JORDAN LAKE MANAGEMENT PLAN

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JORDAN LAKE WATERSHED MANAGEMENT PLAN

List of Lake Advisory Group Members

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PROCEDURE FOR MODIFYING LAKE MANAGEMENT PLAN

The Jordan Lake District will maintain an agenda item of "modifying lake management plan" on its meeting notices. Although suggested changes or additions can be presented at any time, they will only be acted upon at the annual meeting. It is anticipated that the Lake Advisory Group will continue to function as a research and advisory group for the Lake District.

BASELINE INFORMATION

The Jordan Lake Surface Watershed, located Jackson Township, Adams County, Wisconsin, covers approximately 7 square miles. The ground watershed is also entirely in Jackson Township and slightly larger about 8 square miles) than the surface watershed. The ground watershed lies west and north of the lake itself. There are no major streams in either watershed. There are some private lakes/ponds in both watersheds, mostly located close to Jordan Lake.

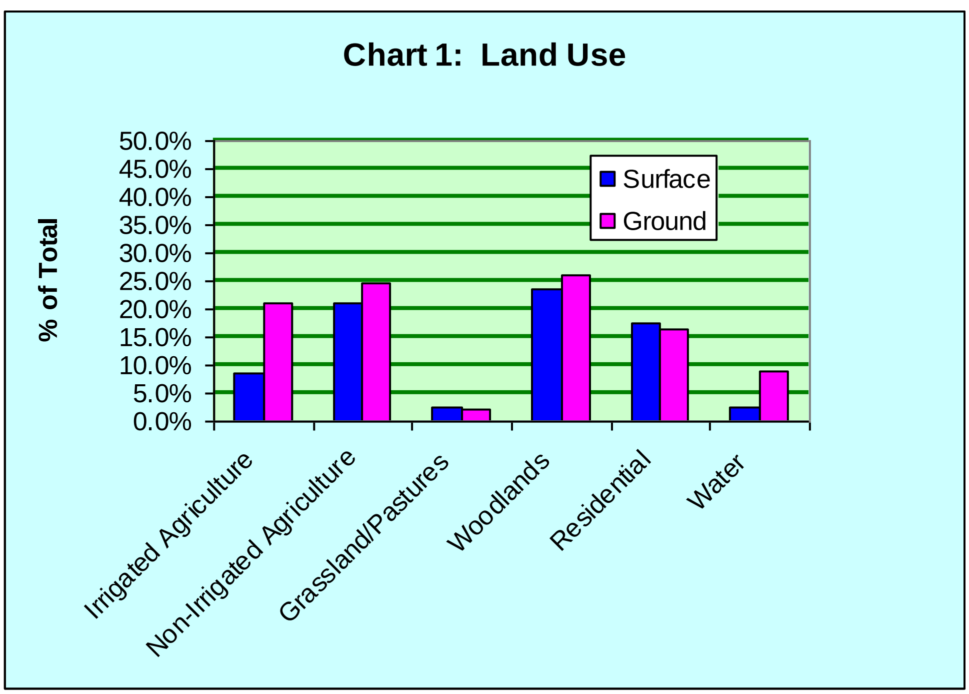
Jordan Lake is a natural seepage lake. A seepage lake is a natural lake fed by precipitation, limited surface runoff and groundwater. The water level of a seepage lake is affected greatly by variations in the groundwater level. Jordan Lake does not have either a stream inlet or outlet. The original WDNR depth map had the lake with 213 surface acres and maximum depth of 82 feet. In 2008-2009, the Jordan Lake District had the depth map updated. The new bathymetric map showed just over 233 surface acres, with a maximum depth of 92 feet. Over 45% of the lake is more than 20 feet deep; less than 15% is less than 3 feet deep. It is the largest and deepest natural lake in Adams County.

Watershed Land Use

Land Use is very important in looking at ways to maintain or improve water quality. Studies have shown that types of land use affect sedimentation rate, erosion rate and runoff rate (with included pollutants). Increased sedimentation can not only fill in shallow areas of water, but also causes excessive turbidity that harms aquatic life by destroying habitat and smothering oxygen. Increased runoff carries with it pollutants besides sediments, including pathogens, nutrients that affect algal & aquatic plant growth (nitrogen & phosphorus), pesticide residue, fertilizer chemicals, organic matter, metals, petroleum products and road salt. Increased runoff can also reduce ground water recharge and increase shore erosion. Addition of such substances not only degrade water quality and habitat, but also limit aesthetic and recreational enjoyment.

Studies also suggest that an increase in impervious surface around a waterbody of 20% may negatively impact water quality. Impervious surfaces include areas such as pavements, roofs, decks, sidewalks, compacted soil, cement patios, etc. Similarly, traditional closely-mowed lawns, as opposed to unmown lawns or native vegetation, tend to have high runoff rates and low infiltration rates. Soil types may also influence runoff amounts. Research in Indiana established the difference in average runoff amounts, based on land use. Runoff from general residential (i.e., not necessarily highly-developed) was twice as much as runoff from forested land. Runoff in highly-developed areas may be up to fourteen times more than forested lands and twice as much as from agricultural lands. With a highly-developed residential shore, residential runoff at Jordan Lake will be one of the main negative impacts on its overall water quality in the future if steps are not taken to address this problem.

The Adams County Land & Water Conservation Department conducted a land use evaluation for both the ground and surface watersheds of Jordan Lake in 2004. The (2004) surface watershed land use was 21.2%, non-irrigated agriculture, 8.7% irrigated agriculture, 26.5% water (including Jordan Lake), 23.6% forests, 17.4% residential and 2.6% open grassland/pasture. Currently, according to phosphorus-loading modeling done by the Adams County Land & Water Conservation Department, residential land use around the lake is contributing about 15% of the phosphorus loading, with agriculture contributing another 36%. Some phosphorus loading, such as that from woodlands or other water surfaces, is not controllable by humans; however, some of the phosphorus loading from residential and agricultural inputs is controllable. Residential practices such as not using lawn fertilizers, installing native vegetation and/or unmowed buffers and controlling runoff from impervious surfaces can reduce phosphorus input. Agricultural practices such as conservation tillage, increased residue and field buffers can reduce agricultural phosphorus input.



Non-irrigated agriculture took up 24.75% of the ground watershed acreage, with an additional 21.11% in irrigated agriculture. 26.2% of the ground watershed is in forests, with the rest of the ground watershed being 16.6% residential, 9.02% water and 2.32% open grassland/pasture.

There are a few small businesses in the watershed, mostly located around the lake. These include a restaurant/bar, campsites and resorts. According to the Wisconsin State Historical Society, the only archeological site in the watersheds is a burial mound group located on the northeast side of the lake's western lobe.

Public Use and Value

In 2006, the Adams County Land & Water Conservation Department conducted a mailed citizen survey about lake issues. 70% of those responding had lakefront property on Jordan Lake. 19% of the respondents were full-time residents; 31% were year-around weekend residents; the remaining were summer or occasional residents. While only 4% of the respondents had owned their property less than 5 years, 62% had owned their land over 20 years. Most respondents owned some kind of boat, with pontoon boats dominating, then foot-paddle & fishing boats.

52% of the respondents felt the lake water quality had stayed substantially the same in the time they'd been coming to the lake, but some 42% felt the water quality had declined. Declining water quality was attributed most strongly to the invasion of exotic species (46%), recreational overuse (32%), and development (28%).

60% of the respondents felt aquatic "weed" growth had increased. In fact, aquatic plant growth was identified as the most problematic water quality issue, with human use coming a far second.

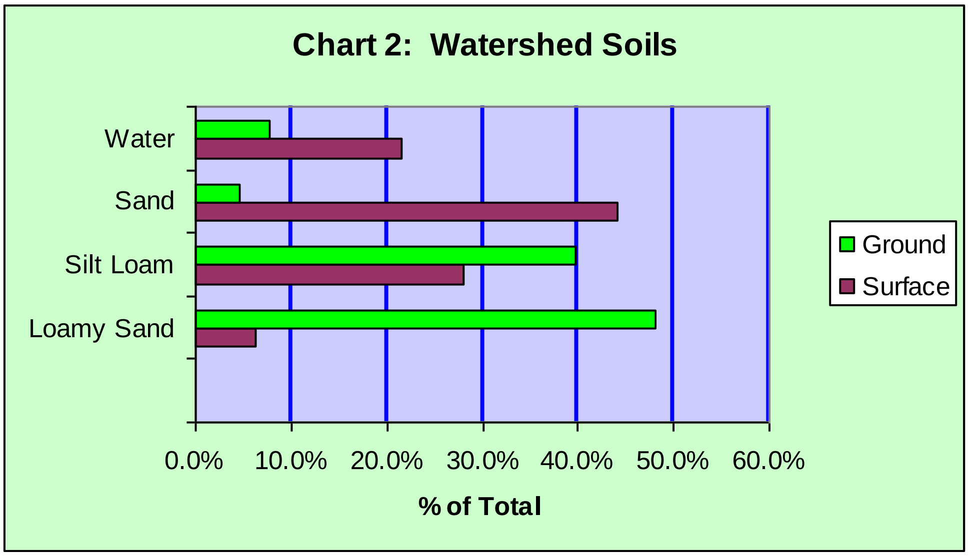
The main reasons respondents chose to use Jordan Lake were its good water quality, its distance from their primary residence and the quality of its fishing. The four most popular uses of the lake by the respondents were motorized boating, fishing, swimming and waterskiing/tubing.

There is a county-park owned public boat ramp on the northwest side of the lake, entered off of County Road G. There are also private ramps connected with a condo development and another subdivision development.

Soils in the Watershed

Soils in the both watersheds range from silt loams to sands, with slopes from nearly flat to over 12%. In the surface watershed, the dominant soil type is Sand, followed by Silt Loam and Loamy Sand. Water covers 21.6% of the surface watershed.

Loamy Sand dominates the ground watershed, followed by Silt Loam and Sand. Water comprises 7.7% of the ground watershed.



Sands and Loamy Sands are generally well-drained to somewhat excessively drained, with moderate to rapid permeability in the surface layer and slow to rapid permeability in the subsurface layers. Land runoff is slow to rapid, mostly depending on slope. Available water capacity ranges from usually low, as is natural fertility organic matter content. There are wide ranges of suitability for cropping, tree-production and engineering uses. Most of these soils have erosion, blowing and drought hazards as well. Depth to groundwater is mostly over 20', although there are some areas of perched water tables. Bedrock is mostly sandstone.

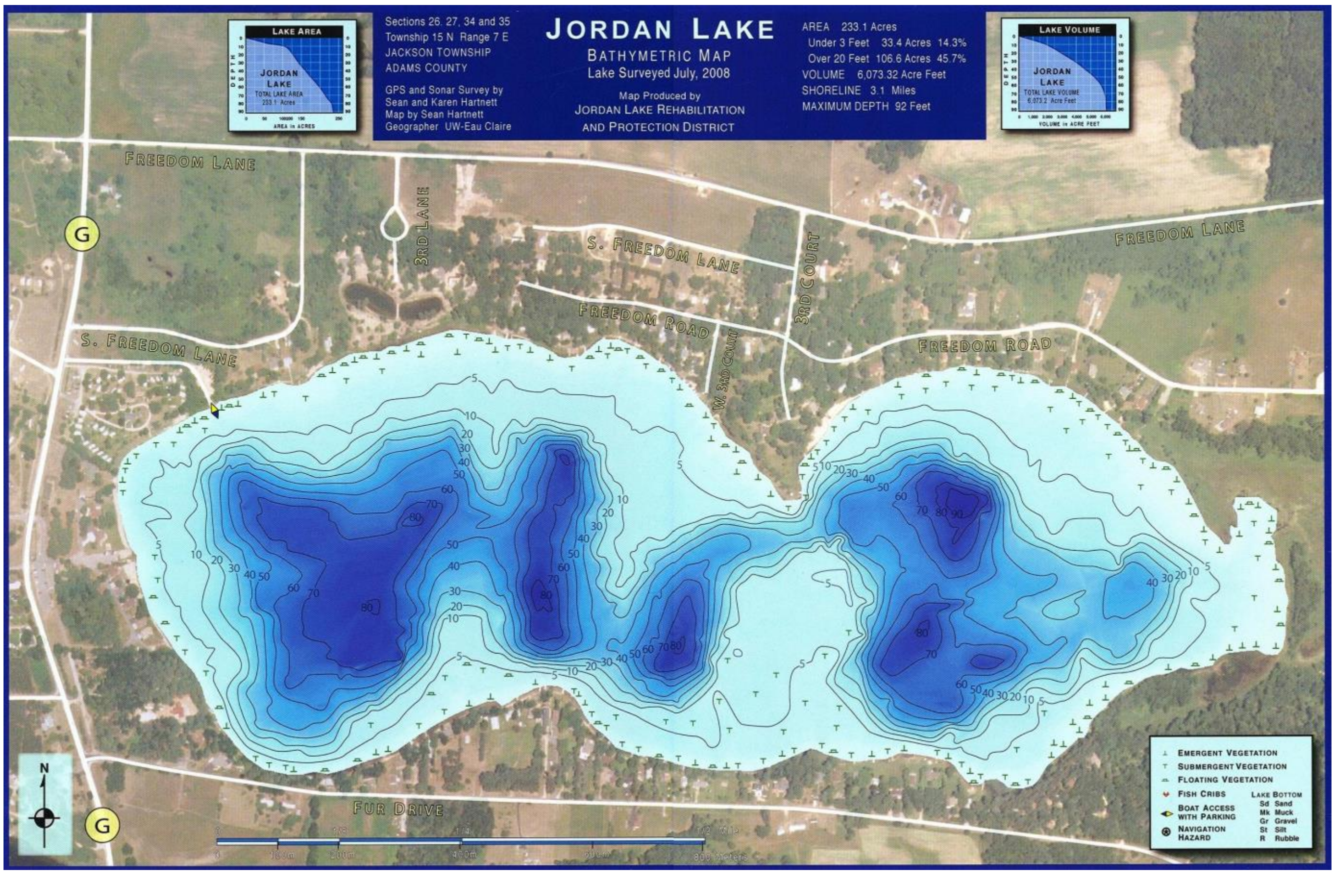
Silt Loams are well-drained with moderately slow to slow permeability. Runoff in cultivated areas tends to be rapid. Available water capacity, natural fertility and organic matter content are all medium. These soils can be subject to ponding in heavy rains. These soils are generally good for cultivated crops (if erosion control is used), hay, pasture and trees, but poor for most engineering purposes. Heavy use of these soils when they are wet may result in compaction and surface runoff.

Lake Basin Shape

Jordan Lake has an irregular shore and widely-varying depths. It has a broad littoral zone around the edges of the lake, after which it drops off sharply in several places to depths of up to 100 feet. Most of the depths under 20 feet are populated with aquatic plants.

According to a 2005 survey, sand was found at 80.6% of the sample sites. Also found were muck (18.2%) and rock (1.2%). In some instances, sediment type can be a limiting factor for aquatic plant growth, but this does not appear to be the case on Jordan Lake, based on the 2005 survey information.

Prior to the 1980 water rise, a vegetated sandbar separated the lake into two distinct lobes that were connected by a narrow channel about 30 feet deep. In the past few years, with various drought periods, the water depth over the sandbar has sometimes been less than 4 feet deep.



Critical Habitat

Designation of critical habitat areas within lakes provides a holistic approach for assessing the ecosystem and for protecting those areas in and near a lake that are important for preserving the qualities of the lake. Wisconsin Rule 107.05(3)(i)(I) defines a "sensitive 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, sensitive areas often can provide the peace, serenity and beauty that draw many people to lakes in the first place.

Protection of critical habitat areas must include protecting the shore area plant community, often by buffers of native vegetation that absorb or filter nutrient & stormwater runoff, prevent shore erosion, maintain water temperature and provide important native habitat. Buffers can serve not only as habitats themselves, but may also provide corridors for species moving along the shore.

Besides protecting the landward shore areas, preserving the littoral (shallow) zone and its plant communities not only provides essential habitat for fish, wildlife, and the invertebrates that feed on them, but also provides further erosion protection and water quality protection.

Critical habitat area designations provide information that can be used in developing a management plan for the lake that protects the lake's ecosystem by identifying areas in need of special protection. These areas usually contain several types of aquatic plants: emergent; free-floating; rooted floating-leaf; and submergent.

Field work for a critical habitat area study was performed in October 2006, on Jordan Lake, Adams County. The study team included staff from the Wisconsin Department of Natural Resources and Adams County Land & Water Conservation Department. Two areas of Jordan Lake were designated as "critical habitat."

Critical Habitat Area JO1 extends along approximately 2600 feet of the shoreline along the north side of the lake, extending up to the ordinary high water mark. Sediment includes marl, muck, peat, sand, silt and mixtures thereof. 6% of the shore is wooded; 20% is native herbaceous cover. The balance of the short is bare sand, cultivated lawn and hard structure. There is a shallow marsh area along this shoreline. Large woody cover is present for habitat.

The results of an October 2006 fish shocking survey indicated that Jordan Lake has a good panfish population of substantial size, including bluegills, black crappie and perch. More scarce were largemouth bass and northern pike, although they were present. Brown trout, bullheads, walleyes and white suckers have also been found in Jordan Lake. There is a historical report of cisco in the lake, but the most recent fish survey did not find any.

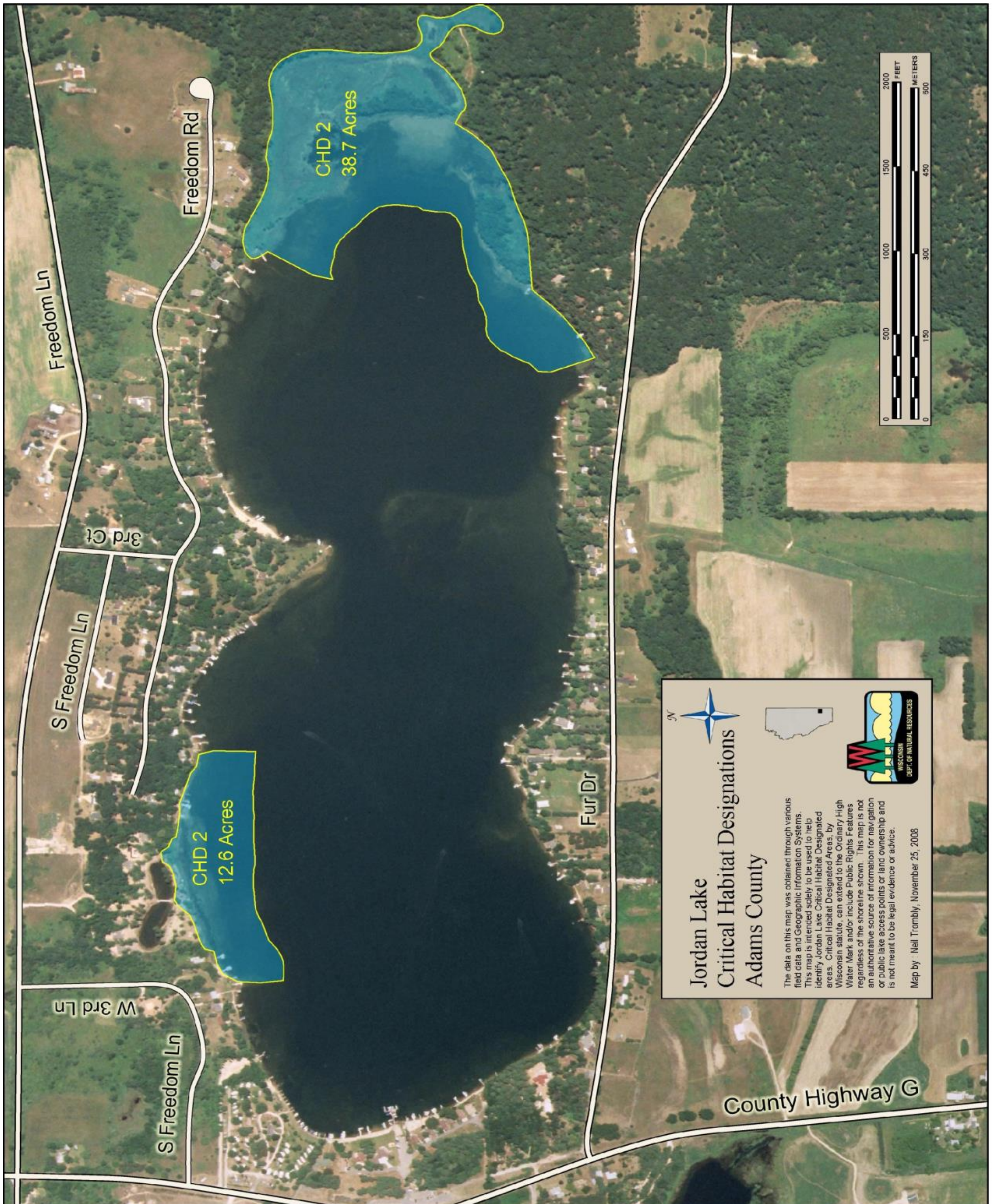


Figure 2. Critical Habitat Designated Areas

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. Free-floating plants were limited to Lemna minor (Small Duckweed). Five species of rooted floating-leaf plants were also found in this area, as well as seventeen submergent species. Floating-leaf vegetation provides cover and dampens waves, protecting the shore. Such a diverse submergent community provides many benefits. One exotic invasive plant, Myriophyllum spicatum, was found in this area.

Critical Habitat Area JO2 covers 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 feet, with a steep dropoff. Sediment includes peat, sand, silt and mixtures thereof. 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.

Seen during the field survey were various types of waterfowl and songbirds. It appeared that all these took cover or shelter in this area, as well as nested and fed in this area. Downed logs serving as habitat were also seen. Muskrat and mink are known to use JO2 for cover, reproduction and feeding. 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. Since human disturbance is relatively minimal in JO2, it provides high-quality habitat for many types of wildlife.

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. Five emergent species were present. One free-floating plant, Lemna minor was found at this site. Two floating-leaf rooted plants were found, as were 15 species of emergent vegetation.

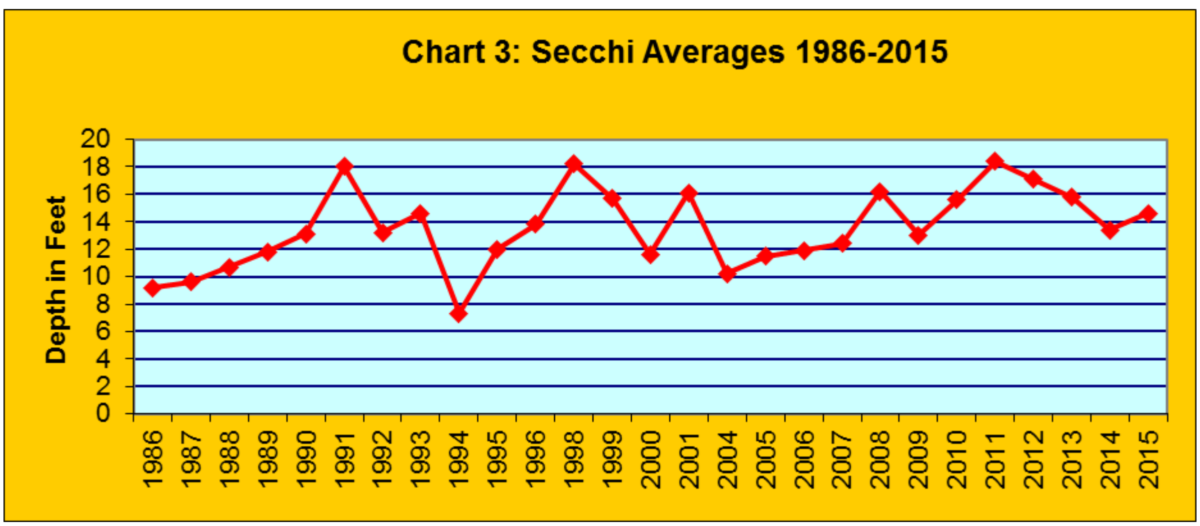
Specific recommendations for these two sites can be found in the Jordan Lake Critical Habitat Report on either the WDNR website or the Adams County LWCD Website.

Lake Chemistry

One indicator of water quality is a lake's trophic status. Oligotrophic lakes have clear, often cold, water with low overall productivity and very desirable fisheries of large game fish. Eutrophic lakes have poor water clarity, with high production of plants and frequent algal blooms likely. Eutrophic lakes also may have fish kill histories due to oxygen depletion and often have rough fish, such as carp, that contribute to the "muddiness" of the lake water. Mesotrophic lakes are those in between oligotrophic and eutrophic lakes, with more production and accumulated organic matter than oligotrophic lakes, but only occasional algal blooms, and a good mixed fishery.

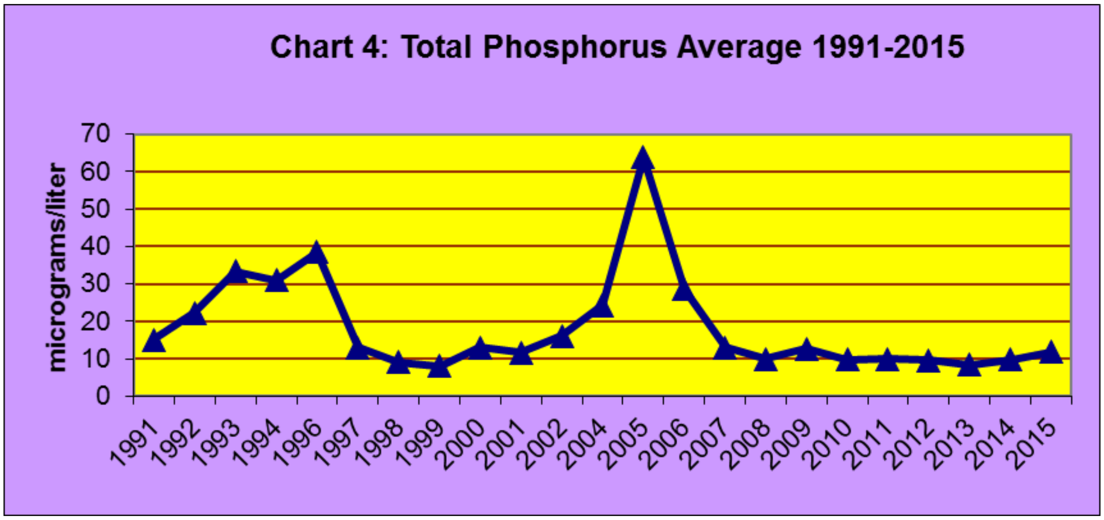
There are three lake chemistry readings that Wisconsin has traditionally used to determine a lake's trophic status. These are Secchi disk readings, which test water clarity; total phosphorus level, which indicates the amount of phosphorus available for aquatic plant and algae production; and cholorophyll a, which correlates to algal blooms. Three groups have been involved in taking these measurements: citizen volunteers through the WDNR Self-Help Lake Monitoring Program (1986-2002; 2007-2012), the Wisconsin Department of Natural Resources (1992-1994), and the Adams County Land & Water Conservation Department (2002-2006). The Jordan Lake District has been lucky enough to have a dedicated volunteer, Mike Backus, that has continued doing regular monitoring of the lake through the Citizens Lake Monitoring Program.

Secchi Disk Readings: Secchi disk readings taken in Jordan Lake over the years have generally been good to excellent. The average growing season water clarity reading from 1986-2015 was 13.5 feet. This average puts Jordan Lake in the oligotrophic or mesotrophic class based on water clarity.



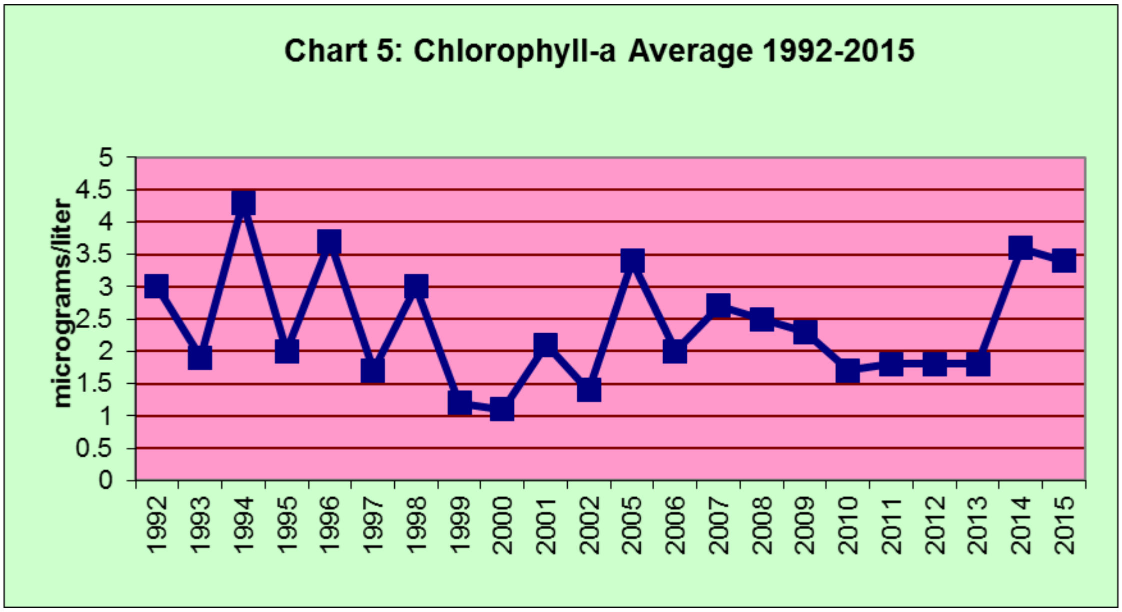
Total Phosphorus Readings: From 1992 through 2002, the WDNR tested Jordan Lake's total phosphorus level one to six times per year, taking separate surface and bottom measurements for the years 1992-1996. From 1992-1995, the WDNR average surface phosphorus reading was 34 micrograms/liter; from 1995-1998, the WDNR surface average decreased to 15 micrograms/liter. For 1999-2002, the surface phosphorus average for WDNR testing was 12 micrograms/liter.

WDNR phosphorus results from water from Jordan Lake's bottom tended to be higher than that at the surface. From 1992-1996, the average bottom phosphorus reading was 61 micrograms/liter. The 1992-1995 WDNR average phosphorus bottom reading was 70.5 mg/l, elevated for a natural lake. The overall growing season total phosphorus average from 1991-2015 was 18.4 micrograms/liter.



Chlorophyll a: Chlorophyll-a is the third factor often used in evaluating water quality, since studies have shown it is correlated with algal bloom frequency. The WDNR did not take any readings of Chlorophyll-a for Jordan Lake, but the Self-Help Monitoring citizens did take some, as did Adams County LWCD. Average Self-Help Monitoring results showed Chlorophyll-a readings from 1993-2002 was 2.28 milligrams/liter. Adams County LWCD's average Chlorophyll-a reading for 2003-2005 was 2.21 milligrams/liter. These are low levels of Chlorophyll a, indicative of an oligotrophic, fairly clear lake with good water quality. Using the Carlson Trophic Level determinations, this gives Jordan Lake a chlorophyll-a trophic level of 39, in the "oligotrophic" class. Growing season average for 1991-2015 was 2.4 micrograms/liter, very low.

The waters of Jordan Lake tend to be around neutral, with pH readings ranging from 6.11 to 8.12, with an average of 7.25. The lake has hard water with sufficient alkalinity to protect its fishery from the effects of acid rain or other acidic deposits. Since regular testing started in 2004, all hardness testing results have been "hard" or "moderately hard" for Jordan Lake. Hard water lakes tend to have clearer water and more diverse fishery than soft water lakes. The lake, with its varying depths, maintains sufficient oxygen levels in the lake so that fish kill from low oxygen are not likely to be a problem.



Readings for sodium, chloride, magnesium, sulfate and potassium in Jordan's waters have all been low, below any caution levels. Like all the lakes in Adams County, the calcium level is sufficient to support invasive mussel and snail growth. At this point, the only invasive animal known in Jordan Lake is the Banded Mystery Snail.

A problem that may need to be dealt with is aging septic systems. Of the 2006 survey respondents, 66.7% had septic systems over 10 years old, with most of them being in the 500 to 1000 gallon size. 62.5% had septic sites within 100' of the shoreline.

TROPHIC STATE

The three "trophic" parameters suggest that Jordan Lake is maintaining good water clarity and low Chlorophyll a readings, but that phosphorus levels, especially in the lower depths of the lake, have risen substantially in the last 20 years or so. Phosphorus is especially important related to density & frequency of aquatic plants and of algal blooms. One pound of phosphorus (2.2 kilograms) in the water can produce up to 500 pounds of algae. Nutrient loading is the most common cause of elevated phosphorus levels, so the Jordan Lake Management Plan should investigate how phosphorus levels will be lowered.

Jordan Lake thus scores 42 TSI on Secchi Disk readings; 39 on Chlorophyll a readings; and 43 TSI on Phosphorus Levels, for an average TSI reading of 41, placing it in the "mesotrophic" class overall.

	Score	TSI Level Description
	30-40	**Oligotrophic:** clear, deep water; possible oxygen depletion in lower depths; few aquatic plants or algal blooms; low in nutrients; large game fish usual fishery
Jordan Lake →	40-50	**Mesotrophic:** moderately clear water; mixed fishery, esp. panfish; moderate aquatic plant growth and occasional algal blooms; may have low oxygen levels near bottom in summer
	50-60	**Mildly Eutrophic:** decreased water clarity; anoxic near bottom; may have heavy algal bloom and plant grrowth; high in nutrients; shallow eutrophic lakes may have winterkill of fish; rough fish common
	60-70	**Eutrophic:** dominated by blue-green algae; algae scums common; prolific aquatic plant growth; high nutrient levels; rough fish common; susceptible to oxygen depletion and winter fishkill
	70-80	**Hypereutrophic:** heavy algal blooms through most of summer; dense aquatic plant growth; poor water clarity; high nutrient levels

Aquatic Plants

A private firm performed two field aquatic plant surveys on Jordan Lake in 2005, one in the spring and one in the summer. 19 named species were found in addition to a variety of emergent rushes and sedges. Two of the 19 species were the exotics Eurasian watermilfoil and curly-leaf pondweed. These exotics tended to be found mostly in the littoral area or around boat launches & piers.

The species with the highest frequency in both the spring and summer surveys was *Chara*, a plant-like algae. In the spring 2005 survey, *Potamogeton amplifolius* and *Potamgeton richardsonii* were the next most frequent aquatic plant, while in the summer survey, *Najas flexilis* was the only other plant with a frequency over 10%. The 2005 surveys showed decreases in both of the two exotic aquatic plant species that have entered Jordan Lake: Curly-Leaf Pondweed and Eurasian Watermilfoil.

Due to difficulties with some aquatic plant identification in the private survey, an aquatic plant survey was completed by the Adams County Land & Water Conservation Department in Summer 2006. 35 aquatic plant species were found, with 32 native and 3 exotic invasives. *Chara* spp (Muskgrass) was the most frequently-occurring "plant" in that survey as well, with the next most frequently-occurring plants being *Najas flexilis* (Bushy Pondweed), *Potamogeton pectinatus* (Sago Pondweed) and *Sagittaria latifolia* (Arrowhead or Duck Potato). The lake was surveyed again in 2010, 2012 and 2013. 29 species were found. In all surveys, *Chara* was the most frequently-occurring and dominant species.

Historically, aquatic plant and algal growth have been addressed only by chemical treatment. Diquat was applied 1981-1982. Various brands of 2-4, D were used in 1997-2005. Limited mechanical harvesting (30 tons) on Jordan Lake did occur in 2002 by the Jordan Lake Association. The chemical treatments do appear to be reducing the amount of EWM in Jordan Lake, based on the applications for chemical input—the amount of acreage being treated in 2006 was less than the prior years. In 2002, 25 acres were treated; in 2003, it was 27.7. Starting in 2004, acreage treated has been declining: in 2004, it went down to 25.72 acres, then down to 13.96 acres in 2005 and down to **2.28 acres** in 2006. Chemical treatment has varied from year to year since 2006, with various methods of application being tried and residue samples taken to conduct research on the results of different methods and concentrations.

Due to the research being conducted, there have been a number of aquatic plant surveys on Jordan Lake from 2005 through 2014. The minimum number of species found was 26, with the maximum 33. The most frequently-occurring type of aquatic plants are submergents, although there is a strong emergent community as well. Less frequently-occurring are free-floating and rooted floating-leaf plants. Lake coverage by aquatic vegetation ranged from 67.9% vegetated to 97.8%.

In all of the aquatic plant surveys, the macrophytic algae *Chara spp.* has dominated the aquatic plant community. Other common species are Southern Naiad, Variable-Leaf Pondweed, and Bushy Pondweed.

Aquatic Plants Found in Jordan Lake

Scientific Names	Common Names	2006 PI	2008 T	2010 PI	2011 PI	2012 PI	2012T	2013PI
Brasenia schreberi	Watershield	x	x	x	x	x	x	x
Carex	Sedge	x	x			x	x	
Carex comosa	Bristly Sedge				x			
Carex hystericina	Porcupine Sedge			x				
Ceratophyllum demersum	Coontail		x	x	x	x	x	x
Chara sp	Muskgrass	x	x	x	x	x	x	x
Eleocharis palustris	Common Spikerush	x			x	x	x	
Elodea canadensis	Common Waterweed	x	x	x	x	x	x	x
Impatiens capensis	Jewelweed		x					
Iris versicolor	Blue-Flag Iris				x			
Juncus sp	Rush		x			x		
Lemna minor	Lesser Duckweed		x					
Scientific Names	**Common Names**	**2006 PI**	**2008 T**	**2010 PI**	**2011 PI**	**2012 PI**	**2012T**	**2013PI**
Lychnothamnus beckii	Water Marigold							x
Megalodonta beckii	Water Marigold			x		x	x	
Myriophyllum sibiricum	Northern Milfoil	x	x		x	x	x	
Myriophyllum spicatum	Eurasian Watermilfoil	x	x	x	x	x	x	x
Najas flexlis	Bushy Pondweed	x	x	x	x	x	x	x
Najas guadelupensis	Southern Naiad			x	x	x	x	x

Nitellla sp	Stonewort	x	x	x	x	x	x	x
Nymphaea odorata	White Water Lily	x	x	x	x	x	x	x
Phalaris arundinacea	Reed Canarygrass		x	x		x	x	
Polygonum amphibium	Water Smartweed		x					
Potamogeton amplifious	Large-Leaf Pondweed	x	x	x	x	x	x	x
Potamogeton crispus	Curly-Leaf Pondweed	x	x		x	x	x	x
Potamogeton foliosus	Leafy Pondweed		x					
Potamogeton friesii	Fries' Pondweed	x		x		x	x	x
Potamogeton gramineus	Variable-Leaf Pondweed	x	x	x	x	x	x	x
Potamogeton illinoensis	Illinois Pondweed	x	x	x	x	x	x	x
Potamogeton natans	Floating-Leaf Pondweed	x	x	x	x	x	x	x
Potamogeton praelongus	White-Stemmed Pondweed	x	x	x	x	x	x	x
Potamogeton pusillus	Small Pondweed	x	x	x	x	x	x	x
Potamogeton richardsonii	Clasping-Leaf Pondweed	x	x	x	x	x	x	x
Potamogeton robbinsii	Fern-Leaf Pondweed					x	x	
Potamogeton zosteriformis	Flat-Stemmed Pondweed	x	x	x	x	x	x	x
Ranuculus aquatilis	White Water Crowfood	x	x	x	x	x		x
Sagittaria latifolia	Common Arrowhead	x	x			x	x	
Sagittaria rigida	Stiff Arrowhead					x	x	
Salix spp	Willow		x			x	x	
Schoenoplectus acutus	Hard-Stemmed Bulrush		x	x	x	x	x	x
Schoenoplectus pungens	Chairmaker's Rush			x	x	x	x	x
Schoenoplectus tabernaemontani	Soft-Stemmed Bulrush	x	x	x	x	x	x	x
Scirpus atrovirens	Black Bulrush			x				
Solanum pthycnthum	Bittersweet Nightshade		x					
Solidago spp	Goldenrod		x					
Stuckenia pectinata	Sago Pondweed	x	x	x	x	x	x	x
Typha spp	Cattail	x	x	x	x	x	x	x
Vallisneriaa americana	Water Celery	x	x	x		x	x	x
Zosterella dubia	Water Stargrass		x		x	x	x	
Aquatic Moss			x		x	x		x
Freshwater Sponge			x		x	x	x	x

In 2011, Lychnothamnus barbatus (Bearded Stonewort), was discovered in Jordan Lake. Until it was found in Wolf, Parker, Deep and Peppermill Lakes in Adams County in 2010, this rarest of the Charophytes had never been found in the Western Hemisphere.

Charophytes play important roles in aquatic ecosystems in the food web, in providing habitat, and in increasing water quality. They do not thrive in murky, turbid or dirty water. Many ducks, amphibians & reptiles directly use these species as food. Charophytes also serve as a location for insects that provide food for fish and other wildlife. In particular, insects that provide food for game fish like bluegills, smallmouth and largemouth bass are often found on Charophytes. In the winter, Charophytes provide shelter for overwintering insects.

In addition to providing habitat for important invertebrates and food for fish and wildlife, Charophytes serve as protection and cover for young fish. They are important in the predator-prey ratio. Their presence has even been known to inhibit the survival of mosquito larvae. Studies in Europe suggest Charophyte beds are important for northern pike and walleye spawning.

Perhaps the most important role in an aquatic ecosystem that Charophytes serve is in water quality. They naturally filter the water and play an important part in nutrient cycling. They hold massive amounts of phosphorus that might otherwise be available for less attractive algae or nuisance aquatic plant growth. In hard water lakes like Parker Lake, the calcification on the Charophytes ties up even more phosphorus.

They are known to play important roles in forming and shaping an aquatic environment, influencing both abiotic (pH, water clarity) and biologic (structure of phytoplankton) factors. Besides holding phosphorus, they also hold a lot of nitrogen, which is the second most influential factor in the presence of nuisance aquatics. They deliver oxygen to sediments, enhancing the nitrogen cycle and preventing iron-bound phosphorus from being released into the water column.

Charophytes also stabilize bottom sediments, reducing resuspension of sediment particles (which are often laden with nutrients) into the water column. Studies have shown that they reduce resuspension up to 100 times more than aquatic plants.

<u>Fishery</u>

Jordan Lake has a diverse fishery, with largemouth bass and bluegill being historically the most abundant fish. Black crappie, bullheads, and northern pike were common, but walleyes and perch tend to be scarce. The lake does not have a history of fish kills from low oxygen.

Banded killifish (*Fundulus diaphanous*), a threatened/endangered fish species, has been found in Jordan Lake in the past.

WDNR stocking records for Jordan Lake date back to 1933 when 308 black bass were stocked. The lake was stocked annually from 1933 through 1950, mostly with bass, panfish, walleye and northern pike. Between 1953 and 1981, WDNR stocked the lake only occasionally, mostly with brown and rainbow trout. From 1981 through 2002, Jordan Lake was stocked annually by the WDNR. The bulk of this stocking was walleye (146,051), brown trout (about 9000), largemouth bass (5325) and northern pike (1800).

The most recent fishery survey occurred in 2006. It found predator fish such as largemouth bass and northern pike; panfish including bluegills, black crappie, pumpkinseed; and both yellow perch and brown trout.

Shoreline Use

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 was vegetated with native plants (grasses, forbs, shrubs, trees).

Traditional mowed cultivated lawn had the highest coverage, covering 42.17% of the shore. These types of disturbed shorelines have been found to contribute negatively to water quality. They do not provide food or shelter for wildlife and fish and may degrade spawning beds. They tend to increase runoff and excess nutrients. The lack of plant cover tends to warm the water by disturbed areas, encouraging the growth of algae and nuisance aquatic plants. Also, cover like hard surface retaining walls deflect waves off the walls, stirring up sediments and destroying vegetation. In addition, the Jordan Lake water level rose in the mid-1980s, changing the shore parameters.

Shorelands are critical habitat necessary for the protection and enhancement of lake water quality, fisheries, wildlife and aquatic life. They provide shelter and food for wildlife and fish. They support spawning beds, cover and feeding areas for fish and invertebrates. Native vegetation filters and traps pollutants and excess nutrients, preventing them from entering the lake water, thus protecting water quality. They provide significant aesthetic beauty and can also serve as a visual and audio buffer between the shoreland residents and lake traffic or noise. It is essential to protect existing natural shorelands and restore shoreland habitats that have been eliminated or degraded by nearshore development. Natural shorelands contain a mixture of native plants including trees, shrubs, grasses and forbs (wildflowers) that provide critical habitat for water-dependent wildlife and help filter stormwater runoff by removing excessive nutrients and sediments before they reach the lake.

Wildlife and Endangered/Threatened Resources

The only known endangered or threatened resource on the state or federal lists found in either of the Jordan Lake watersheds is the Banded Killifish. This species has not been seen in recent years. Two families of bald eagles nest around the lake, as do sandhill cranes.

Priority Watershed

From 1992-2002, many conservation practices were planned in the Jordan Lake surface watershed as part of the state's Priority Watershed Program for Neenah Creek. That plan indicated that the watershed had no inventoried animal lots. According to this plan, upland sediment delivery to the lake was estimated at 372 tons per year, with upland erosion being identified as a major source of sediment in the watershed. Sediment delivery from ponds or lakeshores was estimated to be 22 tons per year.

The plan made some recommendations: (1) reduction of runoff from lawn fertilizers, which was believed to be a problem in the lake; (2) installation of shoreline buffers; (3) purchase of an easement on the undeveloped east shore to protect northern pike spawning grounds; (4) development and implementation of a lake management/protection plan. The only one of these goals that has been accomplished is the development of this lake management plan. It does include going forward on recommendations (1), (2) and (3).