SITE SPECIFIC PROJECT PLAN FOR:
Gregg Lake Watershed Management Plan Development
RP-17-M-03

Under the New Hampshire Section 319 Nonpoint Source Grant Program QAPP
RFA# 08262 (Currently under review for 2018 update)

July 30, 2018

Prepared by:
Gregg Lake Watershed Management Plan Committee
Town of Antrim
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Signature/Date
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NHDES Project Manager: ______________________________

Signature/Date
Jeffrey Marcoux, NHDES

Program Quality Assurance Coordinator: ______________________________

Signature/Date
Stephen Landry, NHDES

NHDES Quality Assurance Manager: ______________________________

Signature/Date
Vincent Perelli, NHDES

For Receipt:

EPA Nonpoint Source Program Coordinator: ______________________________

Signature/Date
Erik Beck, U.S. EPA

Table of Contents

Tables

Figures

1 Distribution List

Table 1 lists people who will receive copies of the approved Site Specific Project Plan (SSPP) under the *New Hampshire Section 319 Nonpoint Source Grant Program Quality Assurance Project Plan* dated October 17, 2008.

Table 1. SSPP Distribution List

SSPP Recipient Name	Project Role	Organization	Telephone number and e-mail address
Joan Gorga	Project Manager	GLWMPC	603-588-2569 jgorga2@gorga.org
David Ward	Technical Project Manager	GLWMPC	727-804-0039 David.Ward@arcadis.com
Melissa Lombard	Project QA/QC Manager	GLWMPC	603-799-6575 mlombard603@gmail.com
Forrest Bell	Technical Project Advisor	FB Environmental Associates	207-221-6699 info@fbenvironmental.com
Laura Diemer	Project Manager	FB Environmental Associates	603-828-1456 laurad@fbenvironmental.com
Don Kretchmer	Modeling Oversight	DK Water Resource Consulting, LLC	603-387-0532 dkretchmer@metrocast.net
Richard Claytor	Engineering Oversight	Horsley Witten Group	603-658-1660 rclaytor@horsleywitten.com
Renee Bourdeau	Engineering Assistance	Horsley Witten Group	603-658-1660 rbourdeau@horsleywitten.com
Jeffrey Marcoux	NHDES Project Manager	NHDES, Watershed Management Bureau	603-271-2969 Jeffrey.Marcoux@des.nh.gov
Stephen Landry	NHDES Program QA Coordinator	NHDES, Watershed Management Bureau	603-271-2969 stephen.landry@des.nh.gov
Vincent Perelli	NHDES QA Manager	NHDES, Planning, Prevention, & Assistance Unit	603-271-8989 vincent.perelli@des.nh.gov
Erik Beck	USEPA Project Manager	USEPA New England	617-918-1606 beck.erik@epa.gov

2 Project Organization

The Town of Antrim (TOA) received funding from a United States Environmental Protection Agency (EPA) grant under Section 319 of the Clean Water Act administered by the New Hampshire Department of Environmental Services (NHDES) to develop a Watershed-based Management Plan for Gregg Lake.

2.1 Principal Data Users

The Gregg Lake Watershed Management Plan Committee (GLWMPC) was formed with representatives from Town of Antrim departments and commissions, two lake associations, area residents and landowners to participate in developing a watershed-based management plan to restore the water quality of Gregg Lake. A Core Group of the GLWMPC will be the principal data users and will prepare the watershed-based management plan in consultation with the broader GLWMPC, Technical Project Advisors, and NHDES (Fig. 1).

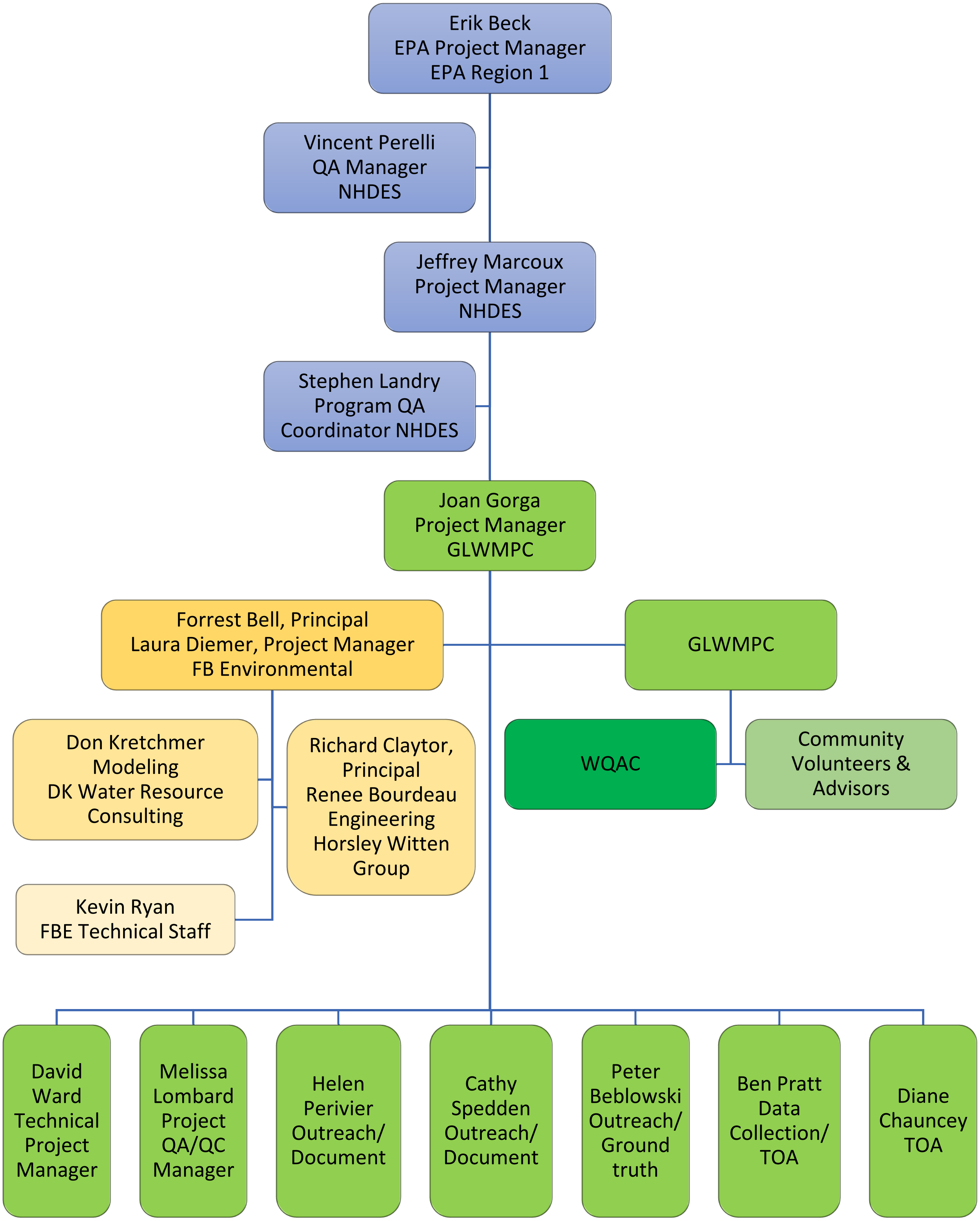


Figure 1. Project organizational chart.

Forrest Bell Environmental Associates (FBE) were selected as Technical Advisors to help GLWMPC complete the scope of services. Forrest Bell will serve as Principal-in-Charge and Laura Diemer will serve as Project Manager for FBE, will provide project oversight and technical expertise, and serve as the main point of contact with the GLWMPC Core Group (Table 2).

Table 2. Personnel Responsibilities and Qualifications

Name and Affiliation	Responsibilities	Qualifications
Joan Gorga, GLWMPC Core Group	Project Manager	Antrim Parks & Recreation Commission Chair, Weed Watch, VLAP, Watershed landowner, PhD Biochemist
David Ward, GLWMPC Core Group	Technical Project Manager	Watershed landowner, Certified GIS Professional
Melissa Lombard, GLWMPC Core Group	Project QA/QC Manager	Antrim Water & Sewer Commissioner, VLAP, PhD Hydrologist with USGS
Helen Perivier, GLWMPC Core Group	Outreach, Document preparation	Gregg Lake Assn, VLAP, Lake Host, Weed Watch, Summer resident, MSc in Natural Resources and the Environment
Cathy Spedden, GLWMPC Core Group	Outreach, Document preparation	Chesapeake Bay Foundation and Smithsonian Environmental Research Center volunteer, Watershed landowner
Peter Beblowski, GLWMPC Core Group	Outreach, Ground-truthing	Antrim Conservation Commission Chair, NH Coverts, former Hydrogeologist at NHDES (retired); Speaking for Wildlife Program
Ben Pratt, GLWMPC Core Group	Data collection, Town regulations	Antrim Treasurer, Gregg Lake Assn, NH Coverts, NHSPE state Mathcounts Director, Gregg Lake Road resident, Professional Engineer
Diane Chauncey, GLWMPC Core Group	Town regulations	Antrim Town Clerk & Tax Collector, Gregg Lake Assn, Gregg Lake Road resident
Forrest Bell, FBE	Technical Project Advisor	On file
Laura Diemer, FBE	Project Manager Project QA/QC Officer for FBE	On file
Kevin Ryan, FBE	Support for watershed build-out analysis	On file
Don Kretchmer, DK Water Resource Consulting	Modeling oversight and review	On file
Richard Claytor, Horsley Witten Group	Engineering oversight	On file
Renee Bourdeau, Horsley Witten Group	Engineering assistance	On file
Stephen Landry, NHDES, Watershed Management Bureau	Reviews QAPP preparation and other QA/QC activities	On file at NHDES
Jeffrey Marcoux, NHDES, Watershed Management Bureau	Reviews and oversees watershed protection and restoration projects funded through NHDES.	On file at NHDES
Vince Perelli, NHDES Planning, Prevention & Assistance Unit	Reviews and approves QAPPs	On file at NHDES
Erik Beck, USEPA Region 1	EPA Project Manager	On file at EPA

Joan Gorga of the GLWMPC will serve as Project Manager and will be the primary point of contact among the GLWMPC, FBE, and NHDES. David Ward will be the Technical Project Manager for GLWMPC. He will lead GIS mapping, land use modeling and ground-truthing efforts, which will include confirming potential pollution sources on foot, by boat or by drone. Melissa Lombard will be the Project QA/QC Manager and will lead in-lake phosphorus, assimilative capacity, and lake modeling analysis for GLWMPC. Cathy Spedden and Helen Perivier will lead outreach efforts, as well as participating in document preparation. Peter Beblowski will focus on outreach and ground-truthing. Ben Pratt and Diane Chauncey will contribute to data collection and provide in-depth knowledge of Town of Antrim operations and regulations. The data generated will be used by the GLWMPC, FBE, and NHDES to develop a watershed-based management plan for Gregg Lake.

2.2 Principal Decision Makers

The Core Group will be responsible for most decisions, in consultation with FBE and NHDES. Officials from watershed landowners NH Audubon, the Harris Center for Conservation Education, and Harbor Camps have all agreed to act in an advisory role in the development of a Gregg Lake WMP. A Water Quality Advisory Committee (WQAC), comprised of representatives from the Town of Antrim, the Gregg Lake Association, the White Birch Point Association, watershed landowners and stakeholders, volunteer water quality monitors, and representatives from NHDES will be charged with setting in-lake water quality goals and ranking best management practice (BMP) priorities for the watershed.

2.3 Corrective Actions

Joan Gorga, Project Manager, will oversee and communicate progress on the project to NHDES, partners, and stakeholders. Ms. Gorga will also document and notify partners and stakeholders of any changes made to the project scope.

3 Site Information

Gregg Lake and its 2,944-acre watershed (Fig. 2) lie entirely within the Town of Antrim in Hillsborough County, New Hampshire. Developed land accounts for 2% of the area; forested land, 84%; woody and emergent wetlands, 4.7%; and open water, 7.4%. A portion of the watershed is within the SuperSanctuary, a regional corridor of protected lands. Much of the watershed is considered “highest rank habitat” by the NH Fish and Game Department.

Gregg Lake has a surface area of 195 acres and a maximum depth of 11 meters (36 ft.), and is classified as oligotrophic. Recreational uses include swimming, fishing and boating. Water flows into Gregg Lake from two main tributaries: Hattie Brown Brook, a 4.3-mile stream that drains the area northwest of the lake, and its tributary, an unnamed 5.7-mile stream that drains the area west of the lake. The two tributaries drain the steep slopes of the Willard Mountain–Tuttle Hill Ridge and Goodhue Hill and traverse beaver-impounded wetlands before entering the lake. Numerous smaller drainages also feed the lake. Although it is a natural lake, the water level has been raised by more than 10 feet by a dam at its outlet, from which Great Brook emerges before flowing through Antrim and emptying into the Contoocook River.

Most of the Gregg Lake watershed is zoned as Rural Conservation District. Areas within 500 feet of the lake shoreline are zoned as Lakefront Residential. Logging activities frequently take place within the watershed. Construction is set to begin on a nine-turbine wind farm on the Willard Mountain–Tuttle Hill Ridge. This project area will drain in part into the Gregg Lake watershed.

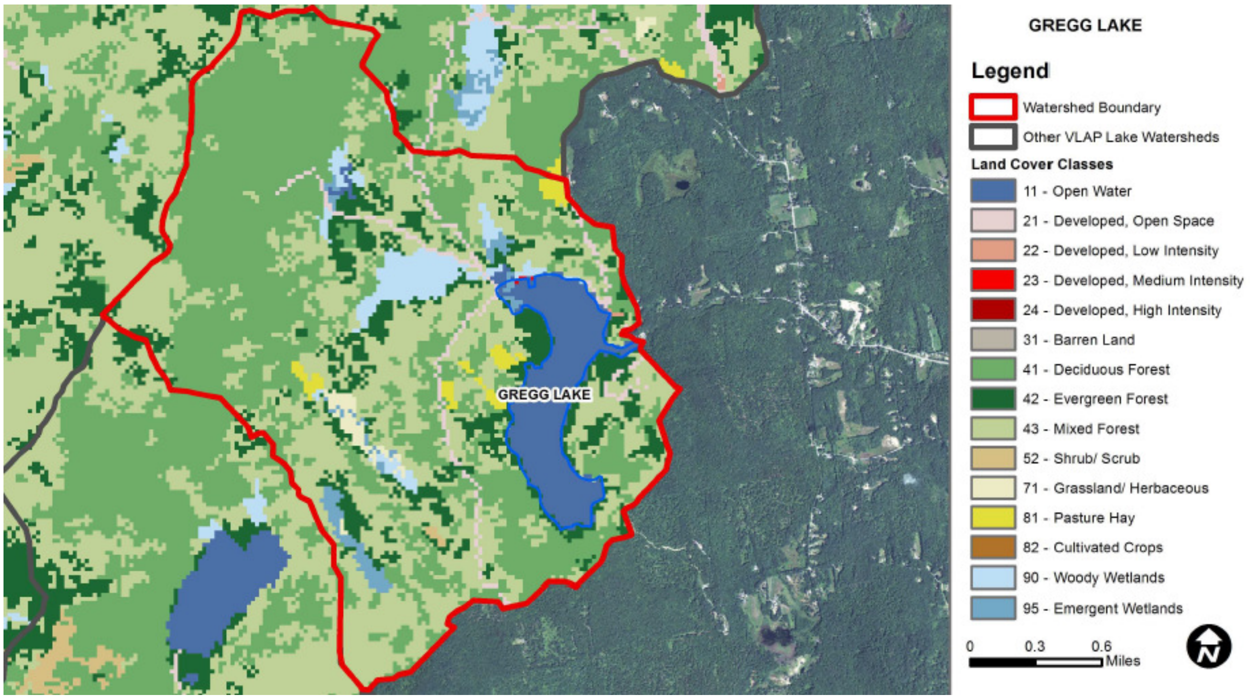


Figure 2. Gregg Lake Watershed; source, NHDES.

4 Project Rationale

4.1 Problem Definition

A decade after being added to the New Hampshire 303(d) list of impaired waters, Gregg Lake experienced unprecedented nuisance algal blooms in 2015 and 2016. While many acres of watershed land have been placed under conservation since the 303(d) listing, the watershed faces increasing pressure from development, including a potential, new subdivision of lakeshore property, recent, renewed, logging activity and an industrial wind power facility.

4.11 Project Purpose

Developing a Gregg Lake Watershed Management Plan (WMP) is an initial strategy toward the goal of restoring and maintaining the water quality of Gregg Lake. The scope of this project is to address excessive nutrient loading, which is known to lead to nuisance and harmful algal blooms, low water clarity and oxygen depletion in watershed systems. Project participants will identify pollution sources and create a watershed inventory of land use, gravel roads, septic systems, and landscaping and stormwater management challenges, analyze watershed loads, set goals for nutrient loads, identify actions needed to reduce pollutant loads and establish a schedule to implement prioritized projects to restore water quality.

4.12 Pollutants of Concern

Water quality data collected through the New Hampshire Volunteer Lake Assessment Program (VLAP) show total phosphorus (TP) and chlorophyll-*a* levels in Gregg Lake to be higher than desirable in comparison to New Hampshire water quality standards. Pollution threats to New Hampshire lakes typically include sediment and nutrients from existing and future development, aging septic systems, roads, logging operations and recreation in the watersheds. All these land uses have the potential to deliver phosphorus, the limiting nutrient in New Hampshire lakes, via stormwater runoff to Gregg Lake and its tributaries. Therefore, water quality goals for Gregg Lake will focus on TP, and a WMP will establish in-lake and watershed load reduction goals for phosphorus.

4.13 Scientific and Regulatory Background

Based on VLAP survey data, NHDES added Gregg Lake to New Hampshire's 303(d) list of impaired waters in 2004. Elevated TP and chlorophyll-*a* levels put Gregg Lake in the "Slightly Bad" category for capacity to support aquatic life, and dissolved oxygen saturation levels are ranked as "Cautionary." NHDES rates Gregg Lake "High" for recovery potential.

4.2 Historical Data

4.21 Previous Studies

Data sets available from NHDES include lake trophic surveys completed in 1978 and 1994/1995, and data collected through the VLAP program since 1997. During most years VLAP testing was performed once each summer. VLAP testing was performed in June, July and August in 2016 and monthly from April to October in 2017 to achieve a more complete data set.

4.22 Historical Problems and Project Background

Analysis of VLAP data retrieved from the NHDES Environmental Monitoring Database shows that measured TP levels in Gregg Lake have been highly variable over the last twenty years, but mean values suggest higher than desired phosphorus levels at all sampling points. Particularly high levels have consistently been found at the inlet. In 2016, mean TP values were 8, 10 and 12 μg/L in the epilimnion, metalimnion and hypolimnion, respectively, and 21 and 8 μg/L at the inlet and outlet, respectively. Due to high data variability, historical trends have not been significant. The NHDES aquatic life use support threshold for TP is <8 μg/L for oligotrophic waterbodies. As the NHDES antidegradation policy recommends that 10% of the state standard to be kept in reserve, target TP levels are below 7.2 μg/L for an oligotrophic lake.

Chlorophyll-*a* levels, which are used to estimate algal growth, have varied moderately over the last twenty years, with mean values exceeding desirable levels. Again, any trend in historical data is not significant due to variability in the data. In 2016, the mean epilimnion chlorophyll-*a* level was 3.44 μg/L. The NHDES aquatic life use support threshold for chlorophyll-*a* is <3.3 μg/L for an oligotrophic waterbody.

Gregg Lake has been protected by active Weed Watcher and Lake Host programs for many years and currently has no exotic aquatic species. Weed Watcher observations noted unprecedented algal blooms in the summers of 2015 and 2016, coinciding with relatively warm temperatures and low rainfall. In addition, dissolved oxygen levels below the threshold to support aquatic life have been found in the deepest waters in all tests recently performed.

5 Project Description and Schedule

5.1 Evaluate Water Quality Data

Historical and current water quality monitoring data will be used to assess current water quality conditions, determine assimilative capacity and assist the WQAC in setting an in-lake water quality goal for phosphorus. Existing water quality data from all available sources will be evaluated for completeness and validity. The NHDES OneStop data portal will be used to access data that has been pre-screened and quality checked by NHDES. The datasets include information from NHDES lake trophic surveys and VLAP data.

Additional sampling will be performed through October of 2018. Assimilative capacity for phosphorus and amount of in-lake phosphorus reduction needed to meet state nutrient criteria will be calculated by December 2018. Joan Gorga and Melissa Lombard will lead the data analysis effort with guidance from Jeffrey Marcoux, using procedures detailed in the 2016 New Hampshire Consolidated Assessment and Listing Methodology (CALM).

The water quality data will be used to assess current water quality conditions, determine the assimilative capacity, and assist the WQAC in setting an in-lake water quality goal for phosphorus.

5.2 Establish In-lake Water Quality Goal

Once the median water quality and assimilative capacity calculations, as well as the land use model and build-out analysis, have been completed, the WQAC will review the data and establish an in-lake water quality goal. The 2016 New Hampshire Consolidated Assessment and Listing Methodology (CALM) will be used to recommend an appropriate in-lake water quality goal. The projected window for convening the WQAC is June 2019 to accommodate seasonal residents.

5.3 Identify Current and Future Pollutant Loading

Watershed-scale and in-lake modeling will identify current and future pollution sources with sufficient resolution to begin developing a restoration plan. It is anticipated that the pollutant loading, in-lake analysis, and build-out analysis will be completed by March 2019.

5.31 Watershed Loading Model

Laura Diemer will conduct land-use analyses, sub-basin delineation, mapping, and watershed-scale and in-lake modeling. GLWMPC will complete septic surveys and land use ground-truthing as requested by FBE. David Ward will lead GLWMPC mapping efforts, using aerial photography and Landsat imagery (available through NOAA, C-CAP, NH GRANIT mapper, etc.), and ground-truthing. Melissa Lombard will lead GLWMPC efforts in support of modeling studies using the ENSR-developed Lake Loading Response Model (LLRM) to estimate current annual pollution source loads and establish a threshold for phosphorus loading in the watershed. Internal phosphorus loading, septic system phosphorus loading, future loading scenarios, and other potential sources not modeled will be estimated. Watershed phosphorus load models will be verified using in-lake phosphorus prediction models. Don Kretchmer, Certified Lake Manager will provide modeling oversight and review.

5.32 In-Lake Total Phosphorus Concentrations

Laura Diemer will lead estimations of in-lake TP and associated chlorophyll-*a* concentrations, Secchi transparency, and probability of algal blooms using in-lake response models in combination with empirical data. Melissa Lombard and Joan Gorga will support as needed, and Don Kretchmer will provide modeling oversight and review.

5.33 Build-Out Analysis / Future Loading Model

Laura Diemer will lead build-out analysis for the watershed and run modeling scenarios to predict future pollutant loading. Melissa Lombard and Joan Gorga will support as needed.

5.4 Identify Best Management Practices

Based on current and predicted future pollution source loads, pollutant load reductions needed to achieve in-lake water quality goals will be determined. Locations needing remediation through BMPs will be identified by November 2018. Laura Diemer (FBE) and Renee Bourdeau and Richard Claytor of Horsley Witten Group (HWG) will complete the watershed survey and prepare a rough, conceptual BMP design, including a cost estimate, for each location, and will estimate the pollutant load reduction expected for each site. Led by Joan Gorga, GLWMPC members will compile an action plan or recommendations matrix and present the results at a public meeting and via other means to provide an overview of the priority areas in the watershed where action is needed. Concurrently, the public will be invited to share their observations on potential pollutant sources and to give input on BMP installation sites and conceptual designs to ensure that no potential source or consideration is overlooked. At least one representative from FBE, HWG, and DK Water Resource Consultants will attend the public meeting.

GLWMPC members will develop an estimated schedule for implementation of prioritized BMP strategies, measurable milestones to determine whether identified actions are being implemented, and a tracking mechanism to determine whether plan recommendations are successful.

5.5 Develop Outreach Strategy

Led by Cathy Spedden and Helen Perivier, GLWMPC members will develop an outreach strategy to support adoption and implementation of recommendations made in the WMP. Joan Gorga will give regular updates at Gregg Lake Association and White Birch Point Association meetings. We will work with the Town of Antrim, lake associations, property owners and lake recreational users to implement stormwater BMPs. We will develop informative online surveys and educate the community about maintaining septic systems and gravel roads. These efforts will begin in the summer of 2018 and continue through the summer of 2019, or until the WMP has been completed.

5.6 Preparation of Documents and Reports

Joan Gorga will be responsible for submitting semi-annual reports and for preparing the final WMP, in consultation with Laura Diemer and Jeffrey Marcoux.

5.7 Schedule

The anticipated schedule for developing a Gregg Lake WMP is shown in Table 3.

Table 3. Gregg Lake Watershed Management Plan development schedule

Objectives and Tasks	Responsible *	2018						2019												2020		
		J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Objective 3: Water Quality Data																						
T11: Additional sampling	CG	■	■	■	■																	
T12: Evaluate data quality	GLWMPC/DES	■	■	■	■	■																
T13: Historical and current TP & Chl-a	GLWMPC/DES	■	■	■	■	■																
T14: Assimilative capacity, WQ summary	GLWMPC/DES	■	■	■	■	■	■															
Objective 4: Water Quality Goal																						
T15: WQ Advisory Committee	GLWMPC												■	■								
T16: WQ goal process	GLWMPC/FBE													■								
T17: Implement and document process	GLWMPC/FBE/DES													■								
Objective 5: Pollution Sources																						
T18: Current pollution source loads	GLWMPC/FBE					■	■	■	■	■												
T19: Survey watershed; Ground-truth	GLWMPC/FBE/DES	■	■	■	■	■																
T20: In-lake response models-TP, Chl-a, etc	GLWMPC/FBE/DES						■	■	■	■												
T21: Build-out analysis	GLWMPC/FBE/DES	■	■	■	■	■	■															
T22: Model future pollutant loading	GLWMPC/FBE/DES									■												
Objective 6: Required Pollution Reduction and Action																						
T23: Determine required load reduction	GLWMPC/FBE														■							
T24: BMP Identification	GLWMPC/FBE				■	■																
T25: Site-specific load reduction	GLWMPC/FBE						■															
T26: Prioritized BMP options	GLWMPC			■	■	■	■	■	■	■	■	■	■	■	■							
T27: Public meeting on BMPs	GLWMPC/FBE														■							
Objective 7: Future Assessment and Tracking																						
T28: BMP implementation schedule	GLWMPC																		■			
T29: Interim milestones	GLWMPC																		■			
T30: WQ monitoring strategy	GLWMPC																		■			
T31: Assess TP loading targets	GLWMPC																		■			
Objective 8: Watershed Outreach																						
T32: Outreach strategy	GLWMPC	■	■	■	■	■	■	■	■	■	■	■										
T33: Online stormwater survey	GLWMPC	■	■	■	■	■	■	■	■	■	■	■										
T34: Septic maintenance education	GLWMPC	■	■	■	■	■	■	■	■	■	■	■	■	■	■							
T35: Gravel roads education	GLWMPC	■	■	■	■	■	■	■	■	■	■	■	■	■	■							
T36: Stormwater BMPs; Soak up the Rain	GLWMPC/DES	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■						
T37: Watershed management outreach	GLWMPC	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■					
Objective 9: Watershed Management Plan																						
T38: Draft GLWMP	GLWMPC/FBE/DES																			■		
T39: Review draft plan	GLWMPC/DES																			■		
T40: GLWMP to DES; final draft	GLWMPC/DES																				■	
T41: GLWMP published	GLWMPC																				■	
T42: Public meeting	GLWMPC/FBE																				■	

*CG, GLWMP Core Group; Con, Consultant; DES, NHDES; GLWMPC, Gregg Lake Watershed Management Plan Committee

6 Methodology

6.1 Water Quality Data

Water samples have been collected through NHDES VLAP and analysis has been performed in the accredited NHDES water testing laboratory. Any further samples will be collected and analyzed following the same protocols. Because of noted variability in samples gathered since 1997, water samples were collected three times in 2016 and seven times in 2017. Samples will be collected seven times again in 2018. The quality of the data will be assessed by the GLWMPC and NHDES before use in loading and modeling studies. Historical VLAP data are available through the NHDES Environmental Monitoring Database (EMD) at the NHDES OneStop data portal. Only final, validated data from NHDES EMD will be used in the analysis.

Water quality data will be summarized by parameter (at a minimum, TP, chlorophyll-*a*, Secchi disk transparency, and dissolved oxygen/temperature profiles, as well as total suspended sediments, total/dissolved organic carbon, and total nitrogen, as available) according to methods described in Appendix B of the NHDES Guidance for Developing Watershed Management Plans in New Hampshire for Section 319 Nonpoint Source Grant Program Projects (revised April 14, 2010) and the State of New Hampshire 2016 Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology (dated November 30, 2017). Data are truncated to between May 24 and September 15, duplicates are averaged, data are extracted separately for epilimnion and hypolimnion, and data are split between historical and recent (previous 10 years) for summary analysis. Median TP for recent (2009-2018), seasonal (May 24-September 15) epilimnetic samples will represent the Existing Median Water Quality applied to the NHDES Assimilative Capacity Analysis. If more than 10 years of data are available, trends in water quality will be analyzed with the Mann-Kendall non-parametric test using the software package *rkt* to run the M-K test in the statistical platform R (Marchetti, 2017).

6.2. Pollutant Load Analysis and In-Lake Response Modeling

The ENSR-LLRM will be used to calculate watershed phosphorus loading and the load reductions that would result from the implementation of different BMPs. This model was developed by AECOM for use in New England and modified for New Hampshire lakes by incorporating New Hampshire land use and TP export coefficients, and adding septic system loading into the model (AECOM and NHDES, 2011a,b). This model has been used extensively for lake TMDLs in New Hampshire. In addition to the VLAP water quality monitoring data, data needed for input include physical characteristics such as lake area, volume and flushing rate; tributary monitoring data, including discharge; corrected GIS land use data; subwatershed land area; precipitation data; and septic system condition and usage data (Table 4). Results of the watershed TP modeling will be input into a series of empirical models that provide predictions of in-lake TP concentrations, chlorophyll-*a* concentrations, algal bloom frequency, and water clarity. Because none of the models are perfect, the average outputs of the models will be used as the predicted TP value for Gregg Lake. The predicted in-lake TP concentration will be compared to actual in-lake water quality data. The model output includes an estimate of water and phosphorus loads by land use type and source group (e.g., atmospheric deposition, internal load, waterfowl, septic system, and watershed), as well as in-lake TP, chlorophyll-*a*, Secchi disk transparency, and algae bloom probability.

Table 4. Data Sources for ENSR-LLRM.

LLRM Input	Source
WQ monitoring data	NH VLAP/NHDES EMD
Physical characteristics	NHDES EMD / NH GRANIT
Tributary WQ monitoring data	NH VLAP/NHDES EMD
Tributary discharge	USGS and/or simple measurements
Corrected GIS land use data	NH GRANIT, other sources, ground-truthing, drone imagery
Subwatershed area	GIS data
Precipitation	NOAA
Septic system data	US Census, TOA

VLAP data have been collected for Hattie Brown Brook, which, along with an unnamed brook that flows into it, drains much of the Gregg Lake watershed and forms the Gregg Lake inlet. Discharge data from the USGS will be used, if available.

GIS land use and subwatersheds will be ground-truthed by David Ward and other members of the GLWMPC. If needed to ensure thorough coverage, aerial photos will be taken by drone under controlled lighting and weather conditions after deciduous trees have dropped their leaves.

As town water and sewer are not available in the watershed, nearly all homes have septic systems. Led by Helen Perivier and Cathy Spedden, GLWMPC will compile relevant information on septic system condition and usage for septic systems within 250 feet of surface waters in the watershed. Relevant information includes septic system age and usage (average number of people using the system year-round or seasonally).

All data will be assessed by project partners before being used in phosphorus loading and lake modeling studies. Forrest Bell will lead this analysis in consultation with Don Kretchmer. GLWMPC support will be coordinated by Melissa Lombard.

Once the model is completed for current conditions, Laura Diemer will manipulate land use and other source loadings to estimate historical and future pollutant loading (e.g., what the phosphorus load was prior to human development and what the phosphorus load will be following “full buildout” of the watershed under current zoning restrictions). These results will be used to help identify which areas of the watershed have the greatest pollutant loading currently or potentially in the future and thus which areas should be targeted for management actions.

6.3 Build-Out Analysis

Kevin Ryan will conduct the build-out analysis using ESRI ArcMap version 10.5 geographic information system (GIS) software and CommunityViz version 4.3. CommunityViz is a GIS-based decision-support tool designed to help planners and resource managers visualize, analyze, and communicate about important land-use decisions. Dr. Ryan will use the software’s ‘Build-out Wizard’ to calculate the development capacity of the study area (numerically and spatially), as well as the ‘Time Scope Analysis’ tool to project and visualize how future development might occur over time. The tools incorporate data on existing buildings, zoning regulations (e.g., setbacks, minimum lot size, etc.), 10-, 20-, and 30-year compound annual growth rates for the town, and environmental constraints to development (e.g., steep slopes, wetlands, hydric soils, conservation land, etc.)

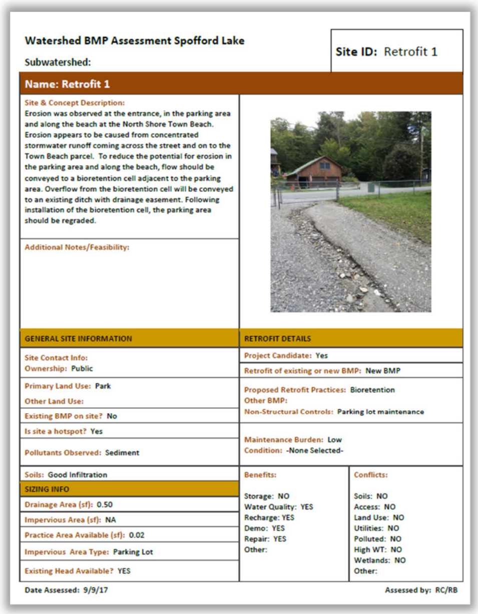
The results of the analysis provide estimates of the numbers of potential lots and new building units that the watershed may see developed at some point in the future. “Build-out” is a theoretical condition which represents the period when all available land suitable for residential, commercial, and industrial uses has been developed to the maximum conditions permitted by local ordinances. “Full build-out” refers to the time and circumstances whereby no more building construction may occur, or the point at which lots have been subdivided to the minimum size allowed and there is no more “developable” land. Performing a build-out analysis reveals what land is available for development, how much development can occur, and at what densities. Municipalities and watershed stakeholders can use the analysis as a tool for planning development patterns in the future and understanding development impacts to water quality.

6.4 Watershed Survey

Laura Diemer and Renee Bourdeau will identify and document sites in the watershed that require implementation of BMPs due to impacts from stormwater, erosion, lack of infiltration (impervious cover), culvert restrictions, and/or lack of vegetated riparian buffer. They will assess the watershed by accessing public roads or waterfront access points.

Field assessments will be completed using handheld, tablet computers with GPS and GIS software for data collection and photography to document the location and existing conditions of specific sites. As part of the field work, Laura Diemer and Renee Bourdeau will note the location (based on GIS coordinates) and the extent of the stormwater impact or source areas, make preliminary recommendations about the type of stormwater management that would benefit the site, rate the severity of the problem, document any observed site constraints for implementing the stormwater management option, and record any other relevant field observations. These data will then be downloaded and loaded into a set of assessment forms that combine the notes, mapped location and GPS coordinates, and photographs of the site. The results can also be provided as a basic KMZ file that can be viewed by project partners in Google Earth, showing each site location with a pop-up summary table.

Following field work, Laura Diemer and Renee Bourdeau will generate pollutant load reduction estimates (e.g., phosphorus, nitrogen, and sediment) for each identified site with successful BMP implementation (see Section 9). We will use the best available topographic data for the watershed to estimate the drainage area to each site, estimate the stormwater volume that can be treated, and then calculate an estimated pollutant load reduction (or range) that can be achieved at each site. The pollutant load reduction estimates will be presented in a summary table (e.g., BMP Priority Matrix). Sites will be prioritized based on a weighted cost that weights the cost per mass of phosphorus removed by the relative environmental impact (high = 1, moderate = 2, low = 3). Lower impact sites have a higher weight to prioritize those sites less than higher impact sites that may have a slightly higher cost per mass of phosphorus removed. Environmental impact will be based on proximity to surface waters, impediment to fish or other aquatic life passage (e.g., undersized or perched culvert), habitat quality, as noted on assessment forms.


Watershed BMP Assessment Spofford Lake
Subwatershed:
Site ID: Retrofit 1
Name: Retrofit 1
Site & Concept Description:
Erosion was observed at the entrance, in the parking area and along the beach at the North Shore Town Beach. Erosion appears to be caused from concentrated stormwater runoff coming across the street and on to the Town Beach parcel. To reduce the potential for erosion in the parking area and along the beach, flow should be conveyed to a bioretention cell adjacent to the parking area. Overflow from the bioretention cell will be conveyed to an existing ditch with drainage easement. Following installation of the bioretention cell, the parking area should be regraded.
Additional Notes/Feasibility:

GENERAL SITE INFORMATION	RETROFIT DETAILS	
Site Contact Info: Ownership: Public	Project Candidate: Yes Retrofit of existing or new BMP: New BMP	
Primary Land Use: Park Other Land Use:	Proposed Retrofit Practices: Bioretention Other BMP: Non-Structural Controls: Parking lot maintenance	
Existing BMP on site? No		
Is site a hotspot? Yes	Maintenance Burden: Low Condition: -None Selected-	
Pollutants Observed: Sediment		
Soils: Good Infiltration	Benefits:	Conflicts:
SIZING INFO	Storage: NO	Soils: NO
Drainage Area (sf): 0.50	Water Quality: YES	Access: NO
Impervious Area (sf): NA	Recharge: YES	Land Use: NO
Practice Area Available (sf): 0.02	Demo: YES	Utilities: NO
Impervious Area Type: Parking Lot	Repair: YES	Polluted: NO
Existing Head Available? YES	Other:	High WT: NO Wetlands: NO Other:

Date Assessed: 9/9/17
Assessed by: RC/RB

Example Watershed BMP Assessment field form.

7 In-lake Water Quality Goal Development

The assimilative capacity analysis, including calculations for total assimilative capacity, reserve assimilative capacity, and remaining assimilative capacity, will be conducted in accordance with the Standard Operating Procedure for Assimilative Capacity Analysis for New Hampshire Waters (Appendix B in the NHDES Guidance for Developing Watershed Management Plans in New Hampshire for Section 319 Nonpoint Source Grant Program Projects, revised April 14, 2010). The amount of in-lake phosphorus and chlorophyll-*a* reduction needed to meet state nutrient criteria will be calculated. Tier 2, or high quality, waterbodies are described as having water quality in which one or more parameters is better than the standard plus the reserve capacity of 10% of the total assimilative capacity. Impaired and Tier 1 waters have no remaining assimilative capacity. The assimilative capacity results for chlorophyll-*a* will dictate the assessment if both chlorophyll-*a* and total phosphorus data are available and the results differ. This is because chlorophyll-*a* (the response indicator) may be limited by another factor regardless of total phosphorus loading. While phosphorus loading should be appropriately managed and reduced in all waterbodies where human activities dominate, the amount of phosphorus reduction set by the in-lake water quality goals may be less stringent if elevated in-lake phosphorus concentrations are not triggering a similar elevation of in-lake chlorophyll-*a* (or algae response). If, as expected, the current median water quality values for Gregg Lake fall within or above the reserve capacity, then the in-lake water quality goal will be determined based on historical water quality and reductions needed to return water quality values to the high-quality range. Joan Gorga and Melissa Lombard will lead the data analysis, with guidance from Laura Diemer and Jeffrey Marcoux.

Laura Diemer, with input from Don Kretchmer and Joan Gorga, will develop documentation that justifies an in-lake water quality goal for Gregg Lake, based on results from the water quality analysis, assimilative capacity analysis, and modeling. A Water Quality Advisory Committee composed of representatives from NHDES, FBE, TOA, lake associations, area residents, and landowners will be charged with discussing the consultants' proposed in-lake water quality goal(s) and setting final in-lake water quality goal(s) that are reasonable and achievable. The following will be considered during the in-lake water quality goal setting process:

- Historical phosphorus loading to determine what the best possible in-lake water quality was prior to human influence.
- Future phosphorus loading to determine what the worst possible in-lake water quality will be following full build-out of the watershed under current zoning regulations. New development using business-as-usual regulations will likely increase current phosphorus loading to waterbodies and possibly hinder progress toward achieving the in-lake water quality goals. Given this consideration, it will be just as important to focus on updating municipal regulations to incorporate more stringent water quality protections for new development as it will be to reduce phosphorus loading from existing development.

8 Quality Objectives, Criteria and Control

Water quality data will be obtained from the NHDES EMD. Water quality data have been collected by volunteers participating in the NHDES VLAP. Each season's data is reviewed by personnel in the NHDES Limnology Center to ensure QA/QC protocols have been met before it is transferred for acceptance into the EMD managed by NHDES. Forrest Bell, Jeffrey Marcoux, and the WQAC will provide input on the data and methods used in the analysis using final, validated data from EMD.

GIS land-use data will be obtained from the State of New Hampshire GIS website (GRANIT). The NH Land Cover Assessment 2001 (or NHLC01) consists of the most recent and detailed classification of land cover in New Hampshire based on satellite images acquired between 1990 and 1999, with further revisions in 2001 (GRANIT). GIS data will be ground-truthed with smart phones, a hiking GPS unit, and GPS-enabled photography by members of the GLWMPC (and/or Laura Diemer).

Laura Diemer will make certain that all data used to inform model outputs have gone through careful review and align with model documentation provided in the LLRM User Guide contained in the Total Maximum Daily Load for Robinson Pond, Hudson, NH (AECOM and NHDES, 2011; https://www.des.nh.gov/organization/divisions/water/wmb/tmdl/documents/robinson-pond.pdf).

To ensure accurate data entry at the levels of field survey forms and spreadsheet entries, calculations and outputs, independent quality control checks will be performed by Joan Gorga and Melissa Lombard after each step of data entry or manipulation. A checklist for reviews and checks will be constructed, and documents will include a section in which reviews are documented. Laura Diemer will also review spreadsheets for inconsistencies. If errors are identified, Joan Gorga will review input values and correct any errors to ensure that no incorrect information is used in model calculations. Errors will be documented, along with resolution described. Forrest Bell and Don Kretchmer will also review all modeling calculations. All calculations and forecasts will be reviewed for completeness and rationality by Joan Gorga, Melissa Lombard, Laura Diemer, and Jeffrey Marcoux.

9 Data Evaluation of Load Reduction Estimates

For areas of the watershed that are shown to contribute substantial amounts of phosphorus to Gregg Lake, the "Simple Method" load reduction model (NHDES, 2010) will be used to calculate estimated load reduction. The Simple Method estimates pollutant load from a drainage, using the drainage area, pollutant concentrations, precipitation data, and land use factors. The pollutant load is calculated as a product of annual runoff volume and pollutant concentration, using runoff coefficients based on land use. A spreadsheet is available from NHDES for this purpose. Load reduction estimates will be reviewed for completeness and rationality, and the results will be compared to other similar watershed analyses in New Hampshire. Observations, conclusions, and limitations will be summarized, and the WQAC will prioritize areas of the watershed to install pollutant runoff controls using BMPs. Laura Diemer and Renee Bourdeau will provide recommendations concerning rough BMP design and estimated construction costs.

10 Final Products and Reporting

The following deliverables will be submitted to NHDES by the completion of the project:

- A summary of the calculation of the current water quality criteria for phosphorus and chlorophyll-*a* and determination of the impaired status of Gregg Lake, December 2018
- Documentation of the process required for formally arriving at the in-lake water-quality goal for phosphorus and its effects on Gregg Lake's water quality impairments, July 2019
- Report identifying the current and future pollution source loads by land use type and source group by subwatershed for each parameter, along with refined pollution source loads for each subwatershed based upon site-specific knowledge using field ground-truthing methods, March 2019

- Report describing and prioritizing the NPS management measures that will be used to achieve the load reduction estimated, as well as other watershed goals identified in the watershed-based plan, and identifying the critical areas in which those measures will be needed to implement the plan, August 2019
- Summary memos or draft watershed management plan chapters for watershed plan elements f, g and h, December 2019
- Documentation of materials produced for participatory workshops and a summary of outreach efforts, October 2019
- Completed Gregg Lake Watershed Management Plan, February 2020

11 References

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