

JORDAN LAKE LAKE CLASSIFICATION REPORT



**Presented by Reesa Evans, CLM, Lake Specialist
Adams County Land & Water Conservation Department
P.O. Box 267, Friendship, WI 53934**

MARCH 2008

JORDAN LAKE LAKE CLASSIFICATION REPORT

TABLE OF CONTENTS

Executive Summary	1
Recommendations	8
Introduction	12
Methods of Data Collection	13
Water Quality Computer Modeling	14
Dissemination of Project Deliverables	14
Adams County Information	15
Figure 1: Location Map for Adams County	15
Background Information	16
Figure 2: Location Map for Jordan Lake	16
Figure 3: Archeological Map for Jordan Lake	17
Figure 4: Soil Map of Jordan Watersheds	19
Current Land Use	21
Figure 5: Table of Land Use	21
Figure 6a: Map of Surface Watershed Land Use	22
Figure 6b: Map of Ground Watershed Land Use	23
Figure 7a: Graph of Surface Watershed Land Use	24
Figure 7b: Graph of Ground Watershed Land Use	24
Wetlands	25
Figure 8: Photo of Wetlands at Jordan Lake	25

Shorelands	26
Figure 9: Graph of Shore Types	26
Figure 10: Map of Shorelands on Jordan Lake	27
Figure 11: Graph of Buffer Types	28
Figure 12: Map of Jordan Lake Buffers	29
Figure 13: Example of Inadequate Buffer	30
Figure 14: Example of Adequate Buffer	31
Water Quality	32
Phosphorus	32
Figure 15a: Graph of TP 1992-1996	33
Figure 15b: Graph of TP 1997-2001	33
Figure 15c: Graph of TP 2002-2007	34
Figure 16: Graph of Average Summer TP	34
Figure 17: Sediments in Jordan Lake	35
Figure 18: Table of Current Phosphorus Loading	37
Figure 19: Impact of Changes in Phosphorus Loading	38
Figure 20: In-Lake Impact of P Reduction	39
Figure 21: Photo of a Lake in Algal Bloom	39
Water Clarity	40
Figure 22a: Graph of Secchi Readings 1986-1989	40
Figure 22b: Graph of Secchi Readings 1990-1995	40
Figure 22c: Graph of Secchi Readings 1996-2000	41
Figure 22d: Graph of Secchi Readings 2001-2007	41
Figure 23: Graph of Average Annual Secchi Readings	42
Figure 24: Photo of Using Secchi Disk	42
Chlorophyll-a	43
Figure 25a: Graph of Chlorophyll-a 1992-1999	43
Figure 25b: Graph of Chlorophyll-a 2000-2007	44
Figure 26: Graph of Average Annual Readings	44

Dissolved Oxygen	45
Figure 27: Lake Stratification Layers	45
Figure 28a: Graph of Dissolved Oxygen 2004	46
Figure 28b: Graph of Dissolved Oxygen 2005	47
Figure 28c: Graph of Dissolved Oxygen 2006	48
Water Hardness, Alkalinity and pH	50
Figure 29: Table of Hardness Levels	50
Figure 30: Graph of County Lakes Hardness	50
Figure 31: Table of Acid Rain Sensitivity	51
Figure 32: Graph of County Lake Alkalinity	52
Figure 33: Graph of Average pH v Depth	53
Figure 34: Table of pH Effects on Fish	53
Other Water Quality Testing Results	54
Calcium & Magnesium	54
Chloride	54
Nitrogen	54
Sodium & Potassium	55
Sulfate	55
Turbidity	55
Figure 35: Examples of Turbid Water	55
Hydrologic Budget	56
Figure 36: Depth Map of Jordan Lake	57
Figure 37: Example of Hydrologic Budget	58
Trophic State	59
Figure 38: Trophic Status Table	59
Figure 39: Graph of Jordan Lake TSI Overview	60
Figure 40: Graph of Jordan Lake TSI Scores	60

In-Lake Habitat	61
Aquatic Plants	61
Figure 41: Table of Aquatic Plants 2006	62
Figure 42: Graph of Plant Species in Jordan Lake	64
Figure 43a: Distribution of Emergent Plants Map	64
Figure 43b: Distribution of Floating Plants Map	65
Figure 43c: Distribution of Submergent Plants Map	65
Figure 44: Photos of Most Common Aquatic Plants	66
Aquatic Invasives	67
Figure 45: Distribution Map of Exotics	67
Figure 46: Photos of Exotics Found in Jordan Lake	68
Critical Habitat	69
Figure 47: Map of Critical Habitat Areas	70
Figure 48: Photo of Part of Area JO1	71
Figure 49: Photo of Part of Area JO2	72
Figure 50: Photo of Part of Area JO2	74
Figure 51: Photo Showing Woody Habitat	75
Fishery/Wildlife/Endangered Resources	76
Figure 52: Most Abundant Fish in Jordan Lake	76
Figure 53: Photo of Banded Killifish	76
Resources	77

EXECUTIVE SUMMARY

Background Information about Jordan Lake

Jordan Lake is located in Adams County in south central Wisconsin and is a 215-acre mesotrophic natural seepage lake located in the Town of Jackson, Adams County, in the Central Sands Area of Wisconsin. This lake has no stream inlet or outlet and fed by precipitation, runoff and groundwater. Jordan Lake is part of the Neenah Creek Watershed, a large watershed of 182 square miles from which water flows into the Fox River and eventually into Lake Michigan. Jordan Lake has a public boat ramp owned by Adams County. There is a Native American archeological site located around Jordan Lake that cannot be further disturbed without permission of the federal government and input from the local tribes.

The soils in the ground watershed for Jordan Lake are nearly evenly split between loamy sand and sand, with slopes from very flat up to 25%. The surface watershed, on the other hand, has a much smaller proportion of sand and much larger areas of silt loam and loamy sand.

Land Use in Jordan Lake Watersheds

The surface watershed for Jordan Lake is fairly small. Overall, the two most common current land uses in the Jordan Lake surface watershed are woodlands and non-irrigated agriculture. The ground watershed is somewhat larger. In the ground watershed, woodlands occupy the greatest number of acres, with both irrigated and non-irrigated agriculture also covering larger areas of the ground watershed.

Jordan Lake has a total shoreline 2.8 miles (14,784 feet). Most of the shoreline is in residential or commercial housing. Several buildings are located less than 70 feet from the high water mark. Some of the banks are steep and sandy; some are flatter. Marsh areas are located along some of the shore. There is an undeveloped section of shore on the east end of the lake.

The Adams County Land & Water Conservation Department conducted a survey of the Jordan Lake shoreline in 2004. Shore types were categorized as “armored” and “vegetated”. Only about 28% of Jordan Lake’s shoreline is vegetated with native plants (grasses, forbs, shrubs, trees). Over 42% of the shore was covered with mowed lawn.

The 2004 inventory included classifying areas of the Jordan Lake shorelines as having “adequate” or “inadequate” buffers. An “adequate” buffer was defined as one having the first 35 feet landward covered by native vegetation. An “inadequate” buffer was anything that didn’t meet the definition of “adequate buffer”, including native vegetation strips less than 35 feet landward. Using these definitions, 25.78% (about 3811.5 feet) of Jordan Lake’s shoreline had an “adequate buffer”, leaving 74.22% (10972.5 feet) as “inadequate.” Most of the “inadequate” buffer areas were found with mowed lawns and/or insufficient native vegetation at the shoreline to cover 35 feet landward from the water line.

Adequate buffers on Jordan Lake could be easily installed on most of the lake by either letting the first 35 feet landward from the water just grow without mowing it, except for a path to the water, or by planting native seedlings sufficient to fill in the first 35 feet.

Water Testing Results

Between 2004 and 2006, Adams County Land & Water Conservation Department gathered water chemistry and other water quality information on Jordan Lake. Part of the information was gained from periodic water sampling done by Adams County LWCD. Historic information about water testing on Jordan Lake was also obtained from the Wisconsin Self-Help Monitoring Program records and from the WDNR.

Although there are several forms of phosphorus in water, the total phosphorus (TP) concentration is considered a good indicator of a lake’s nutrient status, since the TP concentration tends to be more stable than other types of phosphorus concentration. For a natural lake like Jordan Lake, a total phosphorus concentration below 20 micrograms/liter tends to prevent nuisance algal blooms. In 2004-2006, Jordan Lake’s growing season (June-September) surface average total phosphorus level was low enough so that phosphorus-related nuisance algal blooms should occur only rarely.

Water clarity is a critical factor for plants. If plants don’t get more than 2% of the surface illumination, they won’t survive. Water clarity is measured with a Secchi disk. Average summer Secchi disk clarity in Jordan Lake in 2004-2006 was 11.19 feet. This is very good water clarity. Records since 1990 show that the water clarity in Jordan Lake has consistently remained high.

Chlorophyll-a concentrations provide a measurement of the amount of algae in a lake’s water. Algae are natural and essential in lakes, but high algal populations can increase water turbidity and reduce light available for plant growth, as well as result in unpleasing odor and appearance. Studies have shown that the amount of chlorophyll a in lake water depends greatly on the amount of algae present; therefore, chlorophyll-a

levels are commonly used as a water quality indicator. The 2004-2006 summer (June-September) average chlorophyll concentration in Jordan Lake was 2.23 micrograms/liter. This low algae concentration places Jordan Lake at the “oligotrophic” level for chlorophyll a results.

Low oxygen during the summer in the bottom waters of a lake occurs naturally as oxygen in the bottom layer is consumed, but not replenished. It is common that as the summer progresses, the oxygen concentration of the bottom waters decreases. In Jordan Lake, there were hypoxic periods in the depths from 30 feet to 50 feet during the summers of 1998, 2000, 2001, 2002, 2004 and 2005. By the end of summer 1998, oxygen concentration at 40 feet depth was only 3.6 mg/l and continued to decrease as depth increased down to .1 mg/l at 70 feet deep. In the summer of 2000, dissolved oxygen levels were 2.8 mg/l at 40 feet; in the summer of 2001, dissolved oxygen levels were down to 3.4 mg/l in 30 feet deep by July and again continued to decrease as the depth increased. Similar patterns were found in 2002, 2004 and 2005. This pattern was not present in other years tested when oxygen levels at all depths were over 5 mg/l (the minimum level for most fish survival).

The surface water of all of the public access lakes in Adams County have water that is moderately hard to very hard, whether they are impoundments (man-made lakes) or natural lakes. In 2005 and 2006, random samples were also taken of wells around Jordan Lake to measure the hardness of the water coming into the lake through groundwater. Hardness in the groundwater ranged from 242 (very hard) to 424 (very hard). Surface water in Jordan Lake has a much lower hardness average of 119.71 mg/l CaCO₃, varying from 112 to 129. The hardness in both surface and groundwater is likely due to the underlying bedrock in Adams County, which is mostly sandstone with pockets of dolomite and shale. Hard water lakes tend to produce more fish and aquatic plants than soft water lakes because they are often located in watersheds with soils that load phosphorus into the lake water. Hardness levels over 180 mg/l can cause marl to start precipitating out of the water or sediment, thus releasing phosphorus for aquatic plant and algae use. But since Jordan Lake’s hardness less is far below that, the marl in the lake is likely to keep binding a significant amount of phosphorus that would otherwise be in the water column.

A lake with a neutral or slightly alkaline pH like Jordan Lake is a good lake for fish and plant survival. Natural rainfall in Wisconsin averages a pH of 5.6. This means that if the rain falls on a lake without sufficient alkalinity to buffer that acid water coming in by rainfall, the lake’s fish cannot reproduce. That is not a problem at Jordan Lake.

Other water quality testing at Jordan Lake showed no particular areas of concern. The average calcium level in Jordan Lake's water during the testing period was 38.65 mg/l. The average Magnesium level was 40.58 mg/l. Both of these are relatively low-level readings. The presence of a significant amount of chloride over a period of time may indicate that there are negative human impacts on the water quality present from septic system failure, the presence of fertilizer and/or waste, deposition of road-salt, and other nutrients. However, chloride levels found in Jordan Lake during the testing period were average 2.11 mg/l, just under the estimated natural level of chloride in this area of Wisconsin of 3 mg/l. Nitrogen levels can affect other aspects of water quality. The sum of water testing results for nitrate, nitrite and ammonium levels of over .3 mg/l in the spring can be used to project the likelihood of an algal bloom in the summer (assuming sufficient phosphorus is also present). Jordan Lake combination spring levels from 2004 to 2006 were .37, just above the .3 mg/l predictive level.

Both sodium and potassium levels in Jordan Lake are very low: the average sodium level was 2.56 mg/l; the average potassium reading was 1.56 mg/l. To prevent the formation of the gas hydrogen sulfate, levels of 10 mg/l are best. A health advisory kicks in at 30 mg/l. Jordan Lake sulfate levels average 2.56 mg/l during the testing period, far below either level. Turbidity reflects water clarity. The term refers to suspended solids in the water column—solids that may include clay, silt, sand, plankton, waste, sewage and other pollutants. Very turbid waters may not only smell and mask bacteria & other pollutants, but also tend to be aesthetically displeasing, thus curtailing recreational uses of the water. Turbidity levels for Jordan Lake's waters were all at low levels.

Phosphorus

Like most lakes in Wisconsin, Jordan Lake is a phosphorus-limited lake: of the pollutants that end up in the lake, the one that most affects the overall quality of the lake water is phosphorus. The amount of phosphorus especially affects the frequency and density of aquatic vegetation and the frequency and density of various kinds of algae, as well as water clarity and other quality aspects.

The total phosphorus (TP) concentration in a lake is considered a good indicator of a lake's nutrient status, since the TP concentration tends to be more stable than other types of phosphorus concentration. For a natural lake like Jordan Lake, a total phosphorus concentration below 25 micrograms/liter tends to prevent nuisance algal blooms. Jordan Lake's growing season (June-September) surface average total phosphorus level of 15 micrograms/liter is low enough so that nuisance algal blooms should occur only rarely and may be relatively localized.

In most lakes in Wisconsin, phosphorus concentration in the bottom sediments of the lake is considerably higher than the concentration in the water column itself. Bottom sediments can “bind up” phosphorus, making it unavailable for aquatic plants or algae to use. Some sediment types hold phosphorus at a higher rate than others. Jordan Lake does have some marl in its sediments. “Marl” is a calcium carbonate precipitate (solid) that forms in hard water lakes when both calcium and pH levels are high and has a high capacity to immobilize phosphorus and other nutrients. With such an amount of marl sediment, Jordan Lake may benefit from it removing phosphorus from water column, thus making it unavailable for algal and aquatic plant growth.

A review of historical data before the most recent aquatic plant survey suggested that nutrients in Jordan Lake have increased over the years. Testing for phosphorus in the lower depths of Jordan Lake suggests that the lower water depths may be accumulating phosphorus, added to that accumulating in the sediments. This situation should be monitored.

Land use plays a major role in phosphorus loading. A key component of the computer models used is the phosphorus budget, that is, the estimated amount of phosphorus delivered to the lake from each land use type annually. Using the current land use data, as well as phosphorus readings from 2004 through 2006 water sampling, a phosphorus loading prediction model was run for Jordan Lake. The land uses that contribute the most phosphorus are non-irrigated agriculture and residences.

Some phosphorus deposition cannot be controlled by humans. However, some phosphorus (and other nutrient) input can be decreased or increased by changes in human land use patterns. Practices such as shoreland buffer restoration; infiltrating stormwater runoff from roof tops, driveways and other impervious surfaces; using no phosphorus lawn fertilizers; and reducing phosphorus input to and properly managing septic systems will minimize phosphorus inputs into the lake.

Reducing the amount of input from the surface and ground watersheds results in less nutrient loading into the lake itself. Figure 20 graphs the changes there would be if those levels had been reduced by 10% and 25%. A 10% reduction would have meant from .7 to 1.8 fewer micrograms/liter of phosphorus in the lake. Reducing the in-lake phosphorus by 25% would result in 1.7 to 4.6 fewer micrograms/liter of phosphorus. These predictions make it clear that reducing current phosphorus inputs to the lake are essential to improve, maintain and protect Jordan Lake’s health for future generations.

Aquatic Plant Community

The aquatic plant community of Jordan Lake is characterized by high quality and very good species diversity. The plant community suggests that Jordan Lake is closer to an undisturbed condition than the average lake in the state. In the North Central Hardwoods Region, Jordan Lake is in the group of lakes closest to an undisturbed condition.

Aquatic plants cover 97.8% of the littoral zone to a maximum rooting depth of 19 feet. The 0 to 1.5 foot depth zone supported the most abundant aquatic plant growth. The Jordan Lake aquatic plant community is characterized by high quality and very good species diversity. The plant community has a below average sensitivity to disturbance and is closer to an undisturbed condition than the average lake in the state.

Chara spp (muskgrass), a plant-like algae, was the most common and most dense species found during the aquatic plant survey. Second in frequency was *Najas flexilis* (bushy pondweed). *Chara* spp was also the dominant species. *Najas flexilis* was sub-dominant. Three invasive aquatic plants were found: *Myriophyllum spicatum* (Eurasian watermilfoil, a submergent), *Phalaris arundinacea* (reed canarygrass, an emergent), and *Potamogeton crispus* (curly-leaf pondweed, a submergent). Of the invasives, Eurasian watermilfoil was the most commonly occurring species and was found in all four depth zones. The lake historically has used chemical spot treatments to manage the Eurasian watermilfoil. In addition, a survey in 2007 indicated that the native weevil, *Euhrychiopsis lecontei*, was present in parts of Jordan Lake. This weevil, if present in sufficient density, can weaken Eurasian milfoil plants to the point of death.

Critical Habitat Areas

Wisconsin Rule 107.05(3)(i)(I) defines a “critical habitat areas” as: “areas of aquatic vegetation identified by the department as offering critical or unique fish & wildlife habitat or offering water quality or erosion control benefits to the body of water. Thus, these sites are essential to support the wildlife and fish communities. They also provide mechanisms for protecting water quality within the lake, often containing high-quality plant beds. Finally, critical habitat areas often can provide the peace, serenity and beauty that draw many people to lakes. Two areas on Jordan Lake were determined by a team of lake professionals to be appropriate for critical habitat designation.

JO1 extends along approximately 2600 feet of the shoreline along the north side of the lake, extending up to the ordinary high water mark. 6% of the shore is wooded; 20% is native herbaceous cover. The balance of the shore is bare sand, cultivated lawn and hard structure. There is a shallow marsh area along this shoreline. Large woody cover is present for habitat. Maximum rooting depth of aquatic vegetation in JO1 was 19 feet. Seven types of emergent aquatic plants were found in this area. Emergents provide important fish habitat and spawning areas, as well as food and cover for wildlife. One free-floating and three floating-leaf rooted species were present here. Floating-leaf vegetation provides cover and dampens waves, protecting the shore. Eighteen emergent species of aquatic species were also found here. Such a diverse submergent community provides many benefits. Filamentous algae were present at this site, but not abundant.

One exotic invasive plant, *Myriophyllum spicatum*, was found in this area. Most of the aquatic vegetation in this area has multiple uses for fish and wildlife. This area of all three plant structures provides a lot of habitat diversity.

JO2 extends along approximately 1800 feet of the shoreline on the far east end of the lake, up to the ordinary high water mark. Average water depth here is about 15', with a steep dropoff. 11% of the shore is wooded; 6% has shrubs; 23% is native herbaceous cover. The remaining shore is bare sand, cultivated lawn and hard structures, which tend to be concentrated at the edges of this area. The middle area is almost entirely undeveloped and contains some shallow marsh. Large woody cover is present for habitat. With minimal human disturbance along this shoreline, the area has natural scenic beauty. Shore development present in JO2 was confined to the ends.

Maximum rooting depth in JO2 was 19 feet. No threatened or endangered species were found in this area. Two exotic invasives, *Myriophyllum spicatum* (Eurasian watermilfoil) and *Potamogeton crispus* (Curly-Leaf Pondweed), were found in this area. Filamentous algae were present, but not common. Five emergent species were present here. One free-floating plant was found at this site. Two floating-leaf rooted plants were present. Fifteen submergent aquatic plant species were also found here.

Most of these plants are used by wildlife and fish for multiple purposes. Because this site provides all three structural types of vegetation, the community has a diversity of structure and species that supports even more diversity of fish and wildlife.

Fish/Wildlife/Endangered Resources

WDNR fish stocking records for Jordan Lake extend back to 1933, when 308 black bass were stocked. Fish were stocked by that agency most years since then, through 2002. Other fish that were stocked included walleye, perch, smallmouth bass, largemouth bass, northern pike and brown & rainbow trout. The most recent shocking inventory, in October 2006, found bluegills were abundant. Prior inventories have shown the presence of bullheads, ciscos, pumpkinseeds, crappie, suckers and shiners, in addition to the fish type stocked. An endangered species, *Fundulus diaphanus* (Banded Killifish), was found in the lake previously. No other endangered resources in the Jordan Lake watersheds have been identified.

Muskrat and mink are also known to use Jordan Lake for cover, reproduction and feeding. Seen during the field surveys were various types of waterfowl, songbirds, and turkey. Frogs and salamanders are known to use this area for shelter/cover, nesting and feeding. Turtles and snakes also use this area for cover or shelter in this area, as well as nested and fed in this area. Upland wildlife feed and nest here as well.

Conclusion

Jordan Lake is currently a fairly healthy, well-managed lake with many positive aspects, as discussed in this report. The main focus of continued management should include shoreland restoration, integrated management of invasive species, reduction of human-impacts on phosphorus loading, well-managed land use and continued monitoring for water quality and invasive species. Installation of riparian buffers should be a priority. Care should be taken to maintain the overall excellent quality of the lake and its surroundings.

The recommendations on the following pages should help in these aims.

RECOMMENDATIONS

Lake Management Plan

The Jordan Lake District should continue to work on its management plan to be sure the following issues are covered fully: aquatic plant management; control/management of invasive species; wildlife and fishery management; watershed management; shoreland protection; critical habitat protection; water quality protection.

Watershed Recommendations

Results of the computer modeling and water testing suggest input of nutrients, especially phosphorus, are a factor that needs to be explored for Jordan Lake.

Therefore, it is recommended both the surface and ground watersheds be inventoried, documenting any of the following: runoff from any livestock operations that may be entering the surface water; soil erosion sites; agricultural producers not complying with nutrient management plans and/or irrigation water management plans.

If such sites are documented, steps for dealing with these issues can be incorporated into the lake management plan to be completed by the end of 2008.

Shoreland Recommendations

All lake residents should practice best management on their lake properties, including keeping septic systems cleaned and in proper condition, eliminating the use of lawn fertilizers, cleaning up pet wastes and not composting near the water.

Aquatic Plants/Invasives Recommendations

- 1) Residents should continue involvement in the Citizen Lake Water Monitoring Program, Invasive Species Monitoring and Clean Boats, Clean Waters. This will allow not only noting changes in the Eurasian Watermilfoil pattern, but also the other two invasive species known to occur there and any new ones that might be found. Noting the presence and density of these plants early is the best way to take preventive action to keep them from becoming a bigger problem.

- 2) Lake residents should protect and restore natural shoreline around Jordan Lake. Studies have shown that there is lower frequency and density of the most sensitive plant species in the disturbed shorelines. Disturbed shoreline sites support an aquatic plant community that has been less able to resist invasions of exotic species and shows impacts from nutrient enrichment. The Lake Management Plan includes installing some shoreland restoration demonstration sites—that recommendation should be followed.
- 3) All lake users should protect the aquatic plant community in Jordan Lake.
- 4) The Jordan Lake District should maintain exotic species signs at the boat landings and contact DNR if the signs are missing or damaged.
- 5) The Jordan Lake District should continue monitoring and control of Eurasian Watermilfoil to maintain the most effective methods and modify if necessary. Early-season treatments with a specific chemical should be continued as long as it remains effective. The Lake District may need to investigate ways to increase treatment effectiveness in the deeper water. Residents should hand-pull scattered EWM plants. Other invasives known to be present should also be monitored.
- 6) Consideration should be given to propagating the native weevil that attacks Eurasian Watermilfoil to assist in EWM management.

Critical Habitat Recommendations

There are also several recommendations appropriate for the critical habitat areas.

- (1) Maintain current habitat for fish and wildlife.
- (2) Do not remove fallen trees along the shoreline nor logs in the water.
- (3) No alteration of littoral zone unless to improve spawning habitat.
- (4) Seasonal protection of spawning habitat.
- (5) Maintain snag/cavity trees for nesting.
- (6) Maintain or increase wildlife corridor.
- (7) Maintain sedge meadow and deep marsh areas.
- (8) Maintain no-wake zone.
- (9) Protect emergent vegetation for habitat and shoreline protection.
- (10) Removal of submergent vegetation for navigation purposes only.
- (11) Seasonal control of Eurasian Watermilfoil and other invasives by using control methods specific for exotics.

- (12) Minimize aquatic plant and shore plant removal to maximum 30' wide access/viewing corridor. Leave as much vegetation as possible to protect water quality and habitat.
- (13) Use forestry best management practices.
- (14) No use of lawn products.
- (15) No bank grading or grading of adjacent land.
- (16) No pier construction or other activity except by permit using a case-by-case evaluation.
- (17) No installation of pea gravel or sand blankets.
- (18) No bank restoration unless the erosion index scores moderate or high.
- (19) If the erosion index does score moderate or high, bank restoration only using biologs or similar bioengineering, with no use of riprap or retaining walls.
- (20) Placement of swimming rafts or other recreational floating devices only by permit.
- (21) Maintain buffer of shoreline vegetation.
- (22) Maintain aquatic vegetation in undisturbed condition for wildlife habitat, fish use and water quality protection.
- (23) Post landing with exotic species alert and educational signs to prevent introduction and/or spread of exotic species.
- (24) Make critical habitat areas no-wake zones.

LAKE CLASSIFICATION REPORT FOR JORDAN LAKE, ADAMS COUNTY

INTRODUCTION

In 2003, The Adams County Land & Water Conservation Department (Adams County LWCD) determined that a significant amount of natural resource data needed to be collected on the lakes with public access in order to provide it and the public with information necessary to manage the lakes in a manner that would preserve or improve water quality and keep it appropriate for public use. In some instances, there was significant historical data about a particular lake; in that instance, the study activities concentrated on combining and updating information. In other instances, there was no information on a lake, so study activities concentrating on gathering data about that lake. Further, it was discovered that information was scattered among various citizens, so often what information was actually available regarding a particular lake was unknown. To assist in updating some information and gathering baseline information, plus centralize the data collected, so the public may access it. The Adams County LWCD received a series of grants from the Wisconsin Department of Natural Resources (WDNR) from the Lake Classification Grant Program.

Objectives of the study were:

- collect physical data on the named lakes to assist in assessing the health of Adams County lake ecosystems and in classifying the water quality of the lakes.
- collect chemical and biological data on the named lakes to assist in assessing the health of Adams County lake ecosystems and in classifying the water quality of the lakes.
- develop a library of lake information that is centrally located and accessible to the public and to City, County, State and Federal agencies.
- make specific recommendations for actions and strategies for the protection, preservation and management of the lakes and their watersheds.
- create a baseline for future lake water quality monitoring.
- Provide technical information for the development of comprehensive lake management plans for each lake
- provide a basis for the water quality component of the Adams County Land and Water Resource Management Plan. Components of the plan will be incorporated into Adams County's "Smart Growth Plan".
- develop and implement educational programs and materials to inform and education lake area property owners and lake users in Adams County.

METHODS OF DATA COLLECTION

To collect the physical data, the following methods were used:

- delineation & mapping of ground & surface watersheds using topographic maps, ground truthing and computer modeling;
- identification of flow patterns for both the surface & ground watersheds using known flow maps and topographic maps;
- inventory & mapping of current land use with orthographic photos and collected county information;
- inventory & mapping of shoreline erosion and buffers using county parcel maps and visual observation;
- inventory & mapping for historical and cultural sites using information from the local historical society and the Wisconsin Historical Society;
- identification & mapping of critical habitat areas with WDNR and Adams County LWCD staff;
- identification & mapping of endangered or threatened natural resources (including natural communities, plant & animal species) using information from the Natural Heritage Inventory of Wisconsin;
- identification & mapping of wetland areas using WDNR and Natural Resource Conservation Service wetland maps;
- preparation of soil maps for each of the lake watersheds using soil survey data from the Natural Resource Conservation Service.

To collect water quality information, different methods were used:

- for three years, lakes were sampled during late winter, at spring and fall turnover, and several times during the summer for various parameters of water quality, including dissolved oxygen, relevant to fish survival and total phosphorus, related to aquatic plant and algae growth;
- random samples from wells in each lake watershed were taken in two years and tested for several factors;
- aquatic plant surveys were done on all 20 lakes and reports prepared, including identification of exotics, identifying existing aquatic plant community, evaluation of community measures, mapping of plant distribution, and recommendations;
- all lakes were evaluated for critical habitat areas, with reports and recommendations being made to the respective lakes and the WDNR;
- lake water quality modeling was done using data collected, as well as historical data where it was available.

WATER QUALITY COMPUTER MODELING

Wisconsin developed a computer modeling program called WiLMS (Wisconsin Lake Modeling Suite) to assist in determining the amount of phosphorus being loaded annually into a lake, as well as the probable source of that phosphorus. This suite has many models, including Lake Total Phosphorus Prediction, Lake Eutrophic Analysis Procedure, Expanded Trophic Response, Summary Trophic Response, Internal Load Estimator, Prediction & Uncertainty Analysis, and Water & Nutrient Outflow. The models that various types of data inputs: known water chemistry; surface area of lake; mean depth of lake; volume of lake; land use types & acreage. This information is then used in the various models to determine the hydrologic budget, estimated residence time, flushing rate, and other parameters.

Using the data collected over the course of the studies, various models were run under the WiLMS Suite. These water quality models are computer-based mathematical models that simulate lake water quality and watershed runoff conditions. They are meant to be a tool to assist in predicting changes in water quality when watershed management activities are simulated. For example, a model might estimate how much water quality improvement would occur if watershed sources of phosphorus inputs were reduced. However, it should be understood that these models predict only a relative response, not an exact response. Modeling results will be incorporated into topic discussions as appropriate.

DISSEMINATION OF PROJECT DELIVERABLES

The results of this study will be distributed various agencies, organizations and the public as previously described. Based on the classification information, the Adams County Land and Water Conservation Department will identify assistance requests and determine the appropriate future activities, based on the classification determinations. To provide the requested assistance, Adams County Land and Water Conservation Department will incorporate the lake management plans goals, priorities and action items into its Annual Plan of Operations. Goals, priorities and action items may include educational programs, formation of lake districts, further development of lake management plans and implementation of lake management plans.

ADAMS COUNTY INFORMATION

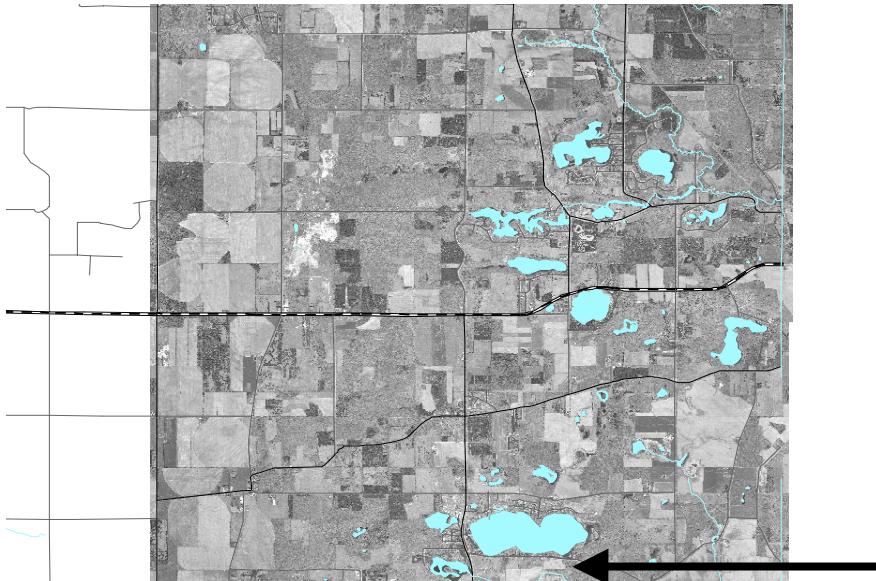
Adams County lies in south central Wisconsin, shaped roughly like the outline of Illinois. Adams County is a small rural county with a full-time population of about 20,000. Between 1980 and 2000, Adams County's population grew by more than 20%, with most of the population increase being located upon the lakes and streams. The population increase has resulted in a greater need for facilitation, technical assistance and education, including information on the lakes and streams.



**Figure 1:
Adams
County
Location in
Wisconsin**

JORDAN LAKE BACKGROUND INFORMATION

Jordan Lake is a 215-acre natural seepage lake located in the Town of Jackson, Adams County, in the Central Sands Area of Wisconsin. A “seepage lake” is a natural lake with no stream inlet or outlet and fed by precipitation, runoff and groundwater. It is one of many lakes in the Town of Jackson, most of which are seepage lakes similar to Jordan Lake (see arrow below pointing to location in the Town of Jackson). There is a public boat launch on the north side of the lake and several condominium and resort developments on the shores. The east end of the lake is largely undeveloped.



**Figure 2:
JORDAN
LAKE
location**

Jordan Lake is part of the Neenah Creek Watershed, a large watershed of 182 square miles from which water flows into the Fox River and eventually into Lake Michigan. The Central Sand Hills, which contain Jordan Lake, are an ecological landscape (a recessional moraine) on the eastern edge of what was Glacial Lake Wisconsin. The area is characterized by glacial moraines and glacial outwash, as well as the kettle holes that formed natural lakes—such as Jordan Lake. Elevations average between 900 to 1000 feet above sea level. There is a lake management plan for the Jordan Lake District before the WDNR for final review and potential approval.

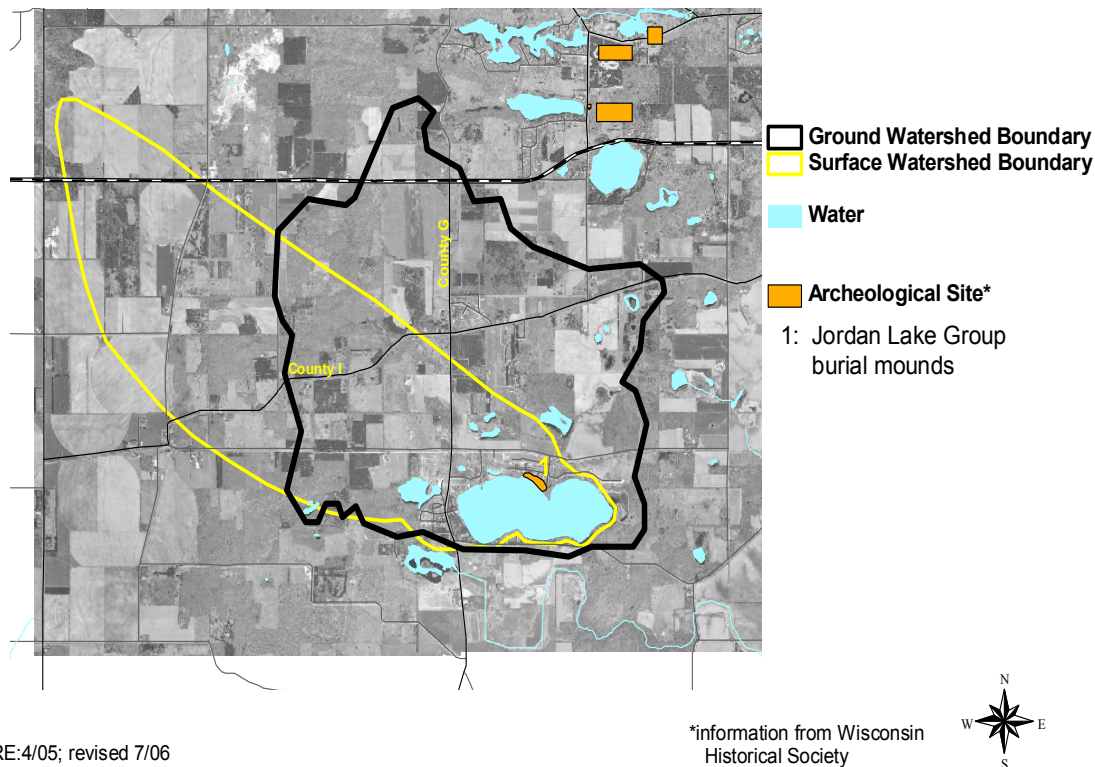
The landowners around Jordan Lake have expressed concern about safety on the lake. In the past few years, traffic on the lake has increased dramatically. During the summer, one may find pontoon boats, speed boats, jet skiers, water skiers and boats towing tubes full of people—mostly ignoring the boating rules such as leaving 100 feet between crafts and staying 200 feet out from the shore. Methods of dealing with these issues have been incorporated into the lake management plan.

Archeological Sites

There are many Native American archeological sites in Adams County, with one located on the middle north shore of Jordan Lake. Under the federal act on Native American burials, this site cannot be further disturbed without permission of the federal government and input from the local tribes.

Figure 3: Jordan Lake Archeological Sites

Jordan Lake Archeological Site



Bedrock and Historical Vegetation

Bedrock around Jordan Lake is mostly sandstone, with pockets of dolomite and shale, formed in the Cambrian Period of Geology (542 to 488 millions years ago). Bedrock is generally 50' to 100' down from the land surface. The water table in most areas around Jordan Lake is fairly near the surface.

Original upland vegetation of the area around Jordan Lake included oak-forest, oak savanna, pine barrens and tallgrass prairie. Wetland areas were also common, including wet-mesic prairies, wet prairie, coastal plain marshes and fen. Hills and kettles created by glacial deposits make up the southeast area of Adams County, where Jordan Lake is located.

Soils in the Jordan Lake Watersheds

Except for some pockets of aquents, sandy loam and silt loam, the soils in the ground watershed for Jordan Lake are nearly evenly split between loamy sand and sand, with slopes from very flat up to 25% (see Figure 4). The surface watershed, on the other hand, has a much smaller proportion of sand and much larger areas of silt loam and loamy sand.

Sandy soil tends to be excessively drained, no matter what the slope. Water, air and nutrients move through sandy soils at a rapid rate, so that little runoff occurs unless the soil becomes saturated. Although water erosion can be a problem, wind erosion may be more of a hazard with sandy soils, especially since they dry out so quickly. There are also draught hazards with sandy soils. Getting vegetation started in sandy soils is often difficult due to the low available water capacity, as well as low natural fertility and organic material. Onsite waste disposal in sandy soils is also a problem because of slope and seepage; mound systems are usually required.

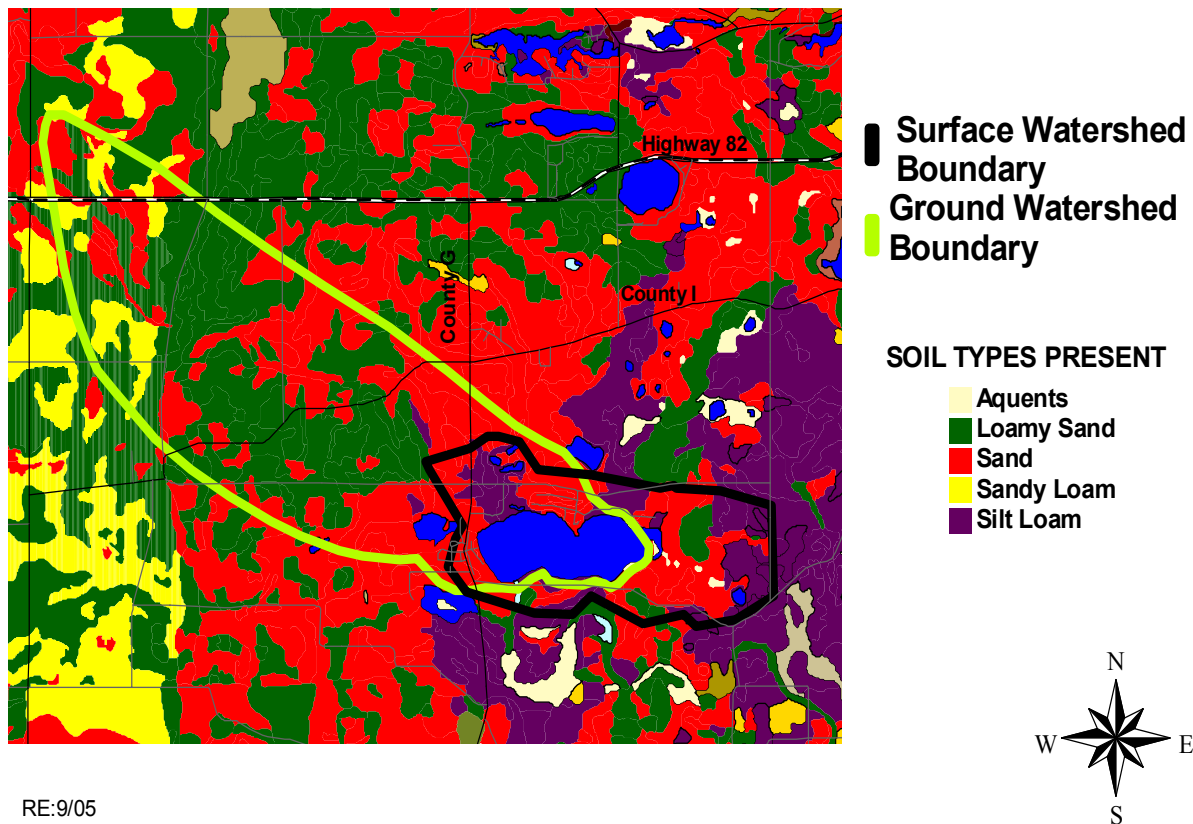
Loamy sands tend to be well-drained, with water, air and nutrients moving through them at a rapid rate. Runoff, when it occurs, tends to be slow. Loamy sands have little water-holding capacity and low natural fertility, although they usually have more organic matter present than do sandy soils. Both wind and water erosion are potential hazards with loamy sands, as is draught. The same difficulties with waste disposal and vegetation establishment are present with loamy sands as with sandy soils.

Silt loams are usually well-drained, although there may be pockets of poorly-drained areas. Water and air move through these soils at a slow to moderately slow rate, with runoff being slow or medium. The available water capacity is moderate. Both natural fertility and organic matter content are medium. Heavy rains or other activities that compact silt loam soils may result in restriction of roots by hardpans formed due to the

compaction. These soils tend to be unsuitable for building site development and onsite waste disposal.

The soil and soil slopes around lakes and streams are very important to water quality. They affect amount of infiltration of surface precipitation into the ground and the amount of contaminants that may reach the groundwater, as well as the amount of surface stormwater runoff. In addition, these two factors affect the amount and content of pollutants and particles (including soil) that may wash into a water body, affecting its water quality, its aquatic plant community and its fishery. Further, soil types and soil slopes help determine the appropriate private sewage system and other engineering practices for a particular site, since they affect absorption, filtration and infiltration of contamination from engineering practices.

Figure 4: Jordan Lake Watersheds



Jordan Lake Levels

For the past several years, discussion has occurred about the current water level of Jordan Lake, which is considerably higher than it was thirty years ago. People have reported having to move their docks several times to keep them out of the water. Others have reported that a former outlet was blocked by road installation and development of the shore.

In 1996, several investigations were done in the area where it was reported there was once an outlet. A water elevation survey was performed in June 1996. The Natural Resource Conservation Service did a soil survey in July 1996 and reported that the soils provided no evidence of historic alluvium to support the idea that the area had regularly been a surface overflow area in the last 100 years. They indicated that there might have been occasional short-term overflow, but nothing that occurred regularly enough for evidence to be found in the soil. Other issues were investigated by the WDNR and Army Corps of Engineers.

A meeting was held in July 1996 that included the Army Corps of Engineers, the WDNR, Adams County Planning & Zoning and Adams County Land & Water Conservation Department. It was determined that the water level fluctuations in Jordan Lake were likely to be part of the lake's natural cycle, which was probably long by human years. Discussion was had at that meeting about constructing an outlet, but it was ultimately decided that doing so would disturb a currently-stable ecosystem. Specific issues of concern included: (1) an outlet would discharge into Widow Green Creek, which is a trout water fishery, creating the risk of thermal warming sufficient to harm the trout; (2) additional water through the area would increase the creek bank erosion and siltation; (3) there would be a negative impact on already declining wetlands around Jordan Lake; (4) installation of such an outlet would cause the fish and wildlife habitat at the end of the lake to be lost.

CURRENT LAND USE

The surface watershed for Jordan Lake is fairly small; the ground watershed is considerably bigger. Overall, the two most common current land uses in the Jordan Lake surface watershed are woodlands and non-irrigated agriculture. (See Figures 5, 6a, 6b & 7). In the ground watershed, woodlands occupy the greatest number of acres, with both irrigated and non-irrigated agriculture also covering larger areas of the ground watershed.

Figure 5: Jordan Lake Watersheds Land Use in Acres and Percent of Total

	Surface		Ground		Total	
Jordan Lake	Acres	% of Total	Acres	% of Total	Acres	% of Total
Agriculture--Non Irrigated	1068.03	23.84%	641.9	24.65%	1709.93	24.14%
Agriculture--Irrigated	417.54	9.32%	539.71	20.73%	957.25	13.51%
Grassland/Pasture	110.66	2.47%	60.67	2.33%	171.33	2.42%
Residential	638.4	14.25%	432.27	16.60%	1070.67	15.11%
Water	384.38	8.58%	44.52	1.71%	428.90	6.05%
Woodland	1861.44	41.54%	884.98	33.98%	2746.42	38.77%
total	4480.45	100.00%	2604.05	100.00%	7084.50	100.00%

Studies have shown that land use around a lake has a great impact on the water quality of that lake, especially in the amount and content of surface runoff. (James, T., 1992, I-10; Kibler, D.F., ed. 1982. 271) For example, while natural woodland may (on the average) absorb 3.5” out of a 4” rainfall, leaving only .5” as runoff, a residential area with quarter-acre lots may absorb only 2.3” of the 4”, leaving 1.7” to run off the land into the lake—the same amount as may be expected to run off from a corn or soybean field. 1.7” of runoff translates into 46,200 gallons per acre ending up in the lake! Percentage of impervious surface, the soil type, vegetation present and slope of the site can all affect runoff volume. (Frankenberger, J, ID-230).

Figure 6a: Land Use in Jordan Lake Surface Watershed

Land Use--Jordan Lake Surface Watershed

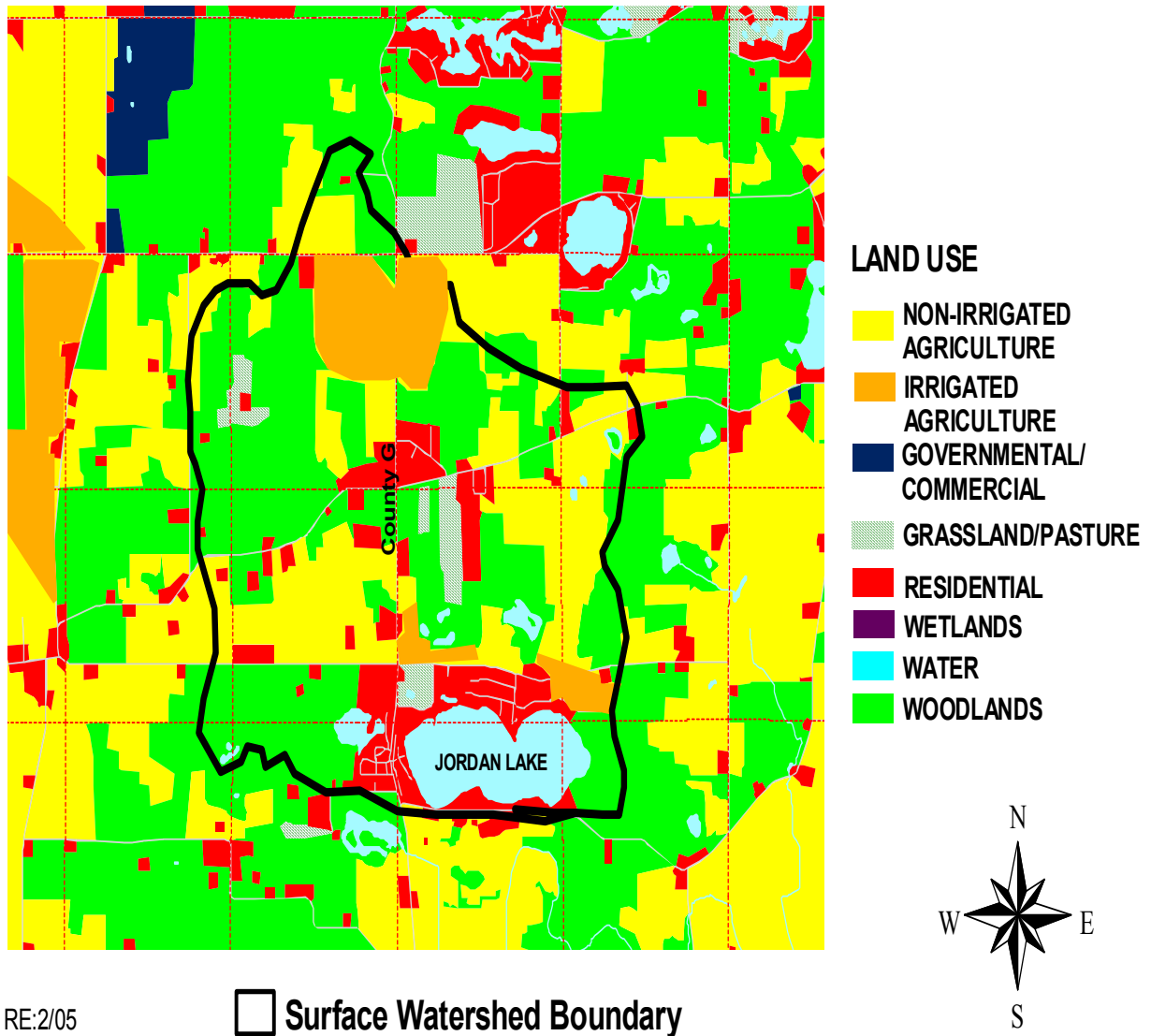
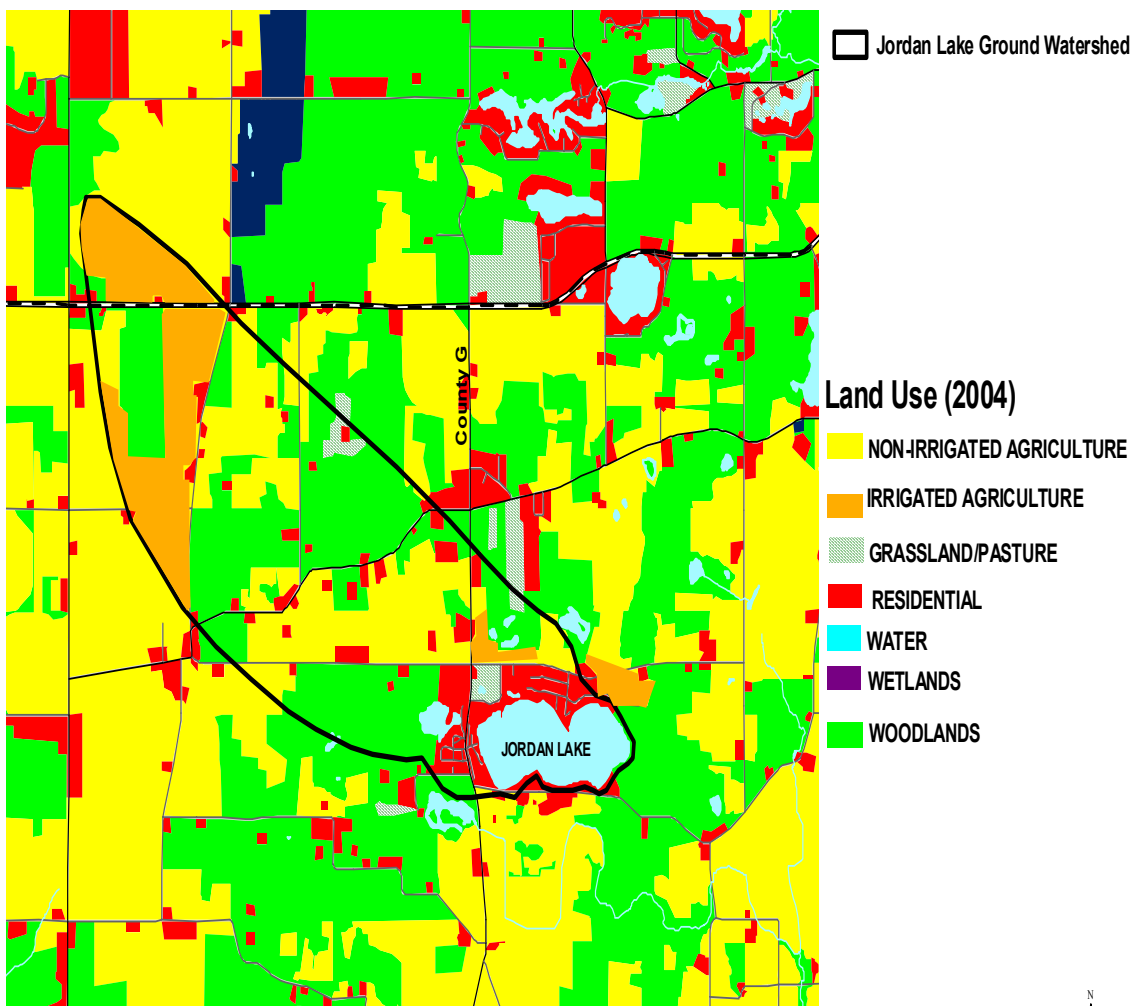


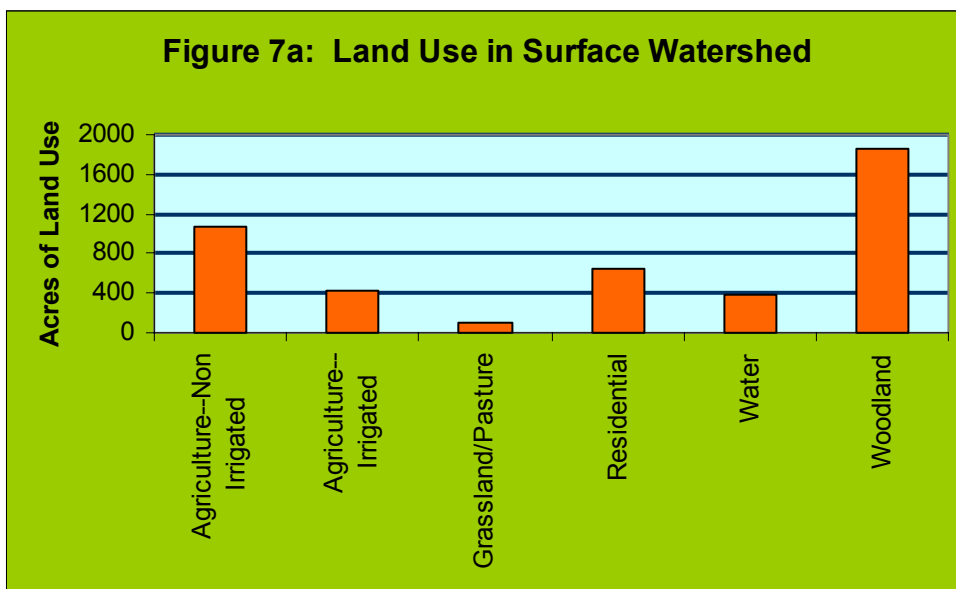
Figure 6b: Land Use in Jordan Lake Ground Watershed

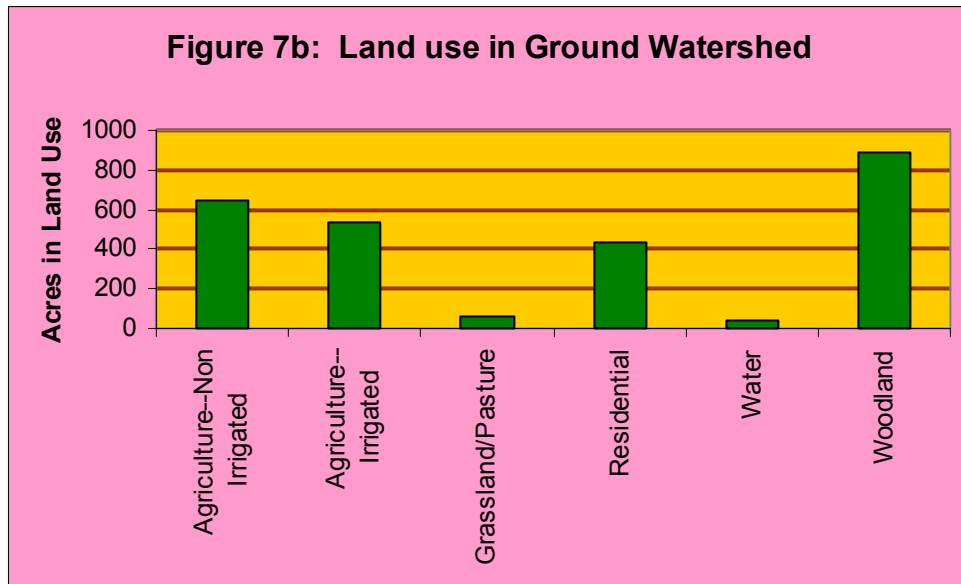
JORDAN LAKE GROUND WATERSHED LAND USE



RE:2/05

When water runs over a surface, it picks up whatever loose pollutants—sediment, chemicals, metals, exhaust gas, etc—are present on that surface and takes those items with it into the lake. Increased development around a lake tends to increase the amount of pollutants being carried into the lake, thus negatively affecting water quality. Residential development areas with lots of one-quarter acre or less may deliver as much as 2.5 pounds of phosphorus per year to the lake for each acre of development.





There are two specific kinds of land use—wetlands and shorelands--that are so important to water quality that it will be separately discussed.

WETLANDS

A number of wetlands are located directly around the Jordan Lake shore, but do not show up clearly on the land use maps. Most of the shore wetlands at Jordan Lake are dominated by bulrushes. In the past, wetlands were seen as “wasted land” that only encouraged disease-transmitting insects. Many wetlands were drained and filled in for cropping, pasturing, or even residential development. In the last few decades, however, the importance of wetlands has become evident, even as wetlands continue to decline in acreage.

Wetlands play an important role in maintaining water quality by trapping many pollutants in runoff and flood waters, thus often helping keep clean the water they connect to. They serve as buffers to catch and control what would otherwise be uncontrolled water and pollutants. Wetlands also play an essential role in the aquatic food chain (thus affecting fishery and water recreation), as well as serving as spaces for wildlife habitat, wildlife reproduction and nesting, and wildlife food. It is essential to preserve these shore wetlands for the health of Jordan Lake.

Figure 8: Jordan Lake shore wetland



SHORELANDS

Jordan Lake has a total shoreline 2.8 miles (14,784 feet). Most of the shoreline is in residential or commercial housing. Several buildings are located less than 70 feet from the high water mark. Some of the banks are steep and sandy; some are flatter. Marsh areas are located along some of the shore. There is an undeveloped section of shore on the east end of the lake.

The Adams County Shoreline Ordinance defines 1000' landward from the ordinary high water mark as "shoreland". The Adams County Land & Water Conservation Department conducted a survey of the Jordan Lake shoreline in 2004. Shore types were categorized as "armored" and "vegetated". Only about 28% of Jordan Lake's shoreline is vegetated with native plants (grasses, forbs, shrubs, trees). Over 42% of the shore was covered with mowed lawn.

Figure 9: Jordan Lake Shore

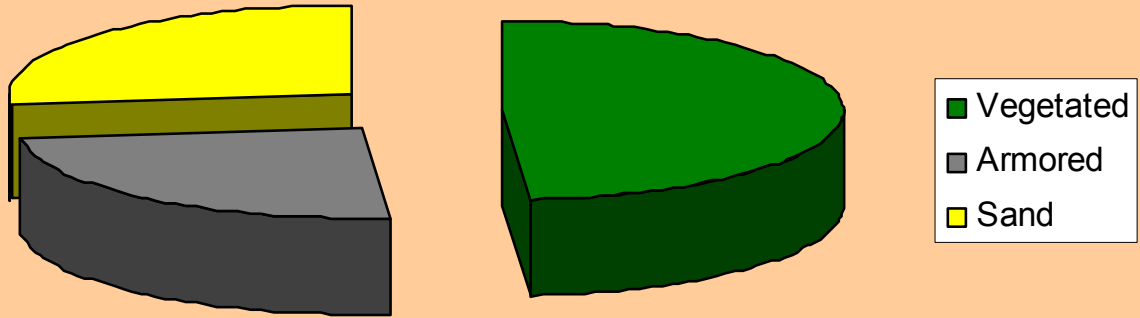
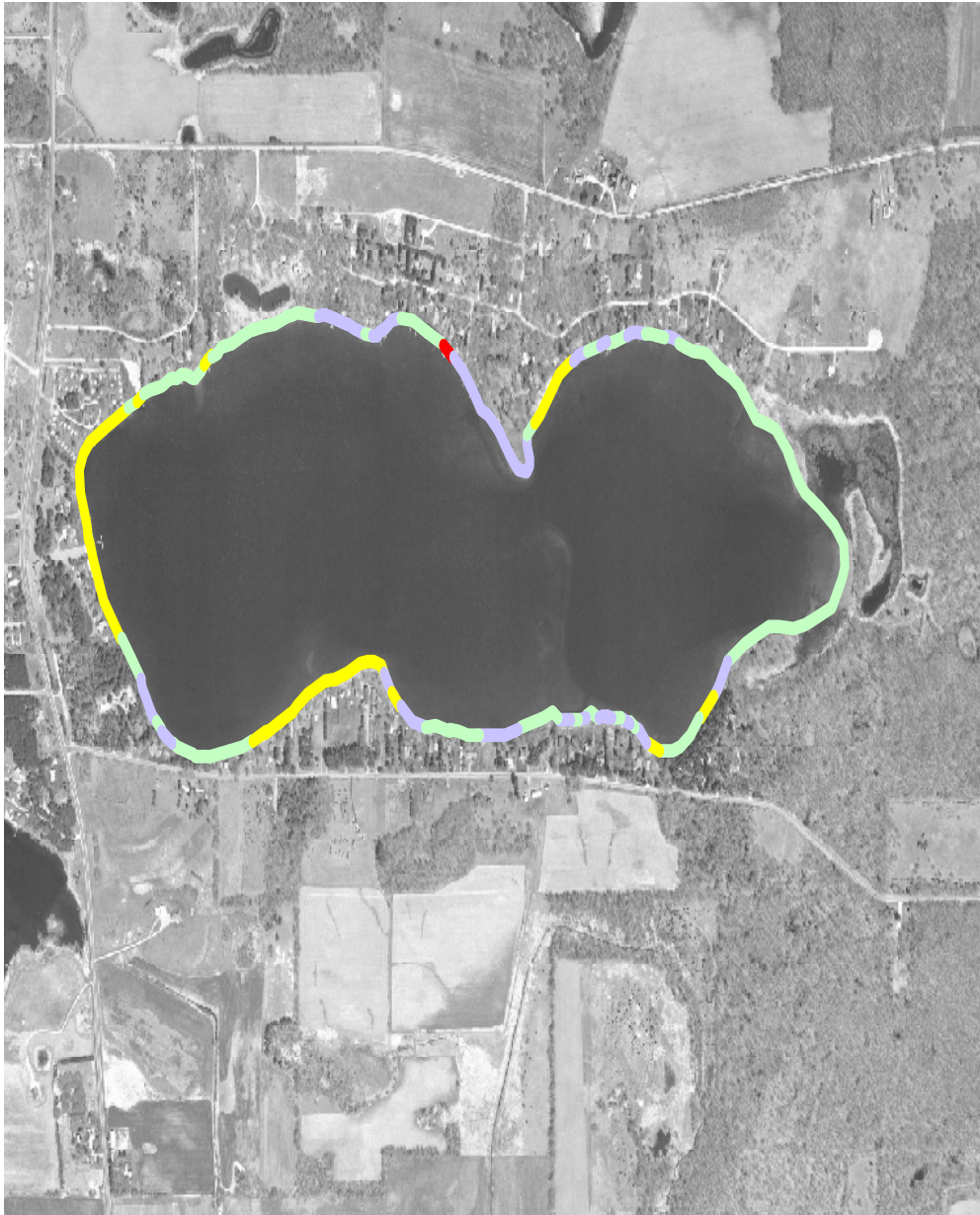


Figure 10: Shorelines on Jordan Lake

Shoreline on Jordan Lake

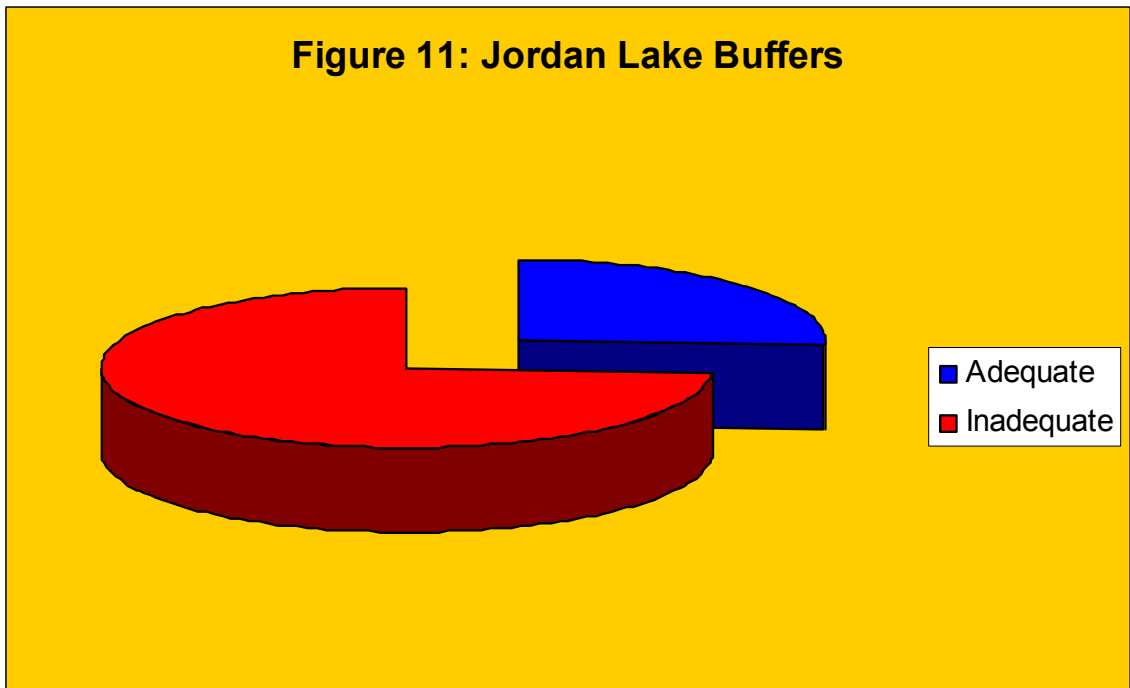


RE:2/05

-  Active Erosion
-  Hard Structure
-  Sand/Beach
-  Vegetated Shore

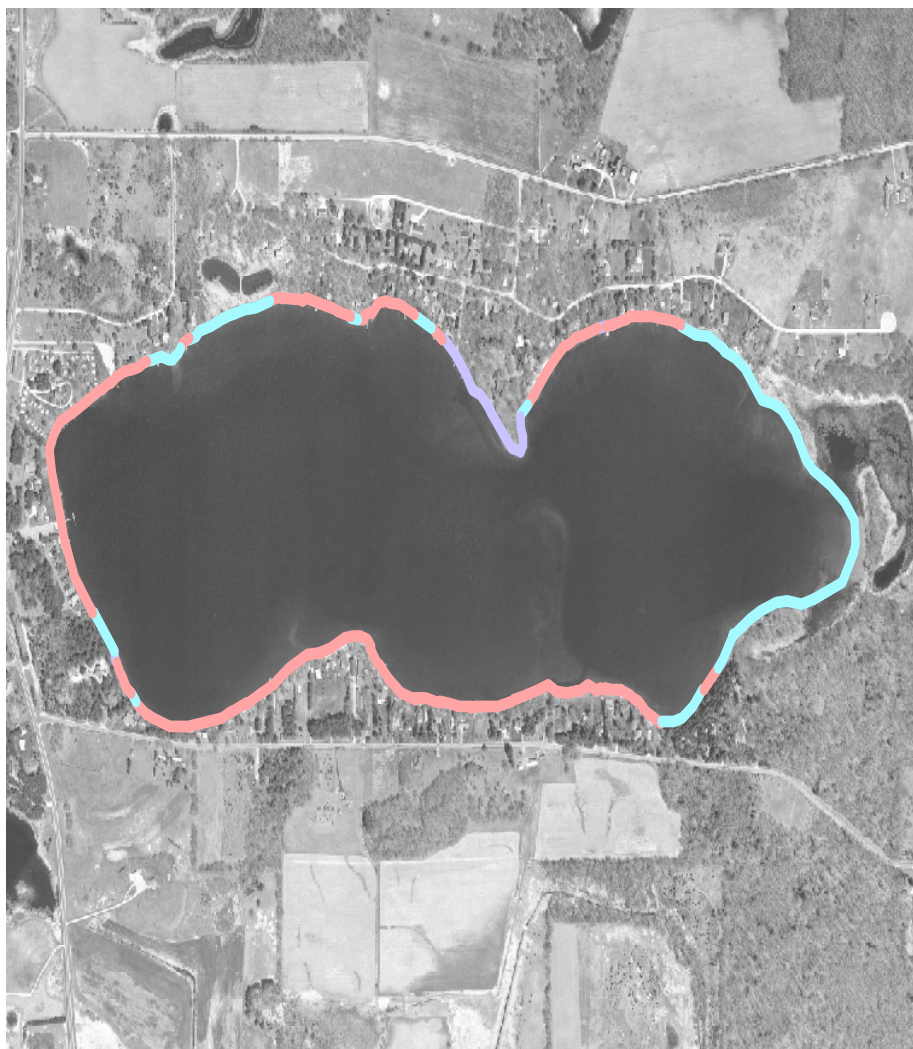
Under the shoreland ordinance, the first 35 feet landward from the water is a “buffer.” Shoreland buffers are an important part of lake protection and restoration. These buffers are simply a wide border of native plants, grasses, shrubs and trees that filter and trap soil & similar sediments, fertilizer, grass clippings, stormwater runoff and other potential pollutants, keeping them out of the lake. A 1990 study of Wisconsin shorelines revealed that a buffer of native vegetation traps 5 to 18 times more volume of potential pollutants than does a developed, traditional lawn or hard-armored shore.

The 2004 inventory included classifying areas of the Jordan Lake shorelines as having “adequate” or “inadequate” buffers (see Figure 11). An “adequate” buffer was defined as one having the first 35 feet landward covered by native vegetation. An “inadequate” buffer was anything that didn’t meet the definition of “adequate buffer”, including native vegetation strips less than 35 feet landward. Using these definitions, 25.78% (about 3811.5 feet) of Jordan Lake’s shoreline had an “adequate buffer”, leaving 74.22% (10972.5 feet) as “inadequate.” Most of the “inadequate” buffer areas were found with mowed lawns and/or insufficient native vegetation at the shoreline to cover 35 feet landward from the water line.



Vegetated shoreland buffers help stabilize shoreline banks, thus reducing bank erosion. The plant roots give structure to the bank and also increase water infiltration and decrease runoff. A vegetated shore is especially important when shores are steep and soft, as are many of the Jordan Lake shores. Figure 12 maps the adequate and inadequate buffers on Jordan Lake.

Figure 12: Jordan Lake Buffer Map



RE:2/05

 Inadequate Buffers  Adequate Buffers

Lakeside buffers also serve as important habitat. Lake edges usually contain aquatic and wetland plants, grading into drier groundcover, then shrubs and trees as one moves inland towards drier land. Buffers provide habitat for many species of water-dependent wildlife, including furbearers, reptiles, birds and insects. Many wildlife species, including birds, small mammals, fish & turtles breed, nest, forage and/or perch in shore buffer areas. Further, 80% of the endangered and threatened species listed spend part of their life in this near-lake buffer area. (Wagner et al, 2006)

When the natural shoreline is replaced by traditional mowed turf-grass lawns, rock, wooden walls or similar installments, bird and animal life, land-based insects, and aquatic insects that hatch or winter on natural shore are negatively impacted. For example, on many Adams County lakes, the non-native aquatic plant, Eurasian Watermilfoil has invaded. There is a weevil native to Wisconsin that weakens Eurasian Watermilfoil by burrowing into and developing within its stems, but that weevil depends on a native-plant shore to overwinter. If the shore is instead covered by rock, seawall or traditional lawn, these weevils will be unavailable for the lake to use as Eurasian Watermilfoil control.



Figure 13: Example of Inadequate Buffer

The filtering process and bank stabilization that buffers provide help improve a lake's water quality, including water clarity. Studies in Minnesota, Maine and Michigan have shown that waterfront property value increases for every foot the water clarity of a lake increases. (Krysel et al, 2003).



Figure 14: Example of Adequate Buffer

Natural shoreland buffers serve important cultural functions. They enhance the lake's aesthetics. Studies have shown that aesthetics rank high as one of the reasons people visit or live on lakes. Shore buffers can provide visual & audio privacy screens for homeowners from other neighbors and/or lake users.

Adequate buffers on Jordan Lake could be easily installed on most of the lake by either letting the first 35 feet landward from the water just grow without mowing it, except for a path to the water, or by planting native seedlings sufficient to fill in the first 35 feet.

WATER QUALITY

Between 2004 and 2006, Adams County Land & Water Conservation Department gathered water chemistry and other water quality information on Jordan Lake. Part of the information was gained from periodic water sampling done by Adams County LWCD. Historic information about water testing on Jordan Lake was also obtained from the Wisconsin Self-Help Monitoring Program records and from the WDNR.

Phosphorus

Most lakes in Wisconsin, including Jordan Lake, are phosphorus-limited lakes: of the pollutants that end up in the lake, the one that most affects the overall quality of the lake water is phosphorus. The amount of phosphorus especially affects the frequency and density of aquatic vegetation and the frequency and density of various kinds of algae, as well as water clarity and other quality aspects. One pound of phosphorus can produce as much as 500 pounds of algae.

Phosphorus is not an element that occurs in high concentration naturally, so any lake that has significant phosphorus readings must have gotten that phosphorus from outside the lake or from internal loading. Some phosphorus is deposited onto the lake from atmospheric deposition, especially from soil or other particles in the air carrying phosphorus. A lake that includes a flooded wetland area may have a significant amount of phosphorus being released during the flushing of the wetland area. Phosphorus may accumulate in sediments from dying animals, dying aquatic plants and dying algae. If the bottom of the lake becomes anoxic (oxygen-depleted), chemical reactions may cause phosphorus to be released to the water column.

Although there are several forms of phosphorus in water, the total phosphorus (TP) concentration is considered a good indicator of a lake's nutrient status, since the TP concentration tends to be more stable than other types of phosphorus concentration. For a natural lake like Jordan Lake, a total phosphorus concentration below 20 micrograms/liter tends to prevent nuisance algal blooms. In 2004-2006, Jordan Lake's growing season (June-September) surface average total phosphorus level of 15 micrograms/liter is low enough so that nuisance algal blooms should occur only rarely.

Since limiting factor is usually phosphorus, measuring the phosphorus in a lake system thus provides an indication of the nutrient level in a lake. Increased phosphorus in a lake will feed algal blooms and also may cause excess plant growth. The 2004-2006 summer average phosphorus concentration in Jordan Lake was 15 micrograms/liter. This is below the 25 micrograms/liter average for natural lakes in Wisconsin. This concentration suggests that Jordan Lake is likely to have few nuisance algal blooms. This places Jordan Lake in the "good" water quality section for impoundments, and in the "mesotrophic" level for phosphorus.

Due to the long history of citizen monitoring and occasional testing by the WDNR, total phosphorus records are available for Jordan Lake back to 1992. Out of 49 samples taken of the epilimnion for total phosphorus levels between 1992 and 2007, only three were higher than the 25 micrograms/liter recommended to avoid algal blooms.

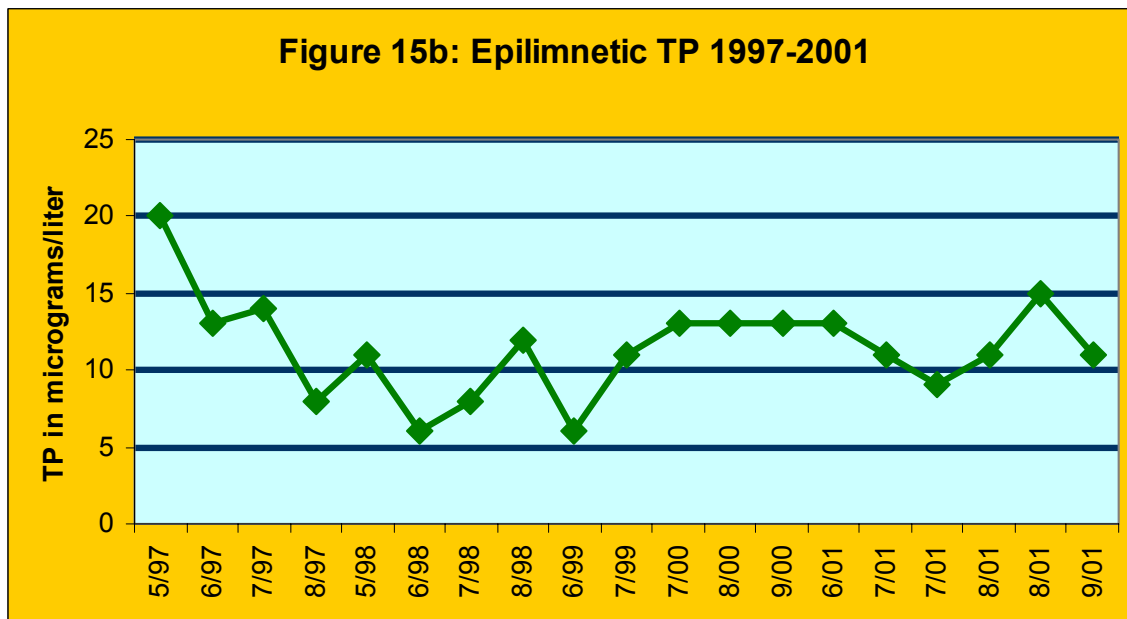
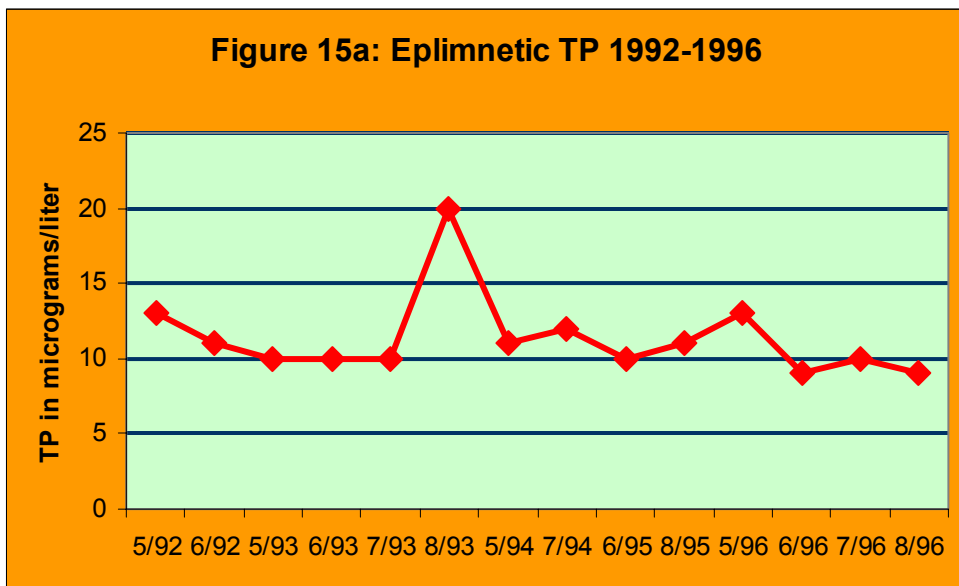
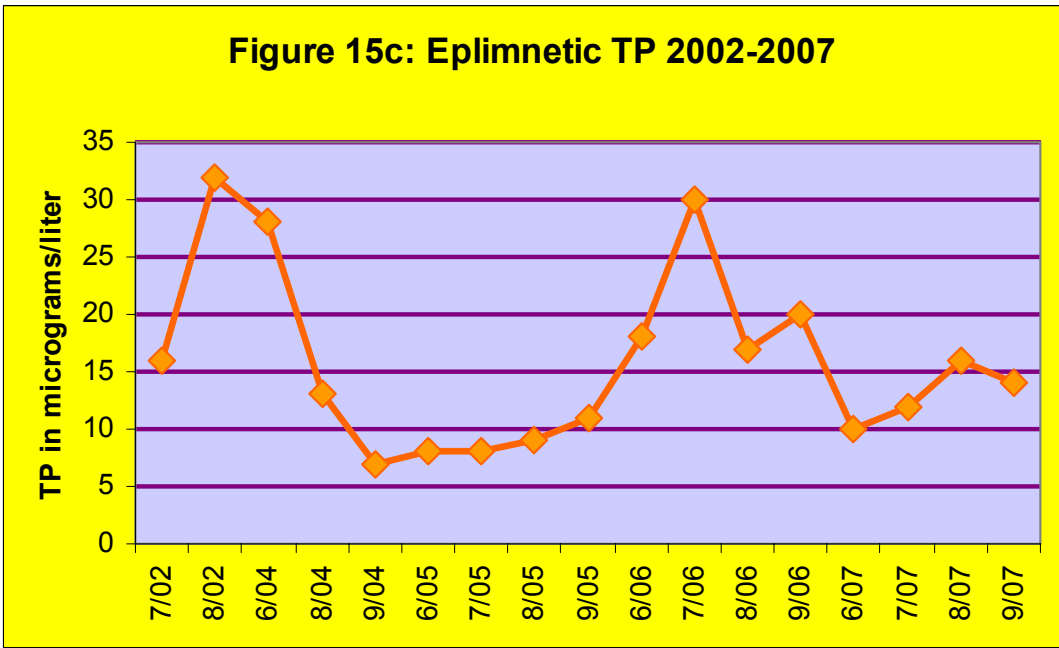
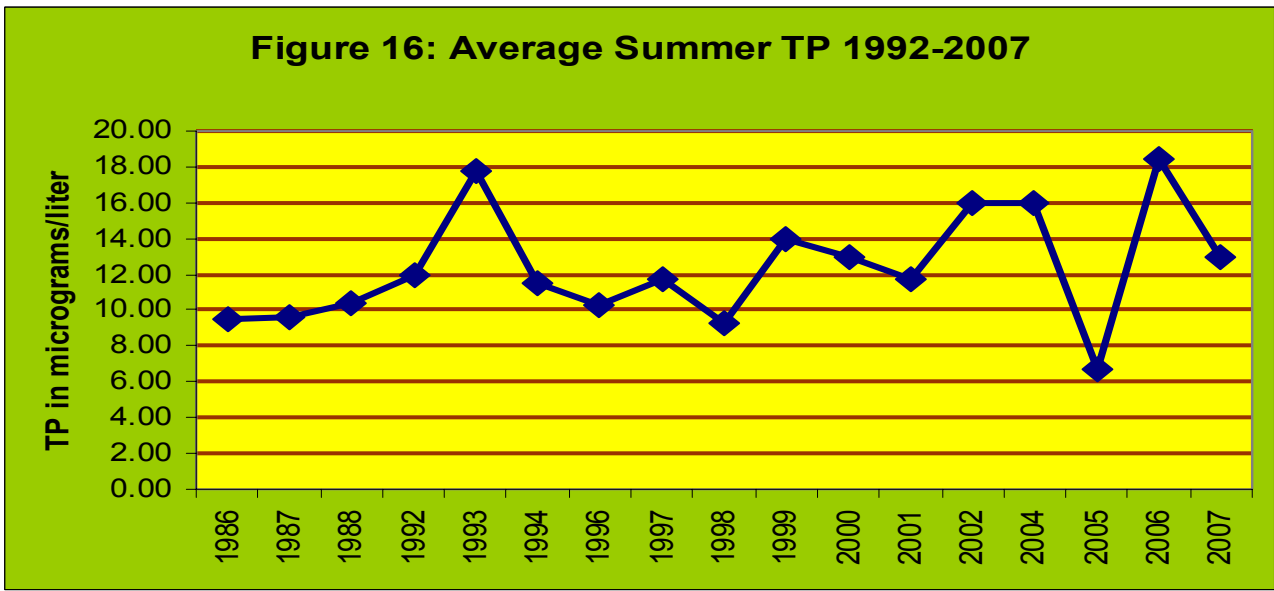


Figure 15c: Eplimnetic TP 2002-2007



However, a comparison of the average summer phosphorus level in the lower depths of Jordan Lake (50 feet and deeper) to the upper depths (surface to 5 feet) shows that phosphorus concentrations in the lower levels of Jordan Lake are nearly three times more than those from the upper layers of water. This suggests that the lower water depths may be accumulating phosphorus, added to that accumulating in the sediments. This situation should be monitored

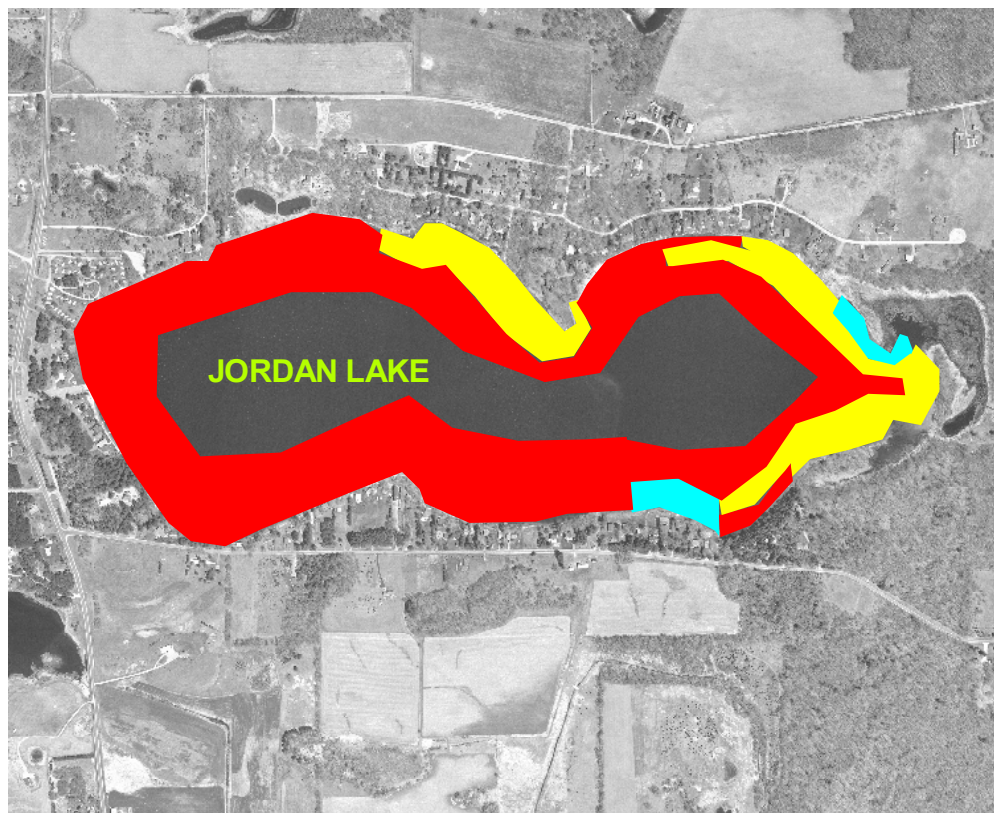
Figure 16: Average Summer TP 1992-2007



As the above graph (Figure 16) indicates, the growing season total phosphorus levels have varied, but stayed below the 25 micrograms/milliliter recommended to avoid nuisance algal blooms. Still, considering that the overall line since 1986 has been showing gradually increased total phosphorus levels for the growing season, phosphorus should continue to be monitored.

In most lakes in Wisconsin, phosphorus concentration in the bottom sediments of the lake is considerably higher than the concentration in the water column itself. Bottom sediments can “bind up” phosphorus, making it unavailable for aquatic plants or algae to use. Some sediment types hold phosphorus at a higher rate than others.

Figure 17: Sediments in Jordan lake



RE:11/06

Red Hard Sediments **Cyan** Mixed Sediments **Yellow** Soft Sediments



Most of the littoral zone of Jordan Lake has sand as its sediment. However, the deeper areas were mined for marl in the past. “Marl” is a calcium carbonate precipitate (solid) that forms in hard water lakes when both calcium and pH levels are high. Marl can be good for a lake because it has a high capacity to bind phosphorus, as well as other nutrients. Jordan Lake may benefit from the marl removing phosphorus from water column, thus making it unavailable for algal and aquatic plant growth.

How much a marl sediment affects aquatic plant and algal growth will depend on where the marl sediment is located, i.e., if the aquatic plants are rooted in the marl, so that they can still draw phosphorus from it, the presence of marl may not reduce aquatic plant growth. Effect will also depend on how much phosphorus the marl has already absorbed. In 80% of Wisconsin’s lakes, phosphorus is the key nutrient that determines the amount of algae and aquatic plant growth. Since nearly all of the marl in Jordan Lake is in the deeper areas of the lake, the marl sediment probably offers more protection against nuisance algal growth than aquatic plant growth.

Groundwater testing of various wells around Jordan Lake was done by Adams County LWCD and included a test one year for total phosphorus levels in the groundwater coming into the lake. The average TP level in the wells tested was 18 micrograms/liter, just a little higher than the summer lake surface water results. This phosphorus may also seep into Jordan Lake, but would add little to the overall level.

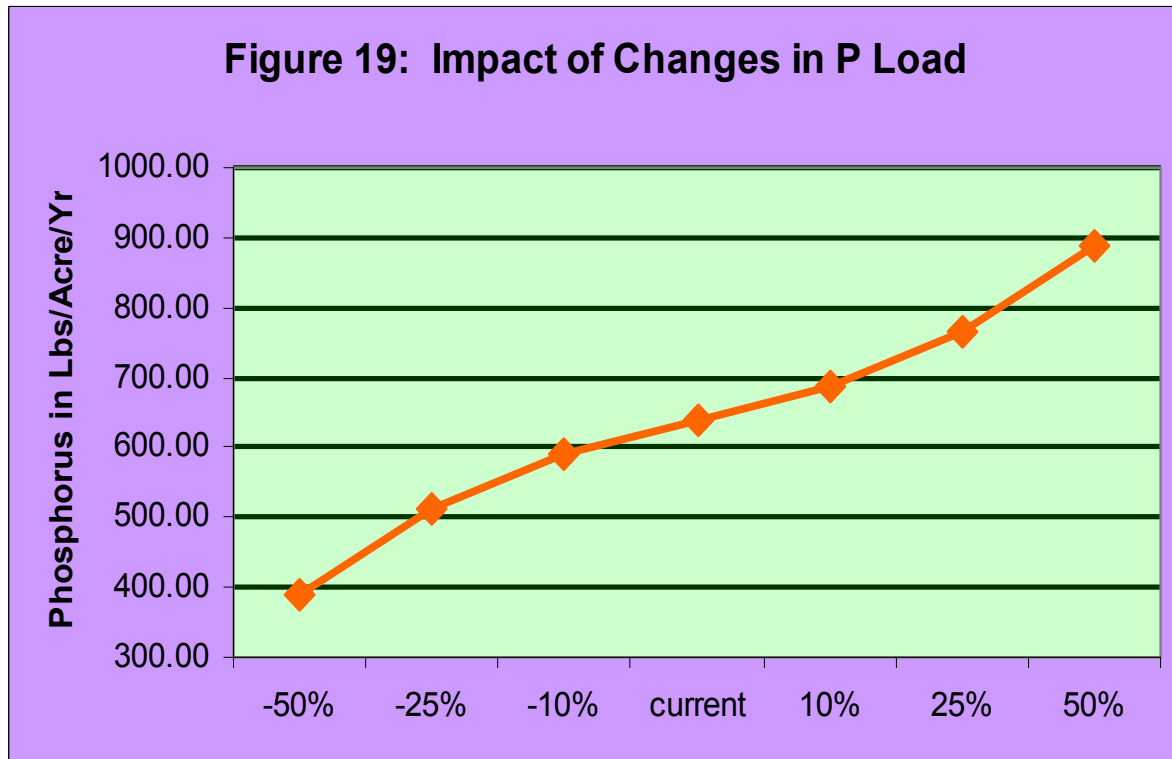
Land use plays a major role in phosphorus loading. A key component of the computer models used is the phosphorus budget, that is, the estimated amount of phosphorus delivered to the lake from each land use type annually. The land uses that contribute the most phosphorus are non-irrigated agriculture and residences. Using the current land use data, as well as phosphorus readings from 2004 through 2006 water sampling, a phosphorus loading prediction model was run for Jordan Lake. The current results are shown in the table below:

Figure 18: Current Phosphorus Loading by Land Use

MOST LIKELY CURRENT PHOSPHORUS LOADING		
Land Use Type	% Loading	TP in lbs/acre/yr
Irrigated Agriculture	24.1%	107.96
Non-Irrigated Agriculture	33.1%	148.11
Pasture/Grass	2.6%	11.60
Residential	15.3%	68.70
Woodlands	4.4%	19.63
Other Water	2.1%	8.92
Ground Watershed	10.5%	47.29
Lake Surface	2.6%	11.60
Septics	5.3%	23.55
	100.0%	447.35

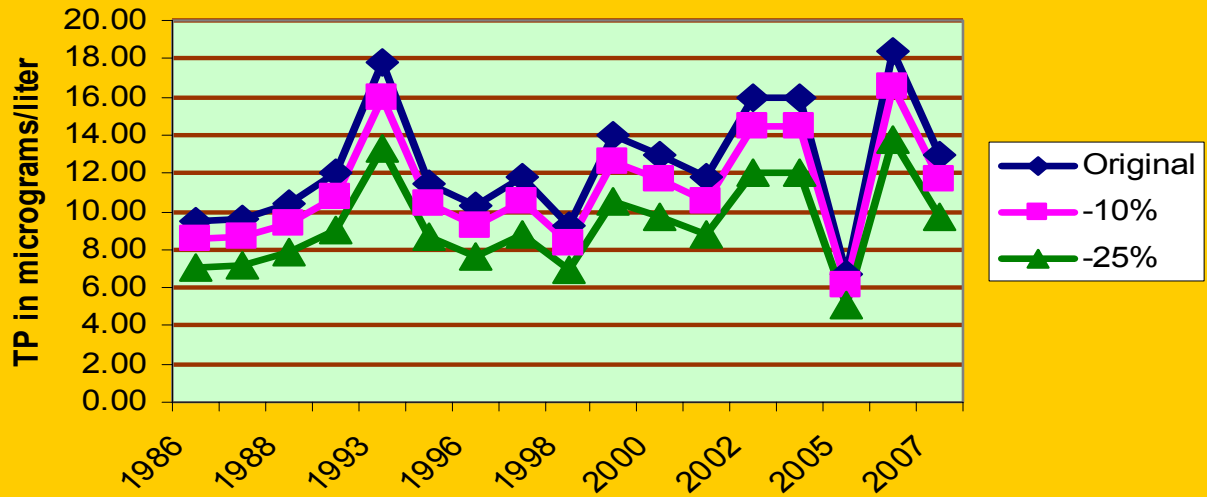
Phosphorus deposits such as that from flooded wetlands or from atmospheric deposition cannot be controlled by humans. However, some phosphorus (and other nutrient) input can be decreased or increased by changes in human land use patterns. Practices such as shoreland buffer restoration; infiltrating stormwater runoff from roof tops, driveways and other impervious surfaces; using no phosphorus lawn fertilizers; and reducing phosphorus input to and properly managing septic systems will minimize phosphorus inputs into the lake. Circumstances such as increased impervious surface, lawns mowed to water's edge, disturbance of shore areas, improperly-functioning septic systems and removal of native vegetation can greatly increase the volume and content of runoff—and thus increase the volume of phosphorus entering the lake. Many of these practices can also increase the concentration of phosphorus entering the lake, by runoff or other methods of entry.

The models were run using not only the current known phosphorus readings in the lake, but also representing decreases or increases of human-controlled phosphorus input by 10%, 25%, and 50%. Results are shown in Figure 20. The figures may not seem like much---until you calculate that one pound of phosphorus can result in up to 500 pounds of algae. A 10% reduction in these three areas could result in 37.76 pounds/acre/year of phosphorus—or up to 18.880 pounds less of algae per acre per year!



Looking at this issue in terms of how much phosphorus readings in the lake might change, based on the computer modeling, looking at in-lake impact perhaps makes it clearer. Figure 16 graphed the epilimnetic summer phosphorus levels in Jordan Lake for 1986-2007. Reducing the amount of input from the surface and ground watersheds results in less nutrient loading into the lake itself. Figure 20 graphs the changes there would be if those levels had been reduced by 10% and 25%. A 10% reduction would have meant from .7 to 1.8 fewer micrograms/liter of phosphorus in the lake. Reducing the in-lake phosphorus by 25% would result in 1.7 to 4.6 fewer micrograms/liter of phosphorus. These predictions make it clear that reducing current phosphorus inputs to the lake are essential to improve, maintain and protect Jordan Lake's health for future generations.

Figure 20: In-Lake Impact of P Reduction



**Figure 21:
Photo of a Lake
with Algal
Bloom**