LAKE MANAGEMENT PLAN
for
MERCER LAKE
IRON COUNTY, WISCONSIN

Prepared for:
MERCER LAKE ASSOCIATION of IRON COUNTY WISCOSIN
April, 2014

by: Cedar Corporation

with the assistance of:

United States Geological Survey
Wisconsin Department of Natural Resources

MERCER LAKE

LAKE MANAGEMENT PLAN

IRON COUNTY, WISCONSIN

Prepared For:

Mercer Lake Association of Iron County Wisconsin, Inc.

Funded By:

Mercer Lake Association of Iron County Wisconsin, Inc.
&
State of Wisconsin
Department of Natural Resources
Lake Planning Grant Program
&
US Geological Survey
Water Resources

April 2014

Cover: Mercer Lake, 2009

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FOREWORD

Improving and maintaining the pristine waters and exceptional lake water quality of Mercer Lake is the driving force behind this Lake Management Plan. The Mercer Lake Association of Iron County (MLA) board of directors and members have dedicated and expended much time, effort, and expense in this important step to attain the long term goal of improving and protecting the water quality of this historic impoundment lake on the Little Turtle River. Adopting a watershed wide US EPA promoted approach, the MLA recognizes the closely entwined relationships of urban, residential, and recreational land uses, runoff, runoff management, water quality, and aquatic plants. This Lake Management Plan prepared for the MLA Board and members, the Town of Mercer, Iron County, and State administrative governmental units and other interested parties is developed in the long term ongoing effort of lake water quality protection, management, and improvement.

Improving and preserving the aesthetic quality of Mercer Lake is the principal goal. Located downstream of a series of interconnected navigable, invaluable water resources in Iron County, this watershed is unique. Much concern has been voiced that the aesthetic, recreational, and environmental quality of the Lake is succumbing to the pressures of human habitation in the watershed. One goal of the project is to return to the historic water quality by minimizing the footprint of past, current and future human impacts in the watershed. Despite the current (2012) remarkable condition of the Lakes; the key to sustaining the natural beauty, clarity, and availability of these waters for future recreational use is the maintenance and protection of the water quality.

To that end, the long-term management of the Lake must remain at the forefront of the local property owners, community, county, and state governments. The Town of Mercer encompasses the lake. Iron County assists in protection of the Lake through County land and zoning ordinances. The Wisconsin DNR and Safety Professional Services (formerly Commerce) provide oversight through provision and regulation of State Administrative Codes. The DNR and U.S. Geological Survey provide funding opportunities to protect and enhance the State’s natural resources and this plan is a result of this funding. Without the commitment of all concerned, the ability to define the watershed characteristics and identify particular issues, and develop the recommendations contained herein to protect lake water quality could not have been completed.

The need for a Lake Association became increasingly obvious as development pressures along and near the lakeshore from the 1960’s through 2005 presented more signs of lake water quality degradation. High density housing and tourist opportunities, uncontrolled sediment erosion, an outfall for a former municipal waste water treatment facility, the discharge of local urban stormwater, and an increase in aquatic plant (macrophytes) density, all contributed to the lake’s decreased water quality and the increased concern to improve and protect the same water quality that encouraged human use of this resource in the first place. The mission of the MLA was, is, and remains to find ways and means to improve lake water quality and protect the lake for future generations to enjoy.

This work could not have been completed without the volunteer efforts and support of:

- the Board and members of the Mercer Lake Association
- the Boards and Chair of the Town of Mercer
- the Wisconsin DNR
- the United States Geological Survey
- concerned citizens and local organizations

GLOSSARY

Acid Rain: Rain or other precipitation with a higher than normal acid range, as a result of polluted air mixing with cloud moisture. High acidity (low pH) can reduce fish population in lake.

Algal Bloom: An unusual or excessive abundance of algae.

Alkalinity: Capacity of a lake to neutralize acid.

Best Management Practice (BMP): A practice or combination of practices that is determined to be most effective and practical (including technological, economic, and institutional considerations) means of controlling point and nonpoint pollutant levels compatible with environmental quality goals.

Bioaccumulation: Build-up of substances in fish flesh. Substances with toxic effects may pass these on to humans consuming the fish.

Bio-manipulation: Adjusting the fish species composition in a lake as a restoration technique.

Catch Basin: Types of inlet to the storm drain system that typically includes a grate or curb inlet where storm water enters the catch basin and a sump is present to capture sediment, debris and associated pollutants.

Chlorophyll-*a*: A pigment produced by algae (and other plants) measured in a water sample and used as an estimate of the amount (biomass) of algae in water.

Dimictic: Lakes which thermally stratify and mix (turnover) twice a year, in spring and fall.

Dry Detention Ponds: A structural BMP or retrofit that consists of a large open depression that stores incoming storm water runoff while percolation occurs through the bottom and sides.

Ecoregion: Relatively homogeneous geographic area as defined by land use, soils, landform, and potential natural vegetation.

Ecosystem: A community of interaction among animals, plants, and micro-organisms, and the physical and chemical environment in which they live.

Epilimnion: Most lakes form three distinct layers of water during summertime weather. The epilimnion is the upper layer and is characterized by warmer water which is less dense than cold water.

Eutrophication: The aging process by which lakes are fertilized with nutrients. Natural eutrophication very gradually changes the character of a lake. The process of eutrophication can be accelerated as a result of human activities.

Eutrophic Lake: A nutrient-rich lake – characteristically shallow, "green" and with limited oxygen in the bottom layer of water.

Fall Turnover: Cooling surface waters, activated by changing seasons and mixing by wind action, sink to mix with lower levels of water. After the spring turnover, all lake water is now at the same temperature.

Groundwater: Subsurface waters with 100% saturation of soils and rocks below.

Heavy Metals: Metallic elements with high atomic weights (e.g. mercury, cadmium, etc.) with the ability to damage living organisms at low concentrations and tend to accumulate in the food chain.

Hypereutrophic: A nutrient-rich lake characterized by frequent and severe nuisance algal blooms and low transparency.

Hypolimnion: The dense, cold bottom layer of lake water during the summer months. The water in the hypolimnion is prone to oxygen deprivation due to higher oxygen consumption and very little mixing action.

Impervious Surface: Harder compacted surface that retards infiltration of water into the soil or subsurface. Also, a hard surface area that causes water to runoff the surface in greater quantities or at increased flow rates as compared to the flow experienced prior to development. Common impervious surfaces include, but are not limited to rooftops, walkways, patios, driveways, parking lots, storage areas, concrete or asphalt paving, gravel roads, packed earthen materials, and oiled, macadam, or other surfaces that similarly impede the natural infiltration of urban runoff.

Infiltration: The penetration of water through the ground surface into subsurface soil or the penetration of water from the soil into sewer or other pipes through defective joints, connections, or manhole walls.

Lake Management: The process involving the study, assessment, development, and implementation of solutions to maintain a lake as a thriving ecosystem.

Lake Restoration: Actions directed toward improving the quality of a lake.

Lake Stewardship: An attitude that recognizes the vulnerability of lakes and the need for citizens, both individually and collectively, to assume responsibility for their care.

Land Conversion: A change in land use, function or purpose.

Limnetic Community: The area of open water in a lake providing the habitat for phytoplankton, zooplankton, and aquatic fauna.

Littoral Community: The shallow areas around a lake's shoreline, dominated by aquatic plants. The plants produce oxygen and provide food and shelter for animal life.

Local Government: Any County, City, or Town having its own incorporated government for local affairs.

Mesotrophic: Midway in nutrient levels between the eutrophic and oligotrophic lakes.

Nonpoint Source: Runoff containing nutrients and other pollutants from multiple sources not discharged from a single point, e.g., runoff from riparian properties, agricultural fields or feedlots.

Oligotrophic: Characterized with low levels of nutrients, is clear and deep with bottom waters high in dissolved oxygen.

pH Scale: The measure of acidity. Low pH equates to higher acidity and vice versa.

Phosphorus: A nutrient essential for plant growth. In lakes and streams excess phosphorous promotes excessive growth of algae and plants. Total phosphorus is the most common form measurement of phosphorous concentrations in water and includes both dissolved and particulate phosphorus. Ortho-phosphorous is a measure of the concentration of soluble phosphorous that is readily absorbed by plants.

Photosynthesis: The process by which green plants produce oxygen from sunlight, water, and carbon dioxide.

Phytoplankton: Algae - the base of the lake's food chain, it also produces oxygen.

Point Sources: Specific sources of nutrient or polluted discharge to a watershed (e.g. storm water, wastewater discharges, etc).

Pollution Prevention: A management measure to prevent and reduce nonpoint source loadings generated from a variety or everyday activities within urban areas. These can include turf management, public education, ordinances, planning and zoning, pet waste control, and proper disposal of oil.

Polymictic: A lake which does not thermally stratify in the summer but tends to mix periodically throughout summer via wind and wave action.

Post-Development Peak Runoff: Maximum instantaneous rate of flow during a storm, after development is complete.

Pre-Development Peak Runoff: Maximum instantaneous rate of flow during a storm prior to development activities.

Profundal Community: The area below the limnetic zone where light cannot penetrate. Roughly corresponds to the hypolimnion layer and is home to organisms that break down or consume organic matter.

Removal Efficiency: The capacity of a pollutant (sediment) control device to remove pollutants from wastewater or runoff.

Retrofit: The modification of an urban runoff management system in a previously developed area. This may include wet ponds, infiltration systems, wetland plantings, stream bank stabilization, and other BMP techniques for improving water quality and creating aquatic habitat. A retrofit can consist of new BMP construction in a developing area, enhancing an older runoff management structure, or combining improvements and new construction.

Runoff: That part of precipitation, snow melt, or irrigation water that runs off the land into streams or other surface water. Runoff can carry pollutants into receiving waters.

Secchi Disk: A device measuring the depth of light penetration in water. A circular disk usually 8 inches in diameter that is painted in alternate black and white quadrants.

Sedimentation: The accumulation of soils to the bottoms of streams, rivers, lakes, and oceans. It is part of the natural aging process of aquatic geo-forms resulting in shallower waters. The process is accelerated by uncontrolled erosion in the watershed.

Sedimentation Basins: Constructed sediment storage areas that may consist of wet or dry detention basins. Excavated areas with storage depression below the natural ground surface; creek, stream, channel or other drainage-way bottoms properly engineered and designed to trap and store sediment for future removal.

Spring Turnover: After ice melts in spring, warming surface water sinks to mix with deeper water. At this time of year, all water is the same temperature.

Thermocline: During summer that layer of lake water between the upper mixed layer (epilimnion) and lower calm deep layer (hypolimnion). A thin but distinct layer in which temperature changes more rapidly with depth than it does in the layers above or below.

Trophic Status: The level of growth or productivity of a lake as measured by phosphorus content, algae abundance as measured by chlorophyll-*a*, and depth of light penetration.

Turbidity: Particles in solution (e.g., soil or algae) which scatter light and reduce water transparency.

Water Density: The mass of a specific volume of water typically referenced as 0.99997 gram per cubic centimeter at 4°C. Water is most dense at 39 degrees F (4 degrees C) and expands (becomes less dense) at both higher and lower temperatures including ice which accounts for ice floating in water.

Watershed: A drainage area or basin where all land and water areas drain or flow toward a central collector such as a creek, stream, river or lake at a lower elevation.

Wet Detention Ponds: A structural BMP or retrofit that consists of a single permanent pool of water that stores and treats incoming storm water. Wet detention ponds usually have three to seven feet of standing water, allowing pollutants to settle, with a defined siltation/sedimentation pond and outlet structure.

Zooplankton: Microscopic animals.

Historic Preface

The following history of the lake is excerpted with permission from the USGS professional paper titled, "Water Quality, Hydrology, and Simulated Response to Changes in Phosphorus Loading of Mercer Lake, Iron County, Wisconsin, with Special Emphasis on the Effects of Wastewater Discharges, (Robertson, et al, 2012)".

> The area near Mercer Lake has gone through many changes since 1894, when the first train arrived in the area bringing early settlers, roads, mills, stores, and other businesses. Historically, the iron mines and lumber industry were very important for this area, but more recently, the area has become very popular for fishing and other outdoor activities. Because of the many uses for the lake and surrounding area, it is an important resource for Iron County. The popularity of the lake has resulted in additional development around Mercer Lake.
>
> In the 1700s and 1800s, the area near Mercer Lake was relatively pristine, except for a major Chippewa Indian village located near the lake (Outdoor Network, Inc., 2011). Local residents remember the Chippewa camps being occupied until the early 20th century. The area near the lake remained relatively untouched until the 1880's, when iron mining became an important industry in Iron County, and the lumber industry moved into northern Wisconsin. As result of these activities, railroad lines were extended into northern Wisconsin, making the area truly accessible for the first time. The mining boom created a demand for timber to build mines, and villages sprang up to support them. Most of the growth around Mercer Lake, other than the Chippewa village, began in 1894 when the first train arrived, and with it came early settlers, roads, mills, stores and other businesses (table 1). The first Mercer school was erected in 1894. Mercer was established as a Town in 1909, along the north shore of Mercer Lake. The town was named after John Mercer, a timberman. In 1910, the population of Mercer was 311.
>
> In the late 1800's, lumbering flourished and Mercer became a well-established community in northern Wisconsin. Initially, pine logs from the Mercer-Manitowish area were floated down the Manitowish and Turtle Rivers, into the Flambeau River, to the downstream sawmills (Outdoor Network, Inc, 2011). Unmanaged logging, however, took its toll on the area, bringing forest fires in 1911 that burned many acres and threatened lives. Following clear cutting, the vast barren areas were burned rather than being replanted in the hopes of providing good farm land, but farming never became a major industry in Iron County. Soon most of the desirable pine trees had been harvested from Iron County, leaving behind considerable hemlock and hardwoods. These trees were too heavy to log and transport by available methods, and resulted in many smaller mills being established closer to areas of hardwood growth and the available railroad lines. In the late 1930s, a moderate scale sawmill was established between Mercer and Grand Portage Lakes.
>
> In the 1930s, along with the lumber industry, Mercer became a popular vacation area for fishing and hunting (Outdoor Network, Inc., 2011). In 1930, the population of Mercer was 666. Cash crop agriculture never reached significant levels in Iron County; at best,

the logging camps and mines in the area created a demand for small-scale truck farming and hay was grown for livestock. By the 1940s and 1950s, most of the small subsistence farms were either abandoned or absorbed by larger operations. Currently, limited dairy farming is the main agricultural activity in the more fertile part of northern Iron County.

The saw mill has been the only significant industrial site near Mercer Lake. The saw mill burned down several times and was rebuilt by different owners. In 1967–68, a subsidiary of a paper company built, modified this site to debark, treat, and ship logs. This operation continued to about 2005 but at that time it was only operating minimally. The property contained an underground diesel fuel storage tank. This area had an investigation and was monitored for leaking from underground tank (J. Kreitlow, Wisconsin Department of Natural Resources, written comm. 2010). The diesel fuel storage tank was removed in 1994 and was found to have contaminated local soil and groundwater, but no private water supplies were found to have been affected. Monitoring wells indicated that the site was no longer an environmental risk and the site was allowed to close in 2001.

The first municipal wastewater treatment plant for the Town of Mercer was constructed in 1965 on the northwest shore of Mercer Lake, and was designed to treat sewage from most of the town of Mercer, which had a population of 1,048 in 1960. This secondary treatment facility employed an activated sludge process and aerobic digestion, with an average capacity of 85,000 gallons per day. The effluent from the plant passed through a 3,000-ft long, 6-in. diameter asbestos pipe laid along the bottom of the lake and discharged near the Little Turtle River outlet of Mercer Lake. At that time, emergent and submergent aquatic vegetation was moderate to dense and the WDNR considered the lake to have an aquatic weed problem.

It was believed that much of the effluent from the plant was not leaving the lake and may have been affecting the water quality of the lake. Therefore, two dye studies were conducted. Based on the first dye tracer study conducted in 1973, the WDNR concluded that effluent was circulating back into the lake and was adversely affecting the water quality of the lake. It was recommended that the outfall line be extended farther into the outlet. The tracer study was repeated in 1976. It was concluded from the second study, that the effluent was being drawn out of the lake into the Little Turtle River. The reason for the different conclusions given was that the dye plume was not observed long enough in the 1973 survey. In addition to the possibility of the effluent not completely leaving the lake, the plant had frequent operating problems and often had difficulty meeting discharge permit limits. The residents also believed that the pipe installed along the lake bottom may have ruptured soon after construction and spilled effluent directly into the main body of the lake until 1995. Operation difficulties and complaints about the treatment plant continued through the 1980s. A new treatment plant was constructed south of Mercer in 1995 which releases its effluent outside the watershed of the lake. The new facility is a sequencing batch reactor type of plant and discharges to groundwater away from the lake through three seepage cells. The design flow for this plant is 82,700 gallons per day, adequate for 1,100 people. The old treatment plant on the lake was completely removed and the site was restored.

Since the late 1890s, many factors have affected the quality of the water and sediments in Mercer Lake, including nutrient inputs from septic and municipal effluent, chemical spills or leaks from lumber mills and roads, and any actions that may have been taken to ameliorate the effects of these factors. After actions were taken (such as installing a sewage treatment plant in the basin and the later installation of a new treatment plant which does not discharge any effluent into the Mercer Lake watershed), it is believed that water quality of the lake has the opportunity to improve. But water quality continues to be poorer than it was historically; in 2006, residents felt that the amount of muck in the lake had increased now dominates the bottom substrate, and both residents and the WDNR agree the lake has an aquatic weed problem.

Lake and Watershed Statistics (*from Robertson et al, 2012*)

LAKE MORPHOMETRICS

Basin	**Area** (acres)	**Shoreline Length** (miles)	**% Developed Shoreline**	**Mean Depth** (feet)	**Volume** (acre-ft)
East Basin	84	1.5	100	11.7	976
West Basin	95	2.7	57	8.6	817
Total	**179**	**4.2**	**71**	**10.0**	**1,793**

LAKE RESIDENCE TIME

0.46 year (2008 – 2009)
0.33 year (typical)

LAKE INDICATORS

	Total Phosphorus (mg/L)	**Chlorophyll *a*** (µg/L)	**Secchi Depth** (feet)
Ave 2008-2009			
East Basin	0.023	3.5	10.1
West Basin	0.024	3.2	10.4

TSI (TROPHIC STATE INDICES)

	Total Phosphorus	**Chlorophyll *a***	**Secchi Depth**
Ave 2008-2009			
East Basin	48.2	43.3	44.0

In general the lake is described as mesotrophic.

WATERSHEDS LAND USE *(Table 4, Robertson et al, 2012)*

Basin	Entire Watershed	Upstream Gaged Area	Tahoe Watershed	Near Shore Drainage
Area (acres)	7,625	6,564	769	292
% Agriculture	0.4	0.5	0.0	0.0
% Forest	74.9	75.0	77.2	66.5
% Shrub/Grass	1.1	1.0	1.9	0.0
% Wetland*	6.6	7.7	0.1	0.0
% Low- density Residential	5.9	5.3	8.0	15.2
% Moderate and High Density Residential	2.2	1.3	3.2	18.3
% Golf Course	0.4	0.0	3.8	0.0
% Water*	8.5	9.2	5.9	0.0

*This does not include the surface area of Mercer Lake.

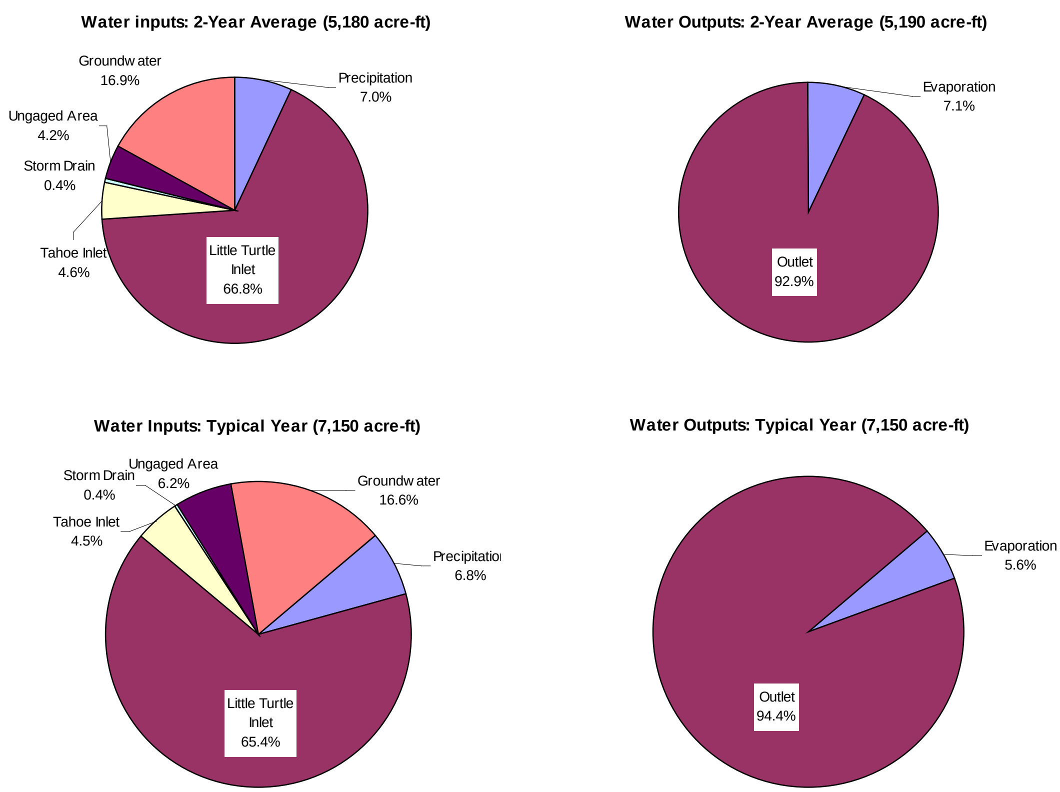


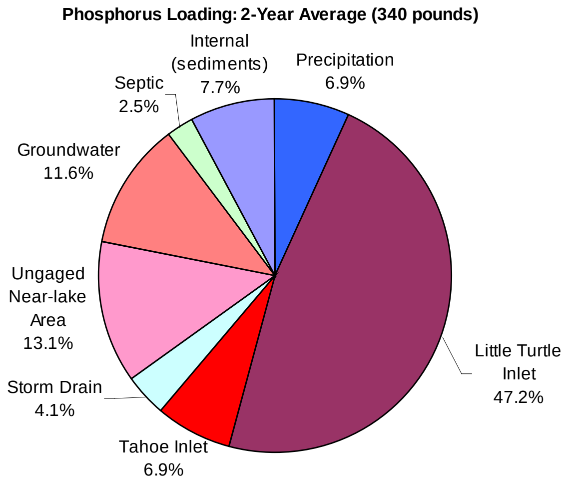
Figure 18 *(reprinted from Robertson et al, 2012)*

WATER & PHOSPHORUS BUDGETS (*Tables 8 & 6, Robertson et al, 2012)*

A comparison between conditions existing based on 2008-09 monitoring adjusted to typical hydrology and the USGS build-out scenario # 17 in 2025 with limited water quality improvements in the form of proposed storm water controls for USH 51 construction and BMPs installed for new developments.

	WATER BUDGET (ac-ft)	**PHOSPHORUS BUDGET (lbs)**	
Component	**Typical Hydrology**	**Typical Hydrology**	**After Build Out**
INPUTS TO LAKE			
Precipitation			
Mercer Lake	489	28.8	28.8
Tributaries			
Little Turtle Inlet	4,678	216.8	216.8
Tahoe Inlet	324	31.8	31.8
Near-Lake Drainage			
Ungaged Area	441	90.7	57.7
Storm Drain	29	18.7	11.9
Groundwater	1,186	53.3	53.3
Septic Systems		8.6	8.6
Internal (sediment) Loading		26.3	26.3
TOTAL INPUT	7,148	475.0	435.2
OUTPUTS from LAKE & STORAGE			
Retained in Sediments		136	124.6
Evaporation	400	0	
Groundwater	0	0	
Little Turtle Outlet	6,748	339	310.6
TOTAL OUTPUT	7,148 ac-ft	475	435.2

Note: In the future scenario there are no forecast changes in water budget as the storm waters are either infiltrated OR limited to 2010 quantities of runoff



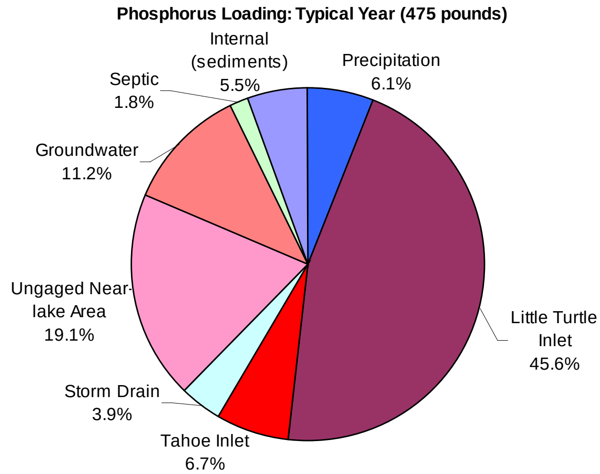


Figure 21 *(reprinted from Robertson et al, 2012)*

Action Plan

The recently completed USGS water quality study of Mercer Lake and the known relationship of human influences resulting in increased algal growth in watersheds allow us to make the following claim.

> **Should the watershed residents choose not to administer and regulate Phosphorus discharges in the watershed now; the discussion of Phosphorus controls in the future will be moot, as the Lake will experience increased algal development, an increase of algae blooms in the back bays where water circulation is low, and the prevalence of blue green algae**.

Chapter 10 of the Mercer Lake Management Plan outlines numerous conclusions and recommendations developed from the many studies and inquiries preceding the preparation of this document. Developing short term Action Plans consisting of both reasonably attainable goals including repetitive educational efforts is the best method to further the Association's objective of sustaining or improving the water quality of Mercer Lake and this watershed for future generations.

Preparation of the Plan is in itself a tremendous accomplishment, but as any manager knows, implementation (and ongoing education and plan evolution) is where the rubber meets the road. Preparation of the elements of the Action Plan presented herein is based on the conclusions presented in Chapter 10 of the final plan and the current activities and goals of the MLA. These objectives include education, marketing, ongoing actions, and short and long term planning.

A. EDUCATION & MARKETING

A key aspect of this Plan is dependent on the efforts of the local community and riparian residents. Education of the local citizenry has been an ongoing function practiced by the MLA and must continue for the successful promotion of stewardship of the watershed shoreland and uplands to protect habitat and promote water quality. Education of the local citizenry has included some of the following elements and should be expanded and continued:

- Participation and presentations at local Town Board of Supervisor and subcommittee meetings (including upstream contributing areas) to discuss the importance of storm water infrastructure, runoff water quality and protection of existing natural storm water treatment areas and lake sensitive areas.

- Meetings and participation with local Town government to discuss budget impacts using grant funds to introduce improvements for runoff water quality methods and mechanisms. Joint preparation of grant funding requests and implementation of awarded grant funding.

- Presentations to local schools on storm water quality, Lake Management Plan, etc. Middle and High School classes already study ecology and the effects of our society on the ecosystem. Continue to involve local science teachers and request they incorporate the Plan into the local curriculum.

- MLA contributed funding to the Town of Mercer for initial stormwater infrastructure assessments and studies for the Town to begin infrastructure program planning.

- MLA continued lake monitoring and testing before, during and following a major Town/WDOT/WDNR infrastructure improvement program.

- MLA volunteer 'engineering' and construction management consulting and support to the Town of both conceptual and detail plans related to infrastructure improvements.

- Present results of focused work efforts through short presentations and/or poster boards at local and MLA sponsored events (aquatic communities, fish stocking, Eurasian milfoil treatments, weevils, phosphorous and lake water quality, etc.)

- Further the awareness of the importance of lake sensitive areas through education, posting, etc.

- Develop a MLA web site with a section on the Plan focusing on nutrient awareness, water quality improvement activities, EWM awareness and location maps, etc.

B. MUNICIPAL STORM WATER RUNOFF - QUALITY IMPROVEMENT ACTIVITIES

- Continue to partner with the Town to develop water quality improvements through implementation of Structural BMPs (Box Treatment Systems) for storm water quality concerns not addressed during USH 51 construction

- Encourage additional Street Sweeping in the near lake areas that are the largest contributors of Total Suspended Solids. Work with the Town to apply for funding to obtain or contract a Street Vacuum that will collect the majority of fines that are not collected by regular street sweeping machines

- Encourage the Town to adopt and enforce local Site Construction Erosion Control and Post Construction Storm Water Runoff ordinances.

- Encourage the Town to develop, adopt, and implement a Storm Water Utility.

- Develop a campaign to encourage debris and sediment sweeping of non-municipal parking areas. Work with the Town to protect lake sensitive areas, watershed wetlands, and near lake area depressions that may be affected by land development.

C. RIPARIAN STEWARDSHIP

- Develop and encourage riparian parcel housekeeping and development guidelines to improve storm water runoff quality for construction site erosion control and post construction storm water management.

- Develop and distribute shoreland/upland guidelines to improve watershed habitat that will enhance and protect fish and wildlife.

- Focus shoreland restoration and outreach efforts on those properties with or adjacent to identified Sensitive Areas.

- Educate property owners to identify native and invasive species; develop and distribute a ‘who to call, what to do’ list for aquatic plant concerns.

- Encourage riparian septic tank owners to become “connected” to existing and future extensions of sanitary sewers.

- Evaluate Lake Protection Funding Mechanisms to assist property owners with riparian property runoff improvements and/or sanitary sewer connection.

Adoption and Implementation of the Lake Management Plan

The development of the Lake Management Plan and its local acceptance has become a community focal point in the last several years. During this time, the Association has developed a stronger voice in the Community and has worked with the town and on its own to implement certain aspects of the Plan.

With this phase of Plan approval by the WDNR achieved, the Board of the Mercer Lake Association should formally adopt the Plan at its next Board Meeting. A draft of a resolution is included in this section for the Board to consider as it adopts this plan.

Also included in this section are the various functions, responsibilities, and objectives of the Association Standing Committees to educate, inform, and implement the watershed Management Plan. As these plans are adopted by the Board they become part of the Long Range Plan to secure the Mercer Lake Watershed Water Quality goals. The Association Committees and Community Liaisons are proposing an aggressive outreach to the community to achieve results and further establish the Plan.

Current Association Organization

Mercer Lake Association of Iron County, Wisconsin, Inc.
PO Box 199
Mercer, WI 54547

2013-2014 Board Members

President	Cary Chabalowski
Vice President	Karin Bodenhagen
Treasurer	Dan Smith
Secretary	Bill Litke
Past President	Doug Chidley
Director #1	Jerry Huffmaster
Director #2	Dick Wilson
Director #3	Pam Powers
Director #4	Don Fortune
Director #5	Bill Grall
Director #6	Doug Shackelton
Director #7	Chris Arnold

Mercer Lake Association
Functions, Responsibilities and Objectives of Standing Committees

A. Membership

a. It is the responsibility of the membership committee to increase the number of both individual and business memberships. The committee does this through personal, written (letters or emails) or phone contacts with the active or prospective members.

b. The membership committee is responsible for assuring that last year's individual members renew their memberships for the current year.

c. The membership committee is responsible for getting past individual members to rejoin as members in the current year.

d. The membership committee is responsible for recruiting new members for the Association.

e. The committee is responsible for recruiting business' to become members of the Association.

f. The committee encourages membership through the education of Association benefits and objectives.

g. The oversight and coordination of the committee's efforts and activities is through the Committee Chairman. The Committee Chairman should recruit as many individual to be a part of the committee as necessary to achieve the desired membership results. The Committee Chairman is responsible to the Directors of the Association.

h. Membership information and collected dues should be forwarded to the Association Secretary and Treasurer, respectively.

i. The committee will work and coordinate with other committees on related issues.

B. Civic

a. The Civic Committee is responsible for organizing and managing community related service programs or project. The efforts of the committee can be focused at either Association specific efforts or broader community efforts.

b. The oversight and coordination of the committee’s efforts and activities is through the Committee Chairman. The Committee Chairman should recruit as many individuals to be a part of the committee as necessary to achieve the desired results. The Committee Chairman is responsible to the Directors of the Association.

c. The Civic Committee is responsible for organizing and carrying out community service activities. Such activities could include: community watch programs, highway clean-up programs or similar activities.

d. The committee will work and coordinate with other committees on related issues.

C. Lake Aquatic Plant Control

a. The Lake Aquatic Plant Control Committee is responsible for monitoring, organizing and managing activities that involve the lake aquatic plants in Mercer Lake water shed and points of introduction of invasive aquatic plants into the water shed. The committee is responsible for aquatic plant control (including cutting/harvesting efforts) activities in the water shed.
b. The oversight and coordination of the committee's efforts and activities is through the Committee Chairman. The Committee Chairman should recruit as many individuals to be a part of the committee as necessary to achieve the desired results. The Committee Chairman is responsible to the Directors of the Association.
c. The committee is responsible for working with the Department of Natural Resources (lake management) and other agencies related to lake aquatic plant issues.
d. The committee is responsible for organizing, communicating and managing the aquatic plant cutting/harvesting program in the lake and water shed. The committee is responsible for establishing the program financial budget and individual cost and reviewing financial information with the Association Directors prior to executing the program. The committee is responsible to determine what "public" areas of the lake might require aquatic plant control and work to accomplish the required results.
e. The committee is responsible for monitoring the lake for invasive lake aquatic plant species. The committee is responsible for coordinating actives to combat invasive species if identified in the water shed.
f. The committee is responsible for organizing boat landing aquatic plant monitoring activities.
g. The committee is responsible for educational or awareness programs related to invasive lake aquatic plants. The committee has the responsibility to report to the Association on lake aquatic plant, invasive lake aquatic plant and control issues.
h. The committee will work and coordinate with other committees on related issues.

D. Fish Management

a. The Fish Management Committee is responsible for monitoring, organizing and managing activities that involve fish management in Mercer Lake. The committee is responsible for activities and programs that will improve Mercer Lake as a recreational fishery and improve the quality of fish in the lake.
b. The oversight and coordination of the committee's efforts and activities is through the Committee Chairman. The Committee Chairman should recruit as many individuals to be a part of the committee as necessary to achieve the desired results. The Committee Chairman is responsible to the Directors of the Association.
c. The committee has the responsibility to report to the Association on fish management.

d. The committee is responsible for working with the Department of Natural Resources (lake/fish management) and other agencies related to fish management issues.

e. The committee is responsible for organizing and managing fish stocking and fish netting programs in Mercer Lake.

f. The committee will work and coordinate with other committees on related issues.

E. Water Quality, Monitoring and Testing

a. The Water Quality, Monitoring and Testing Committee (WQMT) is responsible for organizing and managing activities that involve monitoring and improvement of water quality in Mercer Lake.

b. The oversight and coordination of the committee's efforts and activities is through the Committee Chairman. The Committee Chairman should recruit as many individuals to be a part of the committee as necessary to achieve the desired results. The Committee Chairman is responsible to the Directors of the Association.

c. The committee is responsible for working with the Department of Natural Resources and other local, county, state and federal agencies related to water quality issues.

d. The committee has the responsibility to report to the Association on water quality issues.

e. The committee is responsible for organizing, coordinating and managing water quality monitoring and testing activities. The committee is responsible for reporting test results to the appropriate agencies in a timely manner. The committee is responsible for documenting and maintaining test report information.

f. The committee will work and coordinate with other committees on related issues.

F. Social

a. The Social Committee is responsible for organizing and managing activities that involve promoting improved social relationships between the members of the Mercer Lake Association.

b. The oversight and coordination of the committee's efforts and activities is through the Committee Chairman. The Committee Chairman should recruit as many individuals to be a part of the committee as necessary to achieve the desired results. The Committee Chairman is responsible to the Directors of the Association.

c. Activities of the committee could include: an annual member picnic, participation in the July 4th parade, participation in Loon Day events or Association booth or similar activities.

d. The committee has the responsibility to report to the Association on Association sponsored social activities. The committee is responsible for timely announcement of social activities.

e. The committee is responsible for establishing any activity financial budget and individual cost and reviewing financial information with the Association Directors prior to executing the activity.

f. The committee will work and coordinate with other committees on related issues.

G. Boating, Navigation and Safety

a. The Boating, Navigation and Safety Committee is responsible for organizing and managing activities that involve boating, navigation and navigation aids and safety on or in Mercer Lake. The committee is responsible for activities and programs that will monitor and improve Mercer Lake as a recreational asset and promote the safe use of the lake and its facilities.

b. The oversight and coordination of the committee's efforts and activities is through the Committee Chairman. The Committee Chairman should recruit as many individuals to be a part of the committee as necessary to achieve the desired results. The Committee Chairman is responsible to the Directors of the Association.

c. The committee is responsible for annual installation, maintenance and removal of navigation aids and safety warning aids located in the lake. The committee is responsible for advising the Association on the need and location of additional similar devices. The committee is responsible for coordinating with the Town of Mercer and the Department of Natural Resources on related issues.

d. The committee is responsible for observing and reporting any safety issues related to the Mercer Lake public boat landing. Such safely related issues shall be forwarded to the Town of Mercer.

e. The committee will work and coordinate with other committees on related issues.

H. Fund Raising

a. The Fund Raising Committee is responsible for organizing and managing activities that involve raising funds to support the operation and activities of the Mercer Lake Association. The committee is responsible for activities, events, programs and donations that will provide the financial support for the Association.

b. The oversight and coordination of the committee's efforts and activities is through the Committee Chairman. The Committee Chairman should recruit as many individuals to be a part of the committee as necessary to achieve the desired results. The Committee Chairman is responsible to the Directors of the Association.

c. The committee will plan activities, develop anticipated budgets for review and approval of the Directors and execute the fund raising activities.

d. The committee is responsible for reporting the status of fund raising activities to the Association.

e. The committee will work and coordinate with other committees on related issues.

DRAFT

RESOLUTION NO. ___________

ADOPTING RESOLUTION
MERCER LAKE ASSOCIATION,
IRON COUNTY, WISCONSIN

WHEREAS, numerous reports and studies have been prepared from 2003 through 2014 as part of the evaluation and water quality protection process for Mercer Lake; and,

WHEREAS, a major goal of the association is to provide planning and technical guidance for lake protection and the selection and design of best management practices; and

WHEREAS, the natural resources of Mercer Lake are valuable to the surrounding communities.

NOW, THEREFORE BE IT RESOLVED, that the Mercer Lake Association, wishes to promote lake planning and protection to protect and enhance the natural resources Mercer Lake; and

BE IT FURTHER RESOLVED THAT, the Mercer Lake Association hereby adopts the following reports and studies as a portion of the Mercer Lake Watershed Management Plan and as tools to guide the Mercer Lake Association in planning, improving, and protecting Mercer Lake and the surrounding natural resources.

Cedar Corporation, Mercer Lake; Lake Watershed Management Plan, 2014

Garn, Herbert S.; Robertson, Dale M.; Rose, William J.; and Saad, David A.; **,** *Water Quality, Hydrology, and Simulated Response to Changes in Phosphorus Loading of Mercer Lake, Iron County, Wisconsin, with Special Emphasis on the Effects of Wastewater Discharges*, 2012; U. S. Geological Survey, Water-Resources Investigations Report 2012-XXXX, XX

Schieffer, Steve, et al; *Aquatic Plant Management Plan & Appendices*, 2012

Roth, Jeff; *Fishery Management Plan*, 2012

ADOPTED this ______ day of _____, 2014.

Yes _____ No _____ Absent _____ Abstain _____

MERCER LAKE ASSOCIATION

By: ________________________________ ______________________________________
President Secretary

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CHAPTER 1: INTRODUCTION

This report updates and significantly expands the 2007 Cedar Corporation document (initial Mercer Lake - Lake Management Plan) prepared and submitted to the MLA (Mercer Lake Association) in 2007. It incorporates the findings of that report, the recently completed Aquatic Plant Management Plan, the Fisheries Management Plan and the U.S. Geological Survey (USGS) Scientific Investigations Report (Robertson, et al, 2012). With this additional information, recommendations to maintain and possibly improve Mercer Lake watershed water quality are presented to the MLA and Town of Mercer.

Cedar Corporation was originally retained by MLA in 2005 to assist preparation of funding applications for grants and prepare an initial lake management plan to develop methods and ideas to maintain and/or improve the water quality of Mercer Lake. Key to understanding the dynamics of the Lake is that it is an impoundment of the Little Turtle River, and therefore, subject not only to those immediately adjacent lakeshore influences as well as those in the upstream ecosystem which are transported via the Little Turtle into the Lake. To complicate matters, the influences of thirty years of questionable treated wastewater discharge into the Lake; urban development and untreated storm water from nearby unincorporated Town of Mercer; and, runoff from US Highway 51 on lake water quality must be considered. The intent of this report is to provide a dynamic document that can be altered as future information becomes available.

Activities and uses of the land directly affect the water quality in the drainage of a specific watershed. Knowledge of historic and current land use practices provide a catalogue of sources of water quality degradation and helps develop the basis for the methods and procedures to protect water resources.

To better present the conclusions and efforts of the numerous companies, agencies, and individuals involved, this document has relatively few chapters. Detailed scientific and background information has been relegated as much as possible to the References and Appendices of this report. As the topics are discussed in the body of the report, those more technically oriented readers will be referred to the various References and Appendices to achieve a better understanding of the issues and science of watershed planning. A companion CD-ROM includes this document, the works of the selected References, and the electronic hyperlinked version of the 2009 Shoreline Inventory.

1.1. Lake Management Planning

This Lake Management Plan provides the basis for discussion and site specific plans for habitat and water quality protection and improvements of Mercer Lake. Adopted recommendations of this Plan are intended to guide MLA board and members, local officials, and appropriate technical professionals to the goal of environmentally responsible community development. Although this Plan considers Mercer Lake and the local related watershed, the development issues and strategies discussed herein must be introduced to those watersheds, upstream of Mercer Lake, as the activities in these upstream lakes and watersheds draining into the Little Turtle River have a significant impact on the water quality in Mercer Lake. Anticipated future development will occur in this region, thus the need for planning water quality improvements is now, to ensure future development is constructed with the goal to improve runoff water quality to protect and preserve the character of the region's surface waters. The guiding principle in developing this Plan is the enhancement, protection, and preservation of the unique environmental characteristics of Mercer Lake.

As new techniques and practices to improve Lake and Watershed Water Quality Management develop, this Plan should be updated as this new information comes available. Presented herein are current best available methods, designs, and management practices to improve runoff water quality; reduce velocity and volume of storm water runoff; reduce pollutant loading of storm water; and, reduce the impact of anthropogenic practices on the lakes, wetlands, groundwater, and other natural features in the watershed. Design information and application technologies for various water quality BMPs (Best Management Practices) will change as more applications are applied and others learn from the experience. New BMPs will be developed for specific situations that will improve runoff water quality. This Plan should be considered dynamic and regular updates incorporated.

The purpose of this Plan is to improve or maintain existing lake water quality, encourage habitat redevelopment, shoreland restoration, and long term water quality improvement practices in the watershed. Recommended activities are intended to preserve Mercer Lake as an asset to the adjacent landowner and community, and minimize the negative impact of existing and future water discharges to the Lake and the environment. Implementing this Plan will reduce the quantity of eroded soils and pollutants in runoff waters that discharge to the drainage ways, wetlands, environmentally sensitive areas, the Little Turtle River, and Mercer Lake.

This Plan presents general *technical guidelines*. Specific conditions will require site-specific modifications of the practices described or an alternative practice that is approved by a local permitting authority. The Plan provides a discussion of existing conditions and recommendations to improve runoff water quality and protect lake water quality.

Technical guidance regarding watershed water quality management is necessary because:

> **Location:** The Mercer Lake watershed located in the town of Mercer, in north-central Wisconsin, along State Highway 51 is a desirable area for recreation and development. Part of the lake is heavily populated and access to the area is continuing to be improved.
>
> **Tourism:** Mercer Lake has approximately 4 miles of shoreline to enjoy and a public boat access is located just south of the downtown commercial area. To maintain the attractiveness of the area, one of the most important tasks is to maintain and/or improve the quality of surface water in the area. A significant proportion of the Town of Mercer economy depends on tourism.
>
> **Growth:** Because of its natural beauty and miles of nearby lakeshore, the Town of Mercer has and will continue to experience growth in both resident relocation and tourist activity. The population of this area is growing; 6.2% from 2000 to 2006, and is projected to increase by over 10% annually by the year 2025. In addition to a steady growth of residents, the area attracts a large number of tourists. Tourists as seasonal visitors, may

eventually become permanent residents, and are seen as the primary population growth. Although not all of the additional growth will be within the Mercer Lake watershed area, planning for proper runoff water management is necessary to address the anticipated increase in runoff water as land use development increases. In particular, the undeveloped areas of the Upper Little Turtle River will continue to draw residents to the region. Real estate values of the property on and around the Mercer Lake will be significantly impacted by water quality.

Development: The area around Mercer Lake and its watershed will experience greater development pressure due to its natural beauty, its proximity to Highway 51, the existing Mercer urban area and new industrial park. Population growth translates to land development and new sources of nonpoint source runoff pollution. The Plan proposes BMPs (best management practices) to minimize the discharge of pollutants from developing areas during construction (Construction site Erosion Control) and over the life of the development (Post Construction Long Term Storm Water Management). In many cases, these BMPs can be used to effectively reduce pollutant loads in runoff from existing land development.

Water Quality Concerns: Many water bodies throughout the state are not in compliance with state water quality standards. Beneficial uses such as domestic and agricultural water supply, fishing, swimming, and boating, can be impaired due to excessive pollutants carried into the lakes and streams by storm water runoff. This Plan provides guidance for controls through the use of BMPs to reduce these pollutants, with special consideration for total phosphorus and total suspended sediments.

1.2. Best Management Practices

The Best Management Practices presented in this Plan will not mitigate all water quality problems caused by runoff water from first flush (spring melt runoff and first year rain events) and severe storm events. Nor are they intended to improve lands that are inherently unsuitable for development due to poor soils, high water table, or slope. The proposed techniques can help improve water quality and water quality discharge.

Improvement of local storm water best management techniques, guided by creative land engineering and design, should be considered by all land users. Areas of particular concern that need to be addressed are:

- Residential development has planned patterns that create the rapid flow of runoff from rooftops, yards, storm sewers, and impervious paved surfaces that discharge directly to the Lake. Residential developments need to incorporate natural drainage patterns and BMPs to reduce erosion, sedimentation, and high pollutant loads that have and will continue to be a source of phosphorous in the near lake areas.

- Existing riparian developments can reduce impacts to the Lake by: reducing direct runoff to the Lake by redirecting water flow to rain gardens and natural drainages; improving the shoreline buffer (30 foot wide) along the width of the property; increasing the number of trees on the property; and, minimizing shoreline impacts where possible.

- Land uses such as shopping centers, business parks, and industrial properties contribute an increased rate of runoff that does not exist in the natural landscape. Characterized by large impervious areas with storm sewers designated to carry water quickly and efficiently away from the site, large volumes of water are transferred rapidly into public drainage ways and nearby water bodies. Best Management Practices to address these large volume runoff situations need to be incorporated in the design of such developments and retrofitted in the established urban areas where feasible.

- Maintenance of the new and future storm water collection and treatment systems needs to be a priority in storm water management.

- Frequent collection and proper disposal of street debris, sand, etc. reduces pollutant loading at its source.

- Expansion of the sanitary sewer system as/when needed to reduce septic system discharges of nutrients to groundwater. Compliance with and enforcement of requirements to utilize the sanitary sewer system, where available.

- Public education of why it is important to improve storm water runoff qualify and to point out the results of ignoring the issue.

1.3. Products of the Plan

This Plan has many products. A brief outline of the steps involved in preparation of this Lake Watershed Management Plan and some internal references that will assist the reader in locating information in this report include:

1. Determine watershed (Chapter 4, Appendix I) project area boundaries (watershed, sub-watershed, and sub-area delineations) for use in hydrologic, hydraulic, storm water management, and water quality analysis. (Chapter 5, Appendix G)

2. Gather, inventory, and map data within the project boundary, including land use planning information from WISCLAND, Zoning data, and Comprehensive Plan data, etc. (Chapter 4)

3. Identify existing water quality, runoff water conveyance, and management problems. (Chapter 4) Establish the location and size of runoff water management and conveyance facilities.

4. Solicit community involvement in the process through a survey distributed by the MLA (MLA 2006 Community Survey, Cedar Corporation, 2007). (Chapter 2 and Appendix C)

5. Analyze and estimate the runoff water runoff pollutant loads and runoff water quantity under existing land use conditions. (Chapter 5, USGS Report) The USGS recently completed a water quantity-quality study (Robertson et al, 2012) discussing the lake water quality and potential future water quality issues dependent on actions that the Association, Town of Mercer, and Iron County may undertake.

6. Analyze and estimate the storm water runoff pollutant loads and storm water runoff quantity under proposed future land use conditions, or fully-developed conditions, with and without the implementation of runoff water management facilities and best management practices. (Chapter 5)

7. Based on the guidance provided by the MLA, the Town of Mercer, residents, USGS and WDNR, establish runoff water management goals and policies for the successful implementation, completion, and regular updates of this Plan. (Chapter 3)

8. Complete the mapping and documentation of aquatic plants and develop an Aquatic Plant Management Plan for the ongoing and future management of aquatic invasive species and nuisance aquatic plants (Schieffer, pers. comm.). (Chapter 7)

9. Complete a shoreline survey photographically documenting riparian conditions in May 2009 (Appendix F - This is an electronic document containing photographs of shoreline conditions linked to a map and spreadsheet.)

CHAPTER 2: COMMUNITY SURVEY AND PUBLIC INVOLVEMENT

2.1 Community Involvement

The importance of community involvement in watershed water quality issues cannot be overlooked. Community support – both moral and financial, underscores the success of the project. To that end, the Mercer Lake Association (MLA) has established itself in the community and has already been working with the Town Board, local educators, and local citizens.

2.1.a. Mercer Town Board

It is important that attendance at Town Board meetings be continued to update this Board on MLA activities and water quality issues. Thus, it is important to encourage MLA members to attend and participate in Mercer Town Board meetings; particularly those year round residents.

2.1.b. Mercer School District and Student Involvement

A Lake Management Grant was awarded to the MLA by the Wisconsin Department of Natural Resources (WDNR). The proposed program intended to involve the local high school students to participate in water quality monitoring activities. By involving the local high school in the work being done on this Plan the goal was to better educate them on their local environment and the surrounding local area.

Working with local teachers, involvement efforts included presentations to the students (September 4, 2008) which included a Power Point presentation on Environmental Engineering to Control Storm Water (Appendix P).A second presentation was made to the students in the fall of 2008 to educate them on shoreline development issues and prepare them for the Shoreline Inventory Task (Appendix F).

The class did significant work on the inventory in the fall of 2008 and May 2009 but was unable to complete the task due to the scheduling of available class time and weather It was later completed by the MLA and its consultant.

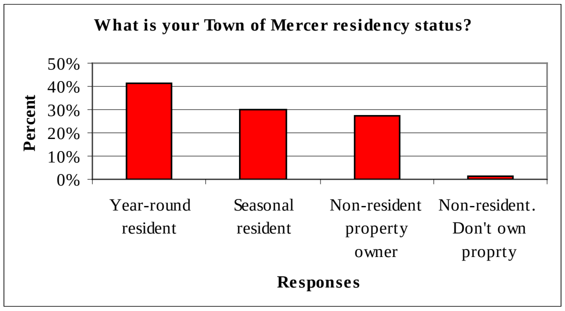
2.2 Mercer Lake Association Community Survey

Working with Cedar Corporation, the MLA designed a Community Survey to assess the area residents' perceptions of the Lake and solicit their comments. The WDNR approved survey is included in Appendix C as are Survey Statistics and Comments.

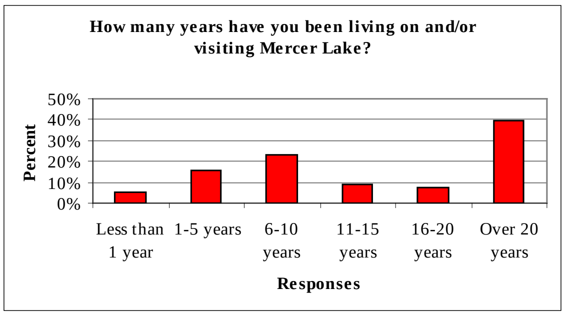
In summer of 2006 a Public Opinion Survey was sent to property owners, business and government officials within the Mercer Lake watershed planning area. The survey was designed to assess landowner views and concerns about local lake issues. Of the 369 surveys sent out 86 were returned (23% response rate). The survey results are summarized below.

Background Data

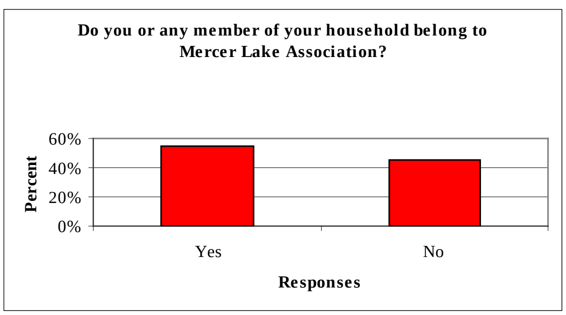
Just over 40% of the respondents are year-round residents on Mercer Lake.



Nearly 50% of the respondents have been living on or visiting the lake for over 15 years.

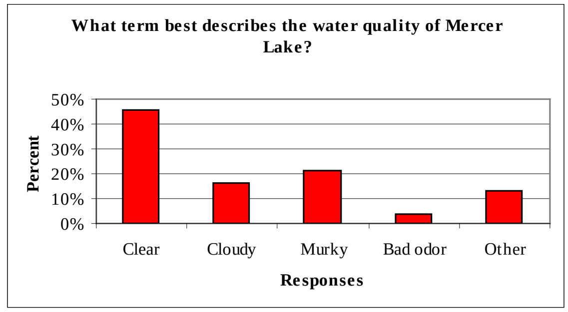


55% of the respondents said they belong to the Mercer Lake Association.

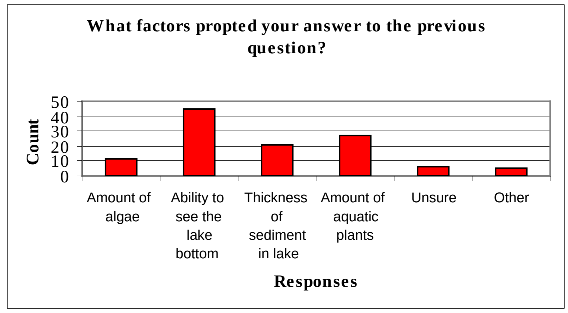


Water Quality

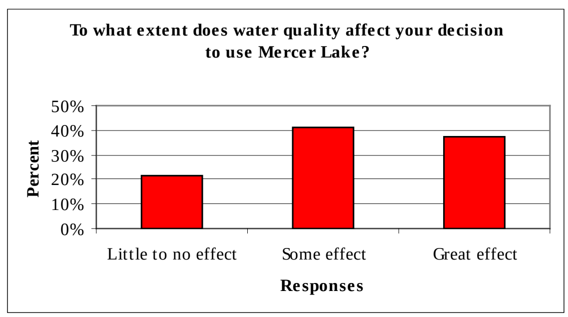
Fewer than half the respondents considered the water in Mercer Lake to be clear.



Of the respondents, 45 people felt the water wasn't clear due to the inability to see the lake bottom.

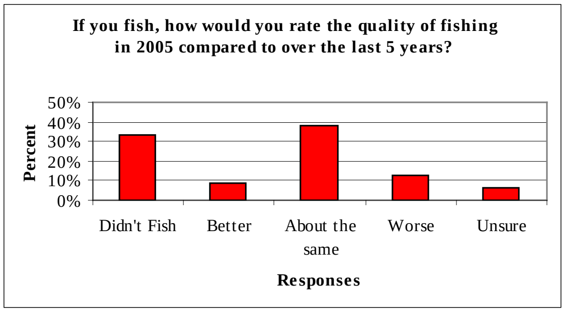


Nearly 80% of the people indicated that the quality of water affects their decision to use the Lake.



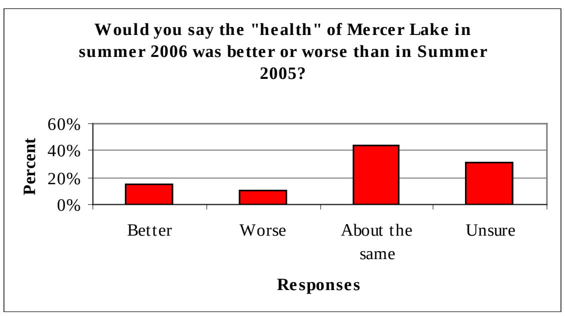
Fishing

Of the people responding that fished, most of the people felt the quality of fishing was about the same in 2005 compared to the past 5 years.

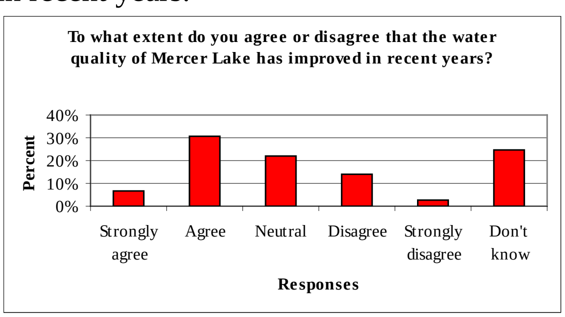


Lake Health

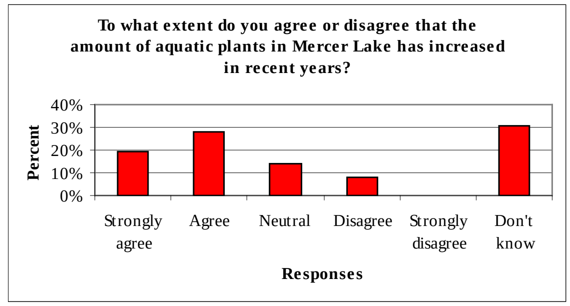
While 14% of the respondents felt that the "health" of Mercer Lake was better in 2006 than in 2005, over 40% felt it to be about the same.



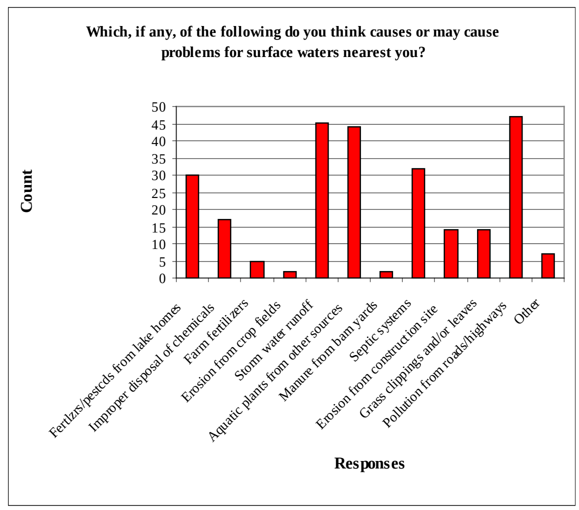
Over 1/3 of the respondents felt that the water quality of Mercer Lake has improved in recent years.



About half of the respondents (47%) felt that the amount of aquatic plants has increased in recent years.

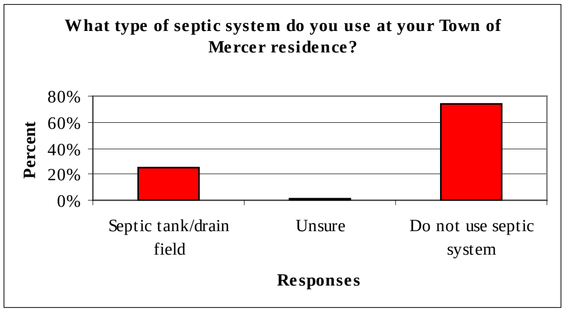


Of the possible causes of surface water problems in the Mercer Lake Watershed Planning Area; pollution from highways (47 people), stormwater runoff (45 people), and aquatic plants from other sources (44 people) were the three top answers.

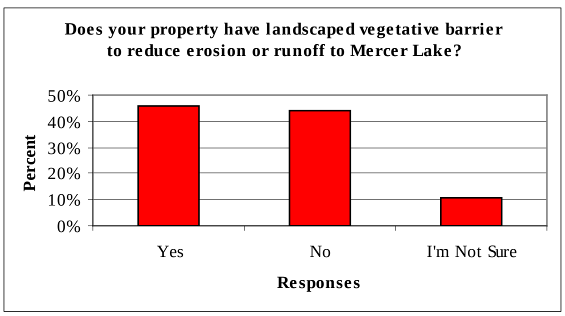


Property Characteristics

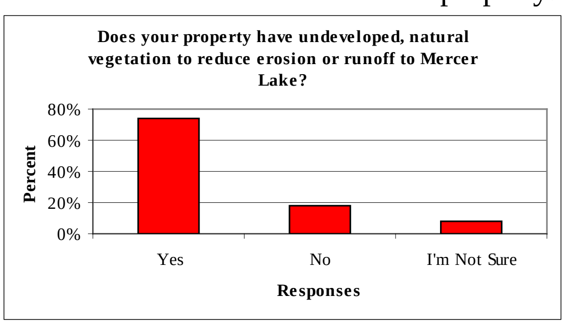
25% of the respondents within the Mercer Lake Watershed Planning area still have some form of septic system.



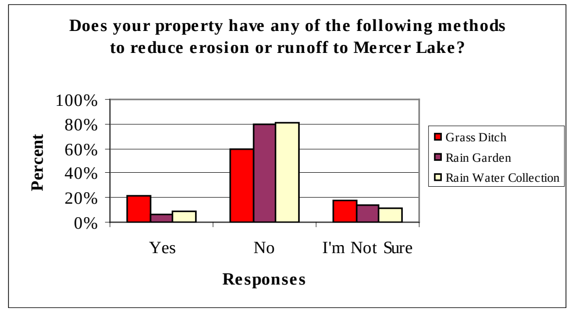
Respondents were pretty evenly split between those that have landscaped vegetative barriers (46%) and those that do not (44%).



A majority of the respondents (74%) indicated that they have a natural barrier to reduce erosion and runoff on their property.



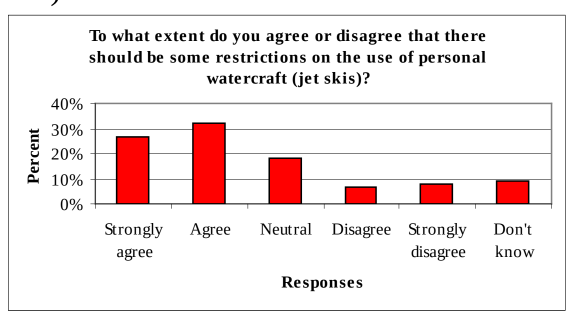
A majority of people did not have a grass drainage ditch (60%), rain garden (80%), or rain water collection system (80%) to reduce erosion and runoff from their property.



At the present time, most respondents (83%) do not have plans for additional methods to control runoff.

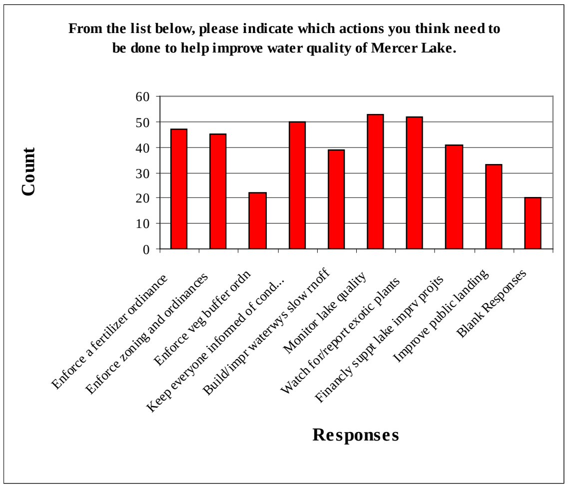
Personal Watercraft Restrictions

Over half (59%) feel that there should be some restrictions on personal watercraft (jet skis).



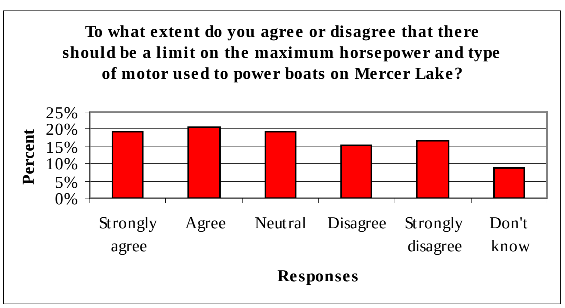
Improving Water Quality

The three most popular responses to what the Mercer Lake Association should do to help improve water quality were monitor lake quality, watch for and report exotic plants, and keep everyone informed of conditions.



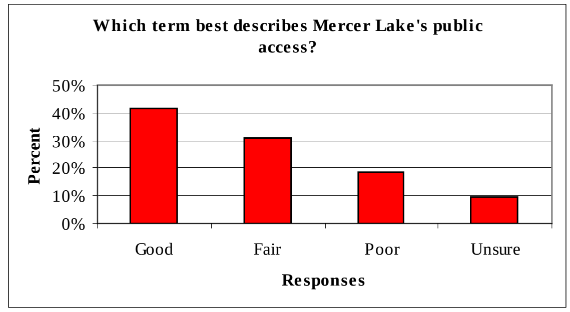
Boat Motor Type and Horsepower

The answers were pretty evenly split when asked if there should be a limit on the maximum horsepower and type of motor that should be used on Mercer Lake.



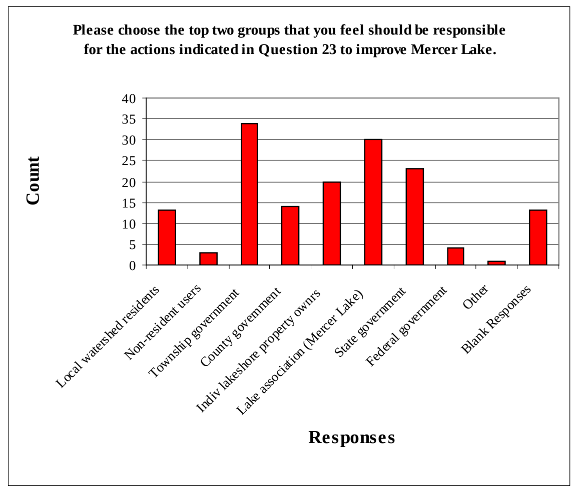
Lake Access

Overall, the majority of respondents (72%) feel the Lake's public access is fair to good.



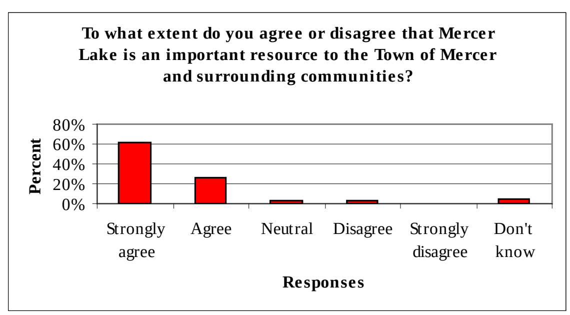
Enforcement of Local Regulation

When asked who should be responsible for the actions above, the top two responses were the Town government and the Mercer Lake Association.



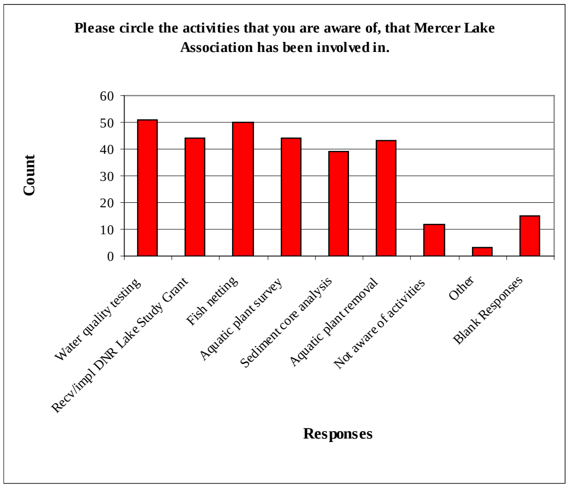
Value of the Resource

Nearly 90% of the respondents feel that Mercer Lake is an important resource to the Town.



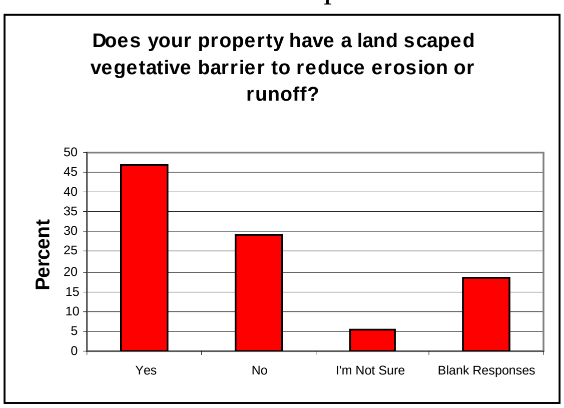
Awareness of Association Activities

About half of the 86 respondents are aware of most of the activities that the Mercer Lake Association is involved in.



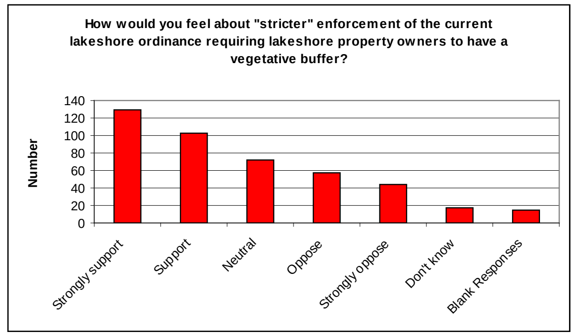
Lakeshore

Nearly 50% of respondents have some form of vegetative buffer to reduce runoff; however there were a high number of blank responses and almost 30% said they do not have a buffer. The other respondents are unsure or chose not to respond.



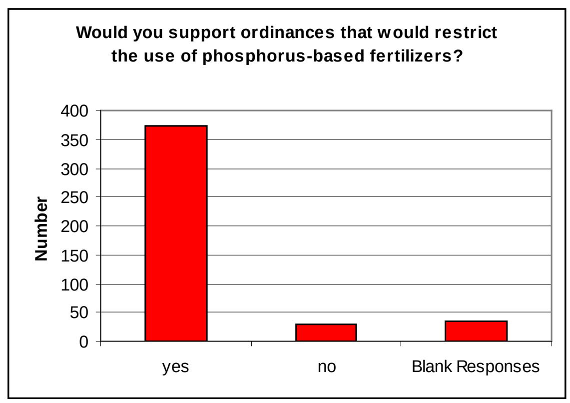
Vegetative Buffer

Over half of the respondents would support stricter enforcement of a lakeshore vegetative buffer ordinance.



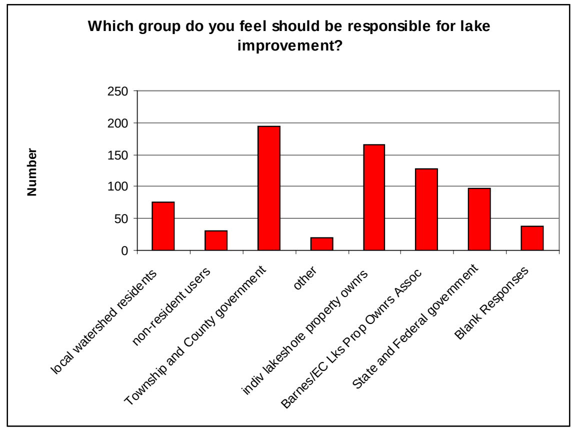
Lake Enforcement and Responsibility

Slightly over 85% of the respondents would support an ordinance restricting phosphorus-based fertilizers.



Responsible for Lake Improvements

A large number of people feel the Town and County government should be responsible for lake improvement while over 40% of the respondents feel it's up to the individual property owner.



There are a significant number of residents in the Town of Mercer concerned about the future of lake water quality. Education of these individuals and others in developing runoff water quality and quantity control efforts will provide the Mercer Lake watershed planning area with a significant resource to address current and future water quality issues.

CHAPTER 3: PROJECT GOALS

Mercer Lake and surrounding area is home to longtime residents, summer and winter visitors, and the natural flora and fauna of the region. This Plan has been developed as a guide to protect the water quality in Mercer Lake from the effects of long term degradation as a result of the human impacts on the region. As in other areas of scenic beauty, the draw to the area can result in negative impacts becoming the downfall of its attraction. Members of the Mercer community have stepped forward to take the lead to preserve the beauty of the natural surroundings as much as possible and maintain the ecological quality we are privileged to enjoy. Protection and preservation must go hand in hand with development which cannot be denied but can be completed with considerably less impact to the environment than has been experienced in the past. Both must be managed for future generations to continue to benefit from the aesthetic quality of the region.

Past land use and development practices in other communities has resulted in the 'greening' of lakes, reduction in recreational activities, importation of invasive species, and decreases in property values. National studies of water quality versus property value indicate a 15% decrease in lake shore property value for every 3 foot decrease in Secchi depth water clarity. Increases in property value occur for improved water clarity but are not as dramatic. The local residents and visitors must understand the resource and the effects of their interaction with the environment and develop the political and human will to alter their behavior.

The desire is to perpetuate the improvement in the water quality of Mercer Lake for future generations to enjoy. To achieve this level of environmental stewardship we must address and set the following goals:

> Maintain and where needed restore the environmental integrity of the Lake system.
>
> Protect and preserve the aesthetic opportunities for residents and visitors.
>
> Manage onshore and on water recreational activities to provide opportunities for all manner of persons to enjoy the Lake.
>
> Establish a balanced ecological community where enjoyment of natural surroundings can coexist with development and protect the water quality of Mercer Lake
>
> Develop a standard for riparian development that achieves balance between human needs and desires and the natural environment

To achieve these goals the MLA has completed numerous studies. This report discusses the results of the studies, references the data to established standards, and presents recommendations to either maintain or achieve these standards and MLA goals. The following chapters present as thorough an understanding as can be attained within economic and technically feasible boundaries. Multiple appendices are included to provide greater background and detail on means and methods, in depth discussions on select topics, and the readers are provided with references to selected works both specific to Mercer Lake, the Mercer area, as well as general information.

CHAPTER 4: LAND USES AND WATERSHED IMPACTS

4.1. General

Lands in and around Mercer Lake the watershed is primarily forest and rural residential with the balance in recreational, single- and multiple-family residential and commercial activities. There are few industrial sites. Each land use has different impacts on its portion of the watershed. Woodland forests and grass lands create less runoff than developed areas due to greater infiltration and transpiration of moisture in the undeveloped lands. Highly developed multi-residential, commercial, and industrial areas have a larger percentage of impervious surfaces which create a greater quantity of high velocity runoff than those less developed properties. To a lesser degree but also capable of impacting lake water quality are residential areas which have a lower percentage of impervious areas and runoff water pollutants. Individually these areas are considered by many to have a low impact on water quality. However, where residential development is adjacent to a lake shoreline, such land use can have a significant impact on water quality unless it is properly managed.

4.2. Statement of Problems

Runoff rates from natural landscapes such as wetlands, prairies, and woodlands are quite low due to the absorptive capacity of the soil and the evaporative uptake of lush vegetation. When surface runoff does occur, it is temporarily stored in adjacent depressions and wetlands. During very wet periods, overland flow drains the landscape via small swales, ditches, and streams, eventually reaching large rivers and lakes. Historically, the natural storage areas, swales, drainage ways, and wetlands have been altered or eliminated by forestry and development practices. Increased runoff rates promote the destabilization of downstream channels, causing stream bank erosion and increased water quality pollutant load discharges. The net effect is an increase in downstream water volume, forcing more water into existing natural and constructed conveyance systems and floodplains resulting in erosion and flooding. Uncontrolled forestry and development practices substantially increased the magnitude and duration of flooding and resultant flood damages. An increase in logging activities in the early 1900's is the most likely cause in an increase in sedimentation in Mercer Lake (Garrison, 2004).

Forestry and agricultural runoff is typically contaminated with sediment, phosphorus, bacteria, and nutrients. Residential and urban runoff, especially from streets and parking lots, is contaminated by sediment, heavy metals, bacteria, nutrients, and petroleum byproducts. During construction, erosion from uncontrolled development sites contributes much larger quantities of sediment and pollutant discharges to storm water runoff. Storm water runoff pollutants degrade receiving rivers, lakes, streams, and creeks by killing sensitive aquatic life, encouraging the growth of non-native invasive vegetation, impairing aesthetic conditions, and making water recreation less desirable. Acute drainage and water quality discharge problems are often highly visible and these problems often receive immediate attention due to public concerns. Long-term or chronic drainage and water quality discharge problems, on the other hand, often go unnoticed. These problems tend to intensify over a long period of time, and appear suddenly as a flood or recognizable deteriorations of water quality (sedimentation, algal blooms, aquatic invasive species, etc.)

Sources of pollutants in the Mercer Lake watershed include: the Mercer urban area, the former discharges from the first sewage treatment plant located adjacent to the Lake, the Midwest Timber site adjacent to Grand Portage Lake that flows into Mercer Lake, riparian development, pollutants from storm water runoff from U.S. Highway 51 and the Town of Mercer, and past and existing residential septic systems. Several of these areas have been addressed since this plan began to be put in place in 2004 including the Midwest Timber site, USH 51 and the urban area of Mercer, all through cooperative efforts of the MLA, Town, State, and Federal government. Stormwater best management practices have been designed and installed to trap and remove the majority of the sediments from stormwater draining the highways and former manufacturing facility prior to discharging to the Little Turtle River or Mercer Lake.

1. The Town of Mercer downtown commercial area, adjacent to Mercer Lake, a significant source of sediment from impervious surfaces, nutrients that attach to sediments, and oils as well as other pollutant residue from the roads and highways. The USH 51 highway improvement project constructed over the last three years has significantly improved the storm water quality discharged from the Town through a series of stormwater treatment swales and other treatment devices constructed as part of this project in an attempt to achieve an 80% reduction in sediment removal.

2. The former Mercer sewage treatment plant (WWTP) was allowed to discharge in the west end of Mercer Lake and has had a negative impact on Mercer Lake’s water quality. Constructed in 1965, the sewage treatment plant’s discharge point was designed to carry effluent to a point near the outlet of Mercer Lake. However, many residents believed the plant’s discharge pipe along the lake bottom ruptured shortly after construction and spilled effluent directly into the main body of the lake. Wastewater effluent contains high concentrations of nutrients and is probably a significant factor in the observed water quality degradation of Mercer Lake from 1965-1995. An examination of the discharge records determined that the sewage treatment plant exceeded established effluent limits 66 times from June through August of 1990 (WDNR letter to the Sanitary District in the fall of 1990). The construction of a new WWTP in a watershed that doesn’t contribute to Mercer Lake was a significant effort to reduce direct discharges to Mercer Lake and attempt to improve water quality.

3. The Midwest Timber site is a large tract of land comprised of mostly compacted soil with little vegetative covering. Post-industrial activity soil testing of the site has yet to be completed to determine potential contaminants that may exist to degrade surface or subsurface waters. Within recent years, the stormwater runoff from the site has been addressed through improved stormwater management and construction of an adjacent BMP structure near the boat landing.

4. Constructed along the north east shore of Mercer Lake and through the unincorporated community of Mercer, US Highway 51, storm water collected along this traffic corridor was directed to the Lake until completion of the USH 51 reconstruction project. The recent highway redevelopment project incorporated state of the art stormwater collection, diversion, and treatment systems to address runoff pollution from the highway and the Mercer urban stormwater collection system.

5. Constructed along with the USH 51 project was an urban stormwater management basin (North Downtown Basin) that addresses the stormwater collected in the central urban area of the unincorporated Mercer community.

6. Septic systems are designed to separate solids and fats from wastewater and discharge the resulting liquid into a seepage bed. The natural soils in the discharge area adsorb the nutrients and sediments found in effluent water. Sediments are effectively removed through filtration as are most bacteria. Phosphorous and nitrogen compounds, however, will adsorb to soil grains until the capacity of the soil absorptive surfaces is reached; then the nutrient laden effluent discharges to ground water. Older septic systems are known to have limited operational ability compared to today's designs and are less able to provide effective treatment. The Mercer Sanitary district extended the sewer collection system along the north and east sides of Mercer Lake and with the connection of these structures have eliminated any recent discharges from the served properties. Discharges from former and currently existing septic systems are considered as nutrient sources and are evaluated as part of the overall nutrient loading to the Lake in the US Geological Survey study.

7. Stormwater runoff from riparian land use also provides excess nutrient and sediment loads, in this case very close to the shore line with greater impacts than buildings and developed areas that are second or third tier from the lake. Impervious surfaces on near shore property (driveways, roofs, decks, sidewalks, landings, etc.) all generate larger than normal stormwater runoff quantities than does untouched shoreland. Considerable runoff and the lake water quality pollutants of sediments, and residual or excess quantities of nutrients, lawn chemicals, pesticide sprays, etc. readily dissolve and enter the runoff and over time contribute to the degradation of lake water quality.

4.3. Land Use

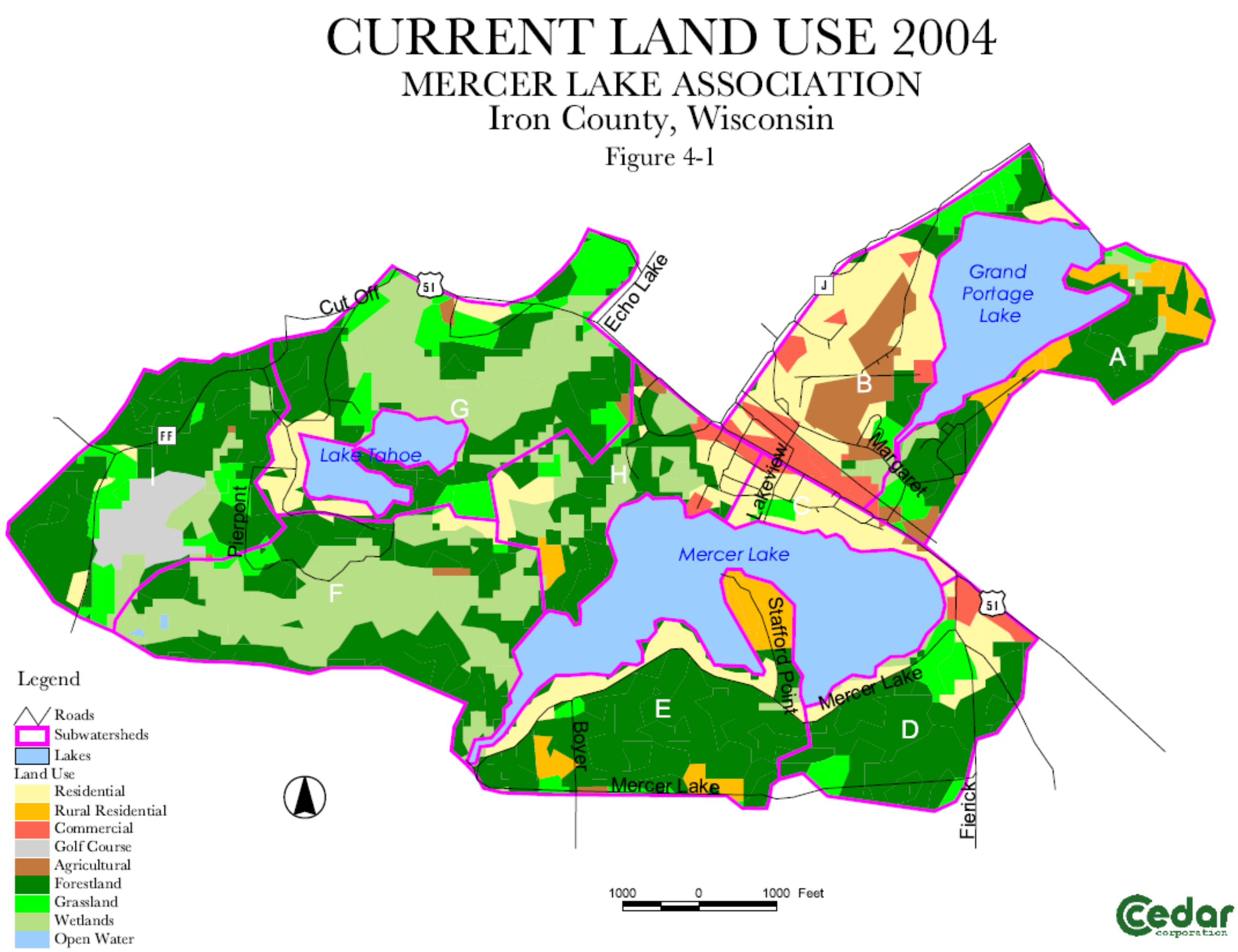
A watershed is a land surface in which the overland runoff can be traced to a predicted outlet; thus, the entire area of one watershed drains to one location in that watershed. The Mercer Lake near watershed (Cedar calculated 1,744 acres including 399 acres of lake surface area between Mercer, Tahoe and Grand Portage Lakes) has been divided into nine sub-watersheds (labeled A to I), five of which (668 acres) drain directly to Mercer Lake and the rest drain to groundwater or tributaries that outlet to Mercer Lake. Also to be considered is that area upstream of Grand Portage Lake some 6,000 acres which is part of the greater Mercer watershed and includes the many swamps and several upstream lakes (Martha, Little Martha and other small lakes farther up the drainage). Water quality in this upstream area affects Mercer Lake through the discharge into Grand Portage Lake. This Lake Management plan must consider this greater watershed area from the perspective of future impacts on Mercer Lake and may through cooperative ventures and lake management planning but this area is beyond the scope of the current LMP.

Lake Management Plans compare existing and future land development to assess current and future impacts of land uses on water quality. To evaluate the impacts of development in the Mercer Lake watershed, land use characteristics were considered for two planning periods to assess land use and related storm water runoff impacts. These planning periods correspond to

WiscLand, 1993, for present land use and the Iron County estimated 2025 land use map for the Town of Mercer.

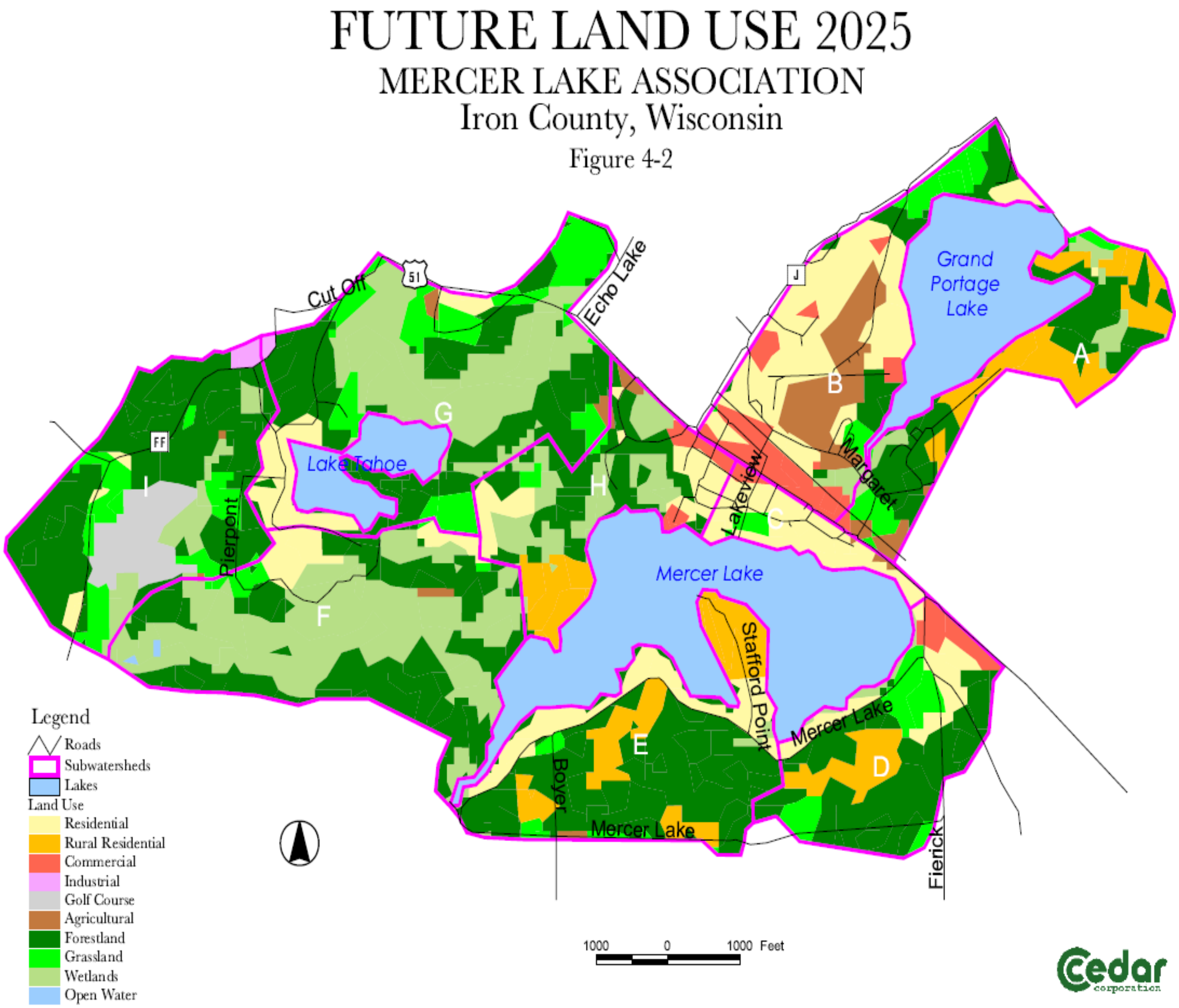
4.3.a. Delineated Land Use (Year 1993/2004)

Existing land use conditions utilized in the preparation of the Mercer Lake Management Plan water quantity and water quality modeling analyses are based on WiscLand (1993) and the Town of Mercer Comprehensive Plan 2004. Figure 4-1 presents the 2004 Current Land Use in the watershed planning area.



4.3.b. Delineated Future Land Use (Year 2025)

Proposed future land use conditions utilized for the preparation of the Mercer Lake Management Master Plan water quantity and water quality modeling analyses were based on Town of Mercer Comprehensive Plan – Land Use Element and available information from Iron County. Figure 4-2 shows the Future Land Use for the watershed planning area.



4.3.c. Land Use Comparisons

The land use area and percentages for Current and Future Land Use are presented in Table 4-1 through Table 4-10. Increases in land use type are presented as **bold text**; decreases in land use are underlined.

Table 4-1 Sub-watershed A Land Use

Current				**Future**			
Watershed	**Land Use**	**Acreage**	**Percentage**	**Watershed**	**Land Use**	**Acreage**	**Percentage**
A	Agricultural	4.49	4.42%	A	Agricultural	4.49	4.42%
A	Commercial	0.78	0.77%	A	Commercial	0.78	0.77%
A	Forestland	57.58	56.62%	A	Forestland	43.84	43.11%
A	Grassland	7.45	7.33%	A	Grassland	7.45	7.33%
A	Residential	0.22	0.22%	A	Residential	0.22	0.22%
A	Rural Residential	22.22	21.85%	A	Rural Residential	**35.96**	**35.36%**
A	Wetlands	8.95	8.80%	A	Wetlands	8.95	8.80%
	Total	101.69	100.00%		Total	101.69	100.00%

Table 4-2 Sub-watershed B Land Use

Current				**Future**			
Watershed	**Land Use**	**Acreage**	**Percentage**	**Watershed**	**Land Use**	**Acreage**	**Percentage**
B	Agricultural	30.41	19.02%	B	Agricultural	30.41	19.02%
B	Commercial	24.76	15.48%	B	Commercial	24.76	15.48%
B	Forestland	18.68	11.68%	B	Forestland	18.68	11.68%
B	Grassland	14.07	8.80%	B	Grassland	14.07	8.80%
B	Residential	68.71	42.97%	B	Residential	68.71	42.97%
B	Wetlands	3.29	2.06%	B	Wetlands	3.29	2.06%
	Total	159.92	100.00%		Total	159.92	100.00%

Table 4-3 Sub-watershed C Land Use

Current				**Future**			
Watershed	**Land Use**	**Acreage**	**Percentage**	**Watershed**	**Land Use**	**Acreage**	**Percentage**
C	Agricultural	0.85	2.47%	C	Agricultural	0.85	2.47%
C	Commercial	1.84	5.34%	C	Commercial	1.84	5.34%
C	Grassland	2.94	8.53%	C	Grassland	2.94	8.53%
C	Residential	28.85	83.67%	C	Residential	28.85	83.67%
	Total	34.48	100.00%		Total	34.48	100.00%

Table 4-4 Sub-watershed D Land Use

Current				**Future**			
Watershed	**Land Use**	**Acreage**	**Percentage**	**Watershed**	**Land Use**	**Acreage**	**Percentage**
D	Commercial	8.33	6.79%	D	Commercial	8.33	6.79%
D	Forestland	77.77	63.37%	D	Forestland	62.70	51.09%
D	Grassland	17.64	14.37%	D	Grassland	17.64	14.37%
D	Residential	16.14	13.15%	D	Residential	16.14	13.15%
D	Wetlands	2.85	2.32%	D	Rural Residential	**15.07**	**12.28%**
	Total	122.73	100.00%	D	Wetlands	2.85	2.32%
					Total	122.73	100.00%

Table 4-5 Sub-watershed E Land Use

Current				**Future**			
Watershed	**Land Use**	**Acreage**	**Percentage**	**Watershed**	**Land Use**	**Acreage**	**Percentage**
E	Agricultural	0.99	0.58%	E	Agricultural	0.99	0.58%
E	Forestland	115.79	67.40%	E	Forestland	<u>98.46</u>	<u>57.31%</u>
E	Grassland	5.16	3.00%	E	Grassland	5.16	3.00%
E	Residential	22.41	13.04%	E	Residential	**26.87**	**15.64%**
E	Rural Residential	25.11	14.62%	E	Rural Residential	**37.98**	**22.11%**
E	Wetlands	2.34	1.36%	E	Wetlands	2.34	1.36%
	Total	171.80	100.00%		Total	171.80	100.00%

Table 4-6 Sub-watershed F Land Use

Current				Future			
Watershed	**Land Use**	**Acreage**	**Percentage**	**Watershed**	**Land Use**	**Acreage**	**Percentage**
F	Agricultural	1.17	0.52%	F	Agricultural	1.17	0.52%
F	Forestland	100.38	44.29%	F	Forestland	<u>90.17</u>	<u>39.78%</u>
F	Grassland	4.79	2.11%	F	Grassland	4.79	2.11%
F	Open Water	0.75	0.33%	F	Open Water	0.75	0.33%
F	Residential	4.30	1.90%	F	Residential	**14.51**	**6.40%**
F	Wetlands	115.27	50.86%	F	Wetlands	115.27	50.86%
	Total	226.66	100.00%		Total	226.66	100.00%

Table 4-7 Sub-watershed G Land Use

Current				Future			
Watershed	**Land Use**	**Acreage**	**Percentage**	**Watershed**	**Land Use**	**Acreage**	**Percentage**
G	Agricultural	2.39	1.01%	G	Agricultural	2.39	1.01%
G	Forestland	88.20	37.12%	G	Forestland	<u>85.97</u>	<u>36.18%</u>
G	Grassland	45.72	19.24%	G	Grassland	45.72	19.24%
G	Open Water	0.05	0.02%	G	Industrial	**1.11**	**0.47%**
G	Residential	20.94	8.81%	G	Open Water	0.05	0.02%
G	Wetlands	80.29	33.79%	G	Residential	**22.06**	**9.28%**
	Total	237.59	100.00%	G	Wetlands	80.29	33.79%
					Total	237.59	100.00%

Table 4-8 Sub-watershed H Land Use

Current				Future			
Watershed	**Land Use**	**Acreage**	**Percentage**	**Watershed**	**Land Use**	**Acreage**	**Percentage**
H	Agricultural	1.88	1.68%	H	Agricultural	1.88	1.68%
H	Commercial	5.98	5.33%	H	Commercial	5.98	5.33%
H	Forestland	49.77	44.38%	H	Forestland	<u>36.75</u>	<u>32.77%</u>
H	Grassland	2.32	2.07%	H	Grassland	2.32	2.07%
H	Residential	17.79	15.86%	H	Residential	17.79	15.86%
H	Rural Residential	3.51	3.13%	H	Rural Residential	**16.53**	**14.74%**
H	Wetlands	30.89	27.55%	H	Wetlands	30.89	27.55%
	Total	112.14	100.00%		Total	112.14	100.00%

Table 4-9 Sub-watershed I Land Use

Current				Future			
Watershed	**Land Use**	**Acreage**	**Percentage**	**Watershed**	**Land Use**	**Acreage**	**Percentage**
I	Agricultural	0.38	0.21%	I	Agricultural	0.38	0.21%
I	Forestland	108.25	61.10%	I	Forestland	105.56	59.58%
I	Golf Course	25.79	14.56%	I	Golf Course	25.79	14.56%
I	Grassland	23.27	13.13%	I	Grassland	23.27	13.13%
I	Residential	3.27	1.85%	I	Industrial	**2.69**	**1.52%**
I	Wetlands	16.21	9.15%	I	Residential	3.27	1.85%
	Total	177.17	100.00%	I	Wetlands	16.21	9.15%
					Total	177.17	100.00%

4.3.d. Future Growth

The most significant findings of the land use study are:

- Current land use shows the watershed is comprised of over 616 acres of forest.
- The principal development in the watershed is currently single-family residential.
- Future land use indicates that 12% of the forest lands will be developed in the next 2 decades.
- Future land use expansion is anticipated to be almost all rural residential/single family homes.

The land uses are summarized in Table 4-10 for both current and future conditions for the Mercer Lake watershed planning area.

Table 4-10 Watershed Summary for Current and Future Land Uses

Current Land Use	Acreage	Percentage	Future Land Use	Acreage	Percentage
Agricultural	42.56	3.17%	Agricultural	42.56	3.17%
Commercial	41.69	3.10%	Commercial	41.69	3.10%
Forest	616.42	45.86%	Forest	**542.13**	**40.33%**
Golf Course	25.79	0.00%	Golf Course	25.79	1.92%
Grassland	123.36	9.18%	Grassland	123.36	9.18%
Industrial	0.00	0.00%	Industrial	**3.80**	**0.28%**
Open Water	0.80	0.06%	Open Water	0.80	0.06%
Single Family	182.63	13.59%	Single Family	**198.42**	**14.76%**
Rural Residential	50.84	3.78%	Rural Residential	**105.54**	**7.85%**
Wetland	260.09	19.35%	Wetland	260.09	19.35%
Total	1344.18	100.00%	Total	1344.18	100.00%

4.4 Discussion

Viewing land use alone, one might consider that there is little need for controls on runoff due to development as there are few currently planned future changes. However, as this report and preceding reports have presented, we have learned that historic land uses promoted nutrient enriched stormwater to enter Mercer Lake and a corresponding increase in the rate of lake eutrophication coincidentally occurred. Therefore, the assumption is that continued development in the Mercer Lake watershed will decrease water quality if untreated surface water runoff from existing and future developed areas continues to enter the lake.

The two subwatersheds that are the most densely developed are B and C. Over 60% of the commercial and over 50% of the single family residential land use for the entire watershed planning area is located in these two sub-watersheds. These sub-watersheds have the greatest impact on lake water quality with respect to storm water runoff and therefore deserve the most planning attention. The USH 51 corridor bisects these water sheds and its reconstruction in the coming years, with development of state of the art storm water management protection devices, is anticipated to be a significant start in the reduction of storm water pollutants reaching Mercer Lake.

Future growth is predicted in all adjoining water sheds, thus implementation of appropriate runoff management from existing and future developments will provide lake water quality protection. The wetlands in the watershed require protection from development as they are vital to the preservation of lake water quality.

CHAPTER 5: WATER QUANTITY AND WATER QUALITY

How do activities in the watershed affect lake water quality? Determining these impacts requires an understanding of the interrelationships of storm water runoff, water quality, watershed surface waters, etc. To understand these relationships in the Mercer Lake and its watershed, both predictive modeling and physical monitoring have been used. The initial Mercer Lake Management Plan issued in 2007 presented predictive computer models to forecast estimates of water quantity and quality. The recently completed USGS Water Quality Study (2012, Robertson) measured both water volume and water quality for two years over the watershed.

5.1 Self Help Water Quality Measurements

Evaluating the condition of the lake has been completed by MLA member volunteers, the WDNR and the USGS. Trained and equipped by the USGS, the MLA volunteers developed a data set that can be referenced online through the recently updated WDNR SWIMS website (www.dnr.wi.gov/org/water/SWIMS). Hoyt Ritter, Jerry Schaefer, and Jerry Huffmaster have all participated in data collection and reporting. The SWIMS website presents graphs, tables and reports which are included in Appendix A – Self Help Data of this report.

Member volunteers, have and are a mainstay in keeping track of the lake chemistry. Ongoing measures of Secchi disk depth, temperature, and dissolved oxygen provide important data on the lake's health. Measured at the deepest point of the lake monthly through the summer, this data provides information on the development and stability of thermoclines which dictate the lake's overall chemical balance. As an example the data collected over the 2006 season are presented in Table 5-1 and graphically portrayed in the accompanying figures which show the development stages of lake stratification.

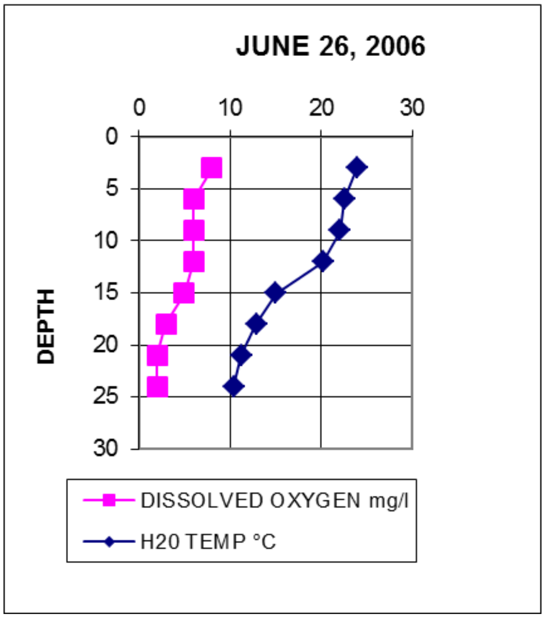
Tables 5-2 and 5-3 present the water quality data collected 2001 through 2011. These data show the lake had a phosphorous level of between 11 and 26 micrograms per liter and chlorophyll-*a* measurements of 0.38 to 8.66 micrograms per liter. Applying the Carlson TSI formula, the lake water quality is calculated to vary from 39 to 51 and is considered mesotrophic. Additional water quality data is included in Appendix A.

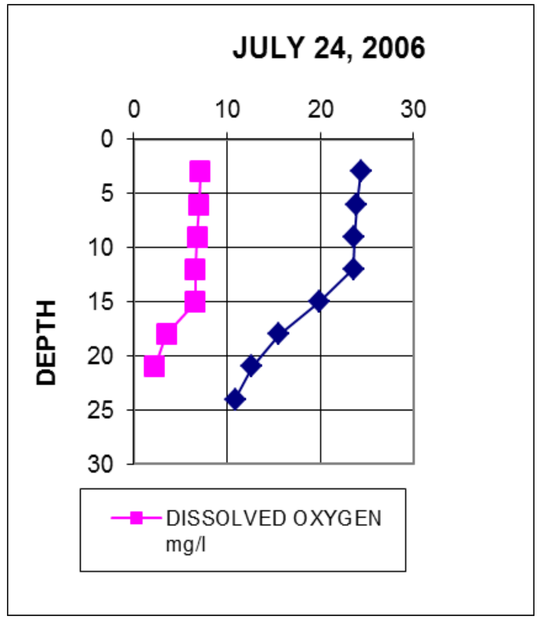
Water clarity is presented in Table 5-4. Water clarity is highest in the least vegetatively productive seasons – spring and fall. Spring clarity is due to the well mixed lake and cool water temperatures at the beginning of the algae growing season. Fall clarity is a result of lake turn over and near surface cooler water temperatures.

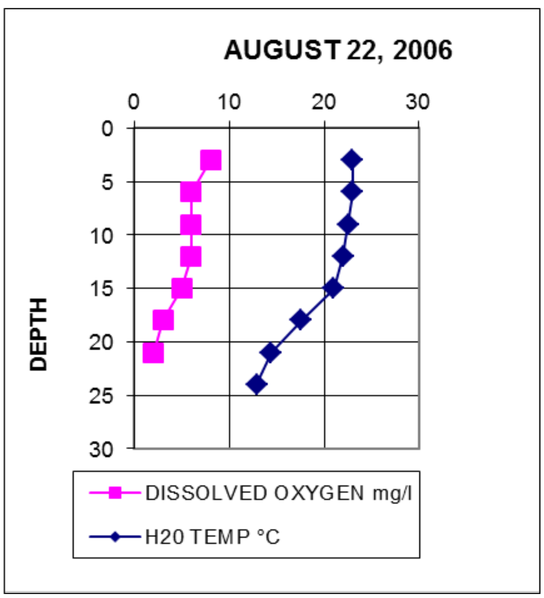
Table 5-1 Dissolved Oxygen and Temperature vs. Depth

SAMPLE DATE	DEPTH feet	H20 TEMP °C	DISSOLVED OXYGEN mg/l
6/26/2006	3	24	8
	6	23	6
	9	22	6
	12	20	6
	15	15	5
	18	13	3
	21	11	2
	24	10	2
7/24/2006	3	24	7.1
	6	24	7
	9	24	6.8
	12	24	6.6
	15	20	6.6
	18	16	3.5
	21	13	2.2
	24	11	
8/22/2006	3	23	8
	6	23	6
	9	23	6
	12	22	6
	15	21	5
	18	18	3
	21	14	2
	24	13	
10/15/2006	3	6	
	6	6	8
	9	6	8
	12	6	8
	15	6	8
	18	6	8
	21	6	8
	24	7	8

Graphical Representation of Mercer Lake Stratification







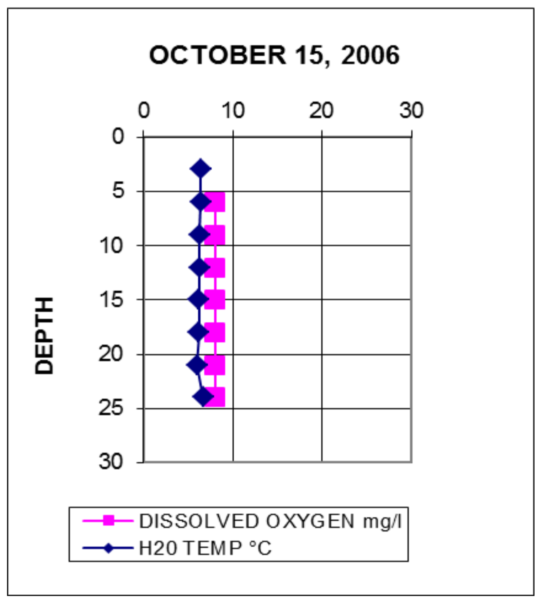


TABLE 5-2

Lake Water Quality Report - 2001 to 2011

Mercer Lake - Iron County STATION: DEEP HOLE

Start Date	Secchi (Feet)	Secchi Hit Bottom?	Secchi (Meters)	Chlorophyll(ug/l)	Total Phosphorus(ug/l)	Secchi TSI	Total Phosphorus TSI	Chlorophyll TSI	Lake Level	Staff Gauge	Appearance	Color
8/28/2001	20	NO	6.1			34			LOW		CLEAR	BLUE
9/14/2001	20	NO	6.1			34			LOW		CLEAR	BLUE
9/28/2001	20	NO	6.1			34			LOW		CLEAR	BLUE
6/7/2002	18	NO	5.5			35			NORMAL		CLEAR	GREEN
7/9/2002	13	NO	4			40			NORMAL		CLEAR	GREEN
8/5/2002	5.5	NO	1.7			53			NORMAL		CLEAR	GREEN
8/29/2002	3.5	NO	1.1			59			HIGH	13.5	MURKY	GREEN
9/8/2002	4	NO	1.2			57			HIGH	12.5	MURKY	BROWN
6/3/2006	13	NO	4			40			LOW	2	CLEAR	BLUE
6/26/2006	10	NO	3	1.99	15	44	49	40	LOW		CLEAR	BLUE
6/27/2006	13.5	NO	4.1			40			LOW	1	CLEAR	BLUE
7/13/2006	15	NO	4.6			38			LOW	2	CLEAR	BLUE
7/24/2006	9.5	NO	2.9	3.6	18	45	51	44	LOW		CLEAR	BLUE
7/29/2006	10	NO	3			44			LOW	2	CLEAR	BLUE
8/22/2006	8.5	NO	2.6	5.98	18	46	51	48	LOW		CLEAR	BLUE
8/30/2006	9.5	NO	2.9			45			NORMAL	3	CLEAR	BLUE
9/15/2006	11	NO	3.3			43			NORMAL	3	CLEAR	BLUE
10/15/2006	8.5	NO	2.6	8.66	21	46	52	51	LOW		CLEAR	BLUE
5/25/2007	12	NO	3.6		20	41	51		LOW		CLEAR	GREEN
6/26/2007	11.5	NO	3.5	1.45	14	42	49	38	LOW		CLEAR	GREEN
7/26/2007	10.75	NO	3.3	1.89	14	43	49	40	LOW		CLEAR	GREEN
9/15/2007	6.75	NO	2.1	3.1	18	50	51	43	LOW		MURKY	GREEN
5/17/2008	8.5	NO	2.6		24	46	53		NORMAL		MURKY	BROWN
6/28/2008	10.75	NO	3.3	2.27	15	43	49	41	NORMAL		MURKY	BLUE
7/25/2008	12.5	NO	3.8	1.39	15	41	49	37	NORMAL		MURKY	BLUE
8/31/2008	10	NO	3	3.15	16	44	50	43	NORMAL		MURKY	BROWN
5/30/2009	8	NO	2.4		16	47	50		NORMAL		MURKY	GREEN
6/30/2009	7.75	NO	2.4	6.63	25	48	53	49	LOW		MURKY	GREEN
7/31/2009	11.5	NO	3.5	2.71	16	42	50	42	LOW		CLEAR	BLUE
9/5/2009	11.75	NO	3.6	3.26	11	42	47	44	LOW		CLEAR	BROWN
5/29/2010	12	NO	3.6			41			LOW		CLEAR	BLUE
6/7/2010	12.6	NO	3.8			41			LOW		CLEAR	BLUE
6/29/2010				2.43	14		49	42				
6/30/2010	12	NO	3.6			41			LOW			
7/8/2010	12	NO	3.6			41			LOW		CLEAR	BLUE
7/16/2010	11	NO	3.3			43			NORMAL		CLEAR	BLUE
7/24/2010	12.6	NO	3.8			41			NORMAL		CLEAR	BLUE
7/31/2010				1.68	13		48	39				
8/9/2010	13	NO	4			40			HIGH		CLEAR	BLUE
8/27/2010				0.38	26		53	27				
6/30/2011	8	NO	2.4	4.25	22	47	52	46	NORMAL		MURKY	BROWN
7/30/2011	11.75	NO	3.6	2.2	16	42	50	41	NORMAL		CLEAR	GREEN
9/16/2011	3.65	NO	1.1	3.07	20	58	51	43	NORMAL		MURKY	BLUE

TABLE 5-3

Lake Water Quality Report - 2004 to 2011
Mercer Lake - Iron County

Start Date	Secchi (Feet)	Secchi Hit Bottom?	Secchi (Meters)	Secchi TSI	Lake Level	Appearance	Color
9/10/2004	7.25	NO	2.2	49	LOW	CLEAR	BLUE
10/5/2004	8.75	NO	2.7	46	LOW	CLEAR	BLUE
5/24/2005	12.5	NO	3.8	41	LOW	CLEAR	BLUE
6/30/2005	7.5	NO	2.3	48	NORMAL	CLEAR	BLUE
7/14/2005	12.5	NO	3.8	41	LOW	CLEAR	BLUE
8/14/2005	9.5	NO	2.9	45	LOW	CLEAR	BLUE
8/31/2005	12.5	NO	3.8	41	LOW	CLEAR	BLUE
9/27/2005	9.5	NO	2.9	45	LOW	CLEAR	BLUE
5/29/2007	11	NO	3.3	43	LOW	CLEAR	BLUE
6/6/2007	11	NO	3.3	43	LOW	CLEAR	BLUE
6/22/2007	12.5	NO	3.8	41	LOW	CLEAR	GREEN
6/30/2007	11.5	NO	3.5	42	LOW	CLEAR	BLUE
7/8/2007	11.25	NO	3.4	42	LOW	CLEAR	BLUE
7/16/2007	11.5	NO	3.5	42	LOW	CLEAR	BLUE
8/2/2007	11.5	NO	3.5	42	LOW	CLEAR	BLUE
8/9/2007	11.25	NO	3.4	42	LOW	CLEAR	BLUE
8/25/2007	10	NO	3	44	LOW	MURKY	GREEN
9/19/2007	9	NO	2.7	45	LOW	CLEAR	BROWN
9/26/2007	15	NO	4.6	38	LOW	CLEAR	BLUE
6/9/2008	10.25	NO	3.1	44	NORMAL	CLEAR	BLUE
6/24/2008	9.5	NO	2.9	45	NORMAL	CLEAR	BLUE
7/3/2008	10	NO	3	44	NORMAL	CLEAR	BLUE
7/11/2008	11.5	NO	3.5	42	NORMAL	CLEAR	BLUE
7/18/2008	13.5	NO	4.1	40	NORMAL	CLEAR	BLUE
7/26/2008	13	NO	4	40	NORMAL	CLEAR	BLUE
8/3/2008	13.25	NO	4	40	NORMAL	CLEAR	BLUE
8/11/2008	13	NO	4	40	NORMAL	CLEAR	BLUE
8/27/2008	11.5	NO	3.5	42	LOW	CLEAR	BLUE
9/5/2008	11	NO	3.3	43	LOW	CLEAR	BLUE
9/12/2008	13	NO	4	40	NORMAL	CLEAR	BLUE
9/21/2008	12	NO	3.6	41	NORMAL	CLEAR	BLUE
9/28/2008	11.5	NO	3.5	42	LOW	CLEAR	BLUE
6/3/2009	10.5	NO	3.2	43	LOW	CLEAR	BLUE
7/5/2009	11	NO	3.3	43	LOW	CLEAR	BLUE
7/13/2009	10.5	NO	3.2	43	LOW	CLEAR	BLUE
7/22/2009	11.5	NO	3.5	42	LOW	CLEAR	BLUE
7/29/2009	10.5	NO	3.2	43	LOW	CLEAR	BLUE
8/6/2009	11	NO	3.3	43	LOW	CLEAR	BLUE
8/22/2009	9.5	NO	2.9	45	LOW	CLEAR	BLUE
8/30/2009	11	NO	3.3	43	LOW	CLEAR	BLUE
9/7/2009	11.5	NO	3.5	42	LOW	CLEAR	BLUE
9/15/2009	11	NO	3.3	43	LOW	CLEAR	BLUE
6/8/2011	9	YES	2.7	45	NORMAL	CLEAR	GREEN
7/2/2011	8	YES	2.4	47	NORMAL	CLEAR	GREEN
7/10/2011	9	YES	2.7	45	LOW	CLEAR	GREEN
7/19/2011	12	YES	3.6	41	LOW	CLEAR	BLUE
7/26/2011	12	YES	3.6	41	LOW	CLEAR	BLUE
8/3/2011	11	YES	3.3	43	NORMAL	CLEAR	BLUE
8/18/2011	12	YES	3.6	41	NORMAL	CLEAR	BLUE
8/27/2011	12	YES	3.6	41	LOW	CLEAR	BLUE
9/12/2011	12	NO	3.6	41	LOW	CLEAR	BLUE
9/19/2011	8	YES	2.4	47	LOW	CLEAR	GREEN
9/28/2011	9	YES	2.7	45	LOW	CLEAR	GREEN

TABLE 5-4

Lake Water Clarity and Temperature

Mercer Lake - Iron County STATION: DEEP HOLE

Date	6/26/2006		7/24/2006		8/22/2006		10/15/2006	
Depth	Temperature	Dissolved Oxygen	Temperature	Dissolved Oxygen	Temperature	Dissolved Oxygen	Temperature	Dissolved Oxygen
(ft)	°C	mg/l	°C	mg/l	°C	mg/l	°C	mg/l
3	23.9	8	24.4	7.1	23.0	8	6.4	8
6	22.6	6	23.9	7	23.0	6	6.4	8
9	22.1	6	23.7	6.8	22.6	6	6.3	8
12	20.2	6	23.6	6.6	22.0	6	6.3	8
15	15.1	5	19.9	6.6	21.0	5	6.2	8
18	12.9	3	15.6	3.5	17.6	3	6.2	8
21	11.3	2	12.7	2.2	14.4	2	6.0	8
24	10.4	2	10.9		12.9		6.7	

Date	5/25/2007		6/26/2007		7/26/2007		9/15/2007	
Depth	Temperature	Dissolved Oxygen	Temperature	Dissolved Oxygen	Temperature	Dissolved Oxygen	Temperature	Dissolved Oxygen
(ft)	°C	mg/l	°C	mg/l	°C	mg/l	°C	mg/l
3	17.0	8	24.6	6	26.9	6	15.2	6
6	17.0	8	24.6	6	24.6	6	15.2	6
9	16.9	8	23.6	6	23.5	6	15.1	5
12	16.5	6	22.0	5	22.5	5	14.9	4
15	15.4	6	19.6	4	20.9	5	14.7	4
18	11.6	5	14.9	3	18.7	3	14.6	4
21	9.4	4	11.9	2	14.4	2	14.5	4
22	9.3		10.4	2	12.8		14.4	

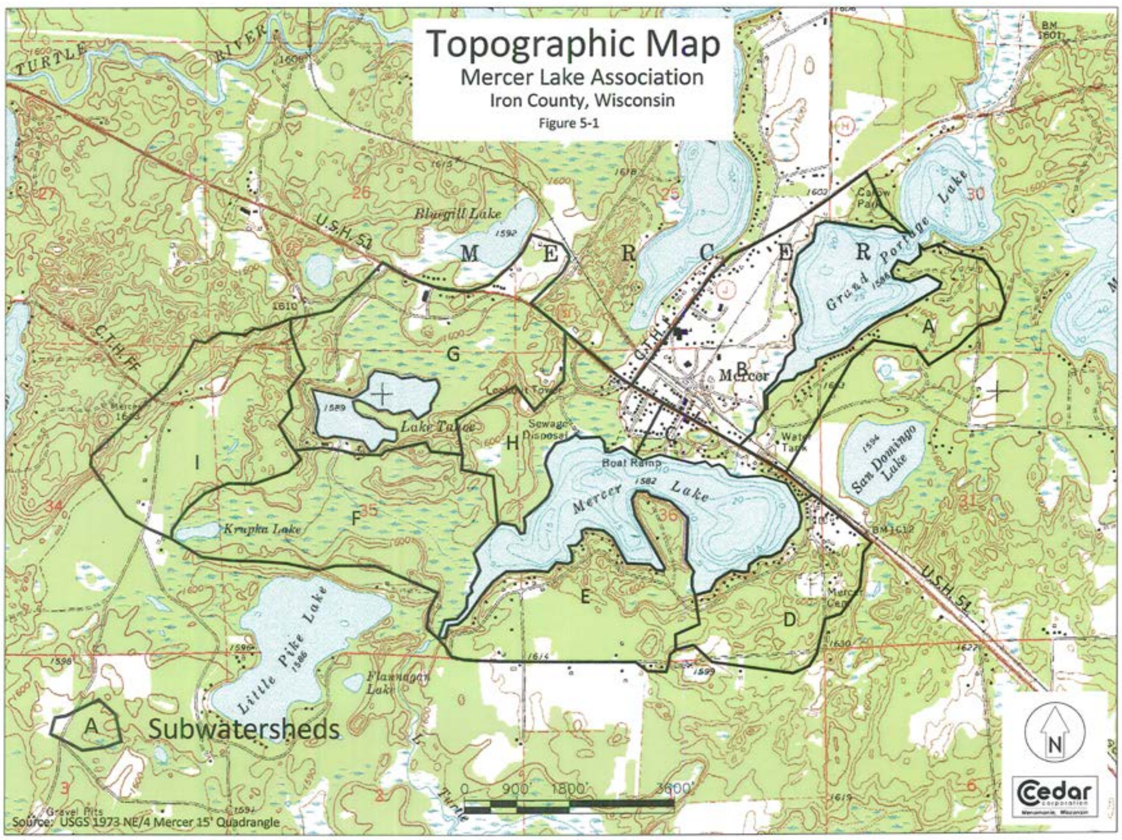
Date	5/17/2008		6/28/2008		7/25/2008		8/31/2008	
Depth	Temperature	Dissolved Oxygen	Temperature	Dissolved Oxygen	Temperature	Dissolved Oxygen	Temperature	Dissolved Oxygen
(ft)	°C	mg/l	°C	mg/l	°C	mg/l	°C	mg/l
3	13.6	8	22.8	8.73	23.1	9.71	21.4	9.5
6	13.6	8	22.7	8.55	23.2	9.5	21.4	9.15
9	13.4	8	22.7	8.49	23.2	9.45	21.1	9.17
12	11.7	7	19.8	8.34	21.8	9.26	20.7	8.43
15	11.0	7	17.9	5.77	20.2	7.81	19.5	6.93
18	9.0	6	14.5	0.49	16.7	7.2	19.2	3.13
21	7.8	1	12.8	0.27	14.0	5.53	15.2	0.35
24	7.3	1	11.4	0.3	13.1	0.49		

Date	5/30/2009		6/30/2009		7/31/2009		9/5/2009	
Depth	Temperature	Dissolved Oxygen	Temperature	Dissolved Oxygen	Temperature	Dissolved Oxygen	Temperature	Dissolved Oxygen
(ft)	°C	mg/l	°C	mg/l	°C	mg/l	°C	mg/l
3	16.9	9.91	19.0	7.71	20.3	8.3	19.7	10.08
6	16.9	9.42	19.1	7.68	20.2	8.25	19.7	10.01
9	16.9	9.36	19.1	7.54	20.2	8	19.2	7.82
12	16.8	9.22	19.1	7.53	20.1	8	18.7	7.59
15	15.9	8.9	16.8	6.93	19.9	5.36	18.2	7.03
18	14.5	7.86	15.2	2.46	17.5	1.35	17.7	6.77
21	13.6	3.8	13.8	0.65	14.9	1.04	17.1	6.74
24	12.6	1.44	12.4	0.39	14.2	0.37	15.0	6.8

Date			6/30/2011		7/30/2011		9/16/2011	
Depth	Temperature	Dissolved Oxygen	Temperature	Dissolved Oxygen	Temperature	Dissolved Oxygen	Temperature	Dissolved Oxygen
(ft)	°C	mg/l	°C	mg/l	°C	mg/l	°C	mg/l
3			22.0	10.3	25.0	8.24	17.1	
6			20.9	10.12	25.0	7.88	17.0	
9			20.2	9.6	24.5	6.82	16.9	
12			18.2	7.9	22.2	7.83	16.8	
15			14.5	3.1	18.1	7.5	16.3	
18			10.9	1.83	12.3	2.38	15.9	
21			9.3	1.5	10.7	1.5	11.9	
24			8.5	0.98	9.4	1.11	11.1	

5.2 Predictive Water Quantity Model

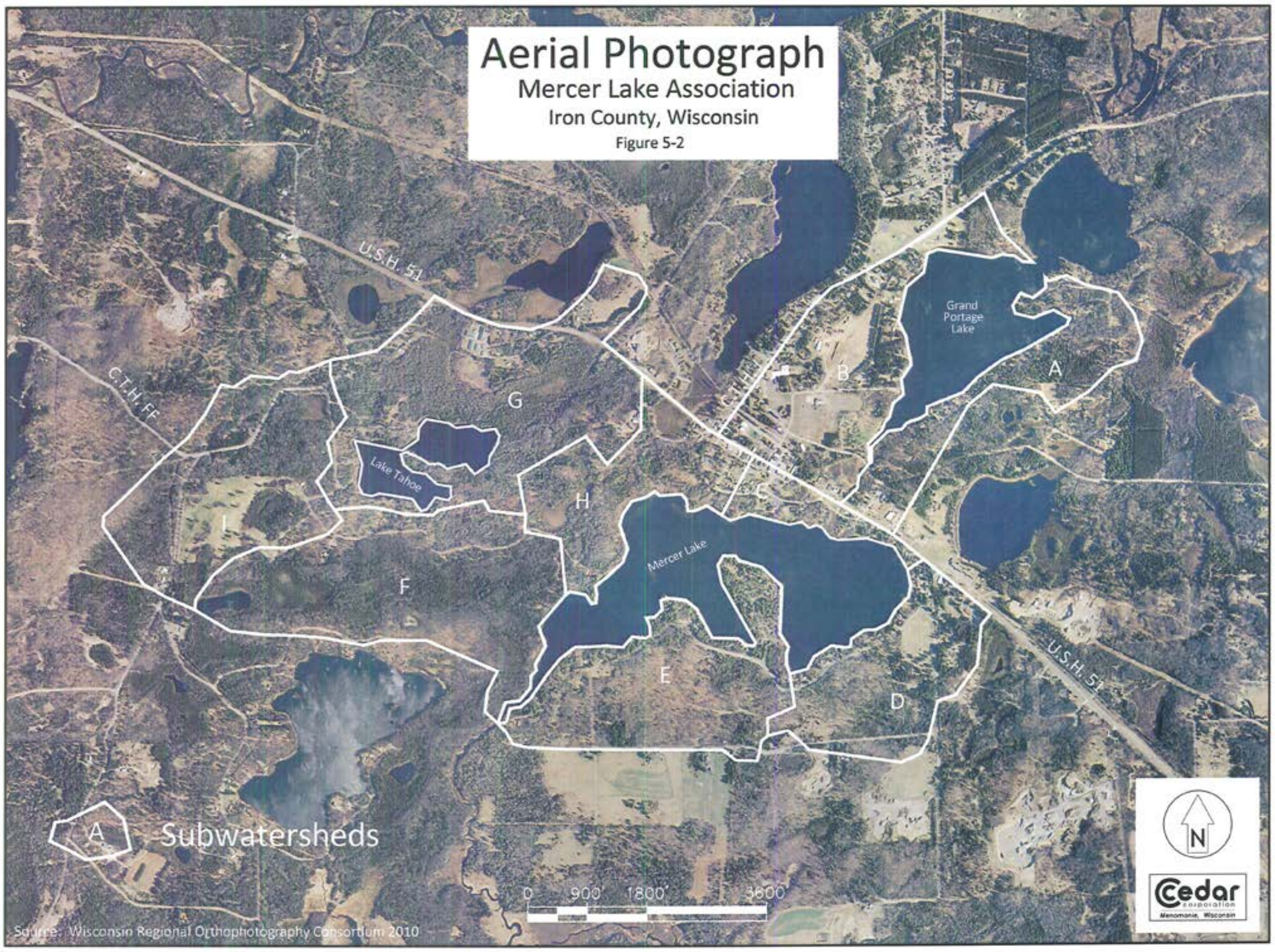
To estimate surface water runoff from the watersheds presented in Figure 5-1, Cedar employed the 2012 WinSLAMM version 9.4 computer model. The models were prepared using the sub-watershed mapping and land use distributions discussed in Chapter 4, NRCS Soil Survey Data from their WPS website provides the soil type determination, and WiscLand 2001 to obtain land use data. Stormwater calculations were made using statistically relevant data as established for the region by the WNDR (base weather station for this area is Duluth, MN for 1975). All WDNR guidelines for this modeling effort were followed.



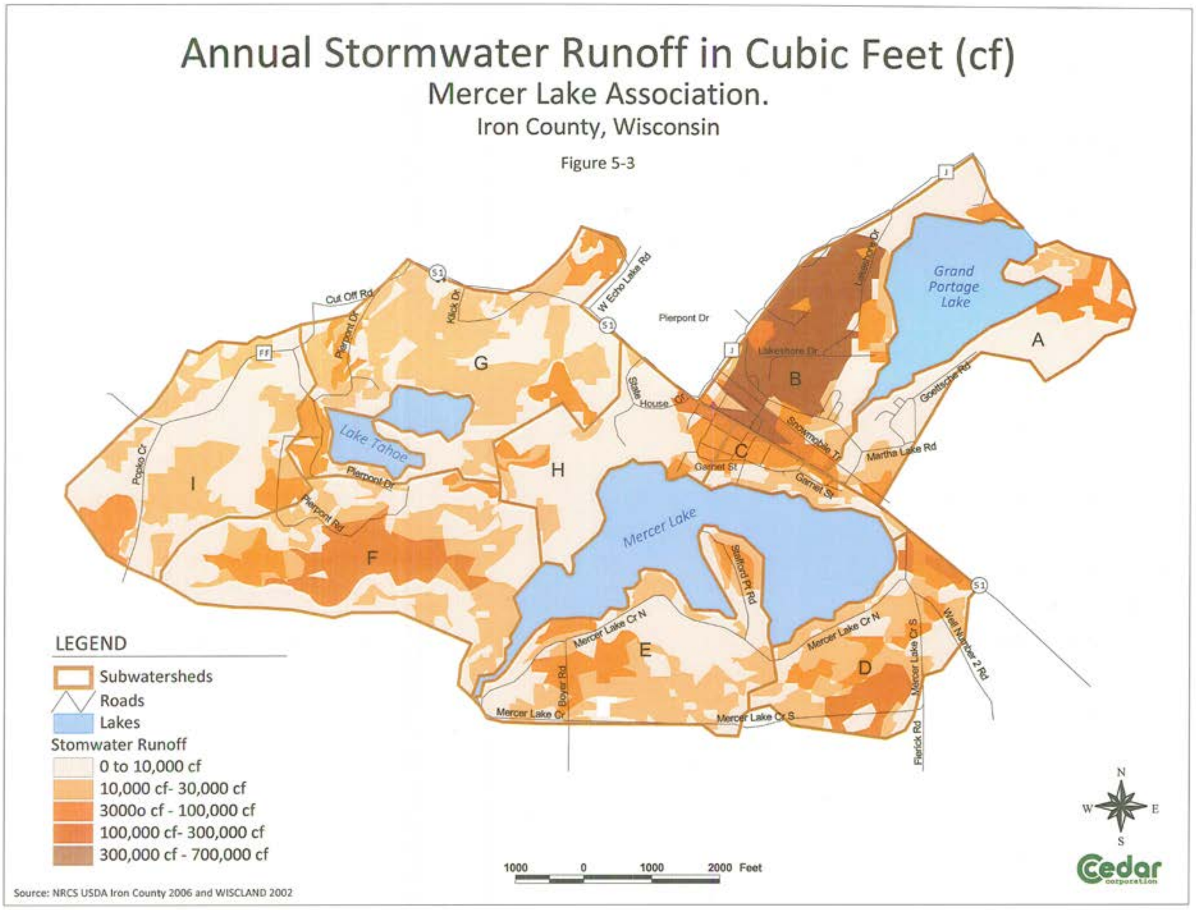
The watershed we used for modelling is presented in Figure 5-1 and drains the near lake 1,345 acres into Mercer Lake. It is bounded by USH 51 and Town roads to the north and south; higher land to the east and west. To the northeast Grand Portage Lake is included in our modeling scenario but not the upstream area (some 6,000 acres) which is part of the Mercer watershed as are the many swamps and several upstream lakes (Martha, Little Martha and other small lakes farther up the drainage). Water quality in this upstream area affects Mercer Lake through the discharge into Grand Portage Lake, but is not included in the land use model as it is primarily forest with some residential development. In addition, this upstream area is part of the area monitored in the USGS study. The real time monitoring completed in the USGS study is much more accurate than the predictive modeling, which is better suited to modeling urban and farm runoff than forested areas.

The 1345 acre near lake watershed is divided into sub watersheds labeled A through G with the majority of the population living in the developed areas labeled A, B, C, D, and E. Sub watershed H includes the wetlands west of Mercer and the area surrounding the wastewater treatment facility. Sub watersheds F and G are wetland areas encompassing Lake Tahoe and sub watershed I appears to drain into F. Figure 5-2 presents the Mercer Lake watershed boundaries on an aerial photograph to provide a different perspective on the developed vs undeveloped lands.

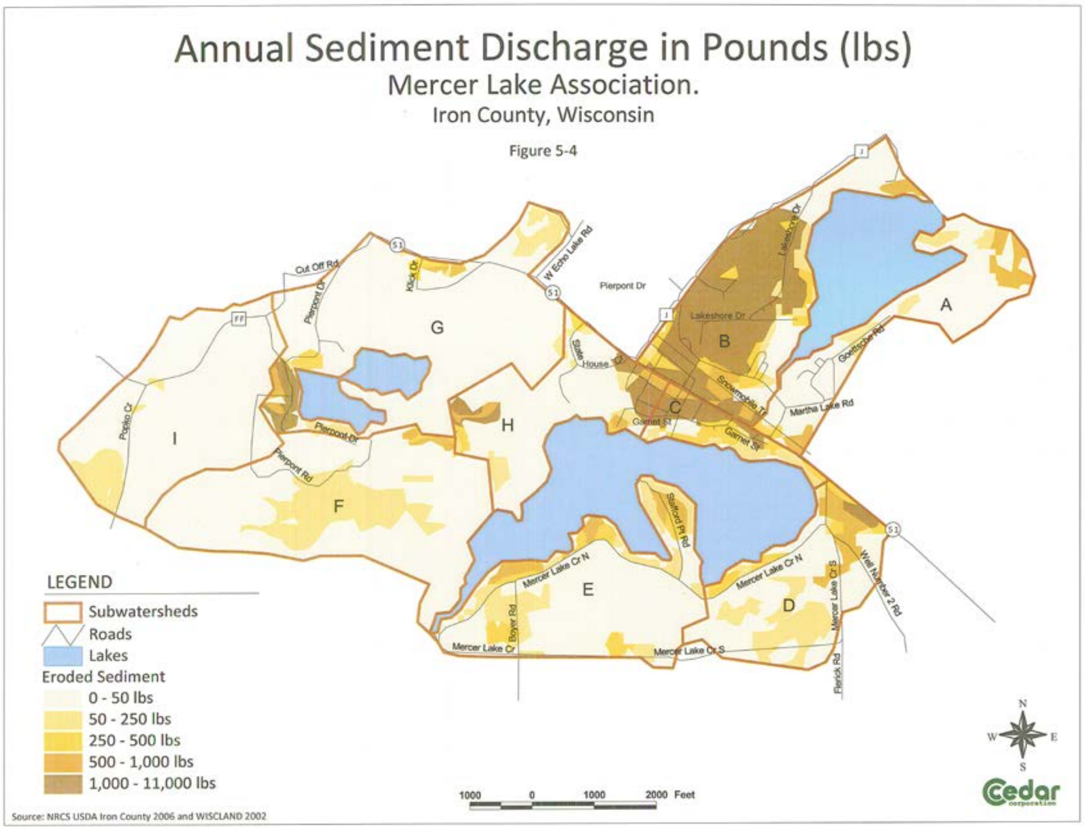
The principal water course through the area is the Little Turtle River which drains a series of low lying lands, small lakes (including Martha and little Martha Lakes) and wetlands flowing through Grand Portage Lake into Mercer Lake and then into the river at the southwest end of Mercer Lake. WinSLAMM uses soil and land use types to compute runoff and is a more sophisticated model than the P-8 model used in the 2007 report. The guiding principles are the same and the WinSLAMM model has experienced several iterations to improve the data quality and improve model user friendliness. Annual water quantity discharged from each mapped land use/soil type combination in each sub watershed is graphically presented on Figure 5-3. The data output files from Win SLAMM are included in Appendix R.

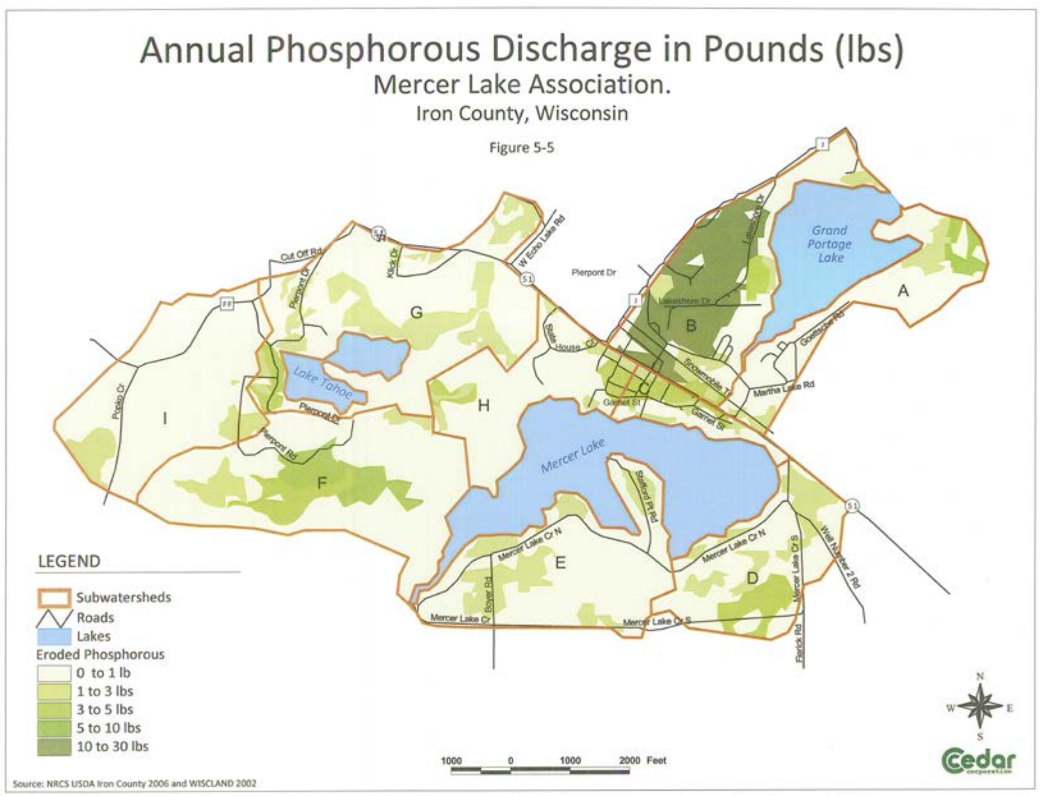


It is important to remember that although the watersheds adjoining Mercer Lake are higher in elevation; physical impediments such as internal lowlands redirect surface water such that not 100% of the computed runoff directly flows into the lake. A good example is the occurrence in sub watershed F of a large area that generates 30,000 to 100,000 cubic feet of runoff. Referring to Figure 5-1 we see this area is wetland, thus we can conclude that the wetland in sub watershed F receives a large proportion of this surface water runoff. This water through minor overland flows and groundwater discharge does eventually empty into Mercer Lake but only after its sediment load has been filtered and the majority of the nutrients have been taken up by the plant life in the wetland areas. These wet areas are prevalent all-round the lake area and act as sinks (traps) in the watershed for sediment collection and nutrient removal from stormwater.



Similarly WinSLAMM can be used to produce maps of sediment and phosphorous discharges and are presented herein as Figures 5-4 and 5-5 respectively.


Annual Sediment Discharge in Pounds (lbs)
Mercer Lake Association.
Iron County, Wisconsin
Figure 5-4
LEGEND
Subwatersheds
Roads
Lakes
Eroded Sediment
0 - 50 lbs
50 - 250 lbs
250 - 500 lbs
500 - 1,000 lbs
1,000 - 11,000 lbs
1000 0 1000 2000 Feet
Source: NRCS USDA Iron County 2006 and WISCLAND 2002


Annual Phosphorous Discharge in Pounds (lbs)
Mercer Lake Association.
Iron County, Wisconsin
Figure 5-5
Grand Portage Lake
Lake Tahoe
Mercer Lake
LEGEND
Subwatersheds
Roads
Lakes
Eroded Phosphorous
0 to 1 lb
1 to 3 lbs
3 to 5 lbs
5 to 10 lbs
10 to 30 lbs
1000 0 1000 2000 Feet
Source: NRCS USDA Iron County 2006 and WISCLAND 2002

The first observation is that the sediment and phosphorous discharge areas appear to be coincident as is expected when considering the source of the discharge is from areas of less infiltration and more developed land uses (and therefore higher runoff potential). Sub watershed B represents a large portion of the community of unincorporated Mercer. Discharges from the town roads and developed areas to the stormwater conveyance system that in the past discharged directly to the lake without any treatment. Large deltas of sediment were noted at the mouth of the principal storm sewer (near the boat landing on the north end of Mercer Lake) serving the downtown area. With the involvement of the Mercer Lake Association, the Mercer community in collaboration with the Wisconsin Departments of Natural Resources and Transportation developed and had incorporated significant improvements into the recent Highway 51 reconstruction. Three significant BMP, grass lined drainage swales have been constructed for storm water collection and discharges and holding areas to allow sediment to settle from collected waters are a few of the proposed changes. Storm water discharges to the Lake are now reduced in both sediment and phosphorous loading.

Also to note are the large areas in sub watersheds F and G that have darker shades of green (Figure 5-5). As previously noted these areas are coincident with mapped. These act as phosphorous traps keeping this nutrient from entering the lake and acting as a fertilizer for aquatic plants. Protection of these natural traps for sediments and nutrients <u>must</u> be considered in all future land use planning and development scenarios.

Previous basic modeling efforts indicated that the watershed would realize only slight increases in storm water and pollutant loads from existing through future phases of development. Much of this is due to the large wetlands acting to protect the lake as well as limited available area in the lake watershed for additional development. The Association recognized that the principal efforts to stabilize or possibly improve water quality would come at reducing pollutant loading at those locations in the watershed generating the most runoff. Considerable effort was directed (and somewhat successfully) to the planned improvements of the WDOT USH 51 and Town of Mercer storm water collection and sewer to ensure storm water is being treated before entering Mercer Lake. Coincidentally, the MLA obtained grants to hire the US Geologic Survey, Water Resources Group in Madison, WI to conduct a two year water quantity and water quality study. This effort was undertaken to provide a better understanding of the dynamics of the watershed, better predict water quality improvements based on storm water quality best management practices, and better understand internal and atmospheric phosphorous loading as well as add credence to the desires for improved storm water management in the Mercer area.

5.3 USGS Study - Water Budget

The USGS study spanning over two years used actual in-field measurements of storm water runoff, precipitation, inlet volumes to Mercer Lake, outflow volumes at the Little Turtle River dam, measurements of groundwater through project specific monitoring wells (piezometers), water quality sampling of the various in-flows and out-flows, and sediment laboratory analyses to develop water and phosphorous budgets. The collected base data formed the input for predictive modeling of lake water quality under future development conditions with estimated contributions of flow, water quality, and water quality treatment methods to determine the long term effects of runoff water quality on lake water quality (USGS, Robertson, et al 2012). The detailed report is included as a reference on the companion CD-ROM. Specific results are presented herein.

Table 5-5: Summary of Water Budget Conclusions for Mercer Lake Watershed
(Typical Conditions – All Values in Acre-Feet)

Inputs	Volume	Percent
Precipitation	489	6.8
Little Turtle Inlet	4,678	65.4
Tahoe Inlet	324	4.5
Landing Storm Drain	29	0.4
Groundwater	1,186	16.6
Ungaged Area	441	6.2
TOTAL INPUT	7,148	100.0
Outputs		
Evaporation	430	5.6
Little Turtle Outlet	6,745	94.4
Groundwater	0	0
TOTAL OUTPUT	7,148	100.0

Table 5-6: Summary of Phosphorous Loading Conclusions Mercer Lake Watershed

Source	2 Year Average (340 lbs)		Typical Year (475 lbs)	
	%	lbs.	%	lbs.
Little Turtle Inlet	47.2	160.5	45.6	216.6
Tahoe Inlet	6.9	23.5	6.7	31.8
Landing Storm Drain	4.1	13.9	3.9	18.5
Ungaged Near Lake	13.1	44.5	19.1	90.7
Groundwater	11.6	39.4	11.2	53.2
Septic Systems	2.5	8.5	1.8	8.6
Internal Sediments	7.7	26.2	5.5	26.1
Precipitation	6.9	23.5	6.1	29.0

Comparing water quantity to phosphorous loading is useful when developing long term action plans.

Table 5-7: Comparison of Percent of Water Budget to Percent of Phosphorous Loading

Source	Water	Phosphorous	P/W Ratio
Little Turtle Inlet	65.4	45.6	0.70
Tahoe Inlet	4.5	6.7	1.49
Landing Storm Drain	0.4	3.9	9.75
Ungaged Near Lake	6.2	19.1	3.08
Groundwater	16.6	11.2	.70
Septic Systems	---	1.8	---
Internal Sediments	---	5.5	---
Precipitation	6.8	6.1	0.90

From Table 5.7, the ratio of percent phosphorous loading to percent water volume (P/W Ratio) in the watershed provides a relatively simple comparison to identify those areas that have the greatest impact on water quality. The lower volumes of storm water from the smaller contributing areas are in the more highly developed source areas and provide greater quantities of phosphorous per volume. These areas are, therefore, worth the extra effort to control phosphorous contributions to surface runoff waters.

The most significant volume of phosphorous contributions comes through the Little Turtle Inlet. Future and existing efforts to further control phosphorous in and around the unincorporated Mercer area, US Highway 51, and the ungaged near lake (riparian) area are important but can be overshadowed if uncontrolled development occurs on the Little Turtle River upstream of Mercer Lake.

5.4 Predictive Modeling of Future Conditions

The USGS study incorporated their field data and statistical modifications to a ‘typical year’ into the most appropriate phosphorous budget models available. Using the Canfield and Bachmann approach and the Carlson TSI equations, the USGS determined that the Mercer Lake response to increased phosphorous in the system provides an almost similar increase in chlorophyll production.

Using the existing watershed (all 7,500 plus acres) calibrated with the watershed wide data collected in 2008 and 2009, the USGS (Table 13 and Figure 22 in USGS Report) evaluated future phosphorous contributions as a percentage of current P (phosphorous) loading. Decreases in P loading of up to 75% were modeled as were increases as high as 200%. Other models included: Model Year (MY) 2008-2009; Typical Year Hydrology with and without Internal Loading; pre-1965; 1965 to 1995 with various % retention of P loading in the lake from sewage plant contributions; and finally a Future Scenario with Best Management Practices used. The output from the model effort is presented in percentage of phosphorous load and predicted Secchi Depth.

As expected decreases in P loading significantly increase Secchi Depth and corresponding increases in P load decrease Secchi Depth (Table 5-8).

Table 5-8: Phosphorous Loading and Secchi Depth – Mercer Lake

P Loading (pounds)	P Loading (% of current load)	Secchi Depth
105	-75%	27.0
183	-50%	16.5
261	-25%	12.2
340	0	9.7 Existing
418	+25%	8.1
496	+50%	7.1
653	+100%	5.6
967	+200%	4.1

Using the predictive model, the anticipated increased development along USH 51 in the watershed model was computed both with and without Best Management Practices (as were later constructed). In the model without BMP, the external P loading increased to 435 pounds (an increase of 25 to 50% in P loading (Table 5-8)). Without Best Stormwater Management Practices, the resulting Secchi Depth is predicted to be 8.1 to 7.1 feet or 1.6 to 2.6 feet less than experienced today. With BMPs in place, the predicted Secchi Depth is 9.9 feet, an improvement of 0.2 feet even though increased development has occurred.

Equating this result to future efforts of storm water control in the watershed, the USGS was able to predict that **if:**

1. Future highway construction is accomplished with the various best management practices for storm water as proposed; and, if,

2. Future development occurs with little increase in runoff and nutrient loading (i.e., best management practices for storm water control are used in future developments and improvements to existing developed areas);

Then, lake water quality should remain similar to that measured during the 2006 – 2010 period.

<u>The USGS report concludes:</u>

> **"Because of the limited phosphorous presently input into Mercer Lake, increases in phosphorous loading could have a large effect on water quality. Therefore, management actions to minimize future phosphorous input into Mercer Lake are likely to greatly benefit water quality.**
>
> **Issues with respect to the internal loading of phosphorous from Lake Bottom sediments are discussed (in the USGS report), but "internal loading only represents 6 percent of its (Mercer Lake) total phosphorous load. Therefore, the phosphorous trapped in the sediments should have a minimal effect on long term …** (aqueous) **… phosphorous concentrations…"**

CHAPTER 6: LAKE SEDIMENTS

The study of lake sediments (paleoecology) can provide an evaluation of historic lake water quality and changes to it, over past decades. Sediments are constantly being deposited on the lake bottom through gravitational deposition of inorganic and organic debris. Scientists have learned how to "read" these sediment deposits or 'records' by coring, cataloguing, and conducting numerous physical and chemical analyses of the sediments, deciphering the skeletons of the tiny plankton that dominated various time periods and specific lake water quality, and developed the ability to "age date" the results.

For Mercer Lake, lake sediment cores and grab samples were collected to define the lake water quality history, provide some insight into the effects on water quality observed through the changes in the watershed, evaluate for hazardous substances, and assess the ability of the sediments to hold or release phosphorous.

6.1 Sediment Cores and Paleoecology

The July 2003 sediment coring effort with a resulting paleoecology report was conducted and prepared by Paul Garrison, WDNR. This project was initiated to evaluate the impact of the former wastewater discharge on Mercer Lake (Garrison, 2004). To provide comparative analysis, a sediment core was also acquired on the same day in Grand Portage Lake. The theory being that similar lakes, both with developed shorelines and in the same locale, but only Mercer Lake received treated sewage discharge (1965 to 1995), thus the sediments of Grand Portage should prove as invaluable reference for lake sediment and water quality.

The results of the sediment core sampling indicate that although geographically similar, water quality has varied between the two lakes over the past 150+ years. Dividing the cores into 0.8 inch segments and using sediment dating techniques that measure Lead-210, diatomaceous organism counts, and other analyses, the WDNR recreated the paleoecology of the lakes, as follows:

> By 1865 the land around these lakes was already platted (surveyed) for development, the dominate land cover was the conifer forest.
>
> Mercer Lake has experienced a very low sedimentation rate over the past 200 years, varying from 0.003 in the early 1800s to 0.022 (grams per square centimeter per year) in recent years which is interpreted as a direct result of increased runoff waters from surrounding land development.
>
> Certain geochemicals associated with development have been analyzed in the Mercer Lake core. Titanium (a function of soil erosion), zinc (an indicator of urban runoff), manganese (formed as a result of anoxic [low oxygen] periods, phosphorous, and nitrogen have been analyzed in each age dated core segment allowing the preparation of accumulation rate graphs of these compounds. Inspection of these graphs in Garrison's report notes a slow rise in accumulation rate until the mid-1800s with the rates

doubling by 1910, no doubt in concert with logging and related soil losses. Soil erosion accumulation peaked in the late 1950s but urban runoff, anoxic conditions, and nutrients peaked in the mid-1930s, late 1960s, and early 1970s, and 2000. Each erosional increase has an associated decline.

In general terms, lake water quality suffered from soil erosion pollutants up to about 1970. This process appears to have slowed until recently (ca. 2000) as the indications are that soil erosion is increasing. The recent increases in phosphorous, nitrogen, and organic matter are likely due to runoff and the proliferation of the aquatic plant community and its annual die off.

Paleontologists study diatoms (siliceous cell walled organisms) to identify specific environmental conditions that resulted in particular diatom growth. Some species can only survive in very narrow environmental conditions. In other words, some diatoms will like certain water quality conditions (for instance) while others do not. Therefore, studying diatomaceous communities in age dated cores can provide a history of the physical and chemical conditions at the time of the diatom deposition.

The Mercer Lake diatom community is noted to indicate that water quality with up to 11.5 feet clarity was present up to about 1880. Water quality by 1965 was poor with less than 6 foot clarity.

Improvements in watershed water quality, notably:

- collection of septic systems to a WWTP (1965)
- removal of WWTP discharge to a point downstream (1995)
- less soil erosion (1970)

have resulted in increases of those diatomic species such that the community now resembles that experienced in the mid-1800s and a corresponding increase in Secchi Depths has also been realized.

The Grand Portage Lake core shows a much different response in diatomaceous community. This lake development did not, and has not, experienced as dense an aquatic plant community as Mercer Lake. In fact, there appears to have been a single change to a more mixed diatomic community (from a plant only community to one with a mix of plant dominant and open water species). For the past 100 years the lake continues to show minimal affects.

The conclusions of the Garrison study include:

- Mercer Lake contained abundant aquatic plants with low water phosphorous concentrations before the mid-1800s.
- Mercer Lake has experienced one of the lowest sedimentation rates statewide over the past 200 years.
- Increased sedimentation rates peaked in 1970 and again in recent years (2000). This is assumed to correspond to increases in soil erosion due to local construction activity.

- The Lake experienced high phosphorous levels and blooms of algae when the waste water treatment plant was installed and operating at its site adjacent to Mercer Lake, and discharged to the Lake; corresponding Secchi Depths were lower during this period.
- Although connected and geographically close together, the two lakes Mercer and Grand Portage) have very different experiences with respect to phosphorous concentrations, all due to urban activities that impact the downstream Mercer Lake.

6.2 Sediment Analysis and Hazardous Compounds

The discharge of treated sanitary sewage effluent (and possible untreated sewage during plant overflows) occurred over a period of 30 years (1965 to 1995). This plant was shut down and demolished in 1995. The new waste water treatment plant (WWTP), located some distance from Mercer Lake, discharges treated wastewater to a series of seepage cells allowing the underlying native soils to further polish the treated waters before entering the groundwater system outside the Mercer Lake watershed. The new WWTP does not impact Mercer Lake or its watershed.

The concern that the waste water residuals which may have accumulated in the lake sediments from the years of discharge was evaluated through a lake sediment sampling and analysis task as part of the USGS study. The USGS collected the sediment samples as part of the phosphorous release study they completed. Laboratory analyses were completed at the Wisconsin State Laboratory of Hygiene (WSLH). Analysis of over 60 compounds is presented in Appendix A in this report.

The various compounds include surfactants, food additives, antioxidants, flame retardants, plastizers, industrial solvents, disinfectants, pharmaceuticals, personal-care products, polycyclic aromatic hydrocarbons, and high use domestic pesticides.

The analytical results are presented in Table A-1 in Appendix A. The analyses in Table A-1 are presented as mass in terms of µg/g or micrograms per gram. This is the equivalent of parts per billion. While reviewing this table the following notations are made:

- "<" means less than. This means that the sample contains less than the laboratory method of detection for that compound and can also be reported as "No Detection".
- "E" means estimated concentration reported due to difficulties in recovery, precision, reference blank contamination, or reference standard issues.

The Burkhardt et al. analytical procedure (Schedule 5433) is referenced in the Ward February 28, 2006, memorandum included in Appendix A which discussed the relevance of the analyses for wastewater contaminants in lake sediments.

The USGS review of the data indicated the following:

1. Wastewater constituents – nothing too unusual except high Phenols (known disinfectant) and Creosol (wood preservative) compounds. Phenols are the only compound with elevated concentration near the lake outlet.

2. Several asphalt, diesel, and gasoline compounds were detected throughout the lake – fluoranthene, naphthalene, phenanthrene, pyrene, and lead.

3. Aluminum and iron concentrations are lower at the lake outlet, possibly due to the flushing action of the lake as it is shallower at the outlet. Cobalt and lead results are lower than expected.

A comparison of the sediment quality results was made with the accepted concentrations of contaminants in sediments list established in 2003 by WDNR. Called the CBSQB (Consensus Based Sediment Quality Guidelines), the list was developed by consensus with the multiple jurisdictions (state, federal, provincial, and tribal) which have the responsibility of protecting human health and the environment in the near shore areas of the Great Lakes.

The CBSQG identifies contaminants as having Threshold, Midpoint, and Probable Effects on organisms that come in contact with them. Threshold Effects are the lowest concentration listed while Probable Effect concentrations are the highest. Mercer Lake sediments are considered:

- Of the analyzed and detected metals in the Mercer and Grand Portage Lakes, all concentrations are lower than CBSQG Threshold Effect Concentrations.
- Of the polycyclic aromatic hydrocarbons (or PAHs) detected only pyrene (West Basin Deep Hole Sample) was noted to have a concentration above a listed Threshold Effect Concentration but is well below the Midpoint Effect Concentration (230 µg/g vs. TEC of 195 µg/g).
- Concentrations of PCBs detected in the sediment samples in the Mercer deep hole and outlet bay samples were measured at 0.024 µg/g, well below the listed TEC of 60 µg/g. As a reference, the detected quantities are at the laboratory Limit of Detection and equate to 24 parts per trillion.

In conclusion, the concentrations of suspected hazardous compounds in the Mercer Lake sediments are not above expected levels and are comparable to the results observed in Grand Portage Lake sediments.

6.3 Phosphorous Loading

Fully discussed in Robertson, et al, 2012, the phenomenon of Mercer Lake sediment loading with inorganic phosphorous was evaluated in the WSLH laboratory. Phosphorous becomes bound in lakebottom sediments when inorganic phosphorous is deposited on lake bottoms under aerobic conditions. Under certain climatic conditions, lakes stratify and the oxygen in the lower strata (below the thermocline) or hypolimnion is reduced as a function of both the lack of near surface water mixing and ongoing aerobic decomposition of debris and detritus on the lake bottom. Reductions of oxygen below concentrations of 1.0 milligram per liter result in anoxic conditions.

This lower oxygen content layer cannot support aerobic organisms and as the water chemistry changes the decomposition process becomes anaerobic. Under the anaerobic process the decomposition bacteria release former sediment bound phosphorous ions into the water column correspondingly increasing the concentration of phosphorous and fertilizing the next crop of algae.

When subjected to anaerobic conditions in the laboratory, Mercer Lake sediments were observed to release phosphorous at rates of 0.672 to 2.115 milligrams per square meter per day. Under aerobic conditions the phosphorous release rate in these sediments varied from -0.094 to 0.077 $mg/m^2/day$, thus some 10 to 25 times slower than under anaerobic conditions.

CHAPTER 7: LAKE HABITAT, AQUATIC PLANT MANAGEMENT and FISHERIES MANAGEMENT PLANS

After the preparation of the grant application and approval of the work plan for the development of the lake management plan and USGS lake study, the WDNR amended the Lake Management Plan guidelines in 2006 to require the inclusion of an Aquatic Plant Management Plan (APMP). This additional scope of work is now required for permit application requests for aquatic plant management activities such as aquatic plant cutting and harvesting, invasive species management, etc. MLA successfully amended the MLMP work plan and received a portion of the additional funding in 2009 to complete the APMP. An additional WDNR grant was applied for and received for the balance of the APMP funding requirements. Additionally, the MLA in cooperation with the WDNR, Fisheries Section, developed a Fisheries Management Plan for Mercer Lake. This plan follows WDNR guidelines and developed long range fishery management plans and strategies for Mercer Lake. The plan was review, approved and adopted by the WDNR. The plan was developed by the retired local fisheries biologist previously responsible for fish management in Mercer Lake. Lake fisheries development plans and stocking programs, commitments and schedules are a part of this plan. The Mercer Lake Fisheries Management Plan is also an attachment to this lake management plan.

7.1 Aquatic Plant Management Plan

The MLA retained Ecological Integrity, LLC an aquatic biology consultant from Amery, WI to complete the APMP for Mercer Lake, which includes extensive aquatic plant surveys, mapping, reporting and public involvement. The APMP is a separate document, “Aquatic Plant Management Plan, Mercer Lake”, 2012; Steve Schieffer, Consultant.. The complete APMP report is presented as an attachment to this lake management plan. A summary of the report is included here.

7.1.a. Planning Process

Aquatic plant management plans include:

- A survey of the plant community (conducted in the spring and the fall)
- Data about the fisheries, watershed, and water quality
- Developed goals to maintain and promote the diversity of the observed plant life
- Strategies to control aquatic invasive species (plants)
- Public involvement, public awareness
- Identification of sensitive areas
- Strategies for water habitat improvement

7.1.b. Aquatic Plant Surveys

Plant Survey – 2003

The July 2003 plant survey (“Aquatic Plant Surveys for Mercer Lake, Mercer Lake, Iron County, Wisconsin” McComas, S. June 2004) identified 15 submerged plant species, two floating pond aquatic plants, and four emergent plants. No exotic (aquatic invasive) species were identified. Most lake plants are found in 10 feet of water or less with some plants found in 13 feet of water. This corresponds to current Secchi Depth of 9.7 feet observed during the USGS lake survey of 2008 – 2009.

Dominant plant species in 2003 were from pond aquatic plant, coontail, cabbages, and northern water milfoil (this is the native variety). The survey was conducted along 21 transects oriented perpendicular to the shoreline. The fertility of the lake (a function of both sediment and water sourced nutrients) supports an abundant vegetation.

Limited data is available on Mercer Lake aquatic plant studies from the WDNR files. A 1951 report noted “abundant vegetation in shallow muck areas”.

1978 Common occurrence of water lilies and pond aquatic plant.
1981 Identified 50% of the littoral bottom type to be sand.
1994 Fish management plan – institute aquatic plant control to decrease available hiding cover. The goal was to increase walleye habitat.

The 2003 plant survey concluded that 51% of the lake bottom is covered with plants and in some areas emergent vegetation is a navigational hazard. It was recommended that navigational channels be developed in the vegetated area, avoiding areas of emergent vegetation.

Water clarity is inherently related to water quality. Improved water quality is typically rewarded with improved water clarity. The linearity of the chlorophyll “a” development and phosphorous concentration observed in the USGS report supports this statement in reference to Mercer Lake. The 2003 Aquatic Plant Report concludes that the abundant vegetation observed in Mercer Lake is also related to water clarity underscoring the fact that the aquatic vegetation limits available phosphorous for algae growth.

Aquatic plant management must be committed to maintaining an effect balance of available plant life for phosphorous removal, yet provide lake users an enjoyable experience, and recognize the value of aquatic cover for fish and other lake habitats.

2010 Survey

Forty-seven native aquatic plants were identified and two aquatic invasive species – reed canary grass and aquatic forget-me-not. Aquatic plants were observed to be lush to very dense with very high index values for Floristic Quality and Simpson’s Diversity of 0.92. Eurasian water milfoil and curly leaf pond aquatic plant were not found during the surveys.

The Mercer survey comprised of 485 sampling points and covered the entire lake. Four primary areas in the central portions of the lake were noted as deeper than 19.1 feet (116 points) and did not contain any plants and help define the littoral zone.

7.2. Mercer Lake Fisheries Management Plan

The importance of the fishery in Wisconsin is underscored by the available literature – private, state, and federal. Fisheries data are included in the various references as well as in Appendix Q. In August, 2012, the MLA hired Aqua Tech LLC to develop a Fisheries Management Plan (included in Appendix Q). The MLA entered into discussion with the local fisheries section of the WDNR. Originally the MLA requested that the WDNR conduct a fisheries study and develop a management plan, similar to that recently developed for the Turtle-Flambeau Flowage. Insufficient funds were available for the WDNR to conduct such an effort for Mercer Lake. The MLA suggested that under existing grant funding, that the MLA would retain the recently retired local WDNR fish biologist and one of the co-authors of the flowage plan. The suggestion was accepted with the conditions that: 1), the flowage report process would be followed, 2), the report would be in the same format, 3), the WDNR would review and approve the final version of the plan, and 4), the state sponsored fish stocking schedules and quantities described in the approved plan would be budgeted and followed by the state. The Mercer Lake Fisheries Management Plan is an attachment to this lake management plan.

7.2.a General

Mercer Lake has undergone numerous fish population surveys throughout the years. Those major investigations took place in 1951, 1968, 1974, 1981, and 1993. Several sampling sessions have occurred since 1993 that were designed to evaluate the success of gamefish stocking, natural reproduction, and status of adults. The fishery in Mercer Lake has been managed predominantly for muskellunge and walleye since 1938.

The Mercer Lake panfish population has also been consistently reported as a low quality fishery, with slower than average growth rates and poor size structure. This has been largely attributed to excessive aquatic plant growth that has inhibited predation that would otherwise keep panfish densities in-check.

7.2.b Survey Process

In January 2012, a fishery questionnaire was sent to 73 stakeholders (fishing MLA members, local fishing guides, bait shop owners, Town of Mercer board members) who were believed to have a committed interest in the future of the Mercer Lake fishery. A variety of questions were directed at identifying the lake user groups involved and their preferences. These topics included:

- Fish species preferences
- Relative importance regarding abundance of fish versus size
- Preferences regarding catch versus harvest
- General lake use

Of the 53 questionnaire returns, 28% clearly indicated fishing was a much lower priority when compared to wildlife viewing, boating, and aesthetics on Mercer Lake. The remaining 72% place fishing as their primary interest while on the lake. Forty percent of those returns indicated they fish once per week or more often. Of the three gamefish species of interest, muskellunge was the most desired. The second most desired gamefish species is walleye. Largemouth bass are the third most desired gamefish species to Mercer Lake anglers. There was no expressed interest in northern pike or smallmouth bass.

Forty-seven percent of the questionnaire respondents desire black crappie over all other panfish species.

7.2.c Plan Development Goals

Recommended strategies for the management and State stocking program represented a consensus agreement between the Fisheries Management Plan, author and Department of Natural Resources fisheries personnel who have the administrative authority for managing Mercer Lake and its fishery.

Goal 1: A **muskellunge** population of moderate density with a moderately high proportion of preferred-size fish.

Goal 2: A **largemouth bass** population of moderately high density with a lower proportion of preferred-size fish.

Goal 3: A **walleye** population of moderately low density with a moderately high proportion of quality-size fish.

Goal 4: A panfish fishery that is comprised of black crappie, bluegill, and yellow perch at moderate densities with a significant proportion of preferred-size fish.

7.2.d Fishery Management Plan Recommendations and Action Plan

A summary of the Fishery Management Plan recommendations and action items are as follows:

- Redirect gamefish management emphasis towards muskellunge fish quality and densities. This involves gaining up-to-date information including population estimates, age/growth and reproduction recruitment data. Supplemental muskellunge stocking should be suspended until a current fish survey is available (2013-2014 time frame) so as not to be counter-productive to achieving the stated species goals and objectives. Creating an unnatural abundance of fish through excessive or unnecessary stocking can only lead to forage base shortages and reductions in growth rates.

- Resume WDNR sponsored alternate year, extended growth muskellunge stocking program as agreed to by WDNR (Spooner, WI) and the MLA.

- Initiate a survey schedule to specifically monitor the largemouth bass population relative to changes in abundance (catch rates) and size structure to assure harvest regulations are appropriate to achieve the stated goals and objectives.

- Angler preferences clearly indicate walleye are a desired gamefish species to the Mercer Lake stakeholders. Therefore, walleye stocking may be permitted as a “bonus” fishery if the MLA or private citizen’s desires to privately fund such a stocking program. Rescind the protective 18-inch minimum length limit /3-bag limit and impose the statewide 15-inch minimum length limit-5fish bag limit to allow anglers increased harvest opportunity.

- Limit harvest of black crappie and yellow perch by imposing a 10 fish panfish bag limit with a 10 inch minimum length limit on black crappie as soon as administratively possible by the WDNR. This will help to promote expansion of these populations.

- Incorporate into 2015 monitoring survey schedule or before, spring sampling (fyke netting or electro-fishing) to assess black crappie and yellow perch abundance and size structure. Periodically monitor bluegill size structure and abundance through early summer fyke netting.

- Continue annual aquatic plant harvesting for purposes of maintaining more “aquatic plant edge” or "fish lanes” to encourage predation on bluegills and to realize improved water access by maintaining an aquatic plant free “lane” for shoreline property owners.

- WDNR, however, recognizes Mercer Lake as having a diverse plant community that is contributing to maintaining the clear-water state. Therefore, the Aquatic Plant Management Program staff of the Department is reluctant in allowing major plant disturbance that might upset this balance. The goal is to maintain the clear water state and prevent opening large areas that may recolonize with invasive plants (if introduced).

7.2.e MLA Fishery Management Considerations

1. Potentially, continue periodic EG walleye stocking, if desired. The MLA could stock walleyes on a ‘donation only basis (MLA use of treasury funding is not allowed under the current by-laws).
2. Actively pursue alternate year WDNR musky stocking based on the investigation information defined in 7.1.4.
3. 2010 monitoring survey includes early spring electro-fishing (SE1), late spring electro-fishing (SE2) and a fall recruitment assessment. Early spring netting (SN1) should be completed in the future to best evaluate and track the adult walleye and musky populations.
4. Continue aquatic plant harvesting as a means of providing “edge-effect” for increased predation.

Increased takes of target fish on all lakes in the region have resulted in reductions of bag limits for most fish species in the past 20 years (Fishery Status Update, 2003). Preserving the fishery and allowing active and future fisher persons to enjoy their pastime has recently become a greater challenge.

7.2.f Goals for the Mercer Lake Association should be:

1. Continue MLA's very active participation in fishery management.
2. Work with local DNR and Fishery Agencies to promote habitat development, preservation and State sponsored fish stocking programs.
3. Continue on a 'donation only' basis a private fish stocking program.
4. Participate in fish counting efforts offered by the state and volunteer efforts such as the recent (2012) MLA Fish Survey.
5. Promote local CPR (catch, photograph, and release) program for game fish.
6. As required, develop slot size limits for fish takes. This approach (limiting fish of a certain length cannot be kept) has been shown to be very effective in increasing slot fish populations.

7.2.g Fishery General Information

Fishing in the ceded territory will continue to be monitored through the Great Lakes Indian Fish and Wildlife Commission in an attempt to ensure both angler and treaty rights. The 2010 Fishery report noted the following goals:

- Continued observation of trends of adult and juvenile walleye populations.
- Continued monitoring of mercury levels in the fishery.
- Conduct extensive fall recruitment surveys to develop trend data for individual lakes in the ceded territory.
- For those lakes in the long term study, conduct annual creel surveys.
- Use the new and updated information to improve the statistical models and better estimate safe harvest limits.
- Inventory, describe, and classify habitat for future protection.

It is important to consider fisheries in any lake when developing a plant management scheme. Mercer Lake has a very desirable fishery. For this reason, fish habitat, water quality, and reproduction need to be protected. The following table presents spawning information for some of the sport fish. Since management of plants may involve early season chemical treatment, spawning times and needs are important. The highlighted areas point out species that spawn at temperatures similar to early season aquatic invasive species treatment. It is important to consider this during treatment since some herbicides can be toxic to fish.

Table 7-1: Fish Species of Mercer Lake

Fish species	Spawning Temp in °F	Spawning substrates
Black crappie	*Upper 50's to lower 60's**	Build nests in 1-6 feet
Bluegill, Largemouth bass and Pumpkin seed	Mid 60's to lower 70's	Build nests in less than 3 feet

Muskellunge	*Mid 50’s to near 60.**	Broadcast eggs over organic sediment, woody debris and submerged vegetation.
Northern Pike	Upper 30’s to mid-40’s soon after ice-out	Broadcast eggs onto vegetation (eggs attach)
Smallmouth Bass	Usually between 62 and 64 but recorded as low as 53	Nests in circular, clean gravel
Walleye	Low 40’s to 50 degrees.	Gravel/rocky shoals with moving or windswept water 1-6 feet deep
Yellow perch	Mid 40’s to lower 50’s	Broadcast eggs in submergent vegetation or large woody debris

**Spawning temperatures in the same range as recommended herbicide application.*

7.3. Lake Sensitive Areas

The WDNR has not completed an official Mercer Lake Sensitive Area Survey. Such surveys are used by wildlife and lake conservation managers to recognize existing special habitat areas. Such areas may be: shallow vegetated areas for pike spawning; rocky bars and islands for walleye habitat; abundances of native aquatic plants which help reduce the ability of aquatic invasive species to gain a foothold in “healthy” lakes; wind and deadfall along shoreline that provide near shore and shoreline habitat for natural flora and fauna, etc.

Although the official map has not been produced by WDNR, MLA longtime residents should produce a map of existing natural habitat areas. Future development in these areas should consider the potential impacts and development considerations could be imposed if such ordinances or regulations were developed at the local level.

Of particular note are lake shore wetland areas. Already protected from development through shoreland-wetland protection zoning, additional protection would be provided by increasing the setback zone of no development to 75 feet from the wetland boundary. The process of definition of wetland boundaries was described by the US Army Corps of Engineers in 1987. This definition includes an evaluation of soil type, soil hydrology, and plant type as opposed to the obvious “swamp edge” that we are familiar with. The importance of the wetlands cannot be overstated as they provide natural areas for storm water runoff quality treatment before water enters the lake system; habitat for all manner of fauna, fish, fowl, and flora; flood protection and sources of lake water during drought.

Designating these sensitive areas will assist the Association members in future efforts for fishery development, aquatic plant management, and long term water quality improvements.

7.4. Endangered, Threatened, and Species of Concern

The following species that are listed as endangered, threatened, or of special concern were on the Town Range T43NR03E list from the Natural Heritage Survey: Records are provided to the public by Town rather than section, so there is no indication if the incidences of these species occur in and immediately surrounding Mercer Lake (Appendix Q provides additional information).

Animals

Canis Lupus	Gray Wolfe	Special Concern
Cygnus B Uccinator	Trumpeter Swan	Special Concern
Falcipennis Canadensis	Spruce Grouse	Threatened
Haliaetus Leucephalus	Bald Eagle	Special Concern
Martes Americana	American Marten	Endangered

7.5. Aquatic Invasive Species

Recent attention in nearby lakes has been oriented to the control of the proliferation of Eurasian Water Milfoil (EWM). To date, EWM has not been observed in Mercer Lake. With public access and STH 51 nearby, it is, however, more likely a matter of "when" instead of "if" Mercer Lake will be infected by EWM. Those lake associations/districts that deal with EWM can readily advise of the considerable time and efforts to control the spread of AIS in the infected lakes. It is therefore important to develop an AIS management plan that can be easily instituted and develop the necessary infrastructure to address the future infestations. Instituting a Clean Boats/Clean Waters Program as sponsored by the WDNR is a step that can be important to the future water quality of Mercer Lake.

AIS management should include:

1. Ability to recognize AIS-EWM, purple loosestrife, curly leaf pond weed.
2. Understand control methods and best practices.
3. Implement native aquatic plant protection programs.

7.6. Goals of the Aquatic Plant Management Plan

1. Reduce or keep Eurasian water milfoil out of the lakes and thoroughfares.
2. Preserve the native plant communities in the lakes and thoroughfares.
3. Prevent the introduction of new aquatic invasive species and develop a rapid response plan to control such introductions.
4. Monitor existing communities of Eurasian water milfoil, curly leaf pond weed, and flowering rush.
5. Restore native shoreline vegetation.
6. Preserve or enhance water quality.
7. Provide extensive education on lake ecology.
8. Institute a Clean Boats/Clean Waters Program.

9. Minimize the opening of large areas of the lake bottom through aquatic plant harvesting that can result in the growth of invasive species.

CHAPTER 8: LAKE WATER QUALITY IMPROVEMENT

This chapter presents various actions to slow or stop the degradation of water quality in Mercer Lake. Individuals, local government, and area businesses have to assume an increasing responsibility for protecting water quality of the area lakes. This report documents that a variety of factors affect the water quality of the lakes, including nonpoint source pollutants – primarily sediments and nutrients (phosphorous and nitrogen), groundwater, precipitation, and background or natural sources. Existing USGS data documents that the state of the lake is good, but fragile. Water quality by visual inspection appears oligotrophic, but the presence of certain parameters such as phosphorous and chlorophyll-*a* indicate the waters are considered mesotrophic (Appendix D, 2005 USGS Report). Clearly, over time the water quality of the Lake has become more eutrophic (1880s – oligotrophic, 1990s – mesotrophic). Thus, the MLA Board and its members, the local population, and the Lake's visitors all need to be aware of the sensitivity of the existing water quality and are encouraged, if not required, to adopt those necessary measures to protect the water quality of Mercer Lake.

In Chapter 5 we determined that a principal contributor to lake water quality degradation is watershed runoff. With the determination that the flow volume from the Little Turtle River, exceeds the watershed contributions it would be easy to dismiss the issue of watershed runoff and not take the initiative to address local storm water quality management. Adopting this attitude is destructive as the water quality of Mercer Lake will continue to decline over the coming decades if nothing is done. It is, therefore, the responsibility of the lake property owners, local citizens, area visitors, commerce, industry, and government to invoke, address, and maintain an attitude that stormwater runoff water quality improvements should and will be made. The most recent local example is the successful collaboration of the WDOT, Town of Mercer, and Mercer Lake Association to achieve the current best possible storm water runoff treatment associated with the reconstruction of USH 51, local streets, and the Town's storm water collection, sewer and dispersal systems.

This Plan is only good if it is used and updated. To measure the progress of lake improvement and to document achieved goals, self-help monitoring and regular updates of the Plan and its initiatives with local political entities are encouraged. Meeting the requirements for watershed management as contained in local ordinances and subdivision regulations (Appendix E) should help embody the necessary comprehensive watershed management philosophy (Appendix L).

8.1 Ordinances, Regulations, and Plans

Whether we like them or not, rules are established for the general good. Specifically, there are State Statutes, Administrative Codes, and County Ordinances for land use, development, shoreland protection, storm water management, and shoreline development. In addition to the various rules, Towns have been required to develop Comprehensive Land Use Plans which may have certain impacts on long range water quality goals.

8.1.a. Existing County Ordinances

At the local level, water quality protection begins at the County with development of land use and land development regulations. In most Wisconsin County Codes of Ordinances, Zoning and Shoreland-Wetland Protection regulate structures, footprint sizes, etc. A brief discussion of the Iron County regulations follows. The Code language, as existed at the time of this report preparation, is included in the Reference Library on the companion CD ROM to this report.

Iron County Regulations Title 8 and Title 9 (References – Iron County) respectively, address land division and land use and shoreline planning. Under Title 8, Chapter 1, the requirements for lot development are defined, including plats, blocks, and subdivisions, as are design standards for streets and right-of-way, cluster and planned unit development, and condominiums. Proposed developments in the Mercer Lake Watershed must adhere to these regulations.

Land Use and Shoreland Protection regulations are stipulated in Title 9 Chapter 1 and its associated amendments. The shoreland protection overlay specifically regulates those lands within 300 feet of a navigable river or stream and 1,000 feet of navigable lakes, ponds, or flowages. Construction setbacks, visual clearance at road intersections, driveway access, lot sizes, etc. are detailed in this Regulation as are the definitions, purposes, permitted uses, and uses authorized by conditional permits for various land uses, including Conservation and Shoreland-Wetland Districts.

8.1.b. Storm Water Management

Wis. Adm. Code NR151 provides regulation for storm water control for non-agricultural performance standards during and after project construction. Specific controls are established for peak discharges, total suspended solids, nutrient management for turfs and gardens, etc. Standards are established for new and redevelopment projects alike.

8.1.c. Shoreline Development

Wis. Adm. Code NR115 provides regulations for the developments along shorelines. Companion documents are Chapters 30 and 31 Wis. Statutes which provide for additional controls for construction projects on the shoreline.

8.1.d Town of Mercer Comprehensive Plan

The Town of Mercer developed its Comprehensive Plan in response to the State of Wisconsin requirements for all towns to develop a long range planning guide. The Plan is an assessment of existing land uses, population, sentiment, and set goals for future development. Excerpts from the current Comprehensive Plan are included in the References section, which was developed to provide projections to the year 2030. Pertinent items from this document that are relevant to this Mercer Lake Management Plan include:

1. Population
   a. Town of Mercer population was relatively stable from 1950 to 1970, and then experienced a jagged increase to 2000. Area of primary expansion is shoreland property development.
   b. Projected population growth over the next 20 year period is positive for Mercer, but negative for Iron County.

2. Overall Goal
   a. Maintain the quality of life in the Town of Mercer

3. Utilities and Common Facilities
   a. Wastewater
      1) Mercer Waste Water Treatment Plant has a capacity of 82,000 gallons per day (gpd) and in 2004 was at 50 percent capacity (ie 41,000 gpd), meaning there is adequate capacity for growth in population and additional sewer hookups.
      2) Post treatment discharge is to a series of seepage cells.

   b. Water Supply
      1) Two wells, capable of pumping 600 gpm, provide 368 connections with water.

   c. Storm Water Management
      1) Existing curb and gutter served areas will be expanded and improved during the US Highway 51 construction slated for 2012-2013. Current storm water is discharged directly to Mercer Lake. Proposed highway construction plans will divert these waters to treatment areas where sediments will be captured prior to release to the lake.

   d. Solid Waste
      1) There are no existing open landfill disposal areas in the Town. Solid wastes are collected for disposal in landfills near Ladysmith, WI or Ontonagon, MI.

4. Future Needs
   a. Expand the sanitary sewer system.
   b. Rehabilitate the storm water management system.

5. Goals
   a. Work with bordering municipalities in regard to new developments.
   b. Improve storm water sewers, sidewalks, street lighting, signage, and landscaping of downtown Mercer.
   c. Address the proper siting of on-site wastewater disposal systems and a storm water management plan.

The Mercer Lake Association's goals are quite similar to those stated in the Town of Mercer Comprehensive Plan. Project coordinators should consult with and partner on common goals. This will develop a stronger united approach to achieve the goals of water quality improvements and provide guidance for community leaders.

8.2 Runoff Water Best Management Practices (BMPs)

Storm water or runoff Best Management Practices (BMPs) are measures intended to reduce or mitigate storm water runoff water quantity and water quality concerns to the maximum extent practical. Certain measures can help reduce impacts, but no BMP will reverse damages caused by previous agricultural practices, construction, and urban development.

In general, there are two types of BMPs for storm water quality treatment.

1. **Source control measures** focus on minimizing or mitigating the source of the contaminants so that pollutants are prevented from contacting storm water runoff or entering the drainage conveyance system.

2. **Treatment control measures** are designed to remove a percentage of the pollutants after they have entered storm water runoff. Treatment control measures tend to be more expensive than source control measures.

Water Quality and Flood Control Best Management Practices can be categorized as either structural or non-structural controls. Most Source Control measures tend to be non-structural, and most Treatment BMPs tend to be structural in nature, although there can be exceptions.

Structural best management controls include:

- Wet detention sediment basins,
- Constructed wetlands,
- Infiltration basins,
- Infiltration trenches,
- Dry detention/retention basins,
- Sump storm sewer inlets,
- Riprap,
- Gabions,
- Construction of grassed channels and drainage ways,
- Silt fence,
- Multi-Chambered Treatment Train,
- Water quality pre-treatment box structure,
- Stone weeper berms,
- Straw bales and silt fence,
- Vegetative strips parallel to the shoreline for riparian properties,
- Repair failing septic systems,
- Install municipal sewerage systems for non-sewered areas.

Appendix G provides an extensive discussion on urban storm water structural controls.

Non-structural best management controls include:

- Street sweeping,
- Catch basin control on winter streets,
- Leaf and lawn waste control,
- Fertilizer and pesticide application control,
- Hazardous waste and spill prevention program,
- Pet and farm animal waste control,
- Construction site erosion control regulations and enforcement,
- Storm water management planning education,
- Ordinances; and
- Land use planning

Appendix E presents examples of Administrative Controls, and Appendix M Public Outreach methods. Using non-structural best management practices rather than expensive structural best management practices can be highly effective in gaining a large percentage of water quantity and quality control benefits. However, some structural controls must be provided to achieve the greatest amount of pollutant reduction and flood control within the Mercer Lake Watershed.

Rural and developing areas allow for unique opportunities to incorporate creative BMPs into site design. These BMPs can be incorporated into natural areas serving as open spaces for community enjoyment. Local authorities, with assistance of WDNR grant programs, can purchase land next to a water resource and create a buffer strip around the area and construct structural BMPs. In certain cases, this may be the only way to protect a sensitive water body from further degradation, even with several structural and non-structural BMPs in place.

To control runoff pollutant loadings and storm water within the Mercer Lake Watershed, the following should be considered.

8.3. Riparian Runoff Water BMPs

As part of the Lake Management Plan, the MLA conducted a Shoreline Survey (Appendix F electronic copy only) that included photographs of the shoreline taken from the lake. Each shoreline property on Mercer Lake was assessed using a shoreline evaluation checklist which ranked existing habitat, development, shoreline buffers, visual sightlines, stormwater management, etc. The checklist is presented as a spreadsheet which, in the electronic version, is hyperlinked to the photographs providing a visual of the observations noted on the shoreline checklist. This shoreline survey can be used by those interested in riparian improvements, visuals to describe areas of concern as well as examples of a lake water quality friendly development.

a. Buffer Strips

Natural vegetation buffer strips located parallel to and along the shoreline restrict surface water runoff by reducing velocity and offering an opportunity for both infiltration and evapotranspiration. Buffer strips are recommended to be 30 feet wide incorporating a minimum width pathway through the buffer that connects the shoreline to the upland. If 30 feet isn't available, then try to achieve 50% of length from the shoreline to the front of the structure.

b. Stormwater Collection Devices

Rain gardens, rain barrels, etc. collect runoff water from impervious surfaces including driveways and roofs. Redirecting the stormwater to collection minimizes overland flow and reduces sediment and nutrient loading of the runoff water, improving water quality prior to discharge to the Lake. Collected water can be used for garden irrigation, etc.

c. Reduce Usage of Lawn Chemicals and Fertilizers

Reduce lawn watering of riparian and other near shore properties reduce the potential for runoff water to collect and concentrate nutrients and sediments and carry these to the Lakes. Find the right balance of fertilizers and chemical treatments, if needed, to promote a healthy lawn and decrease bare soils and potential erosion. Use the minimum recommended quantity of phosphorous free fertilizer and other lawn care chemicals. Collect and compost grass clippings and fall leaves. Use a mulching lawn mower.

d. Septic Systems

- Pump and inspect your system regularly; every 3 years at a minimum.
- As phosphorous is not degraded in septic systems; phosphorous discharges should be minimized by reducing phosphorous usage (soaps, detergents, etc.).
- Properly maintain and repair your septic system.
- Replace failing septic systems.
- Encourage "grandfathered" septic system owners to participate in a maintenance and replacement program.
- Consider using water conservation techniques to reduce the load on your septic system.
- Connect to a municipal sanitary sewer when available.

e. Shoreland Restoration

The desire for the beautiful sandy beachfront has caused many shoreland owners to attempt to recreate this perception of beauty on their own property. Unfortunately these attempts, although well-meaning, are not often successful and may leave behind a much more sterile habitat. The desire to "clear" the shoreland of downed trees, undergrowth, "unsightly debris" such as branches and rocks in the shallow water areas eliminates breeding ground and living spaces for many animals which are forage for larger species of fish and fowl.

With the recognition that the mowed to the water's edge lawn is not an acceptable shoreland attribute, many Wisconsin Counties are requiring and several riparian land owners are volunteering to restore the lake shore habitat in the overall effort of improving lake water quality (Appendix H).

Water quality improvements start with the need for impervious surfaces. Assuming a 100% runoff from an impervious surface, the roofs, driveways, playing courts, sidewalks, and other surfaces covered with asphalt and/or concrete and buildings. Storm water mitigation (treatment) includes:

- increase the variety of shoreline vegetation by not mowing within 30 feet of the shoreline

- increase the shaded areas by the water's edge by limiting the view corridor to a 30 foot width

- redevelop your shoreland access to eliminate those straight pathways or sidewalks that lead directly to the lake, shed runoff water to pervious surface areas

- decrease the size of impervious areas within 300 feet of the shoreline

- employ the use of innovative products that promote infiltration

- develop rain gardens to absorb runoff and promote biodiversity

- do not clear felled trees and shoreline shrubbery; encourage this development to enhance near shore habitat for fish and other aquatic life

- for eroded shoreline areas, seek assistance from local county planning and WDNR on the most efficient ways to halt advancing erosion; most shoreline construction activities will require a county and WDNR permit

- ensure your septic system meets current regulations and is working properly

Mercer Lake Association can maintain a series of useful brochures for riparian and near shore owners (Appendix H). Several of these guides were developed by Wisconsin Shoreland Planners and have been approved by UW Extension and WDNR for homeowners.

8.4. Storm Water Ponds

Detention storm water pond BMPs capture storm water runoff and remove pollutants through settling and/or biological uptake. The BMPs presented in this Plan can reduce water quality pollutant discharges, stream bank erosion and flooding by temporarily detaining and controlling peak discharge rates and pretreating runoff before releasing it at flow rates and frequencies similar to those occurring under natural hydrologic and hydraulic conditions. Detention storm water ponds can be designed to enhance wildlife habitat, provide an aesthetic amenity and satisfy some of the site landscape needs. In some areas, they may require appropriate designs to prevent groundwater contamination. Additionally, consideration should be made of the long-term maintenance and sediment disposal requirements of detention storm water pond BMPs before they are applied.

8.3.a. Wet Detention Ponds

Wet storm water detention ponds are the most effective and most commonly used best management practices for flood control, sedimentation control, and control of numerous pollutants found in storm water runoff. They are reliable and attractive systems that control both storm water quality and quantity. They are the most cost effective systems to operate and maintain. These systems consist of single or multiple permanent pools of water or a combination of a single permanent pool of water with a pretreatment sedimentation area. Wet detention ponds treat incoming storm water and discharge improved storm water quality to sensitive receiving water bodies and groundwater recharge areas. Wet detention basins are typically engineered with four to eight feet of standing static water levels, allowing sediments and pollutants to settle out to the bottom of the wet detention pond. Wet detention ponds should have a defined sedimentation basin forebay, and an outlet control structure.

Many studies have shown that wet detention ponds consistently remove sediments and pollutants that attach to sediments. Removal rates can vary from 50 to 90 percent, depending on particle sizes and on the design size and shape of the system. Wet detention ponds can also control pollutants such as heavy metals, phosphorus, and bacteria, but at lower removal rates than sediments. Pollution control rates can vary depending on the construction of the system.

As development occurs from existing to future land use, constructed wet detention ponds will decrease storm water runoff peak rates and decrease water quality pollutant loads. Significant pollutant loadings are apparent due to high-density residential, industrial and commercial developments, and increased presence of motor vehicles. The increase of pollutant loadings will be greatly reduced by the installation of structural controls and enforcement and implementation of non-structural controls. The affect of implementation of the recommended storm water management practices is quite apparent. A wet detention (BMP) pond would store the sediment and pollutants, so a wetland or receiving water body does not receive the sediment and the associated habitat does not get altered from excess nutrients or pollutants. Wet detention ponds are subject to maintenance which includes sediment removal, therefore this aspect must be considered in design.

We recommend a 10-15 year sediment clean-out cycle for wet detention ponds. This schedule may need to be revised based on specific site design and field observations. Extra storage in the lower stage can be provided to accommodate additional sediment deposition. To reduce removal costs, we recommend provisions be made for on-site disposal or the local authorities should plan for use of the accumulated sediment at some future date. Dependent on the sediment contents, these soils may be appropriate for use in the Beneficial Reuse Program.

Wet detention ponds (Figure 8-1) handle storm water runoff generated from land development activities. Wet ponds also provide water quality benefits dry detention ponds cannot offer. Additionally, many existing dry storm water ponds can be converted to wet ponds through some minor adjustments to outlet structures and earthwork excavation.

A wet pond is an open pond with the discharge outlet set higher than the bottom of the pond. This BMP is designed to have a permanent pool of water, or dead storage, throughout the year, which is very effective in removing pollutants. The wet pond is constructed to store runoff during and after storms above the permanent pool elevation. Wet ponds treat and filter storm water runoff through Stokes Law Settling Theory and through nutrient uptake by plants and other aquatic organisms.

Advantages:

1. Provide for downstream bank erosion protection.
2. Offers water quality and flood control.
3. Most cost-effective and widely used storm water treatment practices.
4. Stores runoff for longer time periods and decreases storm water peak flows.
5. Possible increased property value: The results of one study suggest that "pond front" property can increase the selling price of a new property by 10% (EPA, 1995). Another study found that the perceived value (value estimated by residents of a community) of homes increased by about 15-25% when located near a wet pond (Emmerling-Dinovo, 1995).
6. Pollutant control rates vary depending on the size and shape of the system, but the Wisconsin DNR Storm Water Manual presents these statistics:

Pollutant	% Reduction
Suspended Solids	50-90
Phosphorus	12-79
Nitrogen	6-62
Chemical Oxygen Demand	7-76
Lead	8-84
Copper	7-65
Zinc	13-87

Limitations:

1. Regulations restrict some locations where such ponds can be built.
2. Space requirement.

3. Mosquito breeding area.

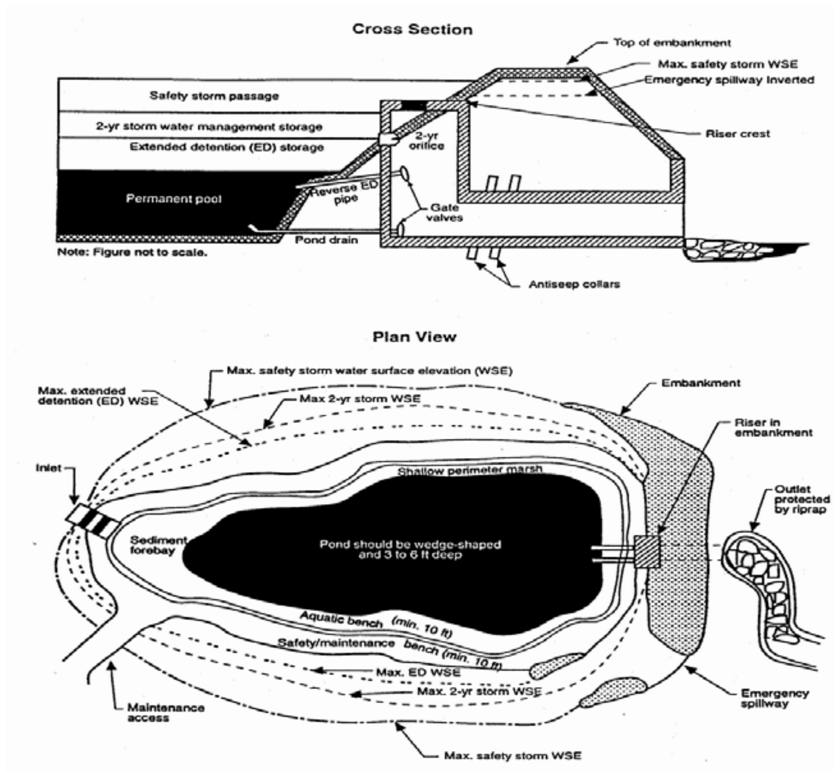


Figure 8-1: Wet Detention Pond

8.5. Constructed Storm Water Wetlands

Constructed storm water wetland systems incorporate natural wetland functions to aid in peak flow reductions and pollutant removal from storm water runoff. These BMPs contain shallow pools that enhance growing conditions for marsh plants to maximize pollutant removal. Constructed storm water wetlands can also provide for quantity control of storm water by providing significant volume storage of ponded water above the permanent pool elevation.

<u>Advantages:</u>

1. Known to effectively remove most pollutants from storm water.
2. Down-stream water quality improvements and peak discharge rate reduction.
3. Reduction in oxygen demanding substances and bacteria from urban runoff.
4. Biological uptake of pollutants by wetland plants.
5. Flood attenuation.
6. Enhancement of vegetation diversity in urban areas.
7. Aesthetic enhancement and valuable addition to communities.
8. Relatively low maintenance costs.

9. Pollutant control rates vary depending on the size and shape of the system, but the Wisconsin DNR Storm Water Manual reports the following to generally be true:

Pollutant	% Reduction
Suspended Solids	14-98
Phosphorus	0-97
Nitrogen	23-30
Chemical Oxygen Demand	22-79
Iron	43-92
Lead	68-82
Zinc	34-50

Limitations:

1. Normally not located within natural wetlands.
2. Release of nutrients during large storm events.
3. May contain difficult maintenance of vegetation when flow rates vary.
4. May act as a heat sink and may discharge warmer water to downstream water bodies.
5. Relative high construction costs in comparison to other BMPs.

8.6. Infiltration Facilities

These facilities are designed to intercept and retain surface runoff long enough to allow infiltration of the underlying soil. Infiltration may be allowed on a case-by-case basis, depending on the soil and water table conditions and elevations of a site. Site-specific soil testing will be required. To help prevent clogging, pretreatment will be required whenever possible and feasible.

8.5.a. Infiltration Basin

Infiltration basins are also called Bio retention Basins (Figure 8-2). These Bio retention Basin BMPs are designed to normally contain the following components: a temporary ponding area, a mulch layer, a sandy or loamy planting soil, the plants, and, where necessary, under drains.

Most bioretention devices are off-line basins designed to infiltrate a portion or all of the flow from a desired size design storm event. However, bio-infiltration swales represent a cross between a bio-detention basin and a vegetated swale. They are designed for conveyance as well as infiltration.

Advantages:

1. Groundwater recharge occurs to maintain stream base flow and colder stream temperatures.
2. Infiltration reduces peak discharges and associated stream bank erosion.

3. Infiltration reduces storm water runoff volume discharges and excess storm water runoff.

Limitations:

1. Limited lifespan.
2. Maintenance in regards to maintaining vegetation cover.
3. Space requirement and suitable soils.

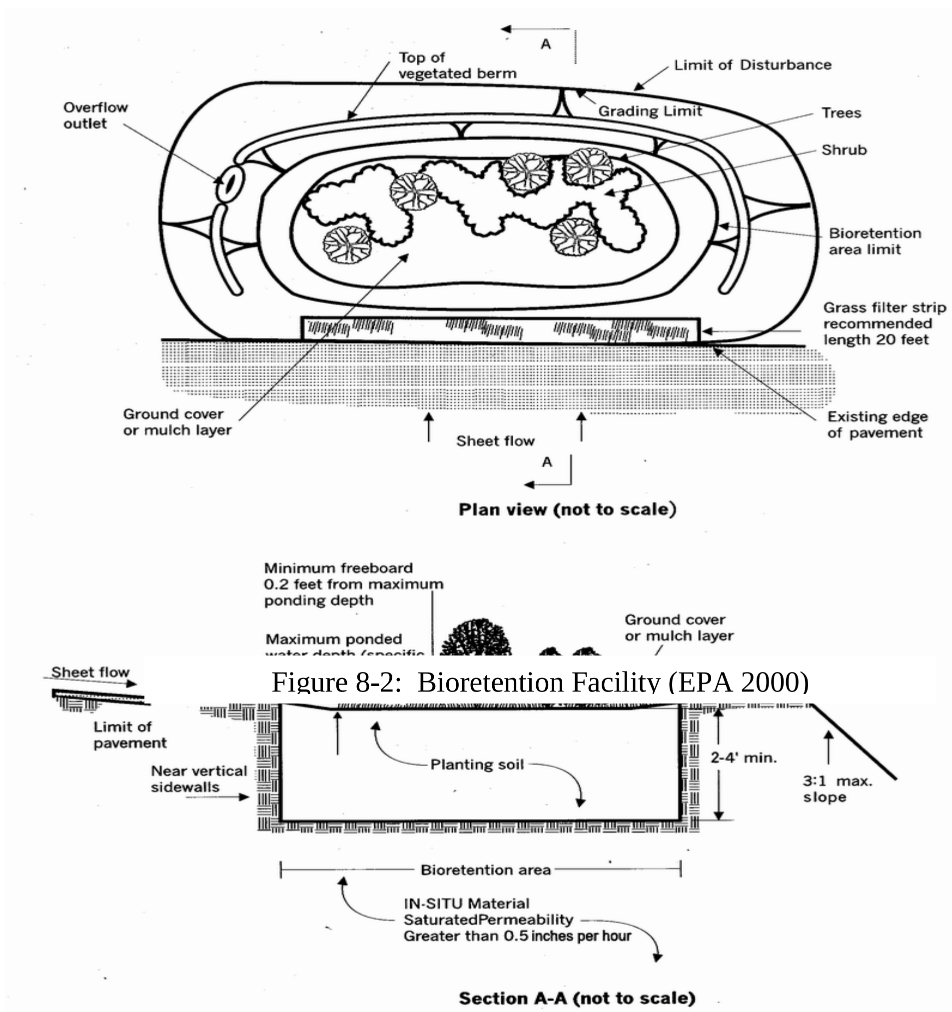


Figure 8-2: Bioretention Facility (EPA 2000)

8.5.b. Infiltration Trenches

Infiltration trenches are designed to intercept and reduce direct site surface storm water runoff rates and volume. They hold runoff long enough to allow it to enter the underlying soil. Typically they include layers of coarse gravel, sand or other filtering media to filter the runoff before it infiltrates the soil.

Infiltration trenches are shallow (three to eight feet deep) and constructed in relatively permeable soils that are backfilled with a sand filter, coarse stone, and lined with filter fabric. The trench surface can be covered with grating and/or consist of stone, gabion, sand, or a grassed covered area with a surface inlet. Depending on the design, trenches allow for the partial or total infiltration of storm water runoff into the underlying soil. An alternative design is to install a pipe in the trench and surround it with coarse stone (French drain); this will increase the temporary storage capacity of the trench.

Advantages:

1. Infiltration maintains groundwater recharge, stream bank baseflow, and colder stream temperature.
2. Reduces storm water runoff rates and volume.

Limitations:

1. Trenches do not perform well in cold climates that experience deep freeze/thaw action.
2. Where installed in cold climates, trenches may provide storage for snowmelt.
3. Pretreatment of storm water runoff is needed to prevent clogging and failure of the trench.
4. The failure rate is known to be high.
5. Preventing soils compaction during construction is important.
6. Expensive operation, maintenance, and replacement costs.
7. May be considered an injection well if not properly designed.

8.7. Porous Pavement

As an alternative to conventional pavement, porous pavement is a permeable pavement surface overlying a stone reservoir. The stored storm water runoff gradually infiltrates into the ground and water table.

Advantages:

1. Maintain groundwater recharge, stream bank baseflow, and colder stream temperature.
2. If sub-soils absorb pollutants, dissolved pollutants may be removed.
3. Used in low traffic areas.

Limitations:

1. Challenge in cold climates.
2. Occasional sweeping or vacuuming of debris will be required to ensure the void spaces do not clog and mitigate system failures.
3. Should not be used in high traffic areas and high contamination sites.

8.8. Street Sweeping

Effective street sweeping program removes debris from gutters and roadsides thereby reducing the debris that enters storm drains and Mercer Lake. Street sweeping is only part of the solution to addressing storm water runoff pollution. Residents can help by being aware of how their actions can contribute to or help solve the problem. For instance, overwatering lawns and washing vehicles washes pollutants from yards and streets into gutters and storm drains.

These pollutants include phosphorous, detergents, pesticides, fertilizers, motor oil, and yard clippings. Residents who rake leaves and yard clippings into the street increase the potential for these potential pollutants to enter the lake system.

Advantages:

1. Highly visible educational tool to promote awareness.
2. Mechanical street sweepers can remove almost 70% of large particles in its path.
3. More effective in industrial and commercial areas.

Limitations:

1. High initial cost and long-term maintenance and replacement costs.
2. Labor costs.

8.9. Catch Basin and Maintenance

Capture and removal of sediments from catch basin sumps on a regular basis reduces the potential for pollutant discharges during rain events and thus reduces the potential for conveyance of urban storm water runoff particulates. Cleaning catch basins annually or more frequently increases the sump capacity for sediment collection.

8.10. Reduce Fertilizer Usage

- Soil test lawns and add only the necessary fertilizers. Current State laws limit the use of zero or low phosphorous concentration fertilizers on Wisconsin residential lawns. However, certain exceptions are allowed, therefore, a local ordinance could be introduced to restrict the use of all phosphorous containing fertilizers in the Mercer Lake watershed.

8.11. Forest Land Management

- Reforestation.
- Follow Wisconsin DNR Forestry Best Management Practices.
- Leave timber on steep slopes.

- When crossing streams and gully areas, build bridges per Wisconsin DNR Forestry Best Management Practices and uphold NR 151 Runoff Management rules.

- If timber is taken from steep slopes or lowland areas, perform this work between January and March to ensure frozen ground and reforest in the same year.

8.12. Government Partnership and Policies

- As State, County, and Town transportation departments minimize the use of road salt, an increase in sand content is common. Highway Departments should consider the use of alternative de-icing compounds in areas near the Lake, and related tributaries, swales, etc., boat landings, culverts or storm water outfalls, and other areas of high salt-use. Snow disposal areas should not drain into lakes or streams.

- Utility and Highway Corridors:

  a. Proper route selection.
  b. Encourage runoff from roads to be directed to sedimentation traps or water-quality pre-treatment ponds before runoff reaches the lakes.
  c. Require Wisconsin DOT construction contractors to follow Wisconsin DNR NR 151 runoff management ordinances for future construction. Encourage the use of BMP to trap road runoff for pretreatment before entering the Lakes.
  d. Don't dump sand on the waterfront.
  e. Make docks and boat houses as unobtrusive as possible. Permits are required for many of these structures. Avoiding permanent structures will reduce shoreline alterations, tree cutting, and filling.
  f. Keep dock lighting to a minimum safe level.

- Local emergency officials should be prepared either as first responders or have readily available information to protect ground and surface water resources from spill contamination (i.e. gasoline, etc.). Spill preparedness should include adequate training and equipment, such as containment booms and spill absorbents. Emergency response consultants can assist fire fighters and emergency crews in spill contingency planning.

- It is recommended that the Town of Mercer adopt and incorporate this Lake Watershed Management Plan, and future updates or amendments into the Natural Resources section of the Comprehensive Plan.

8.13. Regional Partnerships

- Perhaps the most important aspect of planning and implementation is the development of partnerships in the Lake and adjoining watersheds.

- Work with groups and building more partnerships will help implement more BMP practices throughout the Mercer Lake watershed. Partnership development with

Association/District members of those lakes in adjoining watersheds is highly encouraged. Partnerships with related Townships and Counties, Natural Resource Conservation Service, UW-Extension, Wisconsin DNR Forestry and Water Quality, and others should be developed as appropriate. Work with local groups to develop uniformity in the region to encourage uniform practices and a culture for water quality.

- Develop local ordinances to help reduce the degradation of the watershed waters from nonpoint source pollution. Ordinances provide the legal frame work to require suitable management practices to control nonpoint source pollution. Creating and adopting erosion control and storm water management ordinances (these are Lake Protection grant eligible activities) can specify performance standards, specific BMP, or limit peak runoff flow. In future years, as more land is developed, managing runoff to protect water quality will become increasingly important and the ability to control runoff will be limited if the proper ordinances are not in effect. To assist in ordinance creation, the Wisconsin DNR has developed model ordinances that can be adopted or used as a starting point in creation of Town's own ordinance. (Model Ordinances are presented in Appendix E.) Develop a comprehensive storm water management ordinance to provide assurance that future growth will not be significantly detrimental to water resources in the lake watershed.

- Financing ordinance administration to avoid over burdening taxpayers is recognized as a major concern in ordinance adoption (Chapter 9). Developing financing alternatives and administrative strategies may reveal acceptable costs for enacting an erosion control and/or storm water management ordinance. The Town of Mercer should consider retaining the services of an engineer or other professional experienced in storm water management and design, to review new development proposals for compliance with the Town's ordinance(s) and the goals of this Lake Management Plan.

CHAPTER 9: FINANCING OPTIONS for WATERSHED IMPROVEMENT ACTIONS

Financing and funding the recommended lake watershed management project is complex. In the past, general funding and special assessments against benefited properties financed most of the necessary improvements. However, the financial options in unincorporated and riparian communities require certain political mechanisms to enact funding. The main question is, "Which method(s) best suit the needs of Mercer Lake and the Mercer Lake Association?"

The major categories of funding sources are:

- Taxation;
- Development Fees;
- Fee-In Lieu of On-Site Detention/Retention;
- Special Assessments;
- Plan Review and Inspection Fees;
- Storm Water Utility Fees;
- Bonding; and,
- Grants.

Descriptions of funding options are presented in Appendix O. These may be available to the Mercer Lake Association and local governments in the watershed and surrounding areas for certain storm water BMP improvement implementation and Lake's water quality improvements.

CHAPTER 10: SUMMARIES AND RECOMMENDATIONS

Recommendations to reduce riparian and urban loadings are presented in this Lake Management Plan which combines elements of both Lake Management and Urban Stormwater Management plans. The urbanized sub-watersheds bordering Mercer Lake require development of more robust stormwater management techniques than would normally be discussed in a Lake Management Plan designed for a lake with only recreational residences along the shoreline. Also discussed are those recommendations for less developed areas of the lake watershed. A primary concern in communities is the potential cost to implement the recommendations and funding is addressed through administrative development of taxing authorities for this purpose. However, less complex and less costly recommendations can be implemented by both riparian and urban communities that will directly affect and improve the water quality entering the watershed drainage system; the effort must be cooperative and sustained.

Recent developments in the State of Wisconsin provide additional assistance in reducing Phosphorus discharges to the lakes:

1. Effective April 1, 2010, the State of Wisconsin has banned the use of Phosphorus in lawn fertilizer except for specific situations; and,

2. Effective July 1, 2010, the use of phosphorus containing dishwasher detergents was banned in Wisconsin; and,

3. Effective November, 2010, the WDNR established water quality limits of Phosphorus for the streams, rivers, and lakes in the State. The proposed Phosphorus concentration in the Little Turtle River is 0.75 milligrams per liter (mg/L). The USGS monitoring of the Little Turtle measured Phosphorous concentrations between 0.009 to 0.040 mg/L. Phosphorus was measured at 0.023 mg/L in Mercer Lake, thus these water bodies meet, but not by much, the proposed water quality standard. Dischargers to the watershed are required to obtain permits documenting the sediment and nutrient loads that the discharge may experience during the discharge period.

10.1. Report Summaries

The conclusions and/or recommendations presented by the various agencies, consultants, and scientists evaluating this lake system are presented below.

10.1.a. Blue Water Science – Aquatic Plants (2003)

The following recommendations were listed for whole-lake management:

1. Maintain existing aquatic plant populations to the greatest extent possible.

2. Aquatic plant nuisance control should be considered only in non-navigable areas.
3. Protect floating leaf and emergent plants.

4. Minimize the chance of additional invasions of exotic plants by protecting native aquatic plants.

5. Restore shoreland buffers on developed properties where near-shore upland vegetation has been removed.

6. Harvesting is promoted only in non-emergent areas and only to improve navigability.

10.1.b. Aquatic Plant Management Plan (S. Schieffer, 2012)

Mercer Lake Aquatic Plant Management Goals:

1. Preserve the native plant community in Mercer Lake and the designated thoroughfares.

2. Prevent the introduction of new aquatic invasive species and develop a rapid response plan, should such an introduction occur.

3. Monitor existing aquatic invasives such as purple loosestrife, curly leaf pondweed, and flowering rush.

4. Restore native shoreline vegetation.

5. Preserve and/or enhance water quality.

6. Provide extensive education on lake ecology.

10.1.c. USGS Report (Robertson, et al, 2012)

Water Quantity

1. 65.4% of the water inflow into the lake is from the Little Turtle Inlet.

2. Precipitation and ground water contribute approximately 6.8 and 16.6 percent, respectively, totaling 23.4% of water inflow.

3. The near-lake ungaged surface area contributes 6.2% of the inflow of water to the Lakes.

4. Water outflow is primarily through the Little Turtle River outlet (94.4%) with evaporation claiming 5.6%.

5. During the USGS study the computed average residence time for water in the lake is 0.46 years.

Water Quality

1. Pre-development lake water quality (pre-1880s) is estimated to have been oligotrophic with abundant macrophytes.

2. Prior to 1965, sanitary services were provided by on-site septic systems (in Mercer and along the lake). Water quality is estimated to have been eutrophic.

3. 1965 constructed wastewater treatment facility provided treatment for sewage from the unincorporated Mercer area (riparian residences still utilized on-site waste treatment facilities) but still discharged to the lake, albeit near the lake outlet. Water quality in the lake was observed not to improve. This plant was deactivated in 1995.

4. In 1995 a new Town of Mercer waste water treatment plant, remote from Mercer Lake, was constructed with seepage cell discharge and a sewer connector constructed around the north and east areas of the lake. Water quality has been observed to improve and is considered mesotrophic/eutrophic dependent on which of the Carlson TSI indices are measured.

5. The mass of phosphorous contributed to the lake is higher in years with larger water volume transfers.

6. Little Turtle and Tahoe Inlets contribute 47.2 and 6.9 percent of the total phosphorous, respectively.

7. The near lake urban and residential development around Mercer Lake contributes 19.6 percent of the phosphorous yet only 6.6 percent of the water inflow.

8. Of the total phosphorus contributions to the lake, septic systems contribute 2.5 percent, precipitation 6.9 percent, and ground water 11.6 percent.

9. Current water quality conditions indicate the lake is in equilibrium with Phosphorus input/output. Lake bottom sediments are adsorbing the incoming Phosphorus providing a nutrient rich sediment for rooted aquatic vegetation. Current models predict this storage will continue until a significant decrease in water pH occurs and/or the bottom is disturbed allowing anaerobic biota to release the nutrient.

10.1.d USH 51 and Town of Mercer Storm Water Management

The reconstruction of USH 51 entered the stormwater management design phase in 2008 with preparation of a stormwater modeling and analysis of the proposed highway redevelopment. After several months of discussion and revisions including a strong presence and influence from the MLA and the Town of Mercer. This report was published in 2009 (Mercer Stormwater Modelling and Assessment, Ayres Associates, 2009). Final recommendation from this report indicated the WDOT should develop three stormwater control and discharge water quality management basins along the planned route in the Mercer area. The proposed treatment units were accepted and designed into the final plan (after some modifications required by the WDNR).

These stormwater treatment units did not incorporate management systems for the balance of the urbanized area not managed by those stormwater treatment unit designed for USH 51. This included the discharge at the boat landing on the north edge of the lake. Subsequently, the Town of Mercer applied for and received grant dollars through the Targeted Runoff Management program of the WDNR to construct the North Downtown Basin project (TRM Grant Application, 2010). The following year a similar project was conceived funded and constructed to address the Central Town stormwater quality concerns

These projects were completed within 5 years of the concerns regarding urban street runoff presented in the 2007 Preliminary Lake Management Plan. Completion of these projects has addressed over 80 % of the runoff concerns presented in the sub watershed areas of B and C identified in chapter 4 of this report. The recommendations are included herein as a matter of reference in the next section.

10.1.e. Preliminary Lake Management Plan (Cedar Corporation, 2007)

The 2007 Town of Mercer storm sewer system should incorporate structural BMPs at the stormwater inlets and outlets of the pipes in order to limit the stormwater's negative impact on Mercer Lake's water quality. With the opportunity to address these issues presented during the USH 51 reconstruction, the Town of Mercer with MLA involvement worked with the WDOT, EPA, and the DNR to design and where necessary obtain funding assistance to improve stormwater discharge water quality.

Future development and existing infrastructure improvements should be completed with all due consideration of watershed management and planning. New developments without stormwater management systems should be avoided as it is more cost effective to address storm water issues during initial development rather than later when problems may be compounded and space is limited.

The recommendations for storm water management in the urban areas are summarized below.

10.1.e.1. General Design Elements

1. Make provisions to provide or preserve overland drainage routes for emergency storm water runoff overflows.
2. Detailed storm sewer calculations should be provided at the time individual subdivision and site plans are engineered and street improvement plans are prepared.
3. For safety reasons, the maximum depth of water in local streets should not exceed one foot at the deepest point, 6 inches deep in collector streets, and the lowest exposed building elevation should be at least 24 inches above the high water level.
4. Storm water inlets should be placed to eliminate overland flow in excess of 400 feet or 5 cfs for a 10-year event.
5. BMP surface areas and mean depths be provided in order to achieve removal efficiencies of 80% Total Suspended Solids (TSS) for new development and 40% TSS for redevelopment.
6. The potential for illicit discharges exists and storm sewer outfalls can be periodically monitored during dry weather periods for evidence of illicit discharges.
7. That best management practices be implemented to address pollutant loadings and flood control within the Watershed.
8. The Mercer Lake Association continues to focus on Elementary, Middle, and High School students not only as an audience but also a resource for the education and information program.
9. Homebuilders and developers be given the highest priority in the education and information program.

10.1.e.2. Channel Design

1. Open prairie grass conveyance channels are recommended where practical and feasible in lieu of storm sewer pipes to attenuate the storm water flow and increase ground water recharge by maximizing the portion of runoff that infiltrates into the soil.
2. Minimize the use of concrete or riprap lined channels because water quality benefits are not available with lined channels.

10.1.e.3. Sanitary Sewer

1. Sanitary sewer manholes located near low lying and ponding areas should be designed at or above 100-year high water levels where feasible.
2. Sanitary sewer manholes in vicinity of low lying and ponding areas and open channels should be evaluated to determine potential flood inflow and be waterproofed as needed.

10.1.e.4. Detention Ponds

1. Consider, where feasible, that all detention ponds be designed to store the 100-year post-development storm event and discharge at the 10-year pre-development runoff rate.
2. Design detention storage facilities to limit the design outflow to not exceed the capacity of the existing downstream conveyance and storage systems.
3. Plan and design outlets for all existing detention pond areas to mimic pre-development conditions.
4. Use the 100-year 24-hour storm event as the basis for design of wet detention ponds.
5. For existing and proposed structures near wet detention ponds, the elevation of the lowest level should be evaluated and approved by the appropriate governing agency to ensure there is no potential to flood the structure.
6. Developed lands should have positive drainage conveyance to detention ponds.
7. Design wet detention ponds to control 10-year storm event discharges at pre-development runoff rates.
8. Design the initial detention pond and outlet structures to minimize operation and maintenance costs and allow proper access for maintenance.
9. Existing residential areas and proposed commercial areas, industrial areas, and fuel distribution facilities, should provide individual on-site containment and storm water runoff pre-treatment systems, or pre-engineered proprietary devices to minimize pollutant loading to the storm water conveyance system.
10. To promote sediment and pollutant settling and provide space for sediment accumulation, the mean depth of the permanent pool volume should be greater than or equal to 4 feet.
11. For safety purposes and to provide suitable habitat for rooted aquatic plants, the bench width (littoral shelf) should be at least 10 feet and the bench slope should not be greater than 10:1 at a point 2 feet below normal design static water elevation.
12. All pond types should be re-evaluated during final development engineering and design when all factors affecting runoff, water quality, storage, seepage, land costs, and operation and maintenance costs of the pond have been determined.
13. Use infiltration to the maximum extent practical.
14. For designs in areas that currently are completely infiltrated, carefully review storm water management proposals.
15. Ensure proper maintenance for sediment removal structures as these must be regularly maintained to be effective.
16. Insist that the primary treatment methods for the Mercer Lake Watershed storm water runoff are wet detention ponds.

10.2. Computer Simulations

Computer simulations of phosphorous contributions from the watershed to the Lake were completed by Cedar Corporation prior to the USGS water balance study and the USGS conducted predictive models with the models registered to actual field data. Different computer routines were used to predict future phosphorous loadings.

10.2.a. Cedar Models

Cedar Corporation utilized three predictive simulations to calculate existing and future water quantity and water quality. The P8 model was used to estimate runoff quantities from existing and future development to Mercer Lake. Comparisons of water quality between similar watersheds were employed to develop estimates for existing and future nutrient and total suspended solids as was the WiLMS model. These model results (presented in Chapter 5) are summarized below:

Table 10-1 Watershed Loading to Mercer Lake

	Existing		Future
Water Quantity (P8)	387.2 ac-ft		392.3 ac-ft
Comparative Method			
Phosphorous	260	16/yr	276
Nitrogen	874	16/yr	948
Suspended Solids	77,485	16/yr	82,665
WiLMS Model			
Phosphorous	221.6		232.4
Most Likely Scenario		16/yr	

Table 10-1 predictions of future build out do not include implementation of Best Management Practices, the effects of atmospheric phosphorous deposition, internal release rates of phosphorous from sediments, or internal loading from the former WWTP discharge.

10.2.b. Canfield and Bachman Model (USGS)

Using the recently collected lake water quality and quantity data, the USGS used the Canfield and Bachman Model to predict chlorophyll and Secchi depths. Using various build out scenarios and reduction in phosphorous, the USGS developed predictions of water quality. Simulations were completed with scenarios with and without loading reductions due to implemented BMPs and also a series of models that simulated retention of phosphorous due to former WWTP input.

The simulation results can be summarized simply as:

- Growth without BMPs – decrease in water quality (-0.7 feet Secchi depth)
- Growth with BMPs – increase in water quality (0.2 feet)

- Effect of WWTP discharged to lake – decrease in water quality (-0.3 to -4.0 feet Secchi depth.

Computer Model Conclusions

1. Decreases in phosphorus concentrations are observed if Phosphorus controlling Best Management Practices are implemented.

2. Increasing development in the Little Turtle Inlet, Mercer area, and the near shore lake areas without the implementation of Phosphorus controlling Best Management Practices will result in an increase in Phosphorus concentrations in Mercer Lake.

3. Lake water quality appears to be protected from internal phosphorous loading unless extended anoxia periods occur that will stimulate phosphorous release from bottom sediments.

4. Although water quality appears to have been affected by WWTP effluent discharge between 1965 and 1995, the removal of this discharge combined with the wastewater collection from the riparian community has resulted in an improvement of lake water quality.

Should the watershed residents choose not to administer and regulate Phosphorus discharges in the watershed now; the discussion of Phosphorus controls in the future will be moot, as the Lakes will experience increased algal development, an increase of algae blooms in the back bays where water circulation is low, and the prevalence of blue green algae.

10.3. Recommendations

The conclusions of the various organizations and consultants all indicate that the current water quality will degrade, albeit slowly, with increased development in the region. As sure as this area has developed over the past 130 years, population growth will continue. With development will come increases in impervious surface areas, higher pollutant concentrations in developed areas, increased residential development - notably tiered development around the Lakes, increased demands on sewage treatment (sanitary sewer and septic systems), increase in storm water runoff, and increased upstream development.

The recommendations of the studies completed over the last 6 years are as diverse as the backgrounds of those involved in the project. There are, however, some recurrent themes, and to present these as simply as possible, they are itemized in point form.

1. Protect the sensitive areas in the lake, the wetlands, and depressions in the surrounding near lake area. Not only are these areas naturally unique, they provide natural removal of sediment and phosphorous from surface runoff waters.

2. Existing storm water management will be greatly improved with the implemented Best Management Practices for the USH 51 reconstruction completed in 2013. Additional Best Management Practices are needed throughout the watershed.

3. Consider improving or developing a street sweeping program. Augment existing town equipment with contract services.

4. Encourage Private Parking Lot Sweeping. Provides some water quality improvement; however, this non-structural BMP can be very effective as an educational tool, as large retail areas are very visible to residents.

5. Adopt and enforce storm water runoff ordinances to control runoff.

   - construction site erosion
   - future development runoff water
   - redevelopment area runoff water

6. Develop and encourage riparian parcel housekeeping and development guidelines to improve storm water runoff quality, including:

   - construction site erosion control
   - rain gardens
   - impervious surface runoff water controls and/or treatment
   - shoreline buffers
   - canopy development
   - shoreline alterations and developments (regulated under NR115)
   - terracing and/or vegetating steep banks
   - increase natural shoreline habitat for aquatic dwellers
   - educate the public and visitors to identify native and invasive species; develop and distribute a who to call, what to do list for aquatic concerns.
   - Enforce boat and trailer inspections to control transport of aquatic invasive species both into and out of area waters

7. Encourage riparian septic tank owners to become "connected" to existing and future extensions of sanitary sewers. At a minimum, all septic tank owners should have the septic system maintained (pumped and inspected) once every three years. Failing systems should be replaced.

8. Evaluate Lake Protection Funding Mechanisms. The Iron County Land Conservation Department in Hurley can provide technical and funding assistance to property owners with riparian property runoff improvements and/or sanitary sewer connection.

9. Storm Water Utility

As discussed in Chapter 9 and detailed in Appendix O, various financing mechanisms are available to the Township and Lake Association to allow implementation of the recommendations found herein. The Town must recognize that everyone benefits from incremental improvements in water quality and reduction of localized flooding. Likewise, everyone is harmed by incremental degradations in water quality and increased instances of localized flooding. A community-wide approach to address storm water management costs is the establishment of a Storm Water Utility. A Storm Water Utility would allow Mercer to shift some of the costs of storm water utility maintenance and construction directly to developers and property owners, who stand to benefit from the improvements, without incurring additional public debt.

Where realistic, consider developing regional facilities which will serve areas beyond the existing developed area. Sometimes developers may balk at doing more than is necessary for their development alone. In these instances, it is more practical for the Storm Water Utility District to finance, design and construct regional storm water facilities and then recapture that portion of the cost attributable to the initial development.

As discussed throughout this document, all development and urbanization cause many problems associated with increased water quantity and decreased water quality. All residents and landowners in the Mercer Lake Watershed contribute either directly or indirectly to the urbanization of previously undeveloped areas. Whether an area was developed one or 100 years ago, previous to that it was most likely used for logging or in its natural state. Therefore, resolution of storm water problems must be considered a community-wide goal.

We recommend that the Town of Mercer implement a Storm Water Utility to not only address existing storm water quality and quantity problems but also to eliminate potential future problems with regional facilities designed to reduce peak flows and increase water quality.

10. Protect existing habitat areas and encourage and expand existing habitat protection and creation programs. Encourage DNR and wildlife managers to provide habitat development educational opportunities.

11. Participate in available creel count surveys to better understand and protect the fishery. Further the current fish stocking goals.

12. Develop AIS recognition and “First Response” approaches.