

1. Introduction

Whether man made or natural, lakes serve a multitude of purposes which need to be protected. Lakes may be used for flood control, drinking water supplies, fisheries, wildlife, and/or recreational enjoyment such as swimming and boating, making management to protect those uses a complicated issue and task.

The Lake Waukewan and Winona Watershed Restoration Plan (WRP) is part of a long-term strategy to address current impairments in both lakes by focusing on ways to reduce sediment and nutrient loading inputs to the waterbodies. Current water quality impairments in the Waukewan watershed include elevated bacteria, cyanobacteria, low pH, low dissolved oxygen (DO) and DO saturation (*sources unknown*). Potential threats to water quality include development pressure, recreation, erosion, aging septic systems, and land use practices.

The WRP builds upon the previous Waukewan Management Plan completed in 2005 by quantifying nutrient loading by land use and source, sets local goals or thresholds for in-lake phosphorus levels, and presents an action plan to restore the impaired waterbodies to their designated uses. The Plan provides the communities with a tool to guide future development and redevelopment in the watershed in a manner that will have the least negative impact on water quality of the Waukewan subwatershed.

The Lake Winnepesaukee Association's (LWA) mission is to protect the water quality and natural resources of the lake and its watershed now and for future generations. The Lake Waukewan watershed drains to Meredith Bay in Lake Winnepesaukee and contributes the largest volume of water to the bay of all the watersheds that drain to this location. With partial funding provided through 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, the LWA facilitated the development of a watershed-based restoration plan for the Waukewan-Winona watershed. Additional funding for the project has been generously provided by the Town of Meredith Waukewan Watershed Advisory Committee, the Windy Waters Conservancy, and through volunteer in kind match.

1.1 Purpose and Scope

In 2005 Granite State Rural Water Association (GSRWA) developed a management plan for the Waukewan Watershed which provided an extensive description and analysis of potential nonpoint sources of pollution in the watershed. However, the planning process at that time did not include quantifying pollutant loads to the lake, nor the reductions needed in order to maintain a high quality water. In 2010, the "*Plan 1: Meredith, Paugus and Sanders Bay Watershed Management Plan*" was the first plan completed to address nutrient loading to Lake Winnepesaukee. Although the Waukewan-Winona watershed is part of the greater Meredith Bay, Winnepesaukee watershed, the project scope of

work for *Plan 1* did not allow for a comprehensive watershed assessment and nutrient modeling analysis to be performed for the Waukegan watershed.

In 2013, the Lake Winnepesaukee Association (LWA) was awarded a Section 319 Watershed Restoration Grant through the NHDES Watershed Assistance Section to develop a thorough Waukegan-Winona WRP that includes the EPA's "nine mandatory or key elements" for watershed-based plans. The EPA has identified the following 'a through i' elements as critical for achieving improvements in water quality:

- a. Identification of causes of impairment and pollutant sources that need to be controlled to achieve needed load reductions*
- b. An estimate of the load reductions expected from management measures*
- c. A description of the nonpoint source management measures that will need to be implemented to achieve load reductions estimated in element b*
- d. Estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan.*
- e. An information and education component used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, implementing the nonpoint source management measures.*
- f. Schedule for implementing the nonpoint source management measures identified in the plan*
- g. A description of the interim measurable milestones for determining progress in implementing the management measures or actions identified in the plan.*
- h. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards.*
- i. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under element 'h'.*

The watershed restoration plan evaluates existing lake and tributary data, current and future watershed conditions, and in-lake nutrient concentrations to determine the sources and causes of lake quality impairment. A requirement of management plans funded through the Watershed Assistance Grant program is the establishment of local water quality goals for in-lake total phosphorus levels per assessment unit that either meet or exceed the nutrient threshold established by the State. The completed watershed restoration plan provides recommendations for non-structural and structural approaches for reducing current and future sources of nutrient and pollutant loading to the lake in order to achieve the local water quality goal.

Specifically, the plan:

- a) quantifies primary sources of phosphorus loading using existing data and a watershed and lake response model;
- b) uses a build-out analysis approach to predict future phosphorus sources and loading rates,

- c) prioritizes sources and makes recommendations for actions to reduce phosphorus loading to both Lake Waukewan and Winona;
- d) includes an outreach program for residents and lake users about the sources and consequences of non-point source pollution;
- e) includes Best Management Practice (BMP) designs to address sources,
- f) implements two small demonstration projects or BMPs.

This plan supplements both the *2005 Waukewan Watershed Management Plan* and *2010 Plan 1: Meredith, Paugus and Saunders Bay WMP*, which can be found on the Winnepesaukee Gateway site, www.winnepesaukeegateway.org.

1.2 Existing Water Quality Impairments in the Watershed

The Waukewan-Winona watershed includes five towns - Meredith, New Hampton, Center Harbor, Holderness, and Ashland, NH. Developed land of 951 acres makes up 13% of the total 7,162 acres of land in the Waukewan Watershed, with over 6,000 acres of forest land accounting for 84% of the land area. Lake Winona, at 148 acres, and

Lake Waukewan, 928 acres, are the largest waterbodies. Lake Winona outlets to the Snake River, which flows approximately 2 miles before emptying into Lake Waukewan. Development around both lakes consists of a mix of seasonal and year round residential homes, and cottages. Some commercial and light industrial properties are located in the southern part of the watershed.

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 3,000 residents and the business community.

Currently, the NH Department of Environmental Services (NHDES) categorizes Lake Waukewan as oligotrophic and Lake Winona as mesotrophic. Trophic status is a measure of a waterbody's productivity or the amount of organic matter that it produces. It is determined by a number of physical, biological and chemical parameters; mean depth, volume, flushing rate, phytoplankton and zooplankton abundance, aquatic vascular plant abundance, summer bottom dissolved oxygen, summer secchi disk transparency, total phosphorus and chlorophyll-*a* concentrations, and more. Oligotrophic waterbodies in general are low in nutrients, and therefore less prone to algal blooms, while mesotrophic waterbodies have moderate amounts of nutrients, more plant growth, and lower water clarity.

WATERSHED
All the land that surrounds a lake that drains (or sheds) its water into the lake through streams, ditches, over the land or through groundwater.

The Waukegan watershed includes three different sites impacted by nonpoint source pollutants which are listed on the State's current 303(d) list of impaired waters: Waukegan Lake, Waukegan Town Beach, and Winona Lake. Waukegan 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 Waukegan is the public drinking water supply for the Town of Meredith. Waukegan 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." Watershed Report Cards for each lake can be accessed at NHDES' website, http://des.nh.gov/organization/divisions/water/wmb/swqa/report_cards.htm.

1.3 Management Plan Goals

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

Goals identified in the 2005 Waukegan Watershed Management Plan remain relevant to the overarching goal, and implementation of the strategies identified in this plan will help ensure achievement of the 2005 stated goals:

1. Reduce pollution from nonpoint sources in the watershed.
2. Reduce pollution from water contact activities.
3. Reduce pollution from point sources.
4. Increase understanding of the watershed through research and monitoring.
5. Continue watershed protection activities and continue to raise awareness about the watershed.

1.4 Who was involved in developing the Management Plan?

Local lake associations, residents, and community officials have worked with scientists and the NHDES to develop this plan. It has required understanding the lake's current water quality, setting local water quality goals regarding phosphorus loading, predicting future water quality trends based upon land use changes, identifying ways to reduce nutrient inputs, and establishing ongoing monitoring to evaluate how well those strategies are working.

LWA, FB Environmental Associates, and DK Water Resources Consulting held a public meeting on December 9, 2013 at the Meredith Community Center, Meredith, to kick off the project. More than 50

people came to learn about the project and steps involved in developing a watershed restoration plan. Attendees interested in learning more or becoming involved with the project were encouraged to join the Waukewan & Winona Lake Study Advisory Committee, which met four times during plan development to review project outputs. In addition, members of the Advisory Committee provided boats and volunteers in order to complete the shoreline surveys for Lakes Waukewan and Winona.