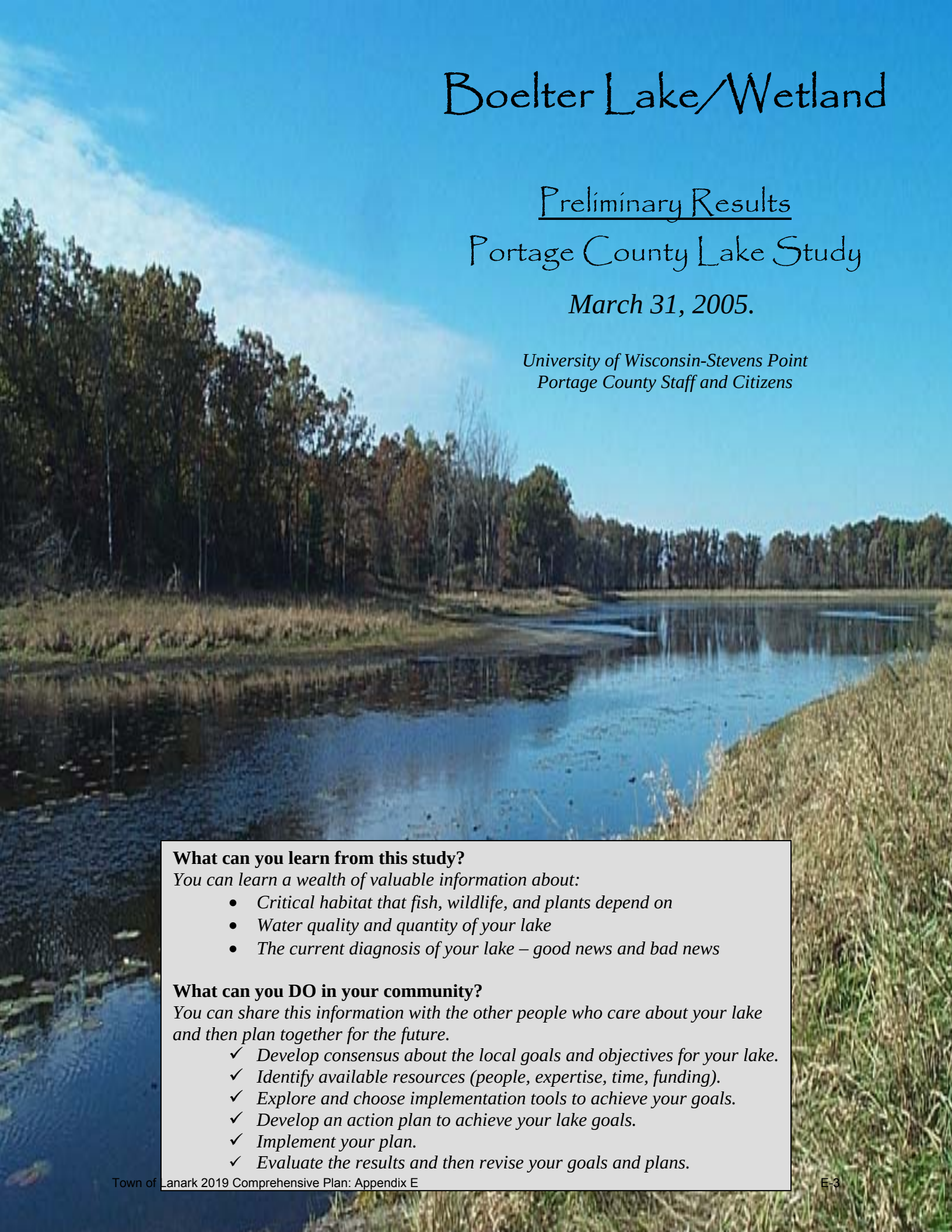
Appendix E

University of Wisconsin
Stevens Point
Lake Study Report

Town of Lanark
2019 Comprehensive Plan



Boelter Lake/Wetland

Preliminary Results

Portage County Lake Study

March 31, 2005.

University of Wisconsin-Stevens Point
Portage County Staff and Citizens

What can you learn from this study?
You can learn a wealth of valuable information about:

- *Critical habitat that fish, wildlife, and plants depend on*
- *Water quality and quantity of your lake*
- *The current diagnosis of your lake – good news and bad news*

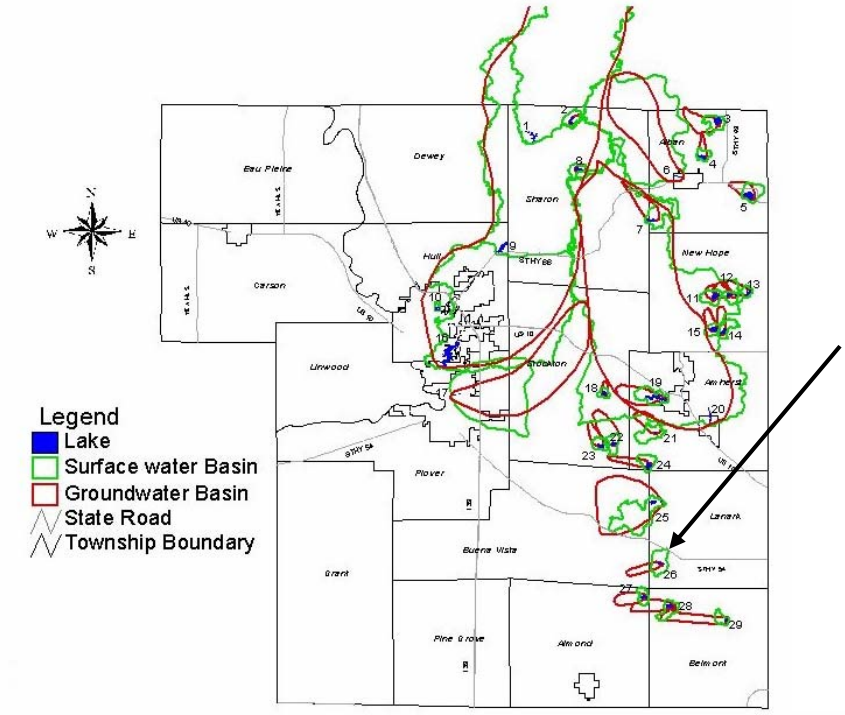
What can you DO in your community?
You can share this information with the other people who care about your lake and then plan together for the future.

- ✓ *Develop consensus about the local goals and objectives for your lake.*
- ✓ *Identify available resources (people, expertise, time, funding).*
- ✓ *Explore and choose implementation tools to achieve your goals.*
- ✓ *Develop an action plan to achieve your lake goals.*
- ✓ *Implement your plan.*
- ✓ *Evaluate the results and then revise your goals and plans.*

To protect

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

Boelter Lake ~ Location



Boelter Lake
South of Highway 54, 9 miles south of Stevens Point, Town of Lanark

Surface Area: 40 acres
Maximum Depth: 5 feet
Lake Volume: 102 acre-feet

Water Flow

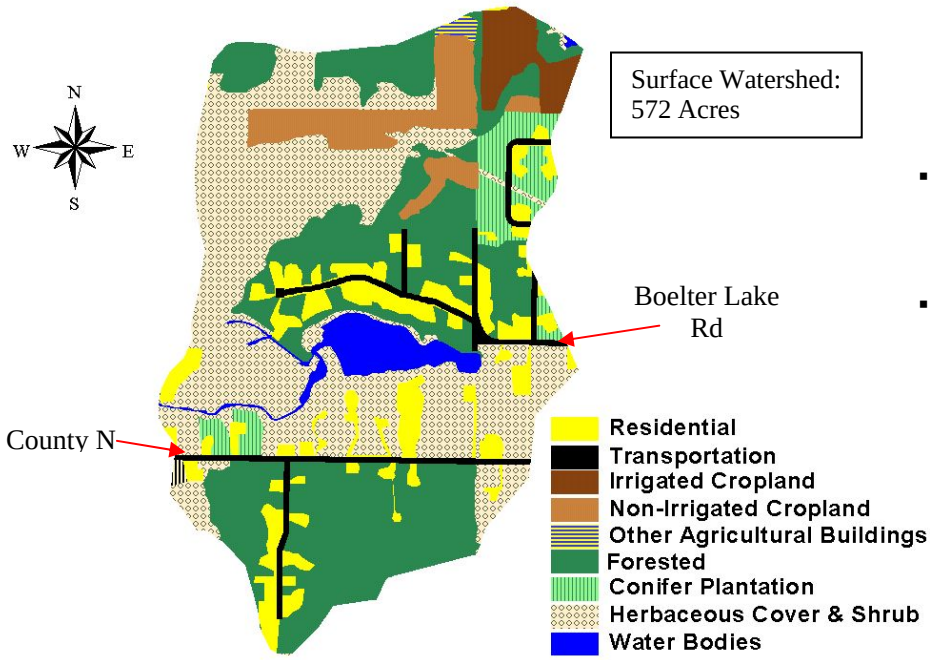
- Boelter Lake is a drainage wetland/lake
- Water enters Boelter Lake from groundwater, one intermittent creek at the at the west end of the lake, with some runoff, and precipitation
- Water exits the lake through groundwater
- This lake experiences fluctuating water levels as the groundwater table fluctuates

Boelter Lake

Boelter Lake ~ Land Use in the Surface Watershed

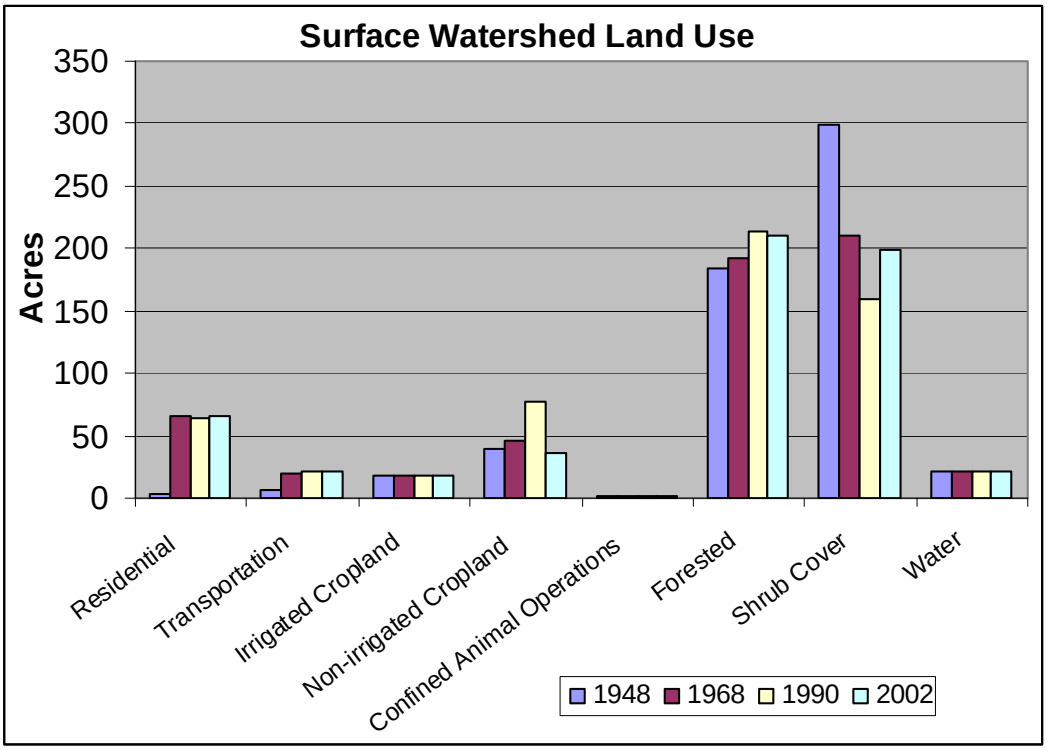
Surface Watershed: The land area where water runs off the surface of the land and drains toward the lake.

Boelter Lake Land Use



Current Predominant Land Use

- Around the lake: shrub cover, forestland, and residential land
- In the watershed: shrub cover, forestland, residential and agricultural

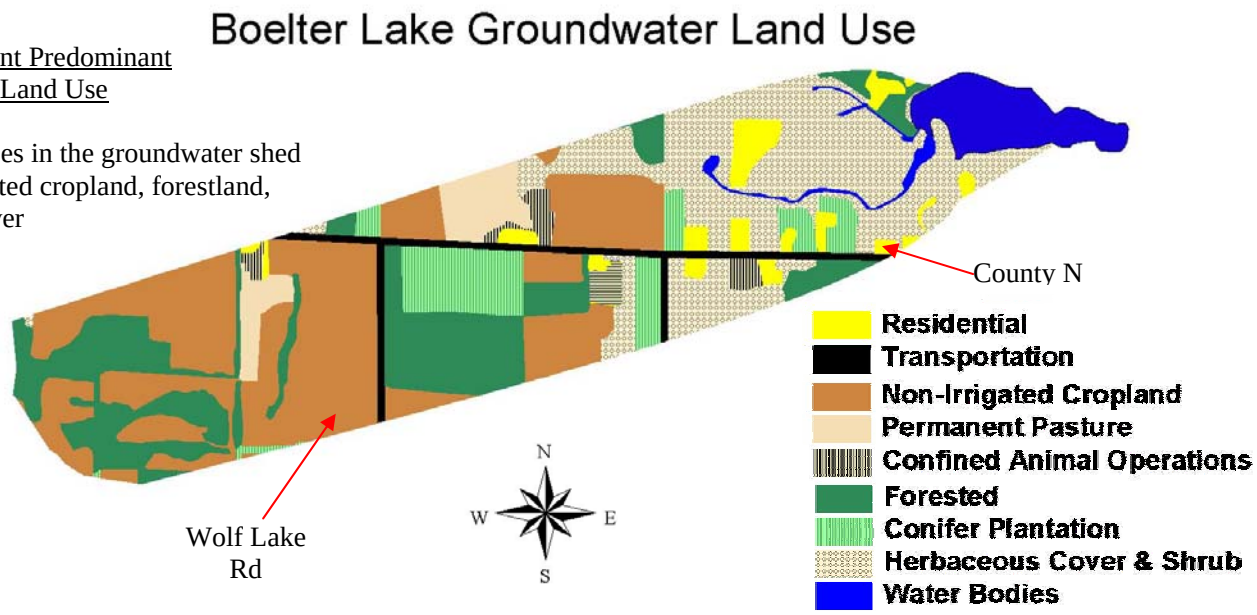


Surface Watershed Land Use

- Forestland and shrub cover have always been the dominant land uses
- Irrigated cropland has remained steady while non-irrigated cropland peaked in 1990 and is now lower than 1948
- Residential and transportation uses are increasing

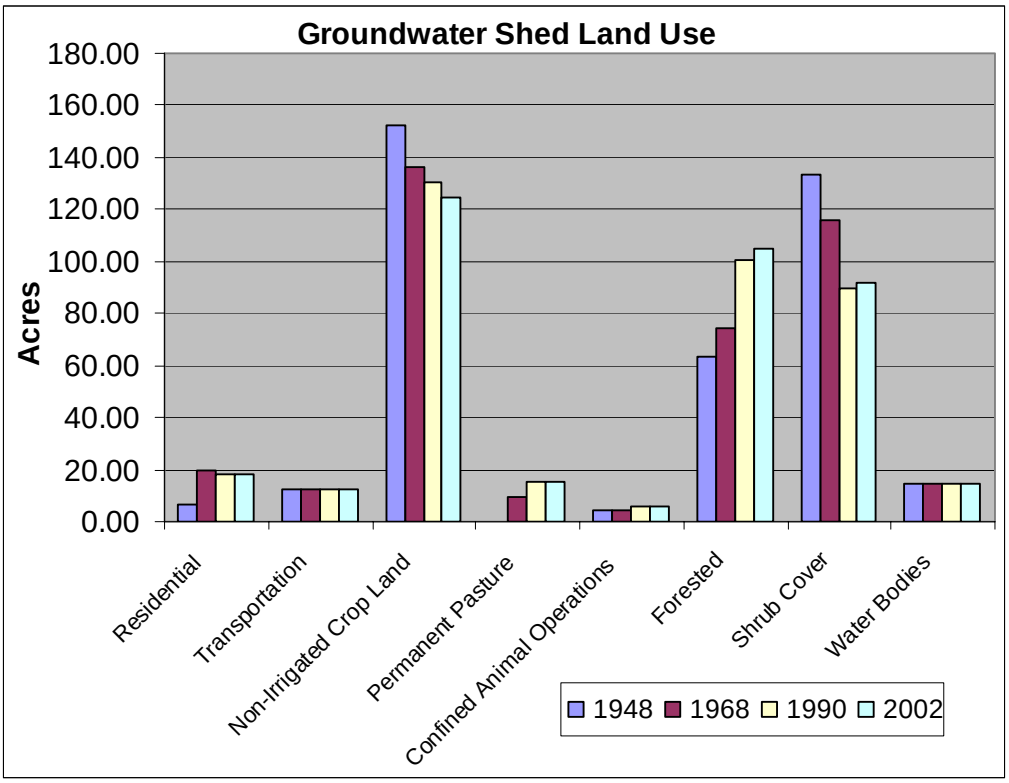
Boelter Lake ~ Land Use in the Groundwater Shed

Groundwater Shed: The land area where water soaks into the ground and travels underground to the lake.



Current Predominant Land Use

- Major land uses in the groundwater shed are non-irrigated cropland, forestland, and shrub cover



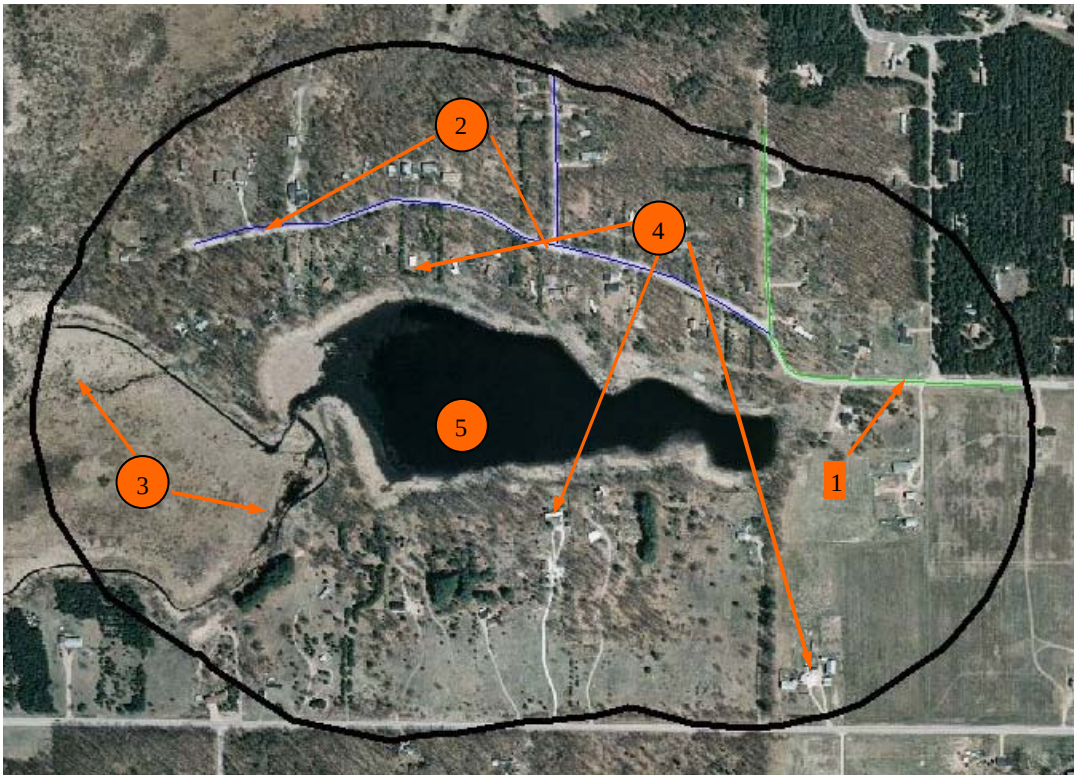
Groundwater Shed Land Use

- Forest, non-irrigated cropland, and shrub cover have dominated the land use since 1948
- Confined animal operations, permanent pasture, and transportation have remained a small fraction of the land use
- Non-irrigated cropland and shrub cover have decreased in area since 1948
- Residential and forested land has increased in area since 1948

Boelter Lake ~ Taking a closer look
(With in a 1,000 feet of lake)

1960 Air Photo Image

1968 Air Photo Image



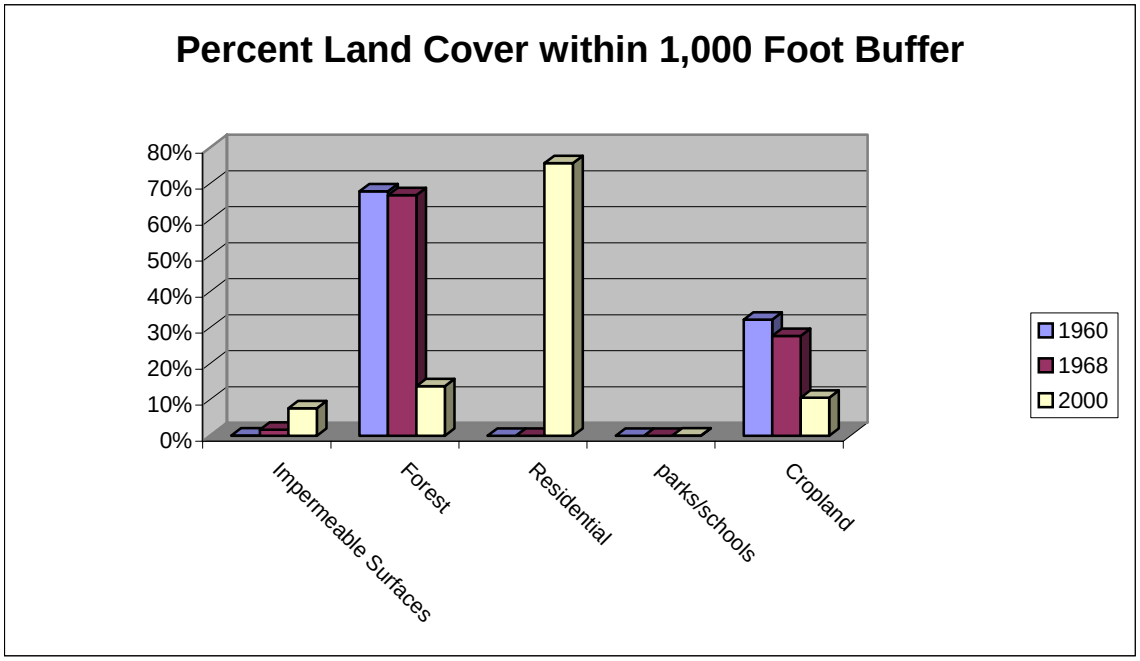
Points of Interest

1. Green line is the only access road to the lake in 1960.
2. Blue line indicates new access roads as of 1968 and the subdivisions near the lake.
3. A natural watershed limits the amount of development on the west side of the river.
4. All development near the lake occurred after 1968.
5. Lake level changes between 1968 and 2000.

Boelter Lake ~ Taking a closer look
(With in a 1,000 feet of lake)

Changes from 1960 to 2000

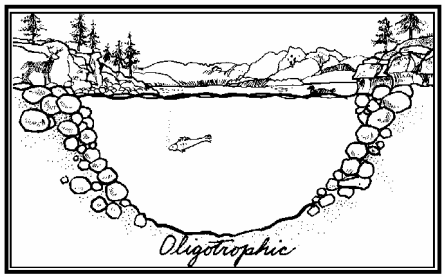
	1960	1968	2000
# of Docks	0	0	1
Impervious Surfaces (acres)	<1	3	13
Residential (acres)	0	0	129
Parks (acres)	0	0	<1
Cropland (acres)	59	53	18
Forest (acres)	124	127	23



Boelter Lake ~ Water Quality

Total Phosphorus

In more than 80% of Wisconsin's lakes phosphorus is the key nutrient affecting aquatic plant and algae growth. Once in a lake system phosphorus levels are difficult to reduce, so limiting phosphorus input is key. Phosphorus at levels above 30 parts per billion (ppb) can lead to nuisance aquatic plant growth and accelerate a lake's change from oligotrophic to eutrophic. Sources of phosphorus include septic systems, detergents, animal waste, farmland and storm sewer runoff, soil erosion, and fertilizers for lawns, gardens, and agriculture.



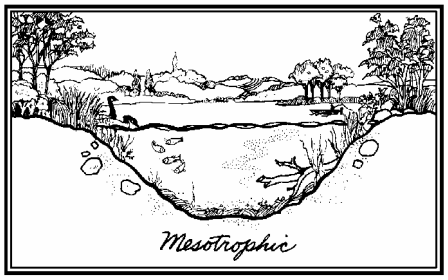
Oligotrophic Lakes

Common uses:

- ✓ Swimming
- ✓ Skiing
- ✓ Boating

Vegetation of oligotrophic lakes:

- ✓ Very little vegetation



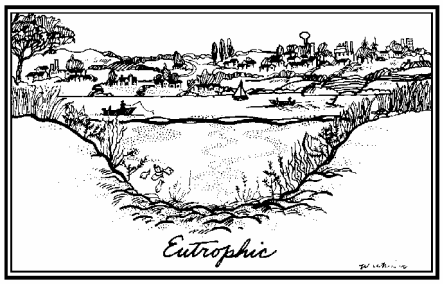
Mesotrophic Lakes

Common uses:

- ✓ Boating
- ✓ Fishing

Vegetation of mesotrophic lakes:

- ✓ Increased vegetation
- ✓ Occasional algal blooms



Eutrophic Lakes

Common uses:

- ✓ Fishing
- ✓ Wildlife watching

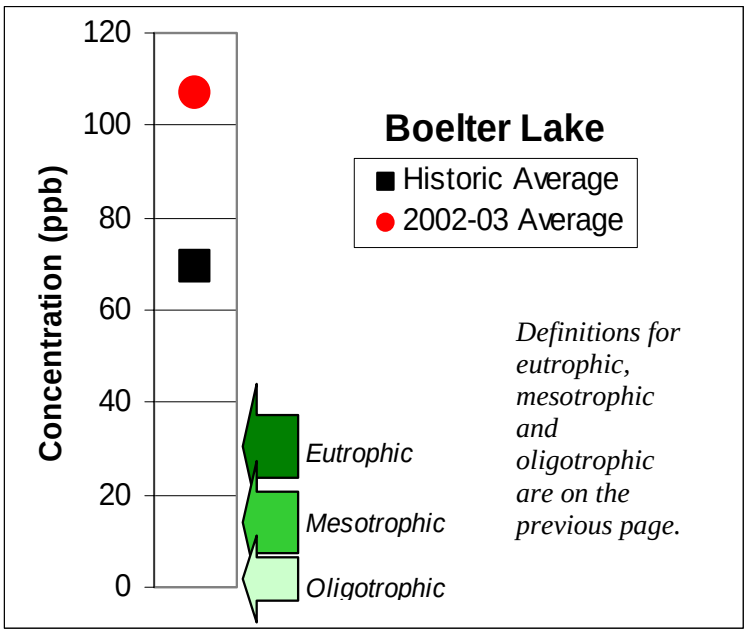
Vegetation of eutrophic lakes:

- ✓ Lots of aquatic plants
- ✓ Frequent algal blooms

Winter kill is most common in shallow lakes

Boelter Lake ~ Water Quality

Average Total Phosphorus Levels

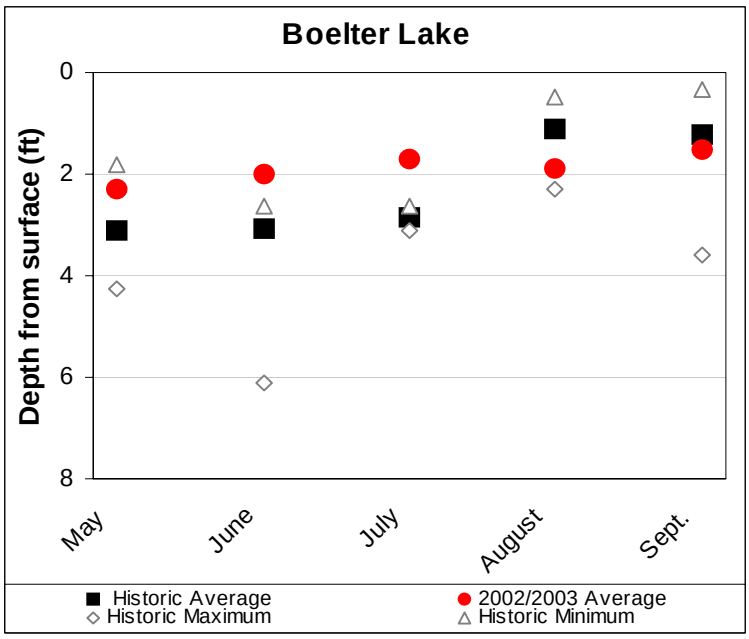


The graph to the left shows total phosphorus levels measured when the lake is well mixed (overturn). Phosphorus levels in Boelter Lake in 2002-03 were significantly higher than the average historic levels, and are much highter than other lakes in the county. Levels of phosphorus above 30 ppb are high enough to categorize a lake as eutrophic, making it subject to aquatic plant growth that results in better fishing and wildlife viewing than swimming.

Overturn: uniform temperature from top to bottom in the lake

Water Clarity

Water clarity (Secchi disc depth) is an indicator of water quality. The two main components affecting water clarity are materials dissolved in the water and materials suspended in the water. Water clarity can indicate overall water quality, especially the amount of algae and suspended sediment present.



The water clarity in Boelter Lake is considered poor. This very shallow lake, partly fed by drained wetland, is not similar to other lakes in the county. Boelter Lake is very shallow and fertile resulting in poor clarity. The water clarity of Boelter Lake during 2002-03 growing season was poorer than the historic growing season average. Fluctuations in clarity throughout the summer are normal as algae populations and sedimentation increase and decrease.

2002 Amphibian Distribution at Portage County Lakes

This summary provides preliminary information on the amphibian species present and their distribution at the twenty-nine Portage County lakes. Surveys were conducted from April 2002 - August 2002, the typical breeding period of the frogs and salamanders found in the county.

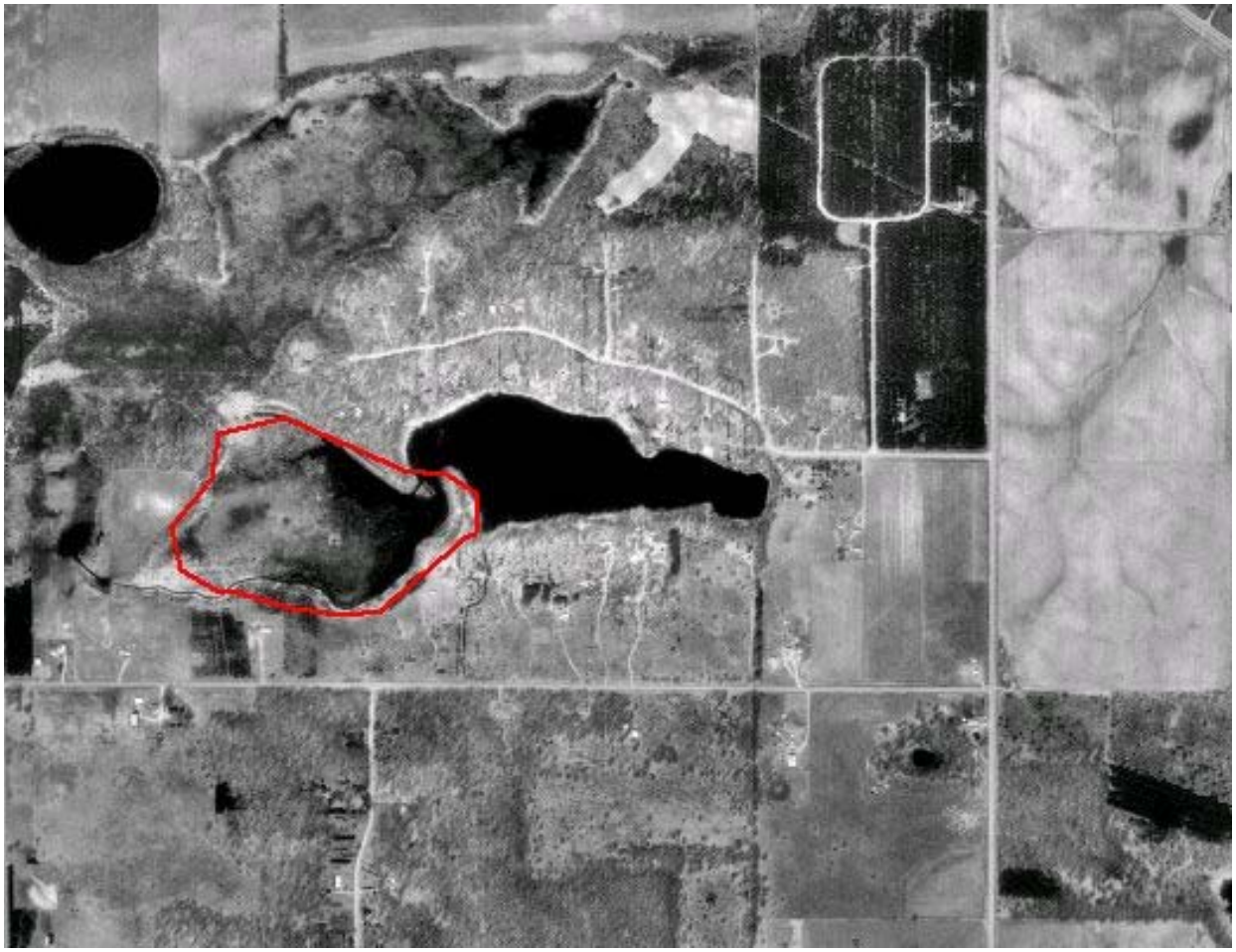
Twelve frog species have been documented in Wisconsin, nine of which currently inhabit Portage County: American toad, chorus frog, spring peeper, eastern gray treefrog, Cope's gray treefrog, green frog, pickerel frog, northern leopard frog, and wood frog. Historically, Blanchard's cricket frog inhabited Portage County but is believed to now exist only in southeastern Wisconsin. Of all species believed to inhabit Portage County, only the pickerel frog was not found during the spring and summer of 2002. The pickerel frog has been listed as a species of special concern in Wisconsin. No new species to Portage County were recorded in 2002.

Seven salamander species have been documented in Wisconsin, all of which currently inhabit Portage County: blue-spotted salamander, spotted salamander, tiger salamander, central newt, mudpuppy, northern redback salamander and four-toed salamander. The four-toed salamander is listed as a species of special concern in Wisconsin.

Large sections of continuous natural shoreline on lakes are ideal habitats for frog and salamander populations. Natural areas with large amounts of submergent, emergent and floating-leaf vegetation provide protection for amphibians. Many species also use the vegetation for attachment of eggs during the breeding season. Green frogs, bullfrogs, pickerel frogs and leopard frogs depend on the shoreline area throughout the year. In contrast, American toads, spring peepers, tree frogs, wood frogs and chorus frogs depend on the shoreline area in the spring for breeding and then move to other areas for the rest of the year.

Undisturbed areas of shoreline that are also connected to large natural upland areas provide ideal habitat for many amphibian species because they lessen frogs' exposure to predators. Many frog and salamander species migrate to the lakes in the spring to breed and spend the summer months foraging in the uplands. Many amphibian species will also over winter in the uplands.

Boelter Lake ~ Frogs



<u>Boelter Lake Frogs</u>
Number of species: 4

Species observed to date: spring peeper, American toad, gray treefrog, Cope's gray treefrog

Location of primary habitat: west and southeast sides of lake

Key features of habitat: undeveloped areas of shoreline with submergent and emergent vegetation

<u>Map Key</u>
Red outlined areas = primary frog habitat

Good news
Several portions of shoreline provide ideal habitat for amphibian and reptile populations

Bad news
Some areas of altered shoreline exist due to development

Boelter Lake ~ Aquatic Plants

Aquatic plant surveys were conducted in each lake more detailed information is available in the final report.

Aquatic Plant Survey

There were 32 species found around Boelter Lake; most of these were growing on the extensive wetland and exposed wet soil; a few species were submersed or rooted in the remaining small areas of water or free floating on open water.

The UWSP herbarium has only a few specimens and few observations made when water levels were higher. Most collection and observations were made in 2003. At this time, following dry years, little water was present in the lake and only a few submersed plants were found: coontail, common bladderwort, and water star-grass. A few plants of white waterlily were growing in pockets of water one to three feet deep, but most plants were stranded on shore or on the mud-flat and were becoming desiccated.

The extensive exposed wet soil, wet sand, and mud-flat was dominated by woolly sedge, spikerushes, broad-leaved cattail, reed canary-grass, and golden dock. However, except for a moderate amount of canary-grass, the flora of Boelter Lake is free of invasive exotic species. Given the open, early successional stage of the vegetation and its vulnerability to establishment of invasive plants, this area should be monitored to remove any exotic plants before they become established. It is also notable that Boelter Lake is the only known location in Portage County for wheelwort toothcup, golden dock, and one of only two locations for slender fringe-rush.

Invasive Exotic Aquatic Plants

> Invasive species displace native species, disrupt ecosystems, and affect citizen's livelihoods and quality of life. They hamper boating, swimming, fishing, and other water recreation, and take an economic toll on commercial, agricultural and aquatic resources. (Wisconsin DNR)

Aquatic plants surveys revealed that some of the lakes in the study have invasive aquatic plants present.

Eurasian milfoil (Myriophyllum spicatum) was present in Bear Lake, Lake Emily, Lake Joanis, Jordan Pond, McDill Pond, Springville Pond and Thomas Lake.

Curly leaf pondweed (Potomogetan crispis) was identified in Spring Lake and Amherst Millpond.

Contact the Portage County Land Conservation Department for additional information.

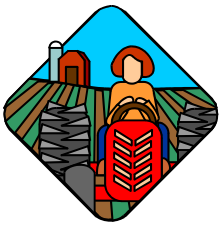
Boelter Lake ~ What can you do to help?

We Can All Help Take Care Of Our Lake

A lake is a magnificent water resource. The quality of its water is a reflection of what happens on the land that surrounds it.

Lake Users:

- ✓ Run boat engines efficiently.
- ✓ Observe no/low wake zones.
- ✓ Refuel away from water.
- ✓ Dispose of trash property
- ✓ Remove all aquatic plants from boats and trailers.



Land Owners:

- ✓ Control soil erosion.
- ✓ Keep livestock out of lakes and streams.
- ✓ Control manure runoff.
- ✓ Carefully manage nutrients and pesticides.
- ✓ Learn to identify and look for invasive species.

Home Owners:

- ✓ Leave natural vegetation buffers in place or replace them if they have been removed.
- ✓ Eliminate the use of fertilizer or use low/no phosphorus fertilizer.
- ✓ Eliminate or minimize use of pesticides.
- ✓ Control soil erosion.
- ✓ Clean up after pets.
- ✓ Learn to identify and look for invasive species.

Project support provided by:

- Wisconsin DNR Lake Protection grants
- UW-Stevens Point
- Portage County
- Portage County Citizens

Study Contacts:

Portage County: Steven Bradley at 346-1334

UW- Stevens Point: Nancy Turyk at 346-4155

Boelter Lake ~ Primary Researchers

Algae
Dr. Bob Bell

Aquatic Plants
Dr. Robert Freckmann

Birds
Dr. Tim Ginnett
Brad Bulin (Graduate Student)

Fish
Dr. Ron Crunkilton

Land Use Coverages/Watersheds
Steve Bradley (Portage County Conservationist)

Planning Assistance
Lynn Markham
Mike Hansen

Reptiles and Amphibians/Near Shore Habitat
Dr. Erik Wild
Rori Paloski (Graduate Student)

Water Quality/Watersheds
Becky Cook
Dr. Paul McGinley
Dr. Byron Shaw
Dick Stephens
Nancy Turyk

Near Shore Summary
Dr. Glenn Bowles

Special thanks to UWSP undergraduate and graduate students and local citizens for their assistance!

Spring Lake

Preliminary Results

Portage County Lake Study

University of Wisconsin-Stevens Point
Portage County Staff and Citizens

April 7, 2005

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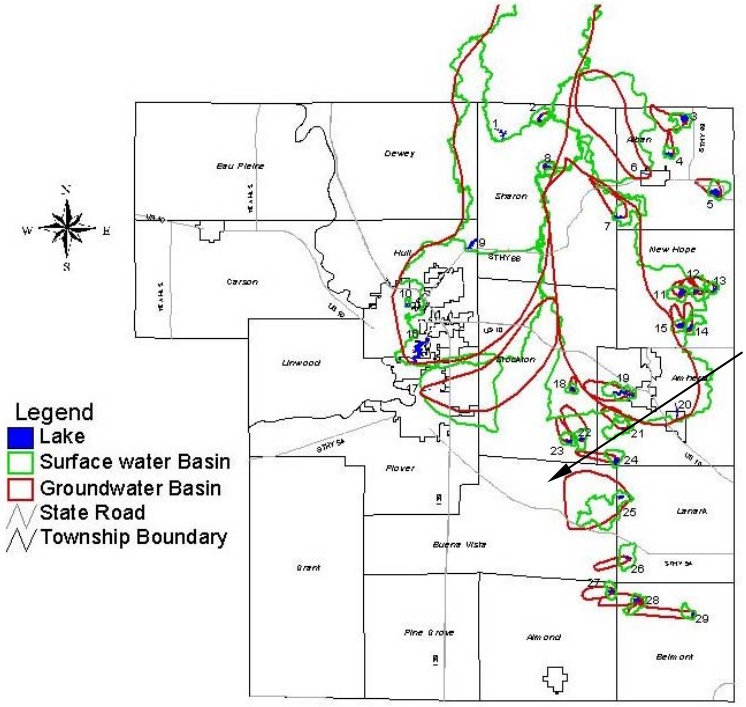
To protect

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

Spring Lake ~ Location

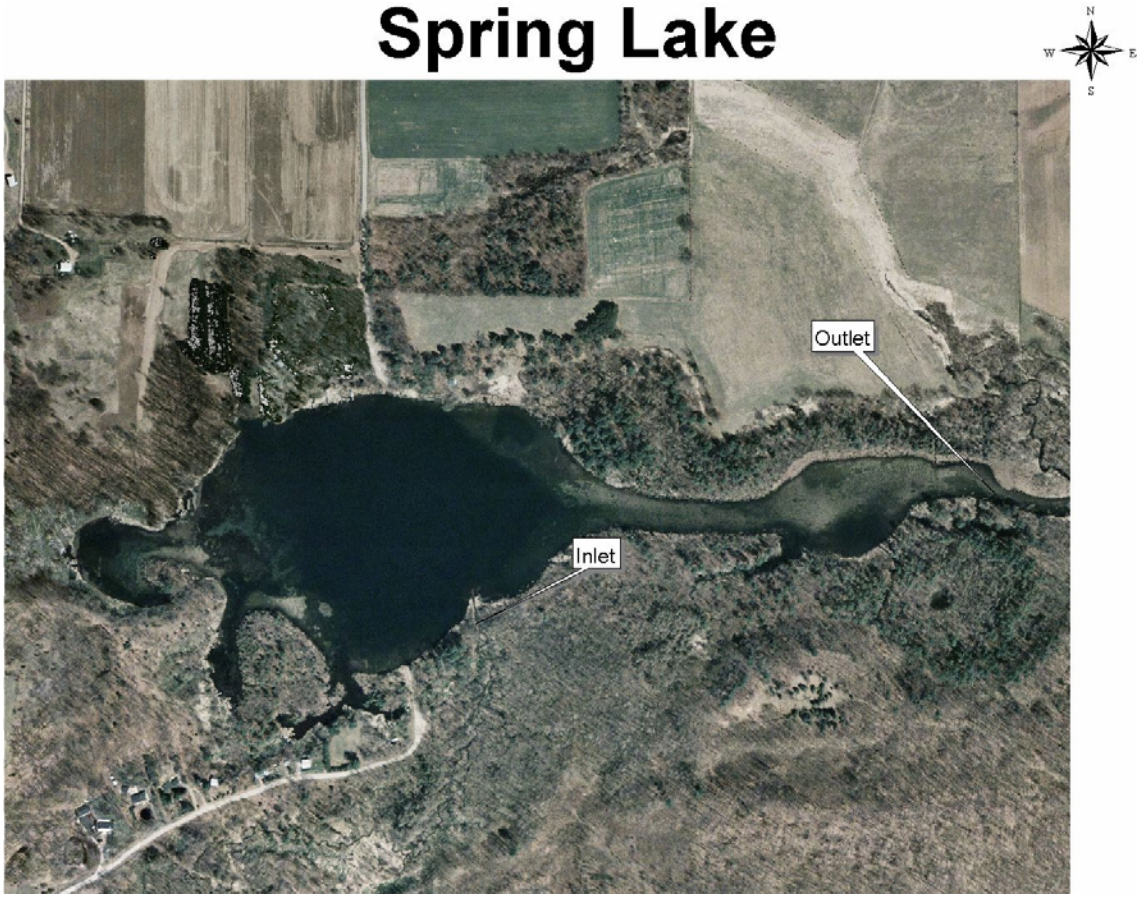


Spring Lake
Southwest of the intersection of County Roads JJ and Q; Amherst Region

Surface Area: 37.5 acres
Maximum Depth: 42 feet
Lake Volume: 311 acre-feet

Water Flow

- Spring Lake is a groundwater drainage lake with large groundwater inflow
- Water enters Spring Lake from groundwater, one inlet at the south end, runoff, and precipitation
- Water exits the lake through an outlet at the east end and to groundwater

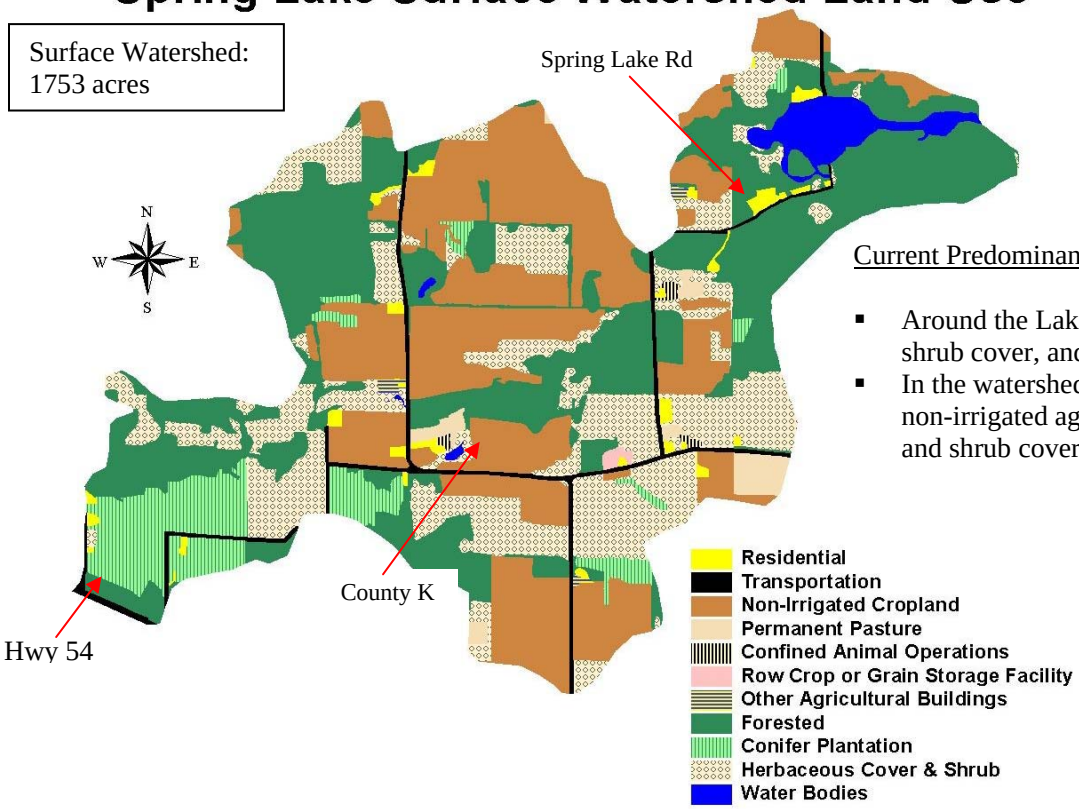


Spring Lake ~ Land Use in the Surface Watershed

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

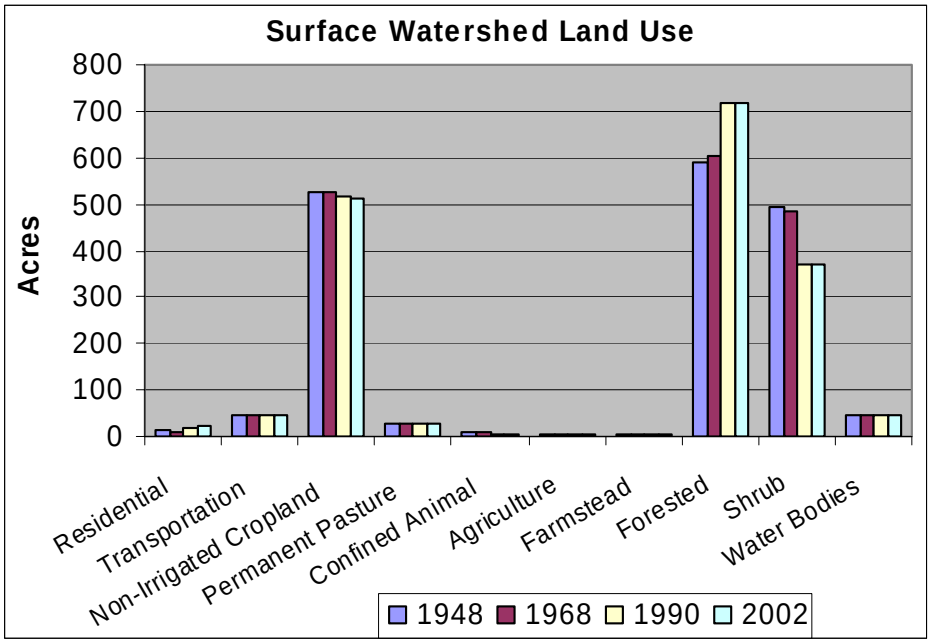
Spring Lake Surface Watershed Land Use

Surface Watershed: 1753 acres



Current Predominant Land Use

- Around the Lake: forest, shrub cover, and residential
- In the watershed: forest, non-irrigated agriculture, and shrub cover

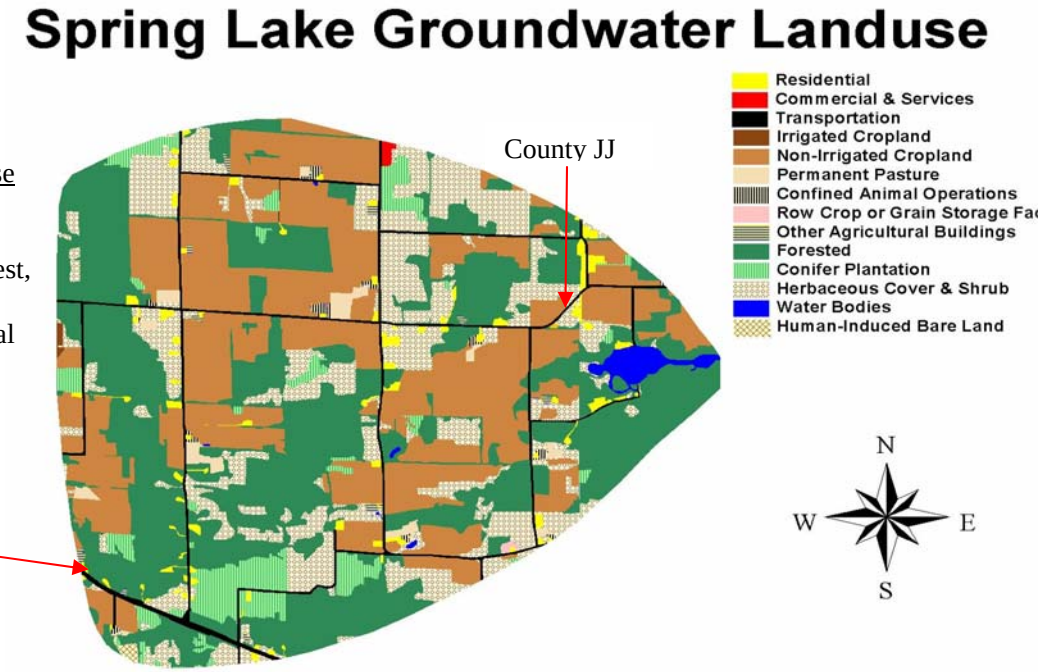


Surface Watershed Land Use

- Very minimal confined animal operations, permanent pasture, and residential land is present
- Forests, non-irrigated cropland, and shrub cover mark the most abundant types of land use

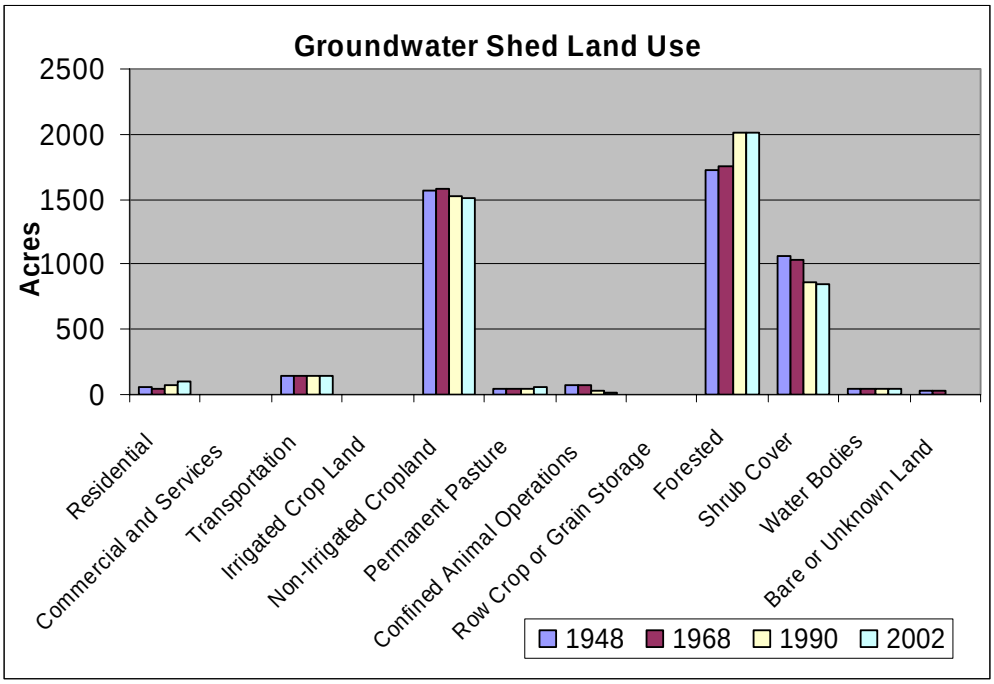
Spring Lake ~ Land Use in the Groundwater Shed

Groundwater Shed: The land area where water soaks into the ground and travels underground to the lake.



Current Predominant Land Use

- Major Uses in the groundwater shed are forest, non-irrigated agriculture, shrub cover and residential



Groundwater Shed Land Use

- Forest and non-irrigated cropland have dominated the land use since 1948
- Permanent Pasture has remained a small fraction of the land use
- Herbaceous and shrub land has decreased since 1948

Spring Lake ~ Taking a closer look
(Within 1,000 feet of the lake)

1968 Air Photo Image

1938 Air Photo Image

1000 Foot Buffer
1968 Boat Landing

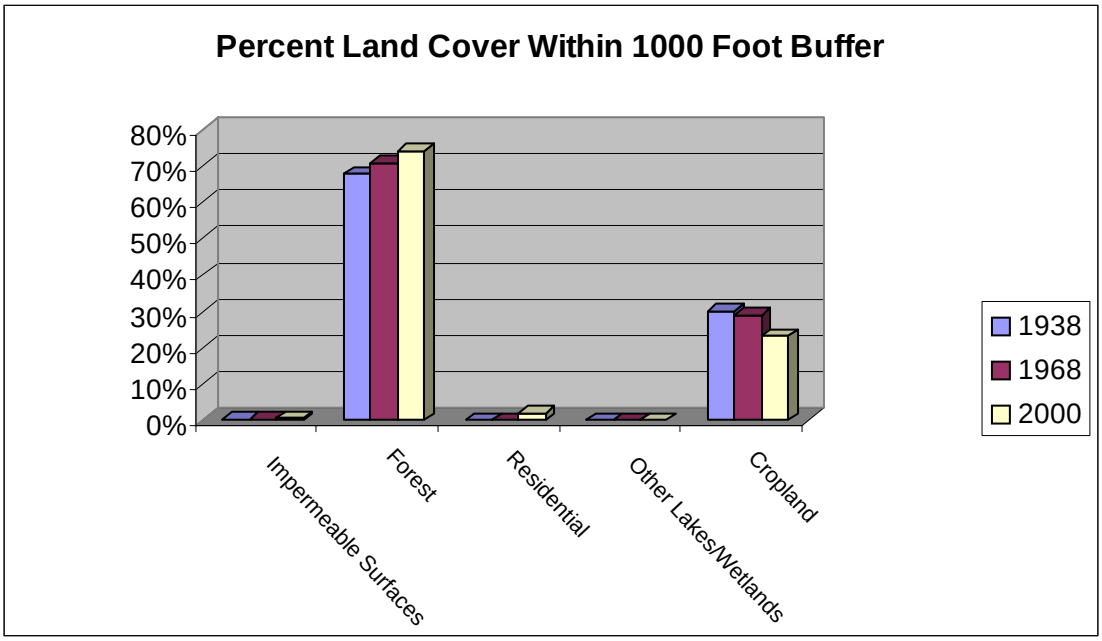
Points of Interest

1. The roads that access the lake were in place by 1968.
2. This area was once mature forest. Forest cover declined sometime after 1938 as the trees were either thinned or cleared for agriculture.
3. Sometime after the 1968 the houses along the access road south of the lake were built and the road was improved.

Spring Lake ~ Taking a closer look
(Within 1,000 feet of the lake)

Changes from 1938 to 2000

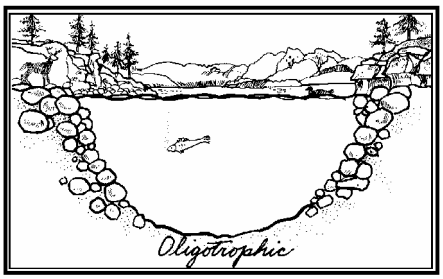
	1938	1968	2000
# of Docks	0	0	1
Impervious Surface (acres)	1	1	1
Residential (acres)	0	0	5
Cropland (acres)	72	68	54
Forest (acres)	162	165	174



Spring Lake ~ Water Quality

Total Phosphorus

In more than 80% of Wisconsin's lakes phosphorus is the key nutrient affecting aquatic plant and algae growth. Once in a lake system phosphorus levels are difficult to reduce, so limiting phosphorus input is key. Phosphorus at levels above 30 parts per billion (ppb) can lead to nuisance aquatic plant growth and accelerate a lake's change from oligotrophic to eutrophic. Sources of phosphorus include septic systems, detergents, animal waste, farmland and storm sewer runoff, soil erosion, and fertilizers for lawns, gardens, and agriculture.



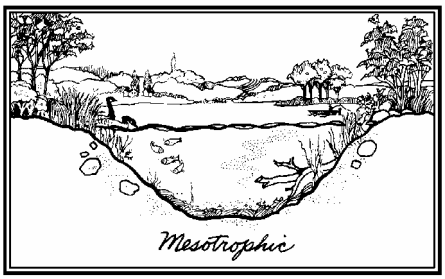
Oligotrophic Lakes

Common uses:

- ✓ Swimming
- ✓ Skiing
- ✓ Boating

Vegetation of oligotrophic lakes:

- ✓ Very little vegetation



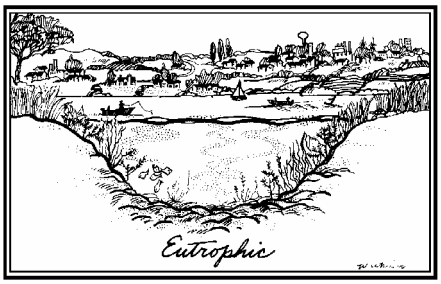
Mesotrophic Lakes

Common uses:

- ✓ Boating
- ✓ Fishing

Vegetation of mesotrophic lakes:

- ✓ Increased vegetation
- ✓ Occasional algal blooms



Eutrophic Lakes

Common uses:

- ✓ Fishing
- ✓ Wildlife watching

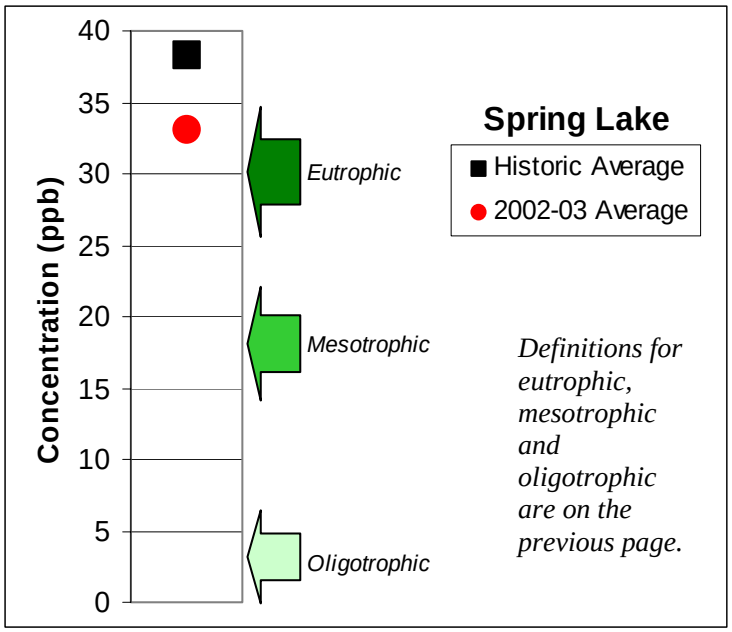
Vegetation of eutrophic lakes:

- ✓ Lots of aquatic plants
- ✓ Frequent algal blooms

Winterkill problems are most likely in shallow lakes.

Spring Lake ~ Water Quality

Average Total Phosphorus Levels

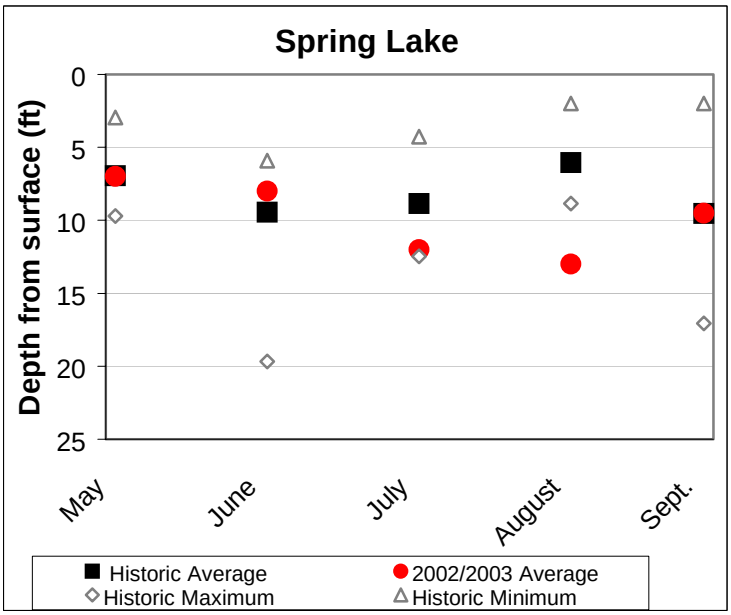


The graph to the left shows total phosphorus levels measured when the lake is well mixed (overturn). Phosphorus levels in Spring Lake in 2002-03 were lower then average historic levels. Levels of phosphorus above 30 ppb are high enough to categorize a lake as eutrophic, making it subject to aquatic plant growth that is better for fishing and wildlife viewing than swimming. Current levels in Spring Lake similar to the 36 ppb concentration for other drainage lakes in the county.

Overturn: uniform temperature from top to bottom in the lake.

Water Clarity

Water clarity (Secchi disc depth) is an indicator of water quality. The two main components affecting water clarity are materials dissolved in the water and materials suspended in the water. Water clarity can indicate overall water quality, especially the amount of algae and suspended sediment present.



The water clarity of Spring Lake during the 2002-03 growing seasons was similar to the historical growing season average, except in July and August when it was better than average. The water clarity in Spring Lake is considered to be good. The month of August shows the best water clarity and the month of May the poorest. Water clarity fluctuations are expected throughout the growing season as algae populations and sedimentation increase and decrease. The average Secchi depth reading for other drainage lakes in the county is about nine feet. Spring Lake appears to have clarity similar to these lakes.

2002 Amphibian Distribution at Portage County Lakes

This summary provides preliminary information on the amphibian species present and their distribution at the twenty-nine Portage County lakes. Surveys were conducted from April 2002 - August 2002, the typical breeding period of the frogs and salamanders found in the county.

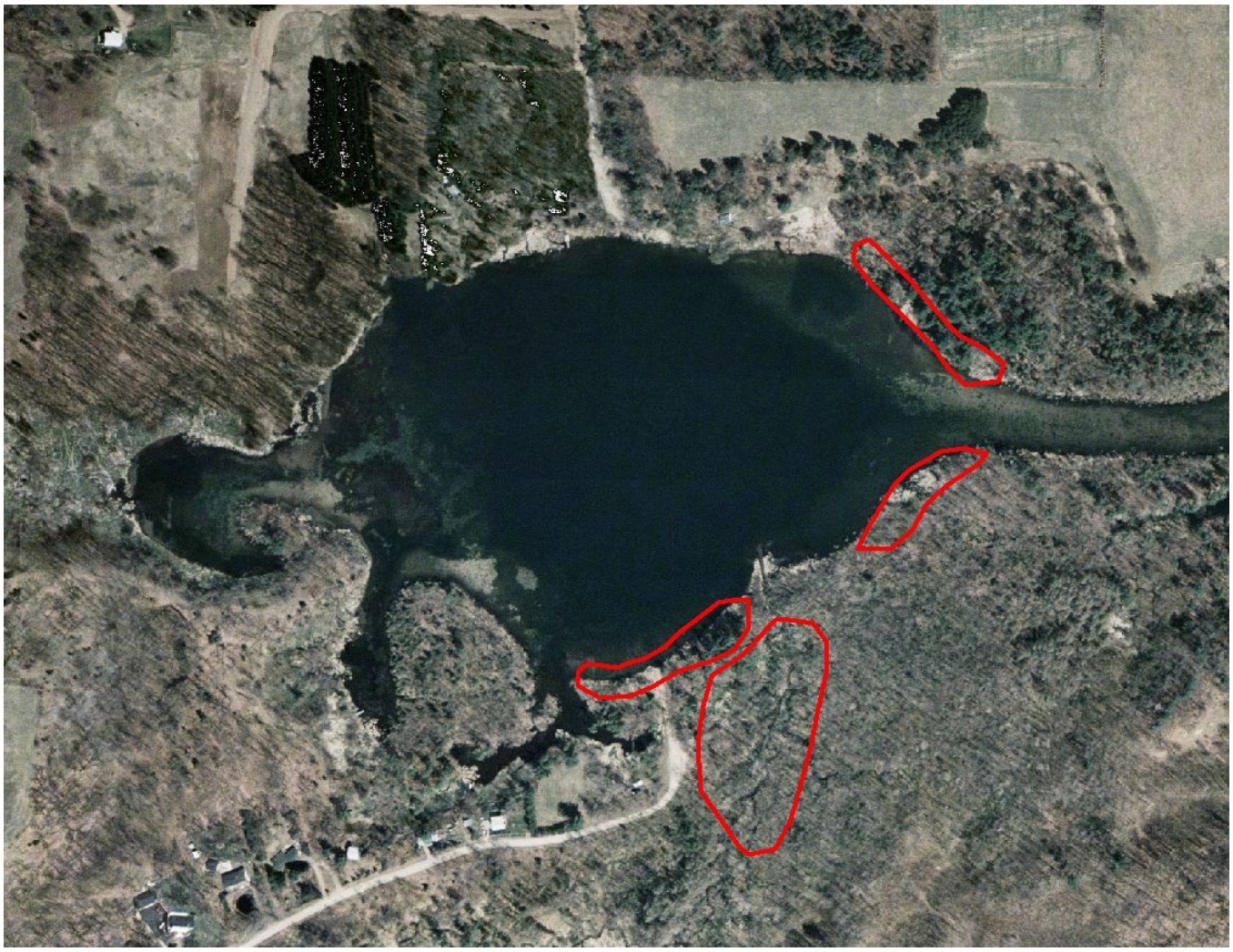
Twelve frog species have been documented in Wisconsin, nine of which currently inhabit Portage County: American toad, chorus frog, spring peeper, eastern gray treefrog, Cope's gray treefrog, green frog, pickerel frog, northern leopard frog, and wood frog. Historically, Blanchard's cricket frog inhabited Portage County but is believed to now exist only in southeastern Wisconsin. Of all species believed to inhabit Portage County, only the pickerel frog was not found during the spring and summer of 2002. The pickerel frog has been listed as a species of special concern in Wisconsin. No new species to Portage County were recorded in 2002.

Seven salamander species have been documented in Wisconsin, all of which currently inhabit Portage County: blue-spotted salamander, spotted salamander, tiger salamander, central newt, mudpuppy, northern redback salamander and four-toed salamander. The four-toed salamander is listed as a species of special concern in Wisconsin.

Large sections of continuous natural shoreline on lakes are ideal habitats for frog and salamander populations. Natural areas with large amounts of submergent, emergent and floating-leaf vegetation provide protection for amphibians. Many species also use the vegetation for attachment of eggs during the breeding season. Green frogs, bullfrogs, pickerel frogs and leopard frogs depend on the shoreline area throughout the year. In contrast, American toads, spring peepers, tree frogs, wood frogs and chorus frogs depend on the shoreline area in the spring for breeding and then move to other areas for the rest of the year.

Undisturbed areas of shoreline that are also connected to large natural upland areas provide ideal habitat for many amphibian species because they lessen frogs' exposure to predators. Many frog and salamander species migrate to the lakes in the spring to breed and spend the summer months foraging in the uplands. Many amphibian species will also over winter in the uplands.

Spring Lake ~ Frogs and Turtles



Spring Lake
Number of frog species: 3

Frog species observed: spring peeper, American toad, green frog

Location of primary habitat: several areas surrounding the lake

Key features of habitat: protected areas of marsh with large amounts of submergent, emergent and floating-leaf vegetation

Number of turtle species: 2

Turtle species observed: painted turtle, snapping turtle

Map Key
Red outlined areas = primary frog habitat

Good news
Minimal level of shoreline alteration, large sections of natural, undisturbed shoreline

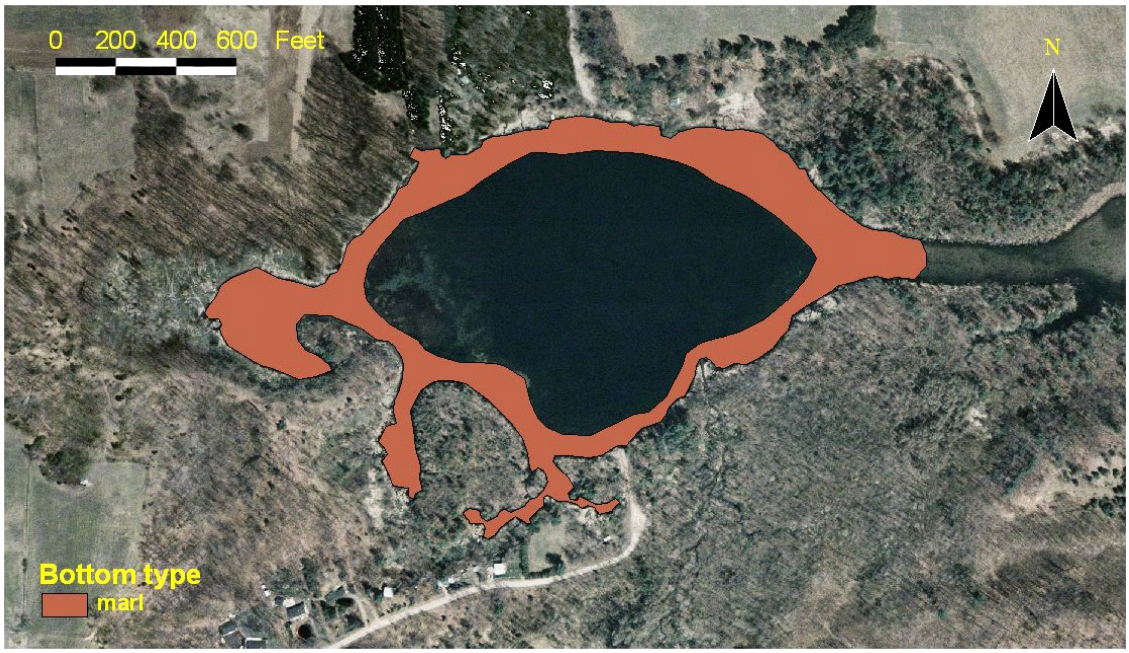
Spring Lake ~ Fish

Spring Lake Fish

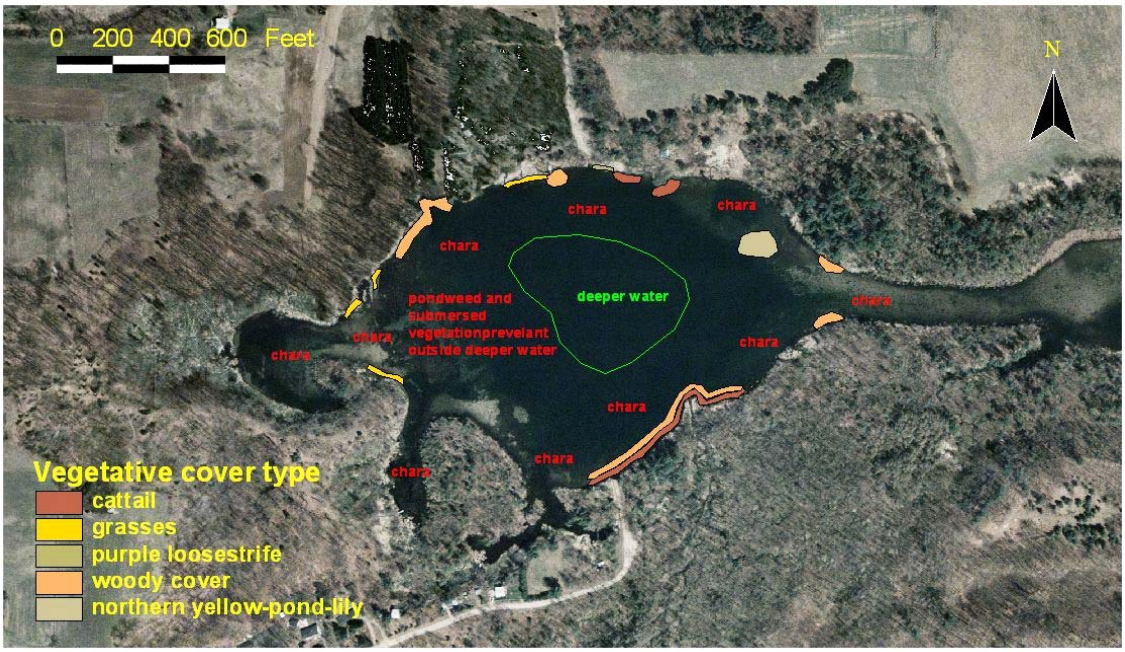
Number of observed species: 15

Species observed to date: This chart represents all species detected, by decade, in Spring Lake since censusing began. Data before 2002 was collected by the Wisconsin DNR and 2002/2003 data was collected by UW-Stevens Point. X represents a decade when the species was detected and S represents a decade when the species was stocked.

	1940's	1950's	1960's	1970's	1980's	1990's	2000's
Brook Trout			X	S	S		
Brown Trout			X	S	S		
Rainbow Trout	X	X		S	X,S	S	S
Bluegill	X	X	X		X		X
Pumpkinseed	X	X	X		X		
Green Sunfish		X					X
Rock Bass	X	X	X				X
Largemouth Bass	X	X	X		X		X
Black Crappie	X				X		X
Walleye					X		
Yellow Perch	X	X			X		X
Iowa Darter		X					X
Banded Darter		X	X				
Northern Pike					X		X
White Sucker	X	X					X
Sucker sp.			X				
Bluntnose Minnow		X	X				X
Golden Shiner			X				X
Blackchin Shiner							X
Brook Stickleback		X	X				X
Banded Killifish							X
Central Mudminnow							X
Mottled Sculpin		X	X				



Substrate: Bottom substrate is almost entirely marl. Woody debris and snail shells embedded in the marl are often successfully used as spawning substrate for species that normally prefer sand and gravel.



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Vegetation: Much of the shoreline is shrub and tree-lined and down timber provides excellent permanent cover in several areas of the lake. Additional standing timber from raising the stream outlet dam will provide additional excellent habitat as it continues to fall into the water in coming years. Chara covers the entire lake bottom and a few beds of water lilies provide surface cover. There are a few areas of emergent vegetation represented by cattails and submerged grasses with rush in the shallows near the outlet.

Spring Lake supports a warm water fishery and stocked cold water fishery. Fifteen species were found in 2002 and 2003 compared to 20 from historical records dating back to the 1940s. Three newly documented species were found including blackchin shiner, banded killifish and central mudminnow. The sport fish community is dominated by bluegill, largemouth bass, and rock bass. All three of these species were more numerous and larger in size than in most other area lakes. The lake has been repeatedly stocked with brown, rainbow and brook trout, but none were found in the fall 2002-2003 survey. They undoubtedly are present at times as they are periodically caught by anglers. The lake has had little development, and other than the water level being raised by a low dam downstream about one mile on the outlet stream, it retains much of its natural characteristics. Seven species previously documented over the years were not found in the present survey including the three trout species, walleye, banded darter, pumpkinseed, and mottled sculpin. There is no spawning habitat for walleye in this lake and the record shows just one individual reported in 1985. It does not appear walleye were ever present in any numbers here. The pumpkinseed, last reported in 1987, has declined in many area lakes because of hybridization with bluegill, although no hybrids were found in Spring Lake in 2002 and 2003. The banded darter is a stream fish and may have been more abundant when fish could more freely move into the lake before the low dam on the outlet stream was built. The mottled sculpin is also a stream fish, but restricted to colder water and would not find suitable spawning habitat in a small lake. Several of these species and others could naturally find their way back into the lake through the outlet at high water or perhaps through the inlet, although this stream is very small and probably supports a low diversity of fish.

Spring Lake ~ Aquatic Plants

Aquatic plant surveys were conducted in each lake. More detailed information is available in the final report.

Aquatic Plant Survey

There are 30 species of aquatic or wetland vascular plants that have been found in Spring Lake or on the wet areas of the shore. That is below average for Portage County lakes.

Spring Lake has a relatively small flora, composed mostly of common species. The alien curlyleaf pondweed is well-established. If Eurasian milfoil becomes established in the future, it would probably become quite abundant. However, a large bog and conifer swamp complex on the south shore should be surveyed; a species list from this bog complex would probably raise the c value and floristic quality index substantially if it were included with the Spring Lake data.

Invasive Exotic Aquatic Plants

> Invasive species displace native species, disrupt ecosystems, and affect citizen's livelihoods and quality of life. They hamper boating, swimming, fishing, and other water recreation, and take an economic toll on commercial, agricultural and aquatic resources. (Wisconsin DNR)

Aquatic plants surveys revealed that some of the lakes in the study have invasive aquatic plants present.

Eurasian milfoil (Myriophyllum spicatum) was present in

- Bear Lake
- Lake Emily
- Lake Joanis
- Jordan Pond
- McDill Pond
- Springville Pond
- Thomas Lake

Curly leaf pondweed (Potomogetan crispis) was identified in

- Spring Lake
- Amherst Millpond

Contact the Portage County Land Conservation Department for additional information.

Spring Lake ~ What can you do to help

We Can All Help Take Care Of Our Lake

A lake is a magnificent water resource. The quality of its water is a reflection of what happens on the land that surrounds it.

Lake Users:

- ✓ Run boat engines efficiently.
- ✓ Observe no/low wake zones.
- ✓ Refuel away from water.
- ✓ Dispose of trash property
- ✓ Remove all aquatic plants from boats and trailers.

Land Owners:

- ✓ Control soil erosion.
- ✓ Keep livestock out of lakes and streams.
- ✓ Control manure runoff.
- ✓ Carefully manage nutrients and pesticides.
- ✓ Learn to identify and watch for exotic plants.

Home Owners:

- ✓ Leave natural vegetation buffers in place or replace them if they have been removed.
- ✓ Eliminate the use of fertilizer or use low/no phosphorus fertilizer.
- ✓ Eliminate or minimize use of pesticides.
- ✓ Control soil erosion.
- ✓ Clean up after pets.
- ✓ Learn to identify and watch for exotic plants.

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- UW-Stevens Point
- Portage County
- Portage County Citizens

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Near Shore Summary
Dr. Glenn Bowles

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