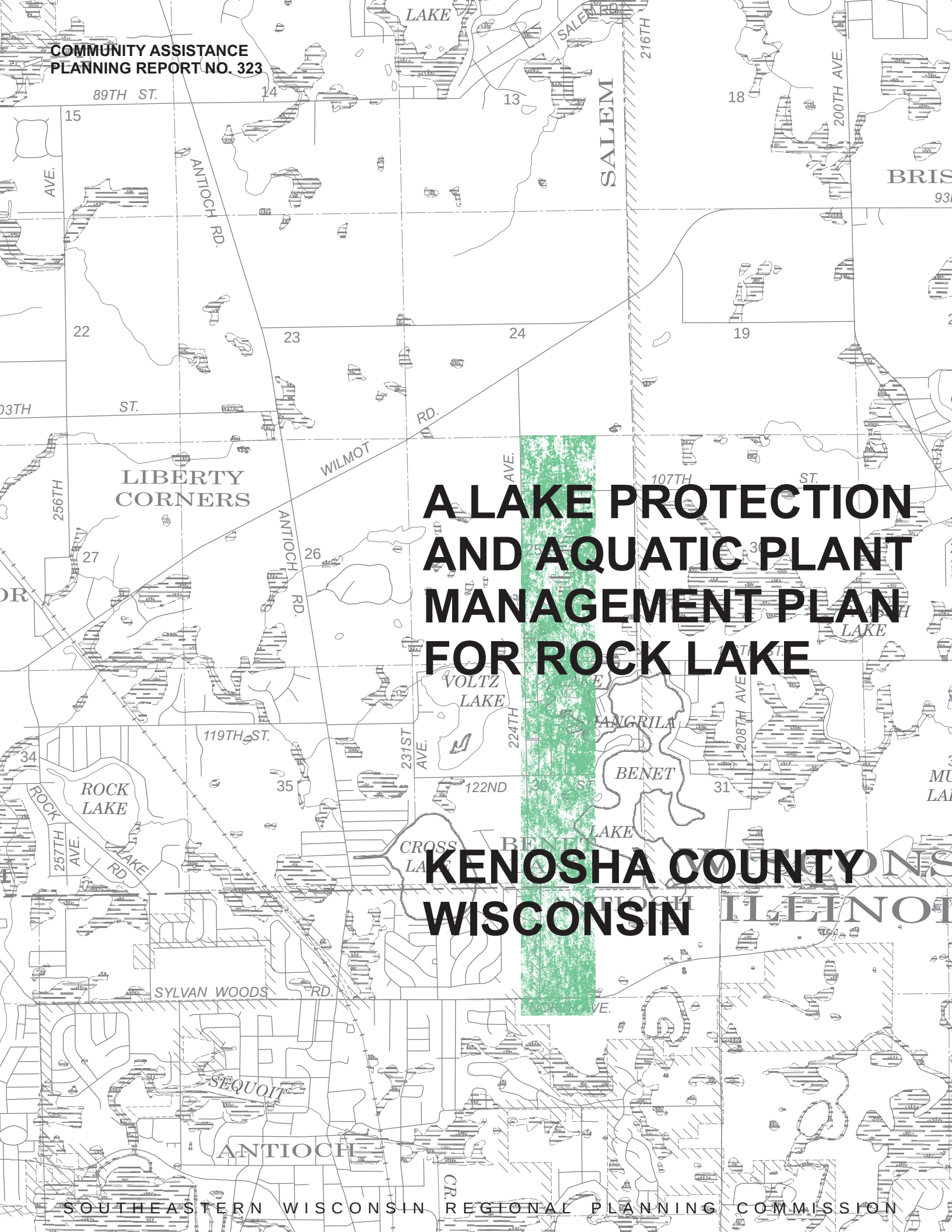
COMMUNITY ASSISTANCE
PLANNING REPORT NO. 323

A LAKE PROTECTION AND AQUATIC PLANT MANAGEMENT PLAN FOR ROCK LAKE

KENOSHA COUNTY WISCONSIN



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NUMBER 323

A LAKE PROTECTION AND AQUATIC PLANT MANAGEMENT PLAN FOR ROCK LAKE, KENOSHA COUNTY, WISCONSIN

Prepared by the

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INTRODUCTION

PURPOSE OF PLAN

Research shows that the health of a lake or stream is usually a direct reflection of the use and management of the land within its watershed. Research also shows that interventions are often necessary to maintain or improve the conditions of these resources. Located within U.S. Public Land Survey Section 34, Township 1 North, Range 20 East, in the Town of Salem, Kenosha County (see Map 1), Rock Lake, together with its watershed and associated wetlands, is a high-quality natural resource (see "Rock Lake Characteristics and Assets" section below). The purpose of this plan is to provide a framework to protect and improve the land and water resources of Rock Lake and its watershed with a focus on *protecting* this existing high-quality resource from human impacts and *preventing* future degradation from occurring. The recommendations provided in this report are appropriate and feasible lake management measures for enhancing and preserving the native plant community and water quality of Rock Lake, while still providing the public with opportunities for safe and enjoyable recreation within the Lake's watershed.

It is important to note that this plan complements other existing plans,[1] programs and ongoing management actions in the Rock Lake watershed and represents the continuing commitments of government agencies, municipalities, and citizens to diligent lake planning and natural resource protection. Additionally, it was designed to assist State agencies, local units of government, nongovernmental organizations, businesses, and citizens in developing strategies that will benefit the natural assets of Rock Lake. By using the strategies outlined in this plan, results will be achieved that enrich and preserve the natural environment.

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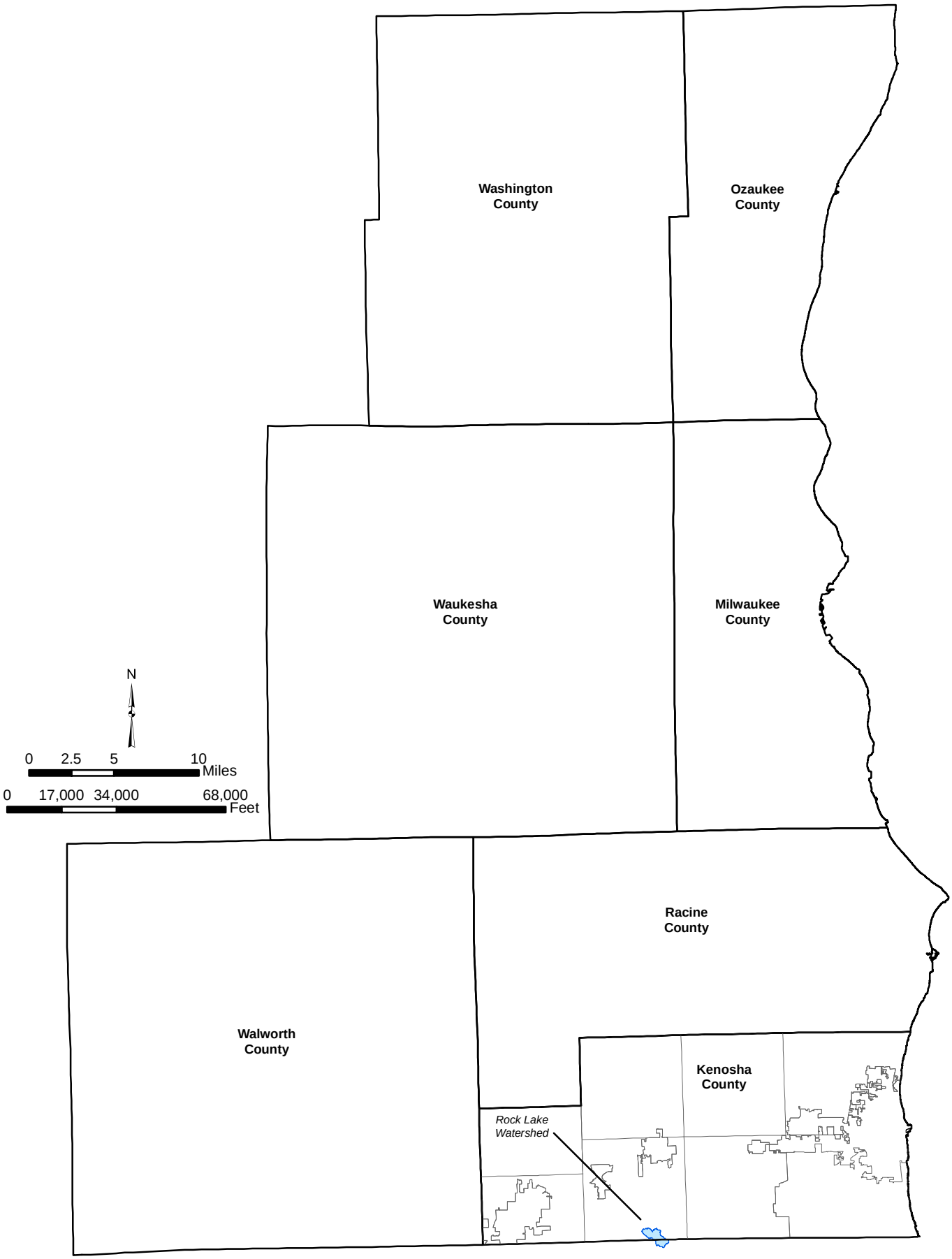
[1]*Town of Salem, Storm Water Management Plan, September 2009; SEWRPC Community Assistance Planning Report No. 275,* A Park and Open Space Plan for the Town of Salem: 2020, Kenosha County Wisconsin, *2005; and SEWRPC Community Assistance Planning Report No. 306,* A Comprehensive Plan for the Town of Salem: 2035, Kenosha County Wisconsin, *2010.*

Map 1

LOCATION OF THE ROCK LAKE WATERSHED STUDY AREA



Source: SEWRPC.

This planning program was partially funded by the Town of Salem and by the Rock Lake Restoration Association.[2] The inventory and aquatic plant management plan elements presented in this report conform to the requirements and standards set forth in the relevant *Wisconsin Administrative Codes.*[3]

ROCK LAKE CHARACTERISTICS AND ASSETS

Rock Lake is a 45.6-acre[4] lake with a maximum water depth of 33 feet (see Map 2 for the Lake's bathymetry). The Lake's levels are maintained by a spillway located on the outlet channel, which eventually discharges to the Fox River. The Wisconsin Department of Natural Resources (WDNR) has classified the Lake as a drained, or headwater, lake, meaning that the Lake has no true inlet (i.e., no river draining towards it) and has a continuously flowing outlet. A drained lake's primary source of water is from precipitation and direct drainage from the surrounding land (as opposed to from groundwater inflows). Table 1 further details the hydrologic and morphologic characteristics of the Lake. Chapter II provides more details on the importance of these characteristics.

Rock Lake and its watershed have a wide range of assets, particularly given their limited sizes. For example, Rock Lake is a recreational lake which is able to support a variety of recreational opportunities as is evidenced by the recreational survey completed by Southeastern Wisconsin Regional Planning Commission (SEWRPC) staff in the summer of 2012 (see Chapter II for more details), which shows that lake users engage in full-body contact uses (such as swimming from the beach) as well as low-speed boating and fishing activities. The Lake is also able to support a wide variety of wildlife including largemouth bass, panfish, and trout. In fact, it is one of the only lakes in Wisconsin that has been managed as a coldwater fishery, due to its ability to maintain cold lake bottom temperatures. Additionally, as is also further described in Chapter II, the Lake's watershed contains a critical species habitat area, as well as a variety of wetlands, uplands, and woodlands. It is also expected that the Lake and its watershed support several species of reptiles and amphibians that live in and around the Lake, as well as a number of bird species that inhabit the area during migration.[5]

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[2]*The Rock Lake Restoration Association is an incorporated association (which is qualified to receive state grant dollars) that engages in management activities on Rock Lake. The Association's purpose, quoted from its Articles of Incorporation, is as follows: "The Corporation is organized and shall be operated to support the protection or improvement of Rock Lake located in the Town of Salem, Kenosha County, Wisconsin, for the benefit of the general public; to engage in activities relating to the aforementioned purposes; and to invest in, receive, hold, use and dispose of all property, real or personal, as may be necessary or desirable to carry into effect the aforementioned purposes."*

[3]*This plan has been prepared pursuant to the standards and requirements set forth in the following chapters of the* Wisconsin Administrative Code*: Chapter NR 1, "Public Access Policy for Waterways;" Chapter NR 40, "Invasive Species Identification, Classification and Control;" Chapter NR 103, "Water Quality Standards for Wetlands;" Chapter NR 107, "Aquatic Plant Management;" and Chapter NR 109, "Aquatic Plants Introduction, Manual Removal and Mechanical Control Regulations."*

[4]*A Lake area of 45.6 acres was reported in two publications on Rock Lake, including a Kenosha County Lake Classification report completed in 1959 and a WDNR aquatic plant survey report completed in 2006. However, there have been other sizes that have been reported as well, including 53 acres on the WDNR website and 43.7 acres in a lake survey conducted by WDNR in 1967.*

[5]*These estimates are based on bird, amphibian, and reptile databases for the Region.*

Map 2

BATHYMETRIC MAP OF ROCK LAKE

DATE OF PHOTOGRAPHY: APRIL 2010

—20'— WATER DEPTH CONTOUR IN FEET

Source: Wisconsin Department of Natural Resources and SEWRPC.

N

0 0.035 0.07 Miles

0 200 400 Feet

LAKE PROTECTION PROGRAMS AND GOALS

General lake protection goals and objectives for Rock Lake, aimed at maintaining and enhancing the Lake's many assets, were developed as a part of this planning process. These goals and objectives were developed in consultation with the Rock Lake Restoration Association and the Town of Salem, as well as in consultation with the public. These goals and objectives also directly address goals established in the Kenosha County multi-jurisdictional comprehensive plan[6] and the Town of Salem Comprehensive Plan,[7] and include:

1. To document the aquatic plant community and fishery of Rock Lake, with emphasis on the occurrence and distribution of nonnative species—This report details the aquatic plant survey completed by SEWRPC staff in 2012 for the purpose of understanding the aquatic plant community, and it summarizes fish surveys completed by WDNR staff;

2. To describe existing conditions in the Rock Lake watershed including identification and quantification of potential point and nonpoint sources of pollution, nutrient and contaminant inputs, and nutrient and contaminant balances—This report identifies pollution sources, and provides nutrient load estimates for the directing pollution control management efforts;

Table 1

HYDROLOGY AND MORPHOMETRY OF ROCK LAKE

Parameter	Measurement
Size	
Surface Area of Lake	45.6 acres[a]
Lake Volume	1,062 acre-feet
Residence Time[b]	1.8 years
Shape	
Length of Lake	0.3 mile
Width of Lake	0.25 mile
Length of Shoreline	1.4 miles
Shoreline Development Factor[c]	1.4
General Lake Orientation	None
Depth	
Maximum Depth	33 feet
Mean Depth	20 feet
Percentage of Lake Area	
Under Three feet	11 percent
Over 20 feet	41 percent

[a]Rock Lake has been reported as several different sizes including 43.7 acres, 45.6 acres, and 53 acres. 45.6 acres was used in this report due this size being the most frequently referenced.

[b]Residence time is estimated as the time period required for a volume of water equivalent to the volume of the lake to enter the lake during years of normal precipitation.

[c]Shoreline development factor is the ratio of the shoreline length to the circumference of a circular lake of the same area. It can be used as an indicator of biological activity (i.e., the higher the value, the more likely the lake will be to have a productive biological community).

Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, and SEWRPC.

3. To identify the extent of any existing and potential future water quality problems likely to be experienced in the Lake, including an assessment of the Lake's water quality using monitoring data being collected as part of ongoing programs along with estimates of changes in these conditions in the future—This report includes an inventory of all available water quality data for Rock Lake, draws conclusions from those data, and provides recommendations based on the evaluation of those data; and

[6]*SEWRPC Community Assistance Planning Report No. 299,* A Multi-Jurisdictional Comprehensive Plan for Kenosha County: 2035, *April 2010.*

[7]*SEWRPC Community Assistance Planning Report No. 306,* A Comprehensive Plan for the Town of Salem: 2035, *March 2010.*

4. To formulate appropriate lake protection programs, including public information and education strategies and other actions necessary to address the identified problems and issues of concern—This report uses the information described above to develop lake protection recommendations and provides recommendations related to the issues and concerns of Rock Lake residents, including an aquatic plant management plan.

In addition to these goals and objectives, this plan provides a comprehensive set of specific recommendations to achieve those goals and to guide future efforts to protect and enhance Rock Lake. Implementation of the recommended actions set forth herein should serve as an important step in achieving the lake use/protection objectives over time.

Chapter II

ISSUES AND CONCERNS

INTRODUCTION

Despite Rock Lake being a valuable resource, as discussed in Chapter I of this report, it is subject to a number of existing and potential future problems and issues of concern. In order to better define and understand these issues, and to provide for the continued recreational use of the Lake, the Town of Salem, at the request of the Rock Lake Restoration Association, executed an agreement with the Southeastern Wisconsin Regional Planning Commission (SEWRPC) to investigate the causes of community concerns and to develop a comprehensive lake management plan to address those causes.

As a part of this planning program, a list of the issues and concerns to be addressed in the management plan were identified through various means, including:

- Consultations with Rock Lake community members, including the Rock Lake Restoration Association and the Rock Lake Highlands Association,[1] which identified nine general issues of concern; and

- A public meeting, where the issues of concerns were further discussed. This meeting also involved an informal survey of participants which provided individuals an opportunity to privately voice their concerns with respect to the Lake and its management. This workshop validated the emphasis on the previously determined issues of concern, and resulted in the identification of two additional issues of concern.

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[1]*The Rock Lake Highlands Association is a homeowners association focused on the management of Rock Lake. The Association's purpose, quoted from their bylaws, is as follows: "To serve as an association of owners who own real estate and improvements in Rock Lake Highlands, a subdivision located in Trevor, Wisconsin, Town of Salem. To serve as a means through which owners may own, administer, manage, operate and control the common areas and lots in accordance with its declaration. To promote the general welfare and improvements to common areas. To maintain, preserve and protect Rock Lake and its surroundings, to enhance the water quality, fishing and boating safety and aesthetic values of Rock Lake as a public recreational facility for the collective interests of the members and the general public. To engage in lawful activity within the purpose, for which a nonstock, nonprofit, corporation may be organized under the Wisconsin Nonstock Corporation Law."*

This chapter presents a summary of each of the issues of concern (as shown in Table 2) and seeks to answer the questions posed by Lake residents at the workshop and during the consultations. This chapter also presents information relevant to understanding the recommendations provided in Chapter III of this report.

Table 2

ISSUES OF CONCERN

	Issues and Concerns
1	Aquatic Plant Growth
2	Water Quality
3	Blue Green and Floating Algae
4	Sedimentation
5	Shoreline Maintenance
6	Water Quantity
7	Spillway/Lake Outflow
8	Recreational Use Maintenance
9	Public Access Site
10	Wildlife
11	Plan Implementation

Source: SEWRPC.

ISSUE 1: AQUATIC PLANT GROWTH

The majority of the issues of concern discussed within this planning process relate to aquatic plant management, which was the initial and primary purpose of this planning effort. Several perspectives were voiced, including 1) differing perceptions of the need for in-lake aquatic plant management and 2) differing perceptions about the best alternatives to use that will still maintain the health of the Lake and its users. Consequently, this section first discusses the general need for aquatic plant management by evaluating the current state of aquatic plants in Rock Lake, and then discusses management alternatives.

Aquatic Plants in Rock Lake

To investigate the need for aquatic plant management, SEWRPC staff completed an aquatic plant survey in the summer of 2012, using a point intercept methodology.[2] This survey revealed that the five most dominant *native* plant species in Rock Lake, in descending order, were: coontail (*Ceratophyllum demerum)*, muskgrass (*Chara* spp.), white water lily (*Nuphar* odorata), elodea (*Elodea canadensis*), and sago pondweed (*Stuckenia peectinata*) (see Table 3 for the list of aquatic plant species that were found and for characterization of their abundance and dominance). Individual distribution maps for each species found are included in Appendix A, along with text explaining the ecological significance of each plant and guidance on their identification.

Of the 66 sites shallow enough to be sampled in Rock Lake in the summer of 2012, all of them had heavy vegetation,[3] and most of them **contained vegetation known to interfere with recreational use** (such as coontail, lilies, and Eurasian water milfoil). <u>These results indicate that the Lake has levels of plants that deter recreational use, thereby warranting aquatic plant management</u>.

It is important, however, to note that even though a plant impedes access to a lake, it should not necessarily be eliminated or even significantly reduced because it may serve other beneficial functions. For examples, the white water lily (one of the plants impeding navigation) plays a major role in providing shade, habitat, and food for fish and other important aquatic organisms. It also plays a significant role in preventing shoreline erosion, as it can damper waves that would otherwise damage the shoreline. Additionally, the shade that this plant provides helps

[2]*The point intercept method uses predetermined points arranged in a grid pattern across the entire lake surface as sampling sites. Each site is located using global positioning system (GPS) technology and a single rake haul is taken at that site. A quantitative assessment of the rake fullness, on a scale of zero to three, is then made for each species identified. Further details on the methodology can be found at Wisconsin Department of Natural Resources, Publication No. PUB-SS-1068 2010.*

[3]*Heavy vegetation in this context refers to a rake fullness measurement of three (see Map 4 or Appendix A for schematic).*

Table 3

ABUNDANCE DATA FOR AQUATIC PLANT SPECIES IN ROCK LAKE: 2012

Aquatic Plant Species	Native or Invasive	Number of Sites Found	Dominance Value[a]
Floating Plants			
Nymphaea odorata (white water lily)	Native	43	193.9
Nuphar variegata (spatterdock)	Native	6	19.7
Emergent Plants			
*Pontederia cordata (*pickerel weed)	Native	3	9.1
Submerged Plants			
Ceratophyllum demersum (coontail)	Native	63	339.4
Chara spp. (muskgrass)	Native	34	250.0
Myriophyllum spicatum (Eurasian water milfoil)	Invasive	44	189.4
Elodea canadensis (waterweed)	Native	27	145.5
Stuckenia pectinata (Sago pondweed)	Native	9	37.9
Potamogeton praelongus (white-stem pondweed)	Native	10	33.3
Zosterella dubia (water stargrass)	Native	8	28.8
Potamogeton gramineus (variable pondweed)	Native	4	16.7
Potamogeton zosteriformis (flat-stem pondweed)	Native	3	10.6
Myriophyllum sibiricum (native milfoil)	Native	2	4.5
Ranunculus longirostris (white water crowfoot)	Native	1	3.0
Vallisneria americana (eel-grass/wild celery)	Native	1	3.0

NOTE: Sampling occurred at 66 sampling sites; all 66 had vegetation.

[a]*The **dominance value** of a species is derived from a combination of how often it was observed at sampling sites that had some kind of vegetation present and its relative density at those sites; it provides an indication of the dominance of a species within a community.*

Source: SEWRPC.

reduce the growth of other plants, such as Eurasian watermilfoil and coontail, because it limits the amount of sunlight that reaches those plants. Given these benefits, removal of native "nuisance" plants (especially white water lilies) beyond the needs for gaining access to the Lake, should be avoided.

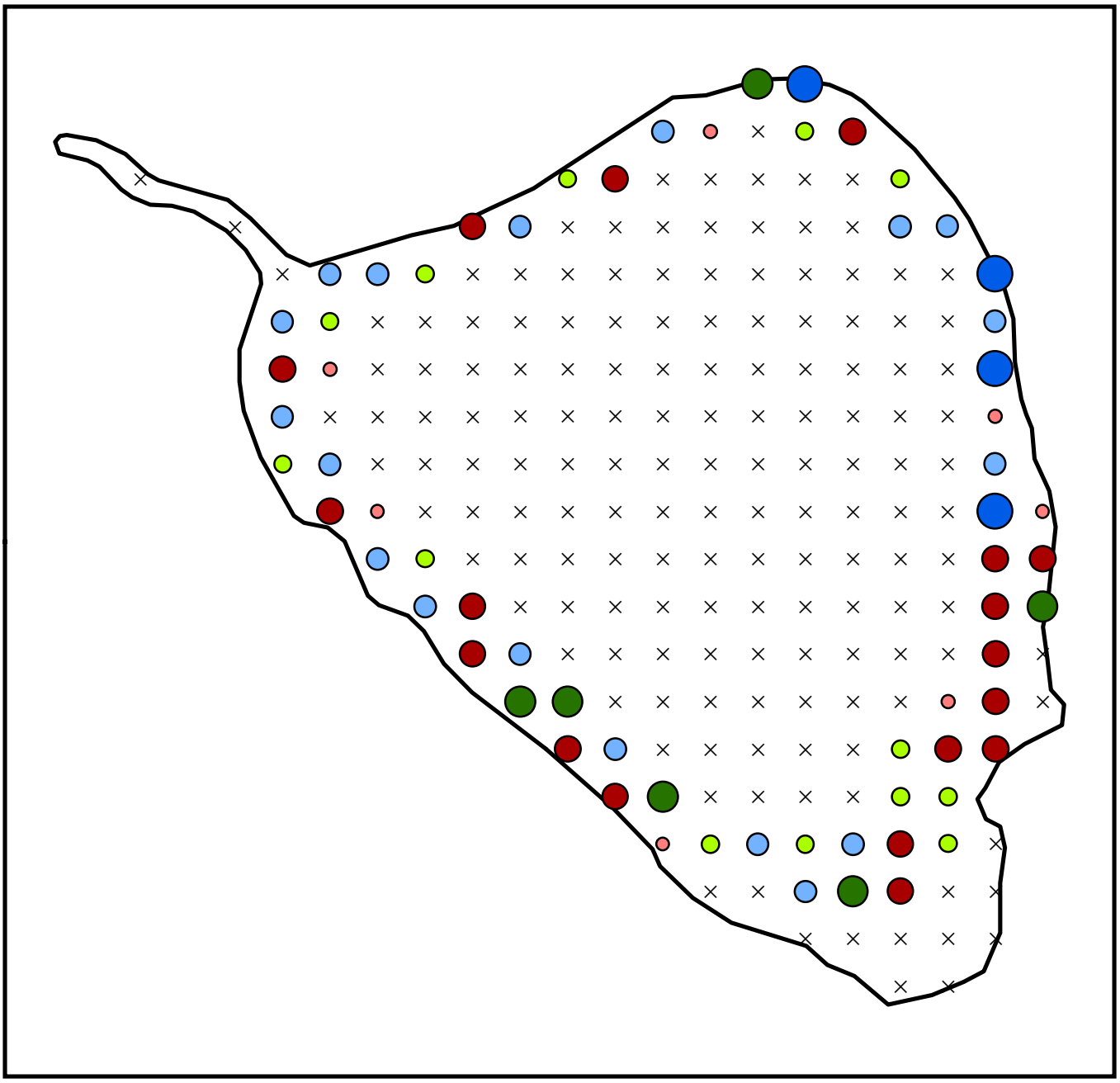
It is also important to note that all lakes have plants. In fact, in a nutrient-rich lake such as Rock Lake (nutrient-rich lakes are very common in the Southeastern Wisconsin Region due to soils in the Region being rich in nutrients), it is actually normal to have high amounts of aquatic plant growth in the shallow areas. Additionally, it is important to note that **native aquatic plants form an integral part of a lake ecosystem**. These plants serve a number of valuable functions, including: improving water quality by using excess nutrients, providing habitat for invertebrates and fish, stabilizing lake bottom sediments, and supplying food and oxygen to the Lake through photosynthesis.

With 14 different native submerged and floating species of aquatic plants (including white-stem pondweed),[4] the 2012 survey also revealed that Rock Lake contains a **very good diversity of aquatic species**, especially for a lake of its size (see Map 3). This indicates that the native plants within the Lake are a crucial part of the Lake's

[4]*Of the pondweeds that occur in the Region, white-stem pondweed is of special importance because of its sensitivity to changes in water quality and intolerance of turbidity. It is considered a valuable water quality indicator species, since its disappearance from a lake is usually an indication of deteriorating water quality. Of the 66 sampled sites, 10 sites contained white-stem pondweed.*

Map 3

SPECIES RICHNESS AT SURVEY SITES IN ROCK LAKE: 2012



NOTE: The above diagram presents the data for number of species observed in Rock Lake at each sampling site during the 2012 aquatic plant survey. Sampling occurred at 65 sampling sites; 65 had vegetation.

NUMBER OF SPECIES

- NOT SAMPLED
- 1
- 2
- 3
- 4
- 5
- 6

N

0 0.025 0.05 Miles

0 150 300 Feet

Source: Wisconsin Department of Natural Resources and SEWRPC.

health. Therefore, the native plants should be protected to the greatest extent practical. This conclusion is also further supported by an aquatic plant survey undertaken by WDNR in 2004,[5] which noted a robust native plant community which appeared to be competing effectively with Eurasian watermilfoil.[6] See Appendix B for the complete WDNR report from 2006.

In addition to the high degree of native plant growth found within the Lake (which indicates that a controlled aquatic plant management effort should be undertaken), the 2012 survey also revealed that **Eurasian water milfoil (*Myriophyllum spicatum*), a *nonnative* species, was, overall, the fourth most dominant species** (Eurasian water milfoil was found in 44, or 67 percent, of the 66 sampling sites in Rock Lake). Map 4 shows the distribution and density of the Eurasian water milfoil infestation in Rock Lake. As this plant has been known to cause severe recreational use problems in lakes within the Southeastern Wisconsin Region, and since Eurasian water milfoil populations can displace native plant species and interfere with recreational use, the abundance of this species indicates the need to actively control its population. This further emphasizes the need to employ an aquatic plant management effort.

Aquatic Plant Management Alternatives

A number of concerns and conflicting positions voiced by Lake residents were discussed during the local consultations and workshop, including:

1. The general desire for effective Eurasian water milfoil control and the desire to have navigation lanes through the heavy aquatic plant growth that occurs in the nearshore areas of the Lake. This discussion revealed varying beliefs among residents about the best way to accomplish these goals.

2. The desire of some residents to prevent chemical treatment, in contrast to the desire of other residents to use chemical treatment effectively. These desires were generally accompanied by concerns about whether this method is effective and safe for residents and the lake ecosystem.

3. General questions and concerns about the efficacy and risks associated with harvesting and hand-pulling as methods for aquatic plant management.

4. Concerns and needs regarding permit requirements and compliance, both in relation to current harvesting practices, as well as potential future chemical treatments.

5. General questions and concerns about harvesting operations, including floating plant fragment collection, plant pickup, and sediment resuspension.

Most of these concerns relate to understanding the efficacy of aquatic plant management alternatives and understanding the process behind their implementation. Consequently, this section discusses each of the management alternatives as it relates to these topics and the risks they pose to lake users and native aquatic plant species in the Lake (which was determined to be a priority, as noted earlier in this chapter). These discussions conclude with initial recommendations for each of the management alternatives.

It is important to note that there are conflicting interests when it comes to aquatic plant management in general. This is because one goal may interfere with the accomplishment of another. Eurasian water milfoil eradication, for

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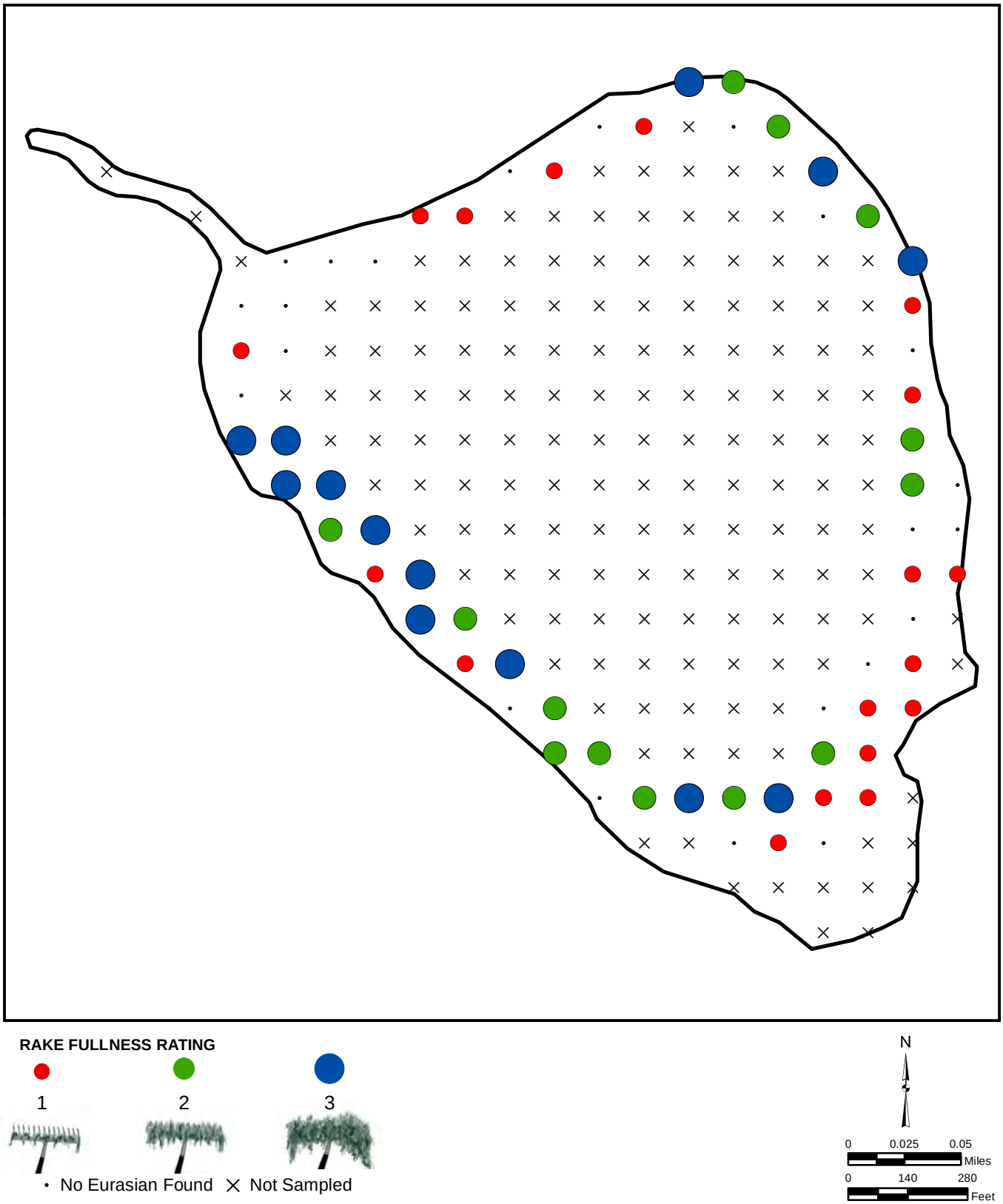
[5]*Maureen McBroom, Mike Hemmingsen, and Craig Helker,* WDNR Aquatic Plant Survey Report, Rock Lake, Kenosha County, *January 2006.*

[6]*A direct comparison between the 2004 and 2012 aquatic plant surveys was not made due to the different methodologies that were undertaken for each of the surveys (grid point versus transect surveys).*

Map 4

EURASIAN WATER MILFOIL OCCURRENCE IN ROCK LAKE: 2012



Source: Wisconsin Department of Natural Resources and SEWRPC.

example, could be accomplished with heavy chemical treatment; however, given that Eurasian water milfoil coexists with native plants (see Figure 1 and Map 5), including a very similar looking native milfoil plant (see Figure 2 and Appendix A), this technique would fail to accomplish the goal of preserving native plant populations. Consequently, all the initial recommendations made in this section are informed by all of the goals that need to be accomplished under this management plan, namely: access maintenance, control of Eurasian water milfoil, and protection of native species.

Aquatic plant management measures can be classified into five groups: 1) *physical measures*, which include lake bottom coverings; 2) *biological measures*, which include the use of organisms, including herbivorous insects; 3) *manual measures*, which involve the manual removal of plants by individuals; 4) *mechanical measures*, which include harvesting and removal of aquatic plants with a machine known as a harvester or the use of what is known as suction harvesting; and 5) *chemical measures*, which include the use of aquatic herbicides to kill nuisance and nonnative aquatic plants. All of these control measures are stringently regulated. Additionally, most of the alternatives require a State of Wisconsin permit. Chemical controls, for example, require a permit and are regulated under Chapter NR 107 of the *Wisconsin Administrative Code*, while placement of bottom covers, a physical measure, requires a Wisconsin Department of Natural Resources (WDNR) permit under Chapter 30 of the *Wisconsin Statutes*. All other aquatic plant management practices are regulated under Chapter NR 109 of the *Wisconsin Administrative Code*.

The aquatic plant management elements presented in this section consider alternative management measures consistent with the provisions of Chapters NR 103, NR 107, and NR 109 of the *Wisconsin Administrative Code*. Further, the alternative aquatic plant management measures are consistent with the requirements of Chapter NR 7 of the *Wisconsin Administrative Code*, and with the public recreational boating access requirements relating to eligibility under the State cost-share grant programs set forth in Chapter NR 1 of the *Wisconsin Administrative Code*.

Physical Measures

Lake bottom covers and light screens provide limited control of rooted plants by creating a physical barrier that reduces or eliminates the sunlight available to the plants. They are often used to create swimming beaches on muddy shores, to improve the appearance of lakefront property, and to open channels for motorboating. Various materials can be used with varied success rates. For example, pea gravel, which is usually widely available and relatively inexpensive, is often used as a cover material despite the fact that plants readily recolonize areas where it is used. Other options include synthetic materials, such as polyethylene, polypropylene, fiberglass, and nylon, which can provide relief from rooted plants for several years. These materials, known as bottom screens or barriers, generally have to be placed and removed annually, as they are susceptible to disturbance by watercraft propellers and to the build-up of gasses from decaying plant biomass trapped under the barriers. In the case of Rock Lake, the need to encourage native aquatic plant growth while simultaneously controlling the growth of exotic species, often in the same location, suggests that the placement of lake bottom covers as a method to control for aquatic plant growth is not viable, as it is not consistent with the objective of encouraging native aquatic plant growth.

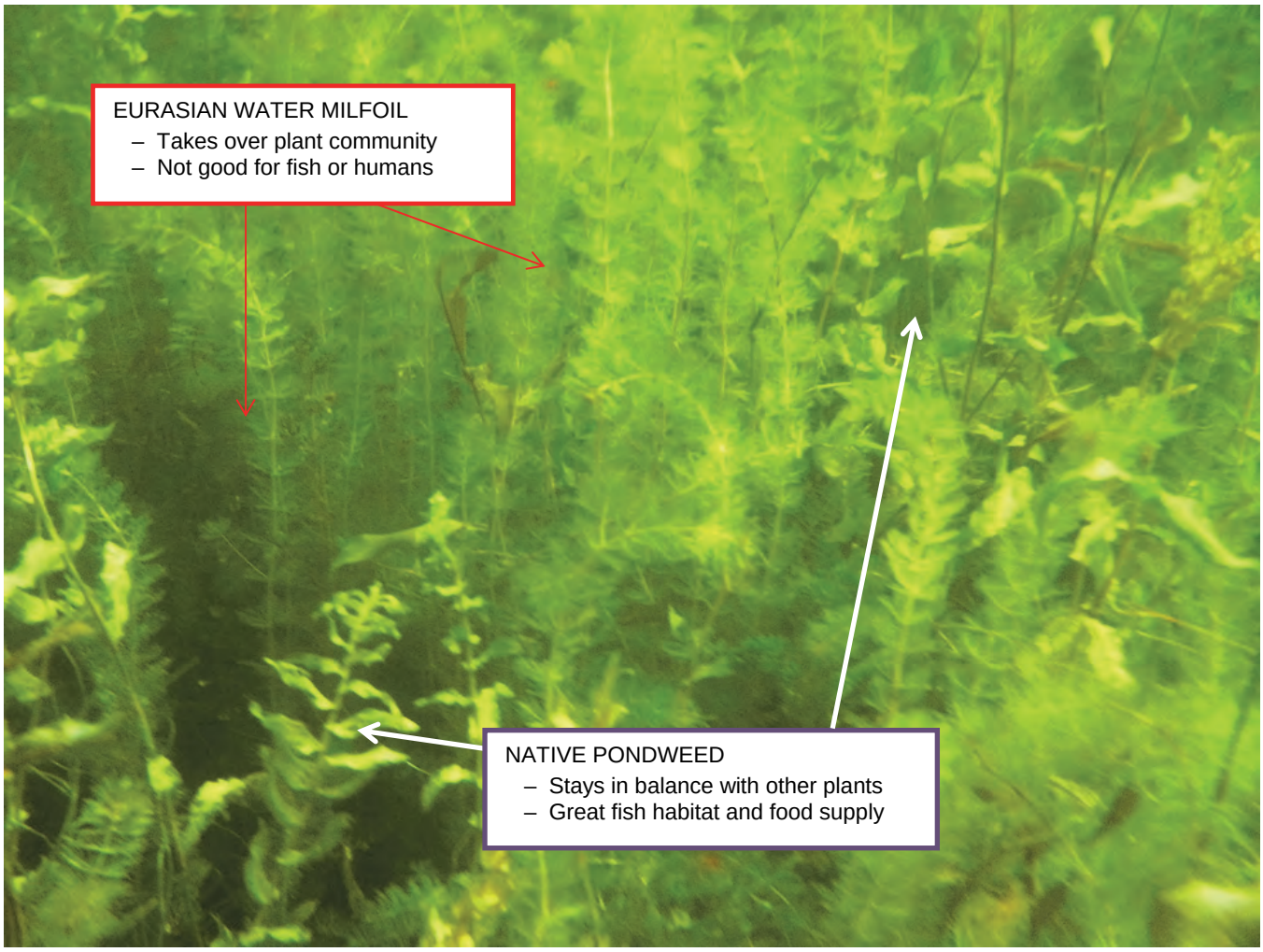
Biological Measures

Biological controls offer an alternative approach to controlling nuisance plants. Classical biological control techniques use herbivorous insects to control nuisance plants and have been shown to be successful in some southeastern Wisconsin lakes.[7] In fact, given that high traffic boat activity is not allowed on the Lake (a factor which often limits the efficacy these programs), Rock Lake may be a valid candidate for this kind of project,

[7]*B. Moorman, "A Battle with Purple Loosestrife: A Beginner's Experience with Biological Control,"* Lake Line, *Vol. 17, No. 3, September 1997, pp. 20-21, 34-3; see also, C.B. Huffacker, D.L. Dahlsen, D.H. Janzen, and G.G. Kennedy,* Insect Influences in the Regulation of Plant Population and Communities, *1984, pp. 659-696; and C.B. Huffacker and R.L. Rabb, editors,* Ecological Entomology, *John Wiley, New York, New York, USA.*

Figure 1

COINCIDENCE OF EURASIAN WATER MILFOIL AND NATIVE PONDWEED



Source: SEWRPC.

specifically if *Eurhychiopsis lecontei*, an aquatic weevil species, is released for the purpose of controlling Eurasian water milfoil. Thus, the use of *Eurhychiopsis lecontei* as a means of aquatic plant management control is considered a viable option for use on Rock Lake, subject to further logistical investigation.

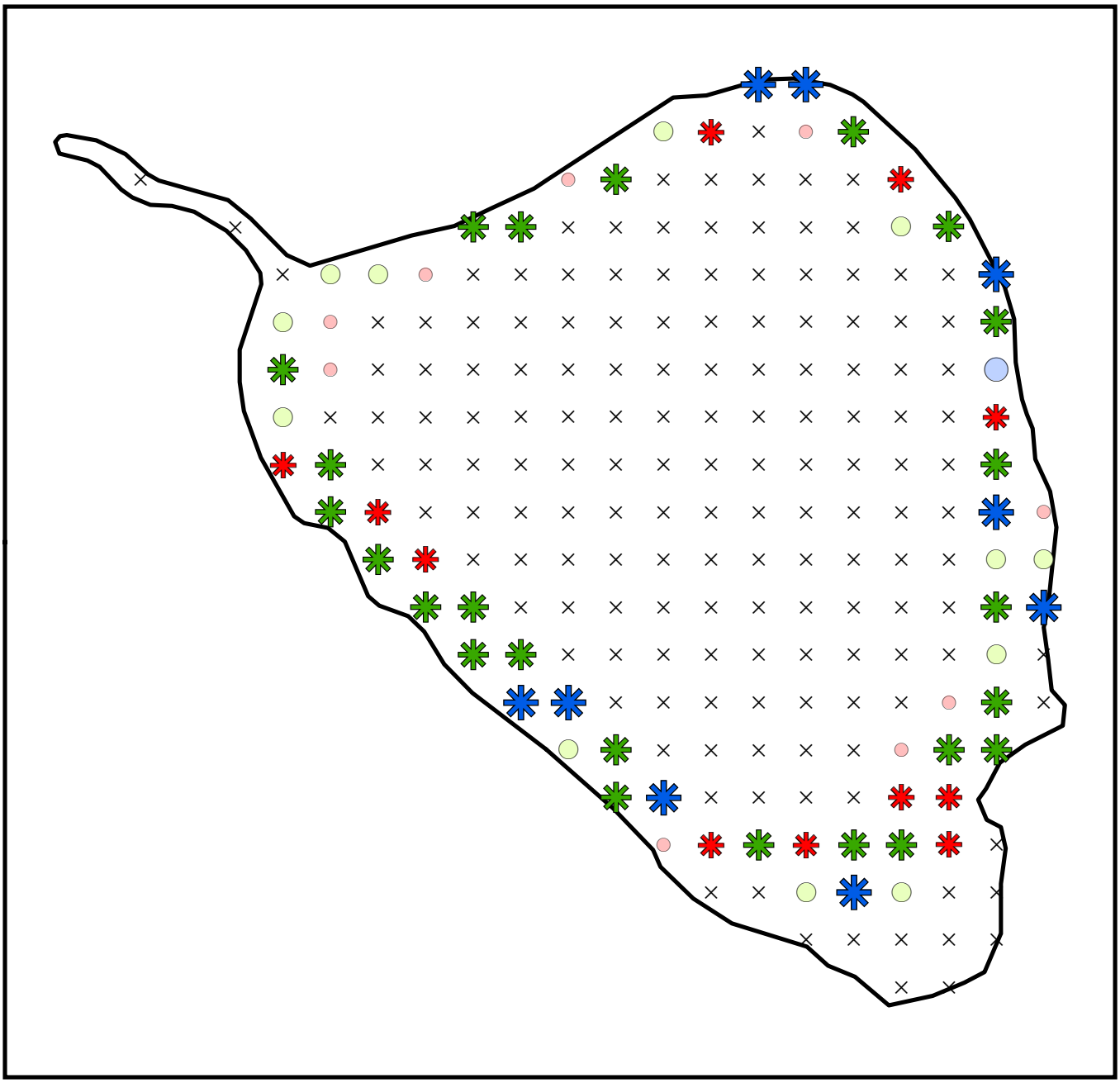
Manual Measures

The manual removal of specific types of vegetation provides a highly selective means of controlling the growth of nuisance aquatic plant species, including Eurasian water milfoil. There are two common manual removal methods: raking and hand-pulling.

Raking is conducted in nearshore areas with specially designed rakes. This method provides an opportunity to remove nonnative plants in shallow nearshore areas and also provides a **safe and convenient method for controlling aquatic plants in deeper nearshore waters around piers and docks**. The advantage of the rakes is that 1) they are relatively inexpensive (costing between $100 and $150 each), 2) they are easy and generate immediate results, and 3) they immediately remove the plant material from a lake without a waiting period, thereby preventing sedimentation from decomposing plant material. Should Rock Lake residents decide to implement this method of control, an interested party could acquire a number of these specially designed rakes for use by the riparian owners on a trial basis. Therefore, to deal with high plant growth in areas where other management efforts are not feasible, raking is considered viable.

Map 5

COINCIDENCE OF EURASIAN WATER MILFOIL WITH NATIVE AQUATIC PLANTS: 2012



[a]Native species richness refers to the number of native plants present at sampling site: Low=1 or 2; Medium=3 or 4; and High=5 or 6.

NATIVE SPECIES RICHNESS[a]

- ONLY EURASIAN WATER MILFOIL (EWM)
- NOT SAMPLED
- LOW
- MEDIUM
- HIGH
- LOW WITH EWM
- MEDIUM WITH EWM
- HIGH WITH EWM

N

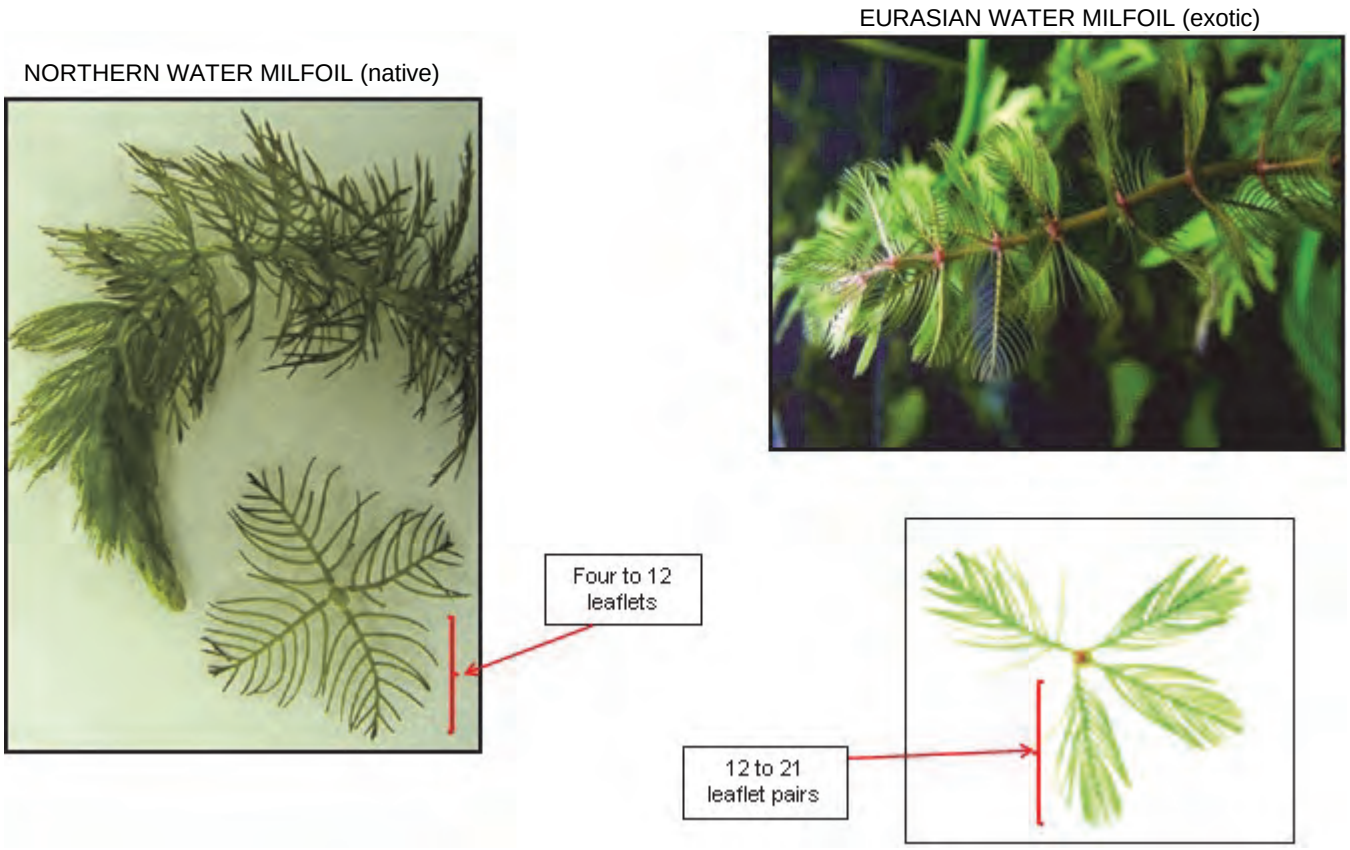
0 0.025 0.05 Miles

0 150 300 Feet

Source: SEWRPC.

Figure 2

COMPARISON OF NATIVE AND EURASIAN WATER MILFOIL



Source: SEWRPC.

The second manual control, hand-pulling of stems where they occur in isolated stands, provides an alternative means of controlling plants such as Eurasian water milfoil. **This method is particularly helpful when attempting to target nonnative plants in the high growth season, when native and nonnative species often coexist**. This is because this method allows for higher selectivity than rakes, mechanical removal, and chemical treatments, and, therefore, results in fewer losses of native plants. Additionally, the physical removal of the plants also prevents sedimentation, which could help maintain water depths in the Lake. Given these advantages, manual removal of Eurasian water milfoil through hand-pulling is considered a viable option in Rock Lake where practical. It could be employed by volunteers or homeowners, as long as they are trained on proper identification of Eurasian water milfoil. WDNR provides a multitude of guidance materials, including an instructional video, on the manual removal of plants, if this management alternative is to be engaged.

Pursuant to Chapter NR 109 of the *Wisconsin Administrative Code*, both raking and hand-pulling of aquatic plants in a 30 by 100 foot area (i.e., 30 feet of shoreline, including the "use" area, extending 100 feet into a lake), is allowed without a WDNR permit, provided that the hand-pulled plant material is removed from the lake. Any other **manual removal would require a State permit, unless employed in the control of designated nonnative invasive species**, such as Eurasian water milfoil. In general, all State permitting requirements for manual aquatic plant removal call for all hand-pulled material to be removed from the lake.

Mechanical Measures

Though other mechanical harvesting methods exist,[8] the use of a harvester (*mechanical harvesting*) and *suction harvesting* are the two methods that are currently permitted in Wisconsin. Consequently, this section will focus on these two measures specifically.

Traditional Harvesting

Aquatic plants can be harvested mechanically with specialized equipment known as harvesters. This equipment consists of a cutting apparatus that cuts up to about five feet below the water surface and a collection system (e.g., a conveyor and a basket) that picks up the majority of the cut plants. Mechanical harvesting can be a practical and efficient means of controlling sedimentation, as well as plant growth, as it removes the plant biomass, which would otherwise decompose and release nutrients into a lake. Mechanical harvesting is particularly effective for large-scale plant growth.

An advantage of mechanical harvesting is that the harvester, when properly operated, typically **leaves enough plant material in a lake to provide shelter for aquatic wildlife and to stabilize the lake bottom sediments, something that none of the other aquatic plant management methods accomplish**. Aquatic plant harvesting also has been shown to facilitate the growth of native aquatic plants by allowing light penetration to the lakebed. Finally, harvesting does not kill native plants in the way that other control methods do. Instead, this method simply cuts them back.

A disadvantage of mechanical harvesting is that the harvesting operations may cause **fragmentation of plants and, thus, unintentionally facilitate the spread of Eurasian water milfoil**, which utilizes fragmentation as a means of propagation, particularly in areas where plant roots have been removed. This <u>further emphasizes the need to prevent harvesting that removes the roots of native plants</u>. Harvesting may also disturb bottom sediments in shallow areas, thereby increasing turbidity and resulting in deleterious effects, including the smothering of fish breeding habitat and nesting sites. Disrupting the bottom sediments also could increase the risk of nonnative species recolonization, as these species tend to thrive under disturbed bottom conditions. To this end, **most WDNR-issued permits do not allow deep-cut harvesting[9] in areas having a water depth of less than three feet,** which would limit the utility of this alternative in some littoral areas of the Lake and especially in the inlet and outlet. Nevertheless, if done correctly and carefully and accomplished under suitable conditions, harvesting has been shown to be of benefit in maintaining navigation lanes and ultimately reducing the regrowth of nuisance plants while still maintaining native plant communities.

Another disadvantage of harvesting is that some cut **plant fragments can escape the collection system on the harvester**. This side effect occurs fairly frequently on lakes where harvesting is used. Generally, to compensate for this, most harvesting programs include a plant pickup program which includes using the harvester to pick up large amounts of floating plant material, as well as a program to pick up plants from lakefront property

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[8]*One of the other existing methods includes "weed rollers," which are used in neighboring States. These machines provide an automatic manual removal method that both cuts plants and displaces muck. At one time, they were permitted in Wisconsin, pending further study. Though the machines maintained plant and muck-free shorelines where they were employed, studies resulting from this trial period noted that the machines caused an increase in total suspended solids in the lake and caused localized nutrient release (by re-suspending the muck into the water column). Consequently, "weed rollers" are no longer permitted in the State of Wisconsin. If other weed control contraptions were identified that used a different mechanism, they could potentially be considered by WDNR pending further studies. The WDNR staff would have to be consulted regarding their use.*

[9]*Deep-cut harvesting is harvesting to a distance of only one foot from the lake bottom. This is not allowed in shallow areas because it is challenging to properly ensure that the harvester does not hit the lake bottom in these areas.*

owners who have raked plant debris onto their docks. This kind of program, when completed systematically, can help alleviate the aesthetic consequences of plant debris, which can accumulate on the lake shore.

During the planning process residents also asked questions related to "how much harvesting is too much?"—particularly in reference to detrimental effects on native plant communities. The answer to this question is dependent on harvester operators properly employing the harvesting technique (i.e., ensuring that plants are not uprooted and that a foot of plant material is allowed to remain). If these conditions are met, then the harvester acts more like a lawn mower for aquatic plants and has very few effects on the native plant community with the exception of preventing any one plant from taking over (something that is generally good).

Given that mechanical harvesting is currently being practiced on Rock Lake and the harvester has been purchased (see Figure 3), and considering the ability of harvesting to provide navigation lanes and prevent sedimentation with minimal damage to the Lake ecosystem, harvesting is considered viable for Rock Lake. However, if this program is to be engaged, plant collection programs to prevent nuisance amounts of aquatic plant fragment accumulation and a training program for all operators[10] should be employed.

Figure 3

PHOTOGRAPH OF HARVESTER LOCATED ON ROCK LAKE

Source: SEWRPC.

Suction Harvesting

In addition to harvesting with a harvester, there is an emerging harvesting method called Diver Assisted Suction Harvesting (DASH). DASH, also known as suction harvesting, is a mechanical process where divers select aquatic plants by their roots at the bottom of the lake and then insert the entire plant into a suction device, which takes the plant to the surface of the lake for disposal. The process is essentially a more efficient method for hand-pulling plants within a lake. This method was first permitted in Wisconsin in 2014. Long-term evaluations will take place to determine the efficacy of the technique. However, there appear to be many advantages to the method, including: 1) **lower possibility of plant fragmentation** in comparison to harvesting and traditional hand-pulling, thereby reducing regrowth of invasive plants like Eurasian water milfoil; 2) **increased selectivity in terms of plant removal** in comparison to harvesting with a harvester, thereby reducing the loss of native plants, and 3) **lower frequency of fish habitat disturbances**. Given these advantages, DASH is considered a viable option for the shallower areas (less than three feet) and in areas where Eurasian water milfoil is present among native plants, subject to permit requirement and provisions.

Both mechanical harvesting and suction harvesting are regulated by WDNR and require a permit for operation. Non-compliance with the permit requirements is legally enforceable with a fine or with the removal of

[10]*WDNR staff have offered to host this training session to ensure that all harvester operators are aware of the terms of the harvesting permit.*

the permit completely. The information and recommendations provided in this report will help meet the requirements for these permits, which can be granted for up to a five-year period.[11] At the end of that period, a new plant management plan will need to be developed to determine the success of the management technique. This updated plan should be based on a new aquatic plant survey and should evaluate the harvesting activities that occurred in the Lake during the harvesting period.[12] The operation of these techniques is overseen by the WDNR aquatic invasive species coordinator for the region.[13]

Chemical Measures

Chemical treatment with herbicides is a short-term method for controlling heavy growths of nuisance aquatic plants. Chemicals are generally applied to growing plants in either liquid or granular form. The advantages of using chemical herbicides to control aquatic plant growth are the relatively low cost, as well as the ease, speed, and convenience of application. The disadvantages associated with chemical control include:

1. **Unknown and/or conflicting evidence about long-term effects of chemicals on fish, fish food sources, and humans**—Chemicals approved by the U.S. Environmental Protection Agency to treat aquatic plants have been studied to rule out short-term (acute) effects on humans and wildlife. Additionally, some studies are also conducted to determine the long-term (chronic) effects of the chemical on animals (e.g., the effects of being exposed to these herbicides on an annual basis). However, it is often impossible to conclusively state that there will be no effects on a long-term basis, due to the constraints of animal testing, time restraints, and other issues. Additionally, long-term studies have not been completed on all of the potentially affected species[14] and there are conflicting studies/opinions regarding the role of the chemical 2,4-D as a carcinogen in humans.[15] (see Appendix C for further facts on 2,4-D). For some lake property owners, the risk of using this chemical may, therefore, be considered too great, despite the legality of use. Consequently, the concerns of lakefront owners should be taken into consideration whenever chemicals are used. Additionally, <u>if chemicals are used, they should be used as early in the season as possible to allow sufficient time for them to decompose in time for swimmers and lake users to utilize the lake in the summer</u>.[16] In relation to this issue, a question was asked about whether chemicals could get into the groundwater supply that the Lake residents use. Since, the chemicals that are used for aquatic plant management have half-lives of about two weeks to about a month,[17] it is unlikely that they would reach any groundwater supplies (as

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[11]*Five-year permits are granted so that a consistent aquatic plant management plan can be implemented over that time. This process allows the aquatic plant management measures that are undertaken to be evaluated at the end of the permit cycle.*

[12]*Aquatic plant harvesters must report harvesting activities as a part of the permit requirements.*

[13]*Information on the current aquatic invasive species coordinator can be found, for consultation, on the WDNR website.*

[14]*U.S. Environmental Protection Agency, EPA-738-F-05-002, 2,4-D* RED Facts, *June 2005.*

[15]*M.A. Ibrahim,* et al., *"Weight of the Evidence on the Human Carcinogenicity of 2,4-D"*, Environmental Health Perspectives, *Vol. 96, December 1991, p. 213-222.*

[16]*Though the labels allow swimming in 2,4-D-treated lakes after 24 hours, it is possible that some swimmers may want more of a wait time to ensure that they receive less exposure to the chemical. Consequently, allowing for extra time is recommended so that residents and Lake users can feel comfortable that they are not being unduly exposed.*

[17]*A half-life can be defined as the time required for half of the applied pesticide to be completely degraded, or broken down. The half-life of* 2,4-D *in water ranges from 12.9 days to 40 days, depending on conditions (see Appendix C). Generally, when chemicals are applied chemical residue tests are completed on the treated lake to ensure that the chemicals are being used in quantities that do not jeopardize the lake's health.*

groundwater moves slowly), thereby reducing the risk of contaminating individual private wells. However, specific studies of the groundwater-surface water interaction in the vicinity of the Lake, correlated with information on the levels of the chemicals that would affect human health, would be needed to determine whether the use of chemicals within the Lake could adversely affect private groundwater supplies.

2. **A risk of increased algal blooms due to the eradication of macrophyte competitors**—When nutrients exist in the Lake water, as is the case in Rock Lake, they will promote growth. Generally, if plants are not the primary user of the nutrients, algae has a tendency to take over. Overall, the loss of native plants and excessive use of chemicals must therefore be avoided, particularly if fish populations are to be maintained at a healthy level (fish require aquatic plants for food, shelter, and oxygen). Further details on this topic are discussed in the "Blue Green and Floating Algae" section of this chapter.

3. **A potential increase in organic sediments, as well as associated anoxic conditions that can cause fish kills**—When chemicals are used on large mats of aquatic plants, the dead plant material generally settles to the bottom of a lake and subsequently decomposes. This process leads to an accumulation of sediments, which may contribute to the muck accumulation that was identified as an issue of concern in this planning process. Additionally, this process can also lead to a loss of oxygen in the deep areas of a lake, as bacteria use the oxygen to decompose the plants (particularly in stratified lakes like Rock Lake). Extensive loss of oxygen can potentially create conditions that no longer support fish, causing fish kills. This process emphasizes the need to limit chemical control to early spring, when Eurasian water milfoil has yet to form dense mats.

4. **Adverse effects on desirable aquatic organisms due to loss of native species**—Native plants, such as pondweeds, provide food and spawning habitat for fish and other wildlife. Consequently, if native plants are unintentionally lost due to chemical application, the fish and wildlife populations often suffer. Consequently, if chemical application were to occur, only chemicals that target Eurasian water milfoil should be used in the early spring (when native plants have not yet emerged).

5. **A need for repeated treatments due to existing seed banks and/or plant fragments**—As mentioned previously, chemical treatment is not a one-time solution. The fact that the plants are not specifically removed from the lake increases the possibility for seeds/fragments to remain in the lake after treatment, thereby allowing for a resurgence of the species in the next year. Additionally, if large areas are left void of plants (both native and invasive) this leaves an area of disturbance (i.e., an area without an established plant community), which tends to be where Eurasian water milfoil thrive. In short, chemically treating large areas can sometimes leave opportunities for reinfestation. Consequently, repeated treatments would likely be needed if chemical treatment were to be employed.

As discussed earlier, there also are complicating factors associated with the application of chemicals to lakes, namely the coincidence of Eurasian water milfoil with native species, the physical similarities between Northern (native) and Eurasian water milfoil, and the presence of hybrid Eurasian water milfoil. However, **due to the early growth period of Eurasian water milfoil, there is an effective way to target the plant with chemicals while minimizing the first two of these factors, namely chemical treatment only in the early spring**. Early spring treatments have the advantage of being more effective due to the colder water temperatures, enhancing the herbicidal effects and reducing the concentrations needed. As discussed above, they also reduce human exposure (swimming does not generally happen in very early spring) and limit the potential for collateral damage to native species.

Another factor to consider is the way Rock Lake reacted to **chemicals that were used previously** (see Table 4). According to WDNR staff, the use of high volumes of chemicals in localized areas (i.e., "spot treatment") appeared to be affecting the native plant community within the Lake (which is why harvesting was

Table 4

CHEMICAL CONTROLS ON ROCK LAKE: 1979-2003

Year	Algae Control		Macrophyte Control		
	Cutrine Plus (gallons)	Copper Sulfate	2,4-D	Diquat (gallons)	Endothall/ Aquathol
1962	- -	- -	50.0	- -	- -
1968	- -	- -	- -	- -	0.9 gal.
1986	5.0	- -	- -	2.0	5.0 gal.
1987	- -	40.0 lbs.	- -	3.5	11.8 gal.
1996	- -	- -	- -	0.8	0.8 gal.
2000	- -	- -	- -	- -	60.0 lbs.
2002	- -	4.5 gal	100.0 lbs. 4.0 gal.	4.5	4.5 gal.
2003	- -	5.0 lbs.		- -	- -
2004	- -		151.3 lbs.	5.0	- -
Total	5.0	49.5	305.3	15.8	83.0

NOTE: Gallons represent liquid forms of chemical; pounds represent granular forms.

Source: Wisconsin Department of Natural Resources and SEWRPC.

recommended instead). Consequently, if chemicals are used to control Eurasian water milfoil in Rock Lake, the use of low volumes of chemicals over the entire Lake in the *early spring* (i.e., a whole lake treatment), should be considered rather than spot treatments (as spot treatments are known to be less effective and more detrimental to native plant communities).[18]

Use of chemical herbicides in aquatic environments is **stringently regulated and requires a WDNR permit and WDNR staff oversight during application**. In order for WDNR to consider permitting a whole lake treatment, specific conditions would need to be met. Specifically, an aquatic plant survey must indicate that the Lake has 75 percent frequency of occurrence[19] of Eurasian water milfoil, along with rake fullness density values over the majority of the sample sites (see Map 4 for schematic of rake fullness).

Finally, Lake residents posed very specific questions about the efficacy of using chemical treatment to maintain navigation lanes after harvesting is completed (i.e., applying chemicals on already-cut navigation lanes to make sure the plants do not grow back). Unfortunately, this method would not be effective because a minimum amount of plant biomass needs to be present for the chemicals to work the way they were designed. Consequently, using this method would only affect the plants adjacent to the navigation lanes (i.e., areas that should not be targeted for control) and is, therefore, not recommended.

[18]*WDNR has been studying the efficacy of spot treatments versus whole lake treatments for the control of Eurasian water milfoil and it has been found that spot treatments are not an effective measure for reducing Eurasian water milfoil populations, while whole lake treatments have proven effective depending on conditions.*

[19]*Seventy-five percent frequency of occurrence of Eurasian water milfoil means that 75 percent of the sites that were found to contain plants were found to have Eurasian water milfoil.*

Table 5

WATERSHED MANAGEMENT EFFORTS AND ASSOCIATED BENEFITS TO AQUATIC PLANT COMMUNITIES

Measure	Goal	Benefit
Nutrient Management	Prevents phosphorous from entering the Lake	Lower amount of nutrients available to support aquatic plant and algal growth
Sediment Reduction	Prevents loss of water depth	Will prevent growth of plants farther into the Lake (as plants grow in shallow areas of lakes)
Buffer Development and Wetland Enhancement	Increases filtration of pollutants and sediments	See benefits associated with nutrient management and sediment reduction listed above

Source: SEWRPC.

Other Aquatic Plant Management Issues of Concern

The recommendations that resulted from the discussions in this section seek to monitor and control aquatic plant growth that has already occurred in the Lake. There are, however, many other activities that contribute to *preventing* aquatic plant growth in the Lake, in general (which would avoid the adverse effects that result from many in-lake control alternatives). A number of factors in lakes lead to the creation of a lake environment conducive to "excessive" plant growth, both in terms of Eurasian water milfoil and native plants (see Table 5). Poor water quality with high phosphorous content (which can result from polluted surface water runoff into the Lake), for example, provides the building blocks that all plants need to thrive and eventually reach what is perceived as a nuisance level. Consequently, the implementation of recommendations that seek to improve water quality conditions needs to be a part of any comprehensive aquatic plant management plan. This is why many of the issues of concern discussed below are also considered priorities and why recommendations related to these factors are included in Chapter III of this report.

ISSUE 2: WATER QUALITY

Actual and perceived water quality conditions continue to be important issues in the Rock Lake community. This is evidenced by the fact that many Lake residents expressed concerns about specific pollutants that could be entering the Lake and decreasing water quality, including general pollution from the nearby railroad; fertilizer and pesticide runoff from shoreline properties; fertilizer runoff from agricultural properties within the watershed; and bacteria sources throughout the watershed (e.g., feces from birds and other animals that live in the watershed). Additionally, the concerns about excessive aquatic plant growth, as discussed above, further reinforce water quality as an issue of concern given the fact that water quality conditions (such as levels of phosphorus) greatly influence the ability of a lake to support excessive aquatic plant growth.

Before water quality within Rock Lake can be discussed, however, it is first important to define what water quality means, as many individuals have varying levels of understanding. Water quality is often discussed in terms of visual cues. Algal blooms or cloudy water, for example, can lead an observer to come to the conclusion that the water in a lake is "unclean;" however, to determine the water quality of a lake, lake managers and residents can look at very specific parameters that affect water quality or are indicators of water quality conditions. The most commonly used of these parameters are the levels of phosphorus, water clarity, chlorophyll-*a*, and dissolved oxygen, each of which acts as an indicator of larger issues in a lake (see Table 6 for details on these parameters). Nutrient pollution from phosphorus containing fertilizers, for example, can cause a lake's phosphorus levels to increase, its clarity to decrease (due to algal growth in the water column), and chlorophyll-*a* (a measure of algae content) to increase. These measurements, therefore, should be monitored over time to detect changes and potential issues.

In addition to phosphorus, water clarity, chlorophyll-*a*, and dissolved oxygen measurements, a number of other parameters can also be measured to determine the "general health" of a lake (see Table 6). These parameters can

Table 6

DESCRIPTION OF WATER QUALITY PARAMETERS AND THEIR REGIONAL AVERAGES

Parameter (in milligrams per liter (mg/l) unless otherwise noted)	Description	Regional Average	Existing Standards
Primary Water Quality Parameters			
Chlorophyll-*a*	The major photosynthetic, "green," pigment in algae. The amount of chlorophyll-*a* present in the water is an indication of the biomass, or amount of algae, in the water. Chlorophyll-*a* levels above 0.10 mg/l generally result in a green coloration of the water that may be severe enough to impair recreational activities, such as swimming or waterskiing	43	- -
Total Phosphorus	Phosphorus, which can enter a lake from natural and manmade sources, is a fundamental building block for plant growth. However, excessive levels of phosphorus in lakes can lead to nuisance levels of plant growth, unsightly algal blooms, decreased water clarity, and oxygen depletion that can stress or kill fish and other aquatic life. Statewide standards exist for phosphorus concentrations in lakes (Rock Lake's phosphorus standard is 0.030 mg/l, meaning that if the Lake exceeded this concentration it would be considered impaired with respect to phosphorus). A concentration of less than 0.030 mg/l is the concentration considered necessary to limit algal and aquatic plant growths to levels consistent with recreational water use objectives	- -	0.02
Dissolved Oxygen	Dissolved oxygen levels are one of the most critical factors affecting the living organisms of a lake ecosystem. Generally, dissolved oxygen levels are higher at the surface of a lake, where there is an interchange between the water and atmosphere, stirring by wind action, and production of oxygen by plant photosynthesis. Dissolved oxygen levels are usually lowest near the bottom of a lake, where decomposer organisms and chemical oxidation processes deplete oxygen during the decay process. A concentration of about 5.0 mg/l is considered the minimum level below which oxygen-consuming organisms, such as fish, become stressed, while fish are unlikely to survive when dissolved oxygen concentrations drop below 2.0 mg/l	10-12	- -
Water Clarity (feet)	Measured with a Secchi disk, a black-and-white, eight-inch-diameter disk, which is lowered into the water until a depth is reached at which the disk is no longer visible. It can be affected by physical factors, such as suspended particles, and by various biologic factors, including seasonal variations in planktonic algal populations living in a lake	5	- -
General Water Quality Parameters			
Alkalinity	The measure of the ability of a lake to absorb and neutralize acidic loadings, aka buffering; influenced by the soils and bedrock of the watershed due to any calcium carbonates ($CaCO_3$) – **higher levels of Ca CO_3 indicate a more alkaline lake with a higher buffering capacity**	173	- -
Calcium	Related to the growth of phytoplankton due to its reactive nature with phosphorus	36	
Chloride	Small quantities are normal in lakes due to natural weathering of bedrock and soils, while large concentrations (from road salts and effluents from wastewater treatment plants or septic systems) have an unknown impact on the ecosystem; however, **can serve as an indicator of increases in other pollutants**	19	- -
Color (Platinum units or "units")	Affects water transparency or water clarity; influenced by dissolved and suspended materials in the water, phytoplankton population levels, and various physical factors	46	
Conductivity (MicroSiemens per centimeter – µS/cm)	The measure of how much resistance to electrical flow exists in the water, thereby indirectly estimating the amount of dissolved ions in the water; **increased conductivity measurements can signal a potential pollution problem**	500-600	- -
Hardness	Measure of multivalent metallic ion concentrations such as calcium and magnesium in a lake; lakes with higher hardness levels tend to produce more fish and aquatic plants	- -	- -
Magnesium	A fundamental building block of chlorophyll and a vital nutrient to all green plants	32	- -
pH (Standard Units – S.U.)	Measures the hydrogen ion concentration on a scale from 0 (alkaline) to 14 (acidic); it influences how much nutrients (e.g., phosphorus, nitrogen) can be utilized and **can affect the solubility and toxicity of heavy metals** (e.g., lead, copper, cadmium), all of this affects the organisms living in a lake	7-8.5	- -

Table 6 (continued)

Parameter (in milligrams per liter (mg/l) unless otherwise noted)	Description	Regional Average	Existing Standards
General Water Quality Parameters (continued)			
pH (Standard Units – S.U.)	Measures the hydrogen ion concentration on a scale from 0 (alkaline) to 14 (acidic); it influences how much nutrients (e.g., phosphorus, nitrogen) can be utilized and **can affect the solubility and toxicity of heavy metals** (e.g., lead, copper, cadmium), all of this affects the organisms living in a lake	7-8.5	- -
Potassium	Linked to the growth of cyanobacteria (blue-green algae), which can sometimes contain toxic byproducts	- -	- -
Silica	Significant role in the production of many algae forms in freshwater lakes, especially diatoms; insufficient levels can shift algal population dominance from beneficial species (i.e., diatoms) to less desirable species (i.e., blue-green algae)	- -	- -
Sodium	Linked to the growth of cyanobacteria (i.e., blue-green algae), which can sometimes contain toxic byproducts	- -	- -
Sulfate	A form of sulfur that is an important nutrient for many aquatic organisms occurs in rocks and fertilizers, affecting the lake's eutrophication process. In high concentrations, especially in highly industrialized areas, can have a deleterious effect on some aquatic plants	20-40	- -
Total Dissolved Solids	An estimation of the total amount of inorganic solids dissolved in water due to the predominant bedrock, topography, climate, and land use in the watershed	- -	- -
Total Nitrogen	Essential to plant growth; natural sources include precipitation, nitrogen fixation in lake water and sediments, groundwater input, and surface runoff; manmade sources include livestock waste, fertilizers, and human sewage	1.43	- -
Total Suspended Solids	The soils and sands found suspended or floating within a sample of water; related to turbidity	- -	- -
Turbidity (Nephelometric Turbidity Units – N.T.U.)	Affects water transparency or water clarity due to suspended particles in the water, usually from runoff, soil erosion, and the disturbance or re-suspension of lake bottom sediments	6.7	- -

Source: SEWRPC.

be selected to be measured depending on what the purpose of the monitoring effort is. *E-coli* and chloride measurements, for example, are frequently taken on some lakes to determine safety in terms of swimming or the extent of manmade pollution entering the Lake,[20] respectively.

To develop a water quality maintenance and improvement program, several factors need to be investigated and considered. These factors include:

1. **The past and current water quality of the Lake**—To determine what water quality management efforts are needed, it is important to establish the current conditions in a lake. To do this, concentrations of the aforementioned parameters (i.e., phosphorus, water clarity, chlorophyll-*a*, etc.) should be measured and compared to past levels to determine if the water quality has been changing over time. Additionally, the parameters that have progressively been getting worse can help determine which pollutants should be targeted for reduction. This information, in combination with general characteristics of the lake that can help provide the context for understanding water quality data, will help determine the extent of water quality problems, as well as the best method for water quality management.

[20]*Chlorides are used as an indicator of manmade pollution because they are only naturally present in low quantities. Generally high chloride levels result from road salt application or fertilizers.*

2. **The lake's watershed characteristics, including land use and associated pollutant loadings**—The pollutants that enter a lake are highly dependent on the land surrounding the lake (i.e., its watershed). This is because different kinds of land use produce different kinds of pollutants (see Figure 4). For example, agricultural land use can be a significant contributor of sediments and nutrients (from fertilizers and soil loss), depending on the type of agricultural practices that are used (e.g., tillage farming can loosen soils and make it easier for these pollutants to enter the waterways). Similarly, urban land uses, such as residential land use, can contribute a significant amount of heavy metals, oils, and nutrients, depending on how residents use their land (e.g., if people have oil leaking off of their driveways, or if they use fertilizers on their lawns, these pollutants may drain to the lake during rain events). Given this connection, it is important to understand the current and planned land use within the watershed. Using these land use conditions, models can be applied to estimate the amount of pollution that is likely entering the lake from these sources. Knowing this can help identify the areas that are likely contributing to any water quality deterioration, and can help determine where in the watershed to focus pollution reduction efforts.

3. **The filtration ability of the lake's watershed and shorelines**—Several natural features can exist within a watershed that can help filter pollutants which would otherwise directly enter a lake. These features, such as wetlands and vegetative buffers (both manmade and natural), can significantly decrease the amount of pollution that ultimately enters a lake through using up and/or trapping pollutants prior to their entering the Lake.

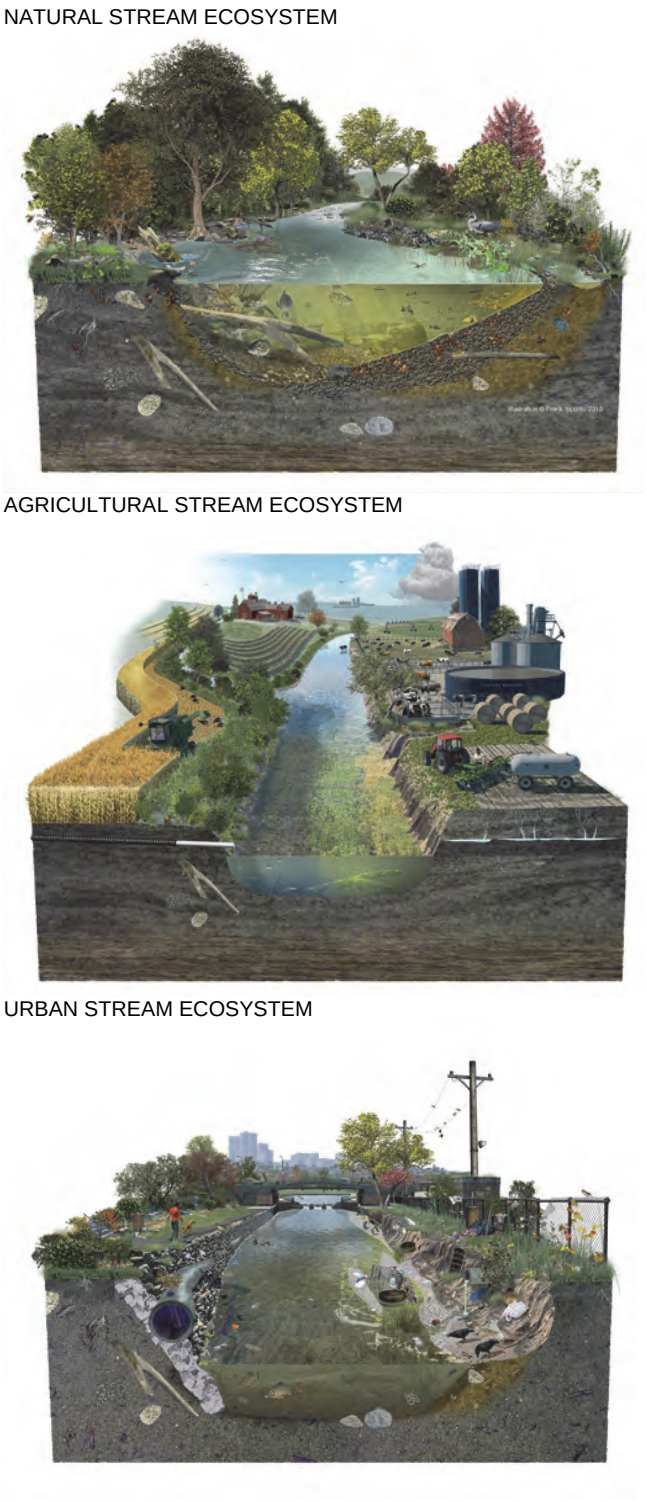
Each of these three factors is further discussed below.

Water Quality and Lake Characteristic Evaluation

As previously mentioned, the evaluation of water quality depends on monitoring data. In general, this monitoring data is used to determine the level and

Figure 4

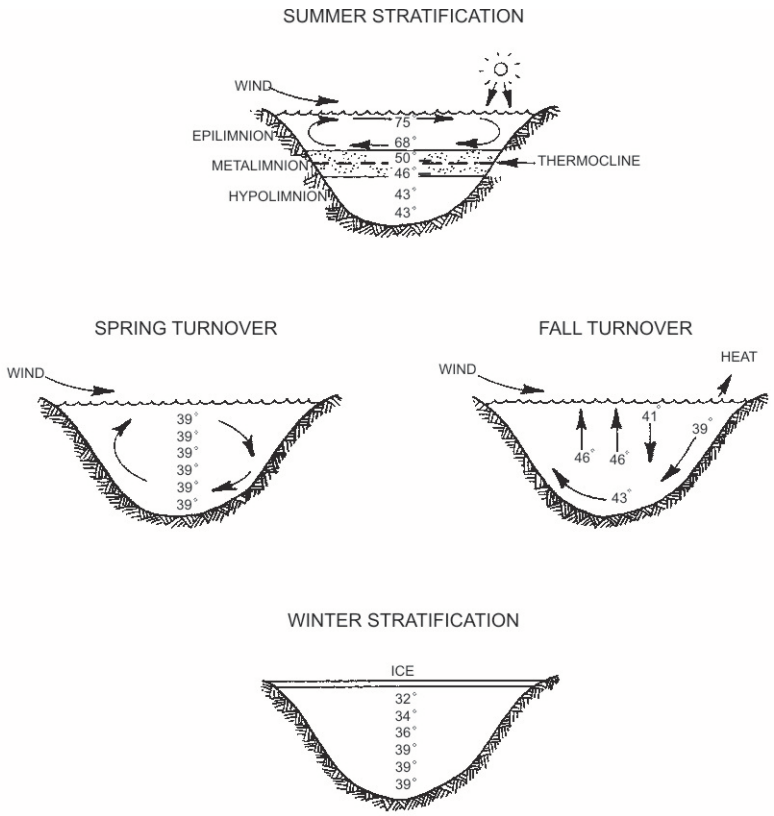
ILLUSTRATIONS OF LAND USE AFFECTING WATERBODIES



Source: Illustration by Frank Ippolito, www.productionpost.com. *Modified from D.M. Carlisle and others.* The quality of our Nation's waters—Ecological health in the Nation's streams, 1993-2005: U.S. Geological Survey Circular 1391*, 120 p.,* http://pubs.usgs.gov/circ/1391*/, 2013, and SEWRPC.*

Figure 5

THERMAL STRATIFICATION OF LAKES



Source: University of Wisconsin-Extension and SEWRPC.

nature of pollution within a lake as well as the risks associated with that pollution. When evaluating water quality within a lake, it is important to know the following characteristics:

1. **Whether the lake stratifies and, if it does, when the lake mixes**—Stratification refers to a state in which the temperature difference (and associated density difference) between the surface waters of a lake (i.e., the epilimnion) and the deep waters of the lake (i.e. the hypolimnion) is great enough to prevent gases and pollutants from mixing between the two layers (see Figure 5). In the summer, this process is caused by sunlight warming only the top of the lake (where the sunlight can penetrate). In the winter the process is caused by cool air making the surface waters cooler than deep waters. It is important to know if stratification occurs because "stratification" is generally followed by a mixing period, caused by the top and bottom layers becoming the same temperature in the fall and the spring, which then can cause pollutants that had accumulated in the bottom during stratification to suddenly mix into the entire water column. In general, when measuring phosphorus and chlorophyll-*a*, the standards are compared to the levels found during this mixing period in order to determine whether there is a pollution issue.

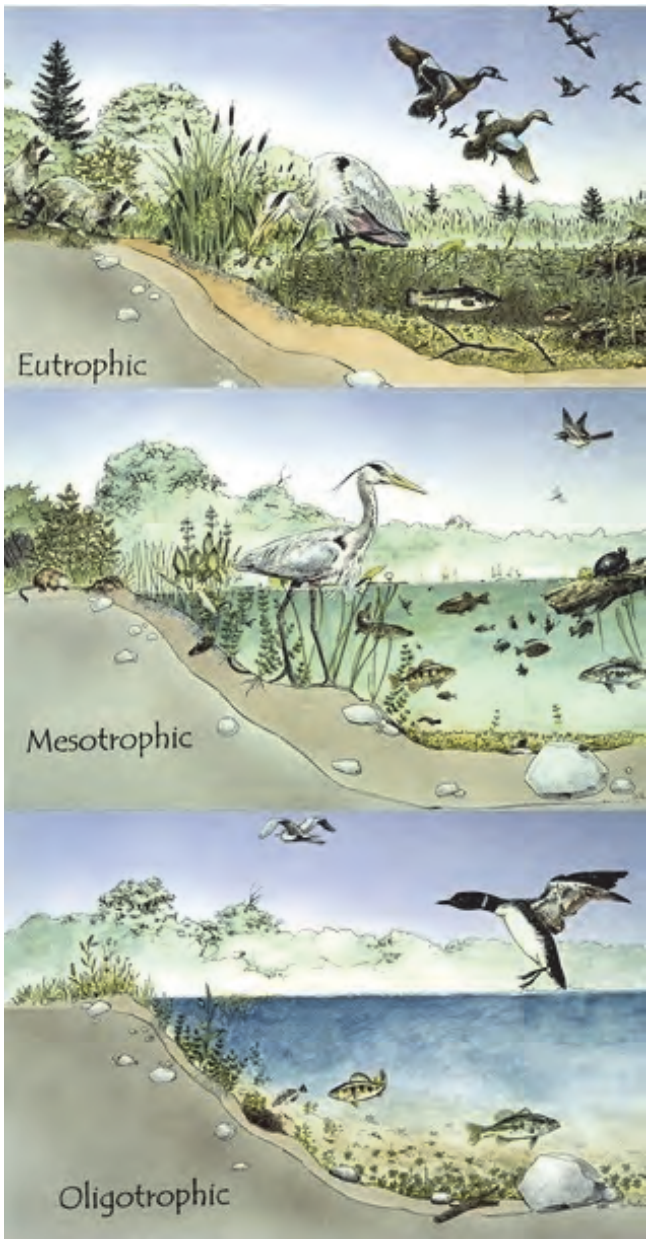
2. **Whether internal loading is occurring**—Internal loading can happen when a lake stratifies. This is due to the fact that oxygen produced by plants at the surface of the lake cannot enter the hypolimnion due to the barrier formed by the stratification process. Consequently, after oxygen is used up in the bottom layer of the lake (by fish and bacteria), the area becomes anoxic. Once this occurs, bacteria use a different process to decompose materials, which accumulate at the bottom of the lake

(anaerobic decomposition). This process can release phosphorus from sediments that would have otherwise remained trapped in the sediments and unavailable to plants and algae. This released phosphorus can then mix back into the water column during the mixing period, thereby causing plant and algae growth issues (both of which occur with high phosphorus levels). If this is occurring, a water quality management plan needs to focus on in-lake phosphorus management efforts in addition to pollution prevention.

3. **The lake's current and past trophic statuses**—Lakes are commonly classified according to their degree of nutrient enrichment, or trophic status. The ability of lakes to support a variety of recreational activities and healthy fish and other aquatic life communities is often correlated with the degree of nutrient enrichment that has occurred. Three terms are generally used to describe the trophic status of a lake: oligotrophic (nutrient poor), mesotrophic (moderately fertile), and eutrophic (nutrient rich) (see Figure 6). Each of these states can happen naturally, and do shift upwards as part of the natural lake aging process (see Figure 7); however, if a lake shifts upwards to a higher trophic level at a fast rate, this can be an indication of pollution issues. Another indication of severe pollution is when a lake enters the "hyper-eutrophic" level, which indicates highly enriched lakes (see Figure 8). This state does not occur naturally (i.e., without contribution of manmade pollution).

Figure 6

ILLUSTRATION OF TROPHIC STATES



Source: DH Environmental Consulting, 1995.

4. **A lake's residence time**—Residence time, also known as retention time or flushing rate, refers to the average length of time that water remains in a lake. This is significant because it can help determine how quickly pollution problems can be solved. Lakes with short retention times, for example, will flush nutrients and pollutants out of the lake fairly quickly, meaning that management efforts could likely focus only on preventing pollution from the watershed. In contrast, lakes with long retention times tend to accumulate nutrients that can eventually become concentrated in their bottom sediments, meaning that in addition to preventing pollution, it is also necessary to engage in in-lake water quality management effort.

To determine the preceding characteristics for Rock Lake, SEWRPC staff completed a comprehensive water quality inventory. Rock Lake has not been the subject of a comprehensive monitoring program, making it difficult to establish existing conditions and to determine trends in water quality, and also to definitively

Figure 7

ILLUSTRATION OF AGING AFFECTING TROPHIC STATUS

Source: Wisconsin Department of Natural Resources.

Figure 8

PHOTOGRAPH OF A HYPER-EUTROPHIC LAKE

Source: University of Minnesota, College of Natural Resources, 2003.

determine the need for management efforts. With the exception of satellite data (see Table 7)[21] and some water clarity measurements obtained on the Lake in the summer 2014 (see Figure 9),[22] the only comprehensive dataset that exists on Rock Lake was taken in 1977 (see Table 8).

It was possible, however, to use that historical data to determine the Lake conditions in 1977. This data indicated that, at the time of sampling, **Rock Lake stratified, had some internal loading, and was mesotrophic**.[23] In general, these conditions indicate that the Lake was relatively healthy in 1977 (largely because the Lake was mesotrophic during the mixing periods), and that in-lake phosphorus controls may need to be considered if current data reveals water quality issues.

It is also important to note that, given that algal blooms and excessive plant growth have been observed in Rock Lake and that the Secchi depth (water clarity) measurements taken in 2013 are between one and 1.5 feet less than measurements taken in 1977, **it is possible that the lake has shifted to a higher trophic state in recent years**. Consequently, current data will need to be obtained to determine the extent of these water quality issues. Additionally, obtaining this data will also provide a baseline for comparison to determine if, over time, management efforts are improving conditions within the Lake.

Finally, though flow measurements[24] (which are often used to develop highly accurate retention times) were not available for the Lake, SEWRPC staff did use a model[25] to determine an approximation of **the retention time in Rock Lake. That time was estimated to be 1.8 years,** a fairly slow flushing rate. Therefore, the degree of nutrient inflow is very important in managing water quality conditions within the Lake (since pollutants accumulate in the Lake). Additionally, in-lake measures to control phosphorus may be needed if further data reveals phosphorus to be an issue.

Ultimately, more data on Lake conditions will need to be collected to determine if water quality is an issue of concern. However, **preventing pollution from entering the Lake is always a good practice**, even if water quality is found to be "good" at present. Consequently, recommendations related to both monitoring and management are discussed in Chapter III of this report, to ensure that the Lake's water quality is maintained and potentially improved.

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[21]*Secchi disk estimates from satellite data can sometimes be inconsistent. Consequently, it is necessary to compare them to in-lake data to ensure their accuracy. However, Rock Lake does not have a sufficient amount of in-lake monitoring data available for comparison.*

[22]*Water clarity measurements were taken as an initial water quality monitoring effort for Rock Lake. Both the Rock Lake Restoration Association and the Rock Lake Highlands Association engaged in efforts at different locations in the Lake. For future monitoring efforts, it will be necessary to keep a consistent methodology and sampling site.*

[23]*The trophic status of Rock Lake in 1977 was determined using the Wisconsin Trophic State Index value formula with 1977 Secchi-disk measurements, total phosphorus levels, and chlorophyll-*a *levels.*

[24]*Flow measurements, used to calculate retention times, refer to measurement of the rate at which volumes of water enter and exit the Lake.*

[25]*The calculation of Rock Lake's retention time was based on relating the average annual volume of precipitation that falls on the watershed, reduced by a factor to account for infiltration and other losses where appropriate, and the water volume of the Lake to estimate how quickly water is pushed out of the Lake through the outlet.*

Watershed Characteristics and Pollutant Loadings

As mentioned above, different land uses can contribute different types of pollution to a lake. Though it is normal for some sediments and nutrients to enter a lake from the surrounding lands (contributing to the natural lake aging process), it becomes an issue of concern when people introduce pollutants (such as heavy metals, fertilizers, and oils) which would not have otherwise entered the system. Issues also arise when land is disturbed through tilling and construction, which causes soils to loosen, erode, and eventually enter streams and lakes.

Given these connections between the practices around a lake and lake water quality, it is important to characterize the area that drains to a lake—its watershed—to determine potential pollution sources and risks to the lake's water quality. Several items need to be examined in order to complete this characterization, including:

Table 7

SECCHI DEPTH SATELLITE DATA FOR ROCK LAKE

Date	Depth (feet)	Depth (meters)
09/15/2011	9.7	3.0
09/07/2011	10.1	3.1
07/21/2011	7.2	2.2
07/05/2011	8.0	2.4
09/28/2010	8.0	2.4
09/12/2010	6.7	2.0
07/10/2010	5.3	1.6
08/04/2009	7.8	2.4
07/07/2009	4.2	1.3
08/28/2008	9.4	2.9
08/03/2007	15.5	4.7
09/17/2003	9.5	2.9
07/09/2001	4.6	1.4

Source: Wisconsin Department of Natural Resources.

1. **The location and extent of the lake's watershed**—Before beginning to characterize a watershed, it is first necessary to delineate that watershed. The process of delineation essentially involves analyzing elevation data on the land area surrounding the Lake to determine the land area that drains toward the lake. Completing this analysis provides the basis for which we can begin to determine whether potential pollutant sources are valid. If a chemical company is near the lake but outside of the watershed, for example, it is unlikely that discharge from that company is reaching the lake, and, therefore, is not an issue of concern in terms of water quality.

2. **The type and location of existing land use within the watershed**—The extent and location of current land use within the delineated watershed can help determine the potential causes of pollution to the lake. In fact, current land use can be input into models in order to estimate total pollutant loads that could potentially be entering the lake. Once these numbers are determined, it is then possible to determine where to focus management efforts (e.g., if agriculture is the primary source of phosphorus, this may be an efficient place to begin pollution reduction efforts).

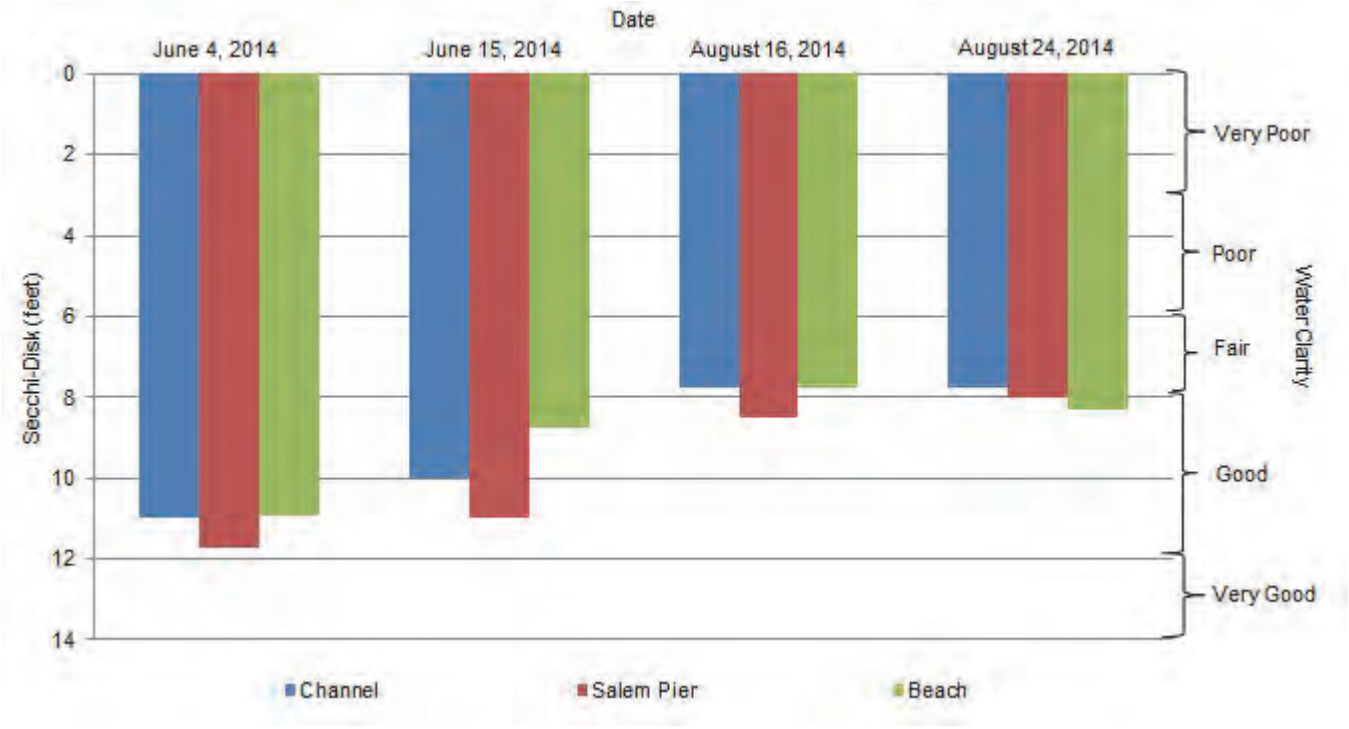
3. **The type and location of past land use changes within the watershed**—Being aware of past land use changes over time can provide a context for understanding what caused past issues within a lake, particularly when considered in coincidence with water quality monitoring data or well-known historical issues. If a long-term lake property owner, for example, remembers or has record of the years that aquatic plant growth, algal blooms, or lake levels were particularly concerning, those dates can be assessed in terms of the historical land use changes in order to determine whether something happened within the watershed to cause that issue (such as an increase in agricultural land use or development). This information can then be helpful in future planning because it is easier to determine how the lake will react to similar situations.

4. **The nature and location of planned land use within the watershed**—In addition to current land use in the watershed, it is also possible to determine the planned land use changes that will occur in the future. Knowing this information is important, as it helps determine the areas that may need to be targeted for management efforts in the future, as well as the potential extent of future pollution issues.

5. **The location of septic systems in the watershed (if applicable)**—Private Onsite Wastewater Treatments Systems (POWTS) or septic systems can be a significant source of phosphorus pollution when not properly maintained. Consequently, it is important to investigate whether they exist within the watershed.

Figure 9

SECCHI-DISK MEASUREMENTS FOR ROCK LAKE: 2014



Source: Rock Lake Highlands Association and SEWRPC.

Table 8

COMPREHENSIVE DATASET: 1977

Parameter	07/12/1977			07/13/1977
	0 Foot	12 Feet	32 Feet	19 Feet
Alkalinity	144	140	180	158
Calcium	26	26	38	31
Chloride	26	28	27	28
Conductivity (µS/cm)	398	388	470	418
Dissolved Oxygen	6.4	6.9	0.1	- -
Iron	0.15	0.15	0.18	0.18
Magnesium Total	29	33	28	30
Manganese (µg/l)	<0.03	<0.03	0.4	<0.03
Nitrogen NH3 Dissolved	<0.04	<0.04	1.62	0.21
Nitrogen NH3-N Total	0.83	0.75	0.94	2.6
Nitrogen, Total	0.042	<0.022	<0.032	0.054
Ortho-Phosphorus Dissolved (µg/l)	0.009	0.008	0.225	0.025
pH (SU)	8.6	8.4	7.5	7.8
Potassium	1.5	2.1	2.5	2.4
Secchi Depth (feet)	8.5	8.5	8.5	- -
Sodium	18	17	18	18
Sulfate	30	30	30	23
Total Phosphorus	0.02	0.02	0.27	0.03
Turbidity (NTU)	1.6	1.4	1.8	3.4
Water Temperature (°C)	27.0	25.0	10.0	- -

Source: Wisconsin Department of Natural Resources.

To characterize the watershed and get an inventory of the information described above, the SEWRPC staff used two-foot elevation contour interval maps to delineate Rock Lake's watershed. SEWRPC has developed or obtained databases that provide comprehensive information quantified within the watershed using mapping software.[26] This exercise, in combination with the use of two models that calculate pollutant loadings,[27] resulted in an inventory of Rock Lake's watershed characteristics. These characteristics are discussed below.

Rock Lake's watershed, shown on Map 6, is situated within the Town of Salem, Kenosha County, on the southern border of Wisconsin, as well as within the Town of Antioch and the Village of Antioch, in Lake County, on the northern border of Illinois. The **total land area that drains to Rock Lake from the southeast to the northwest is approximately 540 acres,** or about 0.8 square mile, in areal extent.

The year 2010 land use in Rock Lake's watershed, as shown on Map 7, is 40 percent urban and 28 percent agricultural (see Table 9) under year 2010 conditions. Thirteen percent of the total watershed area is wetland (located to the east and north of the Lake), 10 percent is water, and 8 percent is woodlands. Using this land use data, two models were used to estimate pollutant loadings that could potentially be entering the Lake,[28] as summarized in Table 10. These estimates could not, however, be compared to any current in-lake data; consequently, they should only be used as guidance for where to engage in watershed management efforts, when data is obtained. These calculations indicate that urban land use is the only significant source of heavy metals. It would therefore be wise to target urban areas if heavy metals are found to be an issue within the Lake after further monitoring.

Historical urban development within the Wisconsin portion of the watershed is shown on Map 8 and represented in Table 11. Changes in population and households over time are shown in Table 12. These changes can also be seen through comparison of aerial photographs representing conditions in 1963, when SEWRPC first obtained regionwide aerial photography, and 2010, the most recent date for which regionwide digital orthophotography is available, as shown in Figure 10. Since 1963, the largest increase in urban land use occurred since 2010. Unfortunately, as historical water quality data for Rock Lake is only available on one date, SEWRPC staff was unable to compare this information to any changes in water quality data. However, Lake residents noted that over the past 20 to 50 years there have been significant increases in aquatic plant and algae growth. This indicates that it is possible that the urban development that has been occurring in the watershed since that point (e.g., the urban development that occurred on the eastern side or the shoreline in the 1990s as shown on Map 8) may have affected the Lake. Further investigation into this timeline should, therefore, be considered.

Year 2035 planned land use[29] for the Rock Lake watershed is shown on Map 9. Map 10 shows the areas within the watershed where land use is forecasted to change by 2035, based upon a comparison of the current year 2010 land use map (see Map 7) and the planned land use map (see Map 9). As can be seen on Map 9, a large area of agricultural land at the center of the watershed is planned to be developed. As summarized in Table 9, **agricultural land uses are expected to decrease significantly from about 28 percent of the land area in 2010, to about 6 percent of the land area in 2035**. Most of this land will be converted to residential use. In addition to changing the nature of the pollutants in stormwater runoff, as can be seen from a comparison of the 2010 and

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[26]*Geographical Information Systems (GIS) were used to complete these analyses.*

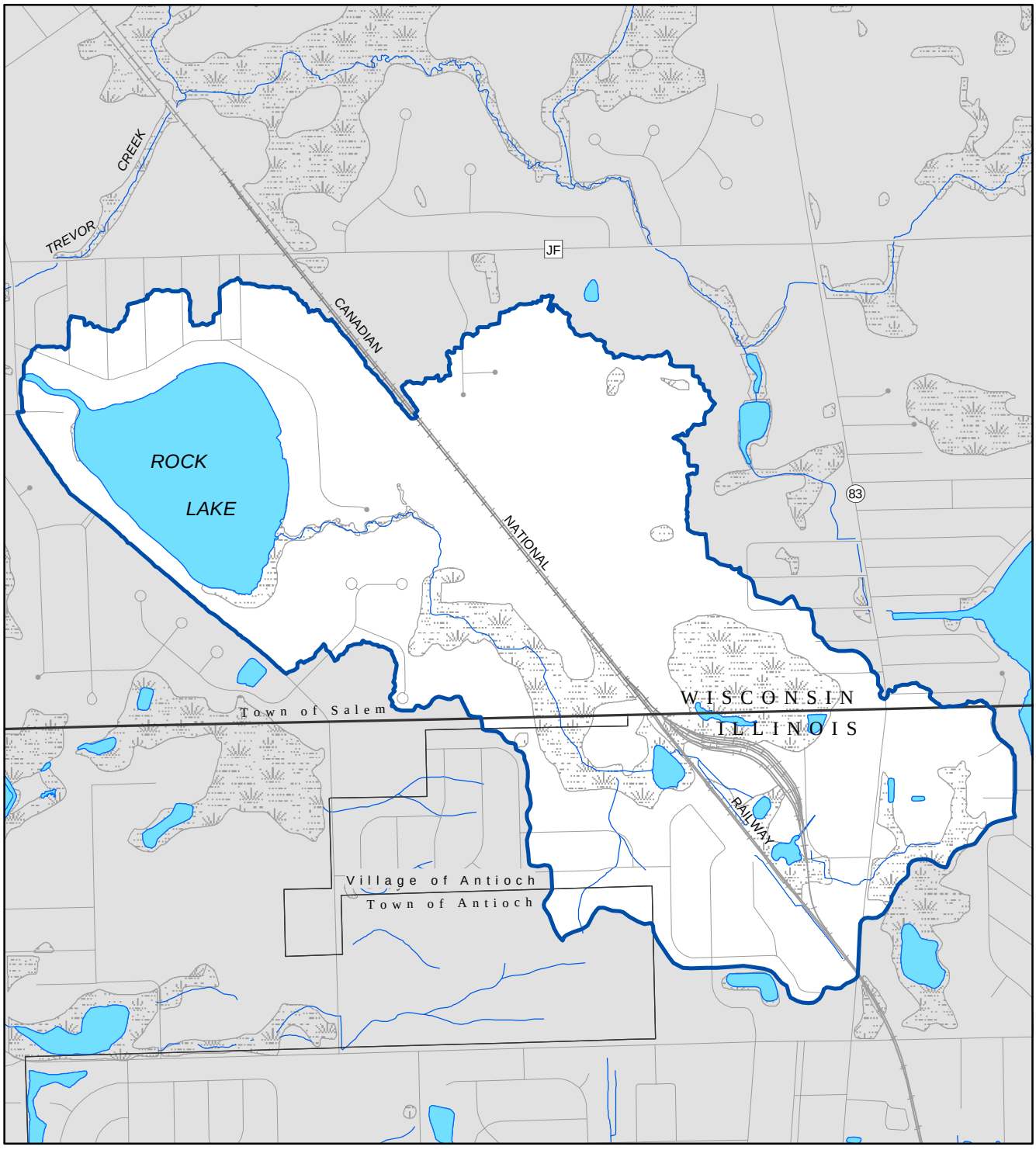
[27]*Wisconsin Lake Model Spreadsheet (WiLMS version 3.0) and the unit area load-based (UAL) models.*

[28]*The calculations for nonpoint source phosphorus, suspended solids, and urban-derived metal inputs to Rock Lake were estimated using either the Wisconsin Lake Model Spreadsheet (WiLMS version 3.0), or the unit area load-based (UAL) model developed for use within the Southeastern Wisconsin Region. These two models operate on the general principal that a given land use will deliver a typical mass of pollutants to a lake.*

[29]*See SEWRPC Planning Report No. 48,* A Regional Land Use Plan for Southeastern Wisconsin: 2035*, June 2006.*

Map 6

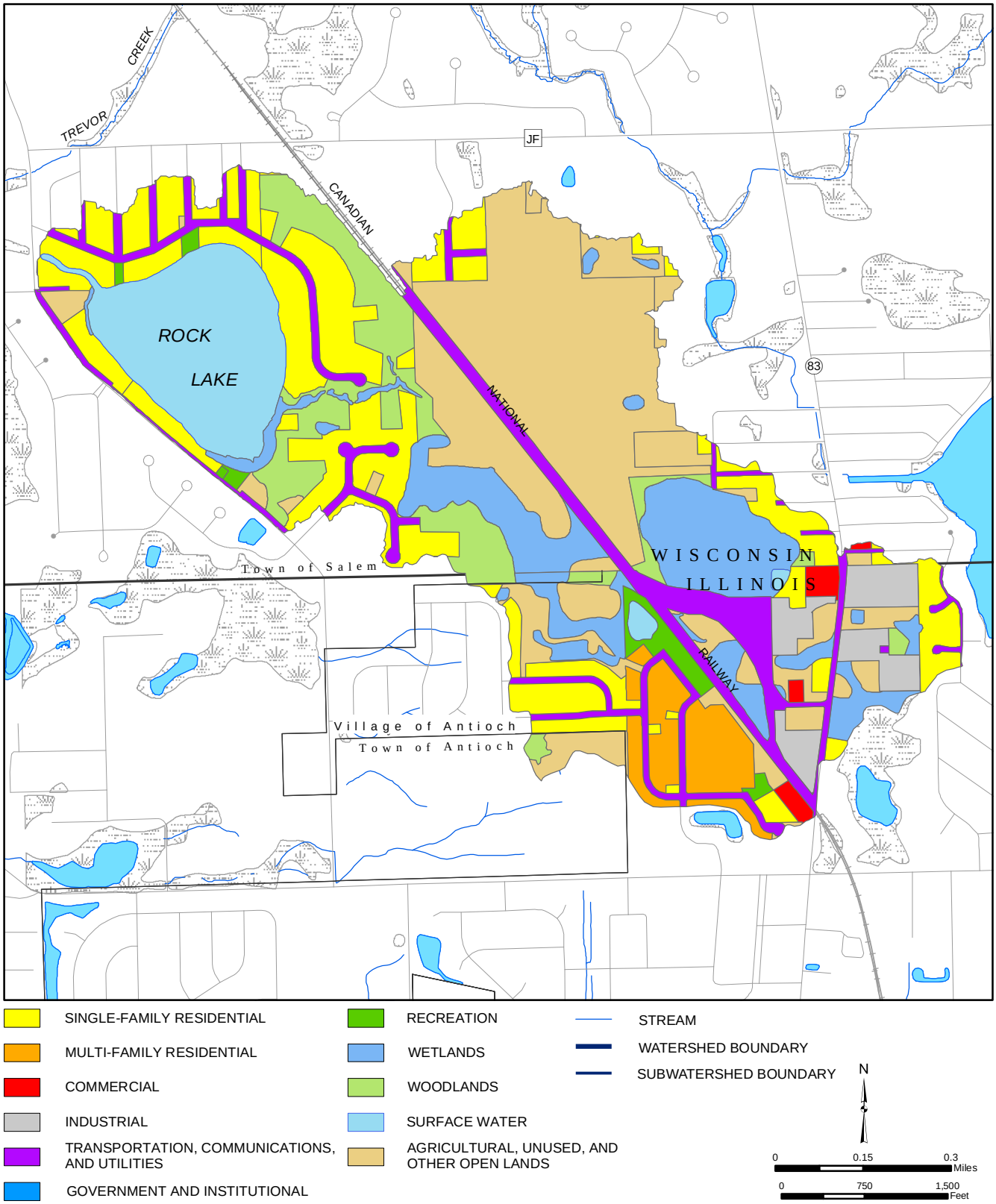
ROCK LAKE WATERSHED



Source: SEWRPC.

Map 7

LAND USE FOR ROCK LAKE WATERSHED: 2010



Source: SEWRPC

Table 9

EXISTING AND PLANNED LAND USE WITHIN THE TOTAL DRAINAGE AREA TRIBUTARY TO ROCK LAKE: 2010 AND 2035

Land Use Categories[a]	2010		2035	
	Acres	Percent of Total Tributary Drainage Area	Acres	Percent of Total Tributary Drainage Area
Urban				
Residential				
Single-Family, Suburban Density	- -	- -	- -	- -
Single-Family, Low Density	57	10.6	135	25.0
Single-Family, Medium Density	54	10.0	54	10.0
Single-Family, High Density	- -	- -	- -	- -
Multi-Family	22	4.1	22	4.1
Commercial	4	0.7	5	0.9
Industrial	19	3.5	28	5.2
Governmental and Institutional	- -	- -	- -	- -
Transportation, Communication, and Utilities	55	10.2	74	13.7
Recreational	7	1.3	18	3.3
Subtotal	218	40.4	336	62.2
Rural				
Agricultural and Other Open Lands	152	28.1	34	6.3
Wetlands	70	13.0	70	13.0
Woodlands	45	8.3	45	8.3
Water	55	10.2	55	10.2
Extractive	- -	- -	- -	- -
Landfill	- -	- -	- -	- -
Subtotal	322	59.6	204	37.8
Total	540	100.0	540	100.0

[a]*Parking included in associated use.*

Source: SEWRPC.

2035 pollution loading estimates in Table 10, this change also poses an **issue in terms of risk for pollution from areas where construction will take place**. Consequently, recommendations to mitigate this risk and ensure the continued health of the Lake are included in Chapter III of this report.

Finally, **the entire Wisconsin portion of the watershed is within the Salem planned sewer service area, and existing development in the Wisconsin portion is serviced by the Town of Salem Utility District No. 2 wastewater treatment plant**. The Village of Antioch, Illinois, also has sanitary sewer service. Therefore, management of private onsite waste treatment systems is not an issue of concern.

Again, since there has not been a comprehensive analysis of water quality in Rock Lake, it is challenging to determine which land uses should be targeted for management efforts. Therefore, Chapter III includes a protocol that should be followed once data is obtained. Additionally, given this lack of information, pollution reduction efforts might most effectively be targeted to enhance the pollution mitigation ability of the watershed (e.g., through maintenance and expansion of riparian buffers), since this will prevent many types of pollution from many different sources rather than just from one land use.

Table 10

ESTIMATED ANNUAL POLLUTANT LOADINGS BY LAND USE CATEGORY WITHIN THE AREA TRIBUTARY TO ROCK LAKE: 2010 AND 2035

Land Use Category	Pollutant Loads: 2010			
	Sediment (tons)	Phosphorus (pounds)	Copper (pounds)	Zinc (pounds)
Urban				
Residential	7.28	55.2	4.0	32.0
Commercial	1.57	4.8	0.9	6.0
Industrial	7.14	22.2	4.2	28.3
Governmental	0.00	0.0	0.0	0.0
Transportation	0.11	2.5	0.0	0.0
Recreational	0.08	1.9	0.0	0.0
Subtotal	16.18	84.7	9.1	66.3
Rural				
Agricultural	34.20	130.7	0.0	0.0
Wetlands	0.13	2.8	0.0	0.0
Woodlands	0.08	1.8	0.0	0.0
Water	5.17	7.2	0.0	0.0
Subtotal	39.58	142.5	0.0	0.0
Total	55.76	227.2	9.1	66.3

Land Use Category	Pollutant Loads: 2035			
	Sediment (tons)	Phosphorus (pounds)	Copper (pounds)	Zinc (pounds)
Urban				
Residential	8.23	74.6	4.0	33.0
Commercial	1.96	6.0	1.1	7.5
Industrial	10.53	32.8	6.5	41.7
Governmental	0.00	0.0	0.0	0.0
Transportation	0.11	2.5	0.0	0.0
Recreational	0.22	4.9	0.0	0.0
Subtotal	21.05	120.8	11.6	82.2
Rural				
Agricultural	7.65	29.2	0.0	0.0
Wetlands	0.13	2.8	0.0	0.0
Woodlands	0.08	1.8	0.0	0.0
Water	5.17	7.2	0.0	0.0
Subtotal	13.03	41.0	0.0	0.0
Total	34.08	161.8	11.6	82.2

Source: SEWRPC.

Pollution Mitigation Abilities

Several land use features serve to filter or remove pollutants prior to the pollutants entering a lake system. It is, therefore, necessary to evaluate where these features exist within the watershed to determine if there are any pollution sources which are potentially entering the Lake directly (without any filtration). These features are as follows:

Table 11

HISTORICAL URBAN GROWTH IN THE ROCK LAKE WATERSHED

Year	Land in Urban Use (acres)[a]
1963	47.0
1990	18.0
2000	0.2
2010	48.0

[a]Data only represents urban growth in Wisconsin. Data was not available for the Illinois portion of the watershed.

Source: SEWRPC.

1. **Stormwater detention or retention ponds**—Stormwater management ponds, when properly maintained, can capture water during rainfall events and provide that water with the opportunity to slow down. This process allows many pollutants, such as sediments and heavy metals, to settle out of the water before reaching the lake. However, these ponds periodically need to be dredged and require maintenance, as any small pond would (e.g., aquatic plant management), to ensure their continued functioning. Although stormwater management efforts are valuable and effective if properly maintained, particularly in developed areas where water moves out of the system very quickly, it is also advantageous to protect and enhance natural or manmade vegetative features, such as buffers and wetlands, that naturally filter and settle pollutants without a major engineering solution.[30] None the less, **the presence of a detention or retention pond can greatly decrease pollution risks**.

2. **Wetlands**—Wetlands, which are normally characterized by water-logged soils and wetland-based plants, such as cattails, are beneficial to the health of a lake, particularly when located at a lake's inlet. These areas are able to slow down water flowing toward the lake, causing sediments and heavy metals to settle (in a similar fashion to stormwater management ponds though at a larger scale). Additionally, **the plant life located in wetlands is able to quickly use up pollutants such as phosphorus and incorporate them into biomass** (thereby preventing the pollutant from entering the lake and causing algae and plant growth there instead). These natural features are invaluable ecosystems and are well known as "nature's pollution filtration system." Therefore, knowing where these are located can help determine if a pollutant source is a high risk. Additionally, enhancing wetlands can help further filter any added pollution.

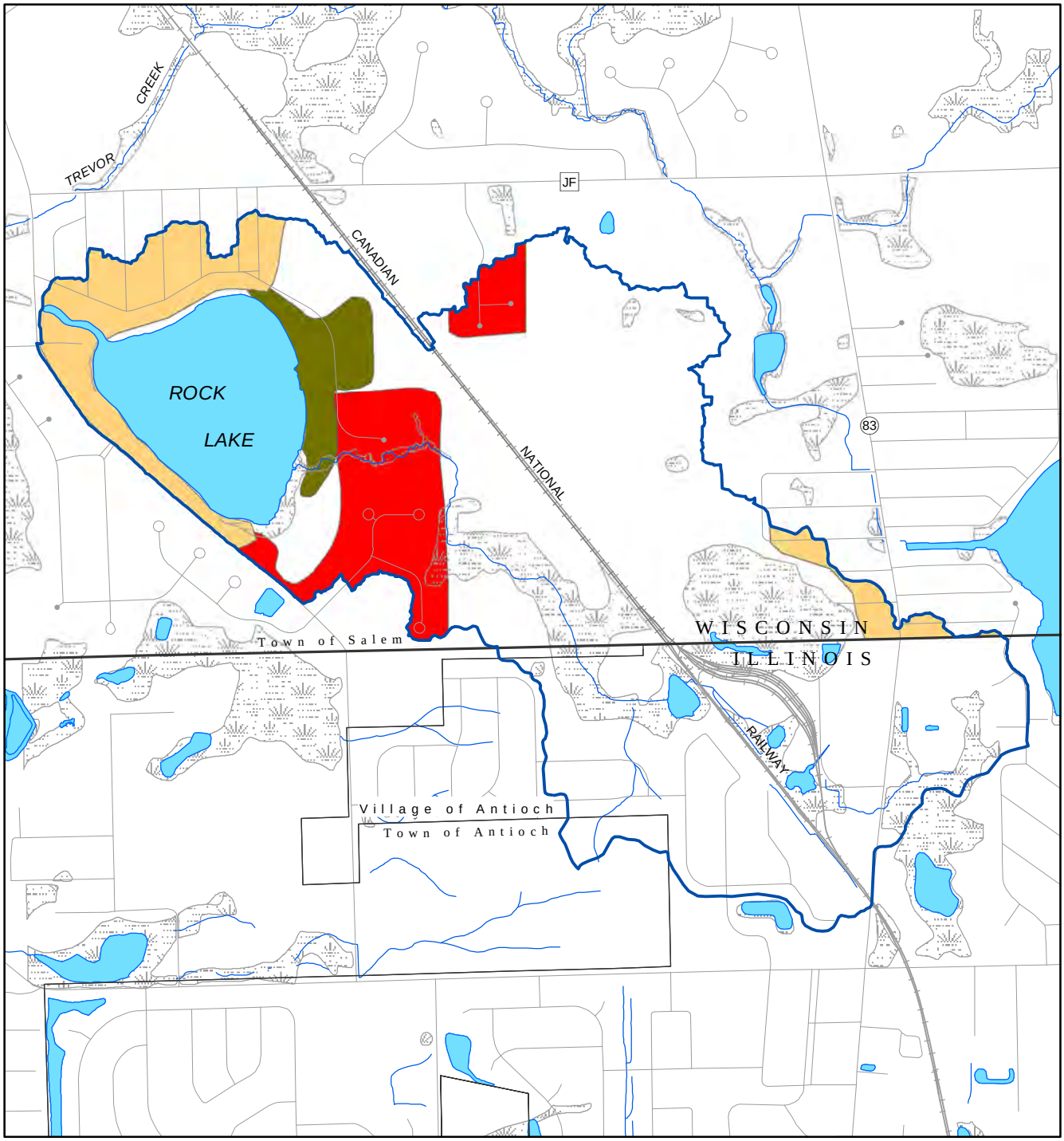
3. **Natural terrestrial buffers (e.g., forests or prairies with extensive natural vegetation)**—Natural buffers primarily refer to natural terrestrial vegetative features such as forests or prairies. These areas, like wetlands, have extensive vegetation that can slow down water and incorporate pollutants into biomass. Consequently, **these areas, located in an area that intercepts water flowing toward the lake system, can help lower pollution risks**. Additionally, enhancing these features, particularly in areas adjacent to a waterbody, can also play a crucial role in ensuring that the watershed can naturally reduce the amount of pollution entering a lake.

4. **Manmade buffers (e.g., grassed waterways, vegetative strips)—**Manmade buffers can take a number of forms, from grassed waterways, to vegetative strips, to gardens located along the shoreline. Buffers are generally constructed to intercept the flow of water toward a river or lake. They function in a similar way to natural buffers (i.e., slowing water down to settle and use pollutants

[30]*Vegetative buffers (e.g., forests, grassed waterways, manmade vegetative strips) and wetlands each have the natural ability to slow down water. This encourages pollutants to settle out prior to their entering the lake.*

Map 8

HISTORICAL URBAN GROWTH WITHIN THE ROCK LAKE WATERSHED: 1850 - 2010



1963

1990

2010

NOTE: The 2000 data is imperciptible on a map of this scale, see Table 11.

SURFACE WATER

STREAM

WATERSHED BOUNDARY

Data not available for Lake County, Illinois

N

0 0.15 0.3 Miles

0 750 1,500 Feet

Source: SEWRPC

Table 12

POPULATION AND HOUSEHOLDS IN THE ROCK LAKE TRIBUTARY AREA: 1960-2010

Year	Population			Households		
	Wisconsin	Illinois	Total	Wisconsin	Illinois	Total
1960	138	N/A	N/A	46	N/A	N/A
1970	212	N/A	N/A	65	N/A	N/A
1980	191	N/A	N/A	67	N/A	N/A
1990	191	282	473	78	121	199
2000	331	620	951	120	291	411
2010	450	892	1,342	155	351	506
Planned 2035	947	N/A	N/A	363	N/A	N/A

Source: U.S. Bureau of Census and SEWRPC.

prior to their entering the waterbody); however, they do need to be carefully designed with native plants to ensure that they function well. **Constructing buffers can enhance the water quality of a lake without affecting the use of land for residential or agricultural purposes**. Further details on manmade buffers and their efficacy are included in Appendix D.

5. **Aquatic Vegetative Buffers—**Vegetation in the nearshore areas, such as bulrushes and cattails, also serve the same purpose as the buffers discussed above. Consequently, encouraging their survival and enhancement can help improve the water quality of a lake.

To locate each of the features described above, SEWRPC staff completed an inventory of the detention basins, wetlands, and natural features such as woodlands within the watershed, using existing databases, mapping software, and aerial imagery. Additionally, to identify the extent of shoreline buffers, SEWRPC staff completed a field assessment of the Rock Lake shoreline in the summer of 2014. These inventories are discussed below.

Four stormwater basins are located within the Rock Lake watershed (see Map 11). If they are being properly maintained, these basins would serve to limit the amount of pollution entering Rock Lake from the commercial and residential areas draining to these basins (also shown on Map 11). Consequently, maintenance of these ponds should be considered a priority. Recommendations related to this topic are provided in Chapter III of this report.

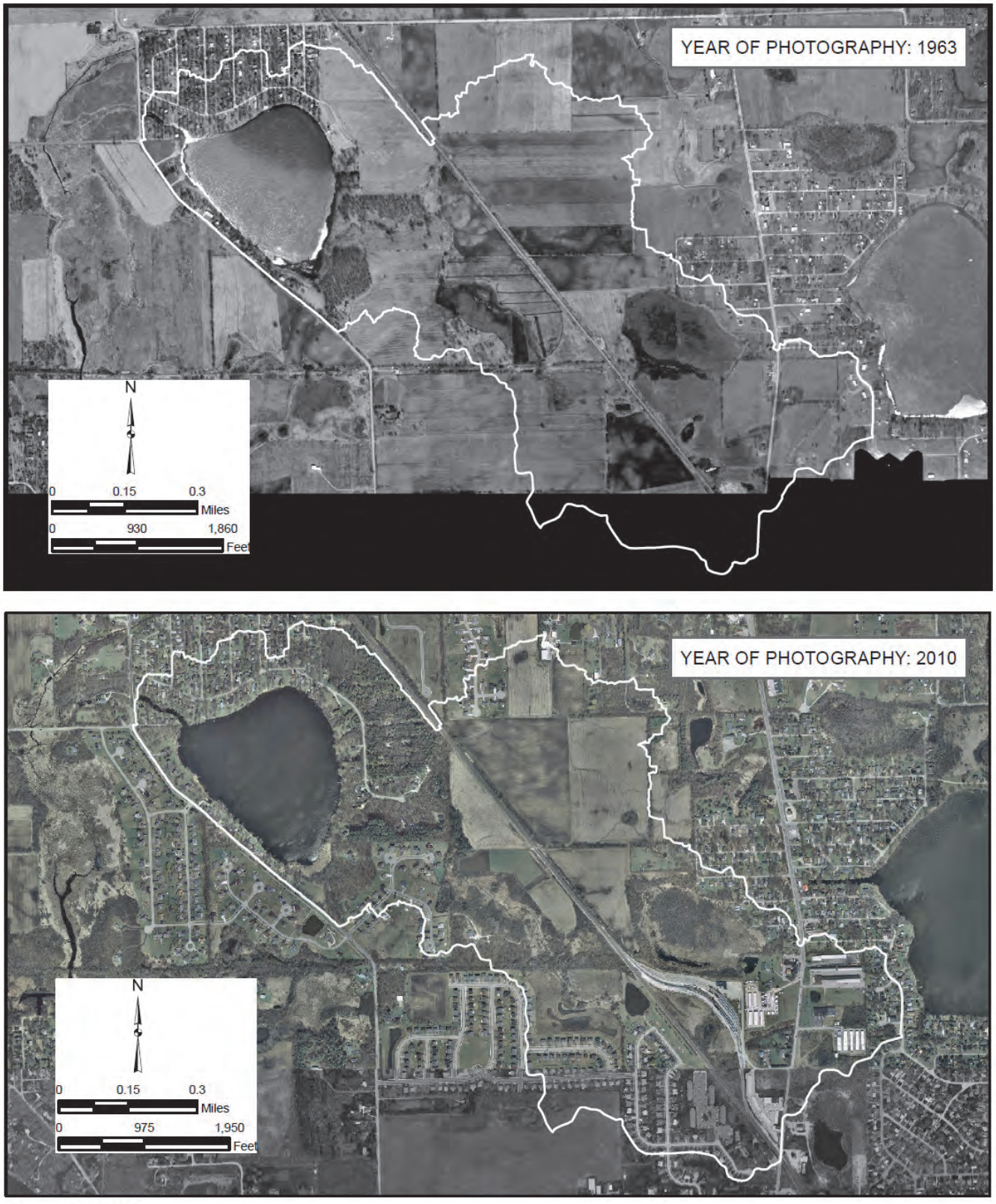
Thirteen percent of the Rock Lake watershed is comprised of wetlands. They are located primarily at the southern end of Rock Lake and along the stream that enters the Lake (see Map 7), providing the Lake with a degree of pollution and sediment reduction from surface water runoff entering the Lake from the southern portion of the watershed. The potential to naturally remove pollutants, in combination with the many other benefits provided by wetlands, illustrates how crucial the maintenance of these wetlands is for Rock Lake. Consequently, recommendations related to maintaining and enhancing wetland functions are also included in Chapter III of this report.

Woodlands, uplands, and other "natural areas," as mentioned above, can also act as buffers to waterbodies. About 8 percent of the Rock Lake watershed is composed of these woodlands. Woodlands and other "natural areas" are particularly valuable when located in areas adjacent to the Lake or its tributaries (see Map 7). Consequently, these areas should be protected to the greatest extent practical to protect the water quality of the Lake (see Chapter III for recommendations).

Manmade buffers and vegetative buffers along the shoreline and near shore-areas of Rock Lake are shown on Map 12. Some manmade buffers, primarily gardens along the shoreline, as well as a few vegetative buffers, provide the Lake some protection from the pollution that could otherwise enter the Lake (e.g., lawn clippings,

Figure 10

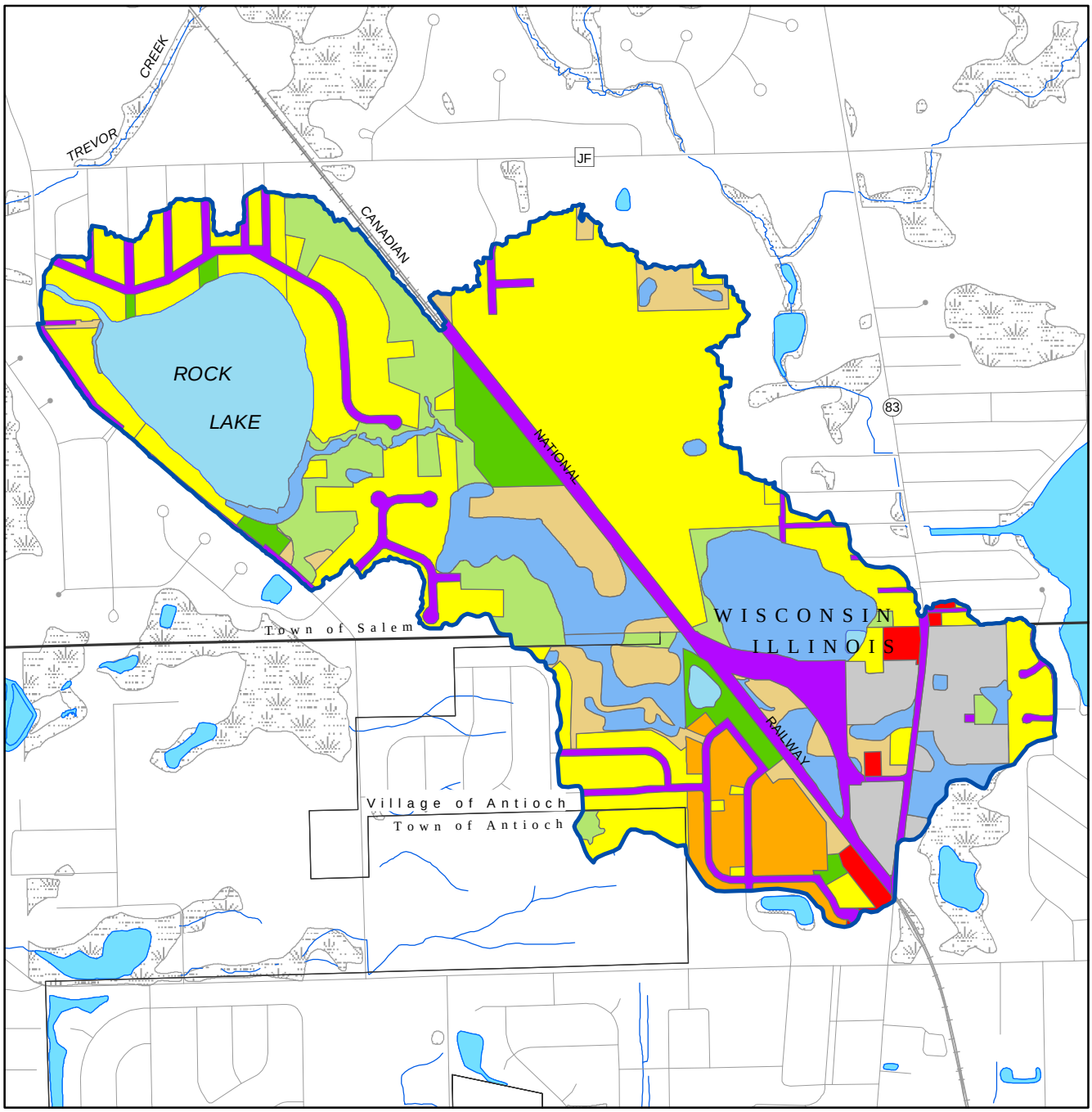
HISTORICAL AERIAL PHOTOGRAPHS OF ROCK LAKE: 1963 AND 2010



Source: SEWRPC.

Map 9

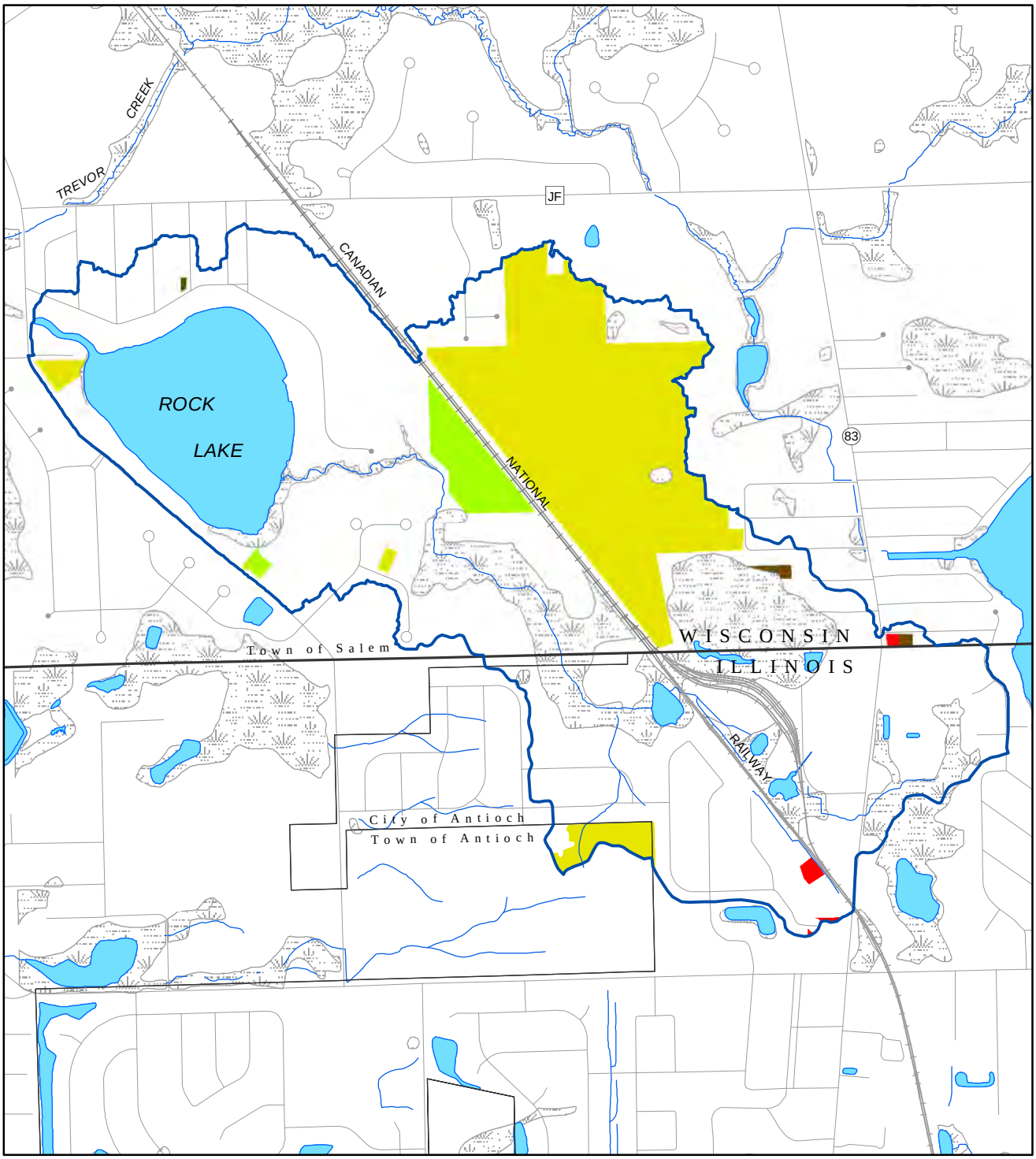
2035 PLANNED LAND USE FOR ROCK LAKE WATERSHED



Source: SEWRPC

Map 10

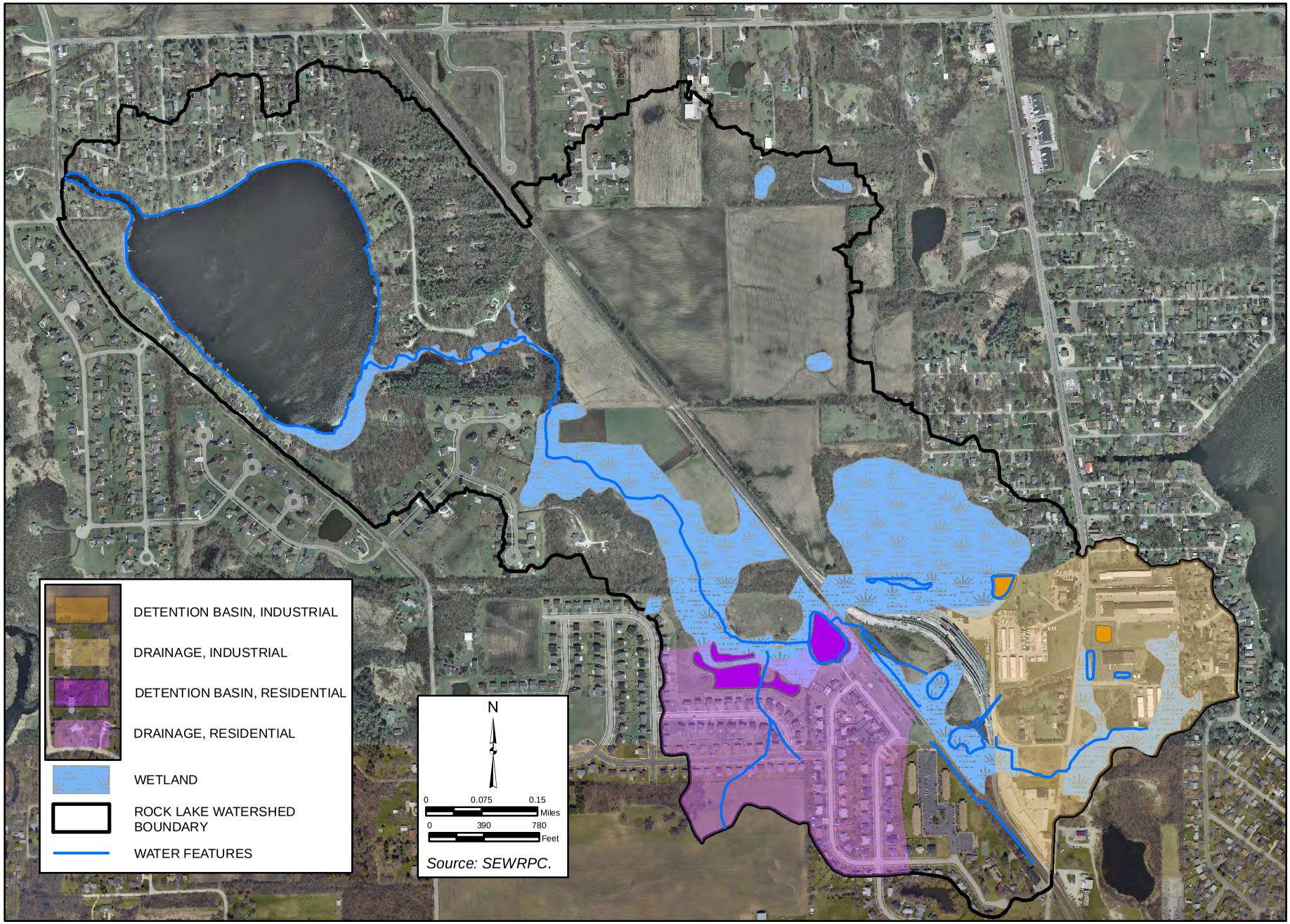
AGRICULTURAL LANDS, OPEN LANDS, AND WOODLANDS THAT WOULD BE CONVERTED TO URBAN LAND USE UNDER YEAR 2035 PLANNED CONDITIONS WITHIN THE ROCK LAKE WATERSHED: 2010



Source: SEWRPC

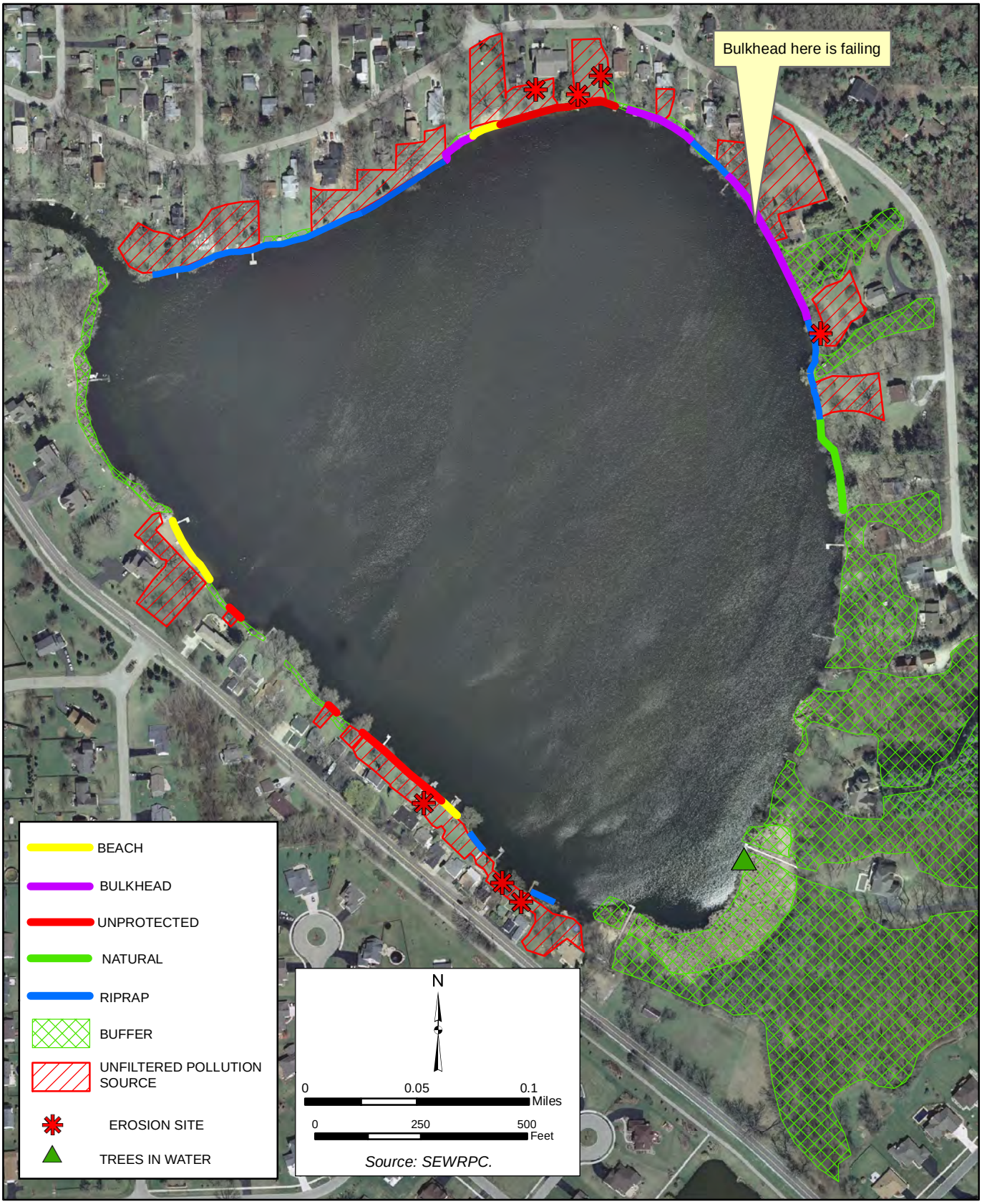
Map 11

LOCATION OF DETENTION BASINS AND THE REGIONS THAT DRAIN TO THEM



Map 12

SHORELINE PROTECTION AND BUFFERS ON ROCK LAKE: 2014



fertilizers, and oils from cars). However, **a large portion of the shoreline is mowed to the water line**. These areas pose risks to the Lake, given their proximity; consequently, enhancement of shoreline buffers along the shorelines should be considered a high priority. Recommendations related to this topic are further discussed in Chapter III of this report.

Buffer creation and the enhancement of existing buffers and wetlands should be crucial aspects of protecting the water quality of Rock Lake. Buffer and wetland maintenance and development should likely be targeted at strategic areas in the watershed that produce runoff which does not have a chance to filter through an existing buffer or wetland system prior to entering the Lake. Some of these areas within the Rock Lake watershed were determined by comparing the flow pathways of the water within the watershed[31] to the locations of the natural and manmade features discussed above (as represented on Map 13). The majority of the areas are located in the areas adjacent to the Lake. Consequently, the near shore area will need to be targeted for pollution reduction efforts and/or buffer enhancement projects. Recommendations related to water quality enhancement within Chapter III will focus on these areas.

ISSUE 3: BLUE GREEN AND FLOATING ALGAE

Blue green and floating algae are ongoing issues of concern for Rock Lake residents and users, as the Lake has experienced algal blooms periodically throughout the spring and summer (see Figure 11). Before discussing excessive algae growth and management, however, it is important to note that the presence of **algae is often a healthy part of any ecosystem**. Algae is one of the primary components of a lake food chain; certain kinds of algae also can produce oxygen in the same way as plants. There are a number of kinds of algae, from filamentous algae to blue green algae (see Figure 12). The majority of algae strains are good for lakes, in moderation. However, the presence of toxic strains (see Figure 13), as well as excessive growth patterns, when found, should be considered an issue of concern. As with aquatic plants, algae generally grow at faster rates in the presence of phosphorus (particularly in stagnant areas). Consequently, when toxic or high volumes of algae begin to grow in a lake it often indicates a problem with phosphorus pollution.

In general, **the most permanent methods for preventing excessive and toxic algae growth are:**

1. **To manage water quality with a focus on phosphorus reduction—**Phosphorus pollution is often the root cause of excessive algal growth. Consequently, the water quality recommendations discussed in Chapter III should be implemented.

2. **To maintain a healthy and active native plant community—**As mentioned in the "Chemical Measures" subsection of this chapter, the maintenance of a healthy, robust native plant community is tied to the prevention of excessive algal blooms. This is because the two directly compete for phosphorus (i.e., when nutrients are in the Lake, plants or algae will grow). Consequently, the careful implementation of the Aquatic Plant Management recommendations provided in Chapter III and the communication of this nutrient-growth relationship to residents (to encourage conservative hand-pulling of vegetation) should be considered a priority.

In addition to these measures, in-lake measures and manual removal methods which could also be engaged, including:

1. **Alum treatments**—Alum treatments involve spreading a chemical over the surface of the lake which then, in turn, forms a solid and carries the algae to the bottom of the lake. This is a temporary solution and can be cost prohibitive. However, if algae become excessive this method could be considered.

[31]*Flow pathways within the Rock Lake watershed were determined using elevation data and field investigations.*

Map 13

EXISTING BUFFERS AND WATER FLOW PATHWAYS IN THE ROCK LAKE WATERSHED

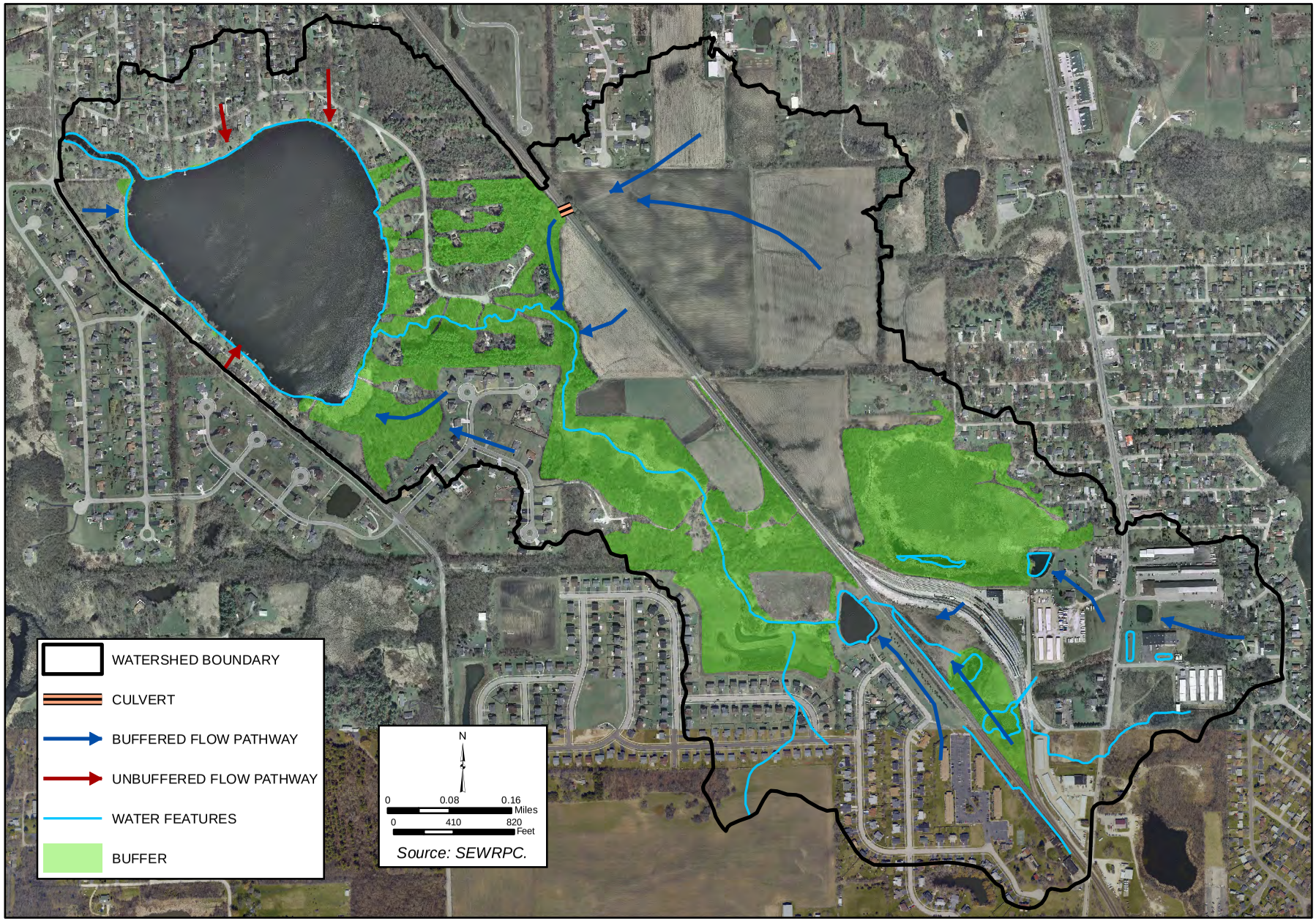


Figure 11

ALGAE IN ROCK LAKE

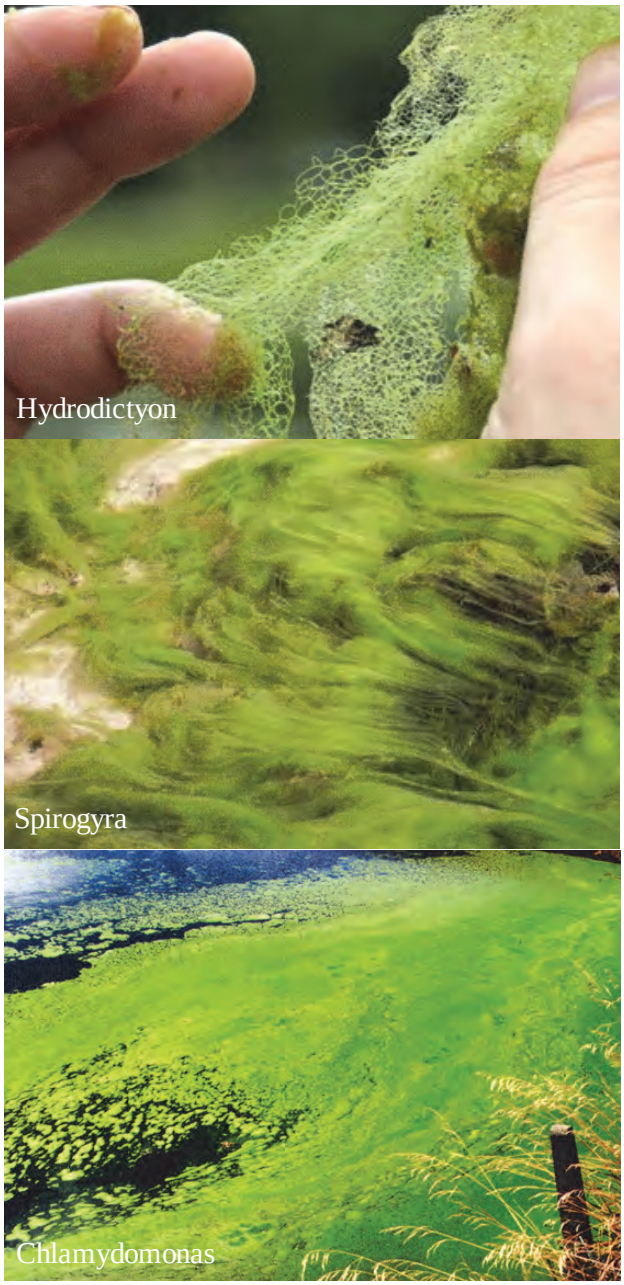
Source: Mary Kelly, Rock Lake resident.

2. **Aeration**—This process involves pumping air to the bottom of the lake to prevent stratification and anoxic conditions in the deep part of the lake. This prevents internal loading (i.e., the release of phosphorus from deep sediments) and reduces the occurrence of algae blooms during the mixing periods. This method is only necessary if internal loading is excessive.

3. **Manual removal**—Manual removal of algae through a suction device has recently been tested within the Region. This measure, though legal, is currently in the early stages of application. Additionally, "skimming" of algae has been tried by lake managers, with little success. Consequently, it may be necessary to further investigate these kinds of measures prior to implementation.

Figure 12

DIFFERENT TYPES OF NON-TOXIC ALGAE



Source: Lewis Lab, University of New Mexico, Landcare Research.

All of the above measures are generally implemented when algal blooms become so excessive that they greatly inhibit recreational use. This is because each method is a temporary fix and can be cost prohibitive. Since Rock Lake has had only minor issues with algal blooms, these methods are not recommended. The more permanent methods of algal control discussed above (i.e., pollution control and plant community maintenance) are recommended, however.

Figure 13

EXAMPLES OF TOXIC ALGAE

Source: National Oceanic and Atmospheric Administration, St. John's River Water Management District.

As a final note about algae, though management for algae prevention is crucial, it may also be advantageous to undertake algae monitoring. There are two primary ways to monitor algae levels. The first is to collect chlorophyll-*a* measurements, which indicate suspended algae levels in the water column (i.e., the green color in water). The second is to collect the algae and have it identified to determine whether it is non-toxic. Neither of these monitoring efforts has occurred on Rock Lake; however, if blooms become excessive, undertaking these efforts should be considered.

ISSUE 4: SEDIMENTATION

The "restoration" of Rock Lake was discussed throughout this planning process. Generally, this issue of concern referred to the need to "get the Lake back" to the conditions that existed 20, even 50, years ago, when residents remember rocky shorelines, minimal aquatic plant growth, and good water quality. As water quality and aquatic plant growth were discussed above, this section will focus on the muck accumulation/loss of rocky lake bottom that has been observed by Lake residents.

Before discussing sedimentation in Rock Lake, it is important to discuss sedimentation and how to prevent it. Sediment deposition can result either from erosion from the watershed or aquatic plant death and biomass accumulation. The mud and loose sediment that is characteristic of sedimentation causes a number of issues. The sediments can, for example, inundate or cover the sand and gravel substrates known as "parent material." This process can degrade fish habitat and cause a loss of aquatic organisms due to the fact that species such as sunfish (e.g., largemouth bass, bluegill, and green sunfish), darters and minnows (e.g., common shiner, sand shiner, and spotfin shiner) are dependent upon the sand and gravel substrates for feeding, nesting, and rearing of juveniles.[32] In addition, the loss of water volume associated with sedimentation can limit recreational opportunities, the total population of fish able to reside in a lake, and the quality of deep-water habitat in a lake.

It is important to note, however, that sedimentation happens naturally when lakes "age" (as shown in Figure 7). In general, this process involves lakes shifting to "stages of life" characterized by increasing levels of biological productivity and nutrient levels, which in turn cause the lake to "fill with muck" at an increasing rate (often caused by increasing amounts of plant biomass and plant death) until the lake is characterized as a marsh, or later as a wetland. Though this process normally occurs naturally over centuries, **it can be accelerated when land use practices in the watershed cause nutrient and sediment deposition into the lake beyond the rates that would have occurred naturally**. When this scenario is occurring, it is crucial to engage in management measures to prolong the aging process to the greatest extent practical so that the lake can be maintained in its current state for as long as possible.

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[32]*Despite the potential that the sedimentation process has to affect fish populations, a number of projects can be put into place to encourage healthy fish populations, even if sandy and rocky sediments are being inundated. These projects are further described in the "Shoreline Maintenance" and "Wildlife" sections of this chapter.*

These kinds of management projects can either seek to address the symptoms of the problems (i.e., efforts to remove sediments after they are deposited, like dredging), or can seek to prevent the sedimentation from occurring. Given the fact that dredging efforts can be costly and detrimental to a lake's plant and animal community (due to significant disturbance of bottom sediments), **preventative measures should be undertaken to the greatest extent practical before a project like dredging is considered**.

Sedimentation prevention projects can take the form of in-lake preventative measures, as well as watershed-level preventative measures. In-lake preventative measures generally refer to efforts aimed at removing plant biomass from the lake prior to the plants dying. This process prevents the dead plant biomass from accumulating at the bottom of the lake and forms the soft sediments. **Removal of plants can be done quickly and somewhat cost effectively using a harvester.** However, **this plant removal can also be undertaken using manual techniques (e.g., hand-pulling) and suction harvesting**, which also ultimately remove plant biomass. Consequently each of these measures should be further considered as aquatic plant management methods due to the added benefits (as discussed earlier in this chapter).

In-lake sedimentation management, however, only works if the major source of the sedimentation is plant death as opposed to erosion entering the lake from the shorelines or from the watershed. In reality, sedimentation generally comes both from plants and from the watershed. Consequently, **another measure that should be undertaken to prevent sedimentation is proper land management and restoration efforts along the shoreline and within the watershed so that sediments and nutrients do not get deposited in the lake**. Buffer enhancement, as described in the "Water Quality" section of this chapter, would serve to help with this effort for two reasons: 1) buffers slow down water, allowing sediments to settle out of runoff prior to entering the lake system and 2) the root systems in the plants that inhabit buffers will prevent the loss of the soils within the buffer (i.e., the root system will prevent erosion). In addition to buffer enhancement, manmade shoreline protection structures also serve to prevent erosion along the shoreline from entering the lake, when properly maintained. Consequently, shoreline maintenance (see the "Shoreline Maintenance" section below) should also be considered a priority.

Sedimentation in Rock Lake

There are two major areas of concern within Rock Lake with regard to sediment accumulation, namely the nearshore areas and the outlet channel. However, to determine the best management solution for sedimentation in Rock Lake, it is necessary to determine the likely causes of the sedimentation. Though a core of sediments in the Lake[33] would be the most accurate way to determine the cause of sedimentation, it is possible to do both an in-lake and watershed investigation to make an educated guess as to the cause. Consequently, SEWRPC staff completed both of these investigations, as described below.

In-Lake Investigation

SEWRPC staff completed a visual inspection of the areas where "muck accumulation" has been observed within Rock Lake (i.e., in the nearshore area and outlet channel). It was found in this investigation that these areas closely correlated to locations where plant populations were heaviest. **This presence of significant plant life in these areas implies that plant-based sedimentation is occurring**. However, as these areas are also affected by activities along the shoreline of the Lake, **it is also possible that erosion from the shorelines could be causing some of these issues**, particularly since inadequate shoreline protection (no buffers) and failing shoreline

[33]*Sediment coring, which uses a coring tool to look at the sediments over time, can be used to collect the sediments within a lake. These sediments can be analyzed for different chemical components to determine the source of the sediments. This can help managers determine the sediment source to target.*

structures were both found during the shoreline assessment (see Map 12). Additionally, **land management practices, such as allowing leaves from the shoreline to enter the lake, may also be contributing to this process**.

Given these findings, recommendations to reduce sedimentation with in-lake management (i.e., plant removal), shoreline restoration methods (i.e., buffer enhancement), and best management practices for shoreline property owners, have been included in Chapter III of this plan. It is also important to note that reducing the amount of plant growth in general would also be advantageous to preventing the sedimentation process. Since this growth is likely linked to water quality issues, the recommendations addressing nutrient management and water quality improvements are also further recommended to slow down the sedimentation process.

Watershed Investigation

Five items can help determine risk for erosional deposition into a lake from its watershed, as follows:

1. **Land use and associated loadings within the watershed—**Watersheds with extensive agricultural land use are high-risk areas for erosion if the farmers use land use practices such as tillage farming and do not make efforts to prevent soil loss (e.g., grassy waterways, buffers, and detention basins). Models can estimate the amount of sediments that will enter a lake from these areas and help determine where management should be focused.

2. **Planned construction within the watershed—**Construction site erosion can add a large amount of sediments to the lake in a short period of time. Therefore, construction site erosion controls generally need to be stringently enforced at all construction sites.

3. **Historical changes in land use in comparison to water quality data or observations—**Matching historical land use changes to observations made in the lake (either field data or anecdotal observations) can potentially help understand the underlying causes of past sedimentation events. If the time when water quality changes began to appear in the lake is known, for example, this could be compared to past land use changes to see if the observations coincide with construction or a land use change.

4. **Slopes within the watershed—**Steep slopes increase the potential for natural erosion as well as extensive erosion when construction occurs in these areas. Consequently, it is helpful to look at the location and extent of slopes in the watershed to determine risk for erosion and areas where construction site erosion prevention will be particularly crucial.

5. **The location and extent of "filtration features" in the watershed**—In addition to filtering pollution (as discussed in the "Water Quality" section of this chapter), buffers, wetlands, and detention basins also provide an opportunity for sediments to settle out of runoff before entering the lake. Consequently, if runoff from the watershed runs through one of these systems (depending on its size and effectiveness), the risk of sediment deposition in a lake can be greatly reduced and therefore may not be considered an issue of concern.

SEWRPC staff did an inventory of the above items and used models to estimate sediment loads from the watershed to determine the risk areas for sediment production. The land use data, as well as the location and extent of "filtration features" were previously described in the "Water Quality" section of this report. Consequently, this discussion will focus on new information, as well as the relevance of the information that has already been discussed.

The land use in the watershed (see Map 7) reveals **a minimal amount of rural land use within the watershed**. **While agricultural land use only represents 28 percent of the watershed area under year 2010 conditions, it**

is estimated that about 61 percent of the sediment load from the watershed comes from agricultural lands.[34] There is expected to be an extensive amount of urban development within these existing agricultural areas in 2035 (see Maps 9 and 10), therefore the loads from agriculture, as well as the overall sediment loads, are expected to significantly decrease (see Table 10). This indicates that management of **agricultural sediment runoff in the Rock Lake watershed may not be as crucial as managing sediments from urban runoff and construction**, since urban runoff will be persistent and will increase over time. Therefore, recommendations related to preventing construction site erosion and decreasing erosion in urban areas are provided in Chapter III of this report.

As discussed earlier in this section, many residents have noticed growth in the amount of muck in the past 20 to 50 years (time frames varied by respondent). Historical urban development within the Wisconsin portion of the watershed (Map 8) shows that, since 1963, the largest increase in urban land use occurred since 2010 (with a large portion of the eastern shoreline becoming developed in the 1990s). This could explain the increased rate of sedimentation that could have been caused by sediment from construction site erosion being transported to the Lake, or by increased nutrient pollution from residential development which ultimately ended up in the Lake and caused excessive plant growth and plant-based sedimentation upon death of the plants. However, lack of water quality data and specific dates/years for observations make it difficult to conclusively establish the causes of sedimentation. Therefore, it is further recommended that a sediment core be taken to help confirm these causes and that a more comprehensive survey of resident knowledge be obtained.

The slopes within the Rock Lake watershed, as shown on Map 14, indicate **a minimal risk of high amounts of slope-related erosion**, with the exception of the one steeply sloped area adjacent to the southeast part of the Lake. This area, however, is currently wooded, which provides adequate protection from erosion due to the root systems keeping soils in place. Consequently, slope-related erosion is not an issue of concern for Rock Lake.

Finally, as was previously discussed, **the only areas within the watershed that do not filter through a buffer or wetland system are the residential properties adjacent to the Lake** (see Map 13). These areas should, therefore, be considered the primary target in terms of preventing erosion. Consequently, the recommendations provided in Chapter III will emphasize these areas as a priority.

ISSUE 5: SHORELINE MAINTENANCE

Many Rock Lake shoreline property owners are concerned about maintaining the Lake's shorelines and usability of the Lake without jeopardizing its health. This issue of concern is further emphasized by the fact that water quality, sedimentation, and aquatic plant growth are all directly related to shoreline maintenance practices, as has been described throughout this chapter.

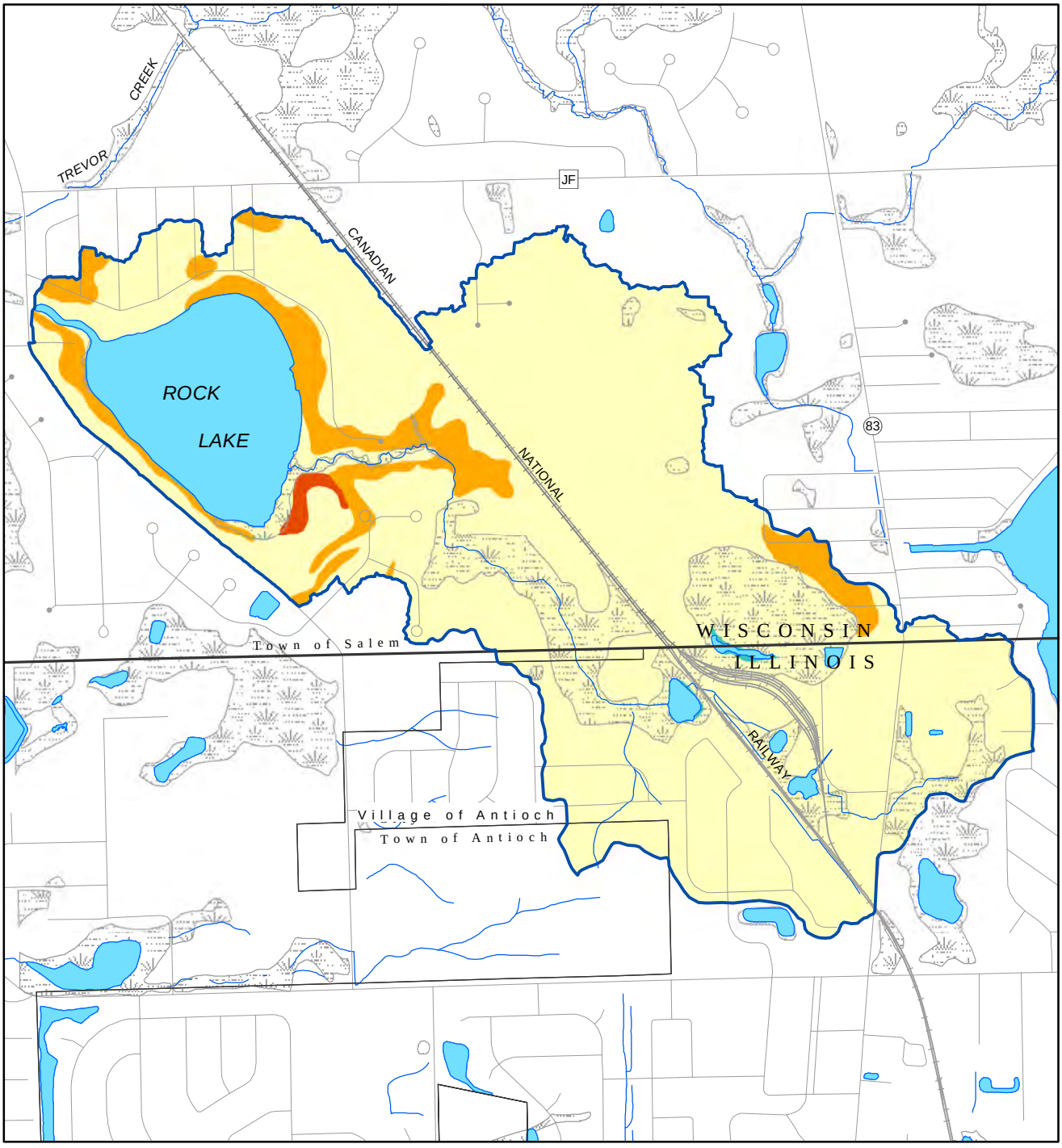
Before discussing shoreline maintenance in Rock Lake, it is important to understand the options for home owners with respect to shoreline maintenance. In general, manmade shoreline protection structures are installed to work against erosive forces and prevent soil loss to the Lake. These structures (see Figure 14), include 1) "bulkheads," where a solid, *vertical* wall of some material, such as poured concrete, steel, or timber, is erected; 2) "revetments," where a solid, *sloping* wall, usually asphalt, as in the case of a roadway, or poured concrete, is used; and 3) "riprap," where rocks and/or stones are placed along the shoreline. All of the structures listed above require permits from WDNR.

However, **shoreline protection does not always depend on the installation of manmade structures**. Many different kinds of natural shorelines offer substantial protection against erosive forces. The rock boulders and cliffs found along Lake Superior, for example, are natural barriers that serve to protect against shoreline erosion.

[34] *As with the phosphorus loading, two models were used to estimate sediment loading to the Lake, including WiLMS and unit area loading.*

Map 14

SLOPES WITHIN THE ROCK LAKE WATERSHED



Source: Natural Resources Conservation Service and SEWRPC.

Figure 14

TYPICAL SHORELINE PROTECTION TECHNIQUES

RIPRAP

NATURAL VEGETATION

BULKHEAD

REVETMENT

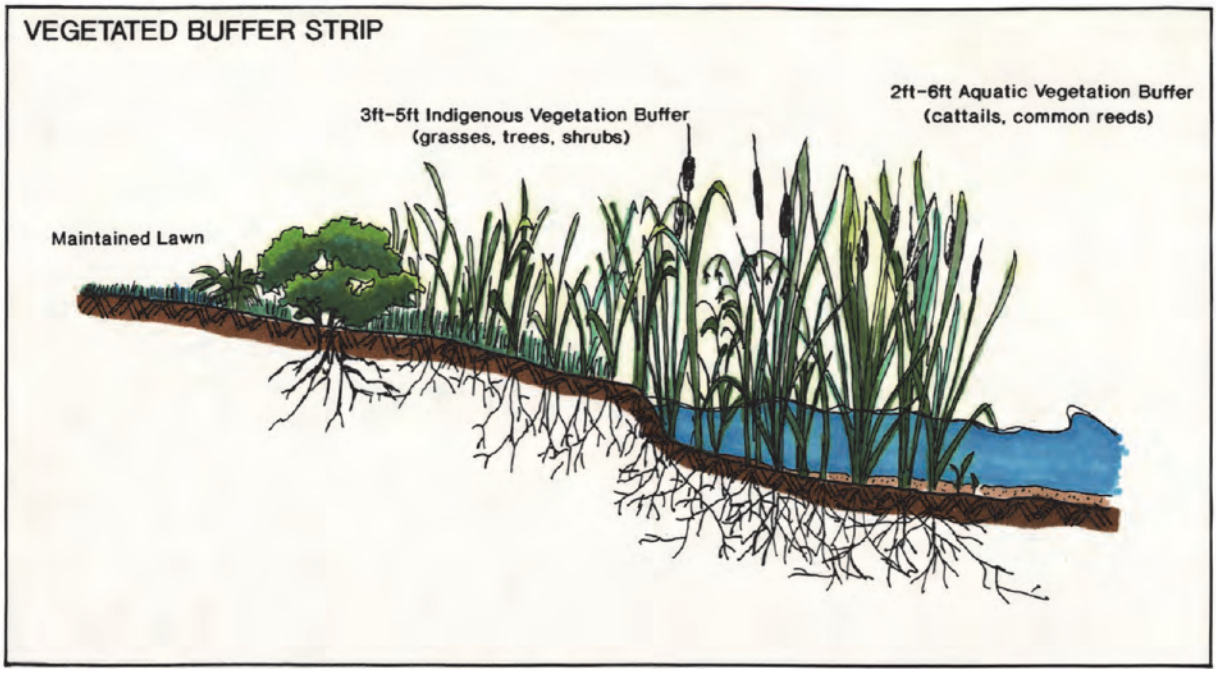
Source: SEWRPC.

Additionally, marshlands, such as those found at the southeast end of Rock Lake, and areas of exposed cattail stalks and lily pads, such as those found around the Lake's shoreline, are effective mitigators of shoreline erosive forces, as they act to disperse and dampen waves by dissipating energy.

The "hard" manmade seawalls of stone, riprap, concrete, timbers, and steel, once considered "state-of-the-art" in shoreline protection, are now recognized as only part of the solution in protecting and restoring a lake's water quality, wildlife, recreational opportunities, and scenic beauty. More recently, "soft" shoreline protection techniques, referred to as "vegetative shoreline protection," (see Figure 15) involving a combination of materials, including native plantings, are increasingly required pursuant to Chapter NR 328 of the *Wisconsin Administrative Code* and increasingly popular with riparian owners. This is because homeowners have become aware of the value of protecting their shorelines, improving the viewshed, and providing natural habitat for wildlife. Additionally, as has been discussed above, **these vegetative protections, which often include constructed**

Figure 15

NATURAL SHORELINE BUFFER SCHEMATIC AND EXAMPLE



Source: Washington County Planning and Parks Department and SEWRPC.

buffers, provide the Lake with protection from pollution and sediment deposition, which would otherwise cause excessive algae and plant growth and increased rates of sedimentation.

Given the benefits of "soft" shoreline protection measures, WDNR no longer permits the construction of "hard" structures in lakes that do not have extensive wave action threatening the shorelines (although repair of existing structures is permitted). As a result, since Rock Lake is a small lake with very little wind and wave action, it is unlikely that the installation of "hard" structures would be permitted. Consequently, the recommendations in this plan related to shoreline restoration focus on "soft" measures, including native planting, the maintenance of aquatic plants along the shorelines, and the use of "bio-logs" (see Figure 16). Beach areas, which legally need to be made from peat gravel,[35] are considered as a separate category. The placement of peat gravel may be permitted; however, this would have to be evaluated by WDNR on a case-by-case basis.

Shorelines of Rock Lake

To determine the shoreline restoration and maintenance needs of Rock Lake, SEWRPC staff completed shoreline assessments on the Lake in the summers of 2012 and 2014 to determine the condition of Rock Lake's shorelines and to develop recommendations related to shoreline maintenance and pollution reduction. The results of these surveys are shown on Map 12. There are **minimal buffers** on the shorelines to prevent pollution and shoreline erosion. Additionally, there are **several areas around the Lake with failing or inadequate shoreline protections (manmade or otherwise), as well as a number of sites where erosion was detected**. Given the desire of Lake users to ensure a healthy Lake, as well as the need to preserve recreational use of the Lake, it should be considered a priority to repair already installed shoreline structures, where feasible, and to install "soft" shoreline protection, such as vegetative shoreline protection (i.e., the maintenance of near-shore native plants) and buffers, in the future to ensure that the Lake can continue to support its current uses.

Further project recommendations for Rock Lake's shoreline are included in Chapter III of this report.

ISSUE 6: WATER QUANTITY

In recent years lake levels became an issue of concern in Rock Lake. During this time, lower water levels led to observed decreases in the flow of water out of the spillway and observed decreases in the depths in the Lake, particularly in the outlet channel. These observations demonstrate how vulnerable the Lake can be if surface and groundwater sources of inflow are inconsistent or lost over a season. Given the fact that climate patterns are changing within Wisconsin,[36] **changes in Lake levels could potentially continue for Rock Lake**. However, the extent and nature of these changes are difficult to predict on a local level without a comprehensive local climate analysis (which is beyond the scope of this study). In general, climate models predict that climate change could alter hydrologic budgets, leading to changes in water levels or flows, and cause water levels to fluctuate more due to larger fluctuations in precipitation.[37]

Generally, an efficient way to increase and maintain water levels is to operate the outflow structure to the Lake so that more water is kept in the Lake and prevented from flowing downstream. This kind of action would require a WDNR permit allowing for the rises in water levels. However, in Rock Lake, the spillway is not designed for this purpose. Consequently, unless the spillway were reconstructed, this would not be a possibility.

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[35]*WDNR no longer permits the use of sand because these materials quickly flow into a waterbody and contribute to the "fill-in" of the Lake.*

[36]*Wisconsin Initiative on Climate Change Impacts (WICCI),* Wisconsin's Changing Climate—Impacts and Adaptation, *2011.*

[37]Ibid.

Figure 16

EXAMPLE OF "SOFT" SHORELINE STRUCTURES

Natural Shoreline

Bio-logs

Buffers (Vegetative Strips)

Cattails

Source: Native Lakescapes and SEWRPC.

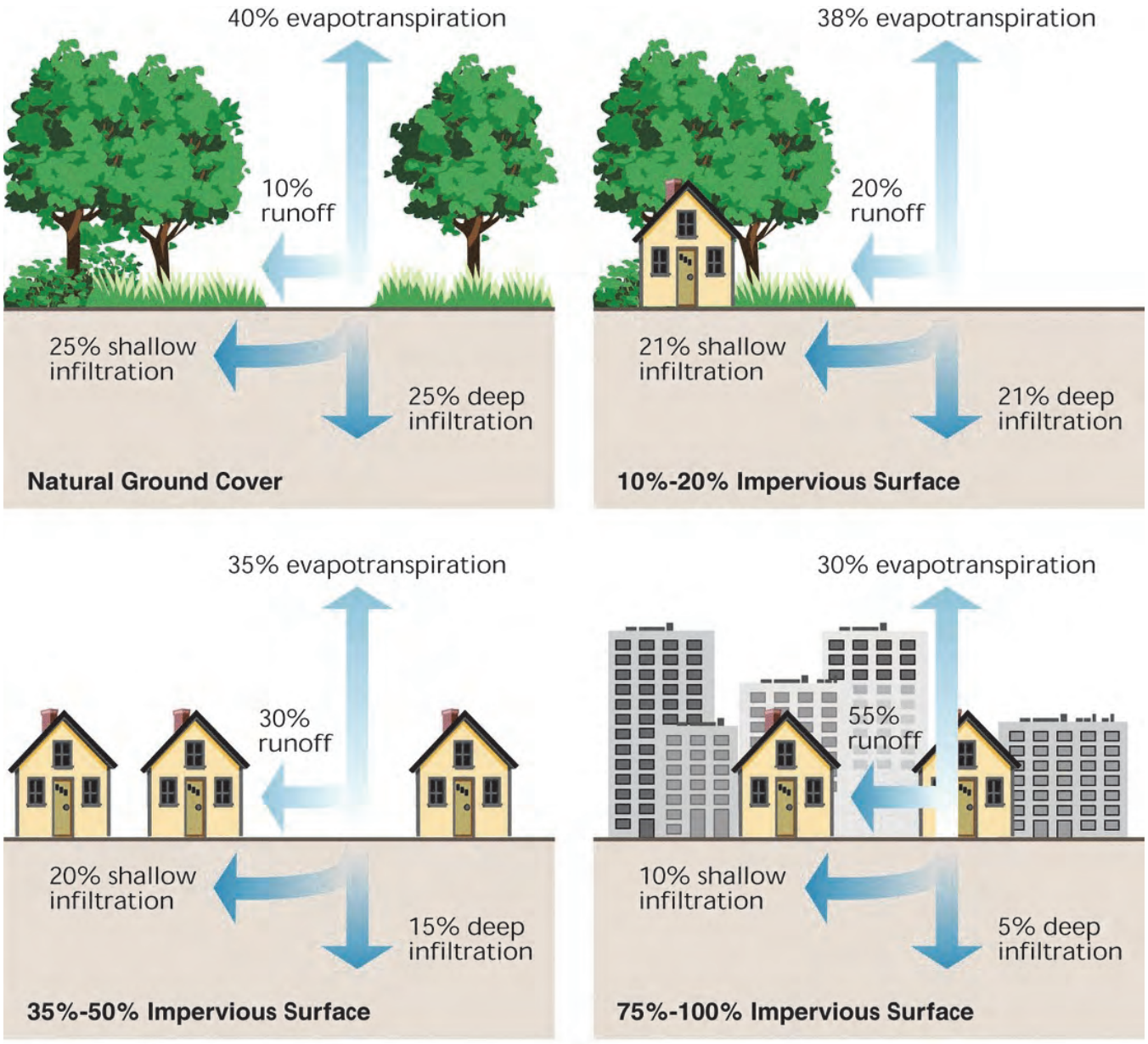
Given this current lack of ability to establish water levels in the Lake through manipulation of the spillway, it is important instead to focus on projects that can be undertaken to increase the consistency of water flows to the Lake. These types of projects generally address the two primary factors that influence water supply to a lake during both periods of adequate rainfall and drought. These factors include 1) the ability of the watershed to store and gradually release surface water runoff (i.e., surface water detention); and 2) the recharge rates of aquifers (i.e., groundwater systems) that supply the baseflow to the Lake. Both of these factors are discussed below.

Surface Water Runoff Management and Baseflow Recharge Rate Maintenance

Runoff from large, intense rainfall events moves across the land surface and through streams at a higher than average velocity. This speed can be decreased when the water encounters detention or retention basins, buffers, or wetlands which slow the flow, storing and gradually releasing it, and, in some instances, allowing the water to

Figure 17

SCHEMATIC OF THE EFFECTS OF IMPERVIOUS SURFACES ON RUNOFF AND GROUNDWATER RECHARGE



Source: Federal Interagency Stream Restoration Working Group.

soak into the ground. Much of the water that soaks into the ground becomes part of the groundwater baseflow and moves slowly toward a lake, maintaining flow to the lake over a period well beyond the day of the rain event.

However, if buffers and wetlands do not exist to store and gradually release the runoff, the runoff could more rapidly enter a lake and depending on the lake size and outlet characteristics, quickly flow out of the lake. In this case, a smaller volume of water is kept within the watershed to gradually supply the lake over time.

Impervious surfaces greatly increase the volume and velocity of runoff after a rainfall (see Figure 17). Consequently, reducing or preventing impervious cover, or installing measures meant to reduce the runoff from

impervious cover (such as rain gardens or buffers), are crucial components in ensuring consistent volumes of water supply to a lake. To determine where improvements can be made to maintain and extend the volume of water supplied to Rock Lake, several factors need to be assessed. These include:

1. **The location and extent of current urban land use within the watershed**—Urban land uses generally have a much higher percentage of impervious cover than rural land uses. Consequently, to assess where management efforts can be made to reduce the amount of impervious cover (or where efforts can be made to slow down or reduce the runoff leaving these areas) it is necessary to identify where urban land use exists.

2. **The location and extent of planned land use changes within the watershed**—Since urban land use has a higher percentage of impervious cover, it is important to know where rural land is expected to be converted to urban land in the future. In such cases, extra precautions can be taken to implement management efforts that will reduce runoff velocity and/or volume when the development occurs in the future.

3. **The location and extent of natural areas and stormwater management structures**—As mentioned previously, stormwater retention and detention basins and natural areas (e.g., buffers, grassy waterways, and woodlands) serve to slow down water, in some cases to store and gradually release water, and to promote infiltration of water into the soils. Consequently, if runoff passes through these kinds of areas, it can modulate runoff peaks and increase the time during which a volume of runoff is supplied to the Lake.

To help target water volume management efforts, the SEWRPC staff inventoried the three preceding factors for the Rock Lake watershed using geographic information system techniques and 2010 color digital orthophotography, which was collected under a Regional orthophotography program administered by the Commission. Current and planned land use data are shown on Maps 7 and 9. **Urban land use currently occupies about 40 percent of the watershed**. Additionally, through comparing the 2010 and 2035 land use data, it can be seen that **an extensive portion of the watershed which is currently in agricultural uses would be converted to residential uses under planned year 2035 conditions** (see Map 10). Though the land planned for conversion from agricultural to residential uses is currently well buffered (see Map 13), the proximity of this development area to the Lake may be a cause for concern if infiltration practices, stormwater management, and buffer enhancement are not considered priorities in these new developments. Consequently, recommendations related to this new planned development, as well as general recommendations for slowing, storing, and infiltrating runoff, are included in Chapter III of this report.

Map 13 also indicates, as was discussed in the "Water Quality" section, that**, with the exception of the majority of the shoreline properties, most of the runoff from within the watershed enters a natural feature that could aid with infiltration**. Consequently, recommendations to increase water infiltration on shoreline properties are also included in Chapter III of this report.

Baseflow refers to water that reaches the Lake inlet and the Lake itself from groundwater. This groundwater is generally replenished through recharge (rainfall that soaks into the ground and enters the aquifer system). **Baseflow is crucial to Rock Lake because it provides water supply during times when surface runoff may be scarce** (e.g., during droughts). Consequently, maintaining the recharge of the aquifers that supply Rock Lake is important.

Generally, the depletion of groundwater flow happens for one of two reasons: 1) over-pumping the aquifer that supplies the baseflow, thereby causing springs to run dry; and 2) reducing or eliminating the recharge of the belowground aquifers through land use changes that increase impervious cover. The first of these most commonly occurs when a high-capacity well, or wells, are installed in the vicinity of a waterbody without proper consideration for the effect they might have on the aquifer. Since this is not currently occurring in the Rock Lake

watershed, it is not considered an issue of concern. However, if a high-capacity well were proposed in the Lake's groundwatershed in the future, its effect on Lake levels should be carefully investigated, and, if those effects were found to be significant, they should be mitigated.[38]

The second of these (i.e., loss of aquifer recharge) happens most commonly because groundwater recharge is not considered when development decisions are made. Consequently, it is necessary to determine what areas need to be protected in order to maintain the baseflow to Rock Lake. To determine this, two factors need to be analyzed, including:

1. **The direction of groundwater flow**—When attempting to ensure adequate baseflow to a lake, it is important to know where the groundwater is coming from. In fact, groundwater recharge that feeds the aquifer system (and in turn feeds the lake) does not always come from areas solely within the surface watershed. This is because subterranean geologic formations can direct the flow of groundwater in a different direction than the surface water. To make an approximate determination of this direction of flow, it is possible to analyze groundwater elevation contours established from depth measurements taken at different groundwater wells within the Region and referenced to a common datum, such as National Geodetic Vertical Datum, 1929 adjustment (NGVD 29). These boundaries are interpreted in a similar way to ground surface elevation data (i.e., water flows downhill), and can be used to get general groundwater flow directions. When performing such an analysis it is necessary to also consider the locations of streams, ponds, and lakes, other than the waterbody of interest, relative to the groundwater flow direction. A stream or pond located down gradient from the highest groundwater contour and upgradient from the waterbody for which it is desired to estimate the contributing groundwatershed, may intercept all, or some, of the groundwater flow, in effect creating one of the groundwatershed boundaries.

2. **The groundwater recharge potential in the area that is likely contributing to the groundwater supply**—Groundwater recharge potential is based on the amount of impervious cover and soil characteristics. An area with no impervious cover and highly permeable soils, for example, would be classified as having high or very high groundwater recharge potential, whereas an area with lower permeability (e.g., clay soils) would be classified as low potential. Establishing areas of groundwater recharge potential enables determination of the highest priority areas for which infiltration functions should be protected (e.g., the areas where impervious surfaces should be avoided or where appropriate infiltration facilities should be implemented).

To determine where management efforts should be employed to protect groundwater recharge to Rock Lake, SEWRPC staff analyzed groundwater elevation contours and the groundwater recharge potential in the areas surrounding the Lake.[39] This inventory was not confined to the surface watershed, as was the case for the other inventories completed in this report, because the groundwater flow may be coming from outside of the watershed. The results of these inventories are described below.

Map 15 shows the general water table elevations, in feet above NGVD 29, in the Rock Lake area. As indicated on the map, **these groundwater table elevations reflect a general north to south flow of groundwater to Rock Lake, thereby indicating that the groundwater recharge area for the Lake's baseflow may be located outside of the surface watershed**. These results cannot be considered conclusive, however, without further study; consequently, recommendations to determine groundwater flows and the recharge area are included in Chapter III of this report.

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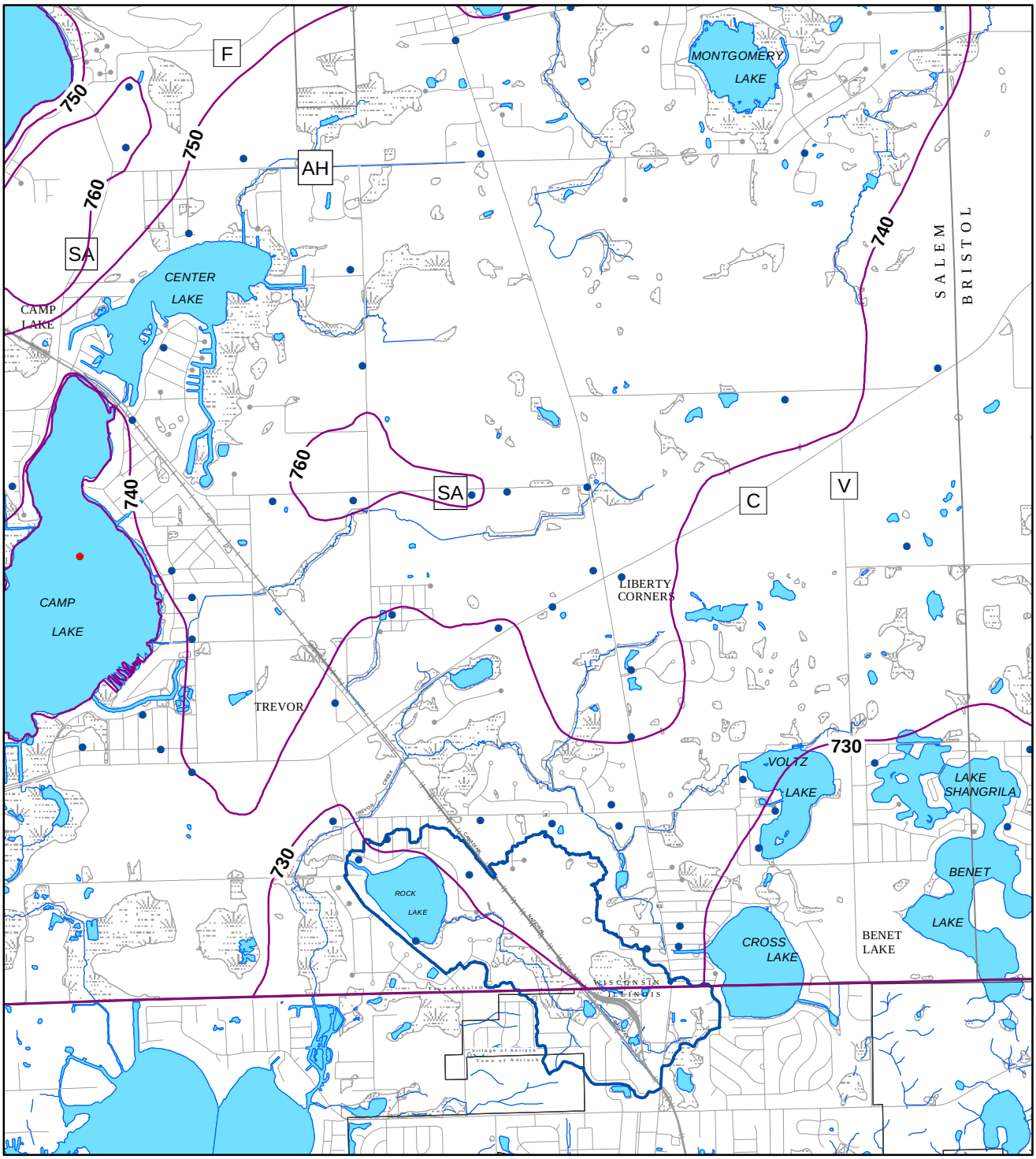
[38]*SEWRPC Planning Report No. 52,* A Regional Water Supply Plan for Southeastern Wisconsin, *December 2010.*

[39]*SEWRPC Planning Report No. 52, op. cit.*

Map 15

GROUNDWATER TABLE ELEVATIONS BASED ON WELL ELEVATIONS WITHIN THE ROCK LAKE WATERSHED



AVERAGE WATER-TABLE ELEVATION (FEET ABOVE MEAN SEA LEVEL)

730 ELEVATION IN FEET ABOVE MEAN SEA LEVEL

WELL DATA POINT

SURFACE WATER

STREAM

WATERSHED BOUNDARY

N

0 0.35 0.7 Miles

0 1,900 3,800 Feet

Source: Wisconsin Geological and Natural History Survey and SEWRPC.

Data not available for Lake County, Illinois.

Given that the groundwater flowing to Rock Lake appears to be flowing from the north, Map 16 shows the groundwater recharge potential for the Rock Lake watershed and areas to the north. There are some high recharge areas located just north of the Lake, which seem to be within a wetland (wetlands are known to be periodic contributors to groundwater recharge). That wetland is at the headwaters of Trevor Creek, which flows in a westerly and then southerly direction, bypassing Rock Lake. Thus, those headwater wetlands, and the areas north of those wetland and of Trevor Creek, may not be part of the Rock Lake groundwatershed. It is possible that some of the moderate potential recharge areas between the wetlands and Rock Lake, and between Trevor Creek and Rock Lake but outside of the Rock Lake surface watershed, may contribute groundwater to Rock Lake. More studies would be needed to develop a conclusive understanding of the areas to protect to ensure continued baseflow to Rock Lake. Consequently, recommendations related to the investigation of these recharge areas are also included in Chapter III.

Even without further study, however, some projects can be undertaken to improve the volume and timing of water delivered to the Lake. In the interest of encouraging these kinds of actions, Chapter III of this report further details a number of recommendations focused on increasing infiltration in the moderate and high groundwater recharge potential areas in the Rock Lake watershed and in the areas that may contribute to Rock Lake's baseflow (i.e., limited areas north of the Lake as well as the areas directly adjacent to the Lake). These recommendations should be implemented where practical.

ISSUE 7: SPILLWAY/LAKE OUTFLOW

The spillway which controls Rock Lake's water levels (see Figure 18) is currently being managed by the Town of Salem (i.e., the Town clears debris from the structure periodically). However, the owner of the spillway is unknown, and consequently, there is no entity that is legally able to modify/fix the spillway. This is an **issue of concern relative to maintaining (or replacing) the spillway if it falls into disrepair**.

This situation (i.e., unknown owner of a spillway) is not unique within Wisconsin, therefore, **there are measures which can be taken to provide ownership of the spillway to another interested party**. Undertaking these measures, though involved, would give the dam owner the ability to control the Lake's levels, subject to permitting conditions, and would hold that entity responsible for repair of the spillway. Consequently, recommendations related to establishing an owner for the spillway are further detailed in Chapter III of this report.

ISSUE 8: RECREATIONAL USE MAINTENANCE

An all-encompassing issue of concern voiced by lake residents was the desire to maintain recreational use of the Lake. This issue of concern relates to many of the topics discussed in this chapter (e.g., aquatic plants, water quality, algal blooms, water quantity, and wildlife) because each one of them can affect the different recreational uses. To evaluate the needs of Rock Lake users, a watercraft census (i.e., a boat count along the shoreline) and recreational survey (i.e., a count of users and use type on randomly selected weekdays and weekends) were completed by SEWRPC staff in the summer of 2012. These studies sought to develop a complete inventory of the many uses of the Lake, as well as to determine the primary uses of the Lake. The results are discussed below.

One hundred twenty-eight watercraft were observed during the census, either moored in the water or stored on land in the shoreland areas around the Lake, as shown in Table 13. About 11 percent of all docked or moored boats were motorized, with fishing boats and pontoon boats comprising the most common types, while 89 percent of all docked or moored boats were nonmotorized (e.g., rowboats, canoes, and pedal-boats/paddleboats).[40] On Rock Lake, the number of moored or docked boats would generally lead to about three to six watercraft on the Lake during high-volume periods;[41] however, **the recreational survey (discussed below) revealed that only three boats were observed on the Lake at any given time**.

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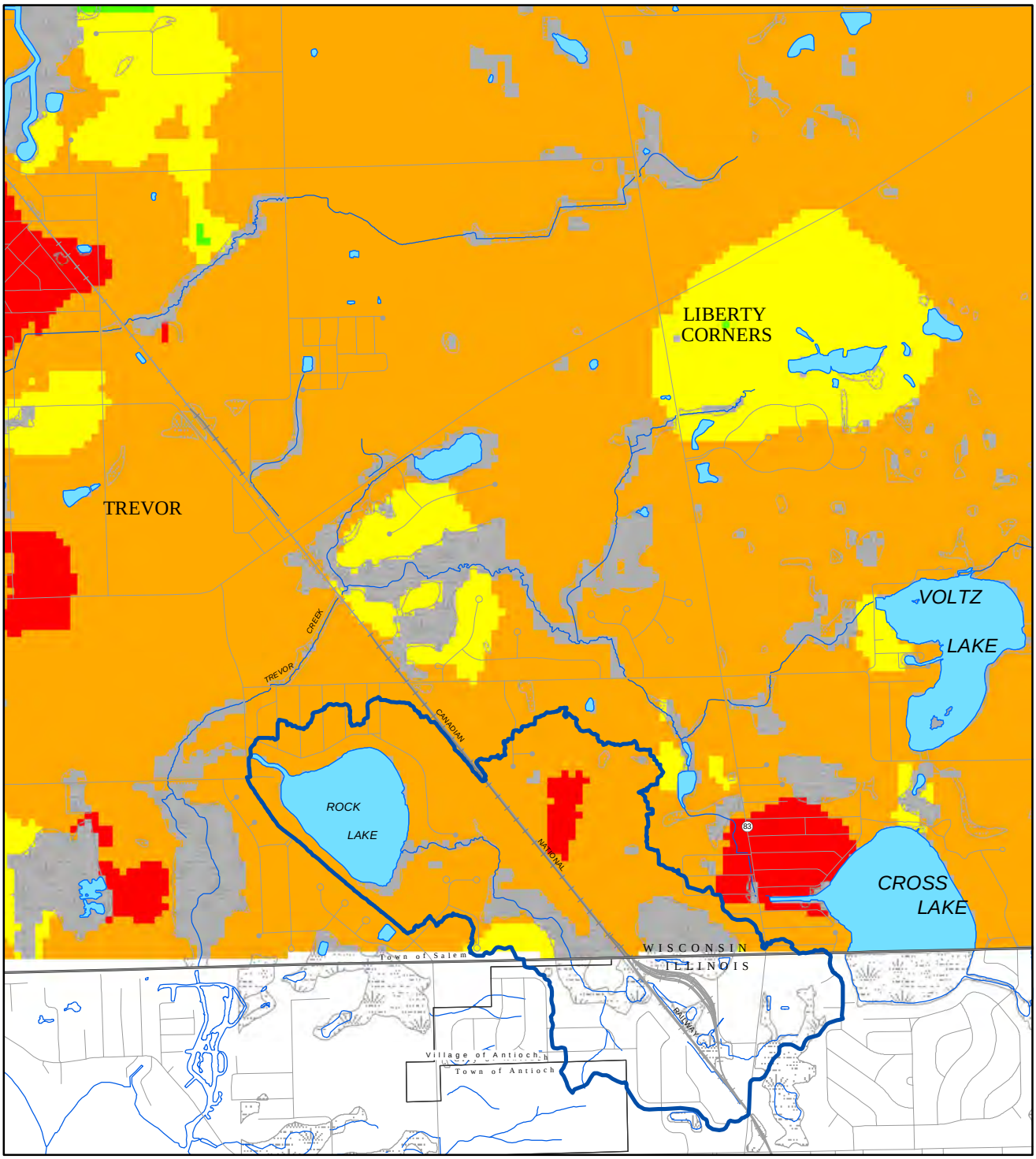
[40]*The small percentage of motorized boats on Rock Lake was expected due to the fact that the Lake has an ordinance prohibiting non-electric motors (see Appendix E).*

[41]*At any given time it is estimated that between about 2 percent and 5 percent of the total number of watercraft docked and moored will be active on the Lake.*

Map I6

ESTIMATES OF GROUNDWATER RECHARGE POTENTIAL WITHIN AREAS SURROUNDING ROCK LAKE



Source: Wisconsin Geological and Natural History Survey and SEWRPC.

Data not available for Lake County Illinois

Figure 18

ROCK LAKE SPILLWAY

Source: SEWRPC.

Table 13

WATERCRAFT DOCKED OR MOORED ON ROCK LAKE: 2012[a]

Type of Watercraft									
Powerboat	Fishing Boat	Pontoon Boat	Personal Watercraft	Canoe	Sailboat	Kayak	Pedalboat	Rowboat	Total
0	8	6	0	28	8	10	26	42	128

NOTE: Local ordinance prohibits motors on Rock Lake, with the exception of electric motors.

[a]*Including trailered watercraft and watercraft on land observable during survey.*

Source: SEWRPC.

The results of the activity survey and recreational boat use on the Lake are shown in Tables 14 and 15. These numbers can provide insight into the primary uses of the Lake. At the time of the survey (summer 2012), during typical summer weekdays, there is very little boating activity on Rock Lake, while weekend boating activities generally exceed those on weekdays, as would be expected. Fishing and low-speed cruising, mainly using

Table 14

RECREATIONAL SURVEY ON ROCK LAKE—WEEKDAYS: SUMMER 2012

		Active Recreational Watercraft and Related Activities on Rock Lake										
		Time and Date										
		6:00 a.m. to 8:00 a.m.		8:00 a.m. to 10:00 a.m.		10:00 a.m. to Noon	Noon to 2:00 p.m.		2:00 p.m. to 4:00 p.m.		4:00 p.m. to 6:00 p.m.	
Category	Observation	June 20	June 28	June 19	June 20	June 26	August 15	August 30	June 27	August 27	June 26	July 31
Type of Watercraft (number in use)	Pontoon boat	0	0	0	0	0	0	0	0	0	0	1
	Fishing boat	0	0	0	0	0	3	0	0	0	0	0
	Kayak/canoe	0	0	0	0	0	0	0	0	1	1	0
Activity of Watercraft (number engaged)	Motorized cruise/pleasure Low speed	0	0	0	0	0	0	0	0	0	0	1
	Fishing	0	0	0	0	0	3	0	0	0	0	0
	Rowing/paddling/pedaling	0	0	0	0	0	0	0	0	1	1	0
Total	On water	0	0	0	0	0	3	0	0	0	1	1
		Recreational Activities Observed on Rock Lake										
Activity (average number of people)	Park goer	0	0	0	0	0	0	0	0	0	4	4
	Beach swimming	0	0	0	0	0	0	0	8	0	4	1
	Pier/boat/raft swimming	0	0	0	0	0	2	0	1	0	1	0
	Canoeing/kayaking	0	0	0	0	0	0	0	0	1	1	0
	Fishing from Boats	0	0	0	0	0	5	0	0	0	0	0

NOTE: Local ordinance prohibits motors on Rock Lake, with the exception of electric motors.

Source: SEWRPC.

Table 15

RECREATIONAL SURVEY ON ROCK LAKE—WEEKENDS: SUMMER 2012

		Active Recreational Watercraft and Related Activities on Rock Lake							
		Time and Date							
		6:00 a.m. to 8:00 a.m.	8:00 a.m. to 10:00 a.m.		10:00 a.m. to Noon	Noon to 2:00 p.m.		4:00 p.m. to 6:00 p.m.	
Category	Observation	July 21	August 11	August 25	August 25	August 19	September 3	June 24	August 11
Type of Watercraft (number in use)	Fishing boat	2	1	0	2	0	1	0	2
	Kayak/canoe	0	0	0	0	0	2	1	0
	Wind board/paddle board	1	0	0	0	0	0	0	0
	Paddleboat (pedalboat)	0	0	0	0	1	0	0	0
Activity of Watercraft (number engaged)	Fishing	3	1	0	2	0	1	0	2
	Rowing/paddling/pedaling	0	0	0	0	2	2	1	0
Total	On water	3	1	0	1	1	3	1	2
		Recreational Activities Observed on Rock Lake							
Activity (average number of people)	Park goer	0	0	0	0	2	0	4	5
	Beach swimming	0	1	0	2	2	2	5	2
	Pier/boat/raft swimming	0	0	0	2	0	2	0	0
	Canoeing/kayaking	0	0	0	0	2	0	1	0
	Fishing from Boats	3	1	0	2	1	0	0	4
	Fishing from Shore	0	0	1	2	2	0	0	0

NOTE: Local ordinance prohibits motors on Rock Lake, with the exception of electric motors.

Source: SEWRPC.

Figure 19

PUBLIC ACCESS ON ROCK LAKE

Source: SEWRPC.

pontoons, are the most popular weekend boating activities on Rock Lake. However, **overall the most popular recreational activities on both the weekends and weekdays were swimming at the beach, fishing from boats, and going to the park**, further emphasizing the need to encourage boating access to the Lake without risking aesthetic beauty and the opportunity to swim.

Given that swimmers, boaters (including fishermen), and individuals who enjoy the aesthetics of the Lake are the primary users of the Lake, the maintenance of these primary uses should be considered a priority. Consequently, all of the recommendations included in Chapter III of this report will be made in the attempt to ensure full use of the Lake. Since accommodating some users is not always advantageous for others, the recommendations contained in Chapter III of this report will seek to encourage compromise between conflicting users so that all users may gain access to the Lake for the purposes that they intend.

ISSUE 9: PUBLIC ACCESS SITE

Two sites are used for public access to the Lake (shown on Figure 19): the public access site at the southwestern shoreline of the Lake and the fire lane on the northern shore. The first site (the official public access site with parking) is a carry-in site, which effectively eliminates the use of boats larger than kayaks or canoes (e.g., boats with electric motors). Also, aquatic plant life in the nearshore area of the dock greatly limits the use of the site. At the second site, the fire lane used for boat launching, there is no parking (or any areas to install public parking). Additionally, this site does not currently meet the launching needs of the Lake residents and users. These issues of concern are important to address in order to ensure that individuals have the ability to access the Lake and that Rock Lake is made a priority for funding and management by the WDNR (as discussed below).

Though all the navigable waters of Wisconsin are considered publicly owned,[42] the level of access to the waters varies greatly from lake to lake. Consequently, in general, **lakes with public access sites that exceed the minimum standards[43] are assigned higher priority level when WDNR decides which lakes will receive grant funds and State management resources.[44]** Though the public access site to Rock Lake currently meets the minimum requirements for a lake of less than 50 acres, there are a number of access issues that, if addressed, could increase the Lake's priority level in terms of grant funding.

Given that accessibility issues have been noted on the Lake and given the advantage that addressing them would provide in terms of obtaining WDNR grant dollars and management efforts, recommendations on improving access are included in Chapter III of this report.

ISSUE 10: WILDLIFE

The protection and enhancement of the aquatic and terrestrial wildlife populations that depend on Rock Lake was identified as an issue of concern by SEWRPC staff and Rock Lake residents. Investigation of the Lake and its watershed by the SEWRPC staff identified the following considerations related to aquatic and terrestrial wildlife:

1. Fishing was identified as a primary recreational use of the Lake, as was verified by the 2012 recreational survey (see "Recreational Use" section);

2. Rock Lake is the only lake in the Southeastern Wisconsin Region that is maintained as a coldwater trout fishery;[45]

3. Two species of special concern are present in the Lake—the least darter (*Etheostoma microperca*), which was added to the list in 1978, and the lake chubsucker (*Erimyzon sucetta*), which was added in 2008;[46]

4. A healthy fish population is present in the Lake, according to a 2008 WDNR fish population study (see Table 16), indicating the need for continued effective management;

5. A critical species habitat[47] is located within the Lake's watershed (see Map 17);

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[42]*Legally, "navigable waters" are held in the public trust by the State. Therefore, providing public access to these areas is a priority for WDNR and other State agencies.*

[43]*According to NR 1.91 of the Wisconsin Administrative Code, the minimum requirements for a lake of less than 50 acres is one carry-in access site with parking for five vehicles, while the minimum requirements for a lake of 50 to 99 acres is one or more access sites that provide parking for a combination of five vehicle and car-trailer units.*

[44]*Management efforts provided by WDNR include fishery surveys, fish stocking, aquatic plant surveys, general monitoring efforts, and site visits to monitor regulatory compliance.*

[45]*This fact was provided by the regional WDNR fisheries biologist.*

[46]*Wisconsin Department of Natural Resources - Natural Heritage Inventory.*

[47]*Critical species habitats are designated based on various parameters, and specifically delineate the areas that need to be protected to maintain specific species of concern. The area within the Rock Lake watershed is discussed further in the Amendment to SEWRPC Planning Report No. 42,* Amendment to the Regional Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin*, December 2010. Rock Lake woods was designated due to the presence of Trillium recurvatum (red trillium).*

6. About 12 species of amphibians and 13 species of reptiles are expected to be present in the Lake's watershed (amphibians and reptiles, including frogs, toads, salamanders, turtles, and snakes, are vital components of a lake ecosystem);

7. The Lake's watershed is likely to support a significant population of waterfowl, including mallards, wood duck, and blue-winged teal, particularly during the migration seasons; and

8. The Lake's watershed is likely to support both small and large mammals, such as foxes and whitetail deer.

Table 16

FISH SURVEY IN ROCK LAKE: 2008

Species Collected	Average Length (inches)
Bluegill	4.8
Common Carp	- -[a]
Northern Pike	24.3
Warmouth	- -[a]
Lake Chubsucker	- -[a]
Largemouth Bass	12.1
Grass Pickerel	- -[a]
Pumpkinseed	5.5

[a]Species was found during WDNR fish survey but not sampled for size.

Source: Wisconsin Department of Natural Resources.

A healthy fish, bird, amphibian, reptile, and mammal population requires: 1) good water quality, 2) sufficient water levels, 3) healthy aquatic plant populations, and 4) well maintained aquatic and terrestrial habitat. Additionally, wildlife populations can also be enhanced by the implementation of "best management practices." Since aquatic plant management, water quality, and water quantity have been discussed previously in this chapter, this section will focus on the maintenance and expansion of habitat, and on the use of best management practices to enhance wildlife populations. In general, these practices vary depending on the type of wildlife that is to be enhanced. This section will, therefore, first discuss *aquatic wildlife enhancement* and then *terrestrial wildlife enhancement*.

Aquatic Wildlife Enhancement

As mentioned above, aside from aquatic plant, water quality, and water quantity management, aquatic wildlife populations can be enhanced through implementation of best management practices and enhancement of aquatic habitat. Each is discussed below:

Aquatic Best Management Practices

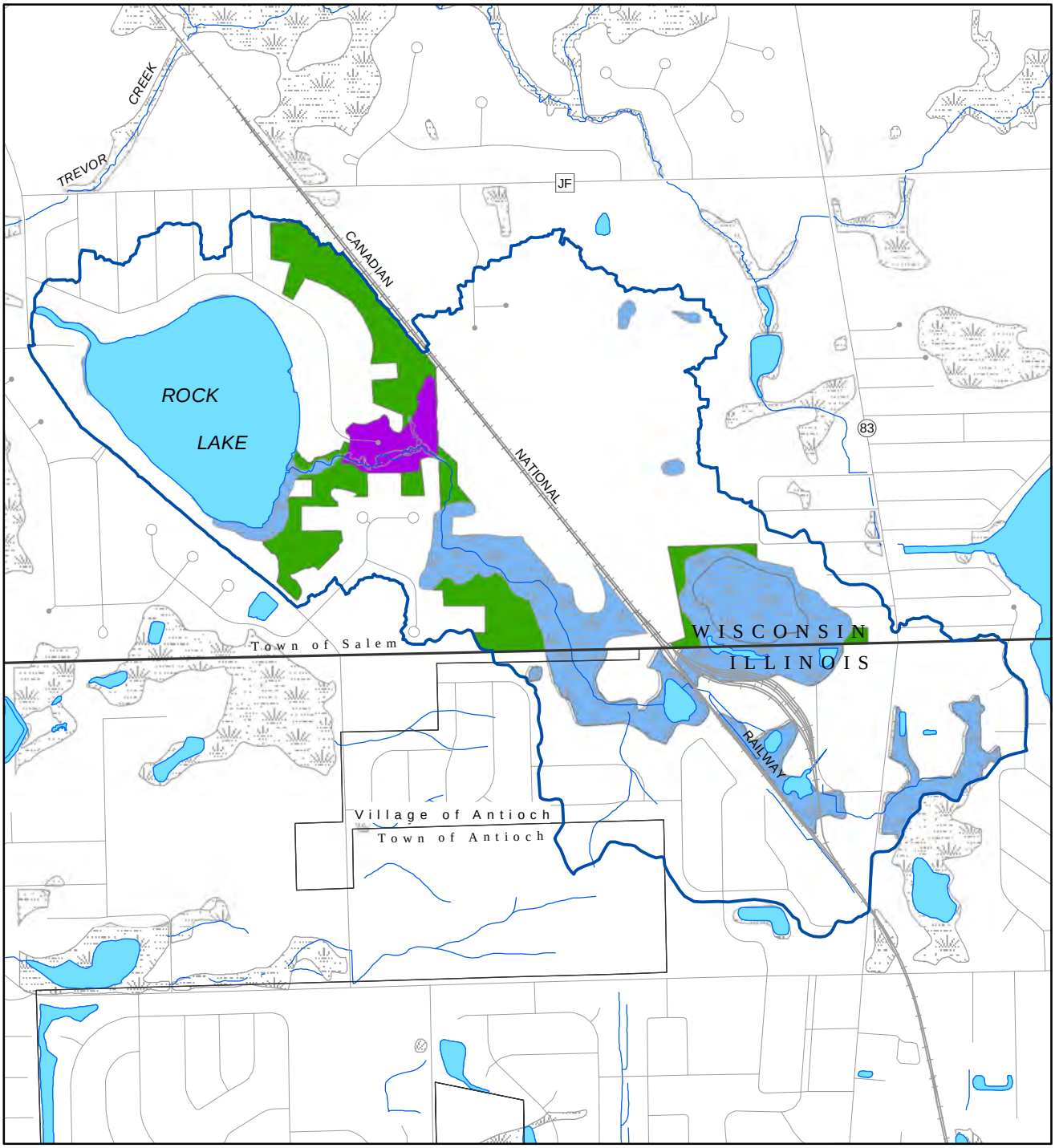
Aquatic best management practices refer to activities in which homeowners and resource managers can engage, such as catch and release fishing and fish stocking, which will improve the fishery within the Lake. To determine the most needed and effective practices, it is important to know:

1. **The population and size structure of the fish species present in a lake**—Studies that examine the species, populations, and sizes of the fish in a lake can help managers understand the issues that might be facing the fish populations. If low numbers of juvenile fish are found, for example, this may indicate that the fish are not spawning in the lake, and, therefore, that habitat needs to be improved. Similarly, if too many juveniles are found, with few large fish populations, this may indicate that over-fishing is a factor limiting the growth of fish, thereby indicating that catch and release should be promoted in the lake. This type of information can, therefore, help lake managers target fish population enhancement efforts effectively.

2. **The history of fish stocking in a lake**—To evaluate the information found in fish population studies, it is important to know how many fish of different sizes have been introduced through stocking activities. If only the large fish that were stocked exist in a lake, for example, it is likely that no natural spawning is actually taking place in the lake, meaning that the lake's fishery is greatly dependent on fish stocking. This, therefore, might indicate that stocking needs to continue until spawning can be established in the lake.

Map 17

CRITICAL SPECIES, WOODLANDS AND WETLANDS WITHIN THE ROCK LAKE WATERSHED



CRITICAL SPECIES HABITAT SITE

WETLANDS: 2010

WOODLANDS: 2010

SURFACE WATER

STREAM

WATERSHED BOUNDARY

N

0 0.15 0.3 Miles

0 750 1,500 Feet

Source: SEWRPC

There are no Natural Areas in the watershed

SEWRPC staff completed an inventory of the studies and stocking efforts completed by WDNR since 1972. This inventory revealed that largemouth bass are reported to be "common" in Rock Lake, while panfish and trout are "present."[48] Additionally, a fish survey conducted in 2008 (see Table 16), by electrofishing[49] noted the presence of other fish in the Lake, including northern pike and walleye, although these species did not appear to be spawning in the Lake (given the lack of juvenile populations). Since fish stocking in the Lake has occurred periodically since 1972 (see Table 17); with northern pike, walleye, rainbow trout, and brown trout being commonly stocked, it is likely that the other fish found in the 2008 study were present due to stocking activities rather than from natural occurrence.

Overall, WDNR concludes in its reports that **Rock Lake has a generally healthy fish population**. This indicates that the current practices in the Lake seem to be maintaining a viable fishery. Consequently, maintenance of the current practices and aquatic habitats (see "Aquatic Habitat" subsection below) within the Lake will be crucial. **The reports also indicate that many of the fish present in the Lake are not naturally reproducing.** Thus, periodic fish stocking should continue if the fishery is to remain viable. Recommendations related to both of these conclusions are included in Chapter III of this report. Additionally, recommendations related to increasing public access to the Lake (to increase the fishery resources the WDNR would be able to invest in the Lake) are also included in Chapter III.

As a final note, the aquatic plant survey of the Lake revealed the presence of common carp,[50] a restricted species within Wisconsin (see Figure 20). Several measures can be taken to reduce the carp population; however, given that the amount of carp found was fairly low in the 2008 survey (in comparison to other lakes in the Region),[51] the most efficient method for reducing this population may be harvesting them (i.e., targeting them for fishing efforts) and ensuring that large Northern Pike (Figure 21) remain in the water (as pike eat juvenile carp). Consequently, recommendations to this affect have been included in Chapter III of this report.

Aquatic Habitat

Aquatic habitat enhancement generally refers to encouraging native aquatic plant (particularly pondweed) growth within a lake, as these plants provide food, shelter, and spawning areas for fish. Additionally, aquatic habitat enhancement also involves protecting wetlands (see "Terrestrial Habitat" section below) as well as encouraging the presence of woody debris along the shorelines, as areas with woody debris mimic natural environments and provide shelter for fish populations.

To determine the state of the aquatic habitat within the Lake, SEWRPC staff completed an aquatic plant survey in the summer of 2012 (see "Aquatic Plant Growth" section), and completed a shoreline assessment in the summer of 2014 (see "Shoreline Maintenance" section). The results of the aquatic plant survey revealed that **Rock Lake**

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[48]*Department of Natural Resources Lake Page:* http://dnr.wi.gov/lakes/LakePages/LakeDetail.aspx?wbic=746000.

[49]*Electrofishing is a process where an electrical pulse is placed in the water, causing fish to be stunned and float to the top of the lake. This process allows for fisheries biologists to record fish types, counts, and sizes without harming the fish populations.*

[50]*Common carp, found throughout Wisconsin, are considered an issue of concern when found in high populations because their feeding method involves re-suspending sediments at the bottom of a lake.*

[51]*According to WDNR staff, the carp catch rate during the 2008 survey was 8.7/mile, which is low compared to other lakes in the area that have moderate to severe carp problems. WDNR generally does not capture the carp (and complete size structure analyses) unless it is in the midst of a carp-specific survey (which is generally undertaken only if the catch rate indicates a need).*

Table 17

FISH STOCKED INTO ROCK LAKE

Year	Species Stocked	Age Class	Number Stocked	Average Length (inches)
2014	Northern Pike	Large Fingerling	92	9.10
2014	Rainbow Trout	Yearling	228	9.70
2013	Walleye	Small Fingerling	1,610	1.5
2012	Northern Pike	Large Fingerling	105	7.54
2011	Brown Trout	Yearling	232	9.10
2011	Walleye	Small Fingerling	1,843	1.70
2010	Rainbow Trout	Yearling	618	9.50
2009	Brown Trout	Yearling	1,000	9.10
1991	Rainbow Trout	Yearling	6,000	10.00
1990	Rainbow Trout	Yearling	2,645	11.00
1990	Brown Trout	Yearling	4,500	9.00
1989	Rainbow Trout	Yearling	3,000	11.00
1989	Brown Trout	Yearling	3,000	9.00
1988	Brown Trout	Yearling	3,000	9.00
1988	Rainbow Trout	Yearling	3,500	9.00
1987	Rainbow Trout	Yearling	21,000	9.00
1986	Rainbow Trout	Yearling	3,000	9.00
1986	Brown Trout	Yearling	3,000	9.00
1985	Brown Trout	Yearling	3,500	11.00
1985	Rainbow Trout	Yearling	3,000	9.00
1984	Rainbow Trout	Yearling	3,000	7.00
1984	Brown Trout	Yearling	3,640	9.00
1983	Rainbow Trout	Yearling	4,000	10.00
1983	Brown Trout	Yearling	3,000	9.00
1982	Rainbow Trout	Yearling	3,000	- -
1982	Brown Trout	Yearling	3,200	- -
1981	Brown Trout	Yearling	6,000	- -
1980	Rainbow Trout	Yearling	3,100	- -
1980	Brown Trout	Yearling	7,200	- -
1979	Brown Trout	Yearling	3,000	- -
1979	Rainbow Trout	Yearling	4,550	- -
1978	Rainbow Trout	Yearling	3,000	- -
1978	Brown Trout	Yearling	5,000	- -
1977	Rainbow Trout	Yearling	4,000	- -
1977	Brown Trout	Yearling	3,000	- -
1976	Brown Trout	Yearling	1,000	- -
1976	Rainbow Trout	Yearling	3,000	- -
1975	Rainbow Trout	Yearling	4,000	- -
1974	Brown Trout	Yearling	2,000	7.00
1974	Rainbow Trout	Yearling	4,00	7.67
1974	Rainbow Trout	Adult	205	15.00
1973	Rainbow Trout	Yearling	4,000	9.00
1973	Rainbow Trout	Adult	100	15.00
1972	Rainbow Trout	Yearling	2,500	11.00
1972	Brown Trout	Yearling	2,500	9.00

Source: Wisconsin Department of Natural Resources and SEWRPC.

Figure 20

COMMON CARP

Source: U.S. Geological Survey

Figure 21

NORTHERN PIKE

Source: Wisconsin DNR.

has very good plant diversity, with four different pondweed species,[52] while the shoreline assessment concluded there are very few areas around the Lake with woody debris in the water. These conclusions indicate that the current aquatic plant community should be maintained, to the greatest extent practical, and that projects should be implemented to provide more woody debris along the shorelines. Consequently, recommendations related to both are presented in Chapter III of this report.

It was also noted that the Lake is primarily filled with "muck" (i.e., silt) which was raised as an issue of concern by Lake residents because sandy and rocky materials are often associated with fish populations. However, it is important to note that fish spawning and feeding (and fish habitat needs in general) are highly complex processes. Measures other than dredging to expose sandy bottoms that can encourage fish populations include buffer installation, water quality management, and maintenance of nearshore vegetation and woody debris. Consequently, the shoreline maintenance recommendations in Chapter III of this report are further emphasized for the purpose of improving fish populations.

Terrestrial Wildlife

As with aquatic wildlife enhancement, two general practices (aside from aquatic plant, water quality, and water quantity management) can enhance terrestrial wildlife populations, namely: best management practices and aquatic habitat enhancement. Each is discussed below.

Terrestrial Best Management Practices

The way people manage their land and treat wild animals can have a significant impact on terrestrial wildlife populations. Turtles, for example, need to travel a long distance from their home lake to lay their eggs. If pathways to acceptable habitats are not available, or are dangerous due to pets, fences, or traffic, the turtles will not have the opportunity to increase their population. Many conservation organizations have developed "best management practices" or behaviors that homeowners and managers can engage in which will improve the wildlife populations within the watershed.

Though some of these best management practices are species- or animal-type specific (e.g., spaying or neutering cats to reduce their desire to kill birds) many of these recommendations relate to general practices that can benefit all wildlife. In general, best management practices for wildlife enhancement can be targeted at agricultural and residential land uses. Agricultural measures tend to focus on encouraging land management that allows for habitat enhancement, such as allowing fallen trees to naturally decompose where practical or allowing for uneven landscapes (which create spawning areas). Alternatively, residential measures tend to focus on practices that

[52] *Pondweed species are significant in a lake because they serve as excellent habitat for providing food and shelter to many aquatic organisms.*

landowners can initiate to provide habitat, such as installing a pool garden or preventing the introduction of nonnative plants and insects. Other recommendations are generally applicable to all landowners. For example, killing native wildlife, particularly amphibians, reptiles, and birds, is generally not advised.

Communication to the public regarding these best management practices may provide a means of encouraging wildlife populations without having to make major investments. Consequently, the implementation of measures to increase the use of these practices is included in the recommendations discussed in Chapter III of this report.

Terrestrial Habitat

Terrestrial wildlife needs large, well-connected areas of natural habitat. Consequently, the protection and expansion of natural habitat is crucial if wildlife populations are to be maintained or enhanced. Open space natural areas can be classified as either:

1. **Wetlands**—Wetlands are defined based on hydrology, hydric soils, and the presence of wetland plants. There are many types of wetlands (see Figure 22), from the traditionally understood wetland, with cattails and bulrushes, to forested wetlands. Most wildlife, both aquatic and terrestrial, has been found to rely on, or associate with, wetlands for at least a part of their lives. This includes crustaceans, mollusks, aquatic insects, fish, amphibians, reptiles, mammals (e.g., deer, muskrats, and beavers), and resident bird species, (e.g., turkey, and migrant species, such as sandhill and whooping cranes).

2. **Uplands—**Uplands are areas not classified as wetlands or floodplains. They are often characterized by the presence of drier, more stable soils. Like wetlands, natural uplands can also exist in many forms (e.g., prairies and woodlands) and also provide many critical functions for wildlife through the provision of critical breeding, nesting, resting, and feeding grounds, as well as refuge from predators for many upland game and nongame species. Unlike wetlands, however, the dry and stable soils make uplands more desirable for urban development and, therefore, such areas are more challenging to protect.

Figure 22

EXAMPLES OF DIFFERENT TYPES OF WETLANDS

MARSH WETLAND

Source: SEWRPC.

SCRUB/SHRUB WETLAND

Source: University of New Hampshire Cooperative Extension.

FORESTED WETLAND

Source: Prince William Conservation Alliance.

As mentioned above, **both wetlands and uplands are critical to wildlife populations**. However, **the dynamic interactions and movement between these two types of land are also crucial** because many terrestrial organisms spend part of their time in the wetlands and the rest of their time in upland areas. For example, amphibians live most of their lives in upland areas but depend on wetlands for breeding. Consequently, if the connections between the uplands and wetlands are severed (e.g., if a road is placed between the two land types) this makes it dangerous, if not impossible, for amphibians to gain access to their breeding grounds, thereby lowering their ability to procreate. In fact, habitat fragmentation (i.e., the splitting up of large connected habitat areas) has been cited as the primary cause of wildlife population decreases globally.[53] Therefore, the protection and expansion of uplands and wetlands, as well as the protection of their connectivity, is necessary for wildlife populations to be maintained or enhanced.

To determine the extent of the uplands and wetlands in the Rock Lake watershed, as well as to determine the state of the connections between these two areas, SEWRPC staff completed an inventory of the wetlands and uplands within the Rock Lake watershed as shown on Map 17. The wetlands are located primarily at the southern end of Rock Lake and along the stream that enters the Lake, while the uplands in the watershed exist as woodlands they are primarily east and south of the Lake, as well as around some of the wetlands. **There is also a clear connection between the wetland and upland complexes just east of the Lake, indicating that there is valuable habitat within the watershed**. Consequently, the protection and expansion of these complexes should be made a priority to maintain and enhance wildlife populations.

It is important to note, however, that the protection and enhancement of wetlands and uplands requires a number of actions, including:

1. Preventing and/or limiting development within the wetland and certain upland areas;

2. Ensuring that any development that does occur does not cut off the connection between uplands and wetlands;

3. Expanding uplands and/or wetlands where practical (e.g., reestablishing wetlands that are currently farmed or reforesting cleared areas); and

4. Ensuring that wetlands and uplands continue to function properly by controlling and/or removing any invasive plant species introduced to those areas.

Therefore, it is important to incorporate all of these components into a comprehensive management plan. Consequently, recommendations related to each of these actions are included in Chapter III of this report. Additionally, guidance as to the implementation of these actions is included in the "Implementation" section below and in Chapter III.

Other Wildlife Issues

The presence of aquatic birds (primarily geese) on the shorelines was also mentioned as an issue of concern. Though some management measures control geese populations (e.g., oiling of goose eggs) the amount of geese observed on Rock Lake does not currently appear to warrant such measures. However, installation of naturally vegetated buffers can discourage the congregation of geese along the shoreline. Consequently, a recommendation related to the installation of buffers is further emphasized in Chapter III of this plan as a part of the wildlife recommendations.

[53] *Lenore Fahrig, "Effects of Habitat Fragmentation on Biodiversity,"* Annual Review of Ecology, Evolution, and Systematics*, Vol. 34, 2003, pp. 487-515.*

ISSUE 11: PLAN IMPLEMENTATION

Another all-encompassing issue of concern that was discussed throughout this planning process was the need for guidance on the implementation of the plan recommendations. A big step toward implementation of a plan is the development of an action plan with timelines, goals, and identification of responsible parties. These kinds of targets can help the implementing agencies to gauge progress over time and can help motivate participants, ensuring that the plan is implemented in the long term.

To develop an action plan, however, it is important to know what implementation would involve. Consequently, it is important to note that some of the recommendations can be achieved using regulation while others involve proactively implementing new management efforts. Both are discussed below.

Regulatory Implementation

Regulatory implementation refers to the maintenance and improvement of water quality, water quantity, and wildlife populations, through the use of local and State laws. A number of regulations relating to activities within the Rock Lake watershed, such as zoning ordinances, boating and in-Lake ordinances, and State regulations, help protect the Lake by mitigating pollution, preventing or limiting development, and ensuring best management practices. Given the different nature of these three categories, they are discussed separately below.

Ordinances

Zoning ordinances dictate where development can take place, the types of development allowed, and the terms that need to be met for development to be permitted. Consequently, **zoning can be a particularly effective tool for protecting buffers, wetlands, uplands, and shorelands when environmental considerations are taken into account during the formulation of zoning decisions**. A way for these environmental considerations to be taken in account within Wisconsin is for the local zoning authorities and other regulatory agencies to use SEWRPC-designated environmental corridors (see Figure 23) to apply conservancy zoning district regulations to help determine where development is permitted and not permitted, as well as to determine the extent of development that is allowed.

In the Rock Lake watershed, zoning is somewhat complicated by the fact that the watershed crosses state borders (see Map 18). In fact, in the **Rock Lake watershed five different units of government have different regulatory authorities** that apply to lake protection, including the Town of Salem and Kenosha County in Wisconsin and the Village of Antioch, the Township of Antioch, and Lake County in Illinois (see Table 18).

Kenosha County has zoning authority in the majority of the watershed. This is advantageous because the general zoning ordinance for **Kenosha County**, which specifically states what development can happen where, **uses the environmental corridor designations to set "no development" zones, as well as "limited development" zones**, depending on whether the area within the corridor is a lowland or upland, respectively. The fact that these corridors are used in zoning decisions means that the areas within the Rock Lake watershed (in Wisconsin), that are contained within environmental corridors (see Map 19), are well protected. Although Lake County does not have similar environmental corridor designations, it does have some restrictions when lands fall within a wetland, or when lands are within 300 feet from a waterbody.[54]

In addition to general zoning, shoreland zoning as well as **construction site erosion control and stormwater management ordinances also play a key part in protecting the resources within the watershed**. Shoreland zoning in Wisconsin, for example, which is governed by Kenosha County, follows statewide minimum standards to create a vegetated buffer strip and building setbacks around navigable waters. Additionally, stormwater

[54]*Lake County Unified Development Ordinance adopted in the year 2000.*

Figure 23

SYNOPSIS OF SEWRPC-DESIGNATED ENVIRONMENTAL CORRIDORS

SEWRPC has embraced and applied the environmental corridor concept developed by Philip Lewis (Professor Emeritus of Landscape Architecture at the University of Wisconsin-Madison) since 1966 with the publication of its first regional land use plan. Since then, SEWRPC has refined and detailed the mapping of environmental corridors, enabling the corridors to be incorporated directly into regional, county, and community plans and to be reflected in regulatory measures. The preservation of environmental corridors remains one of the most important recommendations of the regional plan. Corridor preservation has now been embraced by numerous county and local units of government as well as by State and Federal agencies. The environmental corridor concept conceived by Lewis has become an important part of the planning and development culture in southeastern Wisconsin.

Environmental corridors are divided into the following three categories.

- **Primary environmental corridors** contain concentrations of our most significant natural resources. They are at least 400 acres in size, at least two miles long, and at least 200 feet wide.
- **Secondary environmental corridors** contain significant but smaller concentrations of natural resources. They are at least 100 acres in size and one mile long, unless they link primary corridors.
- **Isolated natural resource areas** contain significant remaining resources that are not connected to environmental corridors. They are at least five acres in size and at least 200 feet wide.

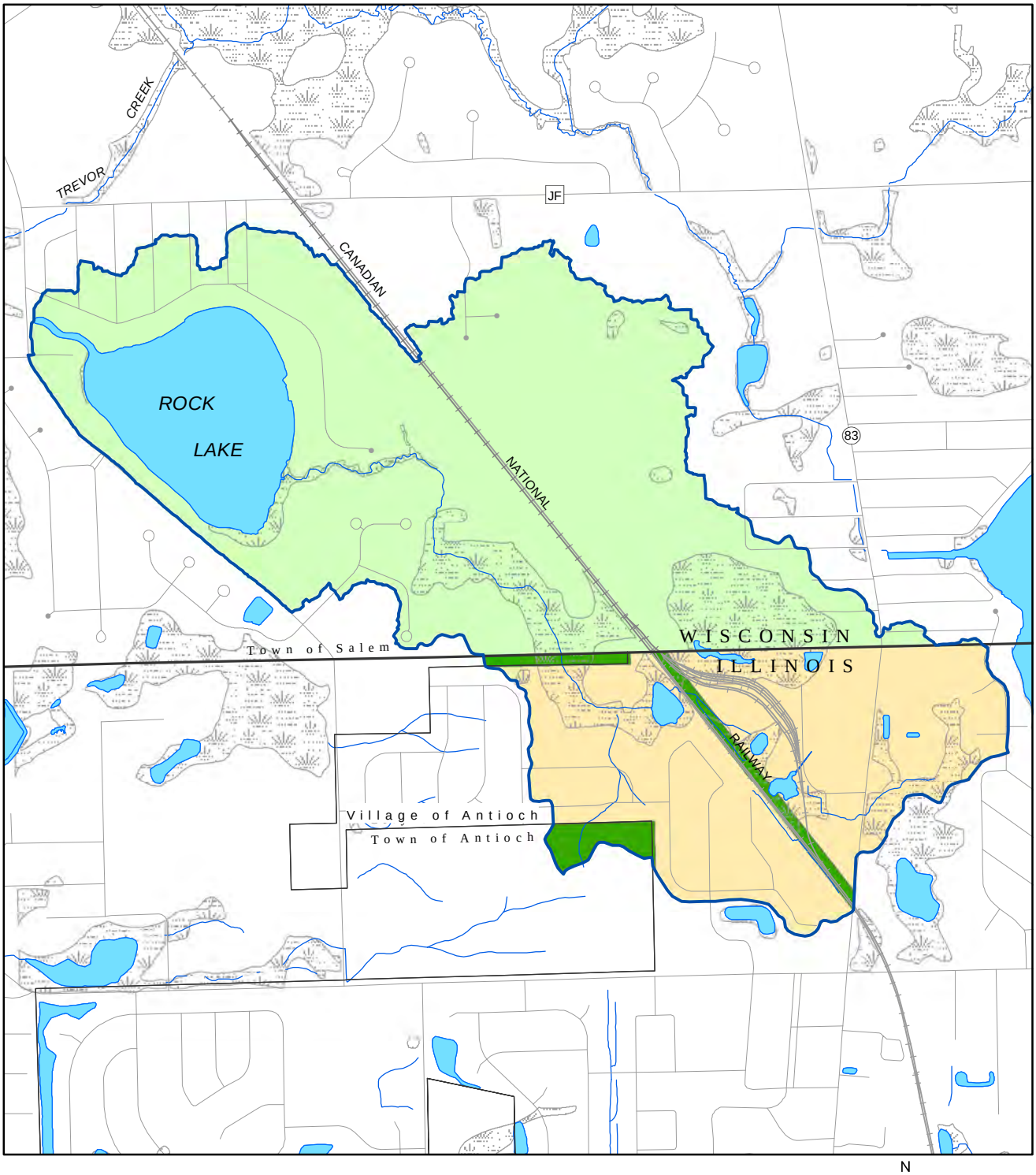
Key Features of Environmental Corridors

- Lakes, rivers, and streams
- Undeveloped shorelands and floodlands
- Wetlands
- Woodlands
- Prairie remnants
- Wildlife habitat
- Rugged terrain and steep slopes
- Unique landforms or geological formations
- Unfarmed poorly drained and organic soils
- Existing outdoor recreation sites
- Potential outdoor recreation sites
- Significant open spaces
- Historical sites and structures
- Outstanding scenic areas and vistas

Source: SEWRPC.

Map 18

CIVIL DIVISIONS WITHIN THE ROCK LAKE WATERSHED



Source: SEWRPC

Table 18

LAND USE REGULATIONS WITHIN THE AREA TRIBUTARY TO ROCK LAKE BY CIVIL DIVISION

Community	Type of Ordinance			
	General Zoning	Shoreland Zoning	Subdivision Control	Construction Site Erosion Control and Stormwater Management
Kenosha County	Adopted	Adopted	Adopted	Adopted
Town of Salem	Regulated under County ordinance	Regulated under County ordinance	Adopted	Adopted
Lake County (Illinois)	Adopted	Adopted[a]	Adopted	Adopted[a]
Township of Antioch (Illinois)	Regulated under County ordinance	Regulated under County ordinance	Regulated under County ordinance	Regulated under County ordinance
Village of Antioch (Illinois)	Adopted	Regulated under County ordinance	Adopted	Regulated under County ordinance

[a] *Regulated under the Watershed Development Ordinance (WDO).*

Source: Lake County, Village of Antioch, and SEWRPC.

management and construction erosion control ordinances help minimize water pollution, flooding, and other negative impacts of urbanization on water resources (lakes, streams, wetlands, and groundwater) and property owners, both during and after construction activities.

Boating and In-Lake Ordinances

Boating and in-lake ordinances regulate the use of the Lake in general, and, when implemented properly, **can help prevent inadvertent damage to the lake such as overfishing or extensive shoreline erosion from wave action hitting the shoreline**. The boating ordinance for the Town of Salem (including Rock Lake) is available in Appendix E. This ordinance is generally enforced by a warden or by the local law enforcement agency.

State Regulations

The State Legislature required the WDNR to develop performance standards for controlling nonpoint source pollution from agricultural and nonagricultural land and from transportation facilities.[55] The performance standards are set forth in Chapter NR 151, "Runoff Management," of the *Wisconsin Administrative Code*, and detail requirements for best management practices and permitting. There are also regulations with respect to construction sites, wetland setbacks, and buffer standards.

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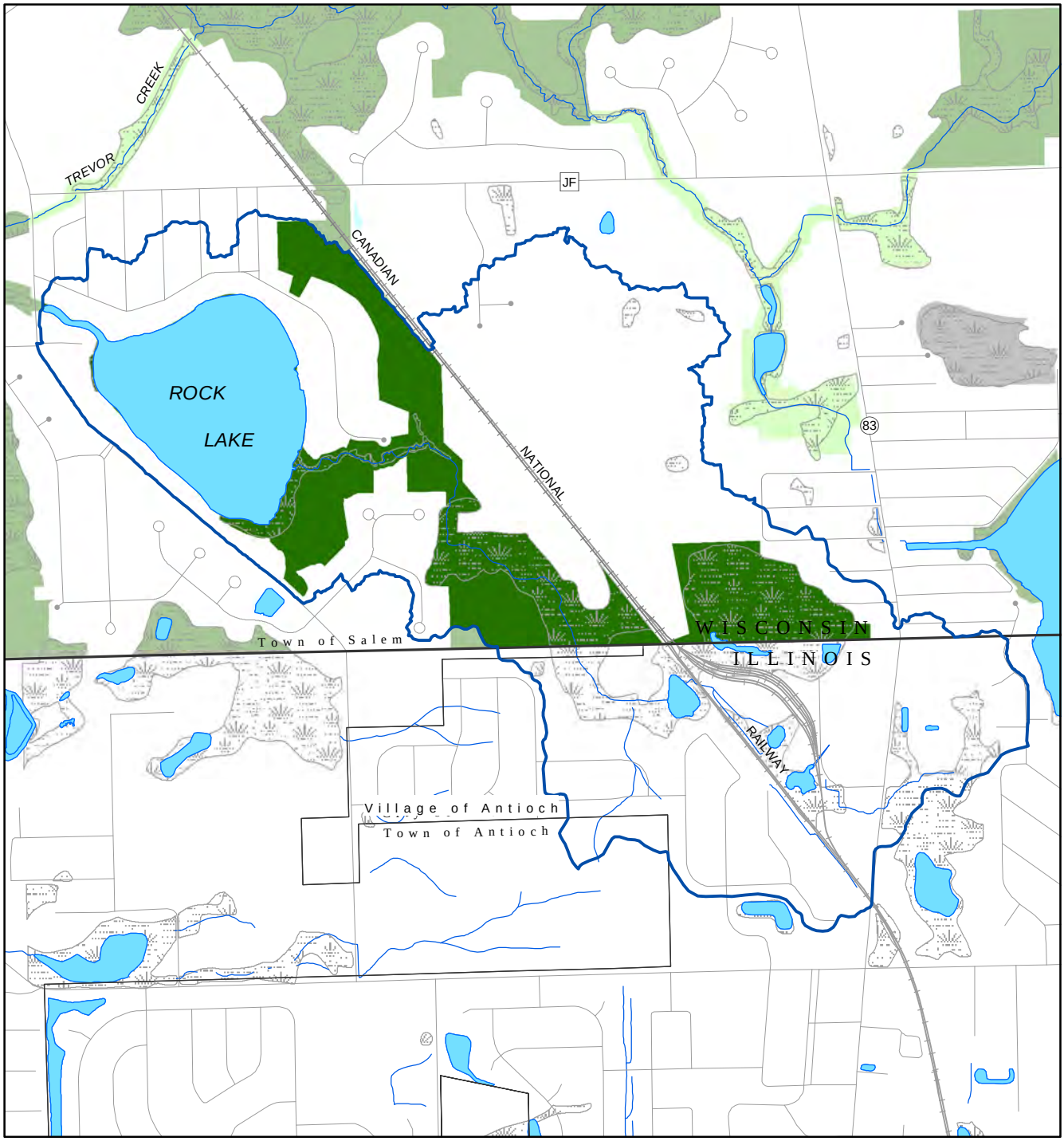
[55]*The State performance standards are set forth in the Chapter NR 151, "Runoff Management," of the* Wisconsin Administrative Code. *Additional code chapters that are related to the State nonpoint source pollution control program include: Chapter NR 152, "Model Ordinances for Construction Site Erosion Control and Storm Water Management;" Chapter NR 153, "Runoff Management Grant Program;" Chapter NR 154, "Best Management Practices, Technical Standards and Cost-Share Conditions;" Chapter NR 155, "Urban Nonpoint Source Water Pollution Abatement and Storm Water Management Grant Program;" and Chapter ATCP 50, "Soil and Water Resource Management." Those chapters of the* Wisconsin Administrative Code *became effective in October 2002. Chapter NR 120, "Priority Watershed and Priority Lake Program," and Chapter NR 243, "Animal Feeding Operations," were repealed and recreated in October 2002.*

Map 19

ENVIRONMENTAL CORRIDORS WITHIN THE ROCK LAKE WATERSHED



PRIMARY ENVIRONMENTAL CORRIDOR

SECONDARY ENVIRONMENTAL CORRIDOR

ISOLATED NATURAL RESOURCE AREA

SURFACE WATER

STREAM

WATERSHED BOUNDARY

Colors outside the watershed boundary are reduced in intensity to show the adjacent extent and distribution of each legend category.

Data not available for Lake County, Illinois

N

0 0.15 0.3 Miles

0 750 1,500 Feet

Source: SEWRPC

It is important to note that the regulations discussed above play a crucial part in maintaining the health of the Lake and of all the resources within the Rock Lake watershed. However, even though developers, residents, and Lake users are legally obligated to adhere to the ordinances, limited resources within the enforcement bodies at a State, County, and municipal level can sometimes make the task of ensuring compliance difficult. Consequently, Chapter III provides recommendations on the best ways for lake organizations to work with regulatory agencies to help them enforce the existing ordinances and regulations to the greatest extent practical.

Proactive Management Efforts

In addition to continued and enhanced ordinance enforcement, there are also a number of recommendations made under this plan that seek to proactively improve conditions within the Lake through voluntary management efforts. Chapter III provides details on these recommendations and guidance on their implementation. However, a number of challenges identified for Rock Lake currently limit the ability of Lake residents to engage in the management efforts provided in this report. Some of these challenges include:

1. **Lack of consistent funding sources for lake management efforts**—There were several concerns about the current cost of aquatic plant management within the Lake as well as the cost that would be associated with management efforts recommended under this plan. Though grant funds may be available to help with some of the projects (as detailed in Chapter III of this report), fundraising or the creation of a lake district (a taxing body) may, therefore, become necessary to ensure that Lake management efforts can consistently remain funded over time.

2. **Institutional capacity—**Institutional capacity refers to the capacity that agencies within the watershed have to implement projects in terms of knowledge, staff, and other resources. There are many resources to help residents and Lake users navigate management; however, some guidance will likely be necessary to ensure that those attempting management projects are completing the projects in an effective way.

3. **Institutional cooperation**—Rock Lake has had some conflict between the different management institutions. However, prior to and during this planning process all of the groups involved have been making strides forward to resolve disagreements through compromise and communication. Maintaining this open line of communication may be crucial to ensuring effective implementation of this plan.

4. **Volunteer and Interest Base** – The planning process for Rock Lake has revealed that many stakeholders have a strong connection to the Lake. However, it was noted that the participants in the planning process were composed of almost entirely lakeshore or near-lakeshore residents. To increase the advocacy and volunteer base for projects like hand-pulling or wetland invasive species monitoring it may be necessary to reach a wider interest group.

All of the funding, institutional, and involvement issues considered in this report subsection are highly relevant to most if not every recommendation under the plan. Consequently, Chapter III provides recommendations and suggested actions that seek to ensure that the above capacity issues are addressed.

In addition to capacity building, communicating the details of this plan will also be crucial to encouraging voluntary management efforts. For example, communicating the difference between native and nonnative plants, and the fact that removal of plants can spur algae growth, are important to ensure that homeowners understand why a “clean” shoreline is not always the best option for a lake (and hopefully to ensure that homeowners maintain a healthy plant community on the shoreline). Consequently, another major recommendation in Chapter III is communicating the necessary and important components of this plan.

SUMMARY

All of the issues of concern expressed by Rock Lake residents during the development of this plan have some merit. Additionally, as discussed in the "Aquatic Plant Growth" section of this report, addressing these issues will contribute significantly to effectively managing the aquatic plant population within Rock Lake and improving the general health of the Lake. Therefore, each issue has associated recommendations set forth in Chapter III. It is important to note that, despite the issues of concern in Rock Lake, there are also a number of opportunities to help ensure the sustainable use of Rock Lake and its watershed. The implementation of the recommendations provided in Chapter III of this report will capitalize on those opportunities.

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Chapter III

LAKE MANAGEMENT RECOMMENDATIONS AND IMPLEMENTATION

INTRODUCTION

Rock Lake is a precious resource to its users and nearby residents, as well as to the larger Fox River watershed due to its role as a headwater lake. This chapter, therefore, provides recommendations that address the issues of concern in Chapter II in order to maintain and enhance the health of the Lake and to encourage its continued enjoyment. The recommendations provided in this chapter are based upon the preliminary recommendations that were also provided in Chapter II.

The recommendations made in this chapter cover a wide range of programs and seek to address every aspect that influences the health and recreational use of Rock Lake. Consequently, it may not be feasible to implement every recommendation in the immediate future. The priority of each recommendation is, therefore, described to guide lake managers in targeting priority projects. Eventually, however, all of the recommendations should be addressed, subject to possible modification based on analysis of logistics or changing conditions, as well as based on the findings of future aquatic plant surveys and water quality monitoring.

The measures discussed in this chapter are primarily focused on those that can be implemented through collaboration between the Rock Lake Restoration Association, the Rock Lake Highlands Association, the Town of Salem, and Rock Lake residents. However, partnerships with WDNR, developers, landowners, and other nearby municipalities may be necessary to ensure the long-term ecological health of Rock Lake. Therefore, those engaging in management efforts on Rock Lake are encouraged to continuously seek out projects and partnerships that will aid in achieving the recommendations contained within the plan.

Though the logistics for implementing each recommendation may not be fully described, this chapter does provide suggestions for potential projects. It is important to note, however, that these project suggestions do not necessarily constitute recommendations; they are presented to provide the implementing entities with ideas about the types of projects to pursue. In short, this chapter is meant to provide a context for understanding what needs to be done, as well as to help the reader picture what those efforts might look like.

ISSUE 1: AQUATIC PLANT GROWTH

As discussed in Chapter II of this report, Rock Lake supports a diverse aquatic plant community capable of supporting a warm and cold water fishery as well as a wide range of recreational uses. However, the 2012 survey (see Appendix A for distribution maps), also indicates two major reasons why an aquatic plant management plan

should be considered a high priority, including 1) high volumes of plants that deter recreational use and 2) existence of invasive Eurasian water milfoil, which could potentially threaten the native aquatic plant community. This section, therefore, details a comprehensive aquatic plant management plan based on the preliminary recommendations provided in Chapter II.

The combined recommendations presented below (which constitute the recommended aquatic plant management plan) balance three major goals, including 1) to improve access to the Lake; 2) to protect the native aquatic plant community; and 3) to effectively control Eurasian water milfoil populations. Plan provisions also ensure that current recreational use of the Lake (i.e., swimming, boating, and fishing) is maintained to the greatest extent practical. The plan recommendations described below take into consideration all of the common, State-approved, aquatic plant management alternatives (see Chapter II), including manual, biological, physical, chemical, and mechanical measures.

Plant Management Recommendations

The most effective plans for managing nuisance and invasive aquatic plant growth rely on a combination of methods and techniques. Therefore, to enhance access to and the health of Rock Lake, four aquatic plant management techniques are recommended under this plan, as described below:

1. **Harvesting for the creation of navigation lanes** should be considered a high priority**.** As can be seen on Map 20, harvesting for *navigation lanes only* has been recommended for the entire perimeter of the Lake, including the outlet, with a priority access lane being located at the public access site. This recommendation is made with several specifications that should be added to current practices to ensure continued recreational use of the Lake and the health of the native plant community, including:

    a. **Leaving at least one foot of plant material at the Lake bottom while harvesting** should be considered a high priority**.** This is done to prevent sediment disturbance and to ensure that native plants communities are maintained (disturbing the sediment uproots native plants and leaves an opportunity for Eurasian water milfoil to take over). Leaving one foot of plant material will likely not be an issue in the areas with depths greater than three feet. However, in the regions where depths are less than three feet special care should be employed. Consequently, as can also be seen on the Map 20, all areas less than three feet deep are designated as "shallow-cut only" areas. This means that, in these areas, only the "top cut" technique (see Figure 24) should be used. Harvesting should not occur where the harvester is unable to leave one foot of plant material (raking and hand-pulling should be used instead of harvesting in these areas).

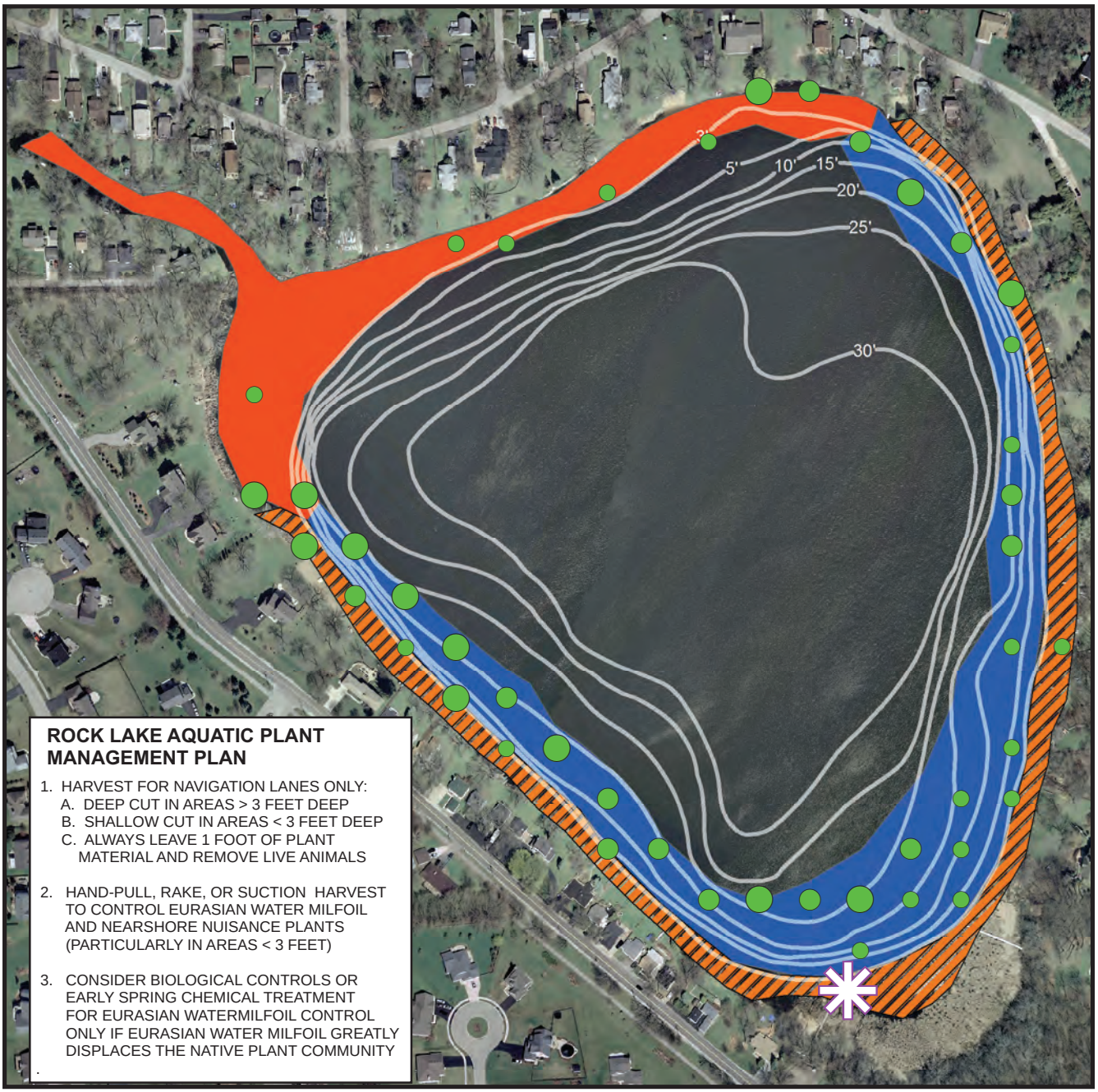
    b. It should be a high priority to **inspect all cut plants for any live animals and those animals should be returned to the Lake immediately**. Some animals can get caught in the harvester, particularly when cutting larger mats of plants. Consequently, it is necessary to examine the cut materials to make sure that live animals are removed to the greatest extent practical.

    c. **Harvesting should not occur in the early spring** (high priority) to prevent disturbance of fish spawning. Fish tend to spawn in the early spring and some studies have suggested that spawning can be significantly disturbed by harvesting activities. Thus, avoiding harvesting during this time would be highly beneficial to the Lake's fishery.

    d. **All harvester operators should undergo WDNR training to ensure that the harvesting permit specifications are sufficiently implemented** (high priority). This training should be taught by the regional WDNR aquatic invasive species coordinator and should cover, at a minimum 1) "deep-cut" versus "shallow-cut" techniques and when to employ

Map 20

AQUATIC PLANT MANAGEMENT PLAN MAP FOR ROCK LAKE



AQUATIC PLANT MANAGEMENT AREAS

- DEEP HARVESTING - NAVIGATION LANES ONLY
- SHALLOW CUT HARVEST OR HAND-PULLING
- SHALLOW HARVEST FOR NAVIGATION ONLY AND/OR MANUAL REMOVAL

EURASIAN WATER MILFOIL [a] RAKE FULLNESS

- 1
- 2
- 3

[a] AREAS TO ENGAGE EURASIAN WATER MILFOIL CONTROL MEASURES

—5'— WATER DEPTH COUNTOUR IN FEET

PUBLIC ACCESS SITE - PRIORITY FOR NAVIGATION LANE CREATION

N

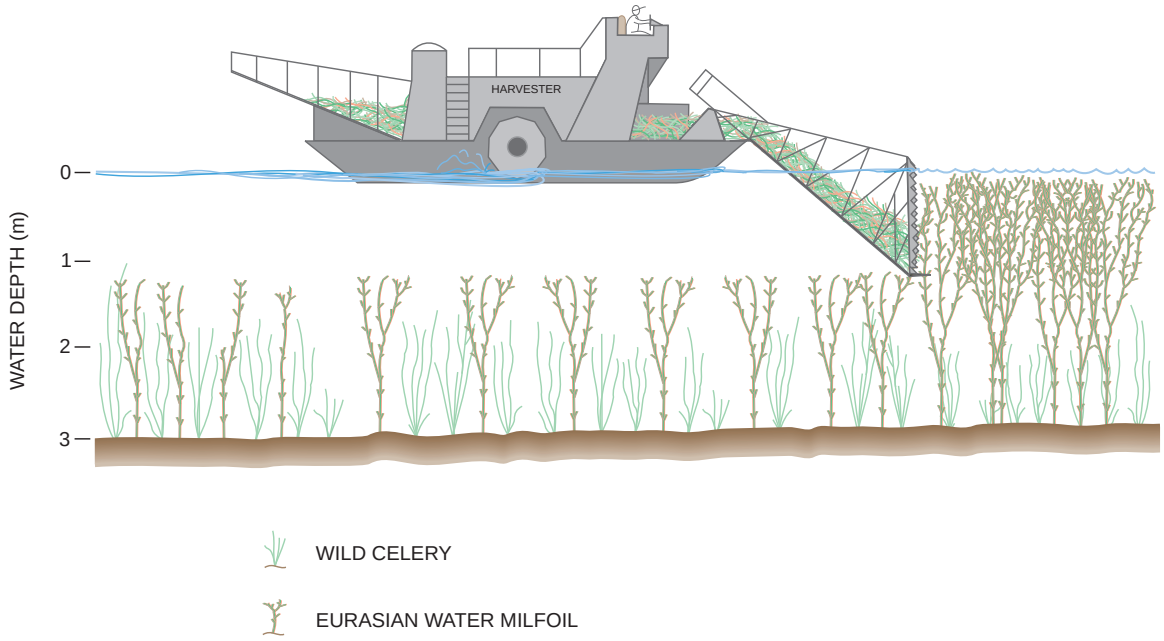
0 0.02 0.04 Miles

0 110 220 Feet

Source: SEWRPC.

Figure 24

PLANT CANOPY REMOVAL OR "TOP CUTTING" WITH AN AQUATIC PLANT HARVESTER



NOTE: Selective cutting or seasonal harvesting can be done by aquatic plant harvesters. Removing the canopy of Eurasian water milfoil may allow native species to reemerge.

Source: Wisconsin Department of Natural Resources and SEWRPC.

each according to this plan; 2) review of the plan, associated permit, and why cutting is restricted in shallow areas; and 3) plant identification to encourage the maintenance of native plant communities. Additionally, this training course should ensure that all harvesters know they need to record their activities, as annual harvesting reports are required as a part of the permit.

e. Since harvesting activities create fragmented plants that accumulate on the shorelines, the harvesting program should include the **implementation of a comprehensive plant pickup program** that all residents can use (high priority). This will help ensure that harvesting activities do not become a nuisance for other Lake residents. This program could include residents raking plants and placing them on the pier for weekly pickup or a regular effort on the part of the harvester operators to pick up cut plants. This effort should be as collaborative as practical.

2. **Hand-pulling and/or raking for nuisance plant growth in the near-shore areas** should be considered a medium priority (i.e., the areas where it is too shallow for harvesting activities)**.** A permit is not required for these activities for a 30-foot width of shoreline (including the recreational use area such as a pier) that does not exceed a 100-foot length into the Lake, as long as all the resulting plant materials are removed from the Lake. It is also recommended that, prior to the "hand-pulling" season, an educational campaign should be undertaken for the purpose of ensuring that shoreline residents know the value of native plants, the relationship between algae and plants (i.e.,

fewer plants means that more algae will grow), the basics of plant identification, and the specifics about the actions they are allowed to legally take to "clean up" their shorelines.[1]

3. **Hand-pulling and suction harvesting (DASH) to control Eurasian water milfoil populations** should also be considered a medium priority. Hand-pulling of Eurasian water milfoil should occur in the shallow "top-cut only" areas on the north part of the Lake (see Map 20), as well as in any other place feasible. This region has low enough levels of Eurasian water milfoil that this effort could be undertaken by volunteers. No permit is needed for hand-pulling as long as the effort targets non-native plants (in the case of Rock Lake, only Eurasian water milfoil),[2] and as long as all plant materials are removed from the Lake. It is also recommended that residents engaging in this effort be educated on the need to prevent extensive loss of native plants and general plant identification prior to the implementation of this campaign. This will ensure that this measure does not harm (or adversely affect) local wildlife and plant communities. Additionally, suction harvesting employed by a contractor should be considered for Eurasian water milfoil control in the other parts of the Lake. This activity requires a WDNR harvesting permit. The use of this measure will contribute to ensuring that Eurasian water milfoil does not displace native communities.

4. **Consideration of biological measures (i.e., aquatic weevils) or *early spring* chemical treatment for control of Eurasian water milfoil if it begins displacing the native community.** If Eurasian water milfoil becomes the dominant plant in the Lake (based on another aquatic plant survey), measures other than harvesting and hand-pulling may be necessary. If this occurs, the use of the aquatic weevil should be investigated first (medium priority if Eurasian water milfoil begins to take over). If this is determined not to be feasible, chemical treatment using a whole-lake strategy should be considered for the control of Eurasian water milfoil only (medium priority) if a 75 percent frequency of occurrence with rake fullnesses of two to three is found in an aquatic plant survey. If chemical treatment is used, it should only occur in the early spring when human contact and risks to native plants are limited. Additionally, only herbicides that somewhat selectively control Eurasian water milfoil, such as 2,4-D and endothall,[3] should be used to prevent the loss of native aquatic species. A WDNR permit and WDNR staff supervision are required to implement this alternative. Additionally, lakeshore property owners need to be informed of the chemical treatment and permit conditions prior to application of chemicals. If chemical treatment does occur, **monitoring chemical residue in the Lake** is also recommended. Generally these chemical residue monitoring efforts are undertaken as a standard component of whole-lake treatments. Implementation of this residue monitoring would be considered a high priority. Additionally, if Lake residents are concerned about the chemicals entering their groundwater wells, they could also have their **wells tested for chemical constituents**. However, given the expected low risk of the wells being affected (as discussed in Chapter II of this report) this recommendation currently is a low priority.

As mentioned previously, Map 20 is provided to help future aquatic plant managers implement the aquatic plant management plan recommendations. However, aquatic plant management must be conducted based on what is occurring at the time of treatment. Consequently, a reevaluation of this aquatic plant management plan in three to five years (at the end of the five-year permitting cycle) is recommended. This effort (high priority)

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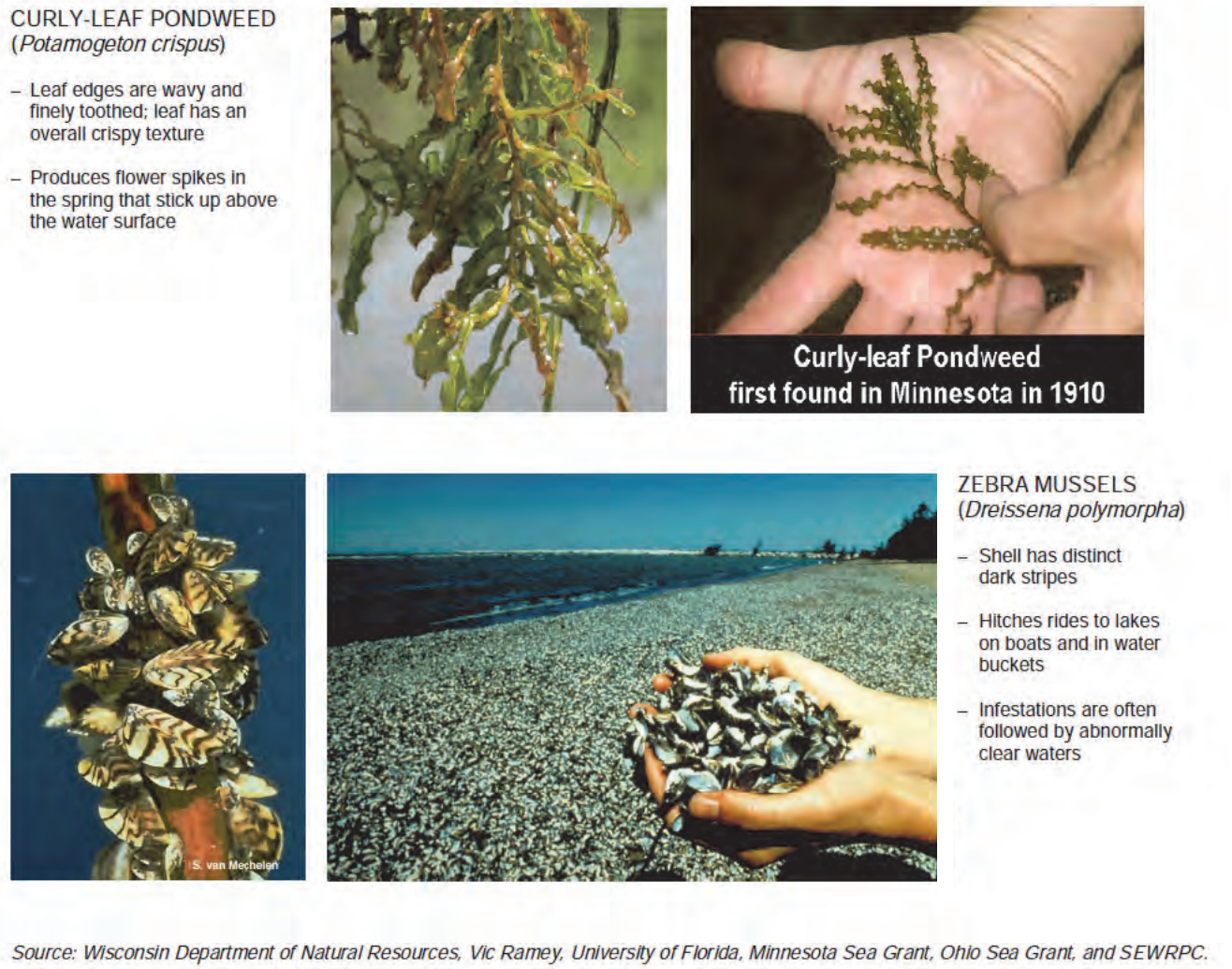
[1]*SEWRPC and WDNR staff could help review this document.*

[2]*If another invasive species, such as curly-leaf pondweed, were to be found in the Lake, this hand-pulling recommendation could also be undertaken to control this species without a permit.*

[3]*Wisconsin Department of Natural Resources PUBL-WR-236 90,* Chemical Fact Sheet: 2,4-D, *May 1990; Wisconsin Department of Natural Resources PUBL-WR-237 90,* Chemical Fact Sheet: Endothall, *May 1990.*

Figure 25

AQUATIC INVASIVE SPECIES WATCHLIST



Source: Wisconsin Department of Natural Resources, Vic Ramey, University of Florida, Minnesota Sea Grant, Ohio Sea Grant, and SEWRPC.

should include a comprehensive aquatic plant survey and an evaluation of the reported harvesting activities. This will help Lake managers evaluate the effectiveness of the aquatic plant management plan in this report and make appropriate changes to the plan.

Other Recommendations

Though not discussed in Chapter II, there is a distinct risk that a new invasive species (e.g., curly-leaf pondweed or zebra mussels) could enter the Lake (see Figure 25). To prevent this from occurring, it is recommended (high priority) that Lake residents be educated on how to prevent these species from entering the waters (see Appendix F). Additionally, it is also recommended that the Lake consider enrolling in a Clean Boats Clean Waters program (i.e., the State program targeting invasive species prevention),[4] to proactively encourage lake users to clean their boats/equipment prior to putting them in the Lake. This will help ensure that invasive species have a lower probability of entering Rock Lake and causing new issues.

[4]*Further information about Clean Boats Clean Waters can be found on the WDNR website at: http://dnr.wi.gov/lakes/cbcw/.*

If a new infestation were to occur, efforts to quickly eradicate the species (if possible)[5] should be employed immediately to ensure that the new invasive species does not become established. If a new species is detected, the WDNR has funding that can aid in early eradication, particularly as it pertains to aquatic plants. Therefore, **citizen monitoring for new invasive species is recommended** as a high priority. The Wisconsin Citizen Lake Monitoring Network (CLMN) provides training to help local citizens engage in these efforts.

Additionally, as previously discussed in Chapter II, a number of conditions can cause excessive plant growth, leading to the onset of aquatic plants at nuisance levels. Accordingly, efforts to mitigate these nuisance conditions—which often go along with improving the overall quality of the Lake and its watershed—can also reduce the amount of plant growth in general. Consequently, **implementation of the recommendations highlighted in the "Issue 2: Water Quality" section of this chapter is also important** for aquatic plant management.

ISSUE 2: WATER QUALITY

As described in Chapter II, limited water quality data is available for Rock Lake. The few data that exist (from 1977) indicate that Rock Lake had moderate amounts of nutrients (i.e., mesotrophic). However, the fact that many Lake residents have concerns about various water-quality-related issues, including sources of pollution in the watershed, the volume of aquatic plant growth, and algal growth, indicates that water quality management is warranted on the Lake (although it is not currently at a state that warrants in-lake measures such as alum treatments or aeration).

As was mentioned in Chapter II, management efforts seeking to improve water quality in Rock Lake should focus primarily on six strategies, namely:

1. **Establishment of a comprehensive water quality monitoring effort** should be considered a high priority. This monitoring generally would occur at the deep hole site (i.e., the point above the deepest part of the Lake) and should include measurements of water clarity (i.e., Secchi depth), total phosphorus concentrations at the surface, chlorophyll-*a* concentrations at the surface, temperature profiles throughout the water column, and dissolved oxygen concentrations throughout the water column. The CLMN provides training and guidance on monitoring the health of lakes. Volunteers monitor water clarity and dissolved oxygen throughout the open water season (preferably every 10 to 14 days) and water chemistry (i.e., phosphorus and chlorophyll-*a* concentrations) four times per year (two weeks after ice off and during the last two weeks of June, July, and August). In addition, chlorides should also be monitored on an annual basis to gauge whether concentrations are increasing over time to levels that could cause damage to the Lake ecosystem. Phosphorus should also be sampled at the bottom of the Lake to determine if internal loading is occurring. Finally, it may be advantageous to complete an inventory of historical observations of Lake conditions, which could add to the narrative of the Lake's past water quality.

2. **Development and protection of buffers and wetlands** should be considered a medium priority. However, if water quality is found to be an issue based on future monitoring, this priority level may increase. These efforts should begin by targeting direct residential inflow sources, i.e., the Lake shoreline properties as well as the adjacent properties. The implementation of this recommendation could involve:

[5]*Eradication of zebra mussels has yet to be achieved in any lake in Wisconsin. Therefore, prevention is currently the only way to ensure a zebra-mussel-free lake.*

a. Continued application of limits on development in SEWRPC-delineated primary environmental (see Map 19 in Chapter II of this report) corridors through County zoning. This will help protect existing natural buffer and wetland systems.

b. Continued enforcement of shoreland setback requirements (i.e., 75 feet from the ordinary high water mark) along navigable waters in the watershed and continuation of active enforcement of construction site erosion control and stormwater management ordinances.

c. Provision of informational materials to shoreland property owners on the benefits of buffers to encourage their installation around the Lake. These materials could include instructions on installation. Such programs would be most productive if accompanied by an incentive program.

d. Consideration of a shoreline best management practice and shoreline buffer enhancement program. This program could encourage the development of rain gardens or buffers along the shoreline. WDNR recently introduced a "Healthy Lakes" grant program that could help fund some of these efforts.

e. Consideration of obtaining conservation easements and purchasing wetlands and uplands, followed by subsequent buffer maintenance and/or installation.

3. **Protecting buffer and wetland functionality** through efforts to control invasive species that threaten ecological value should be considered a medium priority. The major recommendation with regard to this is to **monitor and control any purple loosestrife that may occur in wetlands**. This species, with a characteristic purple flower as shown in Figure 26, spreads quickly and replaces the plants in the wetland that are useful for pollution reduction purposes and for habitat. Consequently, it is recommended that a visual survey of appropriate locations in the watershed be made to determine whether purple loosestrife is a problem. If it is found to be an issue, removal[6] should be a priority.

4. **Continued maintenance of stormwater detention basins** should be considered important although this is currently given a low priority because there is no current evidence that the basins are not functioning. However, if water quality appears to be a major issue based on future monitoring, investigation and subsequent maintenance of these sites should be a higher priority. Maintenance of stormwater basins includes managing aquatic plants, preventing sediment deposition, and ensuring adequate water depth to settle and store pollutants (through dredging if necessary). Specifications associated with the design of stormwater detention basins and maintenance requirements ensure that basins are functioning properly.[7] Inspection of basins should be completed by the responsible regulatory entities in a manner consistent with current practices;[8] however, ensuring that the owners of these ponds know the importance of meeting these requirements (through educational outreach) can help ensure continued water quality.

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[6]*Removal of purple loosestrife can take the form of manual removal, chemical treatment, or biological controls (through the release of a specialized herbivorous insect). If purple loosestrife is found in small populations, manual removal should be implemented (with extra precautions taken to ensure no seed dispersal during removal), whereas chemical or biological controls should be employed if dense populations are found. This campaign could be completed using volunteers or through partnering with other organizations.*

[7]*Technical standards for design and maintenance of wet detention basins and other stormwater management practices can be found at* http://dnr.wi.gov/topic/stormwater/standards/postconst_standards.html.

[8]*Maintenance of stormwater detention basins was also included in the* Town of Salem – Stormwater Management Plan *adopted in March 2010. Consequently, the implementation of this recommendation in a manner consistent with that plan should be further prioritized by the Town.*

Figure 26

EXAMPLE OF PURPLE LOOSESTRIFE ON A LAKE SHORE

Source: The Nature Conservancy.

5. **Stringent enforcement of construction site erosion control and stormwater management ordinances** should be considered a <u>medium priority</u>. However, this priority level should increase at the onset of the major residential construction currently planned within the watershed. Enforcement of these ordinances should be completed by the responsible regulatory entities in a manner consistent with current practices;[9] however, local citizens can help by looking for potential violations and reporting them to the appropriate authorities (see "Issue 11: Implementation" section).

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[9]*Enforcement of the construction site erosion control and stormwater management ordinances was also included in the* Town of Salem – Stormwater Management Plan *adopted in March 2010. Consequently, the implementation of this recommendation in a manner consistent with that plan should be further prioritized by the Town.*

6. **Encouragement of pollution reduction efforts along the shorelines (best management practices)** is currently recommended but is considered a low priority. However, if water quality issues are found under future monitoring efforts, the priority level should increase. Pollution reduction measures include eliminating use of fertilizer where practical, ensuring cars are not leaking fluids on driveways, maintaining rain gardens to which roof runoff can drain, preventing soil erosion, properly disposing of leaf litter and grass clippings, and properly storing salts and other chemicals so they do not drain to the Lake. Communicating these best management practices, and engaging in a campaign to encourage their use (e.g., offering to pick up grass clipping or leaves from aging homeowners) will likely help reduce water quality problems. Additionally, implementation of the pollution prevention program ("good housekeeping practices") recommended in the current stormwater management plan[10] will help to further reduce these issues.

Implementation of these recommendations will significantly contribute to tracking and improving the water quality within Rock Lake. However, since there is currently insufficient data to determine the level of need for these programs, **a reevaluation of the water quality management recommendations should be undertaken** as a medium priority once water quality data is available. This will help determine with more certainty how much water quality management effort should be undertaken, as well as the need for in-Lake treatments for internal loading (if internal loading or algal blooms are found).

ISSUE 3: BLUE GREEN AND FLOATING ALGAE

As was mentioned in Chapter II, though algae was an issue of concern, there is not currently any evidence supporting the need for any in-Lake management efforts for algal growth (e.g., alum treatment or aeration). Consequently, the recommendations provided in this section focus on monitoring algal growth, preparing Lake residents on how to respond if algae growth becomes excessive, and on preventing excessive algal growth. The four recommendations are as follows:

1. **Monitoring algae in the Lake** should be considered. This effort should focus on monitoring chlorophyll-*a* (medium priority), as was described in the water quality monitoring recommendation above. Additionally, if large amounts of suspended algae begin to grow in the future, this monitoring could also include collecting and identifying any new algae to check whether it is a toxic strain (low priority).

2. **Warning residents to stay out of the water in the event of an excessive algal bloom** should be considered a high priority if excessive algal blooms containing toxic strains occur. A method for communicating that water conditions are not conducive to swimming should be developed.

3. **Maintaining and improving water quality** through implementing recommendations provided in the "Issue 2: Water Quality" section of this chapter.

4. **Maintaining a healthy aquatic plant community** (to compete with algal growth) through implementing recommendations provided in the "Issue 1: Aquatic Plant Growth" section of this chapter.

Implementing the above recommendations will help ensure that algae growth in the Lake does not become unmanageable. However, **if further monitoring reveals excessive or highly increased levels of algal growth, reevaluation of these recommendations, including reconsideration of in-Lake management efforts, should be considered** a medium priority.

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[10] *R.A. Smith National, Inc.* Town of Salem – Stormwater Management Plan, *op. cit*.

ISSUE 4: SEDIMENTATION

As was discussed in Chapter II of this report, sedimentation in Rock Lake appears to be occurring along the shoreline areas and has some potential to restrict recreational use of the Lake. As is the case with water quality, there is insufficient data available to form any conclusions about the source of sedimentation in Rock Lake (i.e., due to plant death or shoreline erosion and management practices). Consequently, the recommendations provided in this section relate to managing potential sources and conducting future studies to determine what type of sedimentation is occurring.

The four recommendations related to sedimentation include:

1. **Implementation or a sediment monitoring and investigation program**. This program could involve periodically taking sediment depths around the Lake at established locations to determine whether sediments are accumulating (medium priority). This program could also involve taking sediment cores to determine if plant- or land-based sedimentation is occurring within the Lake (low priority unless sedimentation begins to severely impair navigation). Finally, it may be advantageous to complete an inventory of historical observations of Lake conditions that could add to the narrative of past sedimentation events in the Lake.

2. **Implementation of harvesting or manual removal measures** for the purpose of preventing plant-based sedimentation (low priority unless sedimentation becomes excessive).

3. **Rehabilitation of the shorelines that are unprotected or exhibit signs of erosion around the Lake** as is further discussed in the "Issue 5: Shoreline Maintenance" section of this chapter.

4. **Implementation of the recommendations provided in the "Issue 2: Water Quality" section of this chapter**. This recommendation should focus particularly on those recommendations related to protecting buffers, ensuring that stormwater detention basins remain functional, continued enforcement of construction site erosion control regulations, and improving best management practices (e.g., leaf litter pickup).

Once data is acquired about sedimentation in Rock Lake, the recommendations and their priority levels should be reevaluated (low priority). Additionally, though dredging is not currently recommended, **if navigation becomes severely impaired due to sediment accumulation, the use of dredging as a management alternative**, subject to permit requirements, should be considered a medium priority. If this alternative is considered, however, it will be necessary to prioritize prevention of sediment delivery to the Lake as well, to ensure that the benefits associated with the dredging activities can be prolonged to the greatest extent practical.

ISSUE 5: SHORELINE MAINTENANCE

As discussed in Chapter II of this report, shoreline maintenance is considered a priority due to the results of the shoreline assessment conducted in 2014, which revealed areas of erosion, unprotected areas, a large portion of unbuffered shoreline, and areas with failing shoreline protection. Consequently, the three major recommendations with relation to shoreline maintenance are as follows:

1. **Encouraging the repair or removal of failing "hard" shoreline structures** should be considered a medium priority. This could be done through communication and education of private landowners or through donation-based cost-share programs. Removal of these structures may require technical expertise, consequently, it is also recommended that consultations with WDNR and shoreline restoration experts be undertaken.

2. **Encouraging the installation of "soft" or "natural" shoreline protection** (e.g., bio-logs, buffers, native plantings, and native aquatic plantings) **in the areas where it does not exist and/or where**

erosion is currently taking place should be considered a medium priority. Should these shoreline protections take the form of shoreline buffers (as recommended in the "Issue 2: Water Quality" section of this chapter), there is funding available from WDNR through the "Healthy Lakes Initiative" that can be used for these kinds of shoreline projects.

3. **Ensuring enforcement of shoreline setbacks/shoreland zoning** as discussed in the "Issue 2: Water Quality" section.

The implementation of programs meant to encourage a healthy shoreline will greatly contribute to the health of the Lake in terms of wildlife populations, sedimentation, and water quality. To track success, **it is also recommended that shoreline restoration goals be established and that a new shoreline assessment be completed, once a shoreline restoration program has been implemented** (medium priority). This will help establish how much progress is being made.

ISSUE 6: WATER QUANTITY

As discussed in the Chapter II, the maintenance of water levels can be crucial to the health of the Lake. However, although there is some anecdotal evidence that water levels in Rock Lake may be subject to elevation differences, inadequate data prevents any conclusive support for this issue of concern. Consequently, the following recommendations are made to address monitoring and water quantity measurements:

1. **Water level monitoring** should be considered a medium priority**.** This could be achieved through the installation of a staff gage (referenced to National Geodetic Vertical Datum, 1929 adjustment, NGVD 29), which could be attached to the outlet or another stable structure within the Lake. Once the gauge is installed, its readings should be recorded weekly to monitor water levels so that any issues can be detected early and a long-term Lake level record is obtained.

2. **Development of a comprehensive water budget (and potentially a delineation of the area contributing groundwater to the Lake) should be considered** a medium priority if water levels change drastically. Obtaining a water budget will help determine exactly where water supplied to Rock Lake is coming from, and can help shape where management efforts to increase water levels should be targeted. Additionally, if the water budget determines that groundwater flow is a significant contributor to the Lake, a delineation of the area contributing groundwater can be used to determine what areas need to be protected to ensure an adequate groundwater supply.

3. **Implementation of measures to promote infiltration in near-shore residential areas** is a medium priority. Implementation of this recommendation could involve:

    a. Improving infiltration of rainfall and snowmelt through installation of innovative BMPs that are associated with low-impact development, including rain garden projects[11] (see Figure 27). Some of these projects can be partially funded through the WDNR "Healthy Lakes" initiative; and

    b. Retrofitting current urban development (e.g., disconnection of downspouts or installation of permeable pavement), which could be encouraged through an educational outreach program and through providing resources to lakeshore property.

[11]*Rain gardens are deep gardens that maintain native plants and help water infiltrate into the ground rather than enter the Lake through surface runoff. The installation of rain gardens can help reduce the amount of erosion and unfiltered pollution entering the Lake and can stabilize baseflow to the Lake.*

4. **Reducing the impacts of future urban development** is a medium priority. This recommendation can be implemented by:

   a. Enforcing the infiltration recommendations in the current Town of Salem - Stormwater Management Plan, which sets criteria for infiltration requirements;[12]

   b. Purchasing land or obtaining conservation easements on agricultural and other open lands with high groundwater recharge potential; and

   c. Promoting the consideration of groundwater conditions when designing new developments. This could include encouraging developers to incorporate infiltration considerations in site designs and local government consideration of groundwater recharge during review of development proposals.

Figure 27

EXAMPLE OF A RAIN GARDEN

NOTE: Further details are provided on Natural Resource Conservation Service and Wisconsin Department of Natural Resources websites at: http://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/ndpmctn7278.pdf; and http://dnr.wi.gov/topic/Stormwater/raingarden/.

Source: U.S. Department of Agriculture, Natural Resource Conservation Service.

5. **Continuing to protect wetlands and uplands through enforcement of the County Zoning ordinance** as discussed in the "Issue 2: Water Quality" section of this chapter.

As with the other recommendations made in this chapter, any drastic future changes in Lake levels will spur the need for a reevaluation of the recommendations above. Consequently, **this periodic reevaluation is recommended** as a medium priority if water level issues arise.

ISSUE 7: SPILLWAY

As discussed in Chapter II, the current owner of the Rock Lake spillway is unknown, thereby limiting the ability to repair potential future spillway damage. Consequently, **the major recommendation with respect to the spillway is that the Town of Salem or another government entity consider taking legal responsibility for the spillway** (high priority). If this conversation occurs, the WDNR dam safety engineer responsible for Rock Lake, the Town of Salem, and Kenosha County should be involved to advise and ensure that all considered activities are permittable. Once a potential owner is established, administrative, legal, and logistical details will need to be addressed to give official ownership of the spillway to that individual. However, the designation of an owner will help ensure that any future repairs are made.

This recommendation should currently be considered a medium priority to ensure that future spillway repairs are adequately addressed.

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[12]*R.A. Smith National Inc.*, Town of Salem - Stormwater Management Plant, *p. 2-8. This recommendation can be found at:* http://www.townofsalem.net/vertical/sites/%7BFD43A93D-1DA7-4F52-8644-C09DA66C3401%7D/uploads/%7B9CAD9918-E8E5-4552-8FB9-EA052415CF0B%7D.PDF.

ISSUE 8: RECREATION

As was discussed in Chapter II, the four primary uses for Rock Lake (in no particular order) are swimming, fishing, boating, and sightseeing. Since maintenance of recreation is a priority under this plan, it is necessary to emphasize the recommendations that seek to maintain or encourage these three recreational uses. Consequently, the following recommendations are made:

1. **Maintaining and enhancing boating through improving access** should be considered. This can be achieved through implementing the harvesting recommendations included in this chapter (see "Issue 1: Aquatic Plant Growth" section) as well as through enhancement of the public access site (see "Issue 9: Public Access" section).

2. **Maintaining and enhancing swimming through engaging in "swimmer-conscious" aquatic plant management efforts** should be considered. This can be achieved through implementation of the aquatic plant management recommendations made earlier in this chapter (see "Issue 1: Aquatic Plant Growth" section), including1) implementing a plant pickup program, 2) ensuring that any future chemical treatments occur *only in the early spring* (to prevent human contact), 3) implementing hand-pulling and raking in the nearshore areas (to facilitate nearshore swimming), and 4) implementing hand-pulling and suction harvesting recommendations aimed at controlling Eurasian water milfoil (as this species often deters swimming).

3. **Maintaining and enhancing fishing activities by protecting and improving aquatic habitat and ensuring the fish community remains viable.** This recommendation (medium priority) can be achieved by implementing the aquatic wildlife recommendations provided in the "Issue 10: Wildlife" section of this chapter.

In general, **all management efforts on the Lake should be employed to enhance the health and, in turn, the recreational use of the Lake** (high priority). This should be a general principal guiding all future management, including the efforts which are undertaken consistent with the recommendations of this plan.

ISSUE 9: PUBLIC ACCESS

As discussed in Chapter II, the current public access site on Rock Lake meets only the basic legal requirements for a lake of 50 acres or less. However, recommendations to improve the access site include:

1. **Prioritizing the maintenance of an access lane through aquatic plant growth to the public access site (medium priority)**, which can be achieved through implementing the harvesting recommendations set forth earlier in this chapter (see "Issue 1: Aquatic Plant Growth").

2. **Construction of a boat launch (low priority) if a site becomes available** (e.g., a suitable site goes up for sale), which will allow visitors to enter the Lake without having to pull their boats to the end of the access pier. If this recommendation is implemented, signage communicating invasive species information and Lake ordinances should also be provided.

Increasing public access to the Lake will be crucial to increasing the ability of Lake managers to obtain government funding to implement the recommended management projects for the Lake as a whole.

ISSUE 10: WILDLIFE

As discussed in Chapter II, wildlife is a key indicator of Lake health. Additionally, the presence of wildlife increases recreational use and enjoyment of the Lake and the functionality of the Lake as an ecosystem. To enhance wildlife within the Rock Lake watershed, the following recommendations are made:

1. **Continuing current fish stocking practices** should be considered a medium priority. These activities will help ensure that the fishery is maintained while efforts to increase fish spawning are engaged.

2. **Continuing current fishing practices[13] and ordinance implementation** should be considered because the current fishery appears to be healthy. This would be a low priority, however, unless current recreational uses drastically change.

3. **Improving aquatic habitat in the Lake by allowing or installing woody debris and/or vegetative buffers along the Lake's edge** should be considered a medium priority**.** Implementation of this recommendation could take the form of educational or incentive-based programs to encourage riparian landowners to install "fish sticks"[14] (see Figure 28) or to leave fallen trees in the water, and to develop buffer systems along the shoreline. WDNR grant money is available through the "Healthy Lakes" program on a competitive basis for the implementation of "fish sticks" projects. The installation of buffers will also have the added benefit of deterring geese populations from congregating on shoreline properties.

Figure 28

EXAMPLES OF COMPLETED "FISH STICKS" PROJECTS

Source: Wisconsin Department of Natural Resources.

4. **Encouraging the adoption of best management practices to improve wildlife populations** should be considered as a medium priority (although this should increase to a higher priority if wildlife populations decline). This could be achieved through voluntary, educational, or incentive-based programs for properties adjacent to the shoreline, and by directly implementing these practices on public and protected lands. If this recommendation is implemented, a complete list of best management practices should be compiled and provided to landowners.

[13]*Should residents be interested in reducing carp populations, however, catching and removal of carp and catching and releasing of pike, while fishing, would be advantageous.*

[14]*Natural shorelines generally have hundreds of fallen trees along the shoreline (per mile). "Fish sticks" is a term coined for engineered installation of woody debris (logs) along Lake shorelines to mimic these natural conditions. Generally these projects involve anchoring logs into the shore so that the log is oriented perpendicular to the shoreline.*

5. **Ensuring proper implementation of the aquatic plant management plan** described earlier in this chapter (see "Issue 1: Aquatic Plant Growth" section)—specifically as it relates to avoiding inadvertent damage to native species—should be considered.

6. **Preserving and expanding wetland and terrestrial wildlife habitat, while making efforts to ensure connectivity between these natural areas,** should be considered. This could be achieved through implementation of the buffer and wetland protection recommendations provided in the "Issue 2: Water Quality" section of this chapter.

7. **Improvement of public access** (to encourage an increased priority for WDNR grant and management resources) through the implementation of the recommendations provided in the "Issue 9: Public Access" section of this chapter.

In general, keeping track of fish and wildlife populations will help Lake managers detect any potential issues. Consequently, **continued monitoring of fish populations, and periodic recording of the types of animals found on the Lake and within its watershed, is also recommended** as a medium priority.

ISSUE 11: IMPLEMENTATION

As discussed in Chapter II, the methods to implement the recommendations set forth above depend on the type of recommendation. For example, several important recommendations relate to enforcement of current ordinances (e.g., shoreline setbacks, zoning, construction site erosion control, and boating) by the municipality, the counties, or law enforcement, which often have limited resources available to effect enforcement.

Consequently, the following recommendations (medium priority), aimed at local citizens and management groups are made to enhance the ability of the responsible entities to monitor and enforce these regulations:

1. **Maintaining relationships with the County and municipal zoning administrators as well as law enforcement officers**. This will help build relationships with the responsible entities so that communication can be facilitated when needed.

2. **Keeping track of the activities within the watershed**, such as construction or erosion, that appear to be affecting the Lake and then subsequently notifying the relevant regulatory entity about these activities; and

3. **Proactively educating community members within the watershed about the relevant ordinances**. This will help ensure that residents know that permits are required for almost all construction within the watershed and that such permits offer opportunities to regulate activities that could harm the Lake.

In addition to regulatory enforcement, there are also a number of voluntary and/or incentive-based recommendations. These require proactive efforts to protect and manage the Lake. As was discussed in Chapter II, a number of factors restrict the ability of local citizens and management groups to effectively take on lake management projects. Consequently, the following recommendations aimed at reducing these restrictions are made:

1. **Enhancing the public access site** through the implementation of the public access recommendations made earlier in this chapter (see "Issue 9: Public Access" section). This will help improve the chances to obtain State grant funds to help with the implementation of the recommendations within this report.

Table 19

WISCONSIN DEPARTMENT OF NATURAL RESOURCES GRANTS AVAILABLE TO HELP WITH PLAN IMPLEMENTATION

Deadline	WDNR Grant[a]	Potentially Eligible Recommendations (Corresponding recommendation numbers in Table 20)
December 10	Lake Management Planning (Small Scale and Large Scale)	All planning-based projects 6, 13, 17, 23 (partial), 25, 26, 28, 29 (partial), 31, 33, 36, and 39 (partial)
	Aquatic Invasive Species (AIS) - Education, Prevention, and Planning - Clean Boats Clean Waters	Invasive species prevention programs 5 and 46 (partial)
Year Round	AIS Early Detection and Response	Response to new infestation (none at the moment)
	AIS Maintenance and Containment	Aquatic plant maintenance costs such as the cost of permits, monitoring and record keeping 1 (partial), 2 (partial), and 6
February 1	Lake Protection - Land/Easement Acquisition - Wetland and Shoreline Habitat Restoration	Projects such as land purchases and wetland restoration to improve water quality and wildlife 16 and 18
	Lake Protection - Lake Management Plan Implementation	Many of the recommendations within the plan, with the exception of those pertaining to aquatic plant management (discussion with WDNR for more information)
	Lake Protection - Healthy Lakes Initiative	Infiltration projects, natural vegetation on shorelines, "fish sticks," and erosion control 14, 30, 34, and 41
	AIS Established Population Control	Generally used for WDNR invasive species programs (e.g., purple loosestrife) or for new techniques (e.g., a new comprehensive technique to eradicate) 18

[a] Further information on these grants is available at *http://dnr.wi.gov/aid/surfacewater.html.*

Source: Wisconsin Department of Natural Resources and SEWRPC

2. **Encouraging key players to attend meetings, conferences, and/or training programs to build their lake management knowledge,** which will enhance institutional capacity (medium priority). Some examples of capacity-building events are the Wisconsin Lakes Conference (which targets local lake managers) and the "Lake Leaders" training program (which teaches the basics of lake management and provides ongoing resources to lake managers), both of which are hosted by UW Extension. Additionally, courses, regional summits, and general meetings can also be used for this purpose. Any attendance at these events should include follow-up documents/meetings so that the lessons learned can be communicated to the larger Lake group.

3. **Continuing to ensure inclusivity and transparency with respect to all Lake management activities** (high priority). These efforts should be conducted through public meetings and consensus building so that conflicts can be mitigated prior to the implementation of any particular program.

4. **Monitoring all management efforts to establish lessons learned and communicate these lessons to future Lake managers** (medium priority). This will help further increase the institutional capacity of lake management entities. This could take the form of annual meetings and/or reports to compile and report successes. These records should then be kept for future generations.

5. **Applying for WDNR grants when available** to support the implementation of the programs within this plan (high priority). Table 19 provides a list of potential grants that can be used to implement the plan recommendations.

6. **Consideration of the formation of a Lake District** with the authority to levy taxes. Although currently a low priority, this recommendation should be considered a high priority if WDNR grant funds prove insufficient to cover the cost of Lake management efforts.

7. **Encouraging engagement of Lake users and residents in future management efforts** (medium priority) to add to the donor and volunteer base working toward improving the Lake.

Additionally, as discussed in Chapter II, a major recommendation that should be considered a high priority is the **creation of an action plan which highlights action items, timelines, goals, and responsible parties**. This document will help ensure that the plan recommendations are implemented in a timely, comprehensive, transparent, and effective manner. Additionally, an action plan can help ensure that all responsible parties are held accountable for their portions of the plan's implementation.

As a final note, a major recommendation to promote implementation of this plan is the **education of the Lake residents, users, and governing bodies** on the content of this plan. A campaign to communicate the relevant information in the plan should therefore be given a high priority.

SUMMARY AND CONCLUSIONS

To aid in the implementation of the plan recommendations, Table 20 highlights the 53 recommendations, as well as their priority level. The table also details the alternatives that were not recommended based on discussion within Chapter II. Additionally, Maps 21 and 22, in combination with the aquatic plant management recommendation map (see Map 20), indicate where the recommendations should be implemented. These maps will provide current and future Rock Lake managers with a visual representation of where to target management efforts.

As stated in the introduction, this chapter is intended to stimulate ideas and action. The recommendations should, therefore, provide a starting point for addressing the issues that have been identified in Rock Lake and its watershed. Successful implementation of the plan will require vigilance, cooperation, and enthusiasm from local management groups, State and regional agencies, counties, municipalities, and Lake residents. The recommended measures will provide the water quality and habitat protection necessary to maintain and establish conditions in the watershed that are suitable for the maintenance and improvement of the natural beauty and ambience of Rock Lake and its ecosystems and the enjoyment of its human population today and in the future.

Table 20

SUMMARY OF RECOMMENDATIONS

Number[a]	Recommendations	Suggested Priority Level
ISSUE 1: AQUATIC PLANT GROWTH		
1	General management of aquatic plant growth with an emphasis on enhancing navigation and protecting native species	HIGH
2	Harvesting for navigation lanes (NOTE: Harvesting activities must leave one foot of plant material and must not occur during fish spawning periods. Additionally, animals caught in the harvester should be returned to the Lake). Annual reporting will be required	HIGH
3	WDNR-hosted training of all harvester operators	HIGH
4	Implementation of a comprehensive and consistent plant pickup program	HIGH
5	Implementation of an invasive species prevention and monitoring program	HIGH
6	Reevaluation in three to five years with a new aquatic plant survey	HIGH
7	Manual removal of Eurasian water milfoil wherever feasible (likely along the northern shore where the plant is very sparse and in shallow waters)	MEDIUM
8	Diver Assisted Suction Harvesting (DASH) as a method for Eurasian water milfoil removal wherever feasible	MEDIUM
9	Raking and manual removal of nuisance plants in near-shore areas where other management efforts are not possible (can be completed without a permit for a 30-foot length of the shoreline including the "use" area)	MEDIUM
10	Use of the aquatic weevil *does not currently appear warranted;* however, this technique should be considered as a first resort for the control of Eurasian water milfoil if the plant takes over native populations	MEDIUM if Eurasian water milfoil takes over
11	Use of chemical treatments as a method of controlling Eurasian water milfoil *is not currently recommended*; however, if this species displaces native plant communities in the future this recommendation should be reevaluated. If chemical treatment is used it should occur ONLY in the *early spring* and should use a selective chemical only	MEDIUM if Eurasian water milfoil takes over and use of the aquatic weevil is not deemed feasible
12	Testing of chemical residue in the Lake, as well as voluntary well testing, if chemical treatment does occur	MEDIUM if chemical treatment is undertaken
	Implementation of "Issue 2: Water Quality" recommendations to reduce the conditions that encourage aquatic plant growth	- -
ISSUE 2: WATER QUALITY		
13	Implementation of a water quality monitoring effort	HIGH
14	Installation of shoreline buffers where they do not currently exist	MEDIUM (higher if water quality data identifies an issue)
15	Continued enforcement of construction site erosion control and stormwater management ordinances	MEDIUM (higher if large-scale construction activity begins)
16	Protection of current buffers and wetlands in the watershed through enforcement of zoning and shoreline setback requirements as well as through land purchases	MEDIUM (higher if water quality data identifies an issue)
17	Reevaluation of the recommendations of this plan, once monitoring data is available, particularly if data indicates water quality issues	MEDIUM (higher in five years or if water quality data identifies an issue)
18	Protection of current buffer and wetland functionality through a campaign to control invasive plant species	MEDIUM (higher if survey reveals extensive nonnative populations)
19	Maintenance of stormwater detention basins within the watershed	LOW (higher if water quality data reveals issue)
20	Targeted shoreline pollution reduction efforts through communication of best management practices if pollutant concentrations (such as for phosphorus) are found to be high after further monitoring	LOW (higher if water quality data identifies an issue)
ISSUE 3: BLUE GREEN AND FLOATING ALGAE		
21	Communicating that lake users should not enter the Lake if algae looks "unhealthy"	HIGH if large blooms occur
22	Monitoring for chlorophyll-*a*	MEDIUM
23	In-lake management efforts *are not currently recommended*; however this should be reevaluated if algal blooms become excessive in the Lake	MEDIUM if large algal blooms occur

Table 20 (continued)

Number[a]	Recommendations	Suggested Priority Level
24	Monitoring for toxic blue green algae if a large algal bloom is found	LOW
	Implementation of "Issue 1: Aquatic Plant Growth" recommendations to ensure that a healthy native plant community exists in the Lake to compete with algae growth	- -
	Implementation of "Issue 2: Water Quality" recommendations to reduce the conditions that encourage algal growth	- -
ISSUE 4: SEDIMENTATION		
25	Completion of a sediment depth survey and a sediment core study to determine the source of sedimentation	MEDIUM (LOW for coring unless sedimentation becomes excessive)
26	Dredging activities *are NOT currently recommended*; however, dredging may be warranted if navigation becomes severely limited, subject to permit requirements. Dredging activities should only be engaged after actions to reduce sediment loads are undertaken	MEDIUM if navigation becomes severely limited
27	In-lake prevention of sediments through harvesting (mechanical and suction) and hand-pulling	LOW (higher if navigation becomes severely limited)
28	Reevaluation of sedimentation recommendations if conditions deteriorate and if new data becomes available	LOW if navigation becomes severely limited
	Implementation of "Issue 2: Water Quality" recommendations to prevent plant growth and eventual plant based sedimentation	- -
	Implementation of "Issue 5: Shoreline Maintenance" recommendations to prevent shoreline erosion and to help improve fish spawning	- -
ISSUE 5: SHORELINE MAINTENANCE		
29	Repair or removal of failing shoreline structures	MEDIUM
30	Installation of "natural" shoreline protections on shorelines where they do not exist	MEDIUM
31	Development of shoreline restoration goals followed by a resurvey to monitor progress	MEDIUM
	Implementation of "Issue 2: Water Quality" recommendation 15 (i.e., enforcing zoning) to ensure proper building setbacks and mitigation measures	- -
ISSUE 6: WATER QUANTITY		
32	Installation of a gauge to monitor lake levels as well as regular recording of those levels	MEDIUM
33	Consideration of a study to determine water budget and the area contributing groundwater to the Lake	MEDIUM if water levels begin to decrease
34	Targeting shoreline properties for infiltration projects	MEDIUM
35	A campaign to reduce the impacts of future urban development (e.g., increase the use of infiltration technologies in new developments within the watershed)	MEDIUM if water levels decrease with development
36	Reevaluation of the above recommendations if water levels drop or rise drastically	MEDIUM with water level issues
	Implementation of recommendation 15 (i.e., enforcing zoning ordinances) in "Issue 2: Water Quality" section to help ensure groundwater infiltration	- -
ISSUE 7: SPILLWAY		
37	The Town of Salem, or another government entity, taking ownership of the spillway	MEDIUM (higher if repairs become needed)
ISSUE 8: RECREATION		
38	Use of lake health and lake use as the primary goals of any lake management efforts on the Lake	HIGH
	Ensure implementation of swimmer-conscious aquatic plant recommendations including recommendation 4 (plant pick up program), 8 (hand-pulling and raking near shore areas), and 11 (use of *early spring* chemical application only if necessary)	- -
	Implementation of "Issue 10: Wildlife" recommendations to enhance the fishery	- -
	Implementation of recommendation number 2 (i.e., harvesting access lanes) and through implementation "Issue 9: Public Access" recommendations to enhance boating	- -

Table 20 (continued)

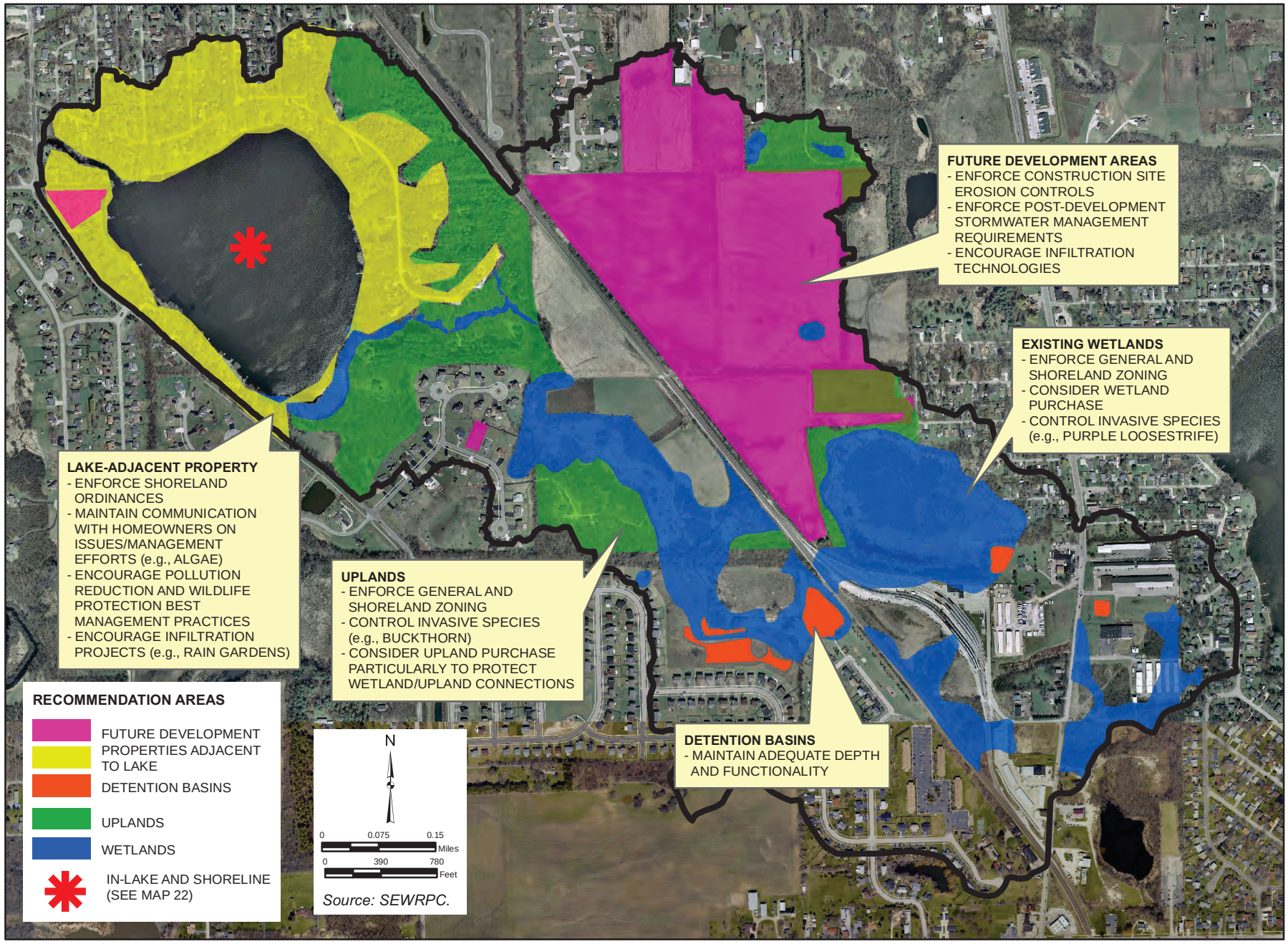
Number[a]	Recommendations	Suggested Priority Level
	ISSUE 9: PUBLIC ACCESS	
39	Improvement of access to the Lake through installation of a public boat launch if a site becomes available	MEDIUM
	Implementation of "Issue 1: Aquatic Plant Growth" recommendations with an emphasis on recommendation 2 (i.e., harvesting access lanes) in the vicinity of the access lane	- -
	ISSUE 10: WILDLIFE	
40	Continuation of fish stocking	MEDIUM
41	Introduction of woody debris (e.g., "fish sticks" or fallen trees) onto the Lake's shoreline as well as encouragement of vegetative buffers on the shorelines	MEDIUM
42	Periodic monitoring of fish and wildlife populations	MEDIUM
43	Communication and encouragement regarding implementing wildlife best management practices along the shoreline and in the rest of the watershed	MEDIUM
44	Maintenance of current practices in terms of boating ordinances and fishing practices, with prioritization on removal of carp and release of pike while fishing	LOW (higher if recreational use drastically changes)
	Implementation of "Issue 1: Aquatic Plant Growth" recommendations to encourage habitat and food availability	- -
	Implementation of "Issue 2: Water Quality" section recommendations 15 and 16 (i.e., buffer and wetland protection) to encourage habitat expansion and fish spawning	- -
	Implementation of "Issue 9: Public Access" section recommendations to receive a higher priority for WDNR wildlife management services	- -
	ISSUE 11: IMPLEMENTATION	
45	Creation of an action plan with action items, timelines, and responsible parties	HIGH
46	Development of a communication plan to educate residents and managers on the important information provided in this plan	HIGH
47	Apply for grants to help cover some of the costs associated with the implementation of this plan	HIGH
48	Continue to ensure cooperation between the relevant management bodies within the Rock Lake watershed	HIGH
49	Actively seek to ensure that the management authorities on the Lake improve "institutional capacity" (i.e., knowledge of lake management and available resources)	MEDIUM
50	Encourage the participation of lake users as well as lake residents in management efforts so as to acquire a wider volunteer base	MEDIUM
51	Work with regulatory agencies to help with the enforcement of current ordinances within the Lake and its watershed through maintaining relationships with responsible entities, keeping track of activity in the watershed, and proactively communicating that information to regulators	MEDIUM
52	Active monitoring of management efforts and their effects to develop and communicate lessons learned	MEDIUM as more management occurs
53	Consideration of the formation of a Lake District	LOW (higher if funding becomes unmanageable)
	Implementation of "Issue 9: Public Access" recommendations to gain more access to WDNR services and grant funds	- -

[a]*Numbers were assigned to new recommendations; recommendations within each issue were organized by priority level. Numbers were not provided for recommendations which were reiterated due to their utility in solving multiple issues.*

Source: SEWRPC.

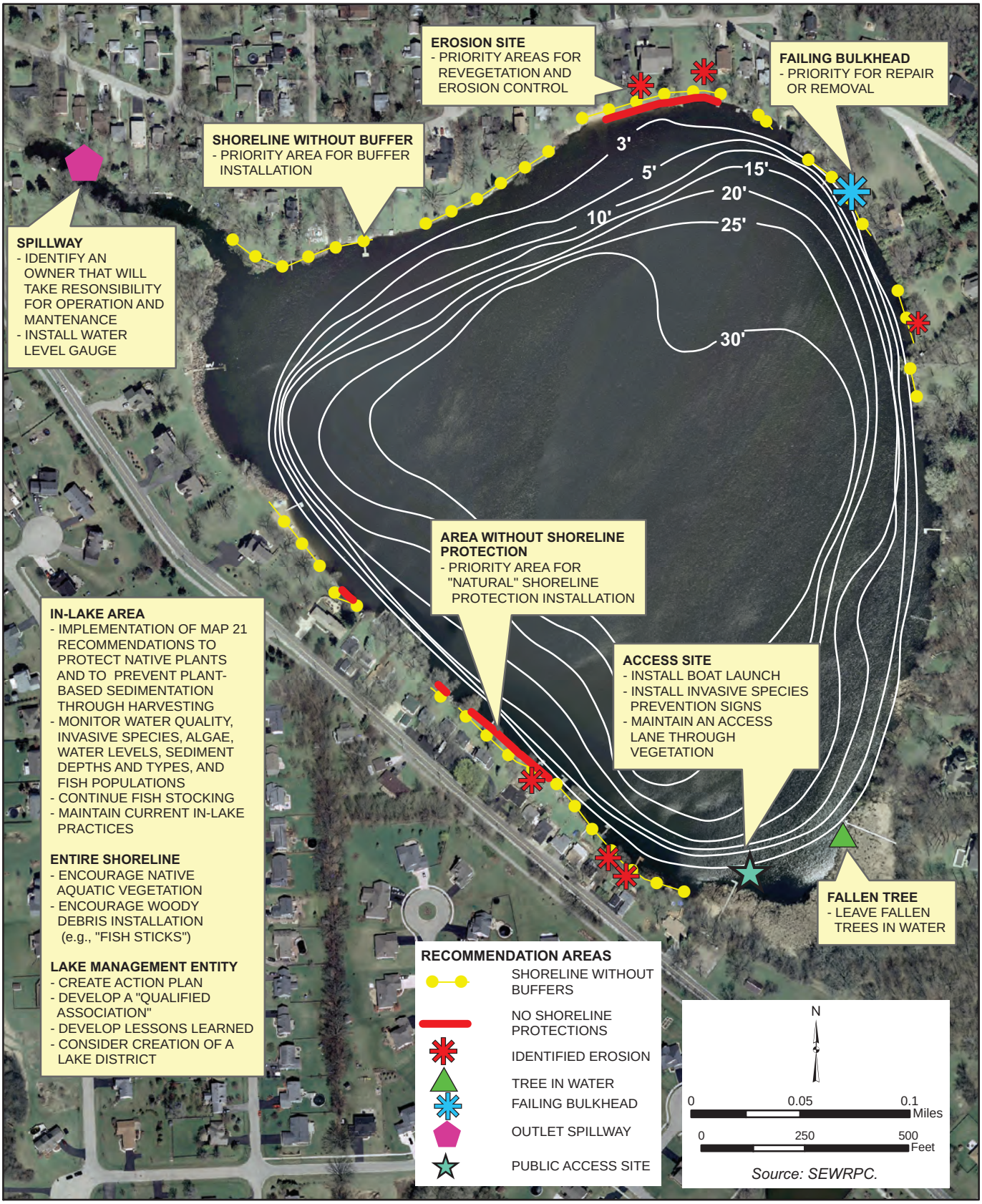
Map 21

SELECTED RECOMMENDATIONS FOR THE ROCK LAKE WATERSHED



Map 22

IN-LAKE, SHORELINE, AND INSTITUTIONAL RECOMMENDATIONS



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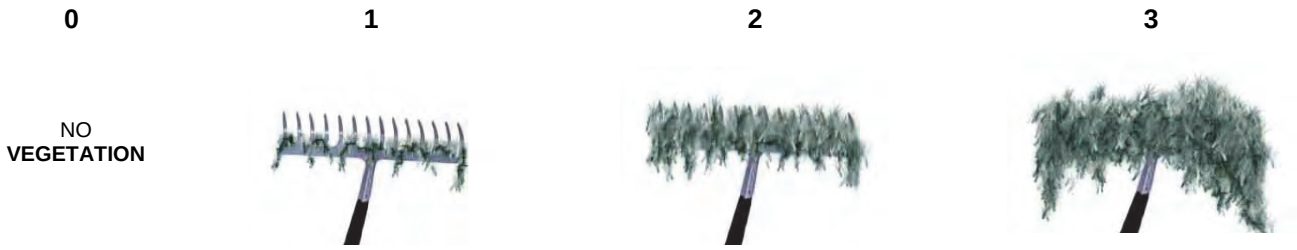
APPENDICES

Appendix A

ROCK LAKE
AQUATIC PLANT SPECIES DETAILS

Figure A-1

RAKE FULLNESS RATINGS



Source: Wisconsin Department of Natural Resources and SEWRPC.

SOURCES OF INFORMATION:

Borman, S., Korth, R., & Temte, J. (1997). *Through the Looking Glass: A Field Guide to Aquatic Plants.* Stevens Point, WI, USA: Wisconsin Lakes Partnership.

Robert W. Freckman Herbarium: *http://wisplants.uwsp.edu*

Skawinski, P. M. (2011). *Aquatic Plants of the Upper Midwest: A Photographic Field Guide to Our Underwater Forests*. Wausau, Wisconsin, USA: Self-Published.

University of Michigan Herbarium: *http://www.michiganflora.net/home.aspx*

Ceratophyllum demersum — Coontail

Native

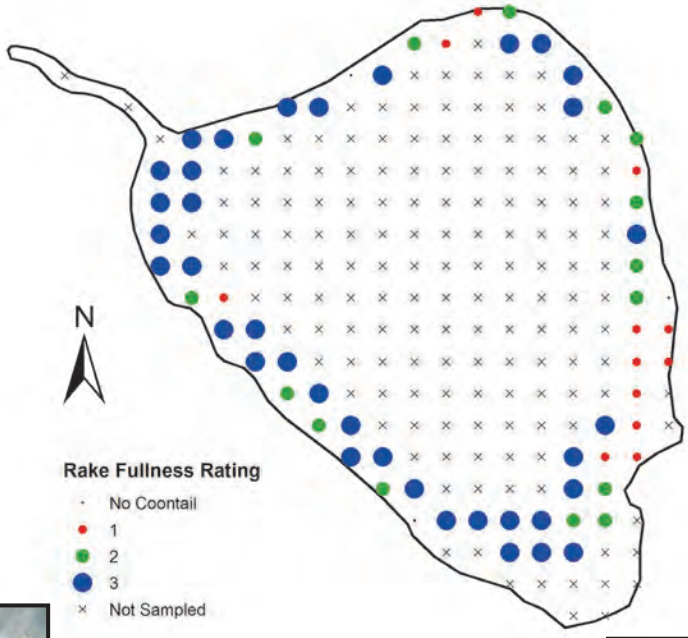
Identifying Features

- Often bushy near tips of branches, giving the raccoon-tail-like appearance ("coontail")
- Whorled leaves with one to two orders of branching and small teeth on their margins
- Flowers (rare) small and produced in leaf axils

Coontail is similar to spiny hornwort (*C. echinatum*) and muskgrass (*Chara* spp.), but spiny hornwort has some leaves with three to four orders of branching, and coontail does not produce the distinct garlic-like odor of muskgrass when crushed

Ecology

- Common in lakes and streams, both shallow and deep
- Tolerates poor water quality (high nutrients, chemical pollutants) and disturbed conditions
- Stores energy as oils, which can produce slicks on the water surface when plants decay
- Anchors to the substrate with pale, modified leaves rather than roots
- Eaten by waterfowl, turtles, carp, and muskrat

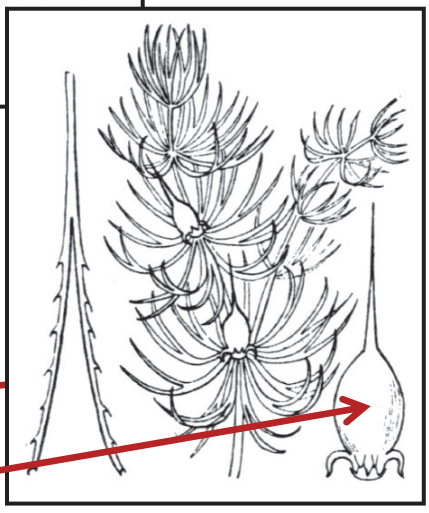


Second-Order Leaf Branching

First-Order Leaf Branching

Toothed Leaf Margins

Fruit (rare)



Chara spp.

Native

Muskgrasses

Algae (not vascular plants)

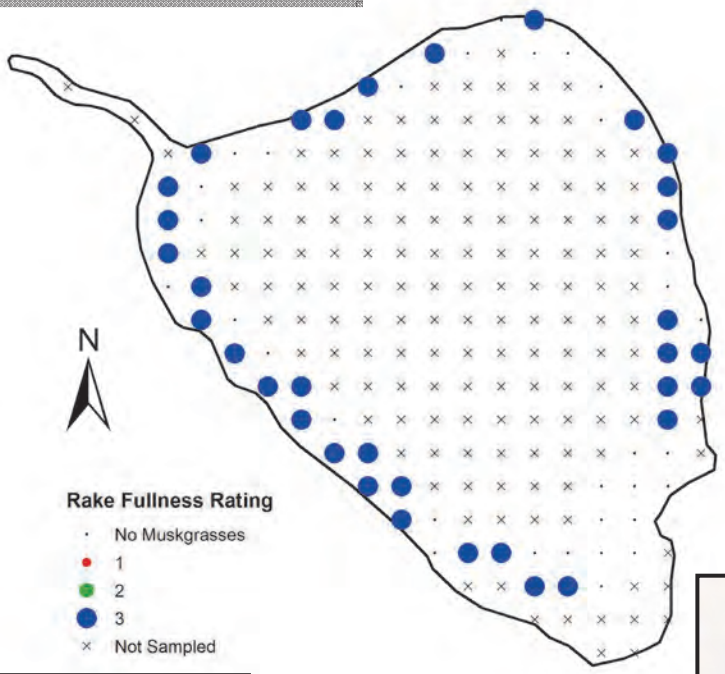
Identifying Features

- Leaf-like, ridged side branches develop in whorls of six or more
- Often encrusted with calcium carbonate, which appears white upon drying (see photo on left, below)
- Yellow reproductive structures develop along the whorled branches in summer
- Emits a garlic-like odor when crushed

Stoneworts (*Nitella* spp.) are similar large algae, but their branches are smooth rather than ridged and more delicate

Ecology

- Found in shallow or deep water over marl or silt, often growing in large colonies in hard water
- Overwinters as rhizoids (cells modified to act as roots) or fragments
- Stabilizes bottom sediments, often among the first species to colonize open areas
- Food for waterfowl and excellent habitat for small fish




Daniel Carter


Christian Fischer

Elodea canadensis — Common Waterweed

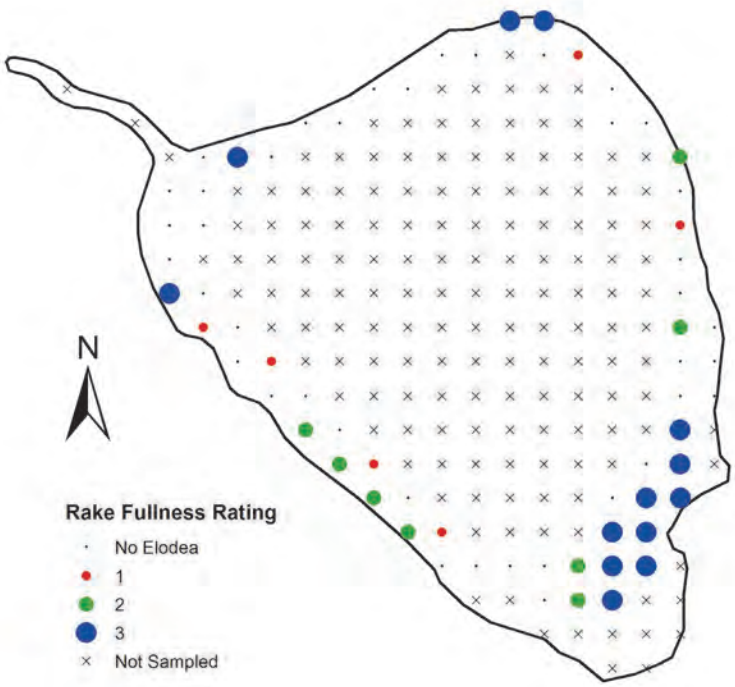
Native

Identifying Features

- Slender stems, occasionally rooting
- Leaves lance-shaped, in whorls of three (rarely two or four), 6.0 to 17 mm long and averaging 2.0 mm wide
- When present, tiny male and female flowers on separate plants (females more common), raised to the surface on thread-like stalks

Ecology

- Found in lakes and streams over soft substrates tolerating pollution, eutrophication and disturbed conditions
- Often overwinters under the ice
- Produces seeds only rarely, spreading primarily via stem fragments
- Provides food for muskrat and waterfowl
- Habitat for fish or invertebrates, although dense stands can obstruct fish movement



Myriophyllum sibiricum — Northern Water Milfoil

Native

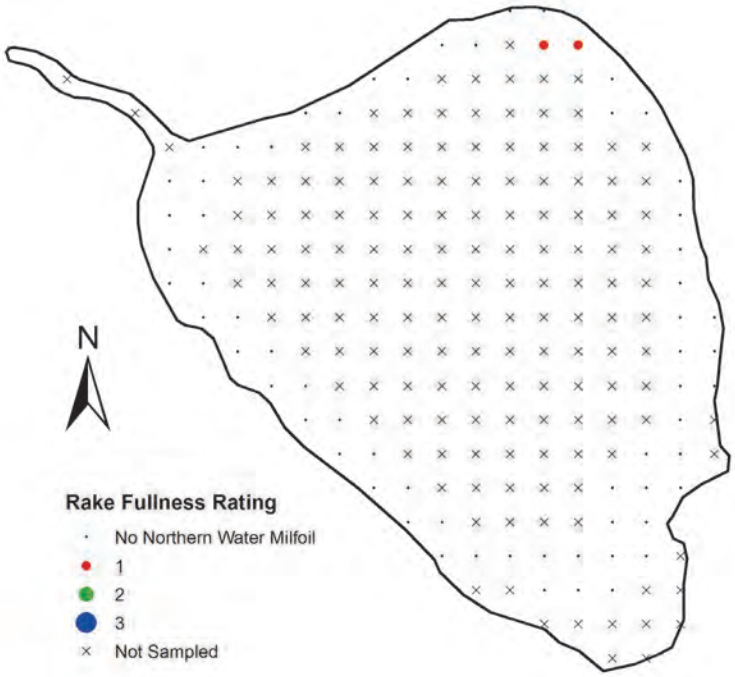
Identifying Features

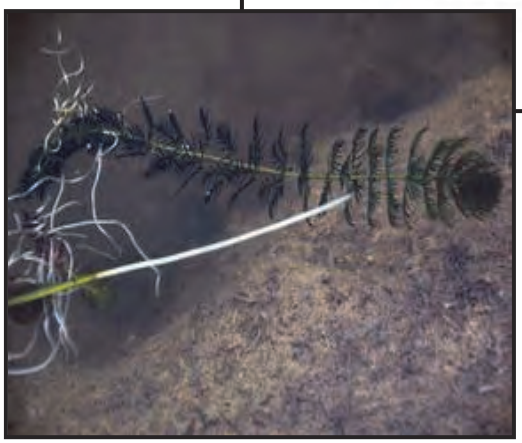
- Light-colored, stout stems
- Leaves in whorls of four to five, divided into four to 12 pairs of leaflets, lower leaflets longer than the upper ones
- Forms winter buds (turions) in autumn

Northern water milfoil is similar to other water milfoils. Eurasian water milfoil (*M. spicatum*) tends to produce more leaflets per leaf and have more delicate, pinkish stems

Ecology

- Found in lakes and streams, shallow and deep
- Overwinters as winter buds and/or hardy rootstalks
- Consumed by waterfowl
- Habitat for fish and aquatic invertebrates
- Hybridizes with Eurasian water milfoil, resulting in plants with intermediate characteristics





Myriophyllum spicatum — Eurasian Water Milfoil

Nonnative/Exotic

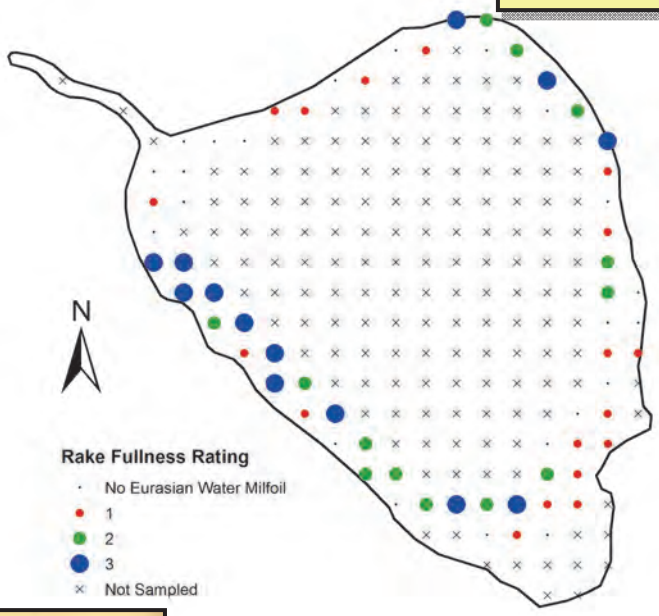
Identifying Features

- Stems spaghetti-like, often pinkish, growing long with many branches near the water surface
- Leaves with 12 to 21 pairs of leaflets
- Produces no winter buds (turions)

Eurasian water milfoil is similar to northern water milfoil (*M. sibiricum*). However, northern water milfoil has five to 12 pairs of leaflets per leaf and stouter white or pale brown stems

Ecology

- Hybridizes with northern (native) water milfoil, resulting in plants with intermediate characteristics
- Invasive, growing quickly, forming canopies, and getting a head-start in spring due to an ability to grow in cool water
- Grows from root stalks and stem fragments in both lakes and streams, shallow and deep; tolerates disturbed conditions
- Provides some forage to waterfowl, but supports fewer aquatic invertebrates than mixed stands of aquatic vegetation



Nuphar variegata — Spatterdock

Native

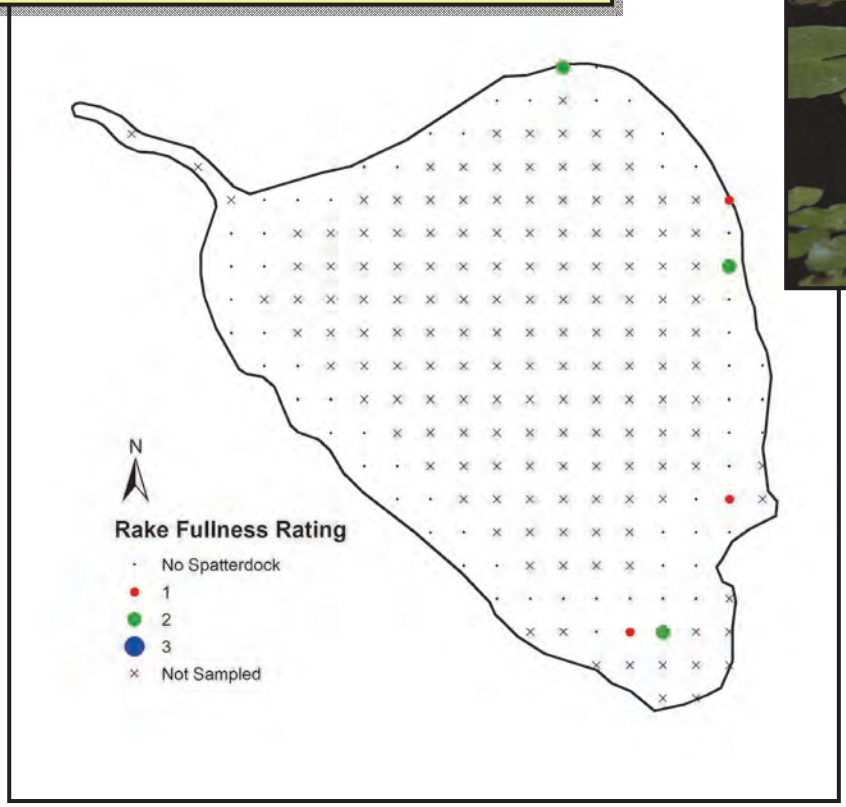
Identifying Features

- Leaf stalks winged in cross-section
- Most leaves floating on the water surface, heart-shaped, and notched, with rounded lobes at the base
- Yellow flowers, 2.5 to 5.0 cm wide, often with maroon patches at the bases of the sepals (petal-like structures) when viewed from above

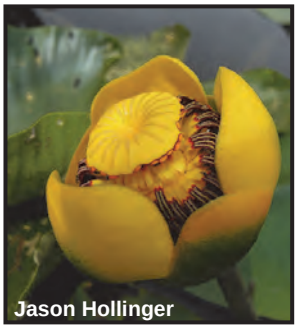
Unlike spatterdock, the similar yellow pond lily (*Nuphar advena*) has leaf stalks that are not winged in cross-section, leaves that more often emerge above the water surface, and leaf lobes that are more pointed. Spatterdock is superficially similar to water lilies (*Nymphea* spp.), but it has yellow versus white flowers and leaves somewhat heart-shaped versus round. American lotus (*Nelumbo lutea*) is also similar, but its leaves are round and un-notched, and its flowers are much larger

Ecology

- In sun or shade and mucky sediments in shallows and along the margins of ponds, lakes, and slow-moving streams
- Overwinters as a perennial rhizome
- Flowers opening during the day, closing at night, and with the odor of fermented fruit
- Buffers shorelines
- Provides food for waterfowl (seeds), deer (leaves and flowers), and muskrat, beaver, and porcupine (rhizomes)
- Habitat for fish and aquatic invertebrates




Ron Edwards


Jason Hollinger

Nymphaea odorata — White Water Lily

Native

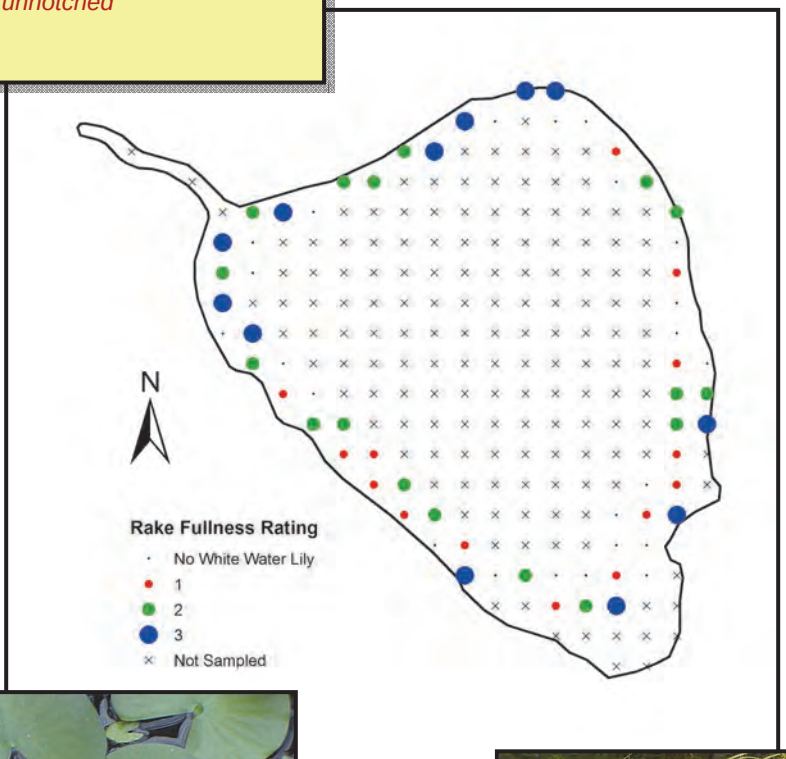
Identifying Features

- Leaf stalks round in cross-section with four large air passages
- Floating leaves round (four to 12 inches wide under favorable conditions), *with a notch* from the outside to the center, and reddish-purple underneath
- Flowers white with a yellow center, three to nine inches wide

Pond lilies (*Nuphar* spp.) are superficially similar, but have yellow flowers and leaves somewhat heart-shaped. American lotus (*Nelumbo lutea*) is also similar, but its leaves are *unnotched*

Ecology

- Found in shallow waters over soft sediments
- Leaves and flowers emerge from rhizomes
- Flowers opening during the day, closing at night
- Seeds consumed by waterfowl; rhizomes consumed by mammals



Pontederia cordata — Pickerel Weed

Native

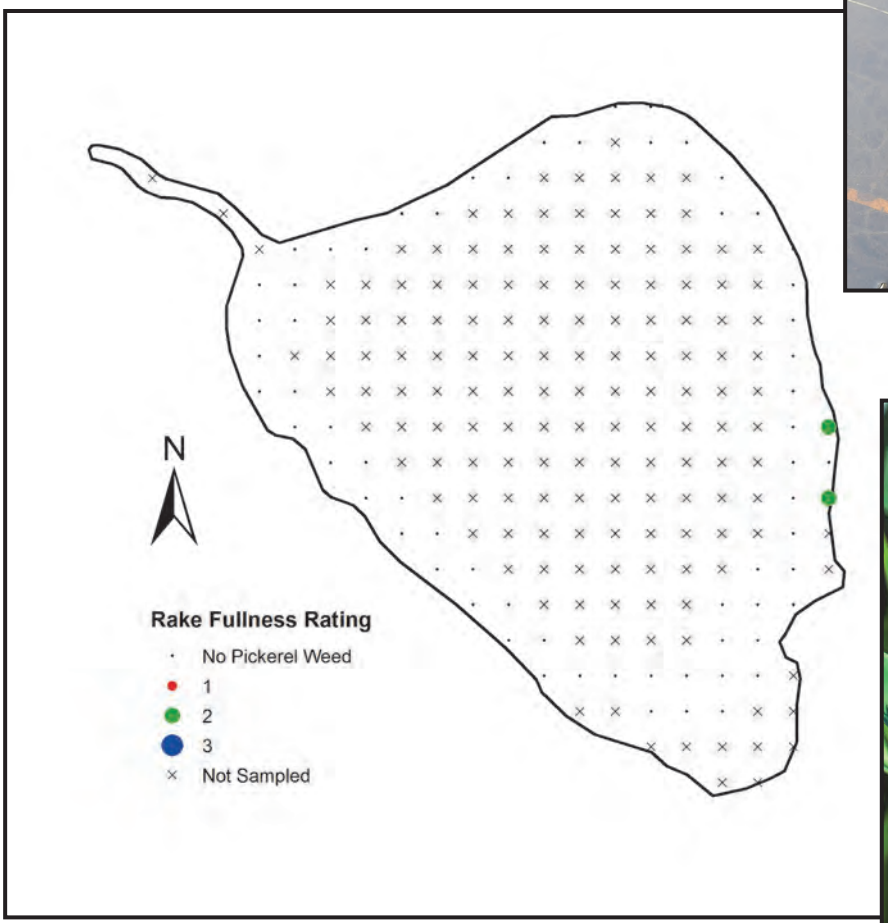
Identifying Features

- Leaves emergent, glossy, heart-shaped, and with many fine, parallel veins
- Flower spikes crowded with small blue (occasionally white) flowers
- Submersed forms have narrow, ribbon-like leaves

Pickerel weed is distinctive, but could be mistaken for arrowhead (*Sagittaria spp.*, calla (*Calla palustris*), or water plantain (*Alisma spp.*) when not in flower. In such cases the heart-shaped leaf base and fine, parallel veins aid identification.

Ecology

- Generally shallow waters, often forming colonies in bays
- Overwinters as stout rhizomes; reproduces both by seed and creeping rhizomes
- *Important shoreline stabilizer*
- Provides habitat and/or food for fish, muskrat, waterfowl, and insects




Kent McFarland


Leo Papandreou

Potamogeton gramineus — Variable Pondweed

Native

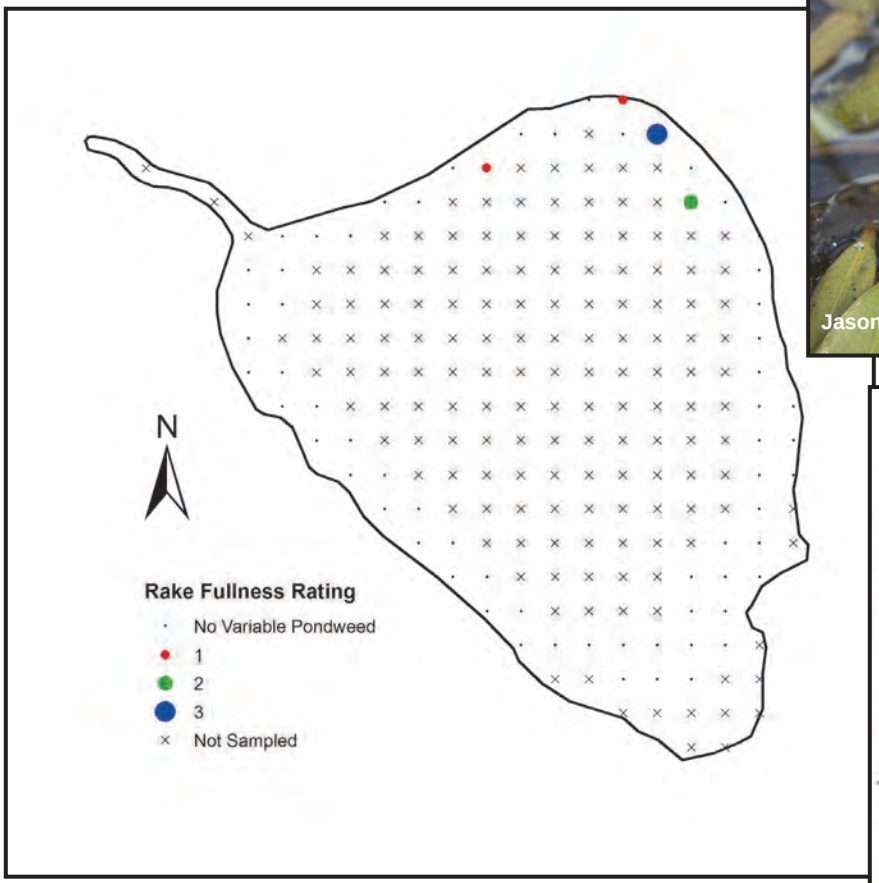
Identifying Features

- Often heavily branched
- Submerged leaves narrow to lance-shaped, with three to seven veins, smooth margins, without stalks, but the blade tapering to the stem
- Floating leaves with 11 to 19 veins and a slender stalk that is usually longer than the blade
- Often covered with calcium carbonate in hard water

Variable pondweed is similar to Illinois pondweed (*P. illinoensis*), but Illinois pondweed has submerged leaves with nine to 19 veins

Ecology

- Shallow to deep water, often with muskgrass, wild celery, and/or slender naiad; requires more natural areas that receive little disturbance
- Overwinters as rhizomes or winter buds (turions)
- Provides food for waterfowl, muskrat, deer, and beaver
- Provides habitat for fish and aquatic invertebrates



Potamogeton pectinatus — Sago Pondweed

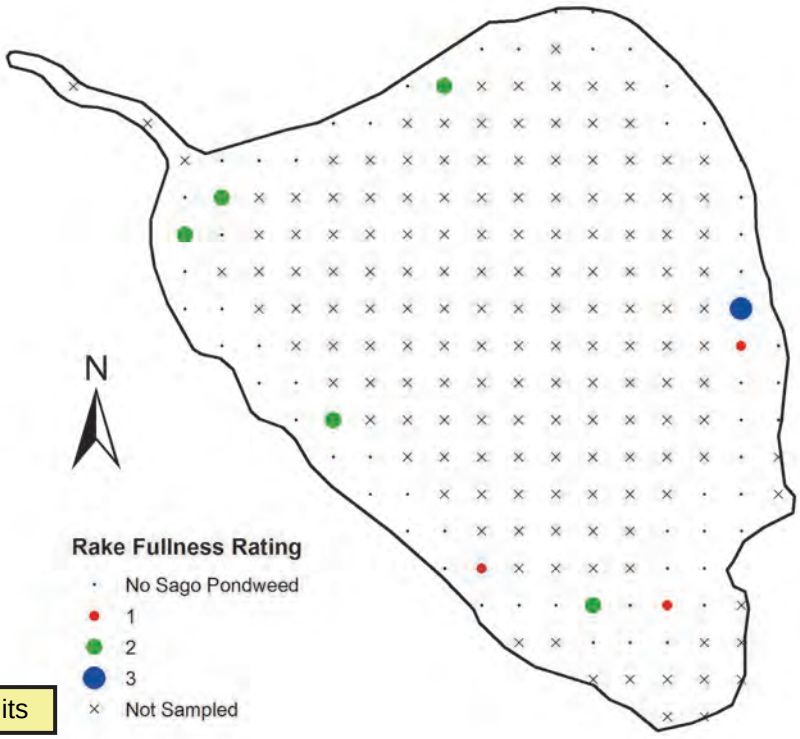
Native

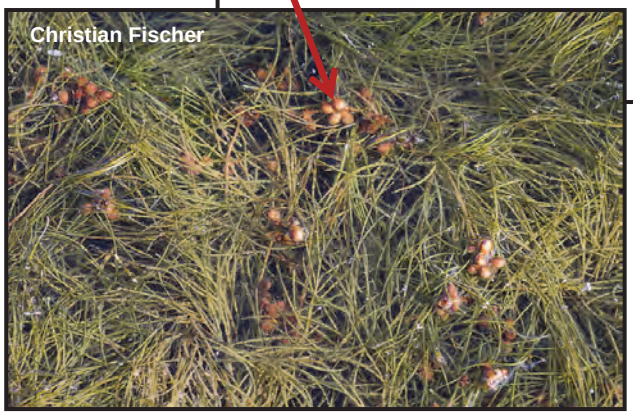
Identifying Features

- Stems often *slightly zig-zagged* and forked multiple times, yielding a fan-like form
- Leaves one to four inches long, very thin, and ending in a sharp point
- Whorls of fruits spaced along the stem may appear as beads on a string

Ecology

- Lakes and streams
- Overwinters as rhizomes and starchy tubers
- Tolerates murky water and disturbed conditions
- Provides abundant fruits and tubers, which are an *important food for waterfowl*
- Provides habitat for juvenile fish





Potamogeton praelongus — White-Stem Pondweed

Native

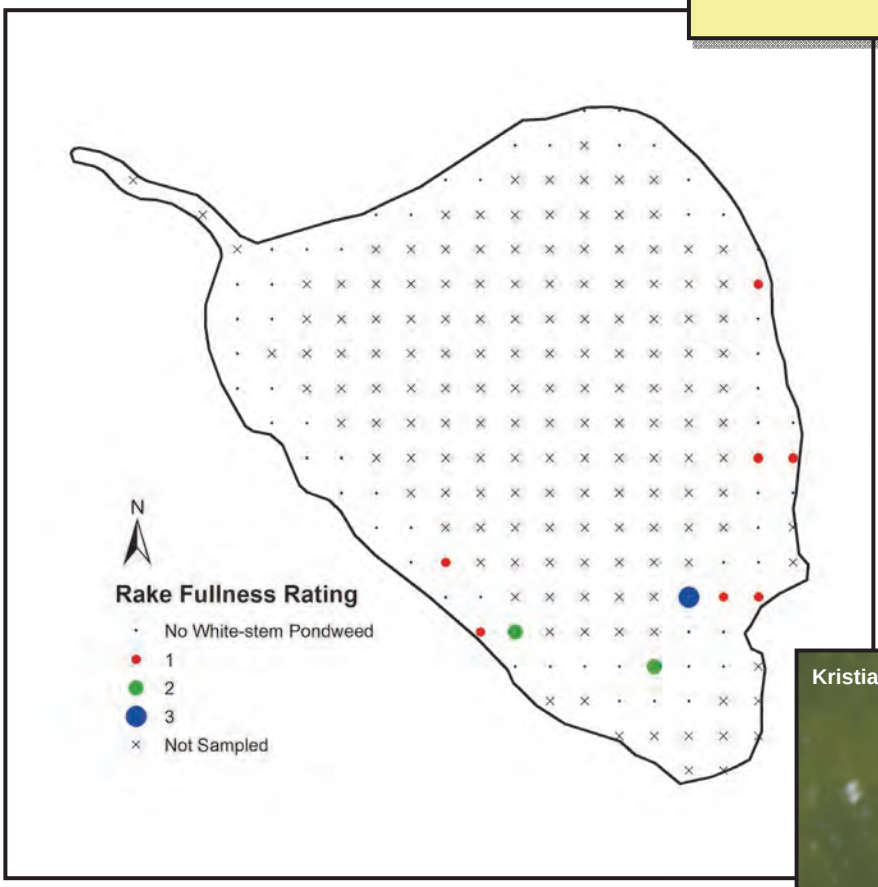
Identifying Features

- Stems usually pale and zig-zagging
- Leaves clasping, alternate, with three to five prominent veins and 11 to 35 smaller ones, with boat-shaped tips that often split when pressed between fingers

White-stem pondweed is similar to clasping pondweed (*P. richardsonii*), but the leaves of clasping pondweed do not have boat-shaped tips that split when pressed

Ecology

- Found in clear lakes in water three to 12 feet deep over soft sediments
- *"Indicator species"* due to its sensitivity to water quality changes; its disappearance indicating degradation; requires more natural areas that receive little disturbance
- Sometimes remains evergreen beneath the ice
- Provides food for waterfowl, muskrat, beaver, and deer
- Provides habitat for trout and muskellunge




Kristian Peters

Potamogeton zosteriformis — Flat-Stem Pondweed

Native

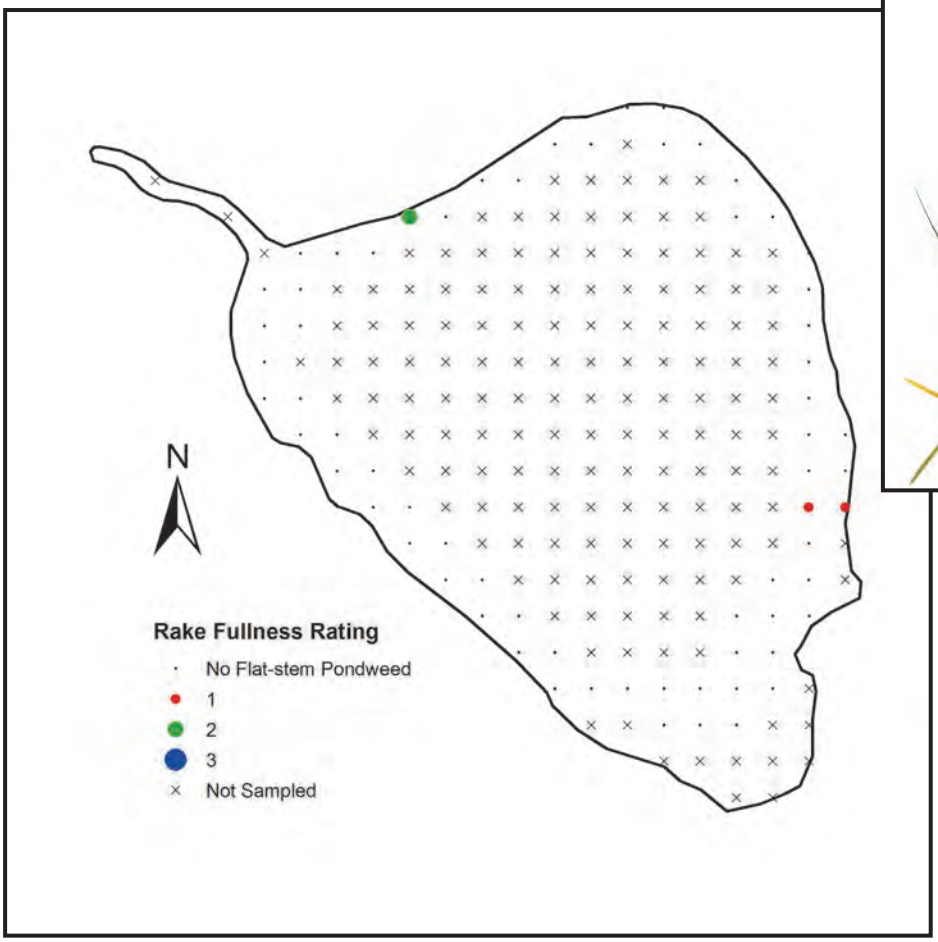
Identifying Features

- Stems strongly flattened
- Leaves up to four to eight inches long, pointed, with a prominent midvein and many finer, parallel veins
- Stiff winter buds consisting of tightly packed ascending leaves

Flat-stem pondweed may be confused with yellow stargrass (*Zosterella dubia*), but the leaves of yellow stargrass lack a prominent midvein.

Ecology

- Found at a variety of depths over soft sediment in lakes and streams
- Overwinters as rhizomes and winter buds
- Has antimicrobial properties
- Provides food for waterfowl, muskrat, beaver, and deer
- Provides cover for fish and aquatic invertebrates



Ranunculus aquatilis — White Water Crowfoot

Native

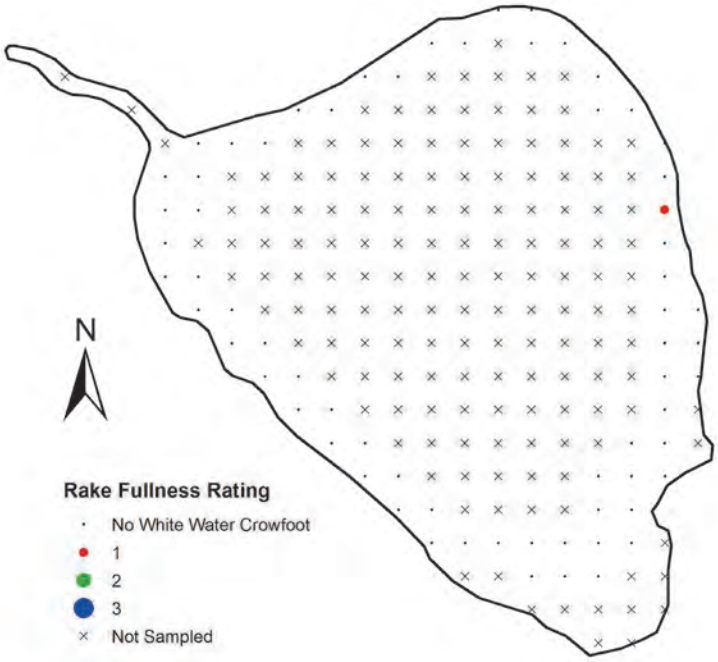
Identifying Features

- Submersed leaves finely divided into thread-like sections, and arranged alternately along the stem
- Flowers white, with five petals
- May or may not produce floating leaves

White water crowfoot is similar to other aquatic *Ranunculus* spp. However, the latter have yellow flowers and leaf divisions that are flat, rather than thread-like

Ecology

- Shallow water in lakes or streams, often with high alkalinity
- Often forms dense patches near springs or sand bars
- Emerges from rhizomes in the spring
- Fruit and foliage consumed by waterfowl and upland birds alike
- Habitat for invertebrates that are food for fish like trout



Vallisneria americana — Eelgrass

Native

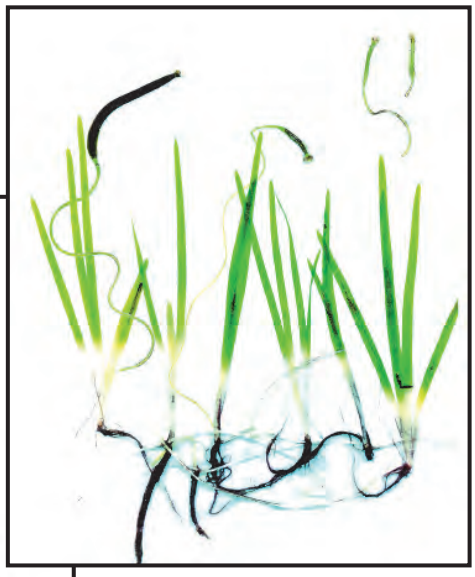
Identifying Features

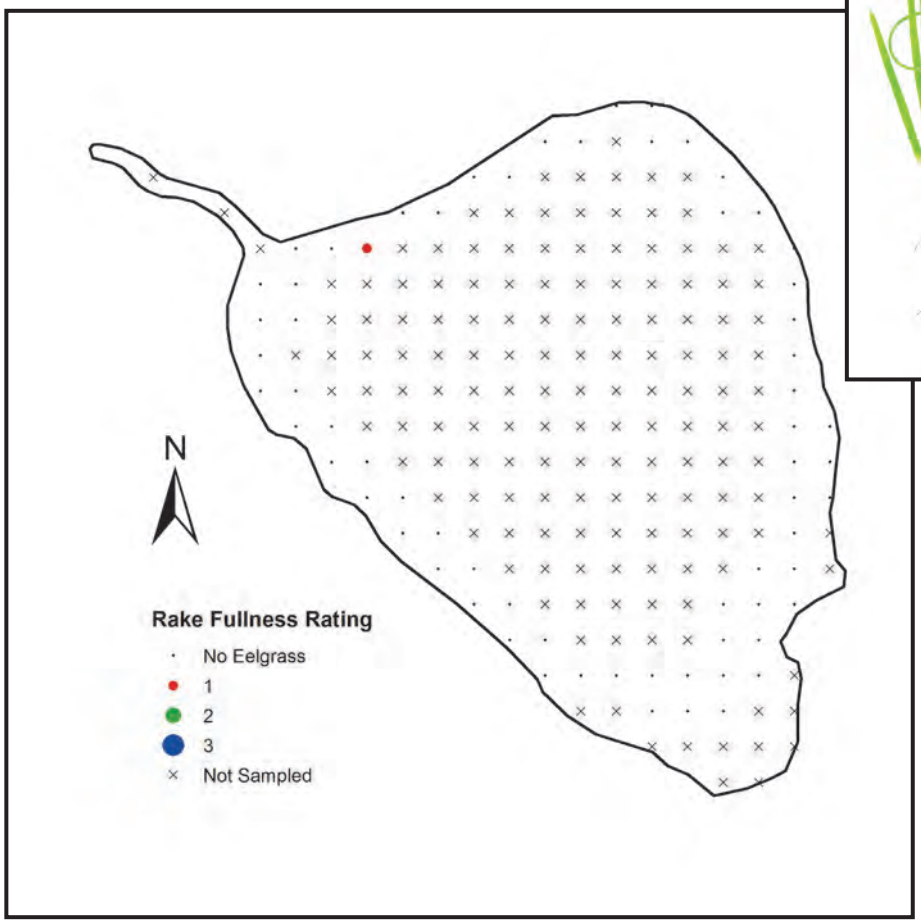
- Leaves ribbon-like, up to two meters long, with a prominent stripe down the middle, and emerging in clusters along creeping rhizomes
- Male and female flowers on separate plants; female flowers raised to the surface on spiral-coiled stalks

The foliage of eelgrass could be confused with the submersed leaves of bur-reeds (*Sparganium* spp.) or arrowheads (*Sagittaria* spp.), but the leaves of eelgrass are distinguished by their prominent middle stripe. The leaves of ribbon-leaf pondweed (*Potamogeton epihydrus*) are also similar to those of eelgrass, but the leaves of the former are alternately arranged along a stem rather than arising from the plant base

Ecology

- Firm substrates, shallow or deep, in lakes and streams
- Spreads by seed, by creeping rhizomes, and by offsets that break off and float to new locations in the fall
- All portions of the plant consumed by waterfowl; an especially important food source for Canvasback ducks
- Provides habitat for invertebrates and fish





Zosterella dubia — Water Stargrass

Native

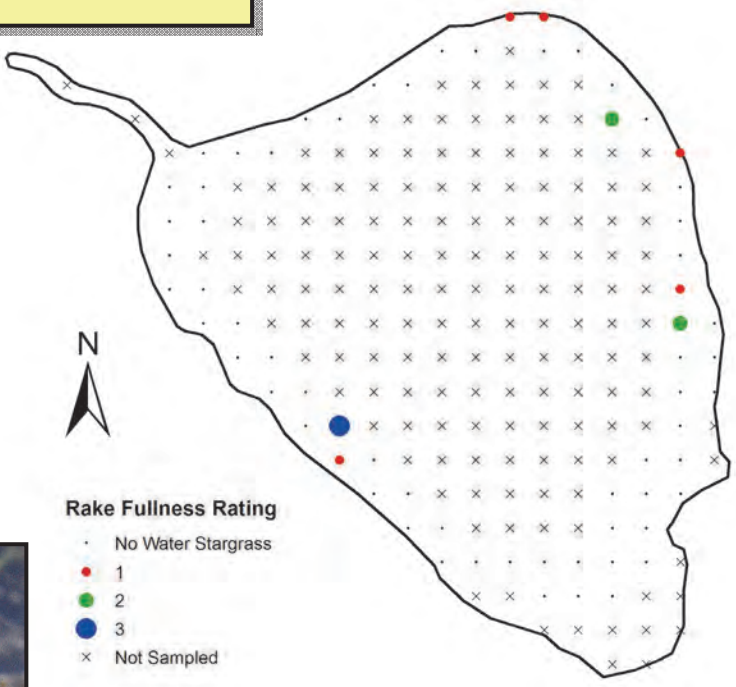
Identifying Features

- Stems slender, slightly flattened, and branching
- Leaves narrow, alternate, with no stalk, and lacking a prominent midvein
- When produced, flowers conspicuous, yellow, and star-shaped (usually in shallow water) or inconspicuous and hidden in the bases of submersed leaves (in deeper water)

Yellow stargrass may be confused with pondweeds that have narrow leaves, but it is easily distinguished by its lack of a prominent midvein and, when present, yellow blossoms

Ecology

- Found in lakes and streams, shallow and deep
- Tolerates somewhat turbid waters
- Overwinters as perennial rhizomes
- Limited reproduction by seed
- Provides food for waterfowl and habitat for fish




Scott Loarie

Appendix B

WDNR AQUATIC PLANT SURVEY REPORT

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ROCK LAKE
KENOSHA COUNTY
AQUATIC PLANT SURVEY REPORT

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

January 4th, 2006

Authors:
Maureen McBroom, Mike Hemmingsen, Water Resource Specialists
Craig Helker, Water Quality Biologist

Survey Information

Wisconsin Department of Natural Resources staff conducted an aquatic plant survey on July 27 and July 29, 2004 on Rock Lake, a 46 acre drainage lake in the Lower Fox River Watershed in the Town of Salem in Kenosha County.

Methods

Nine transects were located, equidistant, around the perimeter of Rock Lake (see Map 1). Rake samples were taken from the four quadrants of the boat, at each of the 2, 4, 6, and 8-foot depth points along each transect. (144 total rake samples.) Species were identified and recorded for each rake tow. Percent frequency of occurrence (ratio of presence/absence on 144 rake tosses) was calculated.

Results

20 different species of aquatic plants were observed during the survey. 6 different types of pondweed (*potamogeton, sp*.) were observed. Algae was present in the water, including *chara*, a large form of algae. One plant, Eurasian water milfoil, (*myriophyllum spicatum*) is considered to be a non-native, invasive species. (The presence or absence of curly-leaf pondweed, another invasive aquatic plant found in other lakes in the region, could not be positively determined due to the time of year this plant survey took place.) see Table 1 and A-1: List of Species Found during rake sampling in Rock Lake, and percent dominance.

Common Name	Scientific Name	Frequency of Occurrence (%)	Density at Sites Found	Density Whole Basin
Coontail	Cerataphyllum demrson	86.8	2.4	2.1
Eurasian water milfoil	Myriophyllum spicatium	59.0	1.4	0.8
Chara	Chara sp.	47.9	3.6	1.7
White water lilly	Nymphaea odorata	44.4	3.2	1.4
Northern water milfoil	Myriophyllum sibericum	28.5	1.1	0.3
Elodea	Elodea canadensis	31.9	1.9	0.6
Water Celery	Vallisneria americina	27.1	1.3	0.3
Ribbonleaf pondweeed	P. epihydrus	9.7	1.1	0.1
Illinois pondweed	P. illinoensis	6.9	1.1	0.1
Clasping leaf pondweed	Potamogeton richardsoni	7.6	1.2	0.1
Flatstem pondweed	P. zosterformis	9.7	1.1	0.1
Spatterdock	Nuphar polysepala	9.0	3.4	0.3
Bushy pondweed	Najas flexilis	2.8	1.0	0.0
Variable pondweed	P. gramineus	0.7	1.0	0.0
Sago pondweed	P.pectinatus	1.4	1.0	0.0
Robbins pondweed	P. robbinsii	0.7	1.0	0.0
White water crowfoot	Rannunculus spp.	2.1	1.0	0.0
Spiny naiad	Najas marinia	1.4	1.0	0.0
Duckweed	Lemna minor	2.1	1.0	0.0
Filamentatious algae	Filamentatious algae	32.6	1.5	0.5
Leafy pond weed	P. foliosus	5.6	1.5	0.1

Note: Curly-leaf pondweed that may be present in Rock Lake will not be reflected due to timing of survey.

Table 1. List of Species Found, Frequency of Occurrence, Density at Sites Found and Density Whole Basin

Frequency of Occurrence

Department staff recorded the frequency of occurrence at 144 sample points:

- 4 samples were taken at the 2 foot contour at each transect;
- 4 samples were taken at the 4 foot contour at each transect;
- 4 samples were taken at the 6 foot contour at each transect;
- 4 samples were taken at the 8 foot contour at each transect =

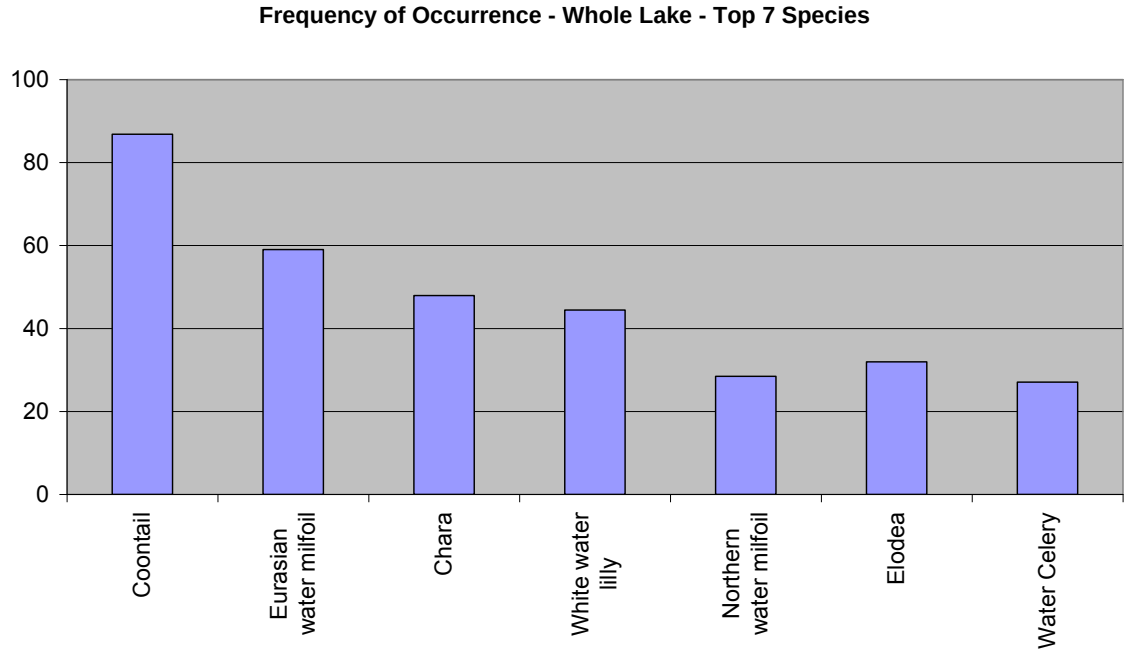
16 samples at each of 9 transects = 144 sample points.

The frequency of occurrence for each individual transect was computed by dividing the number of samples that contained the particular plant species by the total number of samples (16).

> Example: At transect 7, 13 samples contained chara / 16 total samples = 81.25% frequency of occurrence.

The frequency of occurrence for the entire lake was computed by dividing the number of samples that contained the particular plant by the total number of samples (144).

> Example: 125 samples contained ceratophyllum demersum / 144 total samples = 86.8% frequency of occurrence for the entire lake.



Relative Density

The relative density was estimated for each of the 144 samples taken (Density at Sites Found). The following scale was used:

- 5 = amount of plant material on rake teeth is abundant
- 4 = amount of plant material on rake teeth is more than half full, but not overflowing
- 3 = amount of plant material on rake teeth is less than half full
- 2 = amount of plant material on rake teeth uniformly covers the base of the rake
- 1 = just a few plants are captured on rake teeth
- 0 = rake teeth are completely empty

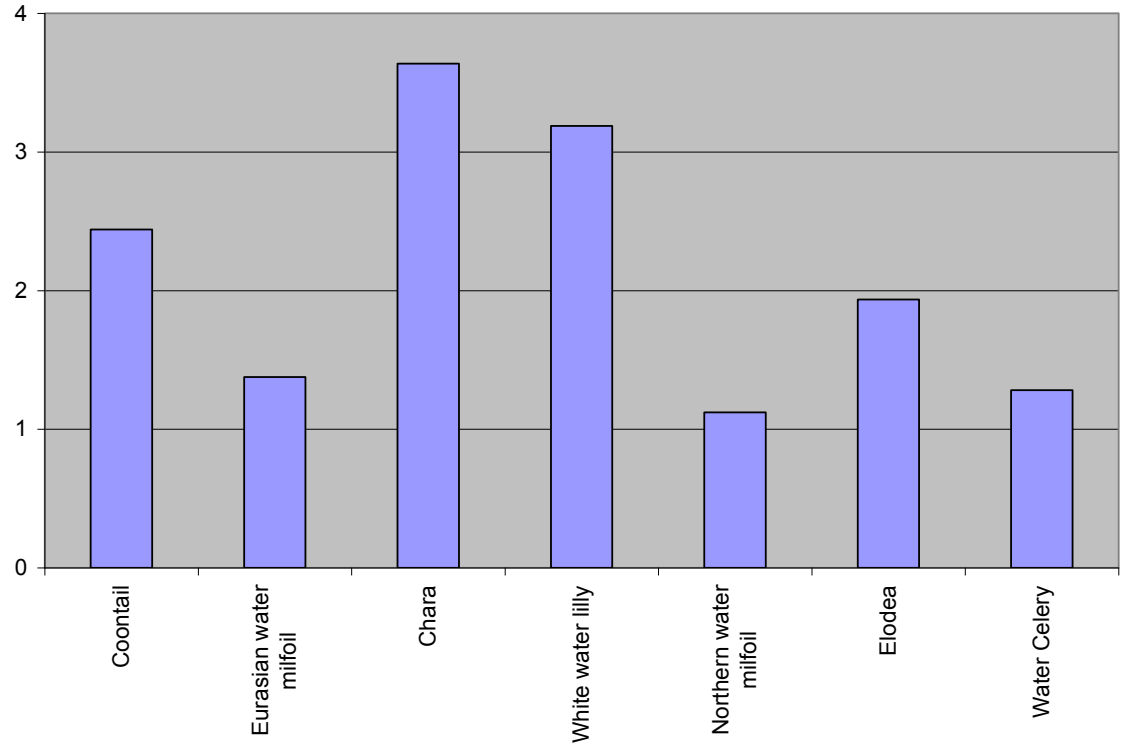
The relative density was calculated for the 7 most common species in Rock Lake at 2, 4, 6 and 8 foot contours and for the entire lake (Density Whole Lake).

The 7 species observed most often during the survey were:

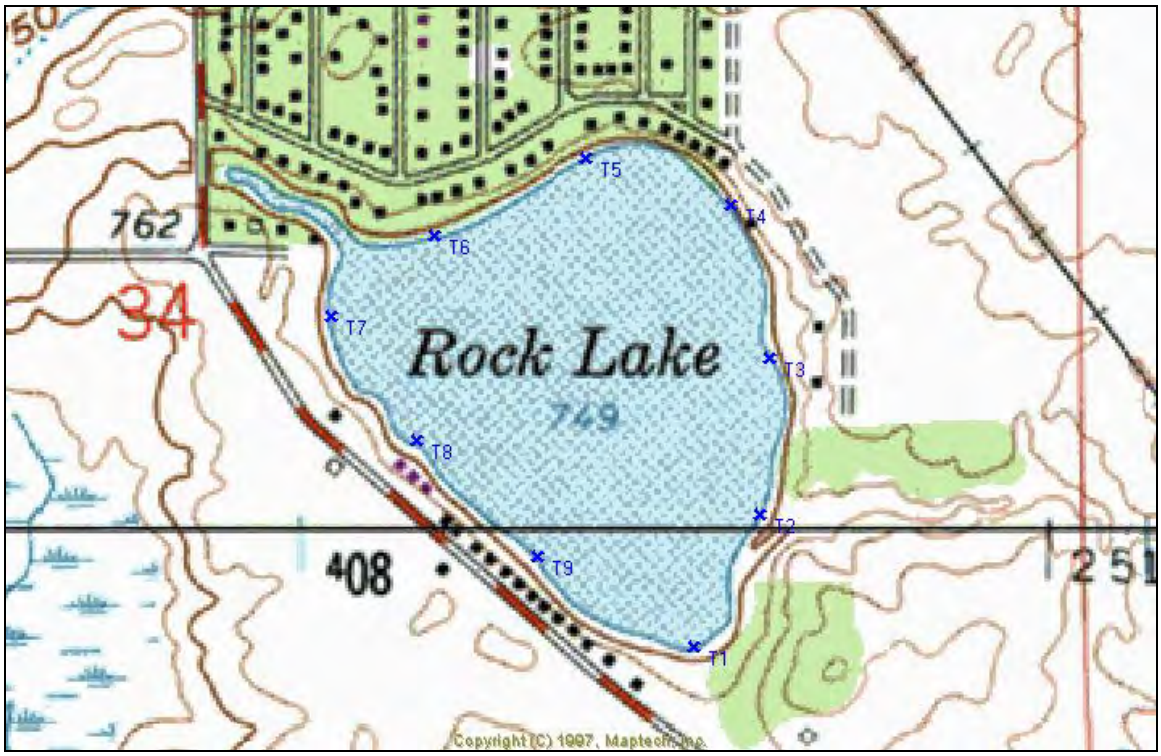
- *Ceratophyllum demersum* (Coontail)
- *Myriophyllum spicatum* (Eurasian water milfoil)
- *Chara*
- *Nymphaea odorata* (White water lily)
- *Myriophyllum sibiricum* (Northern water milfoil)
- *Elodea canadensis* (Elodea)
- *Vallisneria americana* (Water celery)

4 of the 9 sites sampled contained all 7 of these species; 3 sites had 6 of the 7 species, and 2 of the sites had 5 of these species represented. None of the sites sampled displayed monotypic stands of invasive or native plants; all sites had diverse native plant communities, with some *Myriophyllum spicatum* (Eurasian water milfoil) present. (see appendix)

Relative Density - Whole Lake - Top 7 Species



Map 1. Transect locations



Characteristics of Individual Plant Species Sampled

Ceratophyllum demersum (Coontail)

Ceratophyllum demersum is a floating, non-rooted submerged aquatic plant. *Ceratophyllum demersum* is a native plant in Wisconsin, and is commonly found in regional lakes. This plant's structure provides cover for fish and macroinvertebrate habitat, which serve as food for fish and waterfowl. Under certain conditions, large amounts of *Ceratophyllum demersum* can reach nuisance levels, interfering with recreational activities such as boating, swimming, fishing, etc. (see A-12)

Myriophyllum spicatum (Eurasian water milfoil)

Myriophyllum spicatum is an invasive, exotic aquatic plant species which disrupts the natural balance of aquatic ecosystems in Wisconsin. The plant grows vertically from the lake bottom to the surface, where it sprouts branches and grows along the surface, creating dense mats of plant growth. Due to the colder climate the plant originates from, *Myriophyllum spicatum* can tolerate colder water than native aquatic plants and begins growing earlier in the season. The subsurface portions of the plant do not offer the same quality of habitat as native aquatic plants, including *Myriophyllum sibiricum* (northern milfoil). The dense mats found at the surface can block the sunlight from reaching native plant shoots near the lake bottom, stunting growth or preventing

plant growth in deeper areas that already are dependent on limited sunlight. This can alter the location and make up of the plant community, which can shift the aquatic life community from species dependent on a diverse mix of native plants to species tolerant of monotypic stands of this invasive plant. Since *myriophyllum spicatum* mainly reproduces by fragmentation, recreational activities occurring in areas where this plant is present can cause the plant to break, allowing the fragments to become established in other locations of the lake by floating and rooting to the lake bottom.

Each of the 9 transects recorded the non-native *Myriophyllum spicatum,* which would seem to indicate the plant has spread throughout the lake. The frequency of occurrence at site 3 was the highest at 93.75% (or 15 of the 16 samples taken). The lowest frequency of occurrence was at transect 7, where only 25% (4 of 16) of the samples taken contained *m. spicatum*. Site 9 was the only site that *M. spicatum* was the dominant species; *Ceratophyllum demersum* and *M. spicatum* were equally dominant at site 3. The relative densities at all 4 contours (2,4,6, and 8 feet) never ranked above 1.5 for *M. sibiricum*, indicating the plant is not growing in high numbers in segregated beds. Another related factor is the relative density of *M. sibiricum*, which consistently ranked less than 0.5 points below *M. spicatum*. Both *Myriophyllum* species grow in the same substrate and succumb to the same management methods, but *M. spicatum* has an earlier growing season, typically allowing it to dominate *M. sibiricum*. (see A-13)

Chara

Chara is a form of algae, commonly considered an aquatic plant due to its size. *Chara* typically grows close to the bottom and can spread over large areas. It is a valuable member of the native plant community, and particularly useful in reducing turbidity by keeping bottom sediments in place, as well as converting nutrients received in runoff to plant mass. *Chara* also provides cover for aquatic macroinvertebrates, small fish and bottom dwelling crustaceans. (see A-14)

Nymphaea odorata (White water lily)

Nymphaea odorata is a floating-leaf plant that offers shade and habitat for fish, as well as habitat for many macroinvertebrates. Both the tubers and the macroinvertebrates on the plants provide important sources of food for fish, waterfowl and other aquatic mammals. *Nymphaea odorata* can be a nuisance for recreational boaters, swimmers and others using the lake, but the value of the plant is so important that care should be taken to avoid reducing the number of *Nymphaea* plants on the lake.

The frequency of occurrence at transects 1 and 7 were recorded as 81.25% and 100%, respectively for *Nymphaea odorata*. The plant was present at all of the remaining transects, but at much lower levels. The minimum relative density for *Nymphaea odorata* was recorded as 2.7, with the highest density found at the 4 foot contour. This indicates the presence of healthy beds of *Nymphaea odorata* at distinct locations on Rock Lake. (see A-15)

Myriophyllum sibiricum (Northern water milfoil)

Myriophyllum sibiricum tends to be a low-growing submerged aquatic plant, providing valuable cover for fish and habitat for macroinvertebrates that small fish feed on. This plant does not typically grow near the surface, where plants typically reach nuisance levels and interfere with recreational activities. However, this native plant does grow in the same substrates and will succumb to the same herbicides and other management methods that are used to control its non-native invasive relative, *Myriophyllum spicatum.* (see A-16)

Elodea canadensis (Elodea)

Elodea canadensis is a native, submerged aquatic plant which supports macroinvertebrates commonly consumed by local fish populations. *Elodea* can grow in abundance, becoming a nuisance for recreational activities.

3 of the 9 transects recorded a frequency of occurrence for *Elodea* plants above 50% (transects 2, 6 and 8). The relative density was highest at the 4 foot contour, starting at 1.57 for the 2 foot contour, rising to 2.42 at the 4 foot contour, falling to 1.71 at the 6 foot contour, then dropping to 1.00 at the 8 foot contour. (see A-17)

Vallisneria americana (Water celery)

Vallisneria americana is a native annual species that reproduces each year by seed. *Vallisneria* is an important component of the aquatic plant community that supports a diversity of macroinvertebrate life and provides shelter for small fish. The plant resembles tall grass growing under water in shallow areas of lake. The establishment of *Vallisneria* in areas chemically treated for non-native aquatic plants can prevent the re-establishment of invasive species in those areas.

While some transects did not record any *Valissneria* present, (transects 1, 2 and 7) other transects (including transect 3 at 75%) had a fair amount of *Vallisneria* in the plant community. Relative densities for *Vallisneria* were consistently between 1 and 1.5. (see A-18)

Others

Multiple *potomogeton* species, (pondweeds), *lemna, sp*., (duckweed), algae, and other aquatic plants were also recorded during the Rock Lake plant survey. These plants serve as food sources for fish and waterfowl, convert excess nutrients in the water to plant life, stabilize bottom sediments and provide structure for fish. (see A-1)

Implications

The low relative densities of *M. spicatum*, combined with the frequency of occurrence recorded for a number of native plants at each of the transects indicates a healthy native plant community, which appears to be able to survive and even compete with the non-native specie. While m. spicatum was observed at each of the 7 transects, evidence suggests the presence and abundance of the native plants may be a limiting factor preventing the invasive plant from establishing monotypic beds. The result of monotypic *m. spicatum* beds would be a shift in the aquatic life species present in Rock Lake, due to the loss of diversity and valuable plant species other aquatic life forms depend upon. (see A-2 to A-11)

Myriophyllum sibiricum, an aquatic plant native to Wisconsin, was found at 8 of the 9 survey transects. The relative density of m. sibiricum ranged from 1.0 at the 8 foot contour to 1.25 at the 6 foot contour, with comparable amounts found at the shallower sites (see A-6 to A-9). The relative density of *m. sibiricum* in relation to the non-native m. spicatum was consistently lower at all of the 4 depths sampled, although by less than .5. The frequency of occurrence for *m. sibiricum* was the dame or slightly lower to *m. spicatum* at transects 8, 9 and 1, following the western shoreline south to the undeveloped southern tip of the lake. Transects 2, 3 and 4 along the eastern shoreline, shows more than twice the frequency of occurrence for the non-native *myriophyllum* than the native plants. This concludes at transect 5 along the northern shore, where *m. sibiricum* was not reported. At the same site, *m. spicatum* was recorded with a frequency of occurrence of 81.25, second only to *Ceratophyllum demersum.* The presence of the native myriophyllum at all other transects suggests the plant could have been present at this site

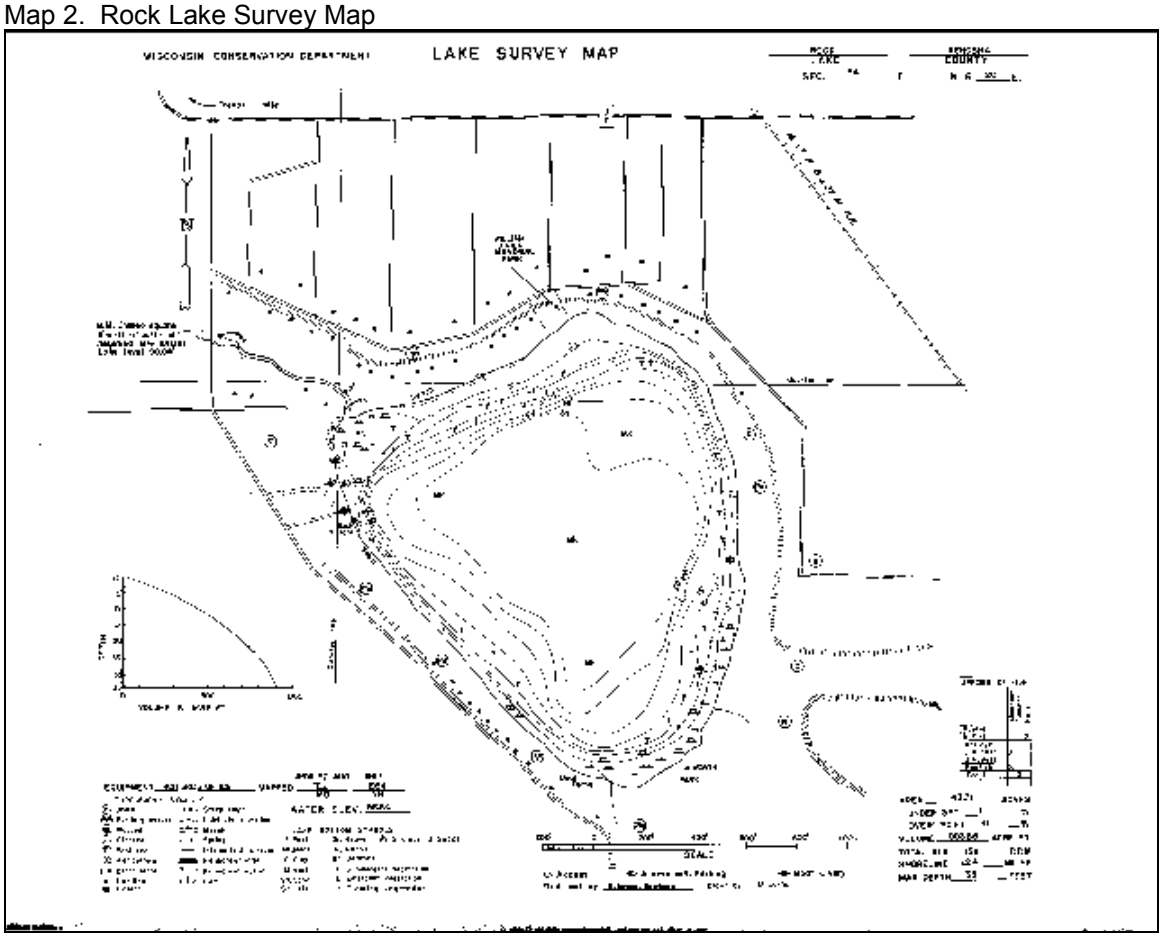
as well, but unidentified conditions allowed for the non-native plant to spread and outcompete the native specie.

Nymphaea odorata and *Chara* had higher relative densities than any other species at each of the 4 depths sampled (see A-6 to A-9). The relative density of *chara* was recorded at 4.182, 3.455 and 4.583 at the 2, 6 and 8 foot depths, respectively. Only *nymphaea odorata* was more dense than *chara* at 4.143 recorded at the 4 foot depth. Lower densities of the other plant species present indicate a balanced plant community. The high relative densities of these plants and the high frequency of occurrence at some sites indicate large plant beds full of *nymphaea* at the surface, with the low-growing *chara* near the bottom. The low frequency of occurrence at other sites further suggest dense beds of these particular species in particular areas of the lake.

Recorded frequency of occurrence for *nymphaea odorata*, in transect 1 was 81.25%, only eclipsed by the number of *Ceratophyllum demersum* specimens retrieved at that site. The shoreline closest to transect 1 has remained primarily natural, due to the park located there. Presumably the presence of the park will aid in protecting the adjacent aquatic plant community and the aquatic habitat it provides from the negative impacts of potential shoreline development.

A diversity of aquatic plants will contribute to the overall health of the lake by providing cover and food sources for fish, waterfowl and other aquatic life, reducing the amount of suspended solids in the water, converting nutrients received from runoff events, preventing the establishment of monotypic stands of non-native aquatic plants and providing natural scenic beauty for all. The available space on the lake bottom and in the water column, the amount of nutrients and the sunlight able to reach the bottom all contribute to the amount and diversity of the aquatic plant community. A diverse aquatic plant community is critical to the enduring diversity of other aquatic and terrestrial life which depends on the lake system for survival.

Map 2. Rock Lake Survey Map



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Appendix C

2,4-D Chemical Fact Sheet

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2,4-D Chemical Fact Sheet

Formulations

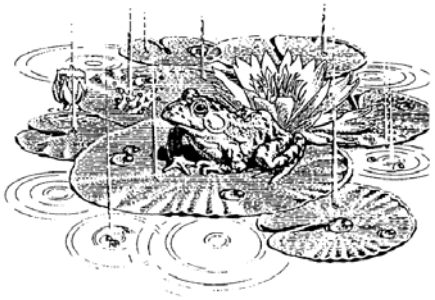
2,4-D is an herbicide that is widely used as a household weed-killer, agricultural herbicide, and aquatic herbicide. It has been in use since 1946, and was registered with the EPA in 1986 and re-reviewed in 2005. The active ingredient is 2,4-dichloro-phenoxyacetic acid. There are two types of 2,4-D used as aquatic herbicides: dimethyl amine salt and butoxyethyl ester. Both liquid and slow-release granular formulations are available. 2,4-D is sold under the trade names Aqua-Kleen, Weedar 64 and Navigate (product names are provided solely for your reference and should not be considered endorsements nor exhaustive).

Aquatic Use and Considerations

2,4-D is a widely-used herbicide that affects plant cell growth and division. It affects primarily broad-leaf plants. When the treatment occurs, the 2,4-D is absorbed into the plant and moved to the roots, stems, and leaves. Plants begin to die in a few days to a week following treatment, but can take several weeks to decompose. Treatments should be made when plants are growing.

For many years, 2,4-D has been used primarily in small-scale spot treatments. Recently, some studies have found that 2,4-D moves quickly through the water and mixes throughout the waterbody, regardless of where it is applied. Accordingly, 2,4-D has been used in Wisconsin experimentally for whole-lake treatments.

2,4-D is effective at treating the invasive Eurasian watermilfoil (*Myriophyllum spicatum*). Desirable native species that may be affected include native milfoils, coontail (*Ceratophyllum demersum*), naiads (*Najas* spp.), elodea (*Elodea canadensis*) and duckweeds (*Lemna* spp.). Lilies (*Nymphaea* spp. and *Nuphar* spp.) and bladderworts (Utricularia spp.) also can be affected.



Post-Treatment Water Use Restrictions

There are no restrictions on eating fish from treated water bodies, human drinking water or pet/livestock drinking water. Following the last registration review in 2005, the ester products require a 24-hour waiting period for swimming. Depending on the type of waterbody treated and the type of plant being watered, irrigation restrictions may apply for up to 30 days. Certain plants, such as tomatoes and peppers and newly seeded lawn, should not be watered with treated water until the concentration is less than 5 parts per billion (ppb).

Herbicide Degradation, Persistence and Trace Contaminants

The half-life of 2,4-D (the time it takes for half of the active ingredient to degrade) ranges from 12.9 to 40 days depending on water conditions. In anaerobic lab conditions, the half-life has been measured up to 333 days. After treatment, the 2,4-D concentration in the water is reduced primarily through microbial activity, off-site movement by water, or adsorption to small particles in silty water. It is slower to degrade in cold or acidic water, and appears to be slower to degrade in lakes that have not been treated with 2,4-D previously.

There are several degradation products from 2,4-D: 1,2,4-benzenetriol, 2,4-dichlorophenol, 2,4-dichloroanisole, chlorohydroquinone (CHQ), 4-chlorophenol and volatile organics.

Impacts on Fish and Other Aquatic Organisms

Toxicity of aquatic 2,4-D products vary depending on whether the formulation is an amine or an ester 2,4-D. The ester formulations are toxic to fish and some important invertebrates such as water fleas (*Daphnia*) and midges at application rates; the amine formulations are not toxic to fish or invertebrates at application rates. Loss of habitat following treatment may cause reductions in populations of invertebrates with either formulation, as with any herbicide treatment. These organisms only recolonize the treated areas as vegetation becomes re-established.

Available data indicate 2,4-D does not accumulate at significant levels in the bodies of fish that have been tested. Although fish that are exposed to 2,4-D will take up some of the chemical, the small amounts that accumulate are eliminated after exposure to 2,4-D ceases.

On an acute basis, 2,4-D is considered moderately to practically nontoxic to birds. 2,4-D is not toxic to amphibians at application rates; effects on reptiles are unknown. Studies have shown some endocrine disruption in amphibians at rates used in lake applications, and DNR is currently funding a study to investigate endocrine disruption in fish at application rates.

As with all chemical herbicide applications it is very important to read and follow all label instructions to prevent adverse environmental impacts.

Human Health

Adverse health effects can be produced by acute and chronic exposure to 2,4-D. Those who mix or apply 2,4-D need to protect their skin and eyes from contact with 2,4-D products to minimize irritation, and avoid inhaling the spray. In its consideration of exposure risks, the EPA believes no significant risks will occur to recreational users of water treated with 2,4-D.

Concerns have been raised about exposure to 2,4-D and elevated cancer risk. Some (but not all) epidemiological studies have found 2,4-D associated with a slight increase in risk of non-Hodgkin's lymphoma in high exposure populations (farmers and herbicide applicators). The studies show only a possible association that may be caused by other factors, and do not show that 2,4-D causes cancer. The EPA determined in 2005 that there is not sufficient evidence to classify 2,4-D as a human carcinogen.

The other chronic health concern with 2,4-D is the potential for endocrine disruption. There is some evidence that 2,4-D may have estrogenic activities, and that two of the break-down products of 2,4-D (4-chlorophenol and 2,4-dichloroanisole) may affect male reproductive development. The extent and implications of this are not clear and it is an area of ongoing research.

For Additional Information

Environmental Protection Agency
Office of Pesticide Programs
www.epa.gov/pesticides

Wisconsin Department of Agriculture, Trade, and Consumer Protection
http://datcp.wi.gov/Plants/Pesticides/

Wisconsin Department of Natural Resources
608-266-2621
http://dnr.wi.gov/lakes/plants/

Wisconsin Department of Health Services
http://www.dhs.wisconsin.gov/

National Pesticide Information Center
1-800-858-7378
http://npic.orst.edu/

Wisconsin Department of Natural Resources
Box 7921
Madison, WI 53707-7921

DNR PUB-WT-964 2012

Appendix D

SEWRPC RIPARIAN BUFFER GUIDE NO. 1
"MANAGING THE WATER'S EDGE"

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Managing the Water's Edge

Making Natural Connections

Problem Statement:

Despite significant research related to buffers, there remains no consensus as to what constitutes optimal riparian buffer design or proper buffer width for effective pollutant removal, water quality protection, prevention of channel erosion, provision of fish and wildlife habitat, enhancement of environmental corridors, augmentation of stream baseflow, and water temperature moderation.

Southeastern Wisconsin Regional Planning Commission

Our purpose in this document is to help protect and restore water quality, wildlife, recreational opportunities, and scenic beauty.

This material was prepared in part with funding from the U.S. Environmental Protection Agency Great Lakes National Program Office provided through CMAP, the Chicago Metropolitan Agency for Planning.

Introduction

Perhaps no part of the landscape offers more variety and valuable functions than the natural areas bordering our streams and other waters.

These unique "riparian corridor" lands help filter pollutants from runoff, lessen downstream flooding, and maintain stream baseflows, among other benefits. Their rich ecological diversity also provides a variety of recreational opportunities and habitat for fish and wildlife. Regardless of how small a stream, lake, or wetland may be, adjacent corridor lands are important to those water features and to the environment.

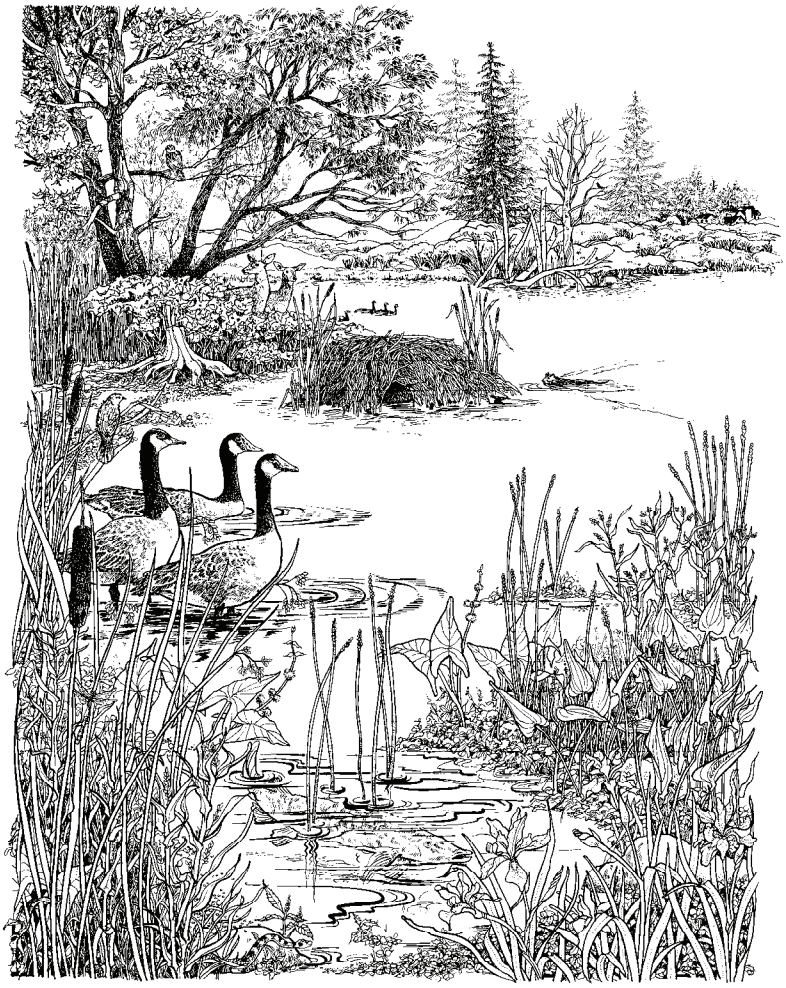
Along many of our waters, the riparian corridors no longer fulfill their potential due to the encroachment of agriculture and urban development. This publication describes common problems encountered along streamside and other riparian corridors, and the many benefits realized when these areas are protected or improved. It also explains what landowners, local governments, and other decision-makers can do to capitalize on waterfront opportunities, and identifies some of the resources available for further information. While much of the research examined here focuses on stream corridors, the ideas presented also apply to areas bordering lakes, ponds, and wetlands throughout the southern Lake Michigan area and beyond. This document was developed as a means to facilitate and communicate important and up-to-date general concepts related to riparian buffer technologies.

Riparian corridors are unique ecosystems that are exceptionally rich in biodiversity

Contents

What Are Riparian Corridors? Riparian Buffer Zones?

The word riparian comes from the Latin word *ripa*, which means bank. However, in this document we use riparian in a much broader sense and refer to land adjoining any water body including ponds, lakes, streams, and wetlands. This term has two additional distinct meanings that refer to 1) the "natural or relatively undisturbed" corridor lands adjacent to a water body inclusive of both wetland and upland flora and fauna and 2) a buffer zone or corridor lands in need of protection to "buffer" the effects of human impacts such as agriculture and residential development.



University of Wisconsin—Extension

The word buffer literally means something that cushions against the shock of something else (noun), or to lessen or cushion that shock (verb). Other useful definitions reveal that a buffer can be something that serves to separate features, or that is capable of neutralizing something, like filtering pollutants from stormwater runoff. Essentially, buffers and buffering help protect against adverse effects.

Riparian buffer zones function as core habitat as well as travel corridors for many wildlife species.

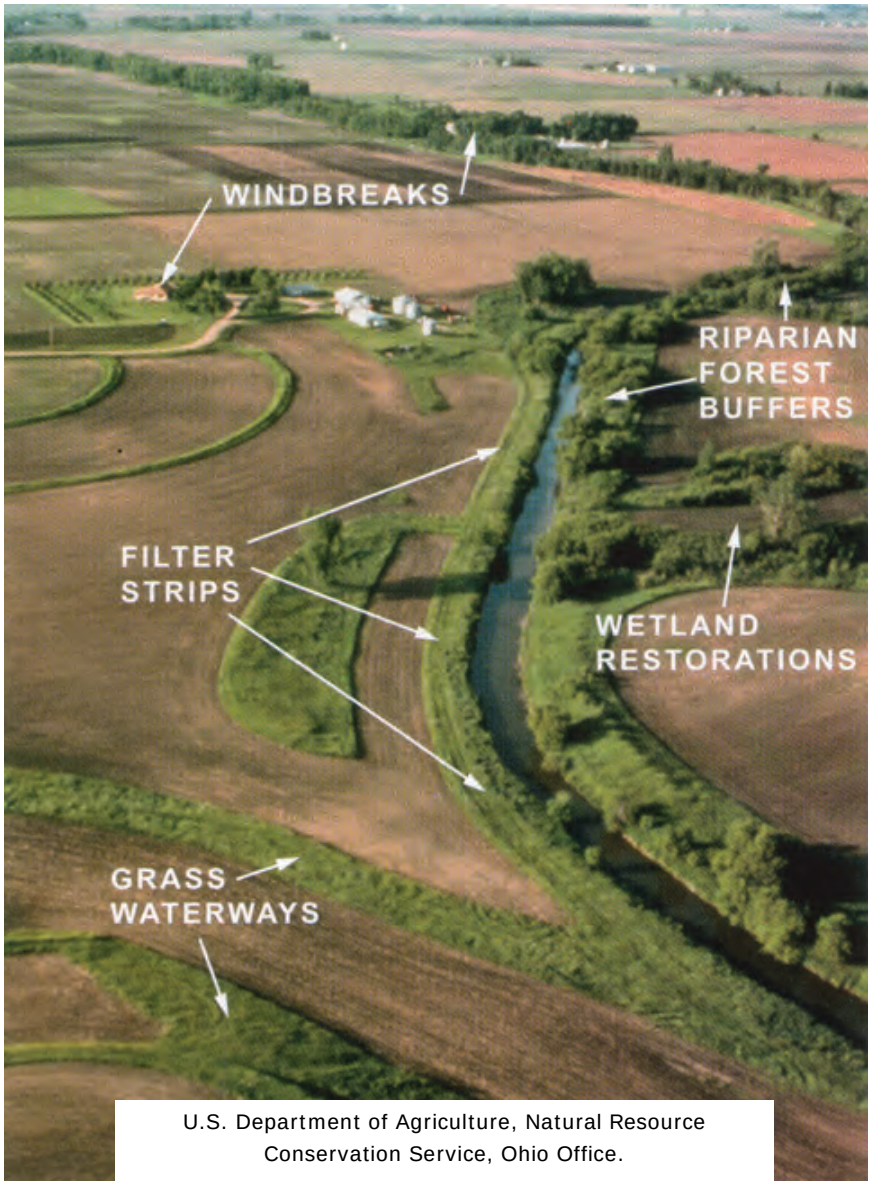
Riparian buffers are zones adjacent to waterbodies such as lakes, rivers, and wetlands that simultaneously protect water quality and wildlife, including both aquatic and terrestrial habitat. These zones minimize the impacts of human activities on the landscape and contribute to recreation, aesthetics, and quality of life. **This document summarizes how to maximize both water quality protection and conservation of aquatic and terrestrial wildlife populations using buffers.**

What Are Riparian Corridors? Riparian Buffer Zones?

Buffers **can** include a range of complex vegetation structure, soils, food sources, cover, and water features that offer a variety of habitats contributing to diversity and abundance of wildlife such as mammals, frogs, amphibians, insects, and birds. Buffers can consist of a variety of canopy layers and cover types including ephemeral (temporary-wet for only part of year) wetlands/seasonal ponds/spring pools, shallow marshes, deep marshes, wetland meadows, wetland mixed forests, grasslands, shrubs, forests, and/or prairies. Riparian zones are areas of transition between aquatic and terrestrial ecosystems, and they can potentially offer numerous benefits to wildlife and people such as pollution reduction and recreation.

In the water resources literature, riparian buffers are referred to in a number of different ways. Depending on the focus and the intended function of a buffer, or a buffer-related feature, buffers may be referred to as stream corridors, critical transition zones, riparian management areas, riparian management zones, floodplains, or green infrastructure.

It is important to note that within an agricultural context, the term buffer is used more generally to describe filtering best management practices most often at the water's edge. Other practices which can be interrelated may also sometimes be called buffers. These include grassed waterways, contour buffer strips, wind breaks, field border, shelterbelts, windbreaks, living snow fence, or filter strips. These practices may or may not be adjacent to a waterway as illustrated in the photo to the right. For example, a grassed waterway is designed to filter sediment and reduce erosion and may connect to a riparian buffer. These more limited-purpose practices may link to multipurpose buffers, but by themselves, they are not adequate to provide the multiple functions of a riparian buffer as defined here.



U.S. Department of Agriculture, Natural Resource Conservation Service, Ohio Office.

Beyond the Environmental Corridor Concept

The term "environmental corridors" (also known as "green infrastructure") refers to an interconnected green space network of natural areas and features, public lands, and other open spaces that provide natural resource value. Environmental corridor planning is a process that promotes a systematic and strategic approach to land conservation and encourages land use planning and practices that are good for both nature and people. It provides a framework to guide future growth, land development, and land conservation decisions in appropriate areas to protect both community and natural resource assets.

Environmental corridors are an essential planning tool for protecting the most important remaining natural resource features in Southeastern Wisconsin and elsewhere. Since development of the environmental corridor concept, there have been significant advancements in landscape ecology that have furthered understanding of the spatial and habitat needs of multiple groups of organisms. In addition, advancements in pollutant removal practices, stormwater control, and agriculture have increased our understanding of the effectiveness and limitations of environmental corridors. In protecting water quality and providing aquatic and terrestrial habitat, there is a need to better integrate new technologies through their application within riparian buffers.

SEWRPC has embraced and applied the environmental corridor concept developed by Philip Lewis (Professor Emeritus of Landscape Architecture at the University of Wisconsin-Madison) since 1966 with the publication of its first regional land use plan. Since then, SEWRPC has refined and detailed the mapping of environmental corridors, enabling the corridors to be incorporated directly into regional, county, and community plans and to be reflected in regulatory measures. The preservation of environmental corridors remains one of the most important recommendations of the regional plan. Corridor preservation has now been embraced by numerous county and local units of government as well as by State and Federal agencies. The environmental corridor concept conceived by Lewis has become an important part of the planning and development culture in Southeastern Wisconsin.

Beyond the Environmental Corridor Concept

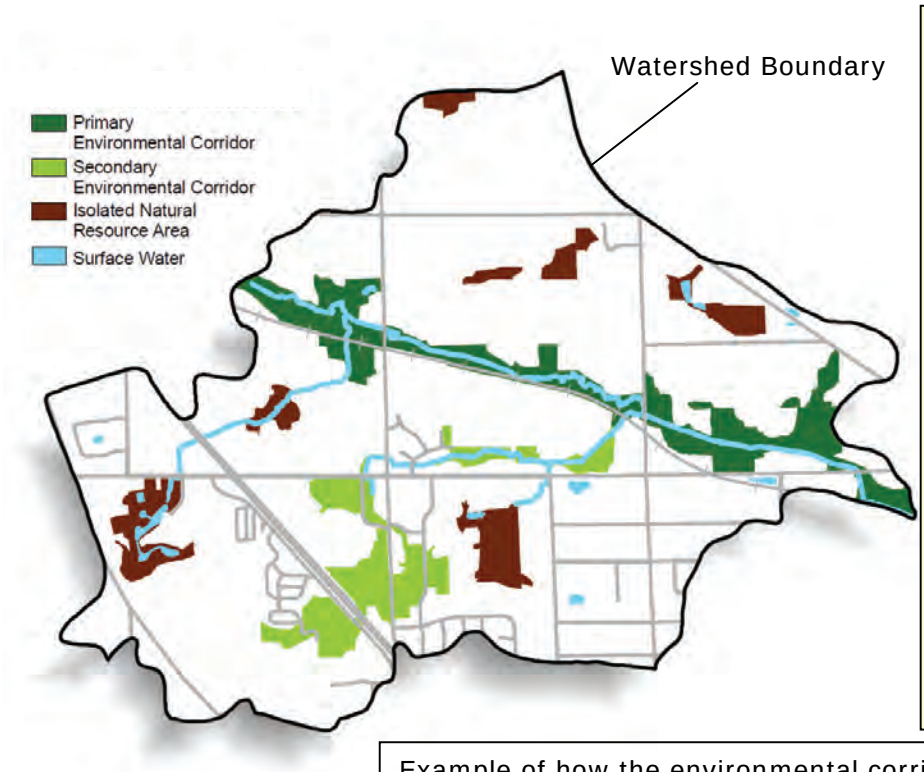
Environmental corridors are divided into the following three categories.

- **Primary environmental corridors** contain concentrations of our most significant natural resources. They are at least 400 acres in size, at least two miles long, and at least 200 feet wide.
- **Secondary environmental corridors** contain significant but smaller concentrations of natural resources. They are at least 100 acres in size and at least one mile long, unless serving to link primary corridors.
- **Isolated natural resource areas** contain significant remaining resources that are not connected to environmental corridors. They are at least five acres in size and at least 200 feet wide.

Key Features of Environmental Corridors

- Lakes, rivers, and streams
- Undeveloped shorelands and floodlands
- Wetlands
- Woodlands
- Prairie remnants
- Wildlife habitat
- Rugged terrain and steep slopes
- Unique landforms or geological formations
- Unfarmed poorly drained and organic soils
- Existing outdoor recreation sites
- Potential outdoor recreation sites
- Significant open spaces
- Historical sites and structures
- Outstanding scenic areas and vistas

Beyond the Environmental Corridor Concept

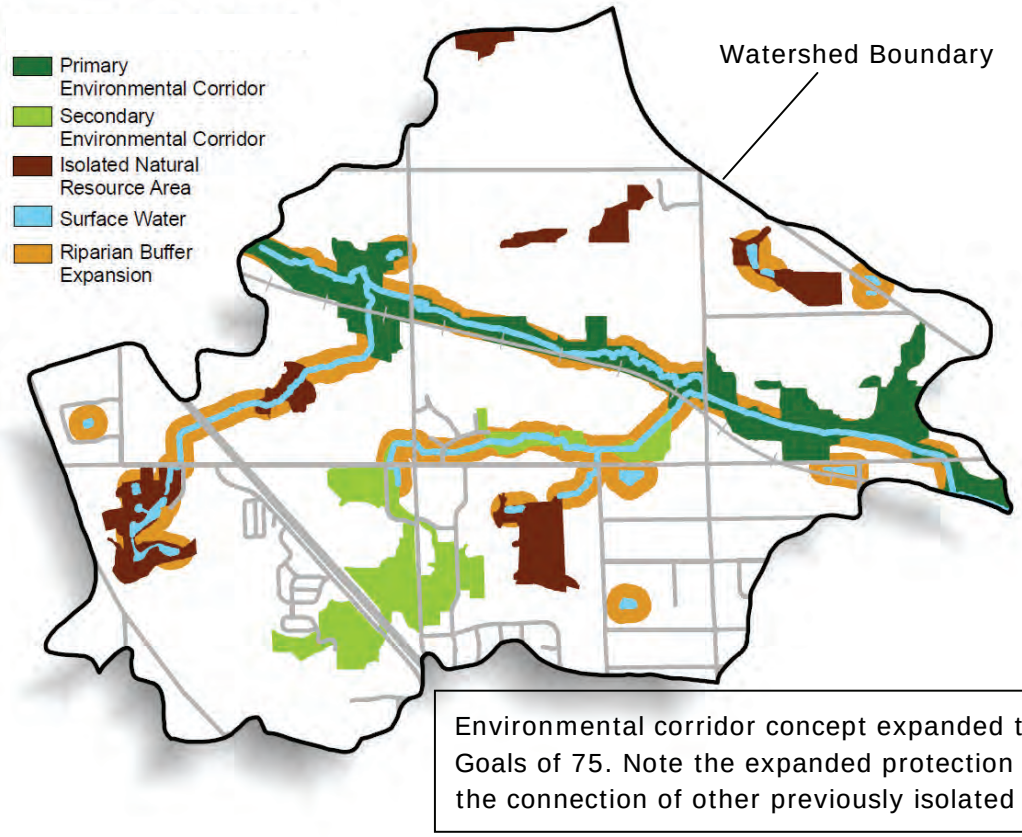


The Minimum Goals of **75** within a Watershed

75% minimum of total stream length should be naturally vegetated to protect the functional integrity of the water resources. (Environment Canada, How Much Habitat is Enough? A Framework for Guiding Habitat Rehabilitation in Great lakes Areas of Concern, Second Edition, 2004)

75 foot wide minimum riparian buffers from the top edge of each stream bank should be naturally vegetated to protect water quality and wildlife. (SEWRPC Planning Report No 50, A Regional Water Quality Management Plan for the Greater Milwaukee Watersheds, December 2007)

Example of how the environmental corridor concept is applied on the landscape. For more information see "Plan on It!" series **Environmental Corridors: Lifelines of the Natural Resource Base** at http://www.sewrpc.org/SEWRPC/LandUse/EnvironmentalCorridors.htm



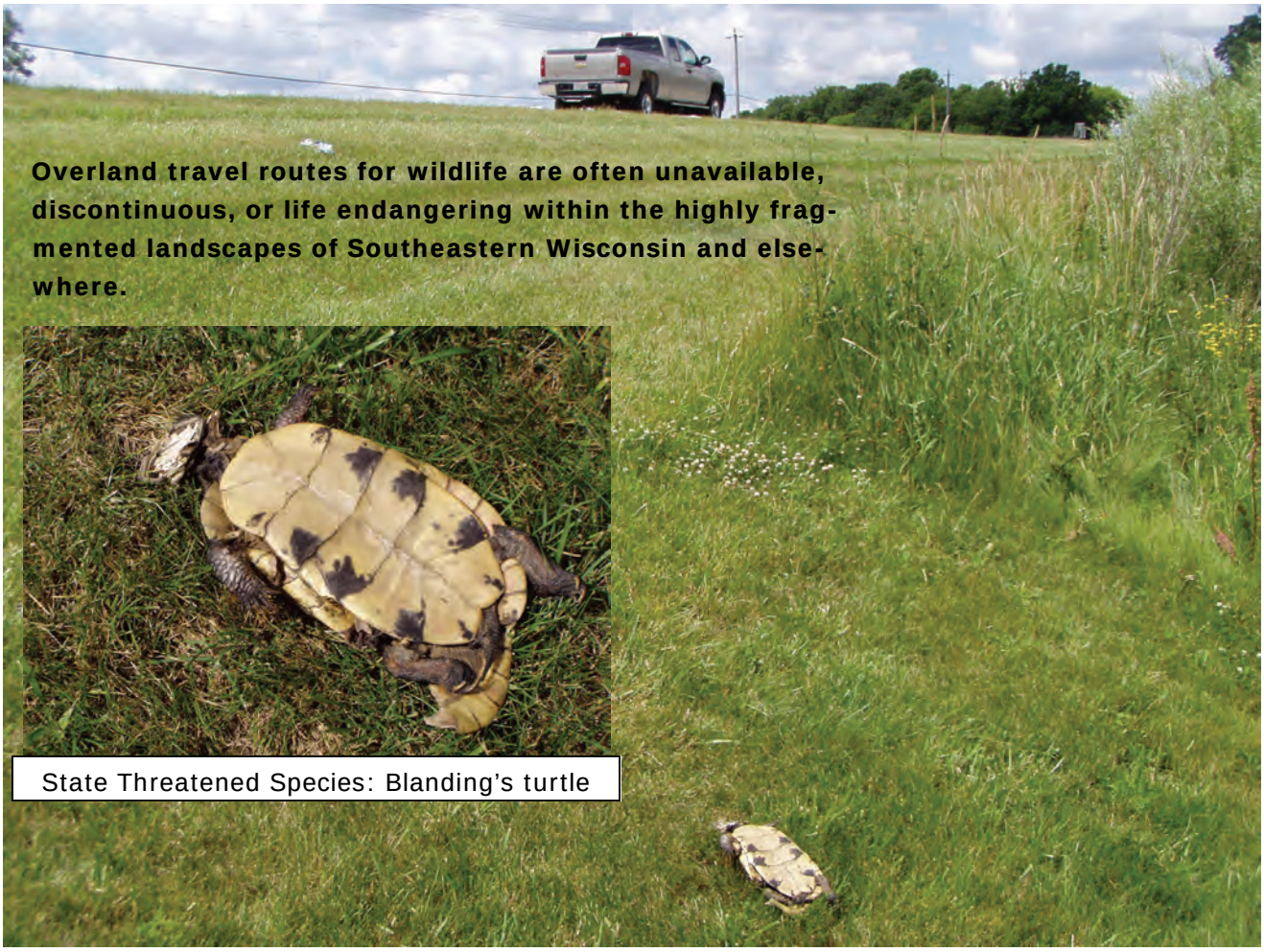
Environmental corridor concept expanded to achieve the Goals of 75. Note the expanded protection in addition to the connection of other previously isolated areas.

Habitat Fragmentation—The Need for Corridors

Southeastern Wisconsin is a complex mosaic of agricultural and urban development. Agricultural lands originally dominated the landscape and remain a major land use. However, such lands continue to be converted to urban uses. Both of these dominant land uses fragment the landscape by creating islands or isolated pockets of wetland, woodland, and other natural lands available for wildlife preservation and recreation. By recognizing this fragmentation of the landscape, we can begin to mitigate these impacts.

New developments should incorporate water quality and wildlife enhancement or improvement objectives as design criteria by looking at the potential for creating linkages with adjoining lands and water features.

At the time of conversion of agricultural lands to urban uses, there are opportunities to re-create and expand riparian buffers and environmental corridors reconnecting uplands and waterways and restoring ecological integrity and scenic beauty locally and regionally. For example, placement of roads and other infrastructure across stream systems could be limited so as to maximize continuity of the riparian buffers. This can translate into significant cost savings in terms of reduced road maintenance, reduced salt application, and limited bridge or culvert maintenance and replacements. This simple practice not only saves the community significant amounts of money, but also improves and protects quality of life. Where necessary road crossings do occur, they can be designed to provide for safe fish and wildlife passage.

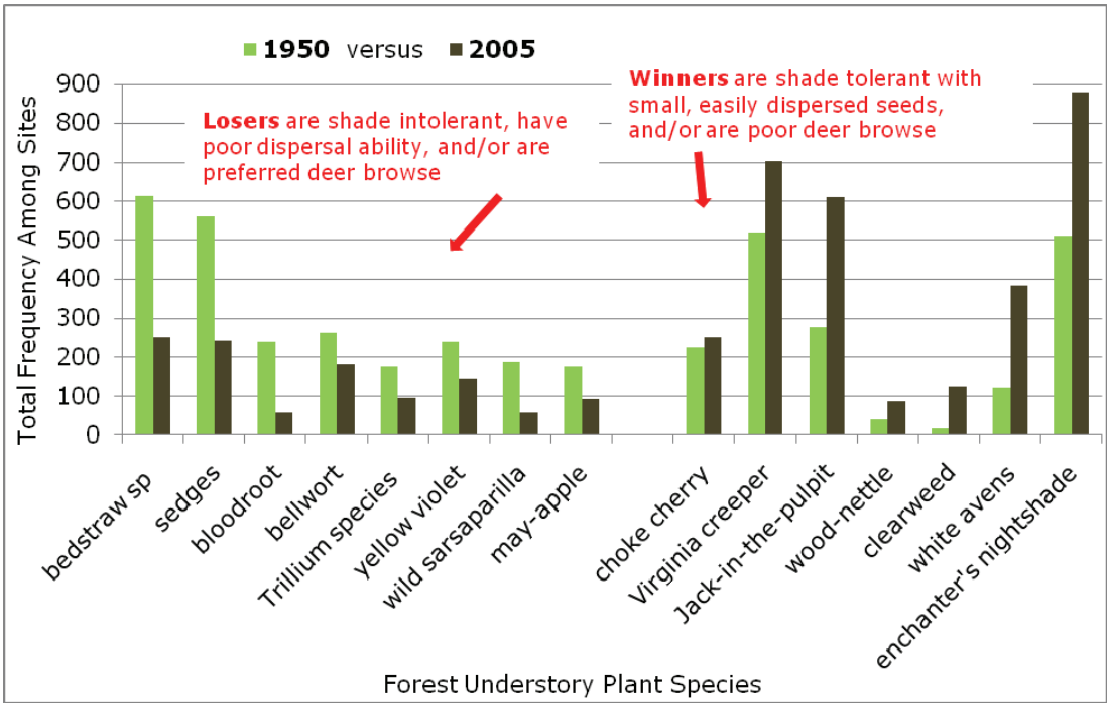


Overland travel routes for wildlife are often unavailable, discontinuous, or life endangering within the highly fragmented landscapes of Southeastern Wisconsin and elsewhere.

State Threatened Species: Blanding's turtle

Habitat Fragmentation—The Need for Corridors

Forest understory plant species abundance among stands throughout Southern Wisconsin



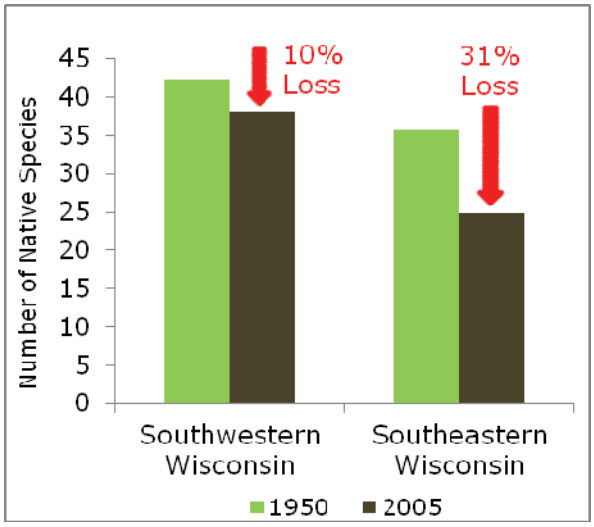
Forest fragmentation has led to significant plant species loss within Southern Wisconsin

(Adapted from David Rogers and others, 2008, Shifts in Southern Wisconsin Forest Canopy and Understory Richness, Composition, and Heterogeneity, Ecology, 89 (9): 2482-2492)

"...these results confirm the idea that large intact habitat patches and landscapes better sustain native species diversity. It also shows that people are a really important part of the system and their actions play an increasingly important role in shaping patterns of native species diversity and community composition. Put together, it is clear that one of the best and most cost effective actions we can take toward safeguarding native diversity of all types is to protect, enhance and create corridors that link patches of natural habitat."
Dr. David Rogers, Professor of Biology at the University of Wisconsin-Parkside

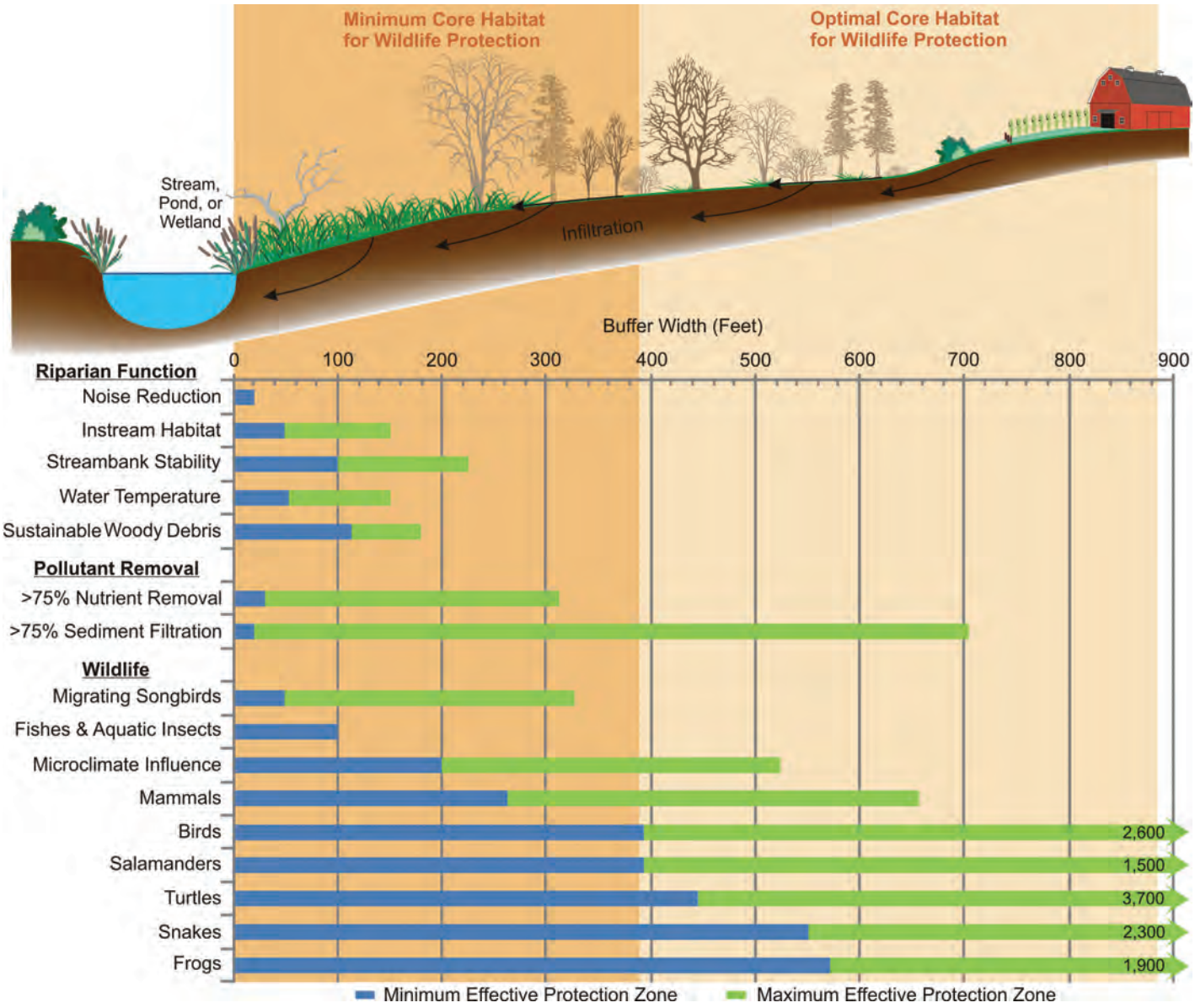
Since the 1950s, forests have increasingly become more fragmented by land development, both agricultural and urban, and associated roads and infrastructure, which have caused these forests to become isolated "islands of green" on the landscape. In particular, there has been significant loss of forest understory plant species over time (shrubs, grasses, and herbs covering the forest floor.) It is important to note that **these forests lost species diversity even when they were protected as parks or natural areas**.

One major factor responsible for this decline in forest plant diversity is that routes for native plants to re-colonize isolated forest islands are largely cut-off within fragmented landscapes. For example, the less fragmented landscapes in Southwestern Wisconsin lost fewer species than the more fragmented stands in Southeastern Wisconsin. In addition, the larger-sized forests and forests with greater connections to surrounding forest lands lost fewer species than smaller forests in fragmented landscapes.



Wider is Better for Wildlife

Why? Because buffer size is the engine that drives important natural functions like food availability and quality, access to water, habitat variety, protection from predators, reproductive or resting areas, corridors to safely move when necessary, and help in maintaining the health of species' gene pools to prevent isolation and perhaps extinction.



One riparian buffer size does not fit all conditions or needs. There are many riparian buffer functions and the ability to effectively fulfill those functions is largely dependent on width. Determining what buffer widths are needed should be based on what functions are desired as well as site conditions. For example, as shown above, water temperature protection generally does not require as wide a buffer as provision of habitat for wildlife. Based on the needs of wildlife species found in Wisconsin, the minimum core habitat buffer width is about 400 feet and the optimal width for sustaining the majority of wildlife species is about 900 feet. Hence, the value of large undisturbed parcels along waterways which are part of, and linked to, an environmental corridor system. The minimum effective buffer width distances are based on data reported in the scientific literature and the quality of available habitats within the context of those studies.

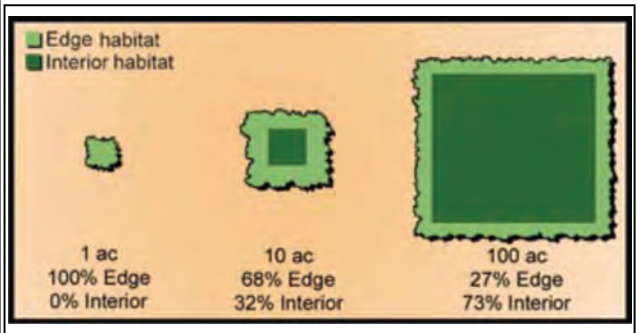
Wider is Better for Wildlife

Wildlife habitat needs change within and among species. **Minimum Core Habitat and Optimum Core Habitat distances were developed from numerous studies to help provide guidance for biologically meaningful buffers to conserve wildlife biodiversity.** These studies documented distances needed for a variety of biological (life history) needs to sustain healthy populations such as breeding, nesting, rearing young, foraging/feeding, perching (for birds), basking (for turtles), and overwintering/dormancy/hibernating. These life history needs require different types of habitat and distances from water, for example, one study found that Blanding's turtles needed approximately 60-foot-wide buffers for basking, 375 feet for overwintering, and up to 1,200 feet for nesting to bury their clutches of eggs. Some species of birds like the Blacked-capped chickadee or white breasted nuthatch only need about 50 feet of buffer, while others like the wood duck or great blue heron require 700-800 feet for nesting. Therefore, **understanding habitat needs for wildlife species is an important consideration in designing riparian buffers.**

Although *Ambystoma* salamanders require standing water for egg laying and juvenile development, most other times of the year they can be found more than 400 feet from water foraging for food.

Wisconsin Species	Mimimum Core Habitat (feet)	Optimum Core Habitat (feet)	Number of Studies
Frogs	571	1,043	9
Salamanders	394	705	14
Snakes	551	997	5
Turtles	446	889	27
Birds	394	787	45
Mammals	263	No data	11
Fishes and Aquatic Insects	100	No data	11
Mean	388	885	

This approach was adapted from *R.D. Semlitsch and J.R. Bodie, 2003, Biological Criteria for Buffer Zones around Wetlands and Riparian Habitats for Amphibian and Reptiles, Conservation Biology, 17(5):1219-1228*. These values are based upon studies examining species found in Wisconsin and represent mean linear distances extending outward from the edge of an aquatic habitat. The Minimum Core Habitat and Optimum Core Habitat reported values are based upon the mean minimum and mean maximum distances recorded, respectively. Due to a low number of studies for snake species, the recommended distances for snakes are based upon values reported by *Semlitsch and Bodie.*

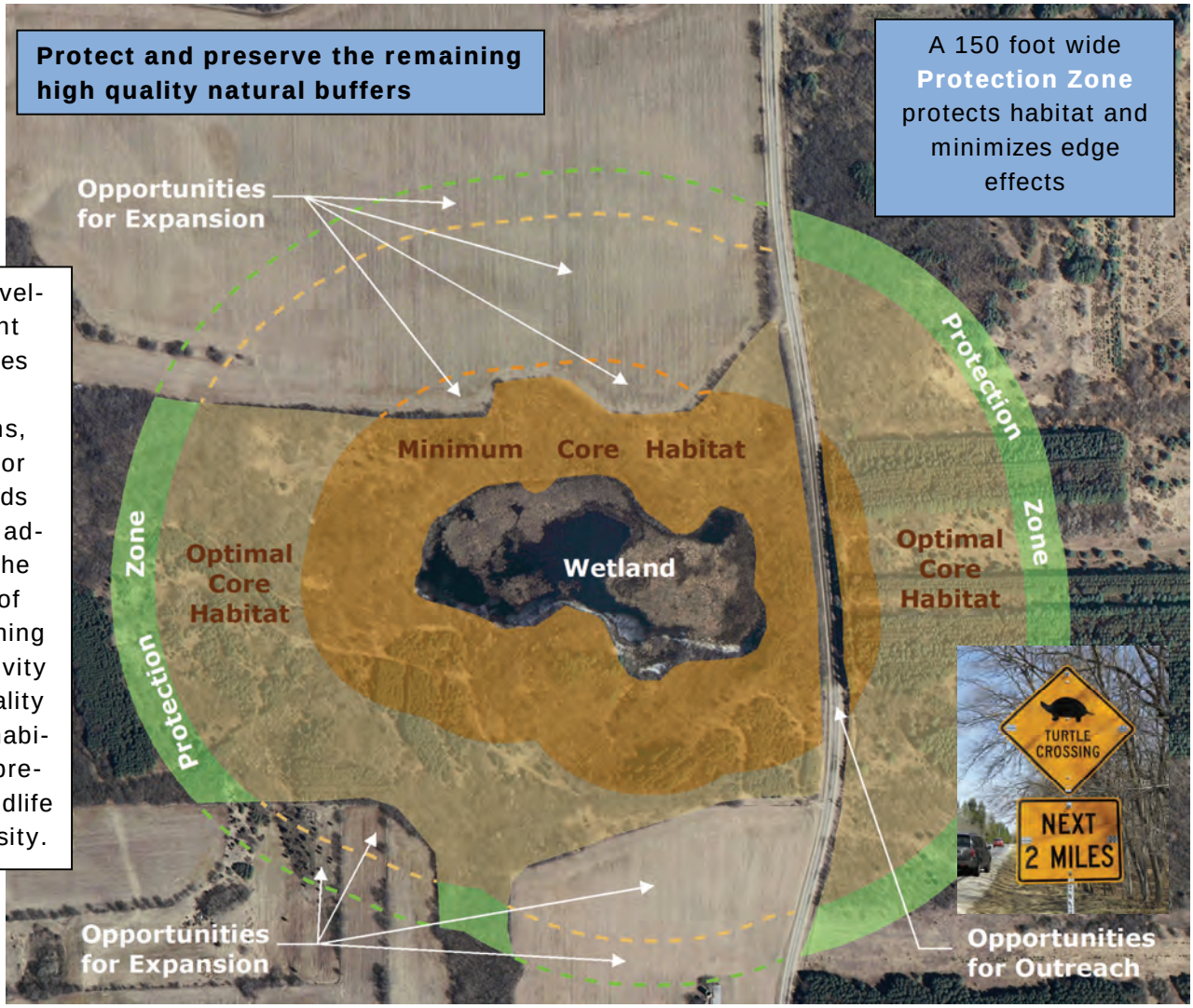


"***Large patches typically conserve a greater variety and quality of habitats, resulting in higher species diversity and abundance."*** *Larger patches contain greater amounts of interior habitat and less edge effects, which benefits interior species, by providing safety from parasitism, disease, and invasive species.*

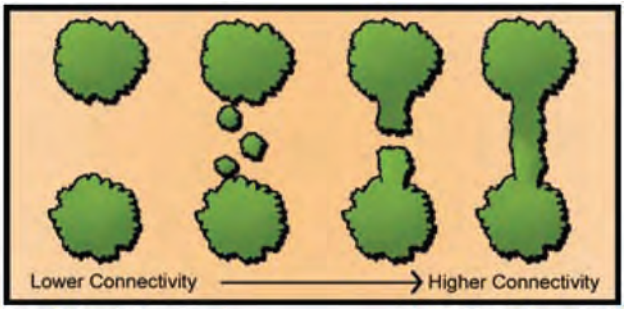
(Bentrup, G. 2008. Conservation buffers: design guidelines for buffers, corridors, and greenways. Gen. Tech. Rep. SRS-109. Asheville, NC: Department of Agriculture, Forest Service, Southern Research Station)

Maintaining Connections is Key

Like humans, all forms of wildlife require access to clean water. Emerging research has increasingly shown that, in addition to water, more and more species such as amphibians and reptiles cannot persist without landscape connectivity between quality wetland and upland habitats. Good connectivity to upland terrestrial habitats is essential for the persistence of healthy sustainable populations, because these areas provide vital feeding, overwintering, and nesting habitats found nowhere else. Therefore, both aquatic and terrestrial habitats are essential for the preservation of biodiversity and they should ideally be managed together as a unit.



Land development practices near streams, lakes, or wetlands need to address the issue of maintaining connectivity with quality upland habitats to preserve wildlife biodiversity.

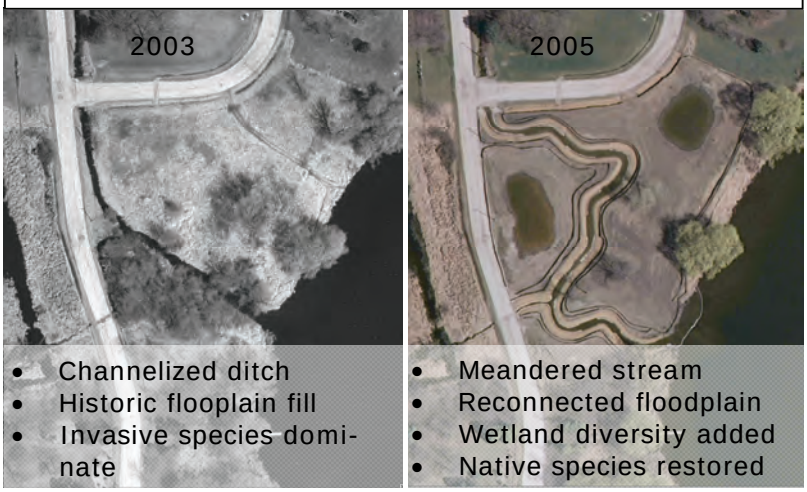


Increasing connectivity among quality natural landscapes (wetlands, woodlands, prairies) can benefit biodiversity by providing access to other areas of habitat, increasing gene flow and population viability, enabling recolonization of patches, and providing habitat (Bentrup 2008).

Basic Rules to Better Buffers

Protecting the integrity of native species in the region is an objective shared by many communities. The natural environment is an essential component of our existence and contributes to defining our communities and neighborhoods. Conservation design and open space development patterns in urbanizing areas and farm conservation programs in rural areas have begun to address the importance of maintaining and restoring riparian buffers and connectivity among corridors.

There are opportunities to improve buffer functions to improve water quality and wildlife habitat, even in urban situations

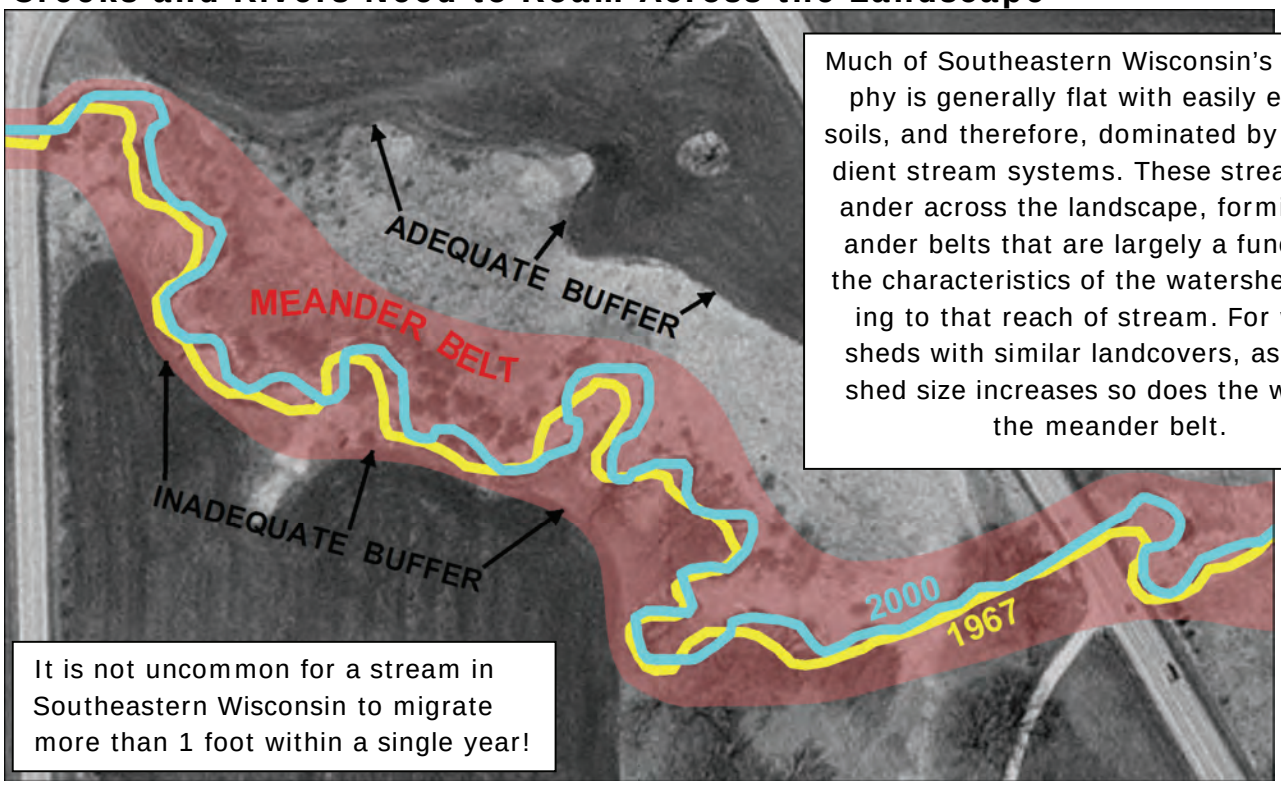


How wide should the buffer be? Unfortunately, there is no one-size-fits all buffer width adequate to protect water quality, wildlife habitat, and human needs. Therefore, the answer to this question depends upon the predetermined needs of the landowner and community objectives or goals.
As riparian corridors become very wide, their pollutant removal (buffering) effectiveness may reach a point of diminishing returns compared to the investment involved. However, the prospects for species diversity in the corridor keep increasing with buffer width. For a number of reasons, 400- to 800-foot-wide buffers are not practical along all lakes, streams, and wetlands within Southeastern Wisconsin. Therefore, communities should develop guidelines that remain flexible to site-specific needs to achieve the most benefits for water resources and wildlife as is practical.

Key considerations to better buffers/corridors:

- Wider buffers are better than narrow buffers for water quality and wildlife functions
- Continuous corridors are better than fragmented corridors for wildlife
- Natural linkages should be maintained or restored
- Linkages should not stop at political boundaries
- Two or more corridor linkages are better than one
- Structurally diverse corridors (e.g., diverse plant structure or community types, upland and wetland complexes, soil types, topography, and surficial geology) are better than corridors with simple structures
- Both local and regional spatial and temporal scales should be considered in establishing buffers
- Corridors should be located along dispersal and migration routes
- Corridors should be located and expanded around rare, threatened, or endangered species
- Quality habitat should be provided in a buffer whenever possible
- Disturbance (e.g. excavation or clear cutting vegetation) of corridors should be minimized during adjacent land use development
- Native species diversity should be promoted through plantings and active management
- Non-native species invasions should be actively managed by applying practices to preserve native species
- Fragmentation of corridors should be reduced by limiting the number of crossings of a creek or river where appropriate
- Restoration or rehabilitation of hydrological function, streambank stability, instream habitat, and/or floodplain connectivity should be considered within corridors.
- Restoration or retrofitting of road and railway crossings promotes passage of aquatic organisms

Creeks and Rivers Need to Roam Across the Landscape



Much of Southeastern Wisconsin's topography is generally flat with easily erodible soils, and therefore, dominated by low gradient stream systems. These streams meander across the landscape, forming meander belts that are largely a function of the characteristics of the watershed draining to that reach of stream. For watersheds with similar landcovers, as watershed size increases so does the width of the meander belt.

It is not uncommon for a stream in Southeastern Wisconsin to migrate more than 1 foot within a single year!

Healthy streams naturally meander or migrate across a landscape over time. Streams are transport systems for water and sediment and are continually eroding and depositing sediments, which causes the stream to migrate. When the amount of sediment load coming into a stream is equal to what is being transported downstream—and stream widths, depths, and length remain consistent over time—it is common to refer to that stream as being in a state of **"dynamic equilibrium."** In other words the stream retains its physical dimensions (equilibrium), but those physical features are shifted, or migrate, over time (dynamic).

Room to Roam

Riparian buffer widths should take into account the amount of area that a stream needs to be able to self-adjust and maintain itself in a state of dynamic equilibrium. … These are generally greater than any minimum width needed to protect for pollutant removal alone.

Streams are highly sensitive, and they respond to changes in the amounts of water and sediment draining to them, which are affected by changing land use conditions. For example, streams can respond to increased discharges of water by increased scour (erosion) of bed and banks that leads to an increase in stream width and depth—or "degradation." Conversely, streams can respond to increased sedimentation (deposition) that leads to a decrease in channel width and depth—or "aggradation."

Why Should You Care About Buffers?

Economic Benefits:

- Increased value of riparian property
- Reduced lawn mowing time and expense
- Increased shade to reduce building cooling costs
- Natural flood mitigation protection for structures or crops
- Pollution mitigation (reduced nutrient and contaminant loading)
- Increased infiltration and groundwater recharge
- Prevented loss of property (land or structures) through erosion
- Greater human and ecological health through biodiversity

Recreational Benefits:

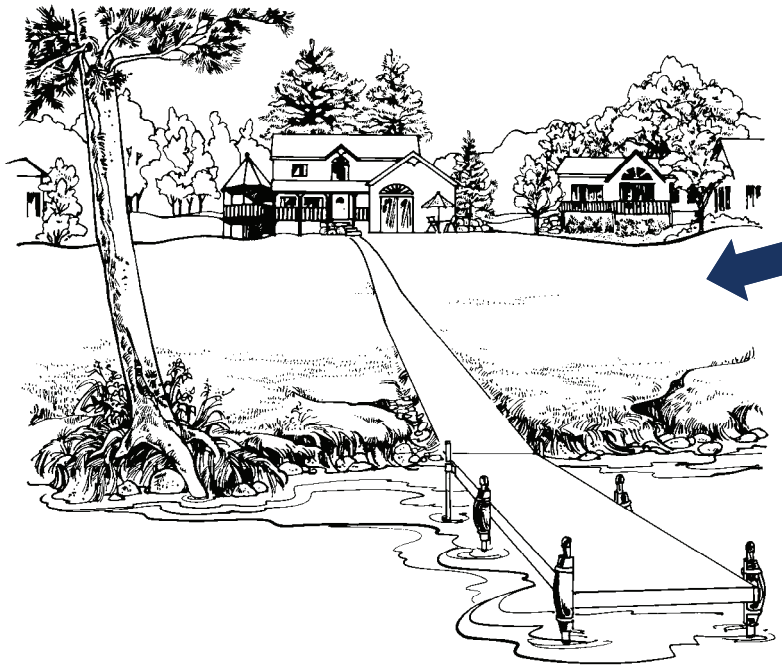
- Increased quality of the canoeing/kayaking experience
- Improved fishing and hunting quality by improving habitat
- Improved bird watching/wildlife viewing quality and opportunities
- Increased potential for expansion of trails for hiking and bicycling
- Opportunities made available for youth and others to locally reconnect with nature

Riparian buffers make sense and are profitable monetarily, recreationally, and aesthetically!

Social Benefits:

- Increased privacy
- Educational opportunities for outdoor awareness
- Improved quality of life at home and work
- Preserved open space/balanced character of a community
- Focal point for community pride and group activities
- Visual diversity
- Noise reduction

A Matter of Balance



University of Wisconsin—Extension

Although neatly trimmed grass lawns are popular, these offer limited benefits for water quality or wildlife habitat. A single house near a waterbody may not seem like a "big deal," but the cumulative effects of many houses can negatively impact streams, lakes, and wetlands.

All the lands within Southeastern Wisconsin ultimately flow into either the Mississippi River or the Great Lakes systems. The cumulative effects of agriculture and urban development in the absence of mitigative measures, ultimately affects water quality in those systems. Much of this development causes increases in water runoff from the land into wetlands, ponds, and streams. This runoff transports water, sediments, nutrients, and other pollutants into our waterways that can lead to a number of problems, including flooding that can cause crop loss or building damage; unsightly and/or toxic algae blooms; increased turbidity; damage to aquatic organisms from reduced dissolved oxygen, lethal temperatures, and/or concentrations of pollutants; and loss of habitat.

Riparian buffers are one of the most effective tools available for defending our waterways. Riparian buffers can be best thought of as forming a living, self-sustainable protective shield. This shield protects investments in the land and all things on it as well as our quality of life locally, regionally, and, ultimately, nationally. Combined with stormwater management, environmentally friendly yard care, effective wastewater treatment, conservation farming methods, and appropriate use of fertilizers and other agrichemicals, **riparian buffers complete the set of actions that we can take to minimize impacts to our shared water resources.**

Lakeshore buffers can take many forms, which require a balancing act between lake viewing, access, and scenic beauty. Lakeshore buffers can be integrated into a landscaping design that complements both the structural development and a lakeside lifestyle. Judicious placement of access ways and shoreline protection structures, and preservation or reestablishment of native vegetation, can enhance and sustain our use of the environment.

University of Wisconsin—Extension

Case Study—Agricultural Buffers

Agricultural nonpoint source pollution runoff continues to pose a threat to water quality and aquatic ecosystems within Wisconsin and elsewhere. In an effort to address this problem, the Wisconsin Buffer Initiative was formed with the goal of designing a buffer implementation program to achieve science-based, cost-effective, water quality improvements (report available online at http://www.soils.wisc.edu/extension/nonpoint/wbi.php).

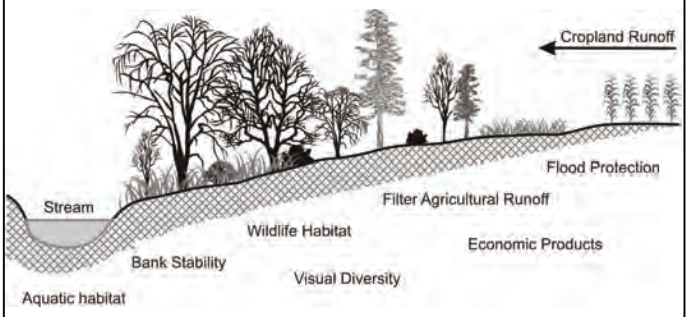
Challenge:
Buffers may take land out of cultivated crop production and require additional cost to install and maintain. Cost sharing, paid easements, and purchase of easements or development rights may sometimes be available to offset costs.

Benefits:
Buffers may offset costs by producing perennial crops such as hay, lumber, fiber, nuts, fruits, and berries. In addition, they provide visual diversity on the landscape, help maintain long-term crop productivity, and help support healthier fish populations for local enjoyment.

While it is true that riparian buffers alone may not always be able to reduce nutrient and sediment loading from agricultural lands, WBI researchers found that "…***riparian buffers are capable of reducing large percentages of the phosphorus and sediment that are currently being carried by Wisconsin streams. Even in watersheds with extremely high loads (top 10%), an average of about 70% of the sediment and phosphorus can be reduced through buffer implementation***." (*Diebel, M.J. and others, 2009, Landscape planning for agricultural nonpoint source pollution reduction III: Assessing Phosphorus and sediment reduction potential, Environmental Management, 43:69-83.*).

Federal and state natural resource agencies have long recognized the need to apply a wide range of Best Management Practices on agricultural lands to improve stream water quality. Although there are many tools available in the toolbox to reduce pollutant runoff from agricultural lands, such as crop rotations, nutrient and manure management, conservation tillage, and contour plowing, riparian buffers are one of the most effective tools to accomplish this task. Their multiple benefits and inter-connectedness from upstream to downstream make riparian buffers a choice with watershed-wide benefits.

Determine what benefits are needed.



The USDA in *Agroforestry Notes* (AF Note-4, January 1997) outlines a four step process for designing riparian buffers for Agricultural lands:

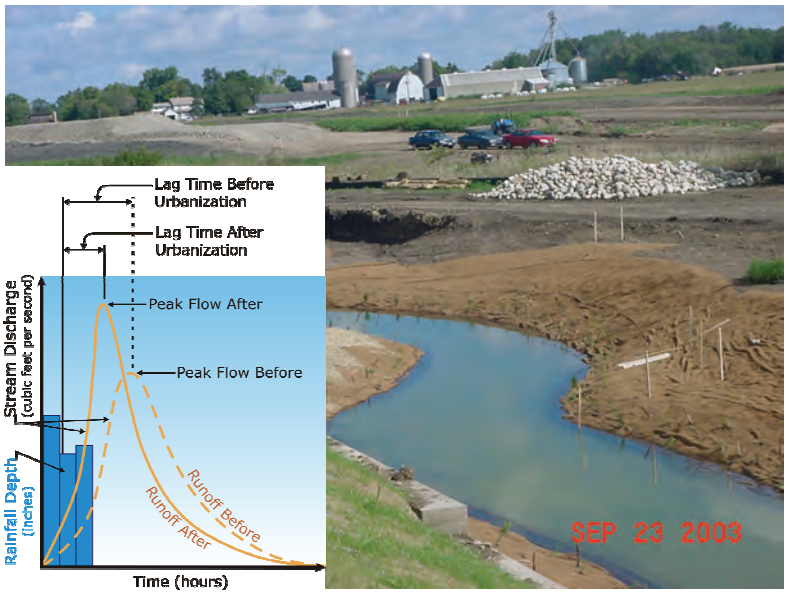
1-Determine what buffers functions are needed
2-Identify the best types of vegetation to provide the needed benefits
3-Determine the minimum acceptable buffer width to achieve desired benefits
4-Develop an installation and maintenance plan

Drain tiles can bypass infiltration and filtration of pollutants by providing a direct pathway to the water and "around" a buffer. This is important to consider in design of a buffer system which integrates with other agricultural practices.

Case Study—Urbanizing Area Buffers

When development occurs near a waterbody, the area in driveways, rooftops, sidewalks, and lawns increases, while native plants and undisturbed soils decrease. As a result, the ability of the shoreland area to perform its natural functions (flood control, pollutant removal, wildlife habitat, and aesthetic beauty) is decreased. In the absence of mitigating measures, one the consequences of urban development is an increase in the amount of stormwater, which runs off the land instead of infiltrating into the ground. Therefore, **urbanization impacts the watershed, not only by reducing groundwater recharge, but also by changing stream hydrology** through increased stormwater runoff volumes and peak flows. This means less water is available to sustain the baseflow regime. The urban environment also contains increased numbers of pollutants and generates greater pollutant concentrations and loads than any other land use. This reflects the higher density of the human population and associated activities, which demand measures to protect the urban water system.

Mitigation of urban impacts may be as simple as not mowing along a stream corridor or changing land management and yard care practices, or as complex as changing zoning ordinances or widening riparian corridors through buyouts.



Comparison of hydrographs before and after urbanization. Note the rapid runoff and greater peak streamflow tied to watershed development. (Adapted from Federal Interagency Stream Restoration Working Group (FISRWG), Stream Corridor Restoration: Principles, Processes, and Practices, October 1998)

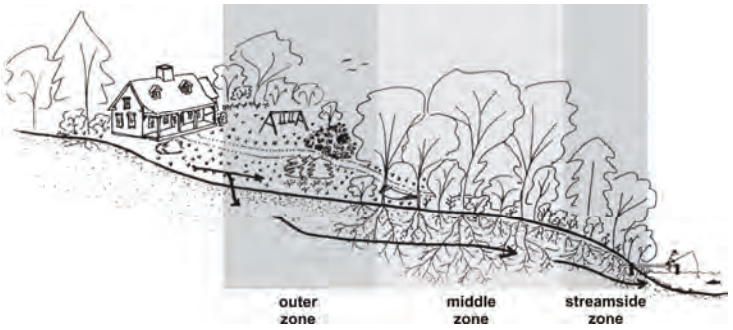
Challenge:

Urban development requires balancing flood protection, water quality protection, and the economic viability of the development.

Opportunities:

Buffers may offset costs by providing adequate space for providing long-term water quantity and water quality protection. In addition, they provide visual diversity on the landscape, wildlife habitat and connectedness, and help maintain property values.

Anatomy of an urban riparian buffer



The most effective urban buffers have three zones:

Outer Zone-Transition area between the intact buffer and nearest permanent structure to capture sediment and absorb runoff.

Middle Zone-Area from top of bank to edge of lawn that is composed of natural vegetation that provides wildlife habitat as well as improved filtration and infiltration of pollutants.

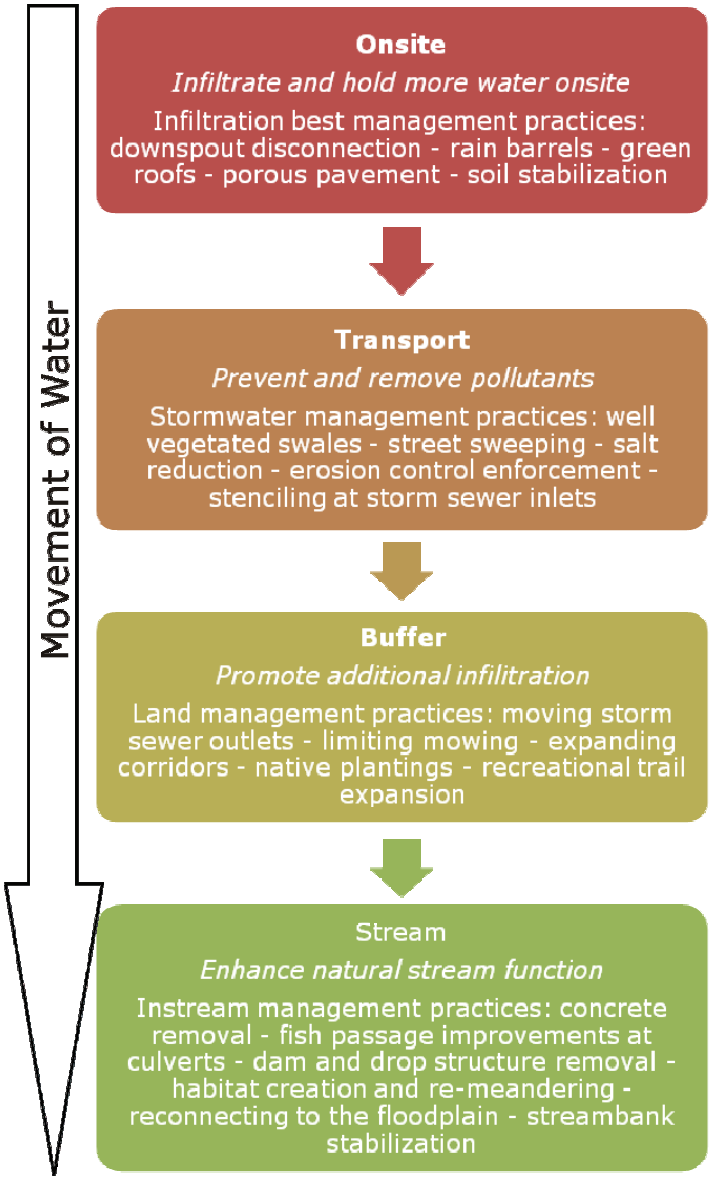
Streamside Zone-Area from the water's edge to the top of the bank or uplands that provides critical connection between water, wetland, and upland habitats for wildlife as well as protect streams from bank erosion

(Fact sheet No. 6 Urban Buffer in the series Riparian Buffers for Northern New Jersey)

Case Study—Urban Buffers

Placement of riparian buffers in established urban areas is a challenge that requires new and innovative approaches. In these areas, historical development along water courses limits options and requires balancing flood management protection versus water quality and environmental protection needs. Consequently, some municipalities have begun to recognize the connections between these objectives and are introducing programs to remove flood-prone structures and culverts from the stream corridors and allow recreation of the stream, restoring floodplains, and improving both the quality of life and the environment.

In urban settings it may be necessary to limit pollution and water runoff before it reaches the buffer.



Challenge:
There are many potential constraints to establishing, expanding, and/or managing riparian buffers within an urban landscape. Two major constraints to establishment of urban buffers include:

1) **Limited or confined space to establish buffers** due to encroachment by structures such as buildings, roadways, and/or sewer infrastructure;
2) **Fragmentation of the landscape** by road and railway crossings of creeks and rivers that disrupt the linear connectedness of buffers, limiting their ability to provide quality wildlife habitat.

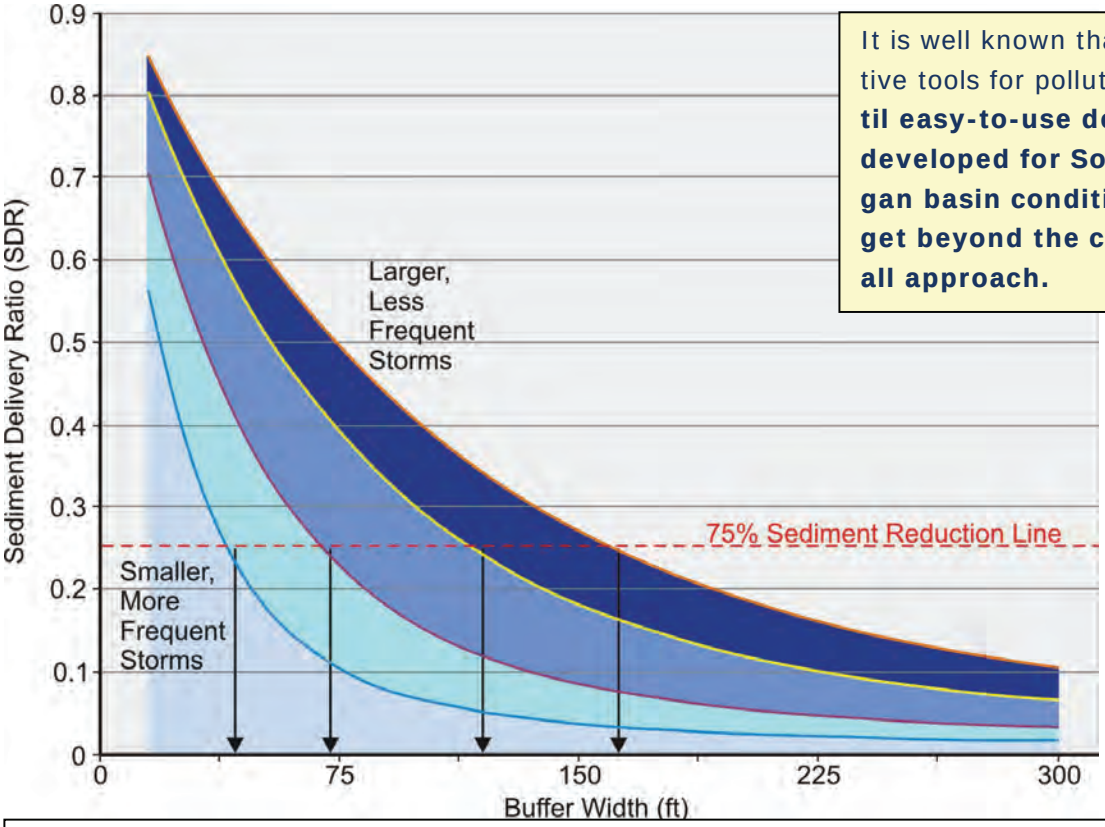
Much traditional stormwater infrastructure intercepts runoff and diverts it directly into creeks and rivers, bypassing any benefits of buffers to infiltrate or filter pollutants. This is important to consider in design of a buffer system for urban waterways, which begin in yards, curbsides, and construction sites, that are figuratively as close to streams as the nearest storm sewer inlet.

A Buffer Design Tool

Design aids are needed to help municipalities, property owners, and others take the "guesswork" out of determining adequate buffer widths for the purpose of water resource quality protection. While there are various complex mathematical models that can be used to estimate sediment and nutrient removal efficiencies, they are not easily applied by the people who need them including homeowners, farmers, businesses and developers.

To fill this gap, design aid tools are being developed using factors such as slope, soils, field length, incoming pollutant concentrations, and vegetation to allow the user to identify and test realistic buffer widths with respect to the desired percent pollutant load reduction and storm characteristics. By developing a set of relationships among factors that determine buffer effectiveness, the width of buffer needed to meet specific goals can be identified.

In the example below, 50-foot-wide buffers are necessary to achieve 75 % sediment removal during small, low intensity storms, while buffers more than 150 feet wide are necessary to achieve the same sediment reduction during more severe storms. Based on this information, decision-makers have the option of fitting a desired level of sediment removal into the context of their specific conditions. Under most conditions, a 75-foot width will provide a minimum level of protection for a variety of needs (SEWRPC PR No. 50, Appendix O.)



It is well known that buffers are effective tools for pollutant removal, but **until easy-to-use design aid tools are developed for Southern Lake Michigan basin conditions, we can never get beyond the current one size fits all approach.**

This generalized graph depicts an example of model output for an optimal buffer width to achieve a 75% sediment reduction for a range of soil and slope, vegetation, and storm conditions characteristic of North Carolina. *(Adapted from Muñoz-Carpena R., Parsons J.E.. 2005. VFSMOD-W: Vegetative Filter Strips Hydrology and Sediment Transport Modeling System v.2.x. Homestead, FL: University of Florida. http://carpena.ifas.ufl.edu/vfsmod/citations.shtml)*

Buffers Are A Good Defense

Today's natural resources are under threat. These threats are immediate as in the case of chemical accidents or manure spills, and chronic as in the case of stormwater pollution carrying everything from eroded soil, to fertilizer nutrients, to millions of drips from automobiles and other sources across the landscape. Non-native species have invaded, and continue to invade, key ecosystems and have caused the loss of native species and degradation of their habitats to the detriment of our use of important resources.

> ***"Riparian ecosystems are naturally resilient,*** *provide linear habitat connectivity, link aquatic and terrestrial ecosystems, and create thermal refugia for wildlife: all characteristics that can contribute to ecological adaptation to climate change."*
>
> *(N. E. Seavy and others, Why Climate Change Makes Riparian Restoration More Important Than Ever: Recommendations for Practice and Research, 2009, Ecological Restoration 27(3):330-338)*

A more subtle, but growing, concern is the case of stresses on the environment resulting from climate change. Buffers present an opportunity for natural systems to adapt to such changes by providing the space to implement protective measures while also serving human needs. **Because riparian buffers maintain an important part of the landscape in a natural condition, they offer opportunities for communities to adjust to our changing world.**

Well-managed riparian buffers are a good defense against these threats. In combination with environmental corridors, buffers maintain a sustainable reserve and diversity of habitats, plant and animal populations, and genetic diversity of organisms, all of which contribute to the long-term preservation of the landscape. Where they are of sufficient size and connectivity, riparian buffers act as reservoirs of resources that resist the changes that could lead to loss of species.

Refuge or protection from increased water temperatures as provided by natural buffers is important for the preservation of native cold-water, cool-water, and warm-water fishes and their associated communities.

Buffers Provide Opportunities

River, lake, and wetland systems and their associated riparian lands form an important element of the natural resource base, create opportunities for recreation, and contribute to attractive and well-balanced communities. These resources can provide an essential avenue for relief of stress among the population and improve quality of life in both urban and rural areas. Such uses also sustain industries associated with outfitting and supporting recreational and other uses of the natural environment, providing economic opportunities. Increasing access and assuring safe use of these areas enhances public awareness and commitment to natural resources. Research has shown that property values are higher adjoining riparian corridors, and that such natural features are among the most appreciated and well-supported parts of the landscape for protection.

We demand a lot from our riparian buffers!

Sustaining this range of uses requires our commitment to protect and maintain them.

Summary

The following guidance suggestions highlight key points to improve riparian corridor management and create a more sustainable environment.

Riparian corridors or buffers along our waters may contain varied features, but all are best preserved or designed to perform multiple important functions.

Care about buffers because of their many benefits. Riparian buffers make sense and are profitable monetarily, recreationally, aesthetically, as well as environmentally.

Enhance the environmental corridor concept. Environmental corridors are special resources which deserve protection. They serve many key riparian corridor functions, but in some cases, could also benefit from additional buffering.

Avoid habitat fragmentation of riparian corridors. It is important to preserve and link key resource areas, making natural connections and avoiding habitat gaps.

Employ the adage "wider is better" for buffer protection. While relatively narrow riparian buffers may be effective as filters for certain pollutants, that water quality function along with infiltration of precipitation and runoff and the provision of habitat for a host of species will be improved by expanding buffer width where feasible.

Allow creeks and rivers room to roam across the landscape. Streams are dynamic and should be buffered adequately to allow for natural movement over time while avoiding problems associated with such movement.

Consider and evaluate buffers as a matter of balance. Riparian buffers are a living, self-sustainable shield that can help balance active use of water and adjoining resources with environmental protection.

Agricultural buffers can provide many benefits. Riparian buffers in agricultural settings generally work well, are cost-effective, and can provide multiple benefits, including possibly serving as areas to raise certain crops.

Urban buffers should be preserved and properly managed. Though often space-constrained and fragmented, urban buffers are important remnants of the natural system. Opportunities to establish or expand buffers should be considered, where feasible, complemented by good stormwater management, landscaping, and local ordinances, including erosion controls.

A buffer design tool is needed and should be developed. Southeastern Wisconsin and the Southern Lake Michigan Basin would benefit from development of a specific design tool to address the water quality function of buffers. Such a tool would improve on the currently available general guidance on dimensions and species composition.

Buffers are a good defense. Combined with environmental corridors, riparian buffers offer a good line of defense against changes which can negatively impact natural resources and the landscape.

MORE TO COME

Future editions in a riparian buffer planning series are being explored with the intent of focusing on key elements of this critical land and water interface. Topics may include:

- Information sharing and development of ordinances to integrate riparian buffers into existing land management plans and programs
- Integration of stormwater management practices and riparian buffer best management practices
- Application of buffers within highly constrained urban corridors with and without brownfield development
- Installation of buffers within rural or agricultural lands being converted to urban uses
- Utilization of buffers in agricultural areas and associated drainage systems
- Integration of riparian buffers into environmental corridors to support resources preservation, recreation and aesthetic uses
- Preservation of stream courses and drainageways to minimize maintenance and promote protection of infrastructure
- Guidance for retrofitting, replacement, or removal of infrastructure such as dams and road crossings, to balance transportation, recreation, aesthetic, property value, and environmental considerations.
- Protection of groundwater recharge and discharge areas
- Protection of high quality, sensitive coastal areas, including preservation of recreational potential

MORE INFORMATION

This booklet can be found at http://www.sewrpc.org/RBMG-no1 . Please visit the website for more information, periodic updates, and a list of complementary publications.

* * *

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May 7, 2010

Appendix E

BOATING ORDINANCE FOR TOWN OF SALEM (ROCK LAKE INCLUDED)

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330-1 Intent.

The intent of this chapter is to provide safe and healthful conditions for the enjoyment of aquatic recreation consistent with public needs and the capacity of the water resource.

§ 330-2 Applicability.

[Amended 4-10-2000 by Ord. No. 00-04-10]

The provisions of this chapter shall apply to the lakes within the jurisdiction of the Town and to the rivers within the Town wherever the provisions of this chapter would be applicable to river traffic, except to the waters of Silver Lake, which shall be enforced exclusively by the Village of Silver Lake.

§ 330-3 Incorporation of state statutes.

A.

The following sections of the Wisconsin Statutes and any subsequent amendments thereto are hereby adopted and by reference made a part of this section as though fully set forth herein:

[Amended 6-13-2011 by Ord. No. 11-06-13]

Wis. Stats. Section	Title
30.50	Definitions
30.51	Certificate of number and registration; requirements; exemptions
30.52	Certificate of number and registration; application; certification and registration period; fees; issuance
30.53	Certificate of origin; requirements; contents
30.531	Certificate of title; requirements; exemptions
30.54(2)	Lost, stolen or mutilated certificates
30.55	Notice of abandonment or destruction of boat or change of address
30.60	Classification of motorboats
30.61	Lighting equipment
30.62	Other equipment
30.635	Motorboat prohibition

Wis. Stats. Section	Title
30.64	Patrol boats
30.65	Traffic rules
30.66	Speed restrictions
30.67	Accidents and accident reports
30.675	Distress signal flag
30.68	Prohibited operation
30.681	Intoxicated boating
30.682	Preliminary breath screening test
30.683	Implied consent
30.684	Chemical tests
30.686	Report arrest to department
30.687	Officers action after arrest for violating intoxicated boating law
30.69	Water skiing
30.70	Skin diving
30.71	Disposal of waste from boats equipped with toilets

B.

Any act required to be performed or prohibited by the provisions of any of the above-referenced statutory sections incorporated herein is required or prohibited by this section.

§ 330-4 Definitions.

As used in this chapter, the following terms shall have the meanings indicated:

MOORAGE

An area where continuous mooring of boats for more than 24 hours is permitted.

PUBLIC ACCESS

A marina or landing facility and the adjoining public shoreline under the ownership of the state, county or other municipality.

SHORE ZONE

The water area within 200 feet of any lakeshore within the Town of Salem, except:

[Amended 6-13-2011 by Ord. No. 11-06-13C]

A.

On Silver Lake, where the shore zone shall mean the water area from the shore to five-foot depth as shown on the hydrographic map bearing legend DNR 1968.

B.

On Lake Shangri-La, where the shore zone shall mean the water area within 100 feet of any lakeshore.

SLOW NO-WAKE BENCHMARK

The elevation of the surface of inland waters within the Town of Salem at which operation of motorboats on such waters at a speed in excess of slow no-wake speed tends to create or cause property damage or abnormal shore erosion due to excessive wake or wash. The slow no-wake benchmark shall be the surface elevation of such inland waters as indicated by markers established for that purpose, the locations of which are depicted on the attached Marker Maps A and B.[1] The slow no-wake benchmarks for inland waters within the Town shall be as follows:

[Added 4-17-2008 by Ord. No. 08-04-17; amended 6-13-2011 by Ord. No. 11-06-13C]

Body of Water	Marker Location	Marker Level
Cross Lake	N42° 29" 53.0', W88° 05" 39.3' Cross Lake Gauging Station No. 1 is located on the west side of Cross Lake approximately 160 feet north of the intersection of S.T.H. "83" and 127th Place. The datum elevation for Cross Lake Gauging Station No. 1 is 810.00. Cross Lake Gauging Station No. 1 is scaled from 3.33 to 6.67 feet.	4.00
Camp Lake	N42° 30" 32.8', W88° 08" 51.9' Camp Lake Gauging Station No. 1 is located on the south side of Camp Lake north of C.T.H. "C" approximately 800 feet southwest of 277th Avenue. The gauging station is	11.50

Body of Water	Marker Location	Marker Level
	located approximately 40 feet north of the center line of C.T.H. "C" and approximately 30 feet west of the dam. The datum elevation for Camp Lake Gauging Station No. 1 is 730.00. Camp Lake Gauging Station No. 1 is scaled from 10.00 to 16.67 feet.	
Center Lake	N42° 31" 56.7', W88° 08" 18.7' Center Lake Gauging Station No. 1 is located on the south side of Center Lake adjacent to Camp Lake Road (C.T.H. "SA") in the waterway that connects Center Lake and Camp Lake. The gauging station is located north of C.T.H. "SA" approximately 400 feet northwest of 271st Avenue. The gauging station is located approximately 60 feet north of the center line of C.T.H. "SA" and approximately 10 feet northwest of a small dam in the waterway. The datum elevation for Center Lake Gauging Station No. 1 is 730.00. Center Lake Gauging Station No. 1 is scaled from 10.00 to 16.67 feet.	12.00
Lake Shangri-La	N42° 30" 31.7', W88° 04" 16.6' Lake Shangrila Gauging Station No. 1 is located on the north side of Lake Shangrila adjacent of 118th Street. The gauging station is located southeast of 118th Street approximately 800 feet southwest of 117th Street. The gauging station is located approximately 30 feet southeast of the center line of 118th Street and approximately 10 feet northeast of the culvert under 118th Street. The datum elevation for Lake Shangrila Gauging Station No. 1 is 790.00. Lake Shangrila Gauging Station No. 1 is scaled from 3.33 to 6.67 feet.	5.85
Hooker Lake	N42° 33" 21.9', W88° 06" 26.9' Hooker Lake Gauging Station No. 1 is located on the southwest side of Hooker Lake approximately 300 feet east of the intersection of 83rd Street and 249th Avenue. The gauging station is located approximately 30 feet east of the east end of 83rd Street. The datum elevation for Hooker Lake Gauging Station No. 1 is 745.00. Hooker Lake Gauging Station No. 1 is scaled from 8.50 to 13.33 feet.	9.80
Voltz Lake	N42° 30" 32.9', W88° 05" 17.1' Voltz Lake Gauging Station No. 1 is located on the northwest side of Voltz Lake adjacent to 231st Court. The gauging station is located east of 231st Court approximately 250 feet south of 117th Street. The gauging station is located approximately 25 feet east of the center line of 231st Court and approximately 30	8.25

Body of Water	Marker Location	Marker Level
	feet south of Trevor Creek. The datum elevation for Voltz Lake Gauging Station No. 1 is 805.00. Voltz Lake Gauging Station No. 1 is scaled from 6.67 to 10.00 feet.	

SLOW NO-WAKE SPEED

That speed at which a boat moves as slowly as possible while still maintaining steerage control.

SWIMMING ZONE

An authorized area marked by official buoys to designate a swimming area.

Editor's Note: The maps are on file at the office of the Town Clerk.

§ 330-5 Speed restrictions.

A.

In addition to the speed restrictions set forth in § **330-3** of this chapter, adopting § 30.66, Wis. Stats., no person shall operate a boat in excess of the slow no-wake speed:

[Amended 6-14-1993 by Ord. No. 93-06-14D; 6-19-1995 by Ord. No. 95-06-19; 3-9-1998 by Ord. No. 98-03-09B; 4-11-2005 by Ord. No. 05-04-11A]

(1)

On any lake within a defined shore zone.

(2)

Except as otherwise provided in this section, on any lake between the hours of 7:00 p.m. and 10:00 a.m. on either the shore zone or the traffic lane.

[Amended 12-14-2009 by Ord. No. 09-12-14]

(3)

On that part of the Fox River bounded on the north by the Highway C bridge and on the south by the Wisconsin-Illinois border.

(4)

On that part of the Fox River bounded on the south by the south face of the bridge on CTH F and on the north by a slow no-wake regulatory buoy placed at 42.32768 north latitude, 88.10749 west longitude. Additional slow no-wake buoys shall be placed to implement the speed restriction as follows:

1 buoy at 42.32517 north latitude and 88.10305 west longitude

1 buoy at 42.32495 north latitude and 88.10413 west longitude

1 buoy at 42.32553 north latitude and 88.10492 west longitude

1 buoy at 42.32675 north latitude and 88.10492 west longitude

1 buoy at 42.32675 north latitude and 88.10509 west longitude

1 buoy at 42.32674 north latitude and 88.10730 west longitude

1 buoy at 42.32701 north latitude and 88.10761 west longitude

(5)

On Lake Shangri-La in the area of the lake known as "the narrows." Slow no-wake buoys shall be placed to implement the speed restrictions as follows:

1 buoy 140 feet from the shore of the property identified as 12026 214th Avenue.

1 buoy 140 feet from the shore of the property identified as 21401 121st Street

(6)

On Camp Lake within the shore zone. Slow no-wake buoys shall be placed in the following locations to implement the restrictions:

[Added 9-10-2007 by Ord. No. 07-09-10B; amended 4-5-2010 by Ord. No. 10-04-05]

1 buoy at 42.31749 north latitude and 88.08702 west longitude

1 buoy at 42.31914 north latitude and 88.08609 west longitude

1 buoy at 42.31990 north latitude and 88.08583 west longitude

1 buoy at 42.31958 north latitude and 88.08466 west longitude

1 buoy at 42.31811 north latitude and 88.08421 west longitude

1 buoy at 42.31697 north latitude and 88.08499 west longitude

1 buoy at 42.31544 north latitude and 88.08435 west longitude

1 buoy at 42.31691 north latitude and 88.08547 west longitude

1 buoy at 42.31467 north latitude and 88.08397 west longitude

1 buoy at 42.31472 north latitude and 88.08385 west longitude

1 buoy at 42.31545 north latitude and 88.08475 west longitude

1 buoy at 42.31401 north latitude and 88.08308 west longitude

1 buoy at 42.31296 north latitude and 88.08231 west longitude

1 buoy at 42.31196 north latitude and 88.08193 west longitude

1 buoy at 42.31132 north latitude and 88.08206 west longitude

1 buoy at 42.31005 north latitude and 88.08353 west longitude

1 buoy at 42.30942 north latitude and 88.08468 west longitude

1 buoy at 42.30870 north latitude and 88.08575 west longitude

1 buoy at 42.30833 north latitude and 88.08691 west longitude

1 buoy at 42.31211 north latitude and 88.08966 west longitude

1 buoy at 42.31501 north latitude and 88.08692 west longitude

1 buoy at 42.31601 north latitude and 88.08723 west longitude

1 buoy at 42.31699 north latitude and 88.08749 west longitude

(7)

On Hooker Lake between the hours of sunset and 10:00 a.m. either in the shore zone or the traffic lane.

[Added 12-14-2009 by Ord. No. 09-12-14; amended 10-14-2013 by Ord. No. 13-10-14]

(8)

On Lake Shangri-La/Benet between the hours of sunset and 10:00 a.m. either in the shore zone or the traffic lane during the months of July and August.

[Added 6-13-2011 by Ord. No. 11-06-13C]

(9)

On Camp Lake between the hours of sunset and 10:00 a.m. either in the shore zone or the traffic lane.

[Added 6-13-2011 by Ord. No. 11-06-13C; amended 3-12-2012 by Ord. No. 12-03-12A]

(10)

On Center Lake within the restricted areas marked by buoys placed at the following locations:

[Added 5-14-2012 by Ord. No. 12-05-14A; amended 11-12-2013 by Ord. No. 13-11-12]

Location	Buoy Type	Latitude	Longitude
Center Lake Woods Beach	Swim area	42° 32' 16.04" N	88° 8' 1.12" W
Center Lake Woods Beach	Swim area	42° 32' 16.64" N	88° 8' 0.82" W
Center Lake Woods Beach	Swim area	42° 32' 16.80" N	88° 7' 59.14" W
Center Lake Woods Beach	Swim area	42° 32' 16.32" N	88° 7' 58.62" W
Center Lake Woods Beach	Swim area	42° 32' 15.78" N	88° 7' 58.25" W
Boat launch channel	No wake	42° 32' 14.63" N	88° 8' 20.60" W
Center Lake Beach	Swim area	42° 32' 19.24" N	88° 8' 15.21" W
Center Lake Beach	Swim area	42° 32' 19.67" N	88° 8' 15.01" W
Camp Wonderland	No wake	42° 32' 24.77" N	88° 8' 6.58" W
Camp Wonderland	No wake	42° 32' 26.99" N	88° 8' 3.86" W
Center Lake Beach	Swim area	42° 32' 28.13" N	88° 8' 1.81" W

B.

Pursuant to § 30.635, Wis. Stats., no person shall operate a motorboat on Rock Lake in excess of the slow no-wake speed.

C.

No person shall operate a motorboat on any inland waters subject to the jurisdiction of the Town of Salem at a speed in excess of slow no-wake speed when the surface water level of such inland bodies of

water exceeds the slow no-wake benchmark as indicated by markers placed and maintained by the Town for that purpose.

[Added 4-17-2008 by Ord. No. 08-04-17]

§ 330-6 Capacity restrictions.

No person shall operate or loan, rent or permit a boat to leave the place where it is customarily kept for operation on the waters covered by this chapter with more passengers or cargo than shall be stated on the capacity information plate as required by § 30.501, Wis. Stats.

§ 330-7 Buoys, piers and rafts.

A.

Removal. The Town may remove or cause to be removed all buoys, markers, piers and their supports, privately owned or placed, which are not removed by December 1 of each year and charge the cost and expense of such removal to the riparian owner. If such charge is not paid within 30 days after request therefor, a penalty of 10% shall be added to such charge, and the same shall constitute a lien on the property of the riparian owner and be inserted on the Town tax roll by the Town Clerk upon order of the Town Board and after notice to the riparian owner.

[Amended 4-10-2000 by Ord. No. 00-04-10]

B.

Compliance. All buoys and aids to navigation must comply with § 30.74(2), Wis. Stats., and administrative regulations and shall have affixed thereto such numbers as assigned to them by the permit. Such numbers shall be located at least 12 inches above the waterline and shall be not less than three inches in height.

C.

Wharves and piers.

[Amended 4-10-2000 by Ord. No. 00-04-10; 11-13-2001 by Ord. No. 01-11-13C]

(1)

No person shall erect or maintain any wharf or pier contrary to the statutes and regulations of the state or extending more than 100 feet from the shore, unless prior written approval is obtained from the Town, on all lakes and waters within the Town's jurisdiction.

(2)

No person may erect, place or maintain a wharf or pier on waters within the Town's jurisdiction which is so old, dilapidated or out of repair as to be dangerous, unsafe or otherwise unfit for normal use.

(3)

If a water patrol officer or public safety officer shall determine that a violation of this section exists within the Town, the officer shall serve notice on the owner or occupant of the premises where such violation exists, either by personal delivery thereof to such person or by posting a copy of said notice in a conspicuous location on the premises. Such notice shall direct the owner or occupant of the premises to abate or remove such violation within 10 days. The notice shall also state that, unless such violation is so abated, the Town will cause the same to be abated and will charge the cost thereof to the owner or occupant of the premises where such violation exists.

D.

Pier or mooring buoy. No pier or mooring buoy shall be placed in the waters located within the boundary of a designated fire lane (extended into the water) unless so authorized, in writing, by the Town Board as to all waters under the jurisdiction of the Town Board, including those waters of Silver Lake into which designated Town fire lanes are extended.

[Amended 4-10-2000 by Ord. No. 00-04-10]

E.

Rafts and platforms.

(1)

No person shall place or maintain any raft or platform more than 100 feet from shore.

(2)

Each raft or platform must:

(a)

Be firmly anchored with at least 18 inches of freeboard above the waterline;

(b)

Be painted white; and

(c)

Have attached thereto, not more than 12 inches from each corner or projection, a red reflector of not less than three inches in diameter.

[Amended 3-11-1996 by Ord. No. 96-03-11]

F.

Buoy permits.

(1)

No bathing beach marker, speed zone marker, information marker, mooring buoy, fishing buoy or other marker shall be anchored or placed on any of the waters under the jurisdiction of the Town unless a written application therefor is made to and approved by the Town Board. The Town shall issue numbers for buoys as required in Subsection **B** above.

[Amended 4-10-2000 by Ord. No. 00-04-10]

(2)

Permit fee established. Any person making application for the placement of a mooring buoy or other approved marker in the waters of any lake within the Town of Salem in accordance with the above section shall pay to the Clerk a permit fee as provided in Chapter **272**, Fees, § **272-6**. Such permit shall remain in effect so long as the applicant owns or rents the property for which such permit is granted. The permits granted hereunder shall automatically expire when an applicant sells or no longer occupies the premises for which the permit has been granted.

G.

Placement of authorized markers. The Chief of the Water Safety Patrol is authorized and directed to place authorized markers, navigation aids and signs in such water areas as shall be appropriate to advise the public of the provisions of this chapter and to post and maintain a copy of this chapter at all public access points within the jurisdiction of the Town.

§ 330-8 Swimming regulations.

A.

Swimming from boats prohibited. No person shall swim from any unmanned boat unless such boat is anchored.

B.

Distance from shore or boats. No person shall swim beyond the shore zone or more than 50 feet from any pier unless within marked or authorized areas or more than 25 feet from anchored rafts or boats unless accompanied by a boat manned by a competent person and having readily available a ring buoy. Such boat shall stay reasonably close to and guard such swimmer; not less than one boat for each two swimmers.

C.

Hours limited. No person shall swim more than 200 feet from the shoreline between the hours of 7:00 p.m. and 10:00 a.m.

§ 330-9 Waterskiing regulations.

[Amended 12-14-2009 by Ord. No. 09-12-14; 6-11-2012 by Ord. No. 12-06-11]

A.

Hours. No person shall operate a boat for the purposes of towing a water skier, aquaplane or similar device or engage in waterskiing during those hours within which operation in excess of slow no wake is prohibited by § **330-5A**.

B.

Traffic lane. Any boat engaged in towing a person on water skis, aquaplane or similar device must conform to all sections of this chapter and, in addition, must operate in a counterclockwise pattern on the lake in the traffic lane. There shall be no waterskiing, aquaplaning or similar activity within the shore zone.

C.

Water ski towing.

(1)

There shall not be more than two persons on water skis being towed by one boat at any one time, and each shall have an individual tow line.

(2)

Persons being towed must wear personal flotation devices as defined in § 30.62(3), Wis. Stats.

(3)

Persons being towed behind a vessel on water skis or similar device or engaged in a similar activity may not come or allow the tow rope to come within 100 feet of a personal watercraft.

D.

Towing of water tubes.

(1)

There shall not be more than two towing lines per boat.

(2)

The human capacity of each water tube shall not exceed that recommended by the manufacturer.

(3)

No vessel towing a person or persons on a water tube may come within 100 feet of other occupied anchored vessels, a personal watercraft, a buoy-marked swimming area or a public boat landing.

E.

Exceptions. The limitations of this section shall not apply to participants in ski meets or exhibitions authorized and conducted as provided in § **330-11** of this chapter.

§ 330-10 Houseboats; littering prohibited.

A.

Any boat or craft which is designed for persons to use for living, sleeping or camping activities, commonly referred to as a "houseboat," shall be equipped with suitable sanitation facilities and comply with § **330-3** of this chapter, adopting § 30.71, Wis. Stats.

B.

No person shall leave, deposit, place or throw on the waterways, ice, shores of waterways or upon any other public or private property adjacent to waterways any cans, bottles, debris, refuse or other solid waste material of any kind or any liquid waste, gasoline, oil or similar pollutant.

[Amended 11-13-2001 by Ord. No. 01-11-13D]

§ 330-11 Races, regattas, sporting events and exhibitions.

A.

Permit required. No person shall direct or participate in any boat race, regatta, water-ski meet or other water sporting event or exhibition on Silver Lake unless such event has been authorized jointly by the Village Board of Silver Lake and the Town Board. On all other waters under the jurisdiction of the Town, such permit shall be authorized by the Town Board.

B.

Permit. A permit issued under this section shall specify the course or area of water to be used by participants in such event, and the permittee shall be required to place markers, flags or buoys approved by the Chief of the Water Safety Patrol designating the specified area. Permits shall be issued only when the proposed use of the water can be carried out safely and without danger to or substantial obstruction of other watercraft or persons using the lake.

C.

Right-of-way of participants. Boats and participants in any such permitted event shall have the right-of-way on the marked area, and no other persons shall obstruct such area during the race or event or interfere therewith.

D.

Permit fee required. Upon making application for a special event permit, the applicant shall pay a permit fee as provided in Chapter **272**, Fees, § **272-6**, to the Town Clerk.

§ 330-12 Driving of motor-driven vehicles on ice.

A.

Speed. No person shall use or operate any automobile at a speed in excess of 10 mph on the ice of any lake or waterway within the Town of Salem.

B.

Hours. No person shall use or operate any automobile on the ice of any lake or other waterway within the Town of Salem after 9:00 p.m.

C.

Definition. The word "automobile," as used in this chapter, shall be construed to mean all motor vehicles of the type and kind permitted to be operated on the highways in the state.

D.

Risk and liability. All traffic on the icebound waters within the Town of Salem shall be at the risk of the traveler as set forth in § 30.81(3), Wis. Stats. Nothing in this chapter shall be construed as rendering the Town liable for any accident to those engaged in permitted traffic while this chapter is in effect.

§ 330-13 Joint jurisdiction over Silver Lake.

Recognizing the joint jurisdiction of the Village of Silver Lake and the Town over the waters of Silver Lake, it is the intent of this chapter that the Village of Silver Lake and the Town shall cooperate and coordinate ordinances, rules and regulations and shall have joint jurisdiction for enforcement purposes, except that violations occurring in the Town shall be brought before the Municipal Court of the Town, and those violations under the jurisdiction of the Village of Silver Lake shall be brought before the Municipal Court of the Village of Silver Lake.

§ 330-14 Water patrol officers; public safety officers.

[Added 4-13-1992 by Ord. No. 92-04-13B; amended 4-12-1993 by Ord. No. 93-04-12]

A.

Qualifications. The Town Board of the Town of Salem may appoint one or more water patrol officers who shall be adults of good moral character with no prior criminal record. A water patrol officer shall be a certified law enforcement officer.

B.

Authority. Water patrol officers of the Town of Salem shall have the authority to make arrests in the course of duty enforcing the provisions of this chapter, including those provisions of the Wisconsin Statutes incorporated by reference. Water patrol officers shall have the authority to carry firearms in the course of duty, subject to the restrictions and policies established by the Town Board from time to time.

[Amended 2-13-1995 by Ord. No. 95-02-13B]

C.

Public safety officers. Town of Salem public safety officers may perform the additional duties of water patrol officers and shall have the power of arrest and may issue citations for violations of this chapter, including those provisions of the Wisconsin Statutes incorporated by reference. Town of Salem public safety officers shall have the authority to carry firearms in the course of duty, subject to the restrictions and policies established by the Town Board from time to time.

[Amended 11-13-2001 by Ord. No. 01-11-13D]

§ 330-15 Boats in marked swim areas prohibited; exceptions.

[Added 11-13-2001 by Ord. No. 01-11-13B]

No boat of any type is permitted within a water area which has been clearly marked by buoys or some other distinguishing device as a bathing or swimming area. This section does not apply in the case of emergency or to patrol or rescue craft.

§ 330-16 Fertilizer applications.

[Added 6-12-2006 by Ord. No. 06-06-12B]

A.

Definitions. As used in this section, the following terms shall have the meanings indicated:

FERTILIZER

Has the meaning specified under § 94.64(1)(e), Wis. Stats.

IMPERVIOUS SURFACE

A highway, street, sidewalk, parking lot, driveway, or other material that prevents infiltration of water into the soil.

LAWN AND TURF FERTILIZER

Has the meaning specified under § 94.64(1)(e), Wis. Stats., except the manufacturer has designated the product to be used for the promotion of lawn and turf growth.

B.

It shall be unlawful for any person to apply within the Town any lawn and turf fertilizer, liquid or granular, that contains more than a trace of phosphorus or other compound containing phosphorus, such as phosphate.

C.

It shall be unlawful for any person to apply or deposit any fertilizer on an impervious surface. If such application occurs, the fertilizer must be immediately contained and either legally applied to turf or any other lawful site or returned to the original or other appropriate container.

D.

Time of application. It shall be unlawful for a person to apply lawn and turf fertilizer when the ground is frozen or when conditions exist which promote or create runoff.

E.

Exceptions.

(1)

Subsection **B** shall not apply when:

(a)

A tissue, soil or other test by UW-Extension Laboratory, or another state-certified soil-testing laboratory, and performed within the last three years indicates that the level of available phosphorus in the soil is insufficient to support healthy turf growth, as determined by the University of Wisconsin Extension Service, provided that the proposed lawn and turf fertilizer application shall not contain an amount of phosphorus exceeding the amount and rate of application recommended in the soil test evaluation.

(b)

The property owner or an agent of the property owner is first establishing or reestablishing turf via seed or sod procedures, and only during the first growing season.

(2)

Subsection **B** shall not apply to fertilizers used in any agricultural use as defined in § 91.01(2), Wis. Stats., to promote crop or product growth.

(3)

Any person who applies a lawn and turf fertilizer containing phosphorus pursuant to the aforementioned exception shall, consistent with the product label instructions, water such lawn and turf fertilizer into the soil where it is immobilized and generally protected from loss by runoff.

§ 330-17 Operation of aircraft on water prohibited; exceptions.

[Added 9-10-2007 by Ord. No. 07-09-10A]

No person, firm or corporation shall operate or authorize the operation of any aircraft capable of landing on water on any river or lake within the jurisdiction of the Town of Salem, with the exception of Camp Lake. For purposes of this section, the term "operation" shall include but not be limited to landing or takeoff and any contact of any portion of such aircraft with the surface of any affected body of water. This section shall not apply to any operation on such bodies of water by duly authorized government or law enforcement officials or any operation necessitated by an emergency situation outside of the control of the operator of such aircraft.

§ 330-18 Violations and penalties.

A.

Unless otherwise provided herein, any person violating any provisions of this chapter shall, upon conviction, be subject to the penalty provided in § **1-4** of this Code.

[Amended 6-13-2011 by Ord. No. 11-06-13]

B.

Any person violating the provisions of § **330-3** of this chapter, incorporating § 30.681 or 30.684, Wis. Stats., shall, upon conviction, be subject to a forfeiture of not less than $150 nor more than $300.

C.

Any person violating any provision of the Wisconsin Statutes incorporated herein, which violation is punishable by the imposition of a fine or imprisonment, or both, shall be referred to state authorities for prosecution.

D.

Citations for violations of this chapter shall be issued on forms prepared by the Department of Natural Resources, and the Uniform Wisconsin Schedule, adopted pursuant to § 23.66, Wis. Stats., shall be effective for the posting of bonds for violations under this chapter.

E.

The provisions relating to citations, arrests, questioning, releases, searches, deposits and stipulations of no contest in §§ 23.51(1m), (3) and (8); 23.53; 23.54; 23.56 to 23.64; 23.66; and 23.67, Wis. Stats., shall apply to violations of this chapter.

[Added 1-12-2004 by Ord. No. 04-01-12C]

§ 330-19 Operation of motorboats on Rock Lake.

[Added 8-13-2012 by Ord. No. 12-08-13; amended 12-10-2012 by Ord. No. 12-12-10A]

The propulsion of boats on Rock Lake shall be limited to the use of oars, paddles, sails or electric motors. This section shall not apply to:

A.

Any operation by duly authorized government or law enforcement officials in the course of the performance of their duties.

B.

Any operation necessitated by an emergency situation outside of the control of the operator of the motor boat.

C.

Any operation necessary for the mechanical or chemical management of weeds or other aquatic growth or shoreline restoration on Rock Lake by the holder of a permit issued by the Wisconsin Department of Natural Resources.

D.

Any operation necessary to complete a salvage operation on Rock Lake.

§ 330-20 Boat launch fees.

[Added 10-14-2013 by Ord. No. 13-10-14A]

A.

Any person, firm or corporation launching a boat at any public boat launch on Camp Lake or Center Lake shall pay a fee, as established below:

(1)

Daily fee: Town of Salem resident (single boat/single day launches): $3.

(2)

Dally fee: nonresident (single boat/single day launches): $4.50.

(3)

Daily launch fee for senior citizens over the age of 65 years: $0.

(4)

Annual launch fee: Town of Salem resident (unlimited launches in calendar year): $20.

(5)

Annual launch fee: nonresident (unlimited launches in calendar year): $30.

B.

The Town shall install and maintain a secured collection box at the public launches to accept the daily fees, shall post notice of the fee requirement in a prominent place at the public launches, and shall provide envelopes for payment with a receipt. In addition, the Town shall make annual fee launch stickers available for purchase at the Town Hall during the Town's normal business hours.

C.

All persons launching a boat at a public boat launch on Camp Lake or Center Lake shall display, at the request of any water patrol or public safety officer, a receipt for payment of the daily fee.

D.

Any person launching a boat at the public launch on Camp Lake or Center Lake in violation of the provisions of this section shall be subject to forfeiture as provided in § **330-18** of this Code.

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Appendix F

INFORMATION FOR THE PREVENTION OF AQUATIC INVASIVE SPECIES

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FOR MORE INFORMATION

If you would like more information about aquatic invasive species, the problems they cause, regulations to prevent their spread, or methods and permits for their control, contact one of the following offices:

Wisconsin Department Of Natural Resources
888-WDNRINFO
DNR.WI.GOV search "Aquatic Invasives"

University of Wisconsin- Extension
(715) 346-2116
WWW.UWSP.EDU/CNR/UWEXLAKES

Wisconsin Sea Grant
(608) 262-0905
WWW.SEAGRANT.WISC.EDU
WWW.PROTECTYOURWATERS.NET

Thanks to the following for supporting educational efforts on aquatic invasive species:

- *U.S. Fish and Wildlife Service*
- *Great Lakes Indian Fish and Wildlife Commission*
- *National Park Service*

PUB WT-801 2011

Graphic Design by Amy Torrey,
Environmental Resources Center, UW-Extension

Photo Credits:
Sea Grant, UW-Extension, DNR

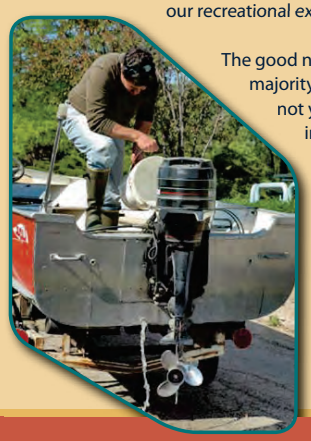
STOP Aquatic HITCHHIKERS

ENJOYING THE GREAT OUTDOORS

Enjoying the great outdoors is important to many of us. Boating, fishing, hunting, and wildlife watching are traditions that we want to preserve for our children and their children. Today, these traditions are at risk. Aquatic invaders such as zebra mussels, purple loosestrife, Eurasian water-milfoil, bighead and silver carp, threaten our valuable waters and recreation. These and other non-native, or exotic, plants and animals do not naturally occur in our waters and are called invasive species because they cause ecological or economic harm.

These invasive species can get into lakes, rivers, and wetlands by "hitching" rides with anglers, boaters, and other outdoor recreationists, who transport them from one waterbody to another.

Once established, these "aquatic hitchhikers," can harm native fisheries, degrade water quality, disrupt food webs and reduce the quality of our recreational experiences.



The good news is that the majority of waters are not yet infested with invasive species and by taking the necessary steps you can help protect our valuable waters.

If you think you have found an INVASIVE SPECIES:

REPORT NEW SIGHTINGS

If you suspect a new infestation of an invasive plant or animal, save a specimen and report it to a local Department of Natural Resources or Sea Grant office. Wisconsin has "ID" cards, websites, and volunteer monitoring networks to help you identify and report invasive species.

CONSULT YOUR NATURAL RESOURCE AGENCY

Do-it-yourself control treatments may be illegal and can make matters worse by harming native fish, wildlife, and plants. Before attempting to control an invasive species or add new plants along your shoreline, contact your local Department of Natural Resources office. DNR staff can provide recommendations and notify you what permits are required.

DNR.WI.GOV search "Aquatic Invasives"

STOP AQUATIC HITCHHIKERS

IS A NATIONAL CAMPAIGN THAT HELPS RECREATIONAL USERS TO BECOME PART OF THE SOLUTION TO STOP THE TRANSPORT AND SPREAD OF AQUATIC INVASIVE SPECIES.

IN WISCONSIN IT IS THE LAW...

Aquatic hitchhikers can spread in many ways such as on recreational equipment, and in water. Fortunately, there are a few simple actions you can take to prevent them from spreading.

INSPECT boats, trailers, and equipment

REMOVE all attached aquatic plants, animals, and mud before launching and before leaving the water access.

Many invasive species spread by attaching themselves to boats, trailers, and equipment and "hitching a ride" to another waterbody. Therefore, Wisconsin law requires that you remove these aquatic hitchhikers before you launch your boat or leave the access area.

DRAIN all water from your boat, motor, bilge, live wells, bait containers and all equipment before leaving the water access.

Many types of invasive species are very small and easily overlooked. In fact, some aquatic hitchhikers, like zebra mussel larvae, are invisible to the naked eye. To prevent the transport of these aquatic hitchhikers drain water from all equipment before you leave the access area.

Draining ballast water and lake or river water can prevent the spread of aquatic invasive species and fish diseases, like VHS.

For more information visit:
DNR.WI.GOV and search "bait laws"

NEVER MOVE plants or live fish away from a waterbody.

In Wisconsin, it is illegal to transport any aquatic plants, mud, live fish or live fish eggs away from any state waterbody. This includes live gamefish and roughfish, like gizzard shad. There are exceptions for minnows obtained from a Wisconsin licensed bait dealer or registered fish farm, which may be transported away live and used again:

- ***On the same waterbody, or***
- ***On any other waterbody if no lake or river water, or other fish were added to their container***

BUY minnows from a Wisconsin licensed bait dealer.

For more information on collecting your own minnows visit:
DNR.WI.GOV and search "VHS Prevention"

DISPOSE of unwanted bait and other animals or aquatic plants in the trash.

When possible, dispose of unwanted bait in the trash at access points. Never release them into the environment.

If possible, dispose of ALL unwanted bait (including earthworms) in a trash can at the boat landing or access point. Otherwise, take them home and dispose of them by placing them in the trash, composting them, or using them in a garden as fertilizer. Likewise, other aquatic plants or animals that you collect, or buy in a pet store, should NEVER be released into the wild.

WISCONSIN REGULATION

Wisconsin has several laws to prevent the spread of aquatic invasive species and the fish disease Viral Hemorrhagic Septicemia (VHS). Failure to follow Wisconsin law can result in fines up to or exceeding **$2000**. Don't be caught unaware!

ADDITIONAL STEPS:

Although not required by WI law, additional steps are highly recommended, particularly if you are transporting a boat and/or equipment from one waterbody to another. Additional steps include:

SPRAY, RINSE, or DRY boats and recreational equipment to remove or kill species that were not visible when leaving a waterbody. Before transporting to another water: ***Spray/rinse with high pressure, and/or hot tap water (above 104° F or 40° C), especially if moored for more than a day. OR Dry for at least five days.***

DISINFECT boats and recreational equipment to kill species and fish diseases that were not visible when leaving a waterbody. Many aquatic hitchhikers can survive out of water for some period of time. ***To prevent their spread, you can sanitize your boat, trailer or equipment by washing it with a mixture of 2 Tbs of household bleach per 1 gallon of water.***

OTHER WATER USES:

Don't get caught spreading aquatic invasive plants or animals! Wisconsin laws, as highlighted above, can apply to many types of water activities, not just boating and fishing. Although these activities might not seem dangerous, they CAN establish and spread invasive species. It is important you follow the steps above for all water activities in order to prevent the spread of aquatic invasive species. These activities include:

- ***Using personal watercraft***
- ***Shore and fly-fishing***
- ***Sailing***
- ***Scuba Diving***
- ***Waterfowl hunting***

FAILURE TO FOLLOW WISCONSIN LAWS CAN LEAD TO FINES.

For additional information contact your local DNR staff or visit:
DNR.WI.GOV

Protect Your Boat

Zebra mussels attach to a variety of materials, including fiberglass, aluminum, wood, and steel and may damage a boat's finish. Veligers are extremely small and can be drawn into engine passages. Once they settle out in the engine cooling system, they can grow into adults and may block intake screens, internal passages, hoses, seacocks, and strainers. The best ways for boat owners to avoid these types of damage are:

- **Use a boatlift** to completely remove the watercraft from the water when not in use.

- **Run your boat regularly** if it is moored in zebra mussel infested waters. Run the engine at least twice a week at slow speeds (about 4-½ mph) for 10 to 15 minutes. Monitor engine temperatures – if you notice an increase, it may mean that zebra mussels are clogging your cooling system. Immediately inspect the system and remove any zebra mussels. The end of boating season is also a good time to inspect and clean the cooling system.
- **Lift the motor out of the water between uses if mooring.** Fully discharge any water that may still remain in the lower portion of the cooling system.
- **Tip down the motor and discharge the water when leaving a waterbody** to reduce the likelihood of transporting veligers (in water) to another waterbody.
- **Clean your boat and equipment.** Physically remove (scrape) adult mussels from your boat, trailer, and equipment by hand. Young zebra mussels and veligers may be too small to see. Wash your boat with high-pressure hot water (use water >104˚F if possible). Use high-pressure cold water if hot water is not available. *(Avoid pressure washing classic wooden boats or others not made of metal.)*
- **Apply anti-fouling paints or coatings to the hull and the engine's cooling system** to prevent zebra mussel attachment. It is best to purchase these from an area boat dealer or your local marina. Anti-fouling paints that are copper based can be used in Wisconsin, and typically need to be reapplied every one to two years. In-line strainers can also be installed in the engine's cooling system.
- **Use motor "muffs", also known as motor flushers, to remove zebra mussels and other materials from your boat engine or personal watercraft.** Clamp the motor flusher onto the lower unit over the cooling inlets on either side of the motor, and screw the nozzle of your garden hose into it. Run the boat engine for approximately 10 minutes or as suggested by the manufacturer.

Amy Bellows, WI DNR

Special note of caution for anglers

Dispose of unwanted bait in the trash - do not transfer bait or water from one waterbody to another. Larval zebra mussels or other invasive species could be present in the water with the bait.

Help prevent aquatic hitchhikers from catching a ride on your boat or equipment:

- ✓ **Inspect** and **remove** aquatic plants and animals,
- ✓ **Drain** water,
- ✓ **Dispose** of unwanted bait in the trash,
- ✓ **Rinse** with hot and/or high-pressure water, OR
- ✓ **Dry** for 5 days.

Clean Boats . . . Clean Waters

For a list of known zebra mussel infested waters, visit:
www.dnr.wi.gov/org/water/wm/GLWSP/exotics/zebra.html

WISCONSIN DEPT. OF NATURAL RESOURCES

UW EXTENSION

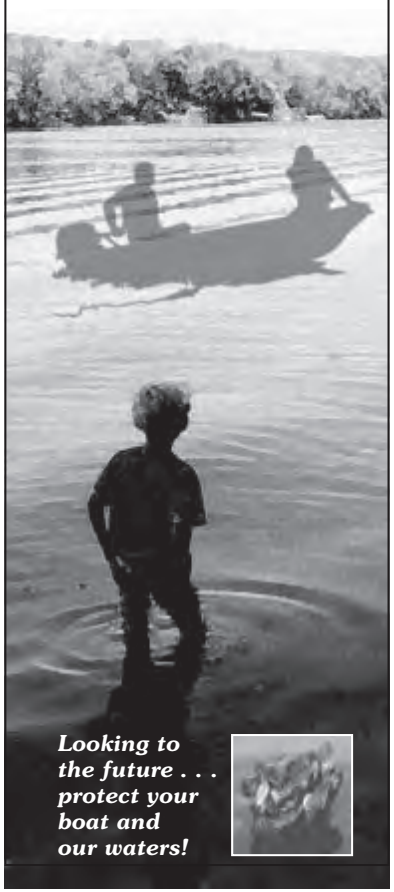
STOP AQUATIC HITCHHIKERS!™
Prevent the transport of nuisance species. Clean all recreational equipment.
www.ProtectYourWaters.net

PRINTED ON RECYCLED PAPER

Sea Grant

Cover photo: L. Pohlod. Inset: Great Lakes Sea Grant Network
Designed by L. Pohlod, Blue Sky Design, LLC *PUB-WT-383 2004*

Zebra Mussel Boater's Guide



Zebra mussel identification and life cycle

Mature zebra mussels look like small D-shaped clams. Their yellowish-brown shells have alternating light and dark stripes.

Ohio Sea Grant

Zebra mussels can reach a maximum of 2 inches in length, though most are smaller than an inch. They are typically found attached to solid objects, often growing in large clusters.

Ontario Ministry of Natural Resources

Amy Bellows, WI DNR

Zebra mussels begin as eggs, then develop into free-swimming larvae (called **veligers**), which are microscopic. The veliger photos shown above were taken with the aid of a microscope. Veligers are spread by currents; after about three weeks, they settle out and firmly attach themselves to hard surfaces, where they grow into adults. Their lifespan is typically three to five years. They begin to reproduce after a year or two - females can release up to one million eggs per year!

James Lubner, University of Wisconsin Sea Grant

What do zebra mussels do?

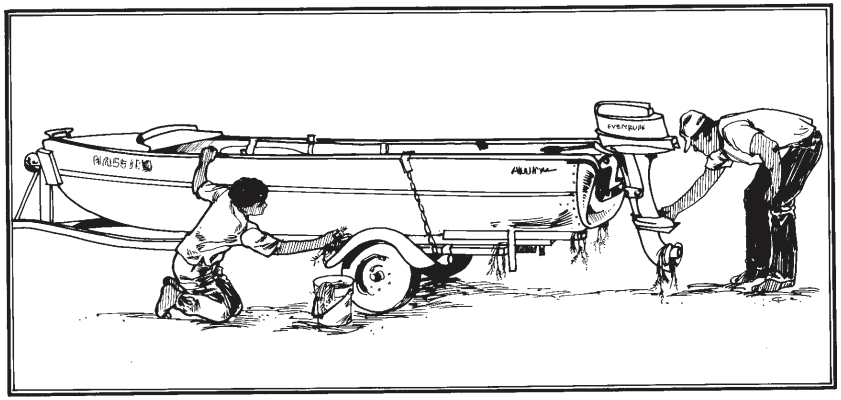
Zebra mussels are **filter feeders** that can filter large volumes of water (up to 1 Liter/day). In some cases they can filter the whole volume of a lake in a few months. They remove plankton – tiny plants and animals – from the water. What they eat (and what they don't eat) ultimately ends up on the lake or river bottom. Plankton is an important food source for young fish, native mussels, and other aquatic organisms. Zebra mussels may concentrate this food at the bottom, leaving open water species with **less to eat**!

Because they are so good at filtering, zebra mussels often **make water clearer**. This may force **light-sensitive fish**, like salmon and walleye, into deeper water to seek shelter from the sun. Increased light penetration allows aquatic plants to grow in deeper water and spread to a larger area. This may help smaller fish to survive by giving them places to hide, but makes it harder for large, predatory fish to find food. **Thicker plant growth** may also cause problems for boaters and anglers.

Don Schloesser, Great Lakes Science Center, National Biological Services

Zebra mussels cause people additional problems. They **clog water intakes and pipes** – large water users on the Great Lakes spent $120 million from 1989 to 1994 to combat zebra mussels. They also **attach to piers, boatlifts, boats, and motors**, which can cause damage requiring costly repair and maintenance. Even when they die, their **sharp shells** wash up on beaches, creating foul odors and cutting the feet of swimmers.

How can I help prevent the spread of zebra mussels?



Microscopic veligers may be carried in livewells, bait buckets, bilge water – any water that's transported to another waterbody. They can also travel in currents to downstream waters. Adults can attach to boats or boating equipment that are moored in the water. They frequently attach to aquatic plants, which themselves may hitch a ride on boats and equipment. For these reasons, it is important to take the following steps to prevent the spread of zebra mussels and other aquatic invasive species while boating:

Before moving your boat from one water body to another:

- ✓ **Inspect** and **remove** aquatic plants, animals, and mud from your boat, trailer, and equipment,
- ✓ **Drain** all water from your equipment (boat, motor, bilges, transom wells, live wells, etc.),
- ✓ **Dispose** of unwanted bait in the trash, not in the water,
- ✓ **Rinse** your boat and equipment with hot (> 104˚F) and/or high pressure water, particularly if moored for more than one day, OR
- ✓ **Dry** your boat and equipment thoroughly (in the sun) for five days.

Pressure washing note:

Avoid pressure washing classic and wooden boats, along with canoes and kayaks that are not made of metal. These types of boats should be drained, cleared of all plant and animal materials, and left in the sun to dry completely.

Effective May 2002, Section 30.715, WI Act 16 prohibits launching a boat or placing a boat or trailer in navigable waters if it has aquatic plants or zebra mussels attached.