow").
3. If excessive puddling occurs during small storms (under ¼") within the sediment traps then remove and replace crushed stone bed of the sediment traps.

If the agreed upon maintenance requirements cannot be met or if the failure of a component is noted, please contact: Lisa Murphy, SWRPC

I understand and consent to the terms of this Agreement.

_____ _____

Property Owner Date

_____ _____

Organization Representative Date

NPS Projects - Pollutants Controlled Report

New Hampshire Department of Environmental Services, Watershed Assistance Section

NHDES Project Number: _____ Date of Report: 11/23/2022

Project Title: Lake Warren Watershed Management Plan Implementation Phase 1: Pine Cliff, Arbor Way and Property Owner Stormwater Best Management Practices

Grantee: Southwest Regional Planning Commission

Table 1. Pollutant Load Reduction Estimates for NPS Sites Treated with BMPs

Waterbody Name	Nitrogen pounds per year	Phosphorus pounds per year	Sediment tons per year
Lake Warren	2.3	.27	.21
Totals	2.3	.27	.21

Table 2. Wetlands, Streambanks, Shoreline Protected / Restored During This Project

Resource	Planned acres	Actual acres	Planned linear feet	Actual linear feet
Wetlands restored	0	0	not applicable	not applicable
Wetlands created	0	0	not applicable	not applicable
Streambank /shoreline protected	not applicable	not applicable	90	850
Stream channel stabilized	not applicable	not applicable	0	0

The estimations in this report were determined using the appropriate estimation model(s) and applied according to the procedures prescribed for the model. To the best of my knowledge these are reasonable estimates using appropriate methods. Documentation is kept on file by the grantee and is available for review by NHDES and USEPA.

Submitted by (for Grantee): Matthew Lundsted, PE 11/23/22 date: Signature

Printed Name

Reviewed by (for NHDES): _____ _____ date:

Signature Printed Name

(603) 271-2457 watershed@des.nh.gov
PO Box 95, Concord, NH 03302-0095
www.des.nh.gov

NPS Projects - Pollutants Controlled Report

New Hampshire Department of Environmental Services, Watershed Assistance Section

NHDES Project Number: _____ Date of Report: 11/23/2022

Table 3. List of BMP Sites and Methods Used

Site ID (Name or # from site list)	Site Location Description	Latitude and Longitude (decimal degrees)	Brief BMP Description	Estimation Method / Sub-Method Used	Implementation Date	Pounds of Nitrogen Per Year	Pounds of Phosphorus Per Year	Tons of Sediment Per Year
EXAMPLE> Site 5	Near #29 Hazen Drive, Concord	43.217947 -71.514385	Stabilize 500 feet of road drainage ditch	Region 5 / CEE	April 30, 2018	1.7	10.4	2.1
Site 1	Arbor Way and Pine Cliff Road, Alstead, NH	43.11972, -72.29487	Install 6 Stone Lined Sediment Traps w/ Existing Catch Basin Overflow	MassDEP WBPT	10/17/2022	2.3	0.27	0.16
Site 3A	Gilsum Mine Road, Alstead, NH	43.11678, -72.28135	Deep Sump CB	MassDEP WBPT	9/26/2022			.03
Site 3B	Gilsum Mine Road, Alstead, NH	43.11687, -72.28205	Slope and Channel Stabilization	USLE	9/26/2022			.02
					Totals:	2.3	.27	0.21

(603) 271-2457 watershed@des.nh.gov
PO Box 95, Concord, NH 03302-0095
www.des.nh.gov

Table C-2: Proposed Management Measures, Estimated Pollutant Load Reductions and Costs

Structural BMPs

BMP TYPE	INFILTRATION TRENCH
BMP SIZE (storm depth; inches)	1.00
DRAINAGE AREA (acres)	0.23
BMP LOCATION	CB1toCB6
LAND USE, COVER TYPE (in drainage area)	**% OF DRAINAGE AREA**
AGRICULTURE, Pervious	5
HIGHWAY, Impervious	95
ESTIMATED POLLUTANT LOAD REDUCTIONS	
TN (lbs/yr)	2.28346
TP (lbs/yr)	0.27374
TSS (lbs/yr)	323.74648
ESTIMATED FOOTPRINT (sf)	317.6
ESTIMATED COST ($)	3,513

BMP TYPE	DEEP SUMP CATCH BASIN
BMP SIZE (storm depth; inches)	
DRAINAGE AREA (acres)	0.18
BMP LOCATION	Gilsum Mine 1
LAND USE, COVER TYPE (in drainage area)	**% OF DRAINAGE AREA**
HIGHWAY, Impervious	100
ESTIMATED POLLUTANT LOAD REDUCTIONS	
TN (lbs/yr)	0.00000
TP (lbs/yr)	0.00000
TSS (lbs/yr)	66.60575
ESTIMATED FOOTPRINT (sf)	
ESTIMATED COST ($)	900

Additional BMPs

BMP TYPE	Lake Slope Stabilization
BMP LOCATION	Gilsum Mine 2
DESCRIPTION	Stabilize steep slopes and flow path with stone surface and stone check dams.
ESTIMATED POLLUTANT LOAD REDUCTIONS	42.43 TSS in LBS/YR
ESTIMATED COST ($)	1,327

Town of Alstead, NH
Lake Warren Watershed Management Plan Implementation Phase 1
Site 1- Pine Cliff Road and Arbor Way
Location Plan
Stone Lined Sediment Traps
(@Existing Catch Basins which act as overflows)
(Not to Scale)

CONCEPTUAL DESIGN 4; Site 3-04: Channelization and Velocity Reduction

Location: 110 Gilsum Mine Rd **Owner:** Lisa Tusveld

Site Preparation and Planning

At the location of the work,take measurements to verify material estimates and adjust quantities listed below as needed. Obtain all the materials specified (if the updated measurements are larger, use those). Plan the work for a day where the weather will be free of precipitation for at least 3 days after the completion of the work to avoid washout.

Construction Instructions and Sequencing

1. Make preparations for all the material to be stored on site with easy accessibility.

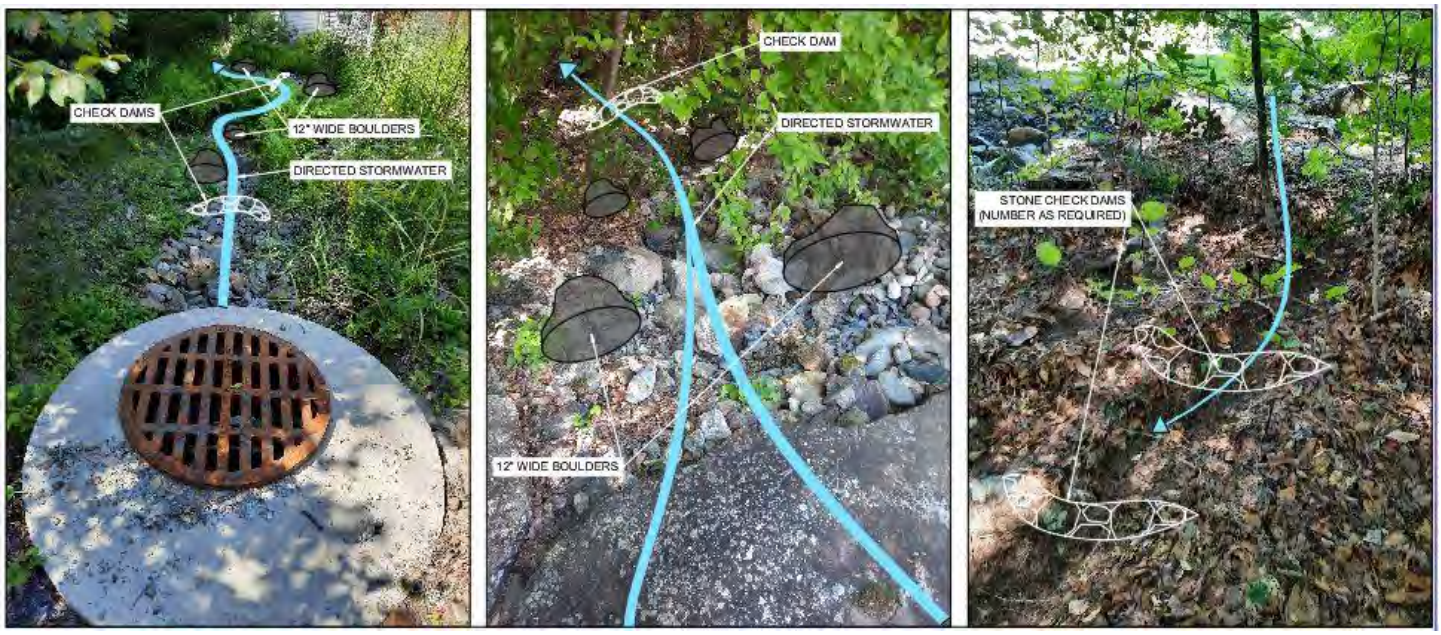
2. Begin by measuring a distance 15 feet from the existing municipal outlet. Measure parallel to the meandering stream as shown in the plan below. Use the 6” diameter stone to create a 12” tall by 36” wide check dam. Make sure the top of the check dam is even and level across the top to avoid “short circuiting” and concentration of flow at one point.

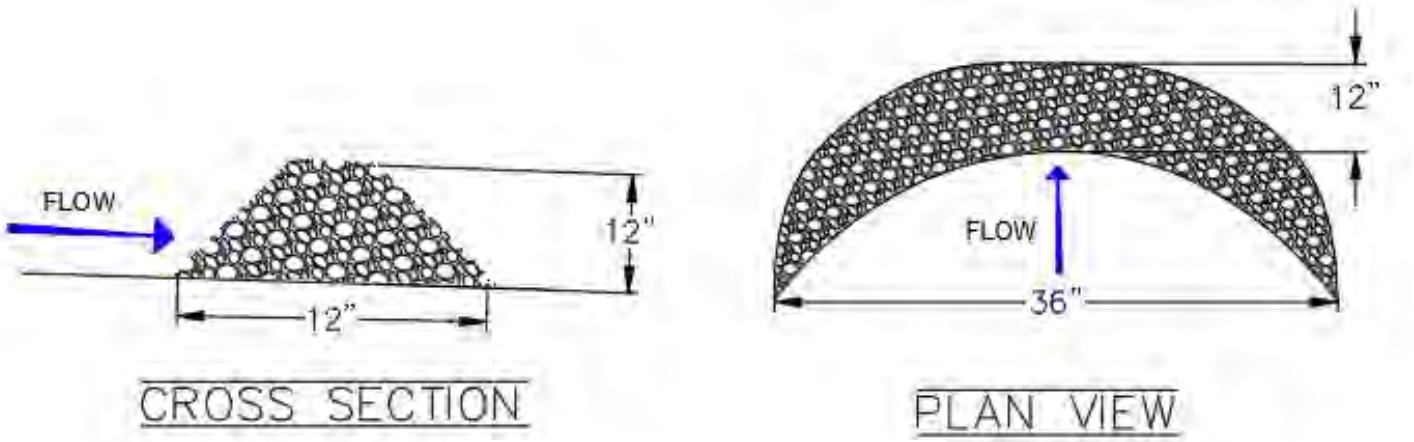
3. Repeat step 2, 15 feet downstream from the previous check dam. Make sure to follow the existing stormwater path. Establish the check dam and repeat the process until you have established two check dams past the edge of the forest.

4. At the existing municipal outlet along Gilsum Road install larger diameter stone. Between each set of check dams, dig one or two small depressions into the ground (approximately 3”). Arrange in a way that splits the stormwater flow. Place one or two 12” stone directly into the depressions and fill in soil so there are no gaps. Hand compact soil as much as possible.

5. Repeat step 6 until either all of the 12” stones are used up, or there are no more spaces between check dams.

Construction Plans and Materials

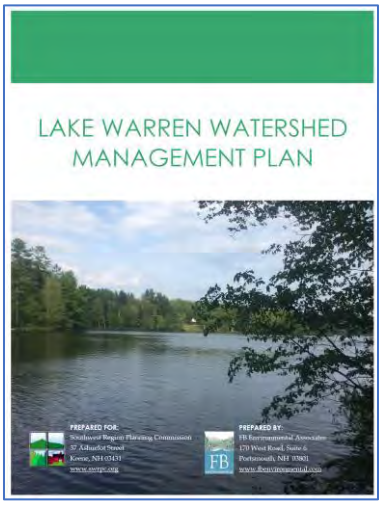




CHECK DAM DIAGRAM

Estimated Material Quantities:	**10-20** X 12" dia. Boulders	**1** X Cu. Yards of 6" dia. Stone
	1 X Stone Delivery (service)	
Estimated Material Cost:	$500 - $1,000	
Estimated Man-Hours	**Labor**	**Equipment**
12 hours (1.5 days)	1 X Laborer	Shovel, wheelbarrow

Lake Warren is an important resource for the residents of the Town of Alstead. The lake is currently listed as impaired by the New Hampshire Department of Environmental Services (NHDES) due to high levels of the nutrient phosphorus which can stimulate the growth of algae in the lake.



In 2016, the **Lake Warren Watershed Management Plan** was developed with the primary goal of preserving the water quality of this important lake. Outcomes of the 2016 study include:

- The largest input of phosphorus to Lake Warren was found to be **stormwater runoff** from the watershed, including Pine Cliff Road and other unpaved roads within the watershed.
- Specific private and town-owned locations throughout the Lake Warren watershed were identified for potential management.
- Completion of this plan has allowed for the availability of **funds from NHDES** to address nutrient pollution from the watershed.

What is Stormwater Runoff?

Stormwater runoff is water from rain or melting snow that doesn't soak into the ground. Instead, it flows over the land surface, picks up pollutants in its path, and flow untreated into nearby waterbodies. Common stormwater runoff problems include eroding soils, fertilizer, pet waste, and septic systems.

Best Management Practices, or BMPs, are a practice or combination of practices that reduce the amount of pollution in stormwater runoff. BMPs are designed to reduce flooding and improve water quality by encouraging stormwater runoff to soak into the ground.

In 2021, NHDES granted funding to the Southwest Region Planning Commission (SWRPC) to work with the Lake Warren Association and the Town of Alstead to address some of the actions identified in the Lake Warren Watershed Management Plan including a redesign of Pine Cliff Road and installation of Best Management Practices (BMPs) at four sites throughout the watershed.

Two of these sites are located on **Eel Rock Road and Arbor Way**. Both of these roads are private, shared access roads. An engineer from Comprehensive Environmental (CEI) visited both of these sites and prepared designs to improve stormwater runoff conditions. The designs include the addition of water diverters and ditching improvements. Work is scheduled to occur in mid-September. **The entire cost is funded by NHDES**. However, labor is not included so any volunteer help is greatly appreciated!

If you have any questions or concerns about the proposed BMPs on your road or you are interested in helping with their installation, you can **attend a virtual meeting with the engineer.**

This meeting will occur via Zoom on **Thursday, August 11 at 6:30 pm.**
(https://us06web.zoom.us/j/81754983637; Meeting ID: 81754983637; Passcode: 283674)

Improving and maintaining the water quality benefits all of us and helps us to enjoy this beautiful lake. Thank you for your cooperation and please consider rolling up your sleeves to help with this work.

MEETING MEMO

ATTENDEES:	Prescott Trafton- Alstead Highway; Matt Lundsted- CEI
FROM:	Matt Lundsted- CEI
SUBJECT:	Lake Warren BMPs
JOB NUMBER:	373-1
MEETING DATE:	September 1, 2022

Prescott and I met at the Arbor Way/Pine Cliff intersection to discuss the watershed improvements for Lake Warren construction progress. The following items were discussed.

1. I explained the outcome of the recent abutter outreach Zoom meeting and how both the Arbor Way and Eel Rock trench work had received significant abutter input and comments after draft and final designs were completed. In summary I explained that Arbor Way lacks volunteer availability for installation/implementation and Eel Rock has erosion, debris and re-routing issues regarding the downstream receiving ditch which developed after designs were finalized which have created abutter concerns about where the proposed leak-offs may cause adverse water problems for abutter properties. Both projects remain viable but will likely be in a future grant. Eel Rock abutters will work off-line to address the ditch concerns.
2. The proposed Arbor Way work for the Town to perform at the Arbor Way/Pine Cliff intersection was discussed. Highway will be able to perform this work as laid out in the field which still addresses the sediment entering the lake from the Arbor Way sub-watershed.
3. Prescott noted that the material costs for the coir logs for proposed bank stabilization along Lake Warren across Pine Cliff Road have not come down since he began quoting them (he has been checking regularly for updates over several months) and seem excessive at $5000. Installation of another sediment trap upstream of another catch basin (CB) along Pine Cliff was discussed in lieu of the bank work. We felt that this would actually result in keeping more sediment out of the lake.
4. While discussing the additional catch basin work it was noted that there is a third CB that he could install the same detail for in lieu of the Eel Rock work if necessary.
5. Prescott agreed to also review any of his drainage work this past summer to see if any falls within the lake watershed.
6. Pine Cliff re-alignment- I explained that we presented the alternatives at a Select Board meeting and the Board recommended that any future proposed work be the subject of a Public Meeting.

End of meeting.

The above text summarizes the events of the meeting at the above date and time.
If this information is not correct, please contact me as soon as possible.

MEMORANDUM

To: Lisa Murphy, Southwest Region Planning Commission

From: Emily DiFranco, Comprehensive Environmental Inc. (CEI)

Re: Lake Warren Technical Site Visit -Pine Cliff Road options

Date: October 25, 2021

CEI conducted a technical site visit to the Lake Warren watershed on August 30, 2021. A primary purpose of this site visit was to discuss changes to Pine Cliff Road to address dust, sedimentation, and bank erosion from the road to Lake Warren. Pine Cliff Road had been identified during the field investigation for the development of the Lake Warren Watershed Management Plan in 2013. This memo outlines options discussed during the field visit and provides pros and cons as well as ranges of cost for each option to allow for discussion of which alternative is preferred by the town.

Attendees at site visit included:

- Prescott Trafton (Alstead Road Agent);
- Sarah Webb (Alstead Conservation Commission);
- Joe Levesque (Alstead BOS);
- John Mann (Lake Warren Association);
- Matt Lundsted (CEI); and
- Chris McGuinness (CEI).

Description of Problem

As discussed in the Lake Warren Watershed Management Plan (2013) and during the site visit, Pine Cliff Road is thought to be a major contributor of sediment to Lake Warren. Residents have observed that recreational users frequently park on the side of the road closest to the lake, contributing to bank erosion and sedimentation. Residents have also observed that during drier weather, dust accumulates from increased traffic. The dirt portion of Pine Cliff Rd is approximately 2,800 ft long and is preceded by paved roadways on either end.

Options for Alteration of Pine Cliff Road

Several options for directing stormwater and maintaining or increasing the vegetated buffer adjacent to the lake were discussed. The options below are intended to provide a big picture idea of the range of options for Pine Cliff Road. In summary, the six options include:

- Option 1: Narrow Pine Cliff Road to 22 feet and add walking path (no paving).
- Option 2: Narrow Pine Cliff Road to 15 feet to create a one-lane road (no paving).
- Option 3: Engage in land swap with abutter to straighten road and elevate road away from lake (no paving).
- Option 4: Narrow Pine Cliff Road to 22 feet, elevate road away from lake, and add parking (no paving).
- Option 5: Narrow Pine Cliff Road to 22 feet and pave road. Add walking path.
- Option 6: Narrow Pine Cliff Road to 15 feet to create one-lane road and pave road.

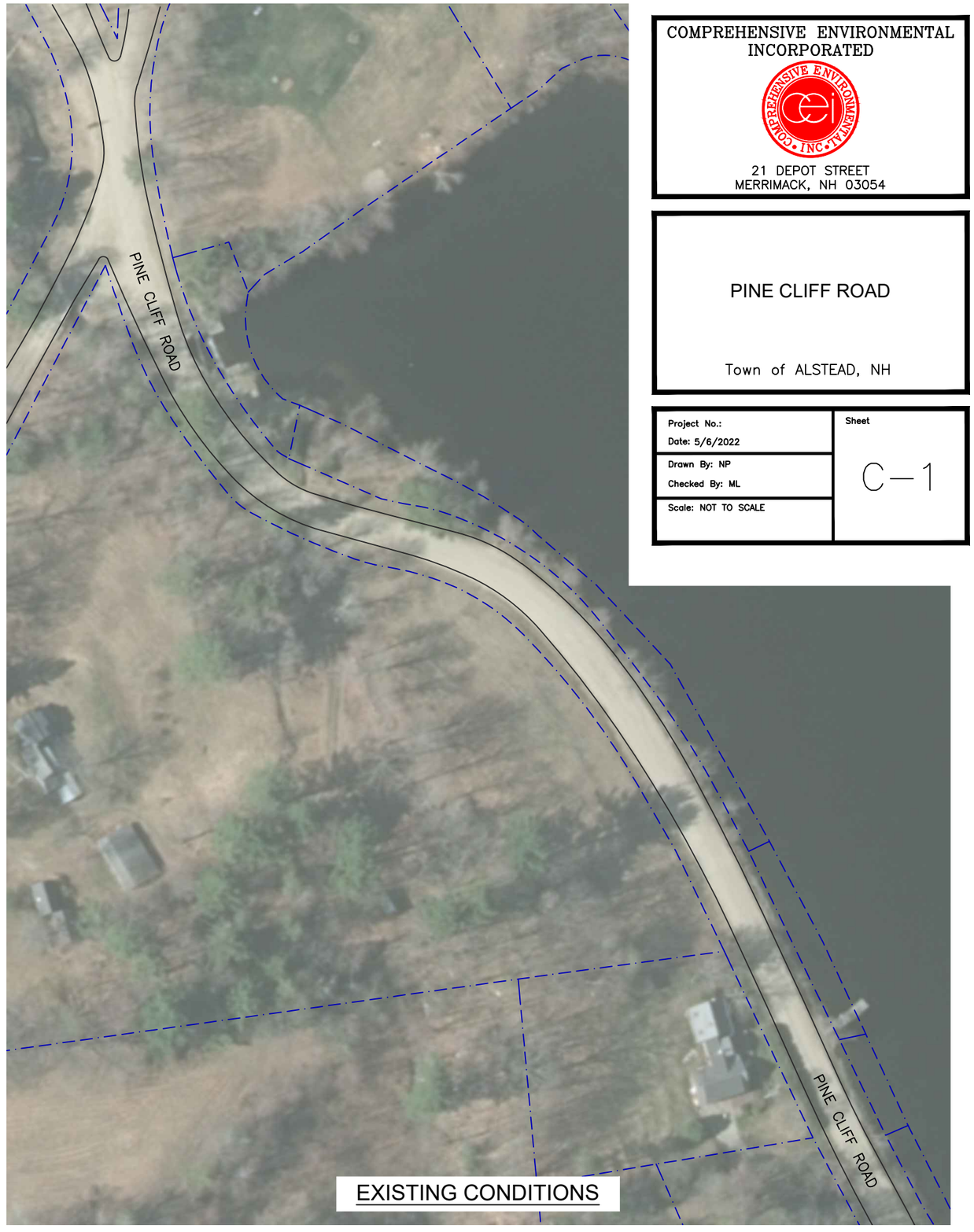
Option	Alternative Description	Pros	Cons	Cost Ranges
1	**Narrow Pine Cliff Road to 22 feet and add walking path (no paving)** • Narrow Pine Cliff Rd to 22 feet wide • Install a defined[1] walking path along the lakeside edge of the road to allow for pedestrian access and increase the lake-side vegetated buffer. • Enhance the drainage ditch on the upland side of the road. Install check dams leading up to drainage culverts that cross road. Create sediment traps at the inlet of drainage culverts for easy maintenance. • Maintain magnesium chloride dust treatment as per town existing procedure.	Added buffer to lake shoreline; walking path; enhanced drainage	Path may be used as parking, regardless of signage	$42,000-$46,000
2	**Narrow Pine Cliff Road to 15 feet to create a one-lane road (no paving).** • Narrow Pine Cliff Rd to 15 feet wide and create a one lane road[2]. • Increase average distance from road to shoreline from approximately 15 feet to approximately 25 feet. • Install a defined walking path along the lakeside edge of the road to allow for pedestrian access. • Enhance existing ditches and drainage culverts. Install check dams leading up to drainage culverts that cross road. • Maintain magnesium chloride dust treatment as per town existing procedure.	Large buffer added to lake shoreline; walking path; enhanced drainage	Path may be used as parking, regardless of signage; One-lane road	$45,000-$50,000

[1] Defined in this context will be accomplished through the use of materials separate to the materials in the road, or through the use of curbing of some form.
[2] Signage for beginning and end of one lane road must be considered and maintained.

Option	Alternative Description	Pros	Cons	Cost Ranges
3	**Engage in land swap with abutter to straighten road and elevate road away from lake (no paving)** • Engage with abutter to swap land for a portion of lakeside property currently owned adjacent to the non-lake-side right of way. • Obtain land and change the alignment of the road to eliminate most of the curvature. • Super-elevate the lakeside edge of the road to slope water towards upland side of the road. • Create a new drainage ditch on the upland side of the road. Install check dams leading up to drainage culverts that cross road. • Extend existing culverts to the location of the new ditch. Create sediment traps at the inlet of drainage culverts for easy maintenance. • Maintain magnesium chloride dust treatment as per town existing procedure.	Large buffer added to lake shoreline; sloped road reduces discharge to lake; enhanced drainage	Negotiation of land ownership; slope to road may encourage speeding; no walking path installed; new road base and culverts must be constructed.	$90,000-$99,000 *includes $25,000 allowance for land swap*
4	**Narrow Pine Cliff Road to 22 feet, elevate road away from lake, and add parking (no paving)** • Narrow Pine Cliff Rd to 22 feet wide. • Super-elevate the lakeside edge of the road to slope water towards upland side of the road. • Eliminate the existing drainage ditch and flatten area. • Install defined, dedicated parking along upland side of the road. • Install drainage grates over culvert inlets, maintain as necessary. • Maintain magnesium chloride dust treatment as per town existing procedure.	Added buffer to lake shoreline; sloped road reduces discharge to lake: additional parking	Reduced drainage; slope to road may encourage speeding; no walking path installed	$65,000-$71,000

Option	Alternative Description	Pros	Cons	Cost Ranges
5	**Narrow Pine Cliff Road to 22 feet and pave road. Add walking path.** • Narrow Pine Cliff Rd to 22 feet wide. • Pave the remainder of Pine Cliff Rd for two-way traffic. • Install a defined walking path along the lakeside edge of the road to allow for pedestrian access. • Enhance the drainage ditch on the upland side of the road. • Install check dams leading up to drainage culverts that cross road. • Create sediment traps at the inlet of drainage culverts for easy maintenance.	Added buffer to lake shoreline; enhanced drainage; drivability and ease of plowing; walking path	Path may be used as parking, regardless of signage; more runoff (impervious surfaces)	$174,000-$192,000
6	**Narrow Pine Cliff Road to 15 feet to create one-lane road and pave road**. • Narrow Pine Cliff Rd to 15 feet wide. • Pave the remainder of Pine Cliff Rd for one-way traffic. • Increase average distance from road to shoreline from approximately 15 feet to 20 feet. • Install defined dedicated parking along upland side of road. • Enhance the drainage ditch on the upland side of the road. • Install check dams leading up to drainage culverts that cross road. • Create sediment traps at the inlet of drainage culverts for easy maintenance.	Added buffer to lake shoreline; enhanced drainage; drivability and ease of plowing; parking	One-lane road; more impervious surfaces; no walking path	$118,000-$130,000

PROPOSED CONDITIONS



EXISTING CONDITIONS

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

21 DEPOT STREET
MERRIMACK, NH 03054

PINE CLIFF ROAD

Town of ALSTEAD, NH

Project No.: Date: 5/6/2022	Sheet
Drawn By: NP Checked By: ML	C-1
Scale: NOT TO SCALE	

MEETING NOTES

ATTENDEES:	Alstead BOS, Public, Anne Hess, Lisa Tusveld, Lisa Murphy, Matt Lundsted- CEI
FROM:	Matt Lundsted- CEI
SUBJECT:	Lake Warren- Pine Cliff Road Alternatives
JOB NUMBER:	373-1
MEETING DATE:	June 21, 2022

The purpose of these notes are to summarize the presentation given to the Alstead Board of Selectmen regarding Lake Warren and the alternatives developed for stormwater improvements to the gravel portion of Pine Cliff Road. Attached is the graphic used for the presentation and the Board's official minutes.

Alternatives presented:

1. Pave remaining gravel portion of Pine Cliff and add water quality treatment swales along the non-lake side;
2. Make Pine Cliff one-way, narrowing the road width to 15', adding vegetated buffer along the lake side and remaining gravel;
3. Make Pine Cliff one-way, narrowing the road width, adding vegetated buffer along the lake side, pave and add water quality treatment swales along the non-lake side;
4. Relocate Pine Cliff to the west and create a large open space/buffer on the lake side with a walking path and enhanced vegetation and water quality swales along the non-lake side;
5. Make Pine Cliff a consistent narrower width at 22', two-way, add water quality swales to the non-lake side and add vegetation and a non-paved path along the lake side.

After substantial discussion of the pros and cons of each option it was agreed that paving (adding a higher degree of imperviousness) would be expensive and counter to the spirit of the project; that one-way options were not desired by abutters/residents and that land acquisition activities would be costly and a long political and administrative process. It was agreed that #5 above is the desired alternative.

Next steps: The Board agreed that additional public meetings would be needed to officially approve this alternative and approve moving forward with seeking grant funds. It is believed that a March 2023 warrant article ballot item would be needed.

The above text summarizes the events of the meeting at the above date and time.
If this information is not correct, please contact me as soon as possible.

TOWN OF ALSTEAD, NEW HAMPSHIRE
Select Board
Approved Minutes for Meeting of June 21, 2022 at 5:00 p.m.
Town Hall, 9 Main Street, Alstead, NH 03602

SELECT BOARD PRESENT: Joseph Levesque, Joel McCarty, Matthew Saxton.

STAFF PRESENT: In person: Stephen Murrell, Police Chief; Mary Schoppmeyer, Office Administrator; Jesse Moore, Ambulance Chief.

COMMUNITY MEMBERS: In person: Ben Howard, Gordon Kemp (first half of the meeting), Rich Nalevanko, Marge Noonan, Barb Viegener, Judith Willis, and two members of the Lake Warren Association. **Google Meet:** Gordon Kemp (2nd half of the meeting).

GUESTS: Lisa Murphy and Matt Lundstedt from Southwest Regional Planning Commission to present on the Lake Warren Best Management Practices (BMP) project.

PLEDGE OF ALLEGIANCE

CALL TO ORDER: The Board Chair called the Select Board meeting to order at 5:00 p.m. and introduced the guest attendees.

PRESENTATION: Lisa Murphy began with an overview of projects that the planning commission has helped the town obtain grants to achieve, concluding with the latest Best Management Practices project, which identifies sites around the lake that are contributing most significantly to the decline of the water body, which is considered an impaired lake. NH DES Grants available through the US EPA for the BMP project offer full coverage of materials with a 40% in-kind match from the town (e.g. labor). Then she introduced Matt Lundstedt, who explained the various options that have been considered for addressing the most significant effort of the project, which is the portion of Pine Cliff Road near the dam. This portion of road contributes a large amount of silt to the lake during high runoff events. There was extensive discussion of the most popular option, which is to narrow the road to 22 feet wide, keep it dirt, install ditching with silt dams to limit silt deposit, and build a pedestrian walkway. There was discussion about when to hold a public hearing, a description of what the grant process looks like, and how best to proceed – for example, public hearing late July early August; make decision about which option to use; put a warrant article on the March ballot and then if approved, proceed with the grant process. There is reluctance to start the grant pre-application process before we have a town-wide commitment to the project. There was further discussion of other components of the BMP project, which also includes remediation efforts on Arbor Way and Eel Rock Road. The board expressed its appreciation of Ms. Murphy's knowledge and efforts on the Planning Commission and thanked her and Mr. Lundstedt for their presentation. Mr. Lundstedt offered his board graphic to the Lake Association for their meeting, and the guests and lake association members departed.

ACTION ITEMS: Sign a PO for the sign trailers. Sign the NPS minutes from June 7 in the right place. Sign the payroll liabilities and payables manifests from the week ending 6/18.

MINUTES FROM PREVIOUS MEETINGS: Minutes of June 14, 2022; Minutes of 2 June 14, 2022 non-public sessions. On a motion made by Matt and seconded by Joel, ***the Board voted to approve the public minutes as written. The motion passed with two in favor and one abstention.*** On a motion made by Matt and seconded by Joel, ***the Board voted to approve the two non-public sets of minutes as written. The motion passed with two in favor and 1 abstention.*** Joe abstained from those votes because he was absent from the 6/14 meeting.

VILAS POOL: Gordon reported that the summer events program has launched, is going strong, and is proving very successful.

POLICE DEPARTMENT: Steve reported with evident relief that our full-time officer has returned to active duty and we have hired a part time officer who will begin on Monday 6/21. The new officer is certified and trained and ready to roll with a short on-boarding/orientation process. In addition, he reported that the new sign trailers were delivered today; he hopes to bring one to a meeting to demo it for the board. He noted that school is out and reminded us all to be careful because the kids are out and about. Gordon Kemp asked what cruiser the new officer will use since we only have two, and he wanted to know if we might use one of the signs to advertise the summer program at Vilas Pool. Joel wondered what sort of data those signs collect and what is done with it. The Chief replied that the new officer will either ride along or use an available cruiser when not in use and, regarding the data, he indicated that once he has studied the materials provided with the devices, he will be better able to answer that question. Joe reminded us that the same grant that we applied for to pay for the signs is also paying for repeater

equipment for both fire stations. Jesse indicated that those are 4-5 weeks out. The vendor is willing to provide information for our web site with pertinent information for amateur radio operators. Steve reported that last year at this time the PD had responded to 210 service calls; this year we are at 400 calls, many of which occurred while the department was short-handed.

AMBULANCE: The ambulance crew has responded to 86 calls this year. Most have been transports so money is incoming to the town for those but the ambulance budget is nearly ¾ consumed, and we haven't hit the busy part of the year yet. In a typical year we budget for 80 calls, and it is past that point already. He urged people to see their primary care doctor proactively so that an emergency situation is not required. Joel reminded us that the incoming money doesn't get assigned to the ambulance budget and Jesse is not allowed to exceed the budget that was passed in March. We have to pay for it when we miss a call and someone else has to cover so they are working hard to avoid that circumstance. The Board acknowledged its role in seeing to it that the ambulance team has what it needs.

INFORMATIONAL: The next regular meeting of the Select Board is scheduled for Tuesday, June 28, 2022 at 5:00 p.m. Alstead will host the next Five-Town Select Board meeting on Friday August 5th, 2022 at 4:30 PM in the Town Hall at 9 Main Street.

BOARD: Joel reported that the property next door continues to collapse. The owner has received an asbestos remediation quote that he is pursuing and an exorbitant demolition quote. **Joel** reported continuing progress on resolving the offending trailer on Gilsum Mine Road by working with the Well Hill Coop. The Community Loan Fund has agreed to pay the bill for pouring the pad, on a reimbursement basis. Efforts to see that process through will continue. **Joe** reported that he attended two US Treasury webinars last week about how to spend our ARPA money and learned that most projects that benefit the low-income sector would be approved. He noted that we should be receiving the second half of our ARPA money soon.

PUBLIC COMMENTS: Rich Nalevanko submitted a Right-to-Know request for information associated with the senior housing project. The Board marked his copy of the request with the date and time and provided the town's copy to the Administrator for appropriate handling. Rich also noted that the power companies are raising their rates – the NH Public Utilities Commission approved a 100 percent increase. **Jesse** reminded us to be on the lookout for people doing unwise things with woodstoves to counteract the higher power expenses because this is when house fires and CO exposure happens. **Joel** summarized the way that utility prices get determined in NH and there was more discussion about that. **Joe** reported that the Broadband Committee has learned that Comcast has indicated that it plans to extend its internet coverage to the rest of the town.

On a motion made by Matt and seconded by Joel, ***the Board voted by roll call (Joe – y; Joel– y; Matt – y) to enter non-public session at 6:35 p.m. pursuant to RSA 91-A3, II(e) – consideration or negotiation of pending claims or litigation.***

Before exiting the non-public session, the Board reviewed the minutes of the session and signed them.

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On a motion made by Joel and seconded by Matt, ***the Board voted by roll call (Joe – absent; Joel– y; Matt – y) to enter non-public session at 6:52 p.m. pursuant to RSA 91-A:3, II(c) – Matters which, if discussed in public, would likely affect adversely the reputation of any person other than a member of this board unless that person requests an open hearing.***

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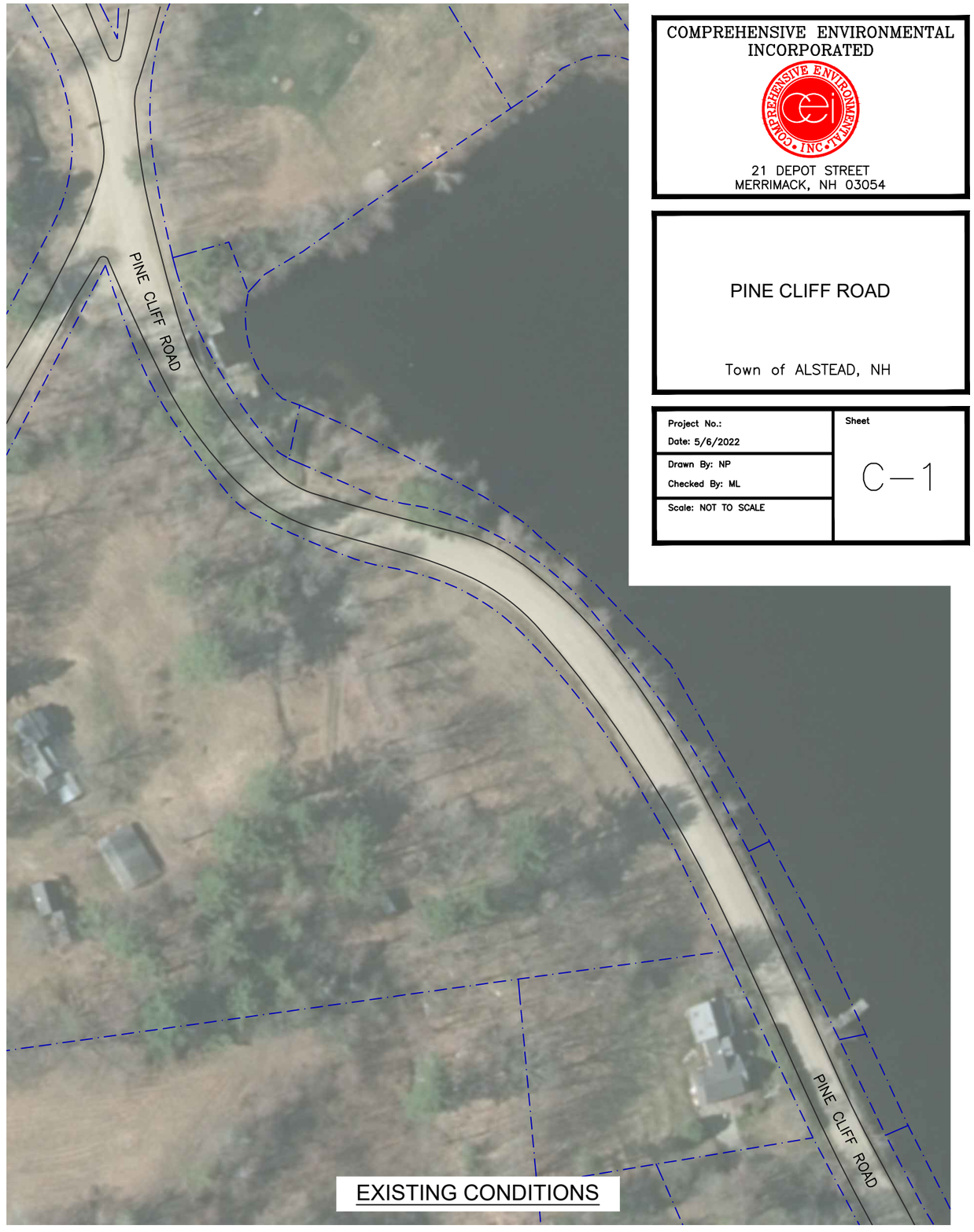
On a motion made by Matt and seconded by Joel, ***the Board voted to adjourn the public meeting at 7:11 p.m. The motion passed unanimously.***

Respectfully submitted,

Mary Schoppmeyer

Mary Schoppmeyer, Office Administrator

PROPOSED CONDITIONS



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21 DEPOT STREET
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Town of ALSTEAD, NH

Project No.: Date: 5/6/2022	Sheet
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Respectfully submitted,

Mary Schoppmeyer

Mary Schoppmeyer, Office Administrator

January 12, 2022

Prescott Trafton
Town of Alstead Highway Department
596 Forest Road
Alstead, NH 03602

Re: Pine Cliff Road Traffic Studies

Dear Mr. Trafton:

Please accept this correspondence as a summary of the results of two automated traffic studies on Pine Cliff Road in the Town of Alstead. Specifically, the locations are just south of Prentice Hill Road and west of Gilsum Mine Road (see Figure 1). One set of studies was conducted during the summer months to better understand peak seasonal traffic, with counts occurring between July 31 and August 5, 2021. A follow-up set of studies was conducted during the school year from November 13 to November 18, 2021. The purpose of conducting the separate studies is to help the Town of Alstead quantify daily traffic volumes along Pine Cliff Road, as well as understand both the speed and types of vehicles using Prentice Hill Road.

Figure 1 – Traffic Study Photos and Overview Map

South of Prentice Hill Road

West of Gilsum Mine Road

Overview Map

Traffic Volume

The results of traffic volume data collected over this period are indicated in Table 1. Please note that the traffic volume results represent data that is not seasonally-corrected and should therefore not be interpreted as an annualized estimate (also called an Average Annual Daily Traffic or AADT estimate).

Table 1 - Summary of Traffic Volumes on Pine Cliff Road (Vehicles Per Day)

	Vehicles Per Day					
	Weekday Average		**Saturday**		**Sunday**	
	Summer	Fall	Summer	Fall	Summer	Fall
South of Prentice Hill Road	362	293	351	253	256	179
West of Gilsum Mine Road	347	278	314	227	238	195

Traffic Speed

In the field of traffic engineering, the 85th percentile speed is frequently used to report and evaluate speeding on all forms of highways. The 85th percentile speed (sometimes used interchangeably with the phrase "operating speed" or "prevailing speed") is the speed at which 85 percent of drivers travel *below.* For that reason, it also means that 15% of drivers travel *faster* than the 85th percentile speed. In general, when posted speed limits and the 85th percentile speed are far apart, speed enforcement becomes more difficult and may require new interventions to slow traffic down.

The operating speeds of vehicles observed at the study locations are summarized in Table 2. Keep in mind that in addition to operating speeds, sight lines, road geometry, and the presence of people walking and biking are some other considerations that come into play when highway engineers recommend posted speed limits. The same factors also influence a driver's preferred speed.

A posted speed limit was not observed in the immediate study area. Without a physical posting, the maximum limit would be 35 miles per hour according to NH RSA 265:60. Table 2 shows that speeding is more prevalent on the stretch of Pine Cliff Road west of Gilsum Mine Road.

Table 2 – Summary of Operating Speeds on Pine Cliff Road[1]

	Maximum Speed (mph)		**85th Percentile Speed (mph)**		**Average Speed (mph)**	
	Summer	Fall	Summer	Fall	Summer	Fall
South of Prentice Hill Road	40.9	36.9	25.6	26.3	20.9	21.5
West of Gilsum Mine Road	63.9	59.4	40.6	41.4	35.1	35.1

Vehicle Type

An analysis of the type or size of vehicles showed that traffic volumes are dominated by passenger or "light" duty vehicles (Tables 3 and 4). The section of road is also used by single-unit or "medium" duty vehicles (e.g. dump trucks or box trucks) and multi-unit or "heavy" duty vehicles (e.g. semi-trailers).

Table 3 - Summary of Vehicle Types on Pine Cliff Road (Summer)

	Average Daily Traffic (Vehicles per day)					
	Weekdays			**Weekends**		
	Light	**Medium**	**Heavy**	**Light**	**Medium**	**Heavy**
South of Prentice Hill Road	349	12	1	282	21	2
West of Gilsum Mine Road	323	23	2	253	21	2

Table 4 - Summary of Vehicle Types on Pine Cliff Road (Fall)

	Average Daily Traffic (Vehicles per day)					
	Weekdays			**Weekends**		
	Light	**Medium**	**Heavy**	**Light**	**Medium**	**Heavy**
South of Prentice Hill Road	272	18	3	205	12	0
West of Gilsum Mine Road	263	12	4	200	11	1

[1] To better represent the speeds chosen by a driver, summary of vehicle speeds includes only those vehicles travelling more than 6 seconds apart.

I hope that this information is helpful in better understanding traffic patterns in this area. For information from routine traffic studies in Alstead, I encourage you to visit nhdot.public.ms2soft.com/tcds, a resource of the New Hampshire Department of Transportation Bureau of Traffic.

Please do not hesitate to contact me if you have questions or would like to discuss the results of this study further.

Sincerely,

Henry Underwood
GIS Specialist/Planner

cc: Joel McCarty, Board of Selectmen (e-mail)
Lisa Murphy, SWRPC (e-mail)

Lake Warren BMP Implementation Work Group

Kick-off Meeting

AGENDA

July 13, 2021
3:00 p.m.

Join Zoom Meeting

https://bit.ly/Jul13LWWG21

Meeting ID: 822 4005 5127
Passcode: 018301
or
Join by Phone: (646) 558-8656

1. **Introduction**

2. **Project Goals**

   a. Discuss the goals for this phase and how they connect to a potential future phase

3. **Project Work Scope and Timeline**

   a. Discuss project details and estimated timeline

4. **Roles of the Work Group**

   a. Discuss assistance needed from the Work Group to help make this project a success

5. **Match Requirement**

   a. Discuss possible ways to meet the match requirement
   b. Volunteer and project match documentation

Lake Warren BMP Implementation Work Group

AGENDA

July 28, 2021
3:00 p.m.

Join Zoom Meeting

https://bit.ly/Jul28LWWG21

Meeting ID: 857 2764 0516
Passcode: 199699
or
Join by Phone: (646) 558-8656

1. **Introduction**

2. **Project Sites**

   Discuss potential project sites identified in the management plan.

3. **Rank Sites**

   Develop a list of 8-10 sites and rank them for potential projects.

4. **Determine a Date(s) for the Site Walk**

   Discuss potential dates for CEI team to walk the properties of the selected sites.

5. **Match Documentation**

   Discuss keeping track of volunteer hours and projects completed within the watershed.

Lake Warren BMP Implementation Work Group

AGENDA

November 17, 2021
10:00 a.m.

Join Zoom Meeting

LW111722

Meeting ID: 864 1412 3445
Passcode: 365653
or
Join by Phone: (646) 558-8656

1. **Introduction**

2. **Project Sites**

   Review the suggested sites and implementation projects.

3. **Next Steps**

   Discuss the steps that will be needed to get the projects ready for construction in Summer of 2022.

4. **Match Documentation**

   Reminder about keeping track of volunteer hours and projects completed within the watershed.

Lake Warren BMP Implementation Work Group

AGENDA

June 2, 2022
4:00 p.m.

Join Zoom Meeting

https://bit.ly/Jun2LWWG2022

Meeting ID: 875 0778 8126
Passcode: 122925

Or by phone: (646) 558-8656

1. **Project Sites**

   Discuss implementation projects and potential start dates. Discuss the steps that will be needed to get projects ready for construction.

2. **Educational Events**

   Discuss dates, locations and topics for two outreach events.

3. **Match Documentation**

   Reminder about keeping track of volunteer hours for meeting contract match requirements.