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Summary

This *WATERSHED MANAGEMENT PLAN* was written to identify the uses designated by the State of Michigan for all public waters and to identify locally desired additional uses for Lake Leelanau, its tributaries and its watershed. The plan identifies threats and impairments to these uses and establishes goals to address these concerns.

Leelanau County has experienced a 26.7 % population increase from 1990-2000 (US Census, factfinder.census.gov). In the last two years, Lake Leelanau has had the highest number of wetland fill permit applications of any lake in Northwest Lower Michigan (M. Tonello, MDNR Fisheries Biologist, personal communication). In the last five years, 1997-2001, there have been 44 riparian (applicants listed Lake Leelanau as adjacent body of water) fill permit applications and approval of 28 of them, denial of 6 and 10 remain undecided. The lake has seen an expanding walleye fishery in the last 10 years, which has attracted regional fishing tournaments and outdoor writers through out the Midwest. Paradoxically, the benefits accruing to the state and regions from activity and development in the Lake Leelanau Watershed are dependent on preservation of its high water quality and scenic attractiveness.

Geographic Scope and Watershed Description

Lake Leelanau (which includes both South Lake Leelanau and North Lake Leelanau) is the largest lake located in Leelanau County, Michigan (Appendix A). The Lake Leelanau Watershed drains 100,981 acres and is located primarily in Leelanau County but has its genesis in Benzie and Grand Traverse Counties. The watershed covers the jurisdictions of 10 townships and contains three villages. In northwest Long Lake Township in Grand Traverse County 50-acre Cedar Lake gives rise to Cedar Run Creek, which flows briefly into northwest Almira Township in Benzie County before flowing north into Leelanau County. Cedar Run Creek is joined by many first and second order, coldwater tributaries as it flows toward its junction with Victoria Creek in Solon swamp just south of Lake Leelanau (Appendix A). The union of Cedar Run Creek and Victoria Creek form the Cedar River, which accounts for 75 % of the total surface water flow into South Lake Leelanau. Cedar River flows for a little less than a mile until emptying into South Lake Leelanau.

The 5,370-acre South Lake Leelanau is joined to the 2,950-acre North Lake Leelanau by a mile long “Narrows” channel. This lake system is about 15 miles in length and has 41.21 miles of shoreline. The maximum depth of South Lake Leelanau is 62 feet with an average depth of 25 feet. The North Lake reaches a maximum depth of 121 feet with an average depth of 43 feet. North Lake Leelanau covers 55 % of the surface area and contains 98% as much volume as does South Lake Leelanau.

The land use within the watershed is dominated by forested lands, 37% (28% deciduous and 8.9% coniferous), followed by agriculture 27.5% (17.3% cropland, 8.8% orchards and vineyards, 1.3% permanent pasture and other agriculture), herbaceous, 11%, water, 8.8%, shrub, 7.8% and residential and commercial uses comprising 4.5% (Appendix A).

The Lake Leelanau watershed was formed by glacial action that gave rise to other prominent oligotrophic systems in Northwest Lower Michigan such as Torch Lake, Crystal Lake and Glen Lake. Elevated lake levels formed the extensive wetland areas along the shoreline of Lake Leelanau in the Nippissing period. At this time, the Lake Leelanau basin was an embayment in Lake Nippissing (elevation 605 ft.). Hills flanking the basin were ‘notched’ by waves, eroding fine sediment that formed sandbars in the adjacent lake. These fertile sandbars became the prolific wetlands that extend throughout the watershed (Appendix A).

The Lake Leelanau watershed is bordered to the east and west by north/south running, streamlined hills formed by retreating glaciers. These hills, called drumlins, are composed of sandy and coarse loam soils that are well drained and conducive to agriculture. The watershed soil types are composed of the Emmet-Montcalm-Kalkaska association, 45.3%, the Blue Lake-Leelanau-Montcalm association, 15.9%, Kalkaska-Leelanau-Emmet association, 12.7%, Eastport-East Lake-Deer Park association, 12.0%, Kalkaska-Rubicon-Duel association, 3.4%, and the Rubicon-East Lake-Eastport association

comprising 1.8% (Appendix A). Watershed valley floors, lakeshores and wetlands are typically composed of Lupton-Markey mucks or marl with a high pH.

Based on water clarity, phosphorous concentration and chlorophyll-a concentration, Lake Leelanau is classified as an oligotrophic lake (Canale and Nielsen 1997, Keilty 1997). In a 1980 report by the Northwest Michigan Council of Governments (NWMCOG), the South Lake Leelanau basin was listed as the third highest priority basin in the NWMCOG ten county region. Water quality concerns at that time included erosion, nutrients from fertilizers and septic fields and wetland development. Michigan's 1988 Nonpoint Pollution Assessment Report named sedimentation, excessive weed growth, nuisance algae blooms, oxygen depletion, impaired fish communities and pesticide toxicity as perceived impacts on the South Lake Leelanau system. Potential sources of these impacts were identified as agricultural fertilizers and pesticides, construction practices, irrigation and erosion.

The past ten years nitrate levels of both North and South Lake Leelanau have bordered on concentrations associated with mesotrophic lakes causing some concern for this nutrients role in the productivity of the Lake Leelanau system (Canale and Nielsen 1997, Keilty 1997, Wetzel 2001). Phosphorus levels have remained within the oligotrophic standard of <8 ug/l for the last ten years while secchi depth has remained constant since about 1985 where upon it had increased from 1975 (Canale and Nielsen 1997, Keilty 1997). The increase in secchi depth from 1975 to 1985 has been attributed in part to the elimination of phosphorus in washing machine detergents (Canale and Nielsen 1997, Keilty 1997). Details of the physical, chemical, and hydraulic data for the watershed may be found in appendices C and D.

Stevenson (1994) found Lake Leelanau to have very low levels of common algae species indicative of high nutrient conditions. Water quality monitoring conducted by the Leelanau Conservancy in the summer of 2001 found significant blooms of *Microcystis aeruginosa*, a known indicator of high nutrient conditions and potential human health concern. The monitoring effort by the Leelanau Conservancy found that zebra mussel (*Dreissena polymorpha*) infestation of Lake Leelanau was increasing annually and may be linked with the Microcystis bloom.

Designated and Desired Uses

The following are existing *designated* uses in the Lake Leelanau Watershed:

1. Coldwater fishery
2. Warmwater fishery
3. Other indigenous aquatic life and wildlife
4. Partial body contact
5. Whole body contact
6. Agriculture and irrigation
7. Public water supply
8. Navigation

The following are the *desired* uses of the Lake Leelanau Watershed:

1. Coldwater fishery with emphasis on improving natural reproduction of trout in Lake Leelanau and its tributaries.
2. Warmwater fishery, which emphasizes less dependence on hatchery maintenance of walleye stocks while improving smallmouth bass and pike growth and reproduction.
3. Wildlife habitat with an emphasis on protecting and monitoring ecologically sensitive habitats.
4. Critical area preservation with emphasis on wetlands and groundwater recharge uplands.
5. Whole body contact recreation year round
6. Agriculture and irrigation practices which emphasize current best management practices and incorporate integrated pest management practices
7. Potable groundwater sources
8. Scenic and rural environment with emphasis on riparian vegetation protection and wetland preservation
9. Navigable waters that safely accommodate current carrying capacities for usage

Water Quality Threats and Impairments

The following uses are currently impaired uses. The pollutants are listed in order of importance and may reflect a cause of impairment rather than a traditional specific pollutant:

<u>Impaired Uses</u>	<u>Pollutants</u>
1. Coldwater fishery	nutrients, sedimentation, thermal pollution, toxic substances, exotic species
2. Indigenous aquatic life/wildlife	nutrients, erosion/sedimentation, habitat loss and fragmentation, exotic species
3. Total Body Contact	swimmers itch, coliform bacteria, toxic algae bloom, algae bloom_

<u>Threatened Uses</u>	<u>Pollutants</u>
1. Warmwater fishery	sedimentation, exotic species, nutrients, toxic substances
2. Rural and scenic environment	natural shoreline and viewshed development
3. Potable groundwater	nutrients, oils and greases, pesticides, herbicides
4. Navigation	sedimentation, nutrients, algae blooms

Pollutants

The pollutants and sources are listed and prioritized in Table 1. The pollutants listed may be a description of the cause of impairment in cases where traditional pollutants (i.e., nutrients) do not represent what is impairing or threatening a particular designated or desired use. Specific sites contributing to sedimentation of Lake Leelanau tributaries are designated in the Lake Leelanau Watershed Road/Stream Crossing Inventory Report by the Grand Traverse Band of Ottawa and Chippewa Indians (Appendix J). Details on nutrient data and budgets for North and South Lake Leelanau can be found in Canale and Nielsen (1997) and Keilty (1997), published by the Leelanau Conservancy.

Table 1. Prioritized list of pollutants and their sources.

Pollutants (listed in order of importance)	Sources (listed in order of importance)
Nutrients	<ol style="list-style-type: none"> 1. atmospheric deposition 2. failing septic systems 3. agricultural and residential fertilizers 4. agricultural manure 5. zebra mussel pseudofeces accumulation
Sediment	<ol style="list-style-type: none"> 1. poorly designed or failing road/stream crossings 2. eroding streambanks 3. riparian and littoral zone degradation
Habitat loss	<ol style="list-style-type: none"> 1. residential and commercial development 2. sedimentation 3. exotic species colonization
Natural shoreline and watershed development	<ol style="list-style-type: none"> 1. residential and commercial development 2. permitted wetland fill practices
Thermal pollution	<ol style="list-style-type: none"> 1. deforestation 2. ponds and impoundments connected to Lake Leelanau tributaries 3. sedimentation of stream channel
Toxic substances	<ol style="list-style-type: none"> 1. poorly designed or failing storage tanks 2. agricultural chemicals 3. potential and existing parking lots 4. improper refuse disposal in the watershed
Exotic species	<ol style="list-style-type: none"> 1. direct transport on/in contaminated vessels 2. introduced by negligent/uneducated person(s) 3. natural dispersion
Coliform bacteria	<ol style="list-style-type: none"> 1. old or improperly managed septic systems 2. improper livestock practices
Toxic algae bloom	<ol style="list-style-type: none"> 1. high nutrient conditions 2. zebra mussel selective filtration
Algae bloom	<ol style="list-style-type: none"> 1. high nutrient conditions

Water Quality Improvement and Protection Goals

The following goals address the threatened and impaired uses of the watershed:

1. Protect and improve water quality in Lake Leelanau and its tributaries.
2. Protect and improve warm and coldwater fisheries in Lake Leelanau and its tributaries.
3. Protect and improve habitat of other indigenous aquatic life and wildlife.
4. Preserve the scenic and natural character of the watershed.
5. Monitor and address exotic species colonization and/or advancement.

Please refer to the Appendix B for the attached Summary Management Plan that outlines the objectives, tasks, milestones, estimated costs, timeline and responsible parties for each of the Water Quality Improvement and Protection Goals identified above. Table 2 (below) identifies the estimated costs of implementation by category.

Table 2. Estimated Cost of Implementation Activities by Category	
Activities Category	Estimated Costs
BMP implementation (managerial, structural and vegetative)	\$ 1,010,000
Road/Stream crossings	\$ 839,000
Ordinance development (including septic system maintenance and inspection)	\$ 12,032,000
Information/Education activities	\$ 29000/year
Establish conservation easements	\$ 10,000,000 *
Water quality assessment activities	\$ 54,000/year
Total:	\$ 23,881,000 + \$ 83,000/year

* indicates that this amount is expected to increase with property values

Summary of Public Support and the Participation Process

The Lake Leelanau Watershed Management Plan was developed as a cooperative effort between the Lake Leelanau Association and The Leelanau Conservancy. The plan has been reviewed by the Lake Leelanau Association Board of Directors,

The purpose of this plan is to improve water quality, fish and wildlife habitat while maintaining the designated and desired uses of the watershed. The above-signed groups have indicated a willingness to conceptually support the watershed plan and to assist with services and funds when and where possible.

Evaluation Process for Plan Implementation and Goal Achievement

The success of the Lake Leelanau Watershed Management Plan will depend on continued support and participation from the Lake Leelanau Association, the Leelanau Conservancy and their volunteers along with the availability of monies to cost share for implementation of the plan. The Executive Committee of the Lake Leelanau Association will annually review the plan and act to stimulate progress where needed, amend the plan as needed and report progress to the association membership. In order to protect the water quality of Lake Leelanau, the Leelanau Conservancy, with financial assistance from the Leelanau Conservation District, will continue their baseline monitoring program in addition to observing and recording exotic species colonization and advancement. The baseline monitoring includes both lake profiles using a Hydrolab (a multiple probe instrument used to simultaneously measure depth, temperature, dissolved oxygen, pH, conductivity, and oxidation reduction potential) and water chemistry analysis of total phosphorus, nitrate nitrogen, and chlorophyll a. Other studies/datasets obtained by the Leelanau Conservancy, as part of the Watershed Council, include seasonal quantitative assays of phytoplankton. These datasets not only provide another instantaneous measure of water quality, but also provide an excellent biological benchmark, which is currently invaluable for pre and post exotic species comparisons.

A tremendous baseline dataset combining discharge and nutrient composition for 25 Leelanau County streams has been also been compiled. This was made possible by funding from the MDEQ (M. Stifler Cadillac office) and a team of volunteer field technicians. These data provided an important component of resultant estimated nutrient budgets calculated by Dr. Ray Canale and Walt Nielsen. Their report is a first step toward accurately pinpointing the sources and relative contributions of nutrition to our lakes and consequently our ability to improve upon our management practices. Continuation of the lake and stream monitoring within the watershed will allow for a trend analysis in determining changes in water quality over time.

Continued monitoring of Lake Leelanau and its tributaries by MDNR fisheries staff will provide an assessment of the health of the fish stocks. Additional shoreline surveys will be compared with past surveys to determine relative loss of lakeshore vegetation. Photographic and GIS/GPS technology will be used to evaluate the extent of development on parcels deemed important to protecting high water quality, fish and wildlife habitat along with the regions scenic and natural character. Conservation easements established with interested landowners will help to reduce the development rate of such parcels.

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