Norrie Lake

Eastern Marathon County Lake Study

Final Study Results 2013

University of Wisconsin-Stevens Point
and
Marathon County Staff and Citizens

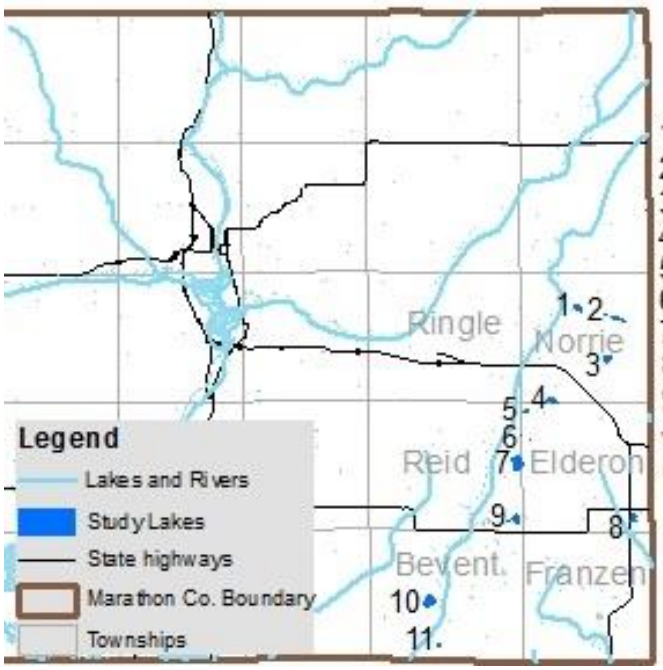
Healthy lakes add value to our communities. They provide a place to relax and recreate, and can stimulate tourism. Like any infrastructure, lakes require attention and good management practices to remain healthy in developed watersheds.

The purpose of this study is to learn about the current conditions of the fishery, habitat and aquatic ecosystems in order to help people make informed decisions to preserve what's good and correct any problems that exist.

To protect

the lake we must protect the "watershed," the land that drains or sheds its water into the lake.

Norrie Lake – Location



1: Mud
2: Mayflower
3: Norrie
4: Bass
5: Lost
6: Rice
7: Pike
8: Lilly
9: Mission
10: Big Bass
11: Wadley

Norrie Lake

Township of Norrie

East of County Road Y

Surface Area: 99.6 acres

Maximum Depth: 21 feet

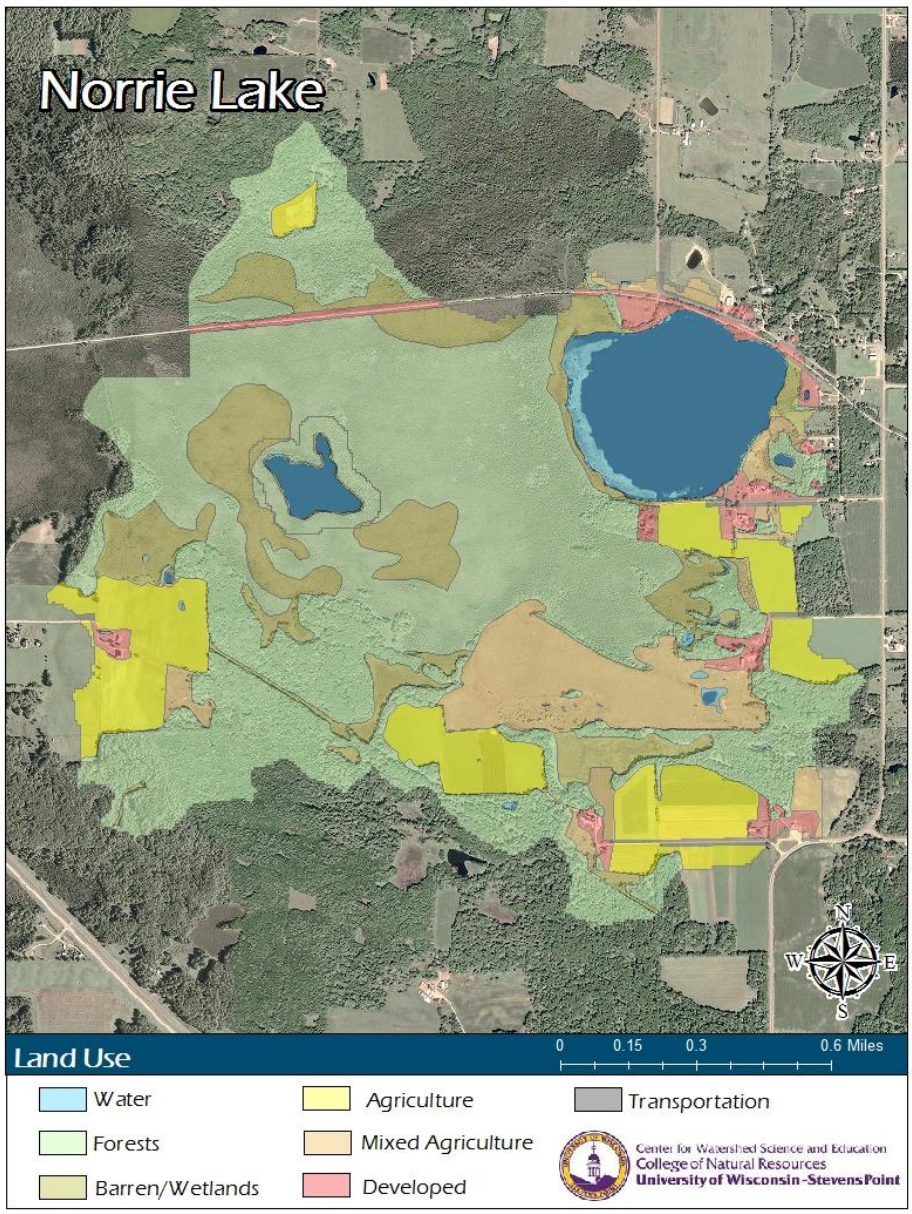
Water Flow

- Norrie Lake is a seepage lake that receives most of its water from groundwater inflow.
- Surface water runoff and direct precipitation also contribute water, but to lesser extents.
- Water exits Norrie Lake through groundwater.

Norrie Lake, Marathon Co.

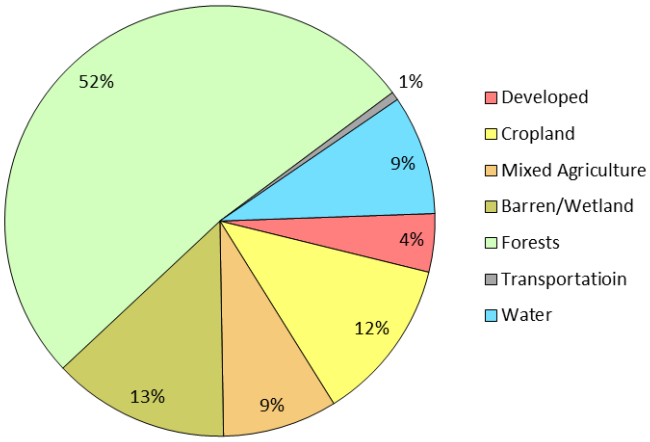
Norrie Lake – Surface Watershed

Surface Watershed: The area where water runs off the surface of the land and drains toward the lake.



- **Land uses** and land management practices occurring in the watershed affect the water quality in the lake.
- Land uses and land management also play major roles in how water moves across the landscape and how much water soaks into the ground (for long-term storage) or quickly runs off the land.
- The surface watershed of Norrie Lake is 647 acres.
- The primary land uses in the watershed are agriculture and forests.
- Residential development is scattered throughout the watershed and is adjacent to parts of the lake. In general, the land closest to the lake has the greatest immediate impact on water quality.

Land Use in the Norrie Lake Watershed

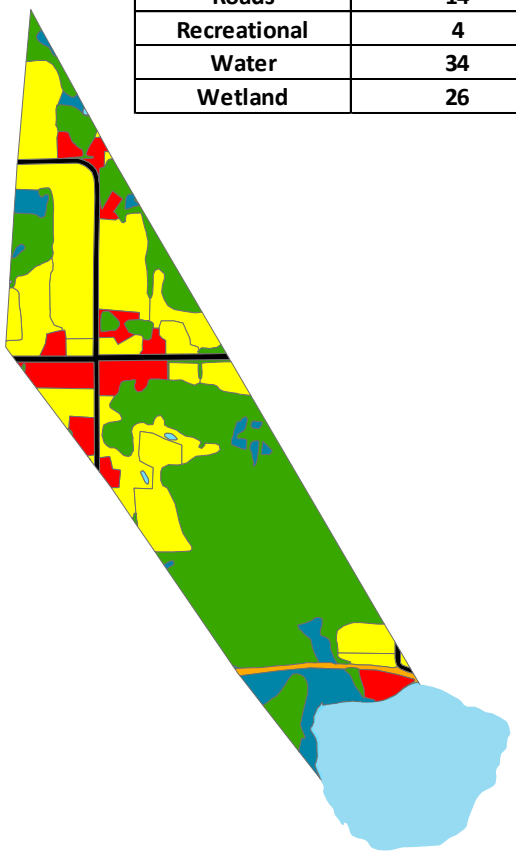


Norrie Lake – Groundwater Watershed

Groundwater Watershed: The area where water soaks into the ground and travels below ground to the lake.

- **Groundwater** slowly contributes water to our lakes throughout the year. Hard surfaces on the landscape prevent water from soaking into the ground and becoming groundwater. This results in less water flowing to the lake during the winter and between rains.
- The quality of groundwater reflects what is happening on the land's surface. Precipitation falling on forested land produces clean groundwater, whereas precipitation falling on residential or agricultural land can pick up chemicals and nutrients. Groundwater contamination in central Wisconsin may include nitrogen, pesticides, herbicides and other soluble chemicals originating from septic systems, crops, barnyards, road maintenance, etc. Once in the groundwater, these chemicals slowly move towards a lake or river.
- The groundwater watershed for Norrie Lake is 463 acres.
- The primary land uses in the Norrie Lake groundwater watershed are agriculture and forests.
- In general, the land adjacent to the lake where groundwater is entering the lake has the greatest immediate impact on water quality. Residential development, wetlands and forests are nearest the lake in the areas of groundwater inflow.

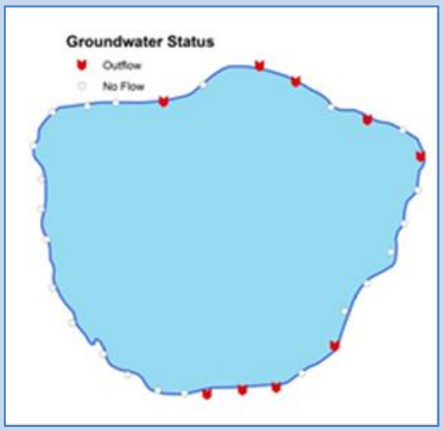
Land Use	Acres
Agriculture	147
Developed	36
Forested	202
Roads	14
Recreational	4
Water	34
Wetland	26



Looking at Groundwater Up Close:

No groundwater upwelling connections were observed at the sampling sites in Norrie Lake.

Groundwater exits Norrie Lake from the northeast and the southeast.



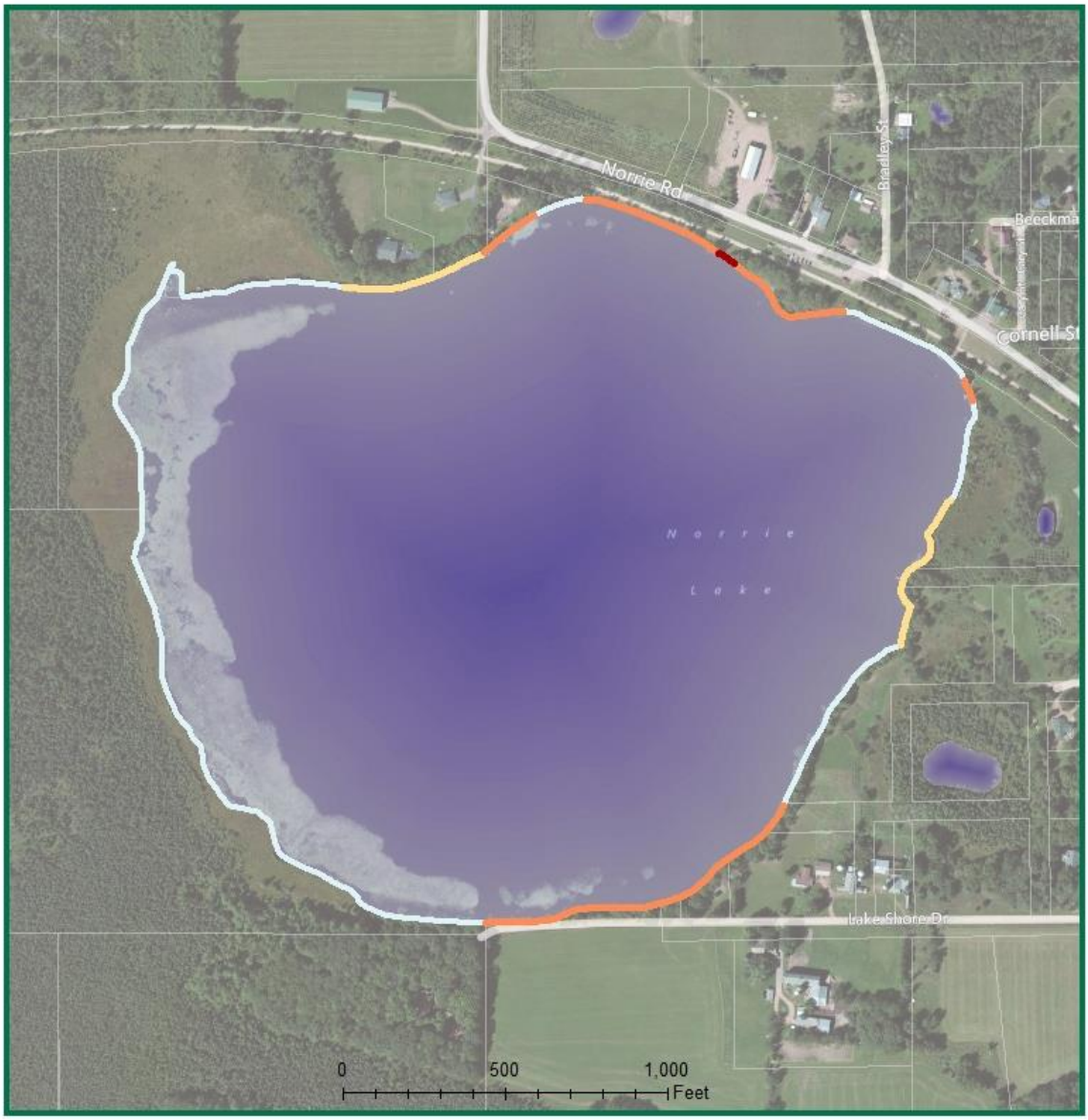
Norrie Lake – Shoreland Vegetation

Shoreland vegetation is critical to a healthy lake's ecosystem. It provides habitat for aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The map below shows how far the 0.5 to 3 foot tall vegetation exists landward from the edge of Norrie Lake. A greater vegetative buffer provides more habitat and better water quality.

Buffer Depth
- No Buffer
- <1'
- 1-5'
- 5-15'
- 15-35'
- **35-50' ***
- >50'

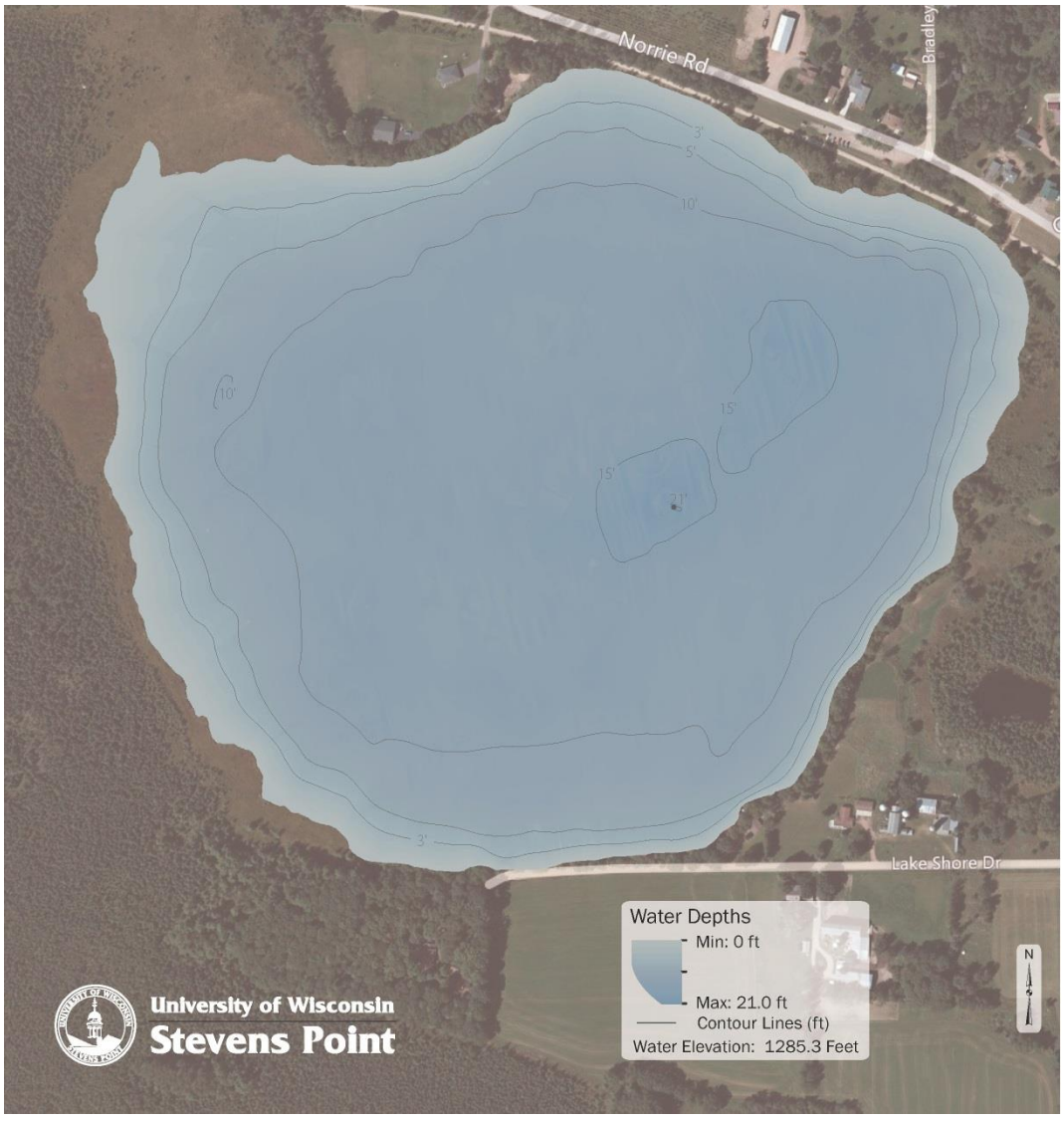
*NR 115 requires at least a 35 foot wide shoreline buffer



Norrie Lake – Lake Map

Norrie Lake's shape and depth play major roles in determining:

- Where aquatic plants can and cannot grow
- Types of fish and where they live
- How fast water in the lake warms up and cools down
- The water quality of the lake
- Abundance of habitat for species living in the water and on the land



NORRIE LAKE
BATHYMETRIC MAP

Map funded by the Wisconsin Department of Natural Resources Lake Planning Grant Program, Marathon County, Marathon County citizens, and lake and fishing groups.

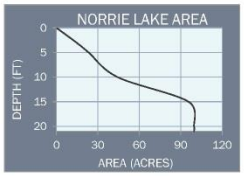
MARATHON COUNTY, WISCONSIN

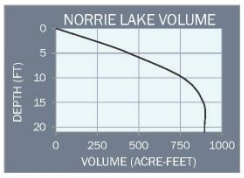
GPS and Sonar Survey
June, 2012

University of Wisconsin-Stevens Point Center for Watershed Science and Education, College of Natural Resources and the GIS Center, College of Letters and Science.

Cartography by Christine Koeller

LAKE AREA	99.6	Acres
Under 3 Feet	14.5	Acres (14.6%)
Over 20 Feet	<1	Acres (<1%)
VOLUME	896	Acre-feet
SHORELINE	1.6	Miles
MAX DEPTH	21.0	Feet





Norrie Lake – Fishery

Many factors determine which fish species thrive in a lake. Physical factors include the lake's type, depth, surface area, geology and lake bed materials. Water quality in the lake also plays a role: water clouded with sediment or algae reduces the success of visual feeders, while low levels of dissolved oxygen will limit the fish population to those that can tolerate periods with low oxygen.

Total catch and length of species in Norrie Lake, 2012 survey

Species	Min Length (in)	Max Length (in)	Average Length (in)	Total Catch
Bluegill	0.9	9.3	4.6	157
Yellow Perch	0.8	4.8	1.8	127
Largemouth Bass	0.9	4.1	1.9	66
Smallmouth Bass	1.4	2.8	2.1	24
Black Crappie	1.1	10.4	5.8	23
Walleye	5.8	22.4	14.9	16
Black Bullhead	0.9	14.6	9.8	7
Pumpkinseed	4.6	7.6	5.9	4

Species occurrence in Norrie Lake in the 2012 survey and historical Wisconsin DNR records

Species	1970	1972	1977	1979	1986	1987	1988	2003	2012
Black Bullhead		x	x						x
Black Crappie		x	x	x	x	x	x	x	x
Bluegill		x	x	x	x	x	x		x
Largemouth Bass		x	x	x	x	x	x	x	x
Northern Pike		x				x			
Pirate Perch	x								
Pumpkinseed				x				x	x
Smallmouth Bass									x
Walleye					x	x	x		x
Yellow Perch		x	x	x	x	x	x	x	x

- Northern pike and pirate perch were documented previously but not detected during 2012. Pirate perch is a species of special concern in Wisconsin.
- The presence of young bass and abundant sunfish sampling indicates successful reproduction is occurring in Norrie Lake.
- The absence of young northern pike in the 2012 sampling may be an indicator of poor reproduction, although more intense population sampling over several seasons would be required to determine this.
- Young walleye were present in Norrie Lake; however, conclusions about natural reproduction would require more intensive sampling.

- Norrie Lake supports a warm water fish community. Historic stocking consists of yellow perch, rock bass, largemouth bass, black crappie, northern pike, muskellunge, smallmouth bass, and in recent years, walleye.
- In 1967, a fish barrier was placed between Norrie Lake and the Embarrass River system to prohibit migration of northern pike that were thought to be negatively impacting the trout population.
- By 1972, fish management focused on producing stable populations of northern pike, largemouth bass and panfish. Walleye and muskellunge stocking was not recommended at this time (and reiterated in a 1978 report) due to a lack of good spawning habitat.
- Fish cribs were installed in various locations following a 1976 permit request.

Norrie Lake – Lake Map

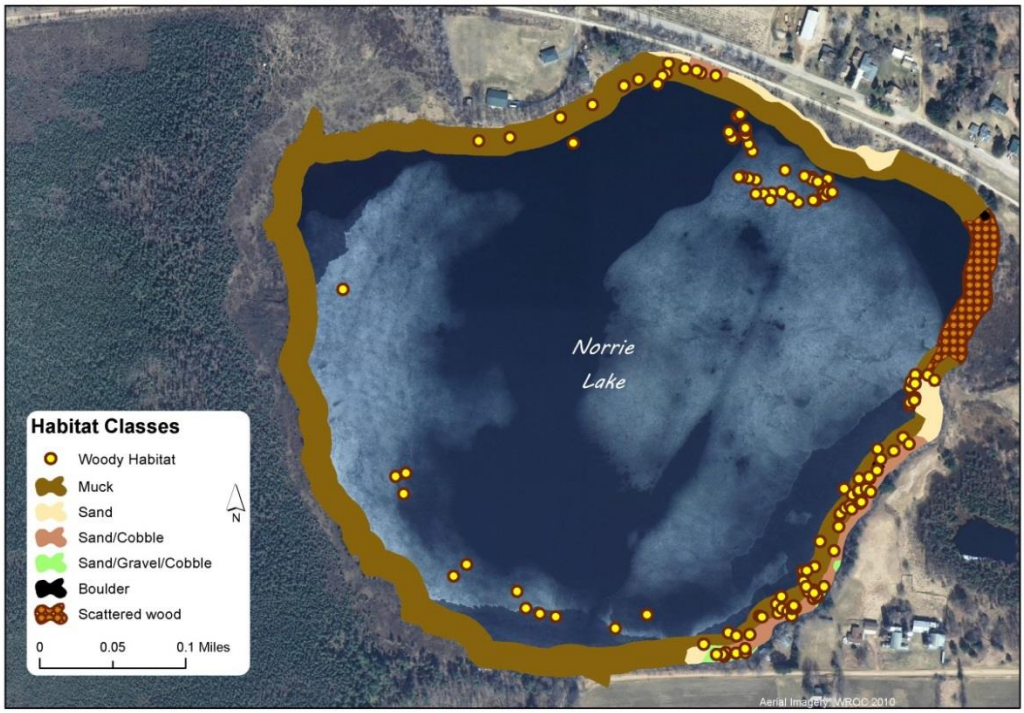
Habitat in and near the lake plays a major role in the composition of a fish community. Habitat is a combination of aquatic plants, woody structure, and lake substrate. Near the shore is found some of the most important fishery habitat.

Coarse woody habitat (CWH) is an important component of a healthy and balanced fishery, playing a key role in the life histories of many fish species. Downed trees, logs and branches along with aquatic plants offer refuge from predators, sheltered substrates for spawning, nurseries for young, and feeding grounds to forage for insects and algae. CWH is very important to other animals that live in or visit a lake including turtles, frogs, birds and mammals.

Coarse woody habitat (CWH) is abundant in Norrie Lake, particularly on the northeastern shore, where scrap wood was deposited by an historic logging operation. Many logs and pieces still cover the bottom today.

This is excellent spawning habitat, protective cover and foraging grounds for aquatic organisms.

Substrate and Coarse Woody Habitat - Norrie Lake
Marathon County, WI 2012



- Gravel areas are used by many species for spawning habitat, including sunfish (bluegill, pumpkinseed and black bass), where males will construct nests and guard their young.
- Northern pike use areas with emergent and floating-leaf vegetation in shallow or flooded areas for spawning.
- Black crappie use bulrush habitat on gravel or sand substrates where they construct nests and guard young. Bulrush is sparse in Norrie Lake.
- Yellow perch and walleye use near-shore cobble in oxygen-rich environments for spawning activity. Sand can be important habitat for non-game minnow reproduction.

Norrie Lake –Aquatic Plants

Aquatic plants are the forest landscape within a lake. They provide food for creatures including fish, ducks and turtles, and habitat for fish, invertebrates and other aquatic animals. They create oxygen in the water and utilize nutrients that would otherwise be used by algae. A healthy lake typically has a variety of aquatic plant species creating diversity that can help to prevent the establishment of aquatic invasive species.

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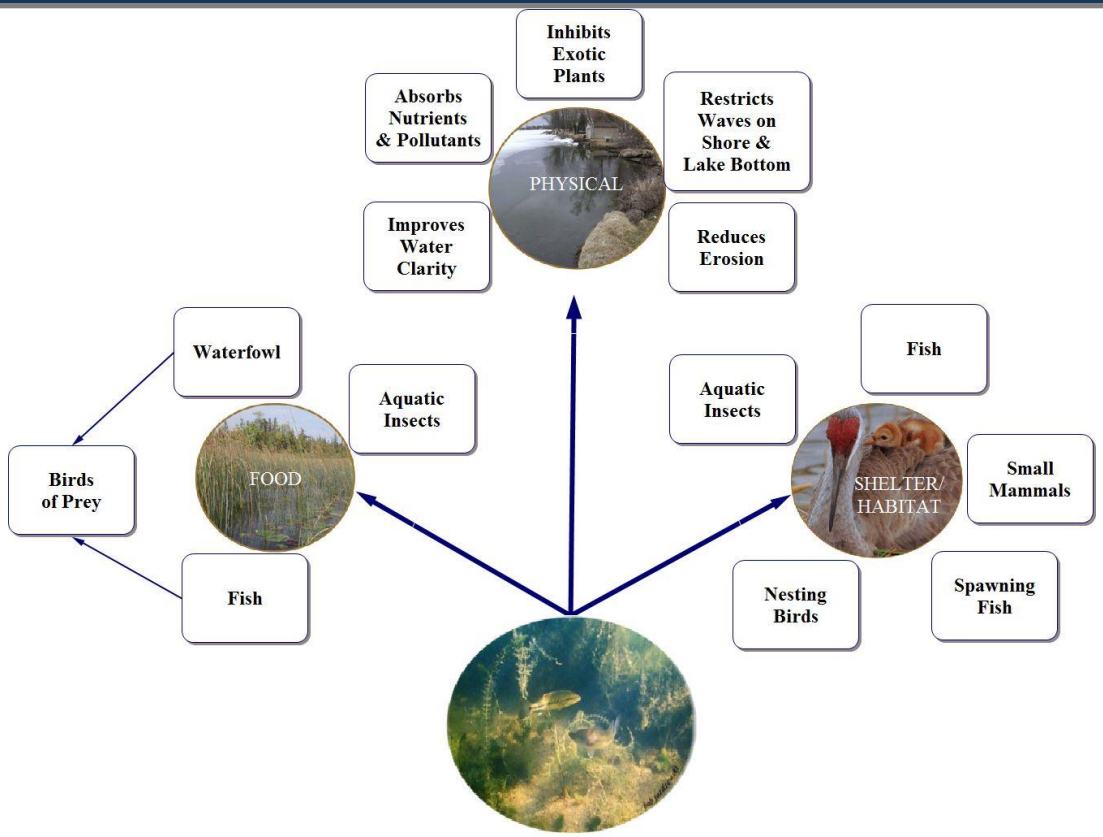


AQUATIC PLANTS
Food and Refuge for Aquatic Life

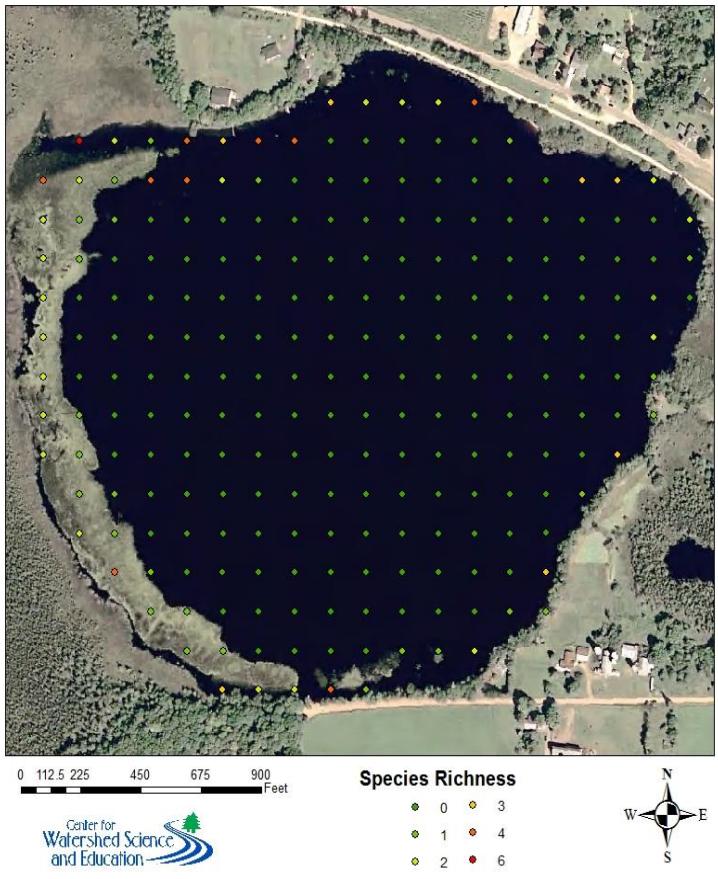
- The aquatic plant community in Norrie Lake is characterized by an average diversity when compared to other lakes in the Marathon County study.
- Aquatic vegetation was found at 50 percent of the sample sites. Most plant growth occurred at depths between 2 and 4 feet.
- The western shore of Norrie Lake is adjacent to a very large bog and is impacted by relatively little development. The bog complex is an excellent habitat with a variety of plant species, which provides multiple benefits to Norrie Lake.
- The water of Norrie Lake is stained, most likely due to tannins from the bog around the lake. Together with algae growth and suspended sediments, the dark water impedes light penetration and is one of the primary factors limiting plant growth in the lake.

Norrie Lake – Aquatic Plants

- The aquatic plant survey in 2012 documented twenty-four species of aquatic plants in Norrie Lake. All of the species present in Norrie Lake are high quality species that are indicative of a healthy lake ecosystem.
- Three species of special concern in Wisconsin were found in Norrie Lake, including the most common plant species in the survey, large purple bladderwort (*Utricularia purpurea*). These species are relatively uncommon and intolerant of disturbance.
- The 2012 aquatic plant survey of Norrie Lake found no non-native plant species. This demonstrates diligence by lake users in cleaning watercraft before entering the lake to prevent non-native species transfer.

Species Richness is a count of the number of plant species found at a survey point. A greater number of species in a lake helps to make the aquatic plant community more resilient to year-to-year changes and aquatic invasive species. More plant species means more diverse habitat and available food sources.

Norrie Lake 2012 Aquatic Plant Survey:
Species Richness



Bladderworts are carnivorous plants. They use special trigger hairs to sense an insect—which then is drawn into digestive "bladders" in the plant. **Large purple bladderwort** is a species of special concern in Wisconsin and is found in Norrie Lake!

Large purple bladderwort

Norrie Lake – Aquatic Invasive Species

Aquatic Invasive Species are non-native plants or animals that may cause significant harm to a lake's ecosystem. Typically, they are introduced to a lake by hitching a ride on clothing, boats, trailers and other water recreation equipment. Aquatic invasive species can be introduced to a lake accidentally or intentionally. Once in a lake, they may be impossible to completely remove and can be difficult and costly to control. Prevention and early detection are the best ways to keep aquatic invasive species from establishing in a lake.

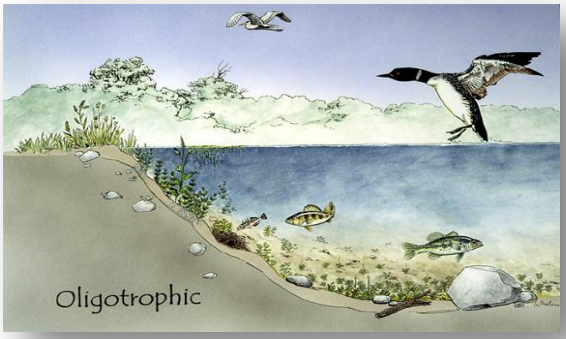
Lakes With Aquatic Invasive Species in Marathon and Northern Portage County, 2012

Lake Name	Banded Mystery Snail	Chinese Mystery Snail	Rusty Crayfish	Curly-Leaf Pondweed	Eurasian Water Milfoil	Purple Loosestrife
Marathon County (Shaded lakes are part of Eastern Marathon Co. Lake Study)						
Big Bass Lake	✓					
Big Rib River			✓		✓	
Eau Claire Flowage		✓			✓	
Flume Creek			✓			
Johnson Creek			✓			
Lake Wausau				✓		
Little Rib River			✓			
Little Trappe River			✓			
Lost Lake		✓				
Mayflower Lake		✓		✓		
Mission Lake	✓				✓	✓
Pike Lake	✓			✓		
Rice Lake	✓	✓		✓		
South Branch Embarrass River			✓			
Spring Brook			✓			
Trappe River			✓			
Wadley Lake	✓	✓		✓	✓	
Wausau Dam Lake					✓	
Wisconsin River			✓		✓	
Northern Portage County						
Tree Lake	✓	✓		✓		
Plover River			✓			
Lake Du Bay		✓	✓	✓	✓	

Learn to identify invasive species & look for them in your lake!

Norrie Lake – Water Quality

Lakes go through a natural aging process that results in increased aquatic plant growth, fish, and wildlife over time. Within a lake's watershed, human activity on the land, in a wetland, or in the lake can dramatically accelerate this process. Depending on land management practices, changes in a lake that may have normally taken centuries to occur may take place in decades or even years. The amounts of nutrients, algal growth, and water clarity measurements help to define the age of a lake. Based on these measures, lakes can be classified for comparison to one another.



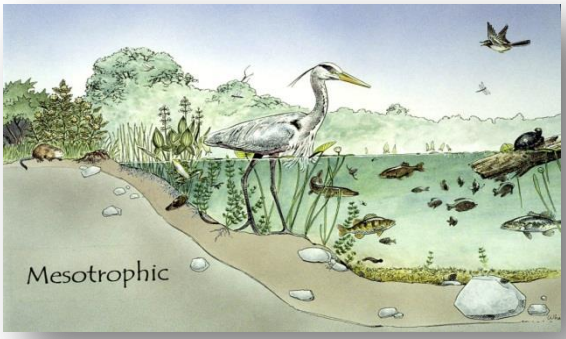
Oligotrophic Lakes

Common uses:

- ✓ Swimming
- ✓ Skiing
- ✓ Boating

Vegetation of oligotrophic lakes:

- ✓ Very little vegetation



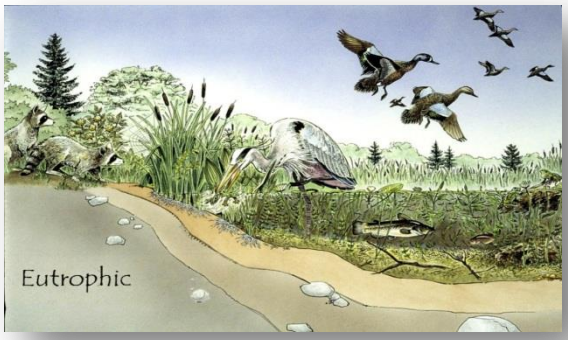
Mesotrophic Lakes

Common uses:

- ✓ Boating
- ✓ Fishing

Vegetation of mesotrophic lakes:

- ✓ Increased vegetation
- ✓ Occasional algal blooms



Eutrophic Lakes

Common uses:

- ✓ Fishing
- ✓ Wildlife watching

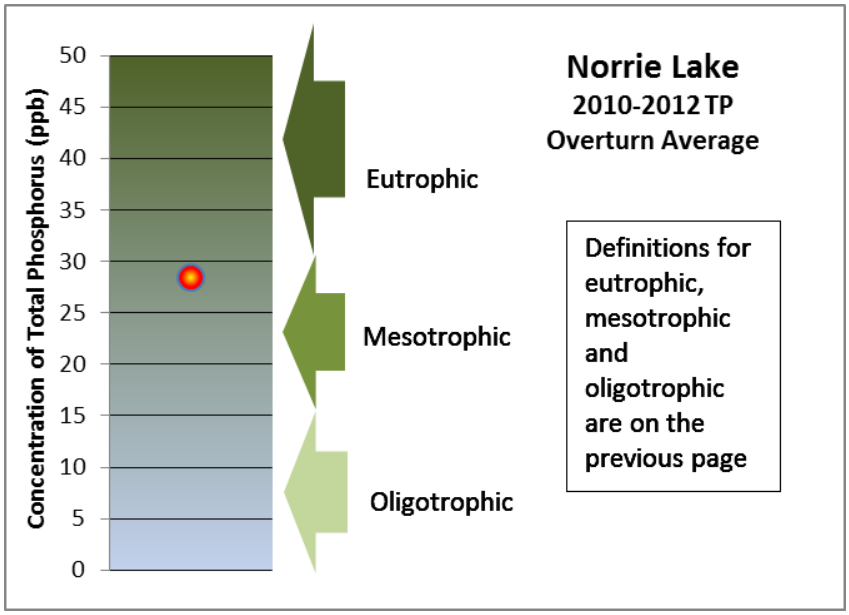
Vegetation of eutrophic lakes:

- ✓ Lots of aquatic plants
- ✓ Frequent algal blooms

Winter fish kills can occur in shallow lakes due to low oxygen levels.

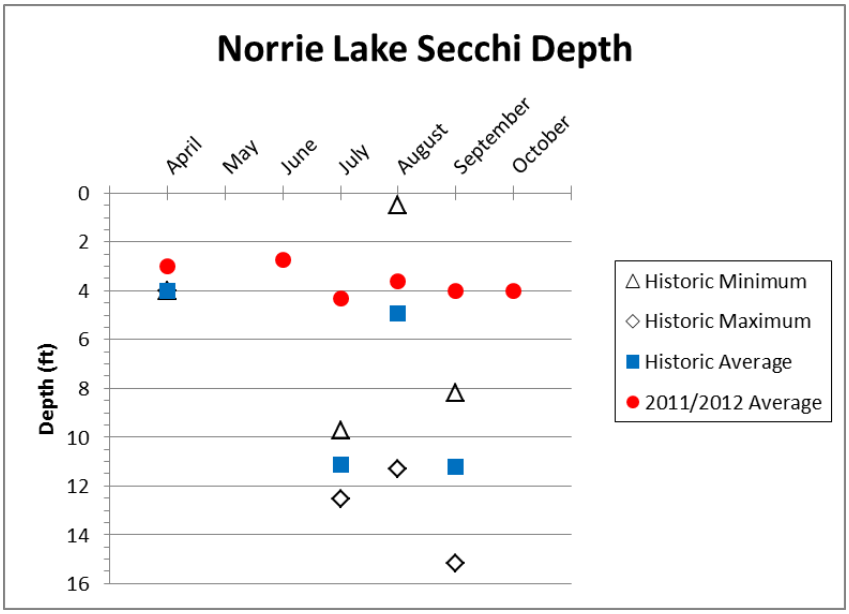
Norrie Lake – Water Quality

Phosphorus is a major nutrient that can lead to excessive algae and rooted aquatic plant growth in lakes. In fact, one pound of phosphorus entering a lake can result 300 to 500 pounds of algal growth. All Marathon County lakes have either sufficient or excessive nutrients for aquatic plant growth, so these lakes will benefit from limiting the addition of more nutrients. Sources of phosphorus include septic systems, animal waste, storm water runoff, soil erosion, and fertilizers for lawns, gardens and agriculture.



- Total phosphorus levels measured when Norrie Lake was well-mixed (overturn) are displayed in the graph to the left.
- Overturn sampling during the 2010-2012 monitoring period indicate that Norrie Lake is a mesotrophic lake with an average total phosphorus level slightly above mid-range.

Water clarity is a measure of how deep light can penetrate (Secchi depth). Clarity is affected by water color, turbidity (suspended sediment), and algae. Water clarity helps determine where rooted aquatic plants can grow.



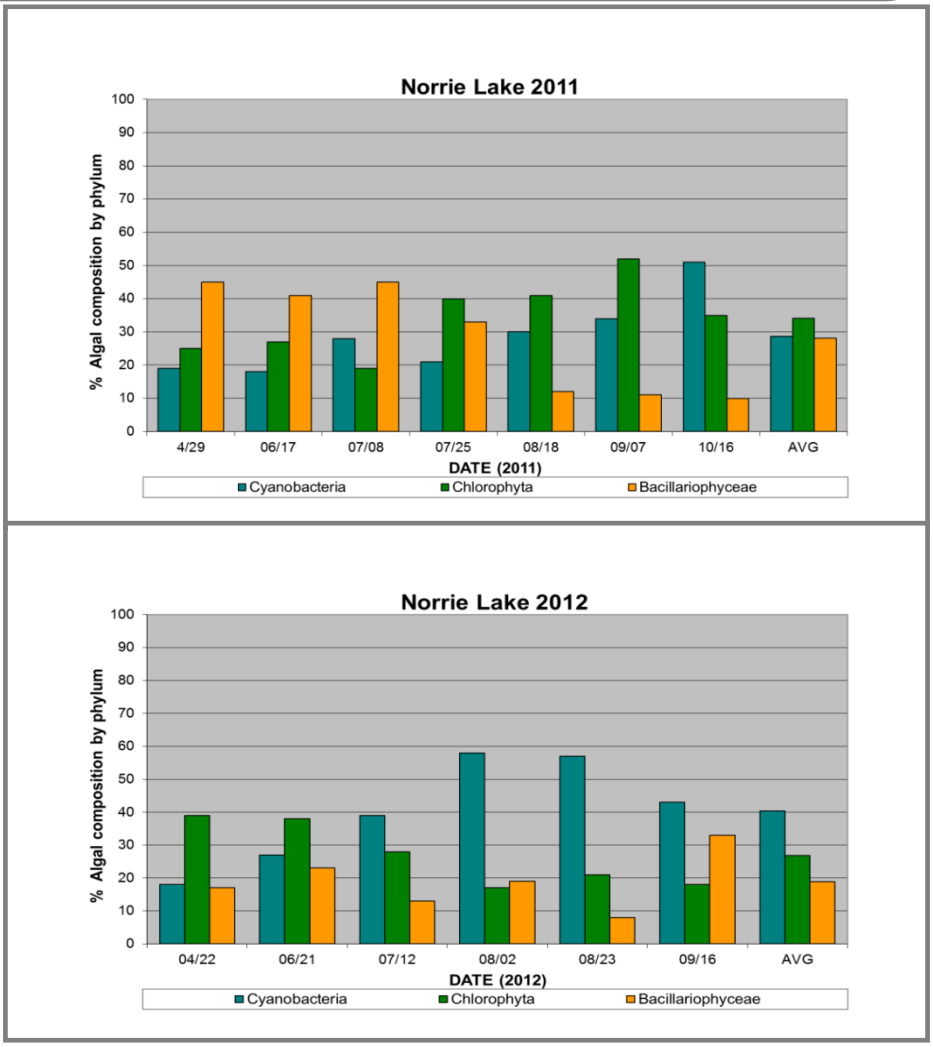
- The graph to the left shows water clarity data collected during the growing seasons in 2011 and 2012. It is typical for water clarity to vary throughout the year.
- The 2011/2012 average Secchi depth readings were relatively shallow and consistent with historic averages, except for the months of July and September. These readings were approximately seven feet shallower than historic values, suggesting recent changes may be impacting water clarity.

Norrie Lake – Algae

Algae are microscopic, photosynthetic organisms that are important food items in all aquatic ecosystems. Different algal groups increase or decrease during the year and they can be used to analyze a lake's water quality because there are more varieties of algae than fish or aquatic plants. Conclusions can be drawn about water temperature, nutrient availability, and overall water quality of a lake using algal populations.

In Marathon County lakes, there are three dominant groups of algae: blue-green algae (Cyanobacteria), green algae (Chlorophyta), and diatoms (Bacillariophyceae).

- The algae of Norrie Lake during 2011 and 2012 were diverse and balanced among the three main algal groups. Community composition patterns differed between the two years. The algal community reflected a moderately mesotrophic lake, possibly moving to a more eutrophic status.
- In both years, the blue-green algae became a dominant component during the mid- or late-season. The green algae and the diatoms each dominated early one of the two years, but in no predictable way.
- Norrie Lake showed an unsettled algal community with no regular seasonal patterns. The species present were a mixture of mesotrophic and eutrophic organisms, and the three major algal groups changed differently each year studied.
- The variable algal community, moderately high total phosphorus value and fluctuating water clarity may indicate a lake undergoing a change in trophic status.



PERCENT ALGAL COMPOSITION FOR NORRIE LAKE IN 2011 AND 2012

Blue-green algae have the widest tolerance range for temperatures and nutrient concentrations. Once well-established in a lake, blue-green algae are difficult to control and remove. A few varieties of blue-greens can produce toxins that are potentially harmful to livestock, pets and humans.

Norrie Lake – What can you do?

Lake Users:

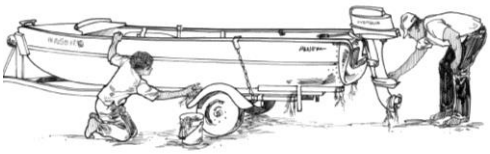
- ✓ Run boat engines efficiently
- ✓ Observe no/low wake zones
- ✓ Refuel away from water
- ✓ Dispose of trash properly
- ✓ Remove all aquatic plants from boats and trailers
- ✓ Respect wildlife and other lake users

Land Owners:

- ✓ Control soil erosion
- ✓ Keep livestock out of lakes and streams
- ✓ Control manure runoff
- ✓ Carefully manage nutrients and pesticides
- ✓ Leave natural shoreland vegetation in place or restore if it has been removed
- ✓ Learn to identify and look for invasive species

Home Owners:

- ✓ Leave natural shoreland vegetation in place or restore if it has been removed
- ✓ Leave woody habitat for young fish, turtles and frogs
- ✓ Eliminate the use of fertilizer or use no phosphorus fertilizer
- ✓ Eliminate or minimize use of pesticides
- ✓ Control soil erosion
- ✓ Control runoff from rooftops and hard surfaces
- ✓ Clean up after pets
- ✓ Learn to identify and look for invasive species



Stop the Spread of Aquatic Invasive Species!

Wetlands and Shorelands:

- LEARN how to identify invasive plants and animals, and who to contact if found.
- DO NOT PURCHASE prohibited and restricted species! Whenever possible purchase native plants.
- NEVER transplant water garden plants or aquarium plants into lakes, streams, wetlands, or storm water ponds. Properly dispose of unwanted plants and animals!
- REMOVE invasive exotic plants from your landscape and replace them with native plants or non-invasive exotic plants. Scout annually for new invasive plants.
- AVOID using garden plants from other regions whose invasive potential is poorly understood.

Lakes and Rivers:

- LEARN what Wisconsin invasive plants and animals look like and who to contact if seen in a lake or river.
- INSPECT your boat, trailer and equipment when traveling to different water bodies and REMOVE any attached aquatic plants or animals (before launching, after loading, and before transporting on a public highway).
- DRAIN all water from boats, motors, and all equipment after use at a lake.
- NEVER release live fish, bait or pets into a wetland or water body.
- BUY minnows from a Wisconsin bait dealer. Only use leftover minnows at that same water body.

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Norrie Lake – Primary Researchers

Algae

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- *Wisconsin DNR Lake Protection grants*
- *UW-Stevens Point and UW-Stevens Point Faculty*
- *Marathon County*
- *Marathon County Citizens*

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http://www.co.marathon.wi.us/Departments/ConservationPlanningZoning/ConservationDivision/LakePrograms.aspx

Center for Watershed Science and Education
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