Appendix A:
Site Specific Project Plan

SITE SPECIFIC PROJECT PLAN WATERSHED MANAGEMENT PLANNING PROJECTS for:

Development of a Watershed Plan for Lake Waukewan and Lake Winona
R-12-M-09

Under the New Hampshire Section 319 Nonpoint Source Grant Program QAPP
RFA# 08262
August 23, 2013

January 27, 2014

Prepared by:
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For Review:

Project Manager: _____
Signature/Date
Patricia Tarpey, LWWA

Technical Project Manager/QA Officer: _____
Signature/Date
Forrest Bell, FB Environmental Associates

NHDES Project Manager: _____
Signature/Date
Stephen Landry, NHDES

Program Quality Assurance Coordinator: _____
Signature/Date
Jillian E. McCarthy, NHDES

NHDES Quality Assurance Manager: _____
Signature/Date
Vincent Perelli, NHDES

For Receipt:

EPA Nonpoint Source Program Coordinator: _____
Signature/Date
Erik Beck, NHDES

3- Distribution List

Table 1 lists people who will receive copies of the approved Site Specific Project Plan (SSPP) for 'Development of a Watershed Plan for Lake Waukewan and Lake Winona' under the *New Hampshire Section 319 Nonpoint Source Grant Program Quality Assurance Project Plan* dated **August 23, 2013**.

Table 1. SSPP Distribution List

SSPP Recipient Name	Project Role	Organization	Telephone number and e-mail address
Patricia Tarpey	Project Manager	LWWA	603-581-6632 ptarpey@winnipesaukee.org
Forrest Bell	Technical Project Manager/QA Officer	FB Environmental	207-221-6699 info@fbenvironmental.com
Don Kretchmer	Pollutant loading and in-lake quality analysis	DK Water Resource Consulting, LLC	603-387-0532 dkretchmer@metrocast.net
Jennifer Jespersen	Task Manager	FB Environmental	207-221-6699 jenj@fbenvironmental.com
Jeremy Deeds	Water Quality Data Review/LLRM	FB Environmental	207-221-6699 jeremyd@fbenvironmental.com
Tom Ballestero	BMP Design	UNH Stormwater Center	Phone: (603) 862-1405. tom.ballestero@unh.edu
Stephen Landry	NHDES Project Manager	NHDES, Watershed Management Bureau	603-271-2969 Stephen.landry@des.nh.gov
Jillian McCarthy	Program QA Coordinator	NHDES, Watershed Management Bureau	603-271-8475 jillian.mccarthy@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

4- Project Organization

Figure 1 (below) outlines the organization structure of the project personnel and Table 2 identifies the roles and responsibilities of those individuals involved in the project.

The principal data users include the Lake Winnipesaukee Watershed Association (LWWA), FB Environmental Associates (FBE), DK Water Resource Consulting, LLC, and NHDES, who will use the data to assist in the development of the watershed-based plan for Lake Waukewan and Lake Winona. Project personnel will present the data to the Waukewan Watershed Advisory Committee, who will be the principal decision makers. The

Waukewan Watershed Advisory Committee will be comprised of representatives from the five communities of Meredith, Center Harbor, New Hampton, Ashland, and Holderness, as well as members of the Waukewan and Winona Watershed Protective Association, Waukewan Shoreowners Association, Lake Winona Improvement Association, Winona Forest Association and others.

Patricia Tarpey, Project Manager, will have the responsibility of overseeing and communicating progress in the project to NHDES, partners and the stakeholders. Ms. Tarpey will also be responsible for documenting and notifying the partners and stakeholders of any changes made to the project.

Figure 1. Project Organizational Chart

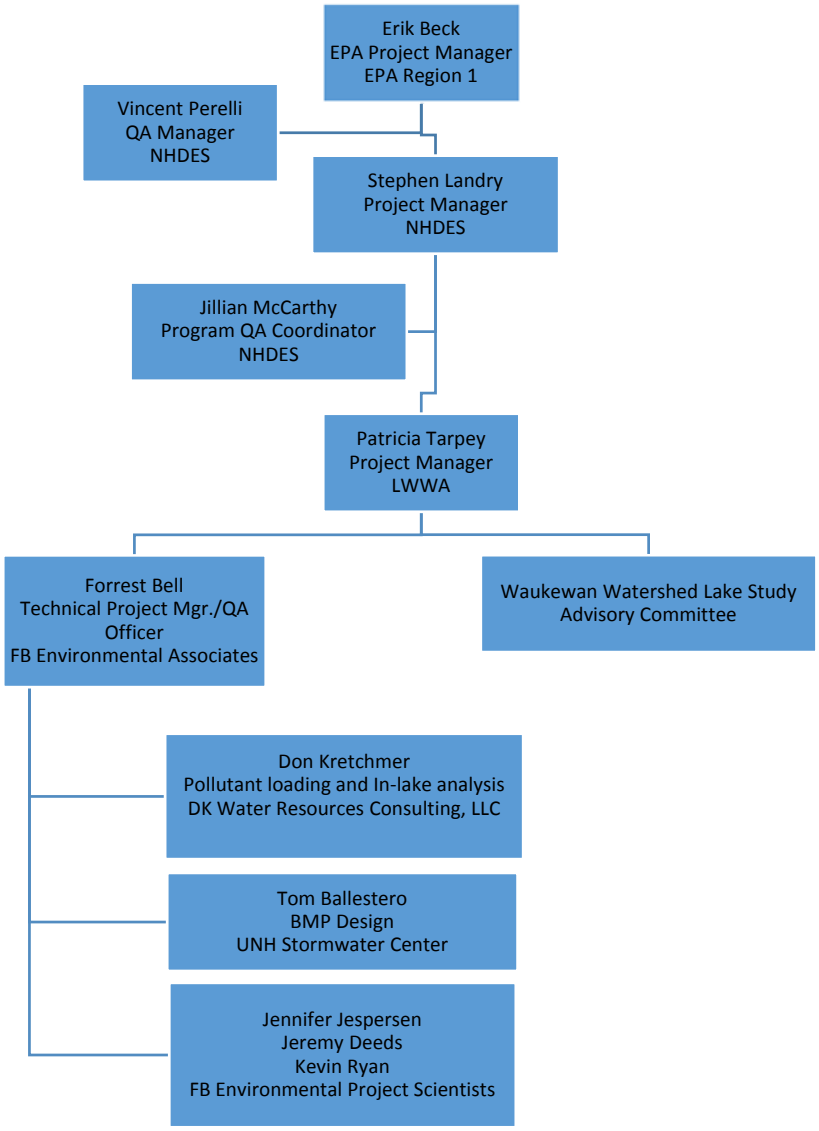

Table 2. Personnel Responsibilities and Qualifications

Name and Affiliation	Responsibilities	Qualifications
Patricia Tarpey, LWWA	Project Manager	On file
Forrest Bell, FBE	Technical Project Manager Project QA/QC Officer	On file
Don Kretchmer, DK water Resources Consulting, LLC	Pollutant loading analysis, In-lake quality analysis, LLRM model specialist.	On file
Jennifer Jespersen, FBE	Task Manager for FBE	On file
Jeremy Deeds, FBE	Water Quality Data and LLRM calculations	On file
Kevin Ryan, FBE	CommunityViz Software	On file
Tom Ballestero, UNH Stormwater Center	BMP Design	On file
Jillian McCarthy, NHDES, Watershed Management Bureau	Reviews QAPP preparation and other QA/QC activities	On file at NHDES
Stephen Landry, NHDES, Watershed Management Bureau	Reviews and oversees projects funded by NHDES 319 Restoration Grants in Merrimack basin.	On file at NHDES
Vincent 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

5 -Site Information

The Waukewan-Winona watershed (Figure 2) includes five towns in and around Meredith, NH; New Hampton, Center Harbor, Holderness, and Ashland, NH. Developed land of 951 acres makes up 13% of the total 7162 acres of land in the Waukewan Watershed, with over 6000 acres of forest land accounting for 84% of the land area. Lake Winona, at 154 acres, and Lake Waukewan, 953 acres, are the largest waterbodies. Lake Winona outlets to the Snake River, which flows approximately 2 miles before emptying into Lake Waukewan. Protecting the water quality of Lake Waukewan is a major priority for the Town of Meredith, as not only is the lake a recreational asset it is also a municipal drinking water supply serving approximately 3000 users.

Currently, Lake Waukewan is categorized as oligotrophic and Lake Winona as mesotrophic (NHDES, Environmental Monitoring Database). Development around the lake consists of a mix of seasonal and year round residential homes and cottages. Businesses on the lake include some commercial and light industrial use, especially in the Monkey Pond subwatershed of Lake Waukewan and several campgrounds.

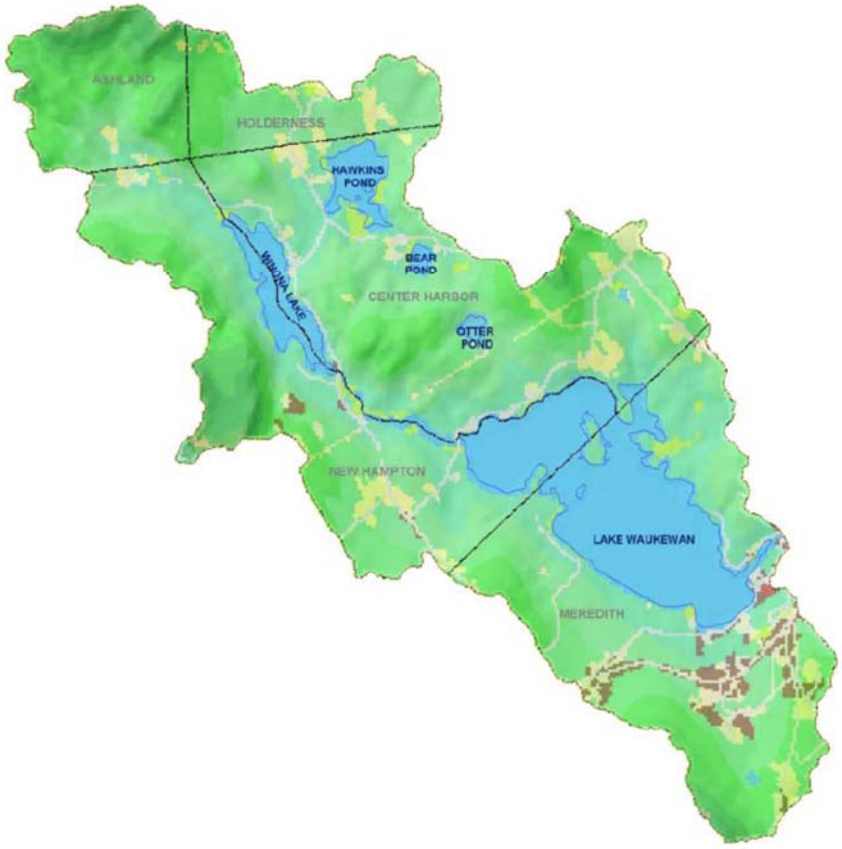

Figure 2. Lake Waukewan watershed

6-Project Rationale

The Lake Waukewan and Lake Winona Watershed Restoration Plan (WRP) project is part of a long-term strategy to create a public, on-line Watershed Management Plan (WMP) for the entire Lake Winnipesaukee watershed that addresses nutrient loading. In 2005 a management plan for the Waukewan Watershed was developed that provides a detailed description and analysis of nonpoint sources of pollution in the watershed; however the planning process at that time did not include quantifying pollutant loads and reductions. In 2010, the "Plan 1: Meredith, Paugus and Saunders Bay" WMP was released as a first step in this process. Lake Winona and Lake Waukewan, which drain to Meredith Bay, Lake Winnipesaukee, contribute the largest volume of water to the bay, but were not included in the modeling during development of the Meredith, Paugus and Saunders Bay WMP.

The Waukewan watershed includes three different sites impacted by nonpoint source pollutants which are listed on the state's current 303(d) list of impaired waters: Waukewan Lake, Waukewan Town Beach, and Winona Lake. Waukewan Lake fails to support designated uses due to a severe dissolved oxygen (DO) and DO saturation impairment (5-P) and a cyanobacteria (hepatotoxic microcystins) impairment (5-M), which is of concern and importance as Lake Waukewan is the public drinking water supply for the Town of Meredith. Waukewan Town Beach fails to support aquatic life use due to a DO impairment (5-M). Winona Lake also fails to support aquatic life use as a result of a severe dissolved oxygen (DO) and DO saturation impairment (5-P). The sources for all of these impairments are listed as "Source Unknown."

Potential threats to the lake quality and public drinking water supply include stormwater runoff, development pressure, recreation, septic systems, erosion, and land use practices. The goal of this project is to protect the surface waters of the watershed from these threats by developing a WMP which will establish in-lake and watershed load reduction goals for phosphorus, the key limiting nutrient for this subwatershed and Lake Winnipesaukee. The planning process will focus on local involvement and result in recommendations and implementation strategies for public education, adoption of best management practices, site restoration projects, and reduction of pollution source materials.

7-Project Description and Schedule

General phosphorus loads for Lake Waukewan were estimated during the development of the Meredith, Paugus, Saunders Bay Sub-watershed Management Plan (MPSB) completed in 2010. The estimated range of P loads (717 to 1060 lbs.) represents low and high estimates of watershed load based on 1% and 10% septic system failure rates, and includes direct precipitation as well. Internal loading or other site-specific problem areas within the watershed were not provided. In addition, no detail was provided for Lake Winona in the MPSB WMP. To assist the Waukewan Watershed Advisory Committee in setting water quality goals for Lake Waukewan and Lake Winona the following will occur:

- Evaluate existing water quality data for completeness and validity in the Waukewan-Winona subwatershed from all available sources, including the 2010 report “Plan 1: Meredith, Paugus and Saunders Bay” and the 2005 WWAC report “Management Plan for the Waukewan Watershed”. NH DES OneStop data portal will be used to access data that has been pre-screened and quality checked by NH DES. The datasets include information from NH DES lake trophic surveys and data from the NH Volunteer Lake Assessment Program. The water quality data will be used to assess current water quality conditions, determine the assimilative capacity, and assist the Water Quality Advisory Committee in setting a water quality goal for phosphorus. Details of the source of the water quality data, the assimilative capacity analysis and water quality goal setting process are provided in Sections 8 and 9 of this plan.
- Complete phosphorus loading analysis for both Waukewan and Winona. In addition, an estimation of internal P-loading, septic system P loading, future loading scenarios, and other potential sources not modeled will be determined. Establish a threshold for phosphorus loading in the sub-watershed using the Lake Loading Response Model (LLRM). Details of the LLRM are provided in Section 10 of this plan.
- Verify watershed P load models using in-lake P prediction models. Details of the prediction models are included in Section 10 of this plan.

The results of the pollutant load, in-lake analysis, and build-out analysis will be used to:

- Formalize the water quality goal(s) for Lake Waukewan and Lake Winona.
- Generate pollution reduction estimates required to meet water quality goals using approved land use/load reduction models and manufacturers’ specification sheets on BMP performance.

It is anticipated that the water quality analysis, pollutant loading, in-lake analysis, and build-out analysis will be completed by July 2014.

8-Historical Data Information

As mentioned above, both Lake Winona and Lake Waukewan are listed on the State's 303 (d) list as not supporting the aquatic life designated use for a severe dissolved oxygen (DO) and DO saturation impairment (5-P), sources unknown. Lake Waukewan is also listed as not supporting primary contact recreation due to a cyanobacteria impairment.

Available water quality data for Lake Winona sets the historical Epilimnion TP at 7.1 ug/L and the historical Hypolimnion TP at 11.8 ug/L, with an overall declining trend in both. The historical chlorophyll-*a* average is 3.85 ug/L. There are two deep lake sampling stations on Lake Waukewan; both show a declining trend in total phosphorus concentrations in the epilimnion, with a combined historical avg. of 5.5 ug/L TP. In contrast, the hypolimnion shows an increasing trend in total phosphorus concentrations with a combined historical avg. of 12 ug/L. Long-term trend for chlorophyll-*a* shows a slight increase, with the historical avg. at 2.5 ug/L.

The historical water quality data for both waterbodies has been collected by volunteers in the NHDES Volunteer Lake Assessment Program (VLAP). As such, each season's data is reviewed by NHDES to ensure QA/QC protocols have been met before it is accepted and entered into the Environmental Monitoring Database (EMD) managed by NHDES.

9-Establishing Water Quality Goals

Potential pollution threats to the lake quality and public drinking water supply include stormwater runoff, development pressure, recreation, septic systems, erosion, and land use practices. The goal of this project is to protect the surface waters of the watershed from these threats by developing a WMP which will establish in-lake and watershed load reduction goals for phosphorus, the key limiting nutrient for this subwatershed and Lake Winnipesaukee.

Water quality goals for Total Phosphorus (TP) will be established for both Lake Waukewan and Lake Winona by the Advisory Committee. Water quality data analysis for each waterbody will be conducted on data available from the EMD by Pat Tarpey, Project Manager. The data will be divided into two categories – historical data over 10 years old, and summer data collected within the last 10 years. The seasonal median for each sampling site will be determined for both TP and Chl-*a*, then the median of the medians will be calculated for each water body.

The assimilative capacity of a water body describes the amount of pollutant that can be added to that water body without causing a violation of the water quality criteria. The water quality nutrient criterion for phosphorus has been set at 8ug/L for an oligotrophic water body (high quality water). The NHDES requires 10% of the state standard to be kept in reserve; therefore, phosphorus levels must remain below 7.2 ug/L to be in the Tier 2 High Quality Water category.

Assimilative Capacity (AC) for Total Phosphorus (TP)

- Total AC = (Water Quality Standard (8 ug/L TP) – Best Possible WQ (0 ug/L) = 8.0 ug/L TP
- Reserve assimilative capacity = 0.10 x Total AC = 0.8 ug/L P
- Remaining assimilative capacity = 7.2 ug/L – Existing WQ

An analysis of a waterbody's assimilative capacity is used to determine the total assimilative capacity, the reserve assimilative capacity, and the remaining assimilative capacity of each water quality parameter being considered.

This information is then used to determine water quality goals and actions necessary to achieve those goals. The assimilative capacity analysis is conducted in accordance with the Standard Operating Procedure for Assimilative Capacity Analysis for New Hampshire Waters.

Currently, Lake Waukewan is categorized as oligotrophic and Lake Winona as mesotrophic (NHDES, Environmental Monitoring Database). The process of establishing water quality goals will be guided by the assimilative capacity analyses conducted by LWWA. LWWA will first determine whether the current median water quality of each waterbody is greater than the reserve assimilative capacity. If median water quality values for each waterbody are greater than the reserve assimilative capacity (Tier 2- exceeds standards), then the water quality goal will be considered based on the current median value and historic water quality data. If the median water quality values fall within the reserve capacity (Tier 1), then the water quality goal will be determined based on historical water quality and potential reductions needed to get water quality values back to the high quality range. Once the initial calculations have been completed and reviewed by FB Environmental and DK Water Resource Consulting, the Advisory Committee, consisting of town selectmen, conservation commission, and planning board members for the Towns of Meredith, New Hampton, Center Harbor, Ashland, and Holderness, representatives of area lake associations, and NHDES staff will help finalize the water quality goals.

10 – Loading Models

Watershed Phosphorus Loading

The Lake Loading Response Model (LLRM; version "*Lake Loading Response Model_LLRM_ver2010*") (also called SHEDMOD or ENSR-LRM) will be used to assess current nutrient loads from the watershed, and the load reductions that would result from the implementation of different best management practices (BMPs). This model was developed by AECOM for use in New England and modified for New Hampshire lakes by incorporating New Hampshire land use, total phosphorus TP export coefficients, and adding septic system loading into the model (AECOM, 2009). This model provides the best fit for the Waukewan-Winona watershed, and has been used extensively for more than 30 recent Lake TMDLs in New Hampshire. A recently completed (and NHDES-approved) LLRM model version, such as the one used in Province Lake in 2013, will be used as the starting point. The LLRM User Guide contained in the *Total Maximum Daily Load for Robinson Pond, Hudson, NH* (AECOM and NHDES, 2011) will serve as the primary documentation on the model.

Data needed for input into the LLRM include water quality monitoring data (total phosphorus, Chl-*a*, and transparency); physical characteristics such as lake surface area, volume and flushing rate; tributary monitoring data including discharge; corrected GIS land use data; subwatershed land area; precipitation data; septic system data (typically available from the US Census Bureau). Weather data will be downloaded from the National Oceanic and Atmospheric Association (NOAA). Tributary discharge data will be used, where available, from USGS gaging stations in the watershed. Subwatershed land area will be calculated using the most current data possible in GIS. In the absence of data that meets project standards for completeness and validity, LLRM default values will be used pending approval of the advisory committee.

Geographical Information Systems (GIS) data will be obtained by FB Environmental to assist with the land use assessment and specifically for determining the total land use area by land use type (in acres) for input into the LLRM. GIS land use data are available 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). These data will be used for the land use loading analysis as described below in the section titled *Future Loading Model/Build-Out Analysis*. GIS land use coverages will be ground-truthed by FB Environmental based on field observations and using publicly available recent aerial photography to ensure the best coverages for input into the model.

Jeremy Deeds of FBE will be running the model. FBE has used watershed loading models for several years, and have successfully applied results from LLRM, AVGWLF, PREDICT, and the USEPA Region 5 Models to many watershed plans. FBE Senior Project Manager Jennifer Jespersen and Don Kretchmer will serve as Task Managers on the project, and will provide technical oversight and confirm that the information used for the model is correct. NHDES will provide technical assistance and review of modeling methods and results. Jeremy will make edits to the model based on feedback from Jennifer Jespersen, Don Kretchmer, NHDES, and the Advisory Committee who will have input on the data and scientific methods used in the analysis.

In-Lake Total Phosphorus Concentrations

Results of the watershed total phosphorus modeling will be input into a series of empirical models that provide predictions of in-lake TP concentrations, Chl-*a* concentrations, algal bloom frequency and water clarity. Also referred to as total phosphorus retention modeling, the model estimates in-lake phosphorus concentrations based on physical and chemical lake characteristics including lake volume, mean depth, watershed area, flushing rate, and estimated watershed phosphorus loading. Because of the imperfect nature of any model to predict processes within natural systems, the model will compare six different in-lake phosphorus models including: Kirchner-Dillon (1975), Vollenweider (1975), Larsen-Mercier (1976), Jones-Bachman (1976), Reckhow General (1977), and Nürnberg (1998). The average of the six empirical models will be used as the predicted TP value for each of the lakes with some exceptions (it may be determined that one of the models is most representative, or a model could be eliminated as inapplicable, which will be documented both in the model spreadsheet and in all applicable reports). The predicted in-lake TP concentration will be compared to actual in-lake water quality data analysis (discussed above). Additional predictions (Chl *a*, water clarity and bloom probability) will be determined based on the average in-lake TP concentration.

Future Loading Model/Build-Out Analysis

FB Environmental will conduct a buildout analysis which will analyze the effects of predicted future watershed development on Waukewan and Winona Lakes. The buildout analysis utilizes GIS-based zoning data and CommunityViz® software to estimate future development within the watershed. The analysis will combine projected population estimates, current zoning restrictions, and a host of additional development constraints (conservation lands, steep slopes, wetlands, existing buildings, soils with development suitability, unbuildable parcels) in order to determine the extent of buildable area in the watershed. Future phosphorus loading will be estimated under full or partial buildout (depending on the timeline of full buildout) and an assessment of the potential effects of future development as it relates to water quality goals. The buildout analysis will be conducted by Kevin Ryan. Kevin is proficient in the use of CommunityViz®, having used it for several similar watershed-based planning projects. Task manager Jennifer Jespersen will provide QA/QC of the buildout data inputs and results of the analysis. This model has been used effectively on previous Watershed Management Plans including Province Lake and the Salmon Falls Headwaters Lakes.

11 – Quality Objectives and Criteria

The utility of model outputs, and the confidence in decisions made on those outputs, are only as strong as the data used to build and calculate the model. FBE will make certain that all data used to inform model outputs have gone through careful QA/QC analyses. The bulk of water quality and GIS data used in this project will be obtained through NHDES, and will therefore have been through a screening process for quality assurance and completeness.

Water quality data will be obtained from NHDES OneStop. The historical water quality data for both waterbodies has been collected by volunteers in the NHDES Volunteer Lake Assessment Program (VLAP). As such, each season's data is reviewed by NHDES to ensure QA/QC protocols have been met before it is accepted and entered into the Environmental Monitoring Database (EMD) managed by NHDES.

Geographical Information Systems (GIS) spatial data will be obtained by FB Environmental to use in the LLRM. 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 land use data will be ground-truthed by FB Environmental based on field observations and publicly available recent aerial photography to ensure the most accurate land use information is used for input into all models.

12 – Quality Control

Quality control checks will be performed by FBE Task Manager Jennifer Jespersen to ensure that information collected during the survey is accurately entered into the spreadsheets. QA/QC checks will be conducted on all field survey forms, and the spreadsheets will be reviewed for inconsistencies. If errors are identified, FBE Project Manager Forrest Bell will review the input values, identify and correct the error to ensure that no incorrect information is used in any model calculation. In addition, FBE Task Manager Jennifer Jespersen will review all modeling inputs, calculations, and outputs for the purpose of QA/QC. All QA/QC issues identified will be properly documented, along with the appropriate steps taken to resolve the issues.

13 – Data Evaluation of Load Reduction Estimates

The "Simple Method" load reduction model will be used to calculate load reduction estimates for areas of the watershed that are shown to contribute substantial amounts of phosphorus to Waukewan and Winona Lakes. The Simple Method is an established empirical model that estimates nutrient or pollutant export amount from watershed sites based on drainage area, precipitation patterns, land use, and known concentrations of pollutants. This method has been used many times by FBE for Watershed Management Plans. It is described in detail by the Minnesota Pollution Control Agency[1].

Load reduction estimates will be reviewed by project staff 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. FBE Task Manager Jennifer Jespersen will be evaluating all loading estimates for the purpose of QA/QC.

The Advisory Committee will identify and prioritize areas of the watershed to install pollutant runoff controls using Best Management Practices (BMPs) based on the results of the load reduction estimate analysis. FBE will estimate load reductions for approximately fifty of the identified BMPs. BMPs will be prioritized based on specific load reduction estimates to select highest priority BMPs. FBE will provide recommendations for a post-construction monitoring and sampling program to confirm that the desired BMPs will produce the desired pollutant removal. These estimates and other estimates of pollutant loading reductions calculated in the pollutant load model will provide an analysis to guide future implementation efforts in the watershed to help reduce phosphorus levels in Lake Waukewan and Lake Winona.

Any observations, trends, conclusions, and limitations in the data will be documented by LWWA in the final report and reported to the Advisory Committee.

[1] Minnesota Pollution Control Agency, *Minnesota Stormwater Manual.* "The Simple Method for estimating phosphorus export," accessed December 20, 2013. http://stormwater.pca.state.mn.us/index.php/The_Simple_Method_for_estimating_phosphorus_export

14 - Final Products and Reporting

The following deliverables will be provided to NHDES by the Project Manager, Pat Tarpey, during the project period:

- Summary of Water Quality Data and Assimilative Capacity Analysis – February 2014
- Documentation of the process followed to establish water quality goals for Lake Waukewan and Lake Winona – July 2014
- Report detailing land use breakdown, and the identification of the current and future pollution source loads by land use type and source group by subwatershed for each parameter. – June 2014
- Report detailing the pollutant load and in-lake quality analysis – June 2014
- Modeling scenarios including natural background, build-out under current zoning, near term, planned future development, and others to meet water quality target. June 2014
- A description of the NPS management measures that will be used to achieve the load reduction estimated based on the target water quality goals (as well as to achieve other watershed goals identified in this watershed-based plan), and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan. – September 2014

Semi-annual reports documenting all work performed on the project at the appropriate intervals throughout the duration of the project will be submitted to NHDES by Pat Tarpey, Project Manager, as required in the contract. The semi-annual reports shall comply with the NHDES and EPA requirements found in the semi-annual report guidance document provided to grant recipients by NHDES. A comprehensive final report in both electronic and hard-copy will be submitted to NHDES on or before the project completion date by the Project Manager. The final report shall include a description of all tasks completed and shall comply with the NHDES and EPA requirements found in the final report guidance document provided to grant recipients by NHDES.