Mud Lake

Eastern Marathon County Lake Study

Final Study Results 2013

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

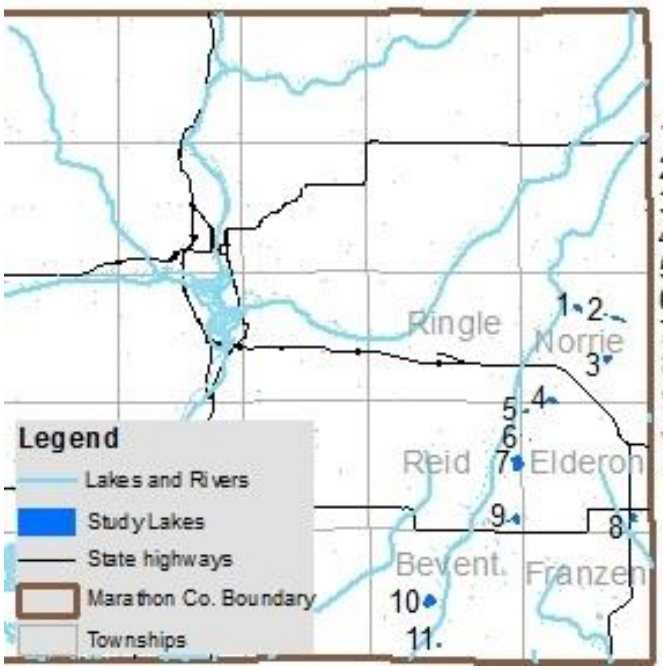
Healthy lakes add value to our communities. They provide a place to relax and recreate, and can stimulate tourism. Like any infrastructure, lakes require attention and good management practices to remain healthy in developed watersheds.

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.

Mud 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

Mud Lake

Township of Norrie

Northeast of Hatley

East of County Road Y

Surface Area: 70.1 Acres

Maximum Depth: 15.4 feet

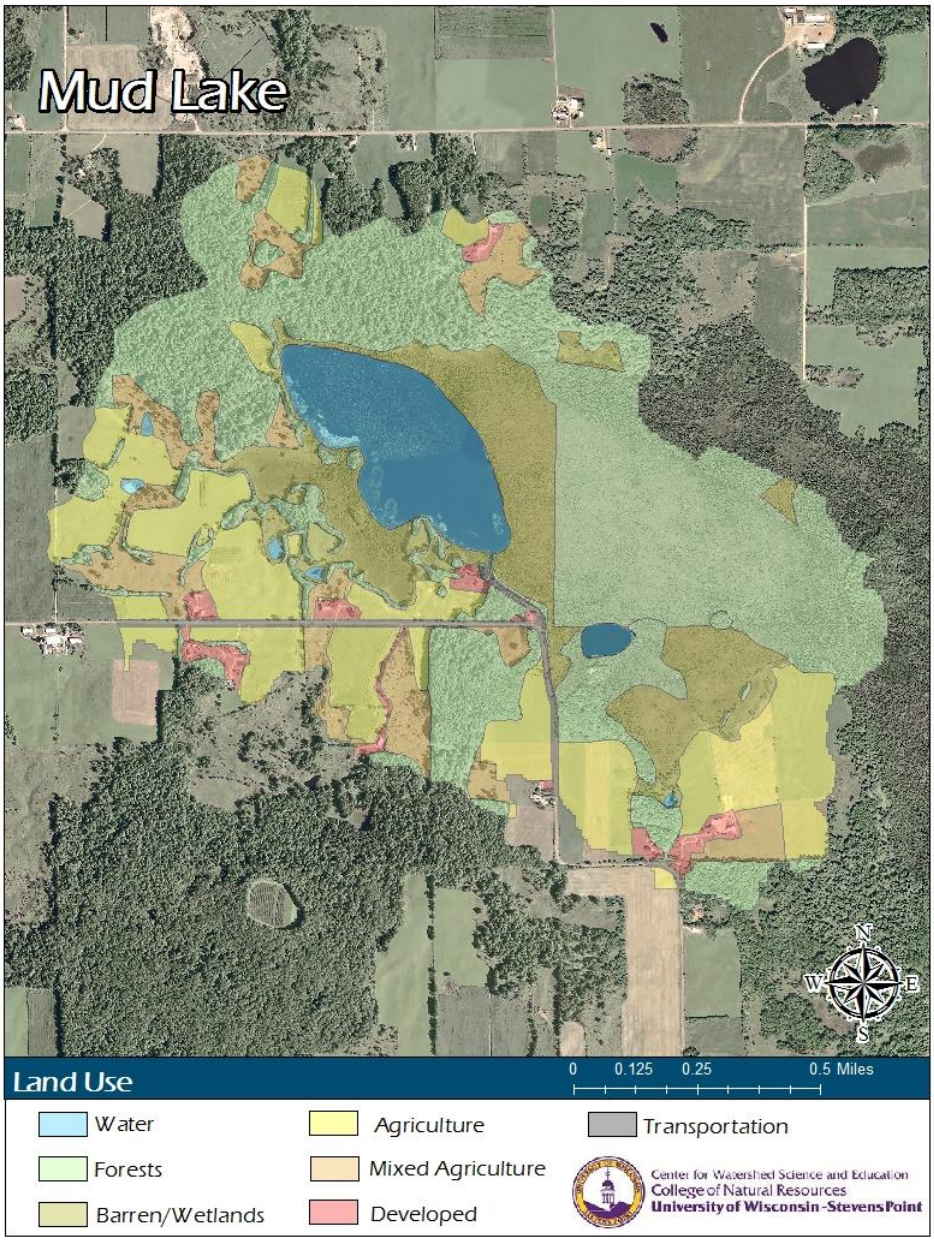
Water Flow

- Mud Lake is a seepage lake with most of the water entering the lake from groundwater.
- Surface water runoff and direct precipitation also contribute water, but to lesser extents.
- Water exits Mud Lake through groundwater.

Mud Lake, Marathon Co.

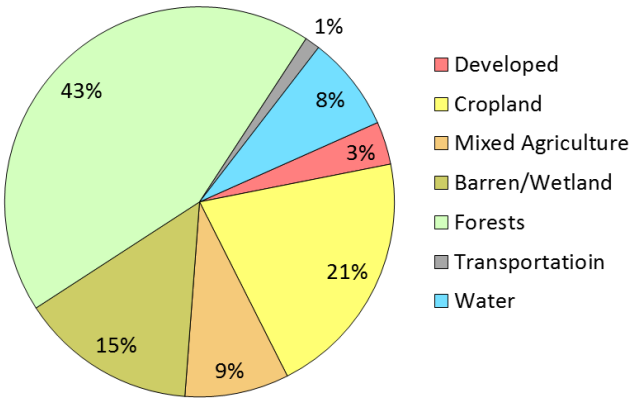
Mud Lake – Surface Watershed

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



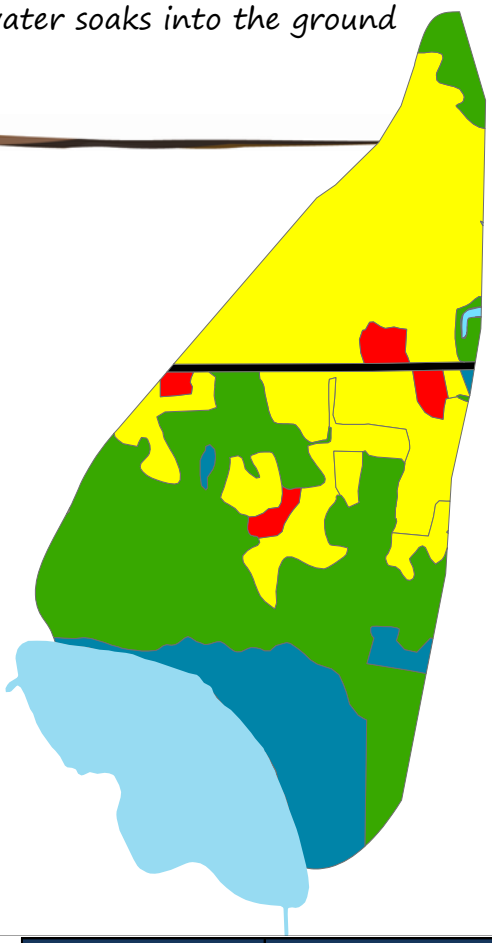
- **Land uses** and land management practices occurring in the watershed affect the water quality in the lake.
- Land uses and land management also play major roles in how water moves across the landscape and how much water soaks into the ground (for long-term storage) or quickly runs off the land.
- The surface watershed of Mud Lake is 354 acres.
- The primary land uses in the watershed are forests and agriculture.
- Forests and wetlands border the entire lake. In general, the land closest to the lake has the greatest immediate impact on water quality.

Land Use in the Mud Lake Waterrshed



Mud Lake – Groundwater Watershed

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



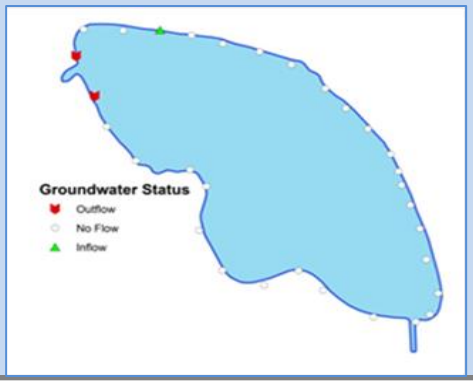
- **Groundwater** slowly contributes water to our lakes throughout the year. Hard surfaces on the landscape prevent water from soaking into the ground and becoming groundwater. This results in less water flowing to the lake during the winter and between rains.
- The quality of groundwater reflects what is happening on the land surface. Precipitation falling on forested land produces clean groundwater, whereas precipitation falling on lands that have chemical use can leach contaminants to groundwater. 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 Mud Lake is 339 acres.
- The primary land uses in the Mud Lake groundwater watershed are agriculture and forests.
- In general, the land adjacent to the lake where groundwater is entering has the greatest immediate impact on water quality. Wetlands and forests are nearest the lake in the areas of groundwater inflow.

Land Use	Acres
Agriculture	132
Developed	8
Forested	126
Roads	4
Water	27
Wetland	42

Looking at Groundwater Up Close:

Groundwater enters Mud Lake from the northeast.

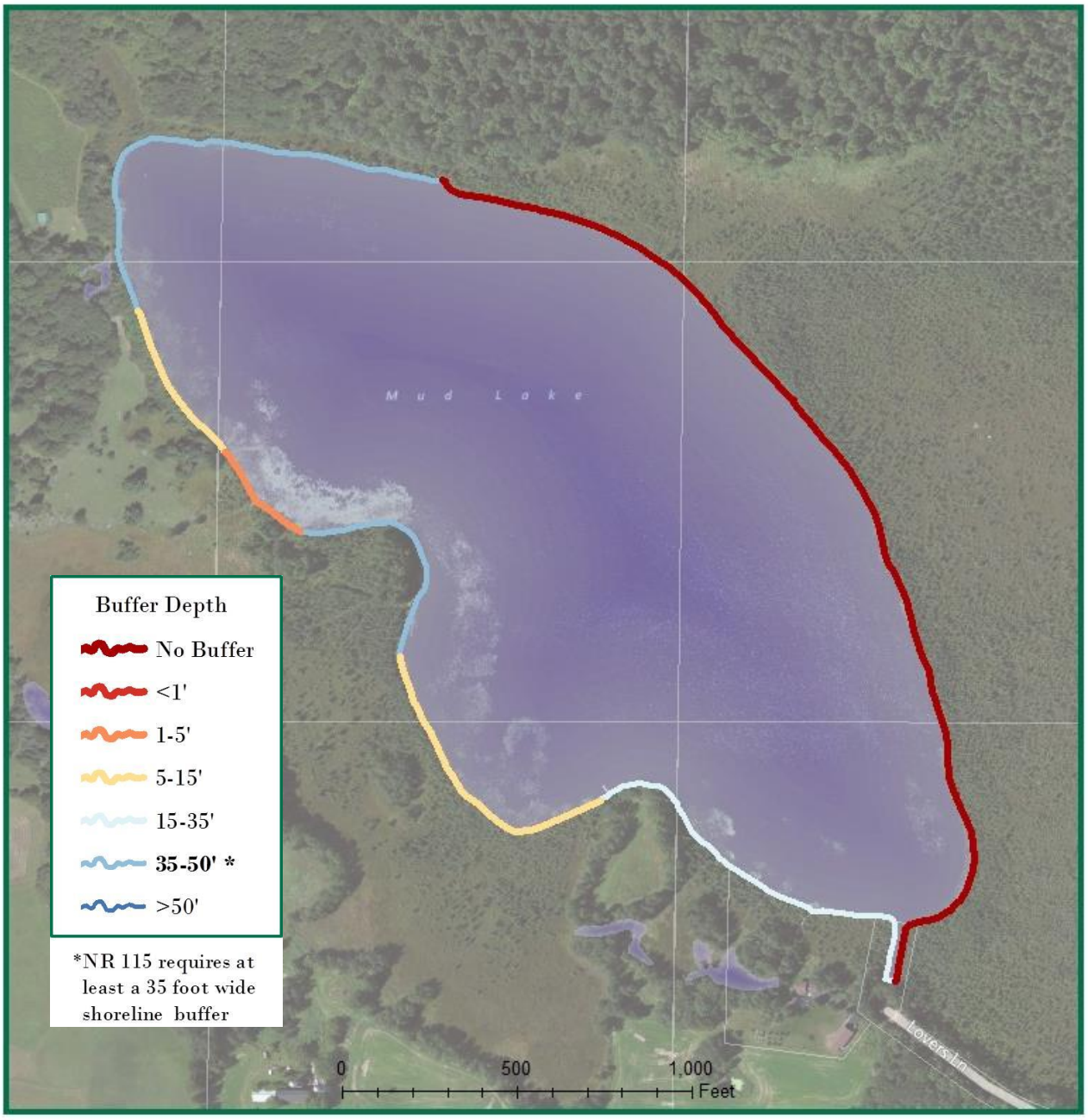
Water exits the western part of the lake.



Mud 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.

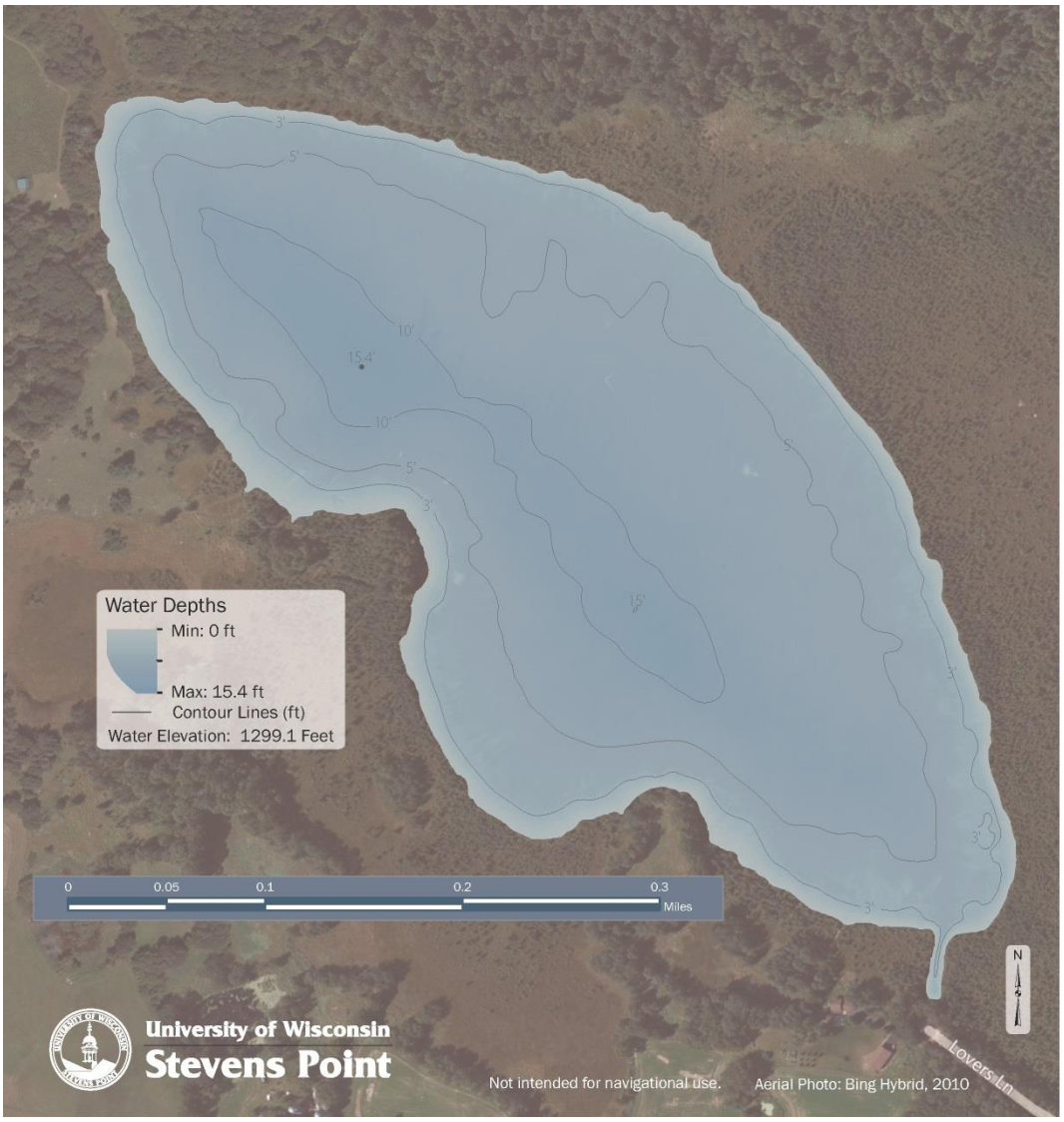
The map below shows how far the 0.5 to 3 foot tall vegetation exists landward from the edge of Mud Lake. A greater vegetative buffer produces more habitat and better water quality.



Mud Lake – Lake Map

Mud 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



MUD 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.

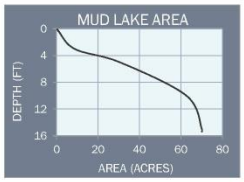
MARATHON COUNTY, WISCONSIN

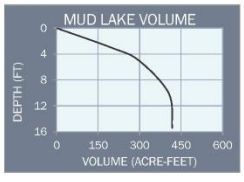
GPS and Sonar Survey
June, 2012

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	70.1	Acres
Under 3 Feet	8.7	Acres (12.4%)
Over 20 Feet	0	Acres (0%)
VOLUME	418	Acre-feet
SHORELINE	1.6	Miles
MAX DEPTH	15.4	Feet





Mud Lake – Fishery

Many factors determine which fish species may 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 Mud Lake, 2012 survey

Species	Min Length (in)	Max Length (in)	Average Length (in)	Total Catch
Bluegill	1.7	10.1	2.6	113
Largemouth Bass	0.9	1.9	1.2	26
Black Crappie	5.6	12.8	8.3	10

- Mud Lake supports a warm water fish community.
- Fish diversity is lower in Mud Lake compared to other lakes in eastern Marathon County. No new fish species were documented during the sampling period.
- The absence of young northern pike in 2012 sampling may be an indicator of poor reproduction, although more intense population sampling over several seasons would be required to determine the reproductive success for individual fish species.

Species occurrence in Mud Lake in 2012 survey and historical Wisconsin DNR records

Species	1964	1971	1972	1975	1979	1980	1982	1985	2005	2008	2012
Black Bullhead	x	x	x	x	x						
Black Crappie								x	x	x	x
Bluegill	x					x	x	x		x	x
Common Shiner		x	x								
Golden Shiner				x							
Largemouth Bass						x	x	x	x		x
Mudminnow						x		x			
Northern Pike	x	x	x	x	x			x		x	
Pumpkinseed				x	x		x				
Yellow Perch	x	x	x	x	x						

- Due to winterkill events from low dissolved oxygen, a recommendation was made in 1958 to stock northern pike since they were more likely to survive low dissolved oxygen conditions.
- In 1958 and 1964, yellow perch size was noted as desirable; however, by 1972 the populations were severely stunted and a recommendation was made to poison the lake to eliminate yellow perch, northern pike and black bullhead.
- In 1979, a chemical fish kill (Mud Lake Fisheries Reclamation Project) was carried out with Rotenone; future management was focused on producing desirable populations of largemouth bass, bluegill and black crappie.
- Since the treatment, black bullhead and yellow perch have not been reported; northern pike was documented in 1985.

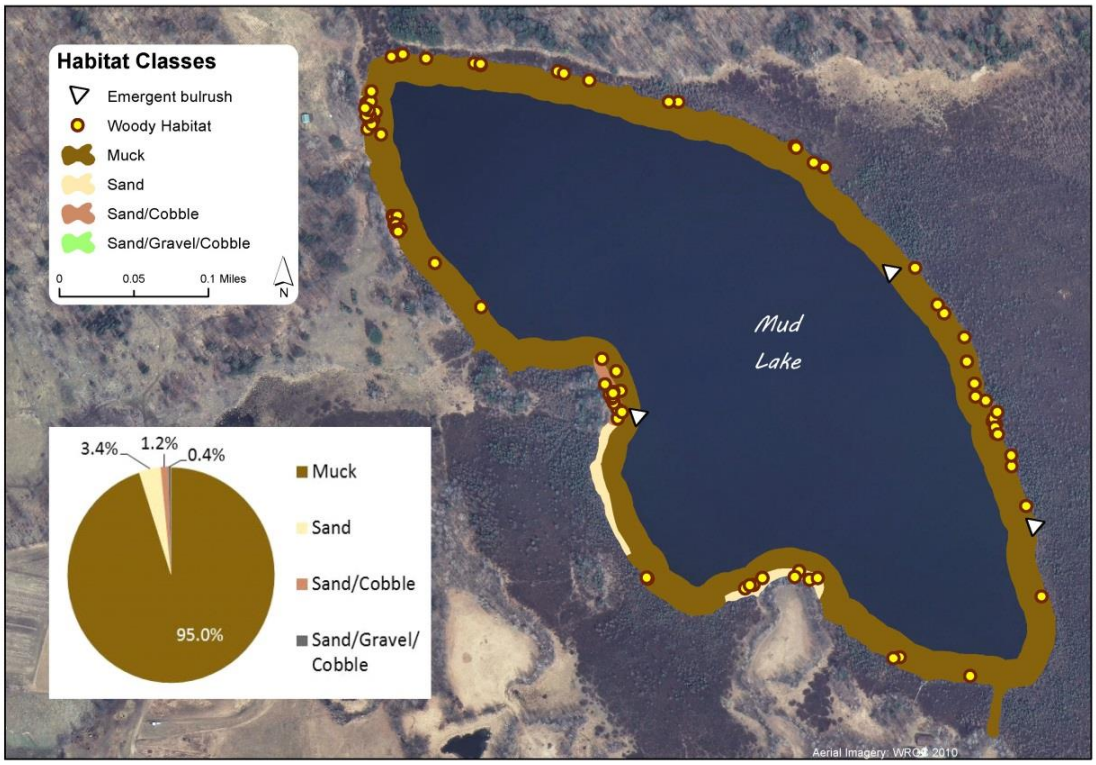
Mud Lake – Lake Map

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 available in Mud Lake and is used by young prey fish and other aquatic organisms for spawning, foraging and protective cover. Additional CWH cover would benefit the fish community.

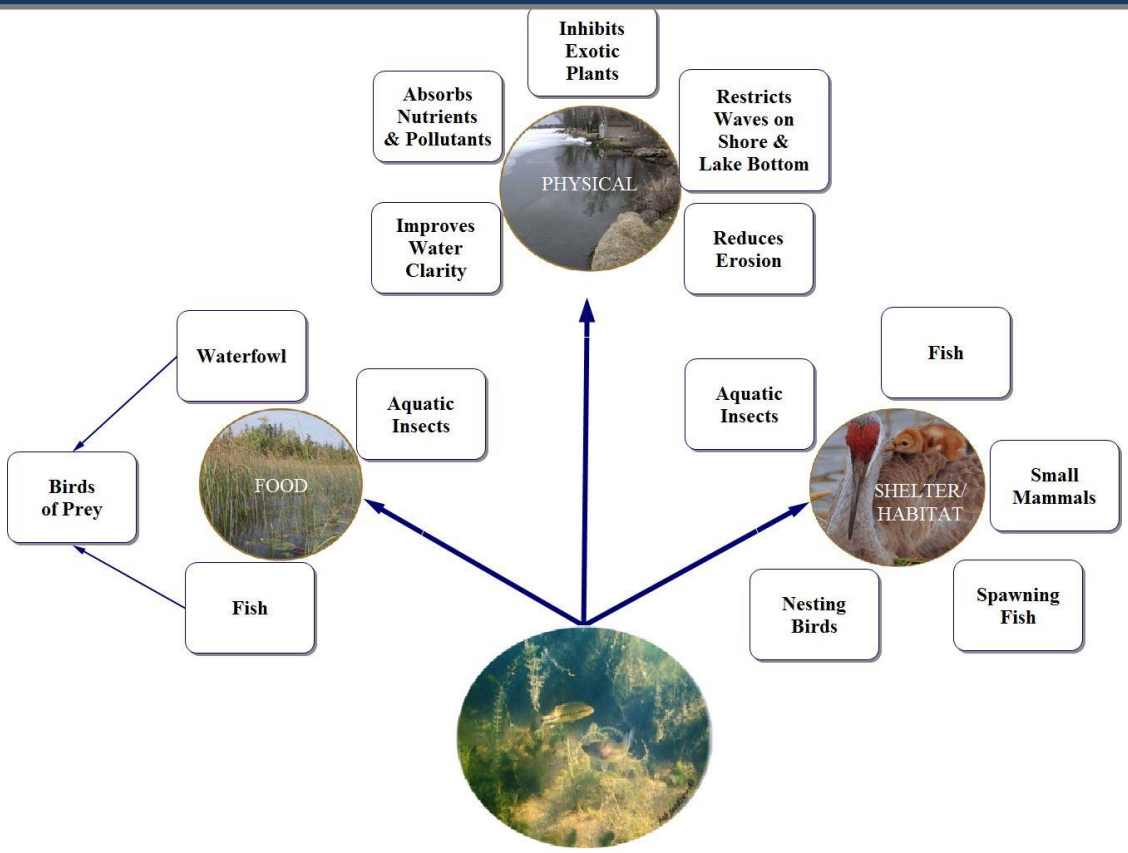
Mud Lake Habitat
Marathon County, WI 2012



- Gravel areas, found in the northwest corner of Mud Lake, are used for spawning habitat by many species, including sunfish (bluegill, pumpkinseed and black bass). Males 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 to construct nests and guard young. Sparse areas of bulrush are present in Mud 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.

Mud 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.



AQUATIC PLANTS
Food and Refuge for Aquatic Life

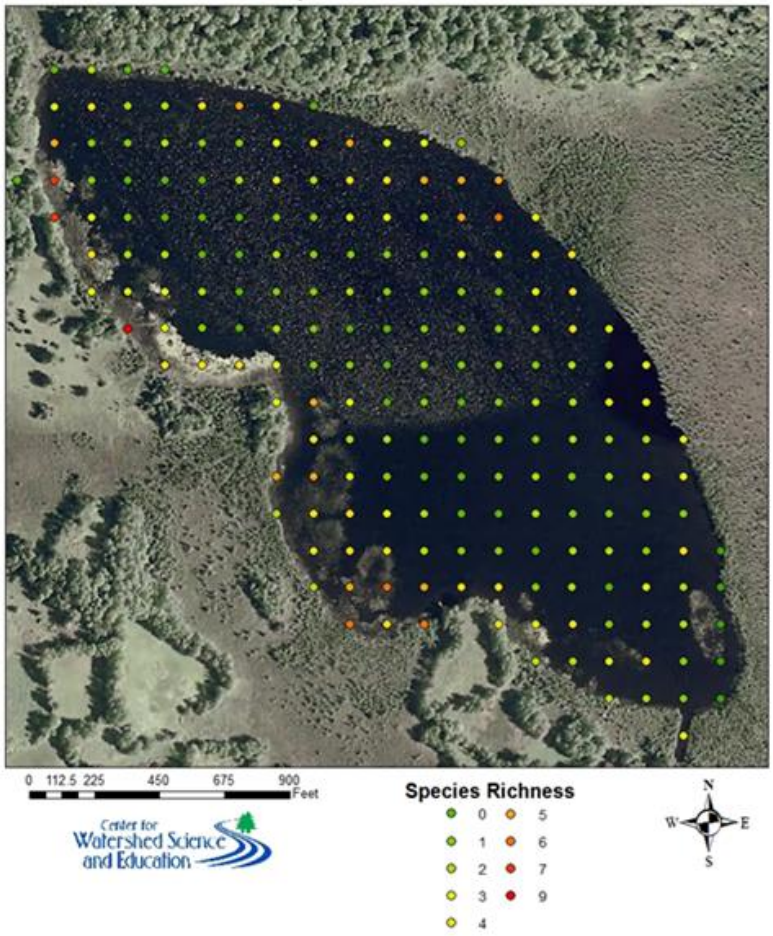
- The aquatic plant community of Mud Lake is characterized by an average diversity when compared to other lakes in the Marathon County study. Greatest species richness was found along the northwestern shore.
- The survey documented nineteen species of aquatic plants, including three species of special concern in Wisconsin.
- The survey documented no non-native plant species. This demonstrates diligence by lake users in cleaning watercraft before entering the lake to prevent non-native species transfer.
- Limited shoreline development supports the healthy aquatic plant communities that benefit water quality and in-lake fish and wildlife habitat. These should be protected if possible.

Mud Lake – Aquatic Plants

- During the 2012 aquatic plant survey of Mud Lake, 89 percent of the sites sampled had vegetation.
- The average depth of sampled sites was 6 feet; the deepest site with vegetation was 13 feet.
- Large purple bladderwort (*Utricularia purpurea*) and small purple bladderwort (*Utricularia resupinata*), both species of special concern in Wisconsin, were the two most common plant species found in Mud Lake.
- Three-way sedge, pipewort and water bulrush were also found during the 2012 survey. These plants are found in undisturbed areas and can indicate high quality habitat.

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.

Mud 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** and **small purple bladderwort** are species of special concern in Wisconsin and both are found in Mud Lake!

Large purple bladderwort

Small purple bladderwort

Mud Lake – Aquatic Invasive Species

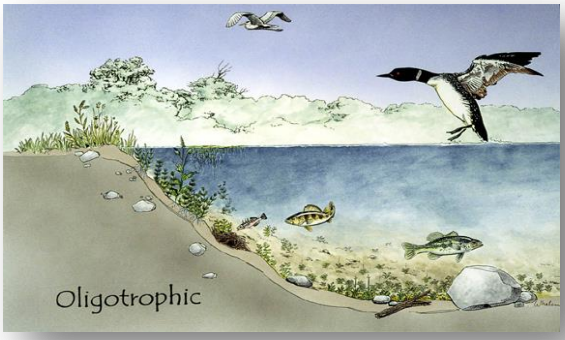
Aquatic Invasive Species are non-native plants or animals that may cause significant harm to a lake's ecosystem. Typically, they are introduced to a lake by hitching a ride on clothing, boats, trailers and other water recreation equipment. Aquatic invasive species can be introduced to a lake accidentally 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!

Mud 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.



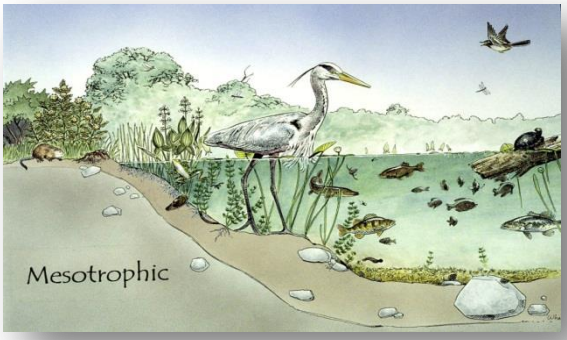
Oligotrophic Lakes

Common uses:

- ✓ Swimming
- ✓ Skiing
- ✓ Boating

Vegetation of oligotrophic lakes:

- ✓ Very little vegetation



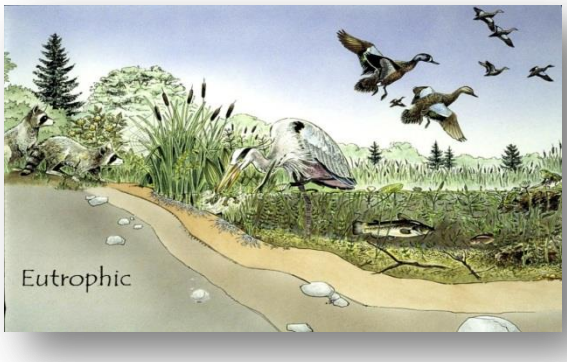
Mesotrophic Lakes

Common uses:

- ✓ Boating
- ✓ Fishing

Vegetation of mesotrophic lakes:

- ✓ Increased vegetation
- ✓ Occasional algal blooms



Eutrophic Lakes

Common uses:

- ✓ Fishing
- ✓ Wildlife watching

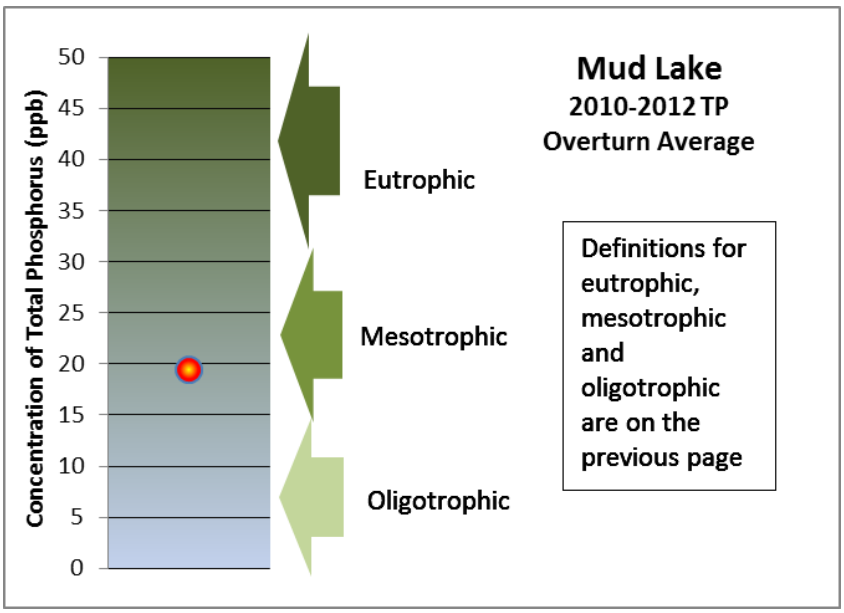
Vegetation of eutrophic lakes:

- ✓ Lots of aquatic plants
- ✓ Frequent algal blooms

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

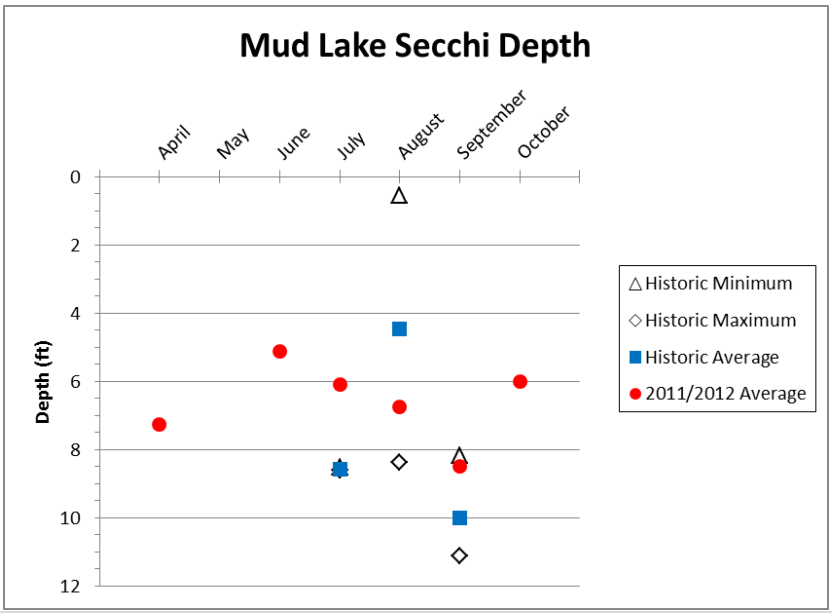
Mud Lake – Water Quality

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 Mud Lake was well-mixed (overturn) are displayed in the graph to the left.
- Overturn sampling during the 2010-2012 monitoring period indicate that Mud Lake is a mesotrophic lake with an average total phosphorus level in the lower end of the 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.



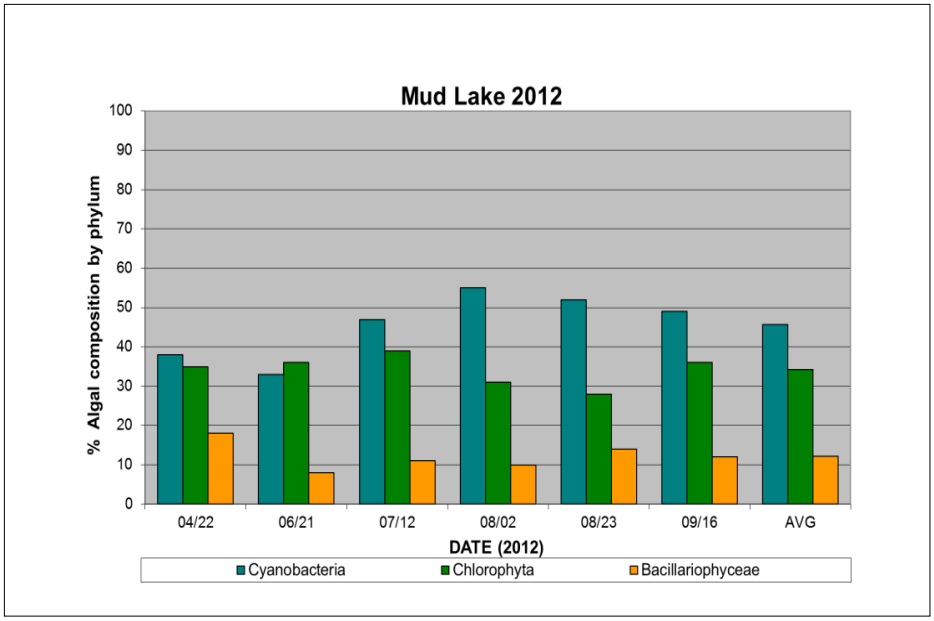
- The graph to the left shows water clarity data collected during the growing seasons in 2011 and 2012. It is typical for water clarity to vary throughout the year.
- The 2011/2012 average Secchi depth readings were relatively consistent with historic averages.

Mud 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 algal community in Mud Lake during 2011 and 2012 was similar in composition and seasonal patterns. The community composition and its patterns were similar to those often found in eutrophic water bodies.
- The blue-green algae dominated both years. Diatoms were of only minor significance in the algal community.
- The abundance of small filamentous and colonial blue-green species is potentially problematic due to the inability of most planktivorous species to ingest and digest them.
- Dense growth of algae species can decrease water clarity and shade out submerged vegetation.
- The total phosphorus value indicates mildly mesotrophic conditions, but the algal community indicates a much more mesotrophic lake – perhaps indicating that Mud Lake is beginning a transition to eutrophic status.



PERCENT ALGAL COMPOSITION FOR MUD LAKE IN 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. There are a few varieties that can produce toxins that are potentially harmful to livestock, pets and humans.

Mud Lake – What can you do?

Lake Users:

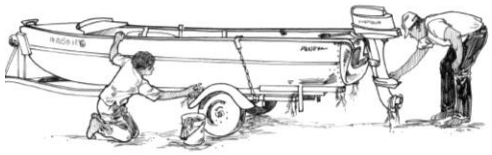
- ✓ Run boat engines efficiently
- ✓ Observe no/low wake zones
- ✓ Refuel away from water
- ✓ Dispose of trash properly
- ✓ Remove all aquatic plants from boats and trailers
- ✓ Respect wildlife and other lake users

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.

Mud Lake – Primary Researchers

Algae

Dr. Bob Bell (UW-Stevens Point)

Aquatic Plants

Jen McNelly (UW-Stevens Point)

Cultural Survey

Dr. Kristin Floress(UW-Stevens Point)

Fisheries and Lake Maps

Dr. Ron Crunkilton (UW-Stevens Point) and Dr. Justin Sipiorski(UW-Stevens Point)

Christine Koeller (UW-Stevens Point)

Sediment Core

Dr. Samantha Kaplan (UW-Stevens Point) and Paul Garrison (Wisconsin DNR)

Shoreland Assessments and Build Out

Dan McFarlane (UW-Stevens Point)

Water Quality and Watersheds

Nancy Turyk (UW-Stevens Point)

Zooplankton

Dr. Chris Hartleb (UW-Stevens Point)

UW-Stevens Point Graduate and Undergraduate Students

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

For more information about the study:

UW- Stevens Point: Nancy Turyk, 715-346-4155 Email: mclakes@uwsp.edu

Marathon County: Shawn Esser, 715-261-6010

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

Center for Watershed Science and Education
College of Natural Resources
University of Wisconsin-Stevens Point