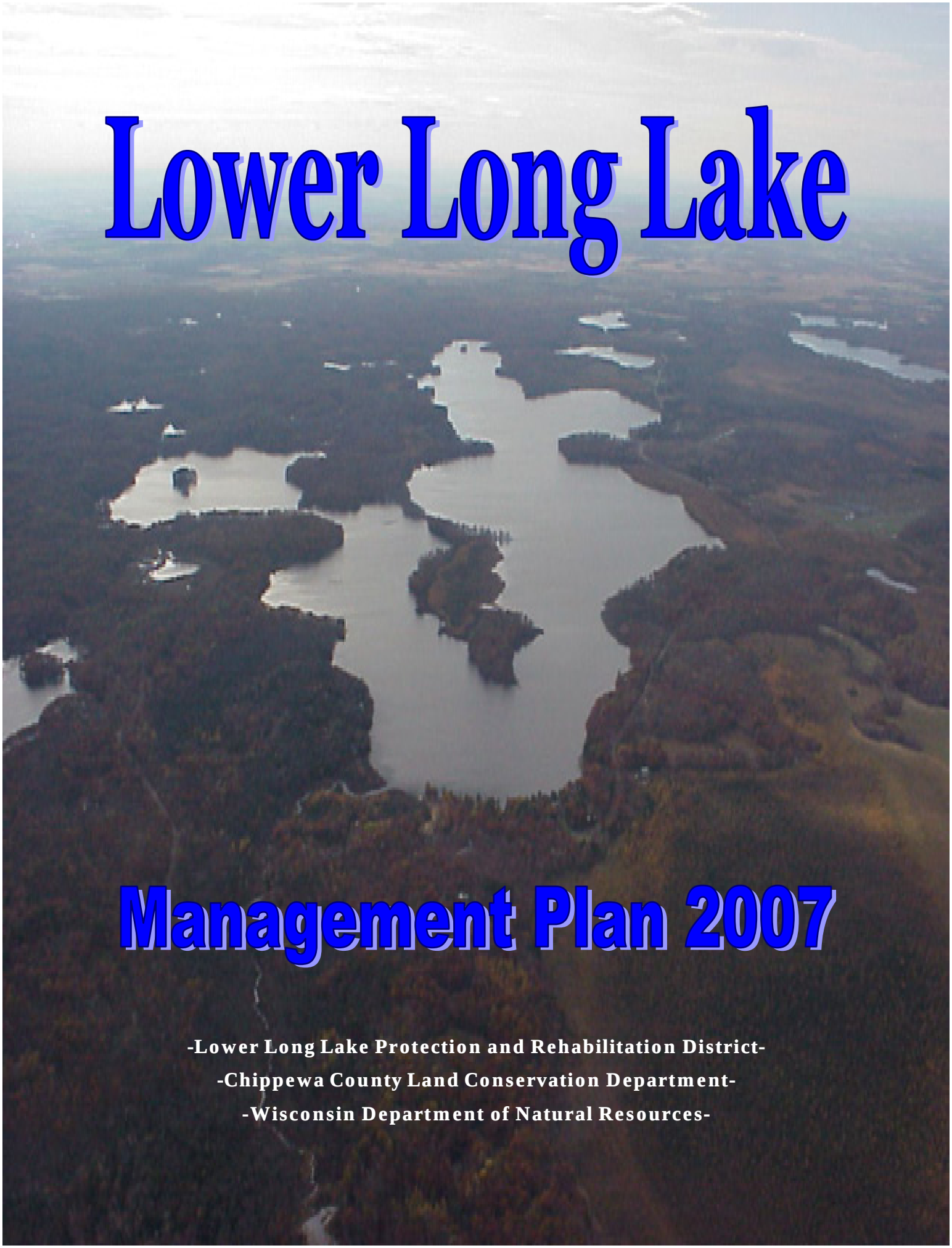


Lower Long Lake

Management Plan 2007

-Lower Long Lake Protection and Rehabilitation District-

-Chippewa County Land Conservation Department-

-Wisconsin Department of Natural Resources-

Acknowledgement…

We would like to deeply thank all of those who were involved in the creation of this document.

The Lower Long Lake Protection and Rehabilitation District Commissioners: Darlene Glass, Pat Andress, Harlyn Misfeldt, Marcia Loofboro (Town of Sampson Representative), and Jim Dahl (Chippewa County Land and Water Conservation Department Representative) – with contributions from Wayne Sauls at the Lower Long Lake Foundation.

The Wisconsin Department of Natural Resources: Patrick 'Buzz' Sorge (Lake Management Planner), Deb Konkel (Aquatic Plant Specialist), Darren Lochner (Basin Educator for Natural Resources), and Joe Kurz (Fisheries Biologist).

The Aulik Family: for their help in compiling and editing this information for marketing and distribution.

Thanks to the property owners and patrons of Lower Long Lake. Your continuous effort to help in the growth, stability, and future prosperity of our lake has helped to set a great example for our posterity.

Chippewa County Land Conversation Department: Dan Masterpole (Chippewa County Conservationist).

Introduction…

Long Lake has been a premier lake that is valued by those who live around and recreate on it throughout the history of Chippewa County, Wisconsin. Long Lake is valued, by the families who use and enjoy the lake, for its good water quality, natural beauty, peace and tranquility, sense of place, high quality fishing and recreational opportunities.

The Lower Long Lake Protection and Rehabilitation District *(LLLPRD)* has coordinated the development of a team to develop a lake management plan for Long Lake. The purpose of the plan is to develop goals to protect the attributes of the lake and implement activities which will protect and improve Long Lake for future generations. The planning team included the LLLPRD board, a Town of Sampson board member, The Chippewa County Land and Water Conservation Department staff, and The Wisconsin Department of Natural Resources Lake Management and Fisheries staff.

The Purpose of these studies has been to provide insights as to how Long Lake is changing over time and describe the current ecological health of the lake…

The LLLPRD has always been concerned with protecting the quality of Long Lake. Protecting the lake was the primary reason for forming the Lake District in 1975. The LLLPRD conducted a diagnostic and feasibility study in 1977 which lead to the development of a lake management plan in 1984. Many lake studies have been conducted the past two decades beginning in the mid 1980's. The purpose of the studies has been to provide insights as to how Long Lake is changing over time, and to describe the current ecological health of the lake.

Studies have been conducted to assess: water quality, shoreline habitats, fisheries, aquatic plants, crayfish populations, watershed land use conditions and mathematical modeling to predict present and future water quality conditions in the lake. The results of these studies provide critical information to be used collaboratively by the planning team to develop lake management goals for Long Lake. The lake management goals describe a desired state of conditions for: water quality, shoreline habitat, fisheries, and the aquatic plant community, the control of crayfish and other invasive and exotic species, and multi-faceted recreational opportunities. These goals have been based on science and the values expressed by property owners of Long Lake.

Background…

Long Lake is a 1052 acres and 101 foot deep drainage lake located in the Town of Sampson in northwestern Chippewa County. Long Lake was first developed during the late 1800's by families from Eau Claire associated with the logging boom of the Chippewa Valley. It is reported that the initial homes and resorts as well as the shore land forest were destroyed by wildfires in 1893-1894 (Laine unpublished manuscript). Long Lake has 13.88 miles of shoreline and an additional 2.31 miles of island shoreline. 6.91 miles of shoreline have been developed into seasonal and/or permanent residences.

Over 90 percent of the aquatic life that lives in Long Lake is dependent upon the near shore shallow water habitat for some or all life stages…

The protection of social values, water quality, fisheries, aquatic life, and natural beauty of Long Lake is dependent upon the continued stewardship of the members of The Long Lake Protection and Rehabilitation District, as well as those who live on and use the lake. The development of riparian *(a dwelling adjacent to a body of water)* property increases water runoff and nutrient inputs to Wisconsin's lakes (United States Geological Survey 2003). Runoff studies conducted on several northern Wisconsin lakes found that phosphorus inputs to lakes from developed lots where 8 times higher than phosphorus inputs from adjacent undeveloped forested lands.

Phosphorus is the nutrient responsible for stimulating algae growth in Long Lake and most other lakes in Wisconsin. The major sources of phosphorus to northern Wisconsin lakes are lawn fertilizers, and increased runoff from roof tops, roadways and other impervious surfaces associated with developed lake lots. Maintaining or slightly decreasing phosphorus inputs to Long Lake will protect water quality conditions for future generations.

High quality shore land habitats are critical to the protection and production of fisheries and aquatic life. Over 90 percent of the aquatic life that lives in Long Lake is dependent upon the near shore shallow water habitat for some or all life stages. This fact demonstrates why it is critical to protect and improve shore land habitats of Long Lake. Several studies of Wisconsin lakes (Christensen 1996, Schindler 2000, Jennings et al 2003, Woodford and Meyer 2003, Lindsay et al

Phosphorus is the nutrient responsible for stimulating algae growth in Long Lake and most other lakes in Wisconsin…

2002, Garrison et al 2005, and Garrison and Wakeman 2000) have documented that current and historical development practices have been detrimental to Wisconsin lake ecosystems. Water quality, fish populations, woodland bird populations, frog populations, aquatic insects & plants, and near shore habitat have all been significantly degraded in developed Wisconsin lakes. The protection and restoration of lake shorelines can restore many critical habitat features.

Several studies have been conducted on Long Lake to assess the health, condition and to assess protection and restoration potential of the lake. A paleolimnological *(The study of lakes from their sediment and fossils)* assessment of lake sediments was conducted to assess water quality changes from pre-settlement conditions through history to present day (Garrison 1994). Trends for: water quality, shore lands, fisheries, and aquatic plants to characterize changes have been conducted by the Wisconsin Department of Natural Resources since 1986 to present monitored trends. The LLLPRD conducted a watershed land use study in 2001 to characterize potential sources of controllable phosphorus inputs from the various land uses in the Long Lake watershed (Applied Data Consultants, Inc. 2001). Surveys of Long Lake fisheries have been conducted from 1967 through present assessing the status of the fishery. A sensitive area designation study was completed in 2002 which identified and mapped critical shore land habitats (WDNR 2002). The Long Lake Management Plan – 1984 was completed by The WDNR for The LLLPRD compiling studies conducted by The LLLPRD in the late 1970's. An assessment of the Rusty Crayfish populations was conducted in 1974 through 1978 (Lorman 1980).

Management Goals and Objectives…

The following goals and objectives are derived from the values and concerns of the members of The LLLPRD and the science evaluating the health of Long Lake. Implementing the goals and objectives of the Long Lake Management Plan will protect what we value most for the current and future generations of those that love and use Long Lake. The Long Lake goals will guide lake management activities by shore land property owners, The LLLPRD, The Town of Sampson, Chippewa County and The Wisconsin Department of Natural Resources to work together as a community to preserve and protect Long Lake. These goals must be inspirational, believable, and actionable if we are to be successful. This plan will be evaluated on annual basis to review, update and document the successful implementation of these goals and objectives...

Objectives…

Implementing the goals and objectives of the Long Lake Management Plan will protect what we value most for current & future generations…

Goal I: Protect water clarity, prevent the occurrence of algae blooms and reduce nutrient levels in Long Lake.

The families and individuals, particularly our children, deserve to have a lake with clean water to use and enjoy. Protecting water quality will be achieved by reducing the spring turnover total phosphorus concentration to 16-18 ug/l *(micrograms per liter)*, and summer surface total phosphorus concentration to 14-15 ug/l. The reduction of the total phosphorus concentration will help prevent the occurrence of summer algae blooms and protect or slightly improve summer water clarity. Reducing the total phosphorus concentration will require reducing the controllable inputs of phosphorus to the lake by 50 to 90 percent and minimizing inputs of future sources of phosphorus.

1. Conduct a 2 year pilot project for up to 30 riparian properties which will control: storm water runoff and restore natural shore land buffers. These restorations will serve as demonstrations at multiple sites around the lake. (2007 and 2008. Lake District, Chippewa County, WDNR.)

2. Apply for *Lake Management Planning Grant* in January 2007 to fund staffing for inventory conduction, planning, and design for storm water runoff and shore land restorations. (2007. Lake District, Chippewa County.)

3. Apply for *Lake Protection Grant* in April 2007 to implement up to 30 storm water plans and shore land restorations. (2007. Lake District and Chippewa County.)

4. Apply for *Lake Planning Grant* to provide technical support and oversight for staff conducting storm water and shore land restoration inventories. (2007. Chippewa County.)

5. Apply for *Lake Management Planning Grant* in July 2008 to conduct community based social marketing assessment. This assessment will be used to determine the most effective strategies to obtain 60 – 80 percent participation from riparian property owners for installation of storm water management practices and shore land buffer restorations. (2008. Lake District.)

6. Provide technical support to assist in implementing storm water management practices and shore land restorations. (2008. Chippewa County, WDNR.)

7. Participate in Town of Sampson comprehensive planning processes to include lake protection and improvement activities. (Ongoing. Lake District.)

Reducing the total phosphorus concentration will require reducing the controllable inputs of phosphorus to the lake by 50 to 90%, and minimizing inputs of future sources of phosphorus…

8. Continue current water quality monitoring in *Long Term Trends* and *Volunteer Monitoring* programs. (Ongoing. Lake District and WDNR.)

Goal II: Protect and restore healthy stable shore land habitats.

Restoring and protecting shore lands will provide privacy and tranquility as well as a natural space for families to enjoy nature. Most of the existing developed shore lands lack adequate natural buffers which provide critical habitat and protect water quality. Restored and properly maintained shore land buffers will provide water quality protection and provide critical habitat areas for water dependent wildlife and aquatic life.

1. *Goal I: Objectives 1 - 8* will help accomplish this goal.

2. Request Chippewa County to update shore land zoning ordinance to include shore land buffer restorations and storm water management activities as requirements for riparian properties which are being *redeveloped* on Long Lake. (2007. Lake District.)

3. Work in partnership with Chippewa County to clearly define shore land buffer protection and storm water management needs for new development on Long Lake. (2007. Lake District, Chippewa County and WDNR.)

4. *Shore Land Zoning Permits* and *WDNR Permits* need to include environmental protection activities to insure the protection of sensitive areas within Long Lake. (2007. Lake District, WDNR, and Chippewa County.)

5. Identify and map undeveloped shore lands and critical watershed areas for lake protection and future conservation easements. (Ongoing. Lake District, Lower Long Lake Foundation, and West Wisconsin Land Trust.)

Restored and properly maintained shore land buffers will provide water quality protection for critical habitat areas…

Goal III: Protect and improve the diverse aquatic life of Long Lake; including a self sustaining fishery and diverse aquatic plant community.

Leaving fallen trees in the water and protecting high quality aquatic plant beds will improve fishing for anglers and many generations of future anglers. Healthy lake ecosystems are valuable natural resources for all lake users. Fish populations will be protected and improved by: maintaining good water quality conditions, improving in-lake habitat conditions, protecting high quality aquatic plant populations, and managing angler harvest. It is critical to protect existing high quality in-lake habitats for fish, wildlife, and aquatic life as well as restore degraded habitat areas.

1. Develop education materials for lake stewardship. Include values and management of aquatic plants, coarse woody habitat, and shore land vegetation. Provide a list of shore land and riparian zone activities which require county, state, and federal permits. (January 2007. Lake District, WDNR, County, and U of W-Extension.)

2. Review shore land zoning and WDNR permits to insure water quality, habitat and natural beauty protection for Long Lake. (January 2007. Lake District.)

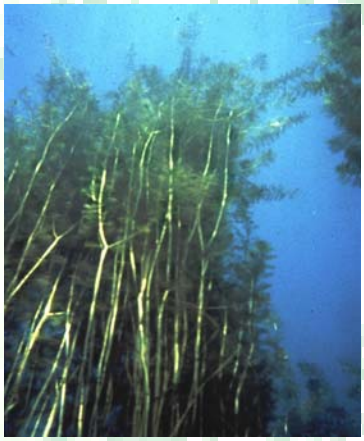
3. Continue *Trends Monitoring* for aquatic plants, shore land habitat, and fisheries on present schedule. (Ongoing. WDNR.)

4. Evaluate Long Lake for potential native aquatic vegetation restoration sites. (2008. WDNR.)

5. *Shore Land Zoning Permits* and WDNR Permits need to include environmental protection activities to insure the protection of sensitive areas within Long Lake. (2007. Lake District, WDNR, and Chippewa County.)

Goal IV: Prevent the expansion and new infestations of invasive and exotic species.

Many families and lake users enjoy the great fishery of Long Lake. The natural populations of fish, aquatic plants, and other aquatic life are continuously threatened by the expansion of Rusty Crayfish or potential new infestations of aquatic invasive species. Recently several nearby lakes have become infested with *Eurasian Water Milfoil*. It is critical to continue to manage the Rusty Crayfish population in order to protect the fishery and aquatic plant populations. Preventing new infestations of invasive aquatic species are critical to maintaining the integrity of native plant and animal communities which will protect and maintain the ecosystem health of Long Lake.



1. Develop and implement *Clean Boats Clean Waters Program* for the prevention of infestations of invasive species. (January 2007. Lake District.)

2. Design and implement long term monitoring for Rusty Crayfish population. (January 2007. Lake District and WDNR.)

3. Design and implement *Invasive Species Monitoring* and *Infestation Response Program*. (2007. Lake District, Citizen Science Center and UWEX.)

4. Continue the fishing regulations which are thought to be critical in decreasing Rusty Crayfish populations. (Ongoing. WDNR).

Goal V: Provide safe multifaceted recreational opportunities.

Boating is a favorite family and social activity for many lake users of the Long Lake community. Recreational needs and uses of Long Lake will continue to increase as populations increases and development continues to occur in northern Chippewa County. It will be important to provide safe recreational opportunities for all lake users while protecting critical lake habitats and water quality.

1. Conduct an assessment to identify potential slow, or no wake areas for the protection of water quality, habitat and public safety. (2008. Lake District, Town of Sampson and WDNR.)

2. Coordinate annual or biannual boating safety course. (2009. Lake District.)

3. Provide appropriate public lake access. (Ongoing. Lake District, Town of Sampson, and WDNR.)

Lower Long Lake Protection and Rehabilitation Survey 2004…

In 2004 The LLLPRD surveyed every property owner on the lake (about 170) and received 79 responses. The survey asked several questions regarding why people chose to own property on Long Lake, how people use the lake, what was the surveyed perception of the quality of the lake, and a variety of additional questions related to owning property on the lake and recreating on the lake. The majority of property owners chose to own property on Long Lake because of its superior quality, proximity to home and family tradition, but the lake is enjoyed most for its peace and tranquility. Many also enjoy entertaining and relaxing with family on the lake.

Shore land property owners use the lake primarily in the summer months with very few people listing winter activities. Many enjoy boating, bird watching, swimming, canoeing, and fishing. The spring, summer, and autumn weekends see the most use of the lake, although people did report that they use the lake year round.

People report that they are very happy with the quality and clarity of the lake. Sixty-nine percent of the people that responded to the survey feel that the lake quality has remained the same or has only *slightly* degraded since they have been on the lake.

Boat traffic does not seem to be an issue with our responders. Eighty-one percent of the respondents report that "it is easy to share the lake" and that watercraft traffic is moderate and "not enough to bother my use."

Regarding access to the lake, 52 of 60 responders say that they feel the access points are adequate for the size of our lake. Comments were made about improving the Morris Erickson landing and the North End Landing.

The survey found that continued water chemistry monitoring, riparian property owner education, and fishery improvements are the issues that matter most to property owners. A number of property owners are interested in having the district test and monitor septic systems near the lake.

A majority feels that The LLLPRD should manage the lake and finance that

management, but many also think that The Town of Sampson or the State of Wisconsin should be involved.

People have many positive comments about The LLLPRD. The respondents encourage education and want to see positive enforcement of regulations. There were many positive comments about land trusts activities.

Paleolimnology…

Paleolimnology is the study of lake sediments to recreate the water quality history of a lake. A paleolimnological assessment was done to reconstruct the changes in water quality in Long Lake from the early 1800's to present day. Each year Long Lake receives a fresh layer of sediment, and within this layer of sediments is stored the water quality characteristics of the lake for that year. *This annual layering of sediment is similar to a tree receiving a growth ring each year*. The sediments are sampled by taking a vertical core down through the annual layers of sediment and the individual layers of sediment are sectioned, dated and analyzed to recreate the water quality history of the lake. A sediment core was taken from the 72 foot deep area west of Camp Manitou in October of 1994.

The sediment core was evaluated to assess the degree that shore land development and watershed land use have changed the water quality of Long Lake. The sediment core assessment has shown that the current level of shore land and watershed development has increased the phosphorus concentration of Long Lake by 50 percent. The predevelopment (early 1800's to 1940) phosphorus concentration of Long Lake was 12 ug/l; the present day phosphorus concentration is 18 ug/l. Phosphorus concentrations in Long Lake ranged from 12 – 14 ug/l from the early 1800's until 1940. As the lake shore lands were developed after 1940, phosphorus levels increased to present day levels. The increase in phosphorus levels is due to the increase in storm water runoff and nutrient delivery to the lake from shore land and watershed development. The current phosphorus levels in Long Lake are increasing to a critical level which could stimulate the growth of higher levels of algae in the lake.

Long Lake's phosphorus concentrations are almost 11% higher than our projected goals…

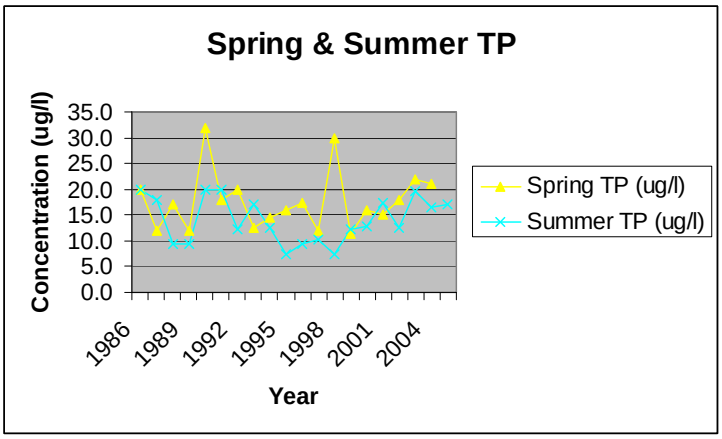
Water Quality…

The health or condition of the Long Lake ecosystem has been a concern of The LLLPRD and The WDNR since the Lake District was formed in the mid 1970's. Water quality monitoring is a tool to assess the health of the lake. Long Lake ecosystem health is routinely assessed by measuring water clarity *(secchi depth)*, nutrient enrichment *(phosphorus concentration)*, and algae abundance *(chlorophyll concentration)*. The WDNR selected Long Lake to be included in the *Long Term Trends Monitoring Program* in 1986 and has monitored water quality the past two decades. Water quality has also been monitored by a volunteer monitor from the Lake District through The WDNR *Self Help Monitoring Program*.

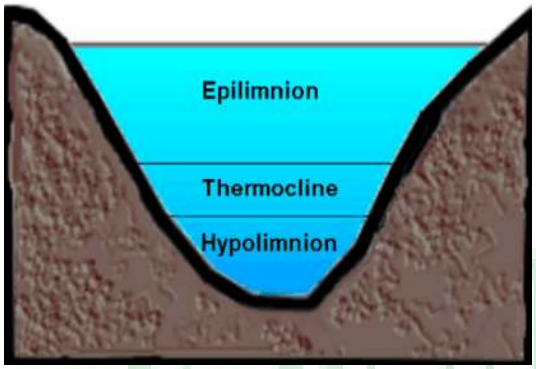
The most concerning information from the water quality monitoring is the lake phosphorus concentration. Phosphorus is the major controllable factor controlling the amount of algae which will grow in Long Lake. The phosphorus concentration in Long Lake is

approaching the threshold value of 20 ug/l *(micrograms per liter)*, where if the average spring turnover and summer phosphorus concentration increases to or above this level more frequent algae blooms will occur and water clarity will decrease. Spring turnover phosphorus concentrations in Long Lake range from 12 to 30 ug/l, with a 20 year average of 18.44 ug/l. The variation in the phosphorus concentration is largely due to the amount of snowfall and rainfall in a given year. Current algae concentrations in Long Lake are moderate at a 20 year summer average of 5.92 ug/l with a range of 2 to 9.5 ug/l. The two decade average summer secchi depth is 2.9 meters (9.5 feet) and has ranged from 2.0 meters (6.56 feet) to 4.15 meters (13.61 feet). The values for phosphorus, algae and water clarity are indicative of a moderately *(mesotrophic)* enriched Wisconsin lake (Figure, Upper Right).

*Phosphorus Concentrations over the past 20 years.



Summer Lake Stratification Zones



Each year as the waters of Long Lake warm in late spring and early summer the lake stratifies, or layers, into 3 distinct layers by water density. The colder bottom layer *(hypolimnion)* of the lake is separated by a mid layer *(thermocline)* from the warmer surface layer *(epilimnion)*. These layers remain stratified into three distinct layer until late fall when the lake mixes top to bottom. The bottom layer of Long Lake is oxygenated by spring mixing *(spring overturn)*. The rapid loss of oxygen from the bottom layer by bacterial decomposition of the deep sediments is an indication of declining water quality. The loss of oxygen is caused by the bottom sediments of the lake being enriched with increasing amounts of decomposing algae. An assessment of oxygen levels in the bottom layer of Long Lake from 1974 to 2000 indicates declining water quality (McGinley and Turyk 2002). The bottom waters *(hypolimnion)* of Long Lake become anoxic *(low in oxygen)* by mid summer and can not support fish.

The loss of oxygen from the bottom waters during the summer is an irreversible decline in water quality…

The water quality of Long Lake is considered good when compared with other Wisconsin lakes. Current phosphorus concentrations indicate the lake is approaching a threshold where algae blooms will occur and water clarity will decrease. The assessment of oxygen levels in the bottom layer of the lake during the summer indicate

water quality is declining. The loss of oxygen from the bottom waters during the summer is an irreversible decline in water quality. The protection or modest improvement of surface water quality can occur by developing lake management goals and implementing management activities to achieve those goals.

Water Quality Modeling…

Water quality models are *computer based mathematical models* which simulate lake water quality and watershed runoff conditions. The models are based on the mathematical representation of lake functions which determine lake water quality. The model is a tool which assists in predicting changes in water quality when watershed management activities are simulated. The model can answer the question of what is the estimated water quality improvement when watershed sources of phosphorus inputs are reduced. It must be acknowledged that models predict a *relative* and not an *exact* environmental response.

A key component of the water quality model is the *phosphorus budget*. The phosphorus budget is the estimated amount of phosphorus delivered to the lake from each land use type annually. The phosphorus budget can be thought of as the fuel which drives the algae population in Long Lake. The only current controllable sources of phosphorus are the phosphorus in the storm water runoff from shore land development.

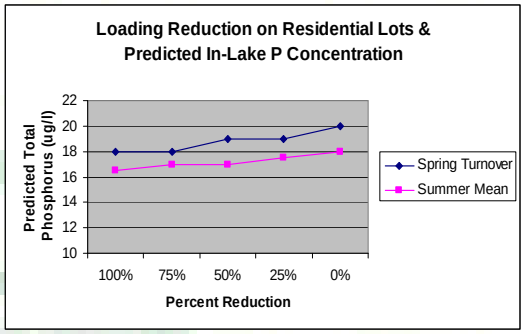
The following model was used to evaluate a series of phosphorus input reduction scenarios.

Land use	Acres	Kg/Year	Lbs/Year
High Density Urban	17.3	11	24.3
Medium Density Urban	125.7	25	55.1
Rural Residential	101.2	4	8.8
Pasture/Grass	218.7	27	59.5
Wetlands	1144.7	46	101.4
Forest	2089.4	76	167.6
Atmosphere	1052	128	282.2
Septics	n/a	6.25	13.8
Total		323.25	712.7

*Land use Nutrient Loads

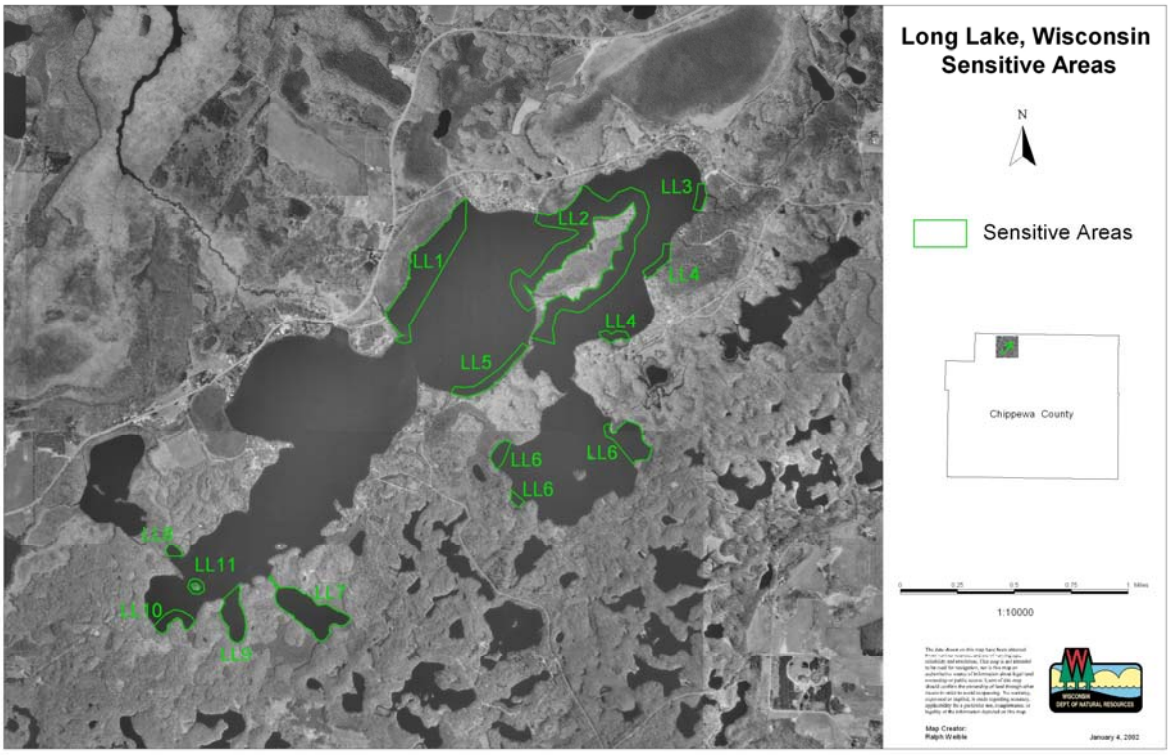
The modeling scenarios represent a 25%, 50%, 75%, and 100% reduction in phosphorus inputs in storm water runoff from shore land development. The model predicted (Table Below) that reducing phosphorus inputs from shore land development will improve and protect Long Lake water quality by reducing the current phosphorus levels by 1-2 ug/l.

The modeling study results clarify the importance of reducing existing controllable phosphorus inputs to improve and protect Long Lake. It also must be recognized that future sources of phosphorus must be minimized if water quality is to be protected for the enjoyment of future generations. The development and implementation of lake management goals by the residents of Long Lake and its watershed will be the *core tools* which protect Long Lake.



Sensitive Areas…

Sensitive areas are areas of aquatic vegetation identified by The Department of Natural Resources as offering critical or unique fish and wildlife habitat, including seasonal or life-stage requirements, or offering water quality or erosion control benefits to the body of water. *The Sensitive Area Designation* was completed for Long Lake in 2002 by The WDNR. The purpose of identifying and mapping sensitive areas is to preserve and protect the most critical habitats within Long Lake.



Eleven sensitive areas have been identified (Figure, Above) in Long Lake. These sensitive areas identify high quality aquatic and riparian terrestrial plant communities, critical fish and wildlife habitats, shore lands critical for protecting water quality and areas of exceptional natural beauty. Portions or all of sensitive areas 1, 2, 4, 6, 7, 8, 9, 10, and 11 have been protected by generous donations from families on Long Lake to land trusts and conservation easements held by land trusts. The vision of the people of Long Lake will protect these critical habitats in perpetuity.

Recommendations included within the "Designation of Sensitive Areas Long Lake, Chippewa County" (WDNR 2002) will assist in developing management decisions and activities to protect critical habitats. The report will assist the Lake District for planning and decision making for lake management or protection projects. WDNR and Chippewa County personnel will use the results for permit decisions regarding shoreline modifications and aquatic plant management. The report will also be used to spur lake stewardship activities and provide a wealth of educational information about important habitats in Long Lake.

Fisheries…

Dramatic changes in the fisheries of Long Lake have occurred since the infestation of the lake by Rusty Crayfish in the 1950's and 1960's. Bluegill and Largemouth Bass levels have declined to where few fish were found in fishery surveys. Today, Walleyes are the most abundant game fish but the fishery also includes Smallmouth Bass, Northern Pike and Muskellunge. Pan fish populations are dominated by Rock Bass followed by Black Crappie. The Bluegill population has increased from 1995 to 2000 and shows great promise for further improvement.

The management of Smallmouth Bass has become the priority management of the fishery to control Rusty Crayfish numbers. Smallmouth Bass have been protected with an 18 inch minimum size limit and a daily bag limit of one fish. Recent research in northern Wisconsin lakes has demonstrated that large Bluegills are effective predators on rusty crayfish (Roth In press). Pan fish populations in Long Lake are protected with a daily bag limit for all pan fish of 10 fish in aggregate. The Walleye population is being managed by a protective slot limit. Walleyes between 14 and 18 inches may not be harvested and only one walleye over 18 inches may be harvested daily. Long Lake is covered by the general statewide health advisory for the consumption of fish.

Aquatic Plants…

The aquatic plant population of Long Lake is a highly valuable component of the lake ecosystem. The aquatic plants are valuable fish and aquatic life habitat, protect shorelines from erosion, protect the lake from the invasion of exotic aquatic plants, and assist in protecting water quality.

The colonization of Long Lake by Rusty Crayfish *(Orconectes rustics)* in the 1960's severely decreased the amount of aquatic plants present in the lake. The changes and condition of the aquatic plant population have been monitored from 1986 to present. Aquatic plant studies have been conducted every three years beginning in 1986 by the Wisconsin Department of Natural Resource as part of the *Long Term Trends Lakes Monitoring Program*. The most recent plant study was completed in 2005 (Konkel 2006). The plant studies found that the aquatic plant population has significantly improved from 1986 to present. The number of species increased from 8 to 25, the maximum rooting depth increased from 3.0 feet in 1986 to 13.0 feet in 2005, and the amount of the shallow water *(littoral zone)* colonized by plants increased from 6.5% to 26.7%. Aquatic plants provide 170 acres of critical habitat in Long Lake.

There has been nearly a 50% decrease in shore land habitat in one decade…

A component of the plant studies includes an assessment of shore land habitat. This assessment documented an alarming loss of shore land habitat in the past decade (1995 – 2005). Natural shoreline cover has decreased from 87% cover to 74% cover in 2005. Aquatic plants along with fallen trees provide critical habitat for fisheries and aquatic life in Long Lake. Conversely, shoreline disturbed by shore land development has increased since 1995 from 13% coverage to 25% coverage in 2005. This is nearly a 100% increase in shore land habitat loss in one decade.

A comparison of the aquatic plant communities adjacent to natural shore lands with aquatic plant communities adjacent to shore lands disturbed by development was conducted. There is a difference in plant communities at the natural shoreline sites and the disturbed shoreline sites. All parameters used to measure the condition of the aquatic plant community indicated a more degraded aquatic plant community associated with developed shore lands (Konkel 2006). Aquatic plant measurements included *Simpson's Diversity Index*, number of species, species richness, amount of habitat, number of sensitive species, average coefficient of conservatism, and floristic quality index (Konkel 2006).

Shoreline disturbed by development has increased from 13% to 25% over the past ten years…

If Long Lake is to be protected for the enjoyment of our future generations it is critical for this plan to develop management actions which when implemented will protect and enhance aquatic plants.

Rusty Crayfish…

The Rusty Crayfish, a native to Illinois, Indiana, Ohio, Kentucky and Tennessee, is an exotic species in Wisconsin. This species of crayfish was likely introduced through its use as fishing bait (Lorman 1980). Plant material makes up a major portion of the Rusty Crayfish diet (Magnuson, et. al. 1975). Since, *Orconectes rusticus* has a higher metabolic rate than other species of crayfish; it can eat twice as much plant biomass as some of the native crayfish

(Gunderson 1995). Crayfish biomass greater than 9g/m^2 can reduce plant biomass by 64% and greater than 140g/m^2 can eliminate all aquatic plants (Miller et. al).

2.7-3.5 grams each to completely eliminate all vegetation in the area in which they occurred.)

Rusty Crayfish in Long Lake would need to be in the size range of only 2.7-3.5 grams each to completely eliminate all vegetation…

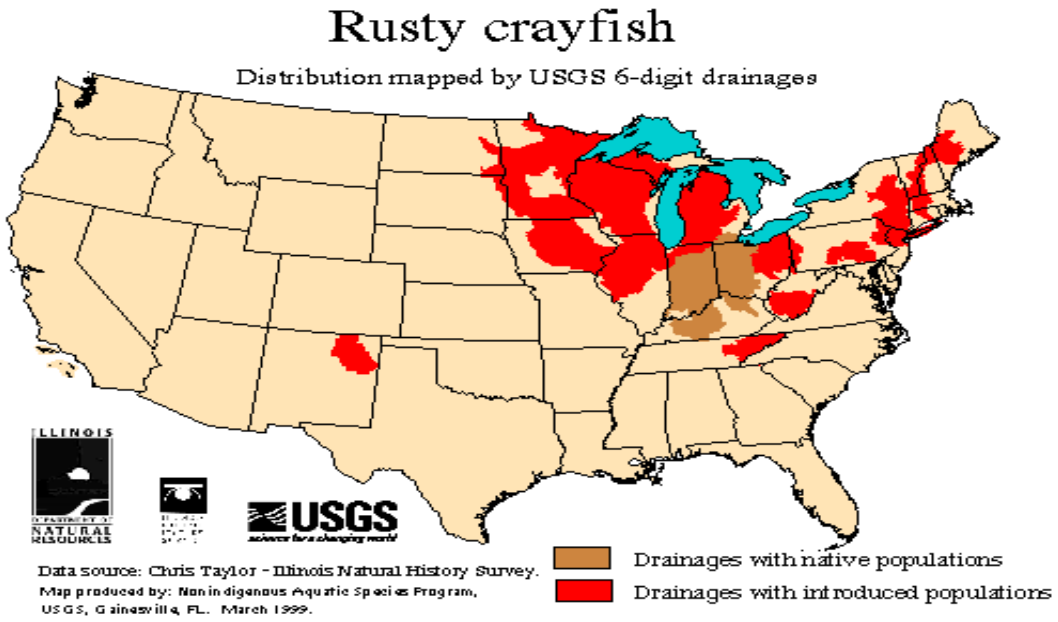
In 1974, a study was sponsored by the National Science Foundation and the Wisconsin Department of Natural Resources to assess the role of crayfish in the decline of aquatic plants. The crayfish study in Long Lake (Magnuson et. al. 1975) indicated:

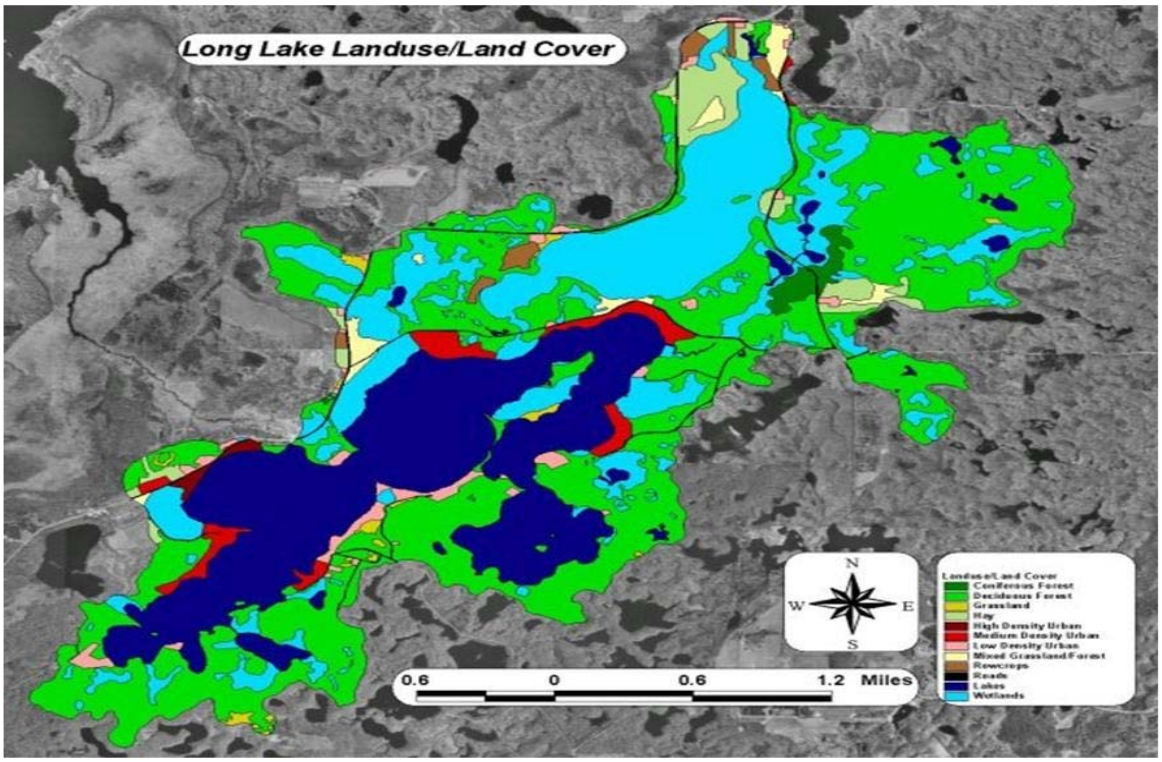
1) Rusty Crayfish density in Long Lake was high, compared to other lakes with rusty crayfish populations.

2) The mean density of Rusty Crayfish in Long Lake was 51 crayfish per meter^2 on rock substrate and 4 crayfish per meter^2 on sand substrate. (Rusty Crayfish in Long Lake would need to be in the size range of only

3) There was an inverse relationship between crayfish abundance and aquatic plant density. Sites in Long Lake with high crayfish densities lacked plants. Areas of the lake in which crayfish were less abundant supported more vegetation (Magnuson et. al. 1975).

The Rusty Crayfish dominated the crayfish community in Long Lake, almost to the total exclusion of native crayfish. The 1974-78 crayfish population in Long Lake was estimated at 5.2 million crayfish, with a yearly production of 6700 kg of crayfish tissue per year (dry weight) (Magnuson et. al. 1975).





Land Use…

There is a common phrase among lake managers - "Lakes are products of their watersheds". Most often the land use of the lands within a watershed will influence the water quality characteristics of the lake. Natural land uses such as forest, grasslands and wetlands deliver natural amounts of storm water runoff and nutrients to lakes. The development of land for residential, commercial, or agricultural purpose significantly increases the amount of storm water runoff and nutrients delivered to lakes. Development increases the amount of storm water runoff by adding *impervious surfaces* (rooftops, sidewalks, and roadways), decreasing the soils ability to infiltrate storm water by compacting soils during construction activity and changing natural drainage by patterns by construction grading or drainage activity. The concentration of nutrients in storm water runoff is increased by increasing the source of nutrients by adding excessive amounts of yard fertilizers, animal manure, agricultural fertilizer, the washing off atmospheric deposition on impervious surfaces, and increased soil erosion from soil disturbance activities.

A watershed land use assessment was conducted for the Long Lake watershed in 2001. The study included a comparison of the land uses in 1938 to present. The most significant land use change from 1938 to present is the increase in the amount of residential development from 44 acres to 188 acres with the majority of this development occurring on the shore lands of Long Lake. The significance of the increased shore land development is that storm water runoff and nutrient inputs were increased causing a decrease in water quality.

The land use information collected in 2001 was used in the lake water quality modeling study to predict existing and potential water quality characteristics in Long Lake.

Conclusion…

The ecological information in this report, as it pertains to the patrons of Lower Long Lake, has been collected for the purpose of information. Staying informed is the only way to help prevent any further damage to our lakes. Understanding how our actions not only effect ourselves, but how they effect others is a valuable asset in the battle to protect our posterity.

Thank you, everyone who has taken the time to read this Lower Long Lake Management Plan for 2007. The simple task of taking the time to read through this compiled data speaks volumes to your dedication to the protection of our natural resources.

Stay up to date with Lower Long Lake current events on the web at: www.lllprd.org or visit the Wisconsin Department of Natural Resources homepage at: www.dnr.state.wi.us

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