

Rosholt Millpond

Introduction

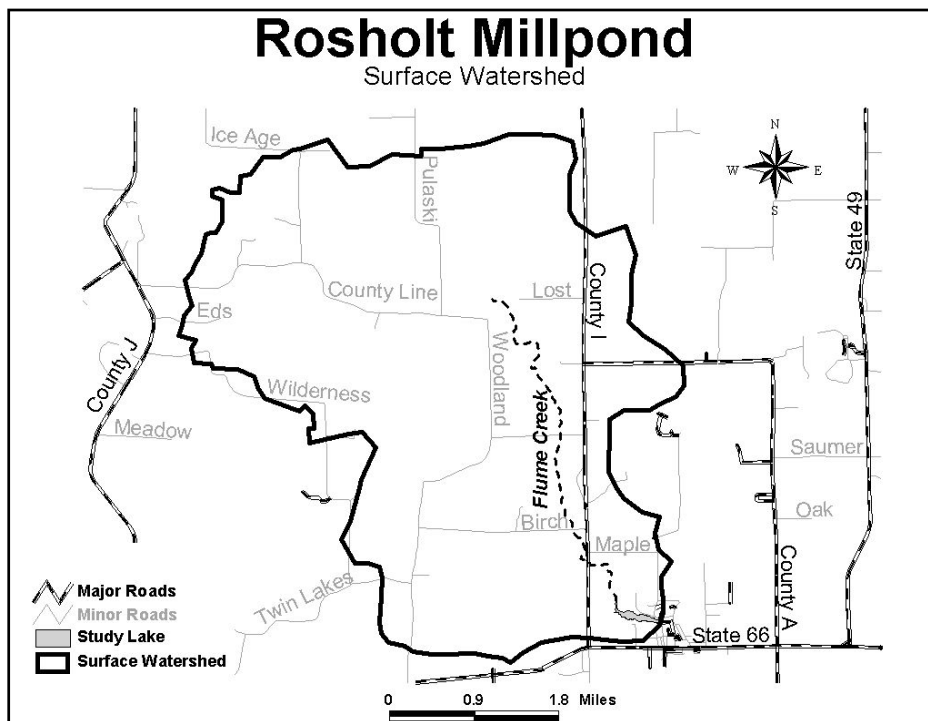
Rosholt Millpond is an **impoundment** on Flume Creek in the Village of Rosholt. At one time the water going through the dam generated power for the grist mill and later for the sawmill, which has been torn down. Rosholt Millpond is a 17.6 acre **impoundment** with a maximum depth of 7 feet and an estimated volume of 61 acre-feet. It contains largemouth bass and panfish. The pond is north of the village with the school on its south bank and a Village Park on the north bank. The area incorporated into the park is especially altered, and kept mowed to the water's edge. The west end of the pond and some of the Flume Creek corridor make up the Rosholt school wetland and upland forest natural area.

Land Use and Watershed

The surface **watershed** of Rosholt Millpond encompasses land northwest of the pond (Figure 1). Since Flume Creek crosses into Marathon County, land use data is only available from the 1992 WISCLAND database (Figure 2). As Figure 3 shows, forest, forested wetland, and agriculture account for 76% of the land use in the 12,245 acre **watershed**. As with the other **impoundments**, study of the **groundwater watershed** for Rosholt Millpond was beyond the scope of this study.

The search for potentially failing septic systems within the **watershed** found 13 in Portage County. There is also one landfill site just north of the millpond. The number of potentially failing septic systems and landfill sites within the **watershed** in Marathon County is unknown.

Figure 1. Rosholt Millpond surface watershed boundary.



*Terms in bold, see glossary pp 13-18

Figure 2. Land use in the Rosholt Millpond watershed.

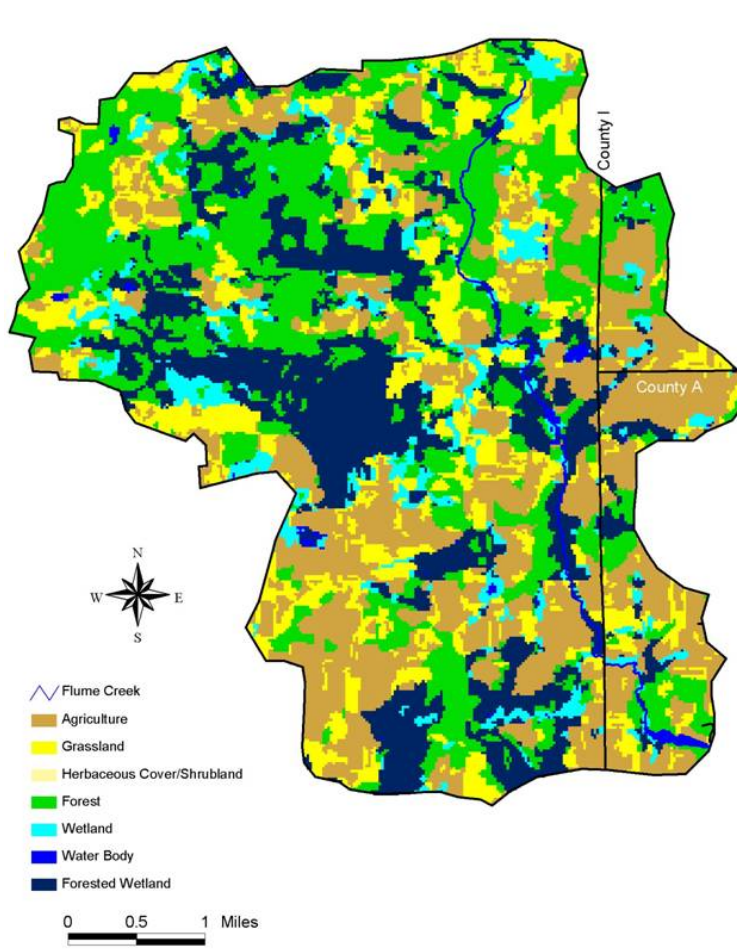
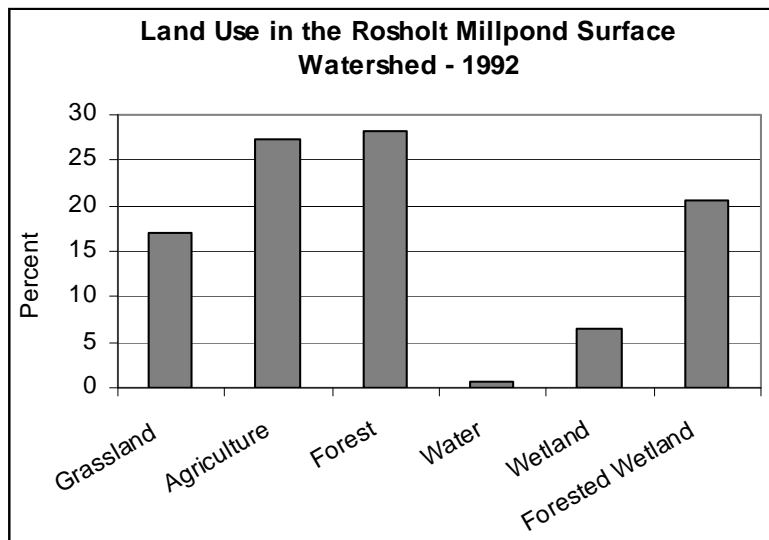


Figure 3. Land use in the Rosholt Millpond surface watershed (1992).

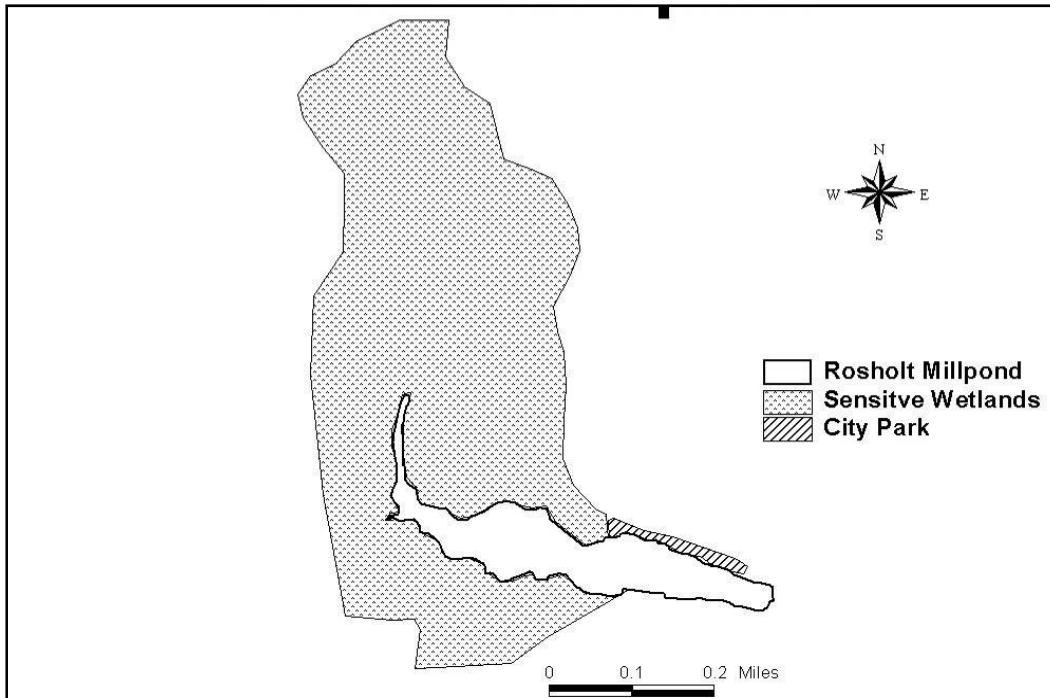


*Terms in bold, see glossary pp 13-18

Upland Sensitive Areas

The survey of upland sensitive areas was conducted to note areas immediately around the pond that are particularly valuable, or sensitive to disruption. The survey of upland sensitive areas for Rosholt Millpond focuses on the natural area west and north of the pond that includes the Rosholt school wetland and upland forest. This undisturbed area provides habitat for many plant and animal species. The north bank, along the Village Park, is noted as sensitive because it is mowed to the edge of the pond making it more susceptible to **erosion** and likely to contribute contaminants to the pond during rain and snow melt events (Figure 4).

Figure 4. Upland sensitive areas near Rosholt Millpond.



Birds

Lakeshore development can negatively or positively affect habitat quality of birds depending on the ecological requirements of each species. Development can play an important role in providing resources unavailable to certain species in a more natural environment, yet eliminate other species' needs altogether, especially at the most extreme levels of development.

Of the 28 most common species, Eastern phoebe (*Sayornis phoebe*), American goldfinch (*Carduelis tristis*), American robin (*Turdus migratorius*), mourning dove (*Zenaida macroura*), and downy woodpecker (*Picoides pubescens*) showed the greatest tendency to be found in developed areas. These species may be taking advantage of different resources available in the urban environment, such as birdfeeders (as in the case of the American goldfinch and downy woodpecker), open foraging areas (American robin and mourning dove), or nest sites (Eastern phoebe).

*Terms in bold, see glossary pp 13-18

At undeveloped sites, least flycatcher (*Empidonax minimus*), great crested flycatcher (*Myiarchus crinitus*), red-eyed vireo (*Vireo olivaceus*), black-capped chickadee (*Poecile atricapillus*), blue jay (*Cyanocitta cristata*), red-bellied woodpecker (*Melanerpes carolinus*), Eastern wood-pewee (*Contopus virens*), indigo bunting (*Passerina cyanea*), and common yellowthroat (*Geothlypis trichas*) were the most common. A majority of these species are insectivores and are likely to feed in more forested environments.

Table 1. Bird species identified near Rosholt Millpond.

Common Name	Number				
	Observed	Food	Foraging	Nest Type	Nest Location
American Goldfinch	1	seeds	foliage gleaner	cup	shrub
Black-capped Chickadee	5	insects	foliage gleaner	cavity	deciduous
Blue Jay	1	omnivore	ground gleaner	cup	coniferous
Catbird	3	insects	ground gleaner	cup	shrub
Chipping Sparrow	4	insects	ground gleaner	cup	coniferous
Common Grackle	1	omnivore	ground gleaner	cavity	deciduous
Common Yellowthroat	3	insects	foliage gleaner	cup	shrub
Eastern Wood-Pewee	2	insects	hawker	cup	deciduous
Great Crested Flycatcher	1	insects	hawker	cavity	deciduous
House Wren	1	insects	ground gleaner	cavity	deciduous
Indigo Bunting	1	insects	foliage gleaner	cup	shrub
Northern Mockingbird	1	insects	ground gleaner	cup	shrub
Northern Rough-winged Swallow	1	insects	aerial foliage gleaner	burrow	bank
Ovenbird	3	insects	hawker	cup	bridge
Purple Martin	2	insects	bark gleaner	cavity	snag
Red-eyed Vireo	2	insects	hover gleaner	cup	shrub
Red-winged Blackbird	2	insects	ground gleaner	cup	reed
Song Sparrow	2	insects	ground gleaner	cup	ground
White-breasted Nuthatch	2	insects	bark gleaner	cavity	deciduous
Yellow Warbler	2	insects	foliage gleaner	cup	shrub
Total	40				

Reptiles and Amphibians

Amphibians (frogs and toads) were included in this survey because with their permeable skin and biphasic lifecycle (meaning that the young live in water while adults can survive on land) they are considered excellent indicators of overall ecosystem health. Furthermore, both turtles and amphibians utilize both aquatic and terrestrial habitats and especially the shoreline interface between these two habitats, and thus are of particular relevance.

Large sections of continuous natural shoreline on lakes are ideal habitats for many frog species. Natural areas with large amounts of submergent, emergent, and floating-leaf vegetation provide protection and a place for attachment of eggs during the breeding season. The upland areas surrounding these lakes also provide important habitat as many frog species migrate to lakes and other bodies of water in the spring or fall to breed and spend the summer months foraging in the uplands. Several species also use the surrounding uplands for overwintering. The turtle species found associated with lakes are predominantly aquatic, usually departing from the water only to

*Terms in bold, see glossary pp 13-18

deposit eggs in a nest. Nests are usually on south facing slopes above the shoreline where there is open vegetation and sandy soil. The newly hatched young then find their way to the water. Thus, both turtles and amphibian are intimately associated with lakes and the associated habitats of a **watershed**.

Four frog species were identified during the survey of Rosholt Millpond (wood frog [*Rana sylvatica*], spring peeper [*Pseudacris crucifer*], gray treefrog [*Hyla versicolor*], and green frog [*Rana clamitans*]). The primary amphibian habitat is located on the west side of the pond (sensitive area is identified in red on Figure 5). Some of the key features of this habitat include protected areas of marsh with large amounts of submergent, emergent, and floating-leaf vegetation.

The good news is that a nature preserve is present on the northwest side of the pond which provides ideal amphibian habitat. The bad news is that some sections of the pond have been altered and are managed in a way resulting in loss of habitat.

Reptile surveys were not conducted on Rosholt Millpond.

Figure 5. Regions of primary amphibian habitat around Rosholt Millpond.



*Terms in bold, see glossary pp 13-18

Aquatic Plants

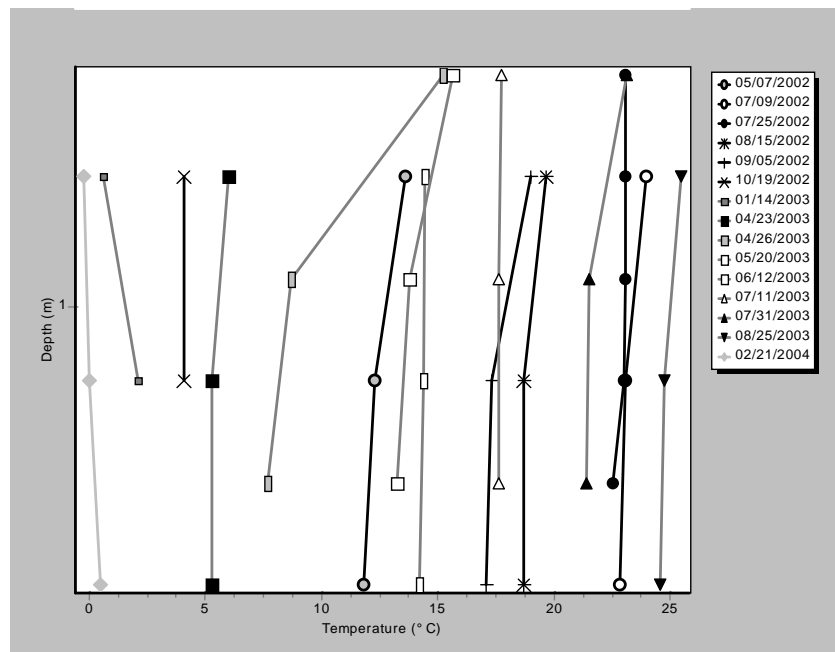
There are **31** species of aquatic or wetland **vascular plants** that were found in Rosholt Millpond or on the adjacent wet parts of the shoreline. This is below average for Portage County lakes. The average **coefficient of conservatism (c value)** is **3.6**, which is below average. The **floristic quality index** is **20.0**, which is also below average for Portage County lakes.

The aquatic flora of Rosholt Millpond is very small. The wet portions of the shoreline are generally narrow, crowded by trees and development on the south shore and by mowed areas on the north shore. No collections or botanical observations were made before 2003.

Current Water Quality Conditions

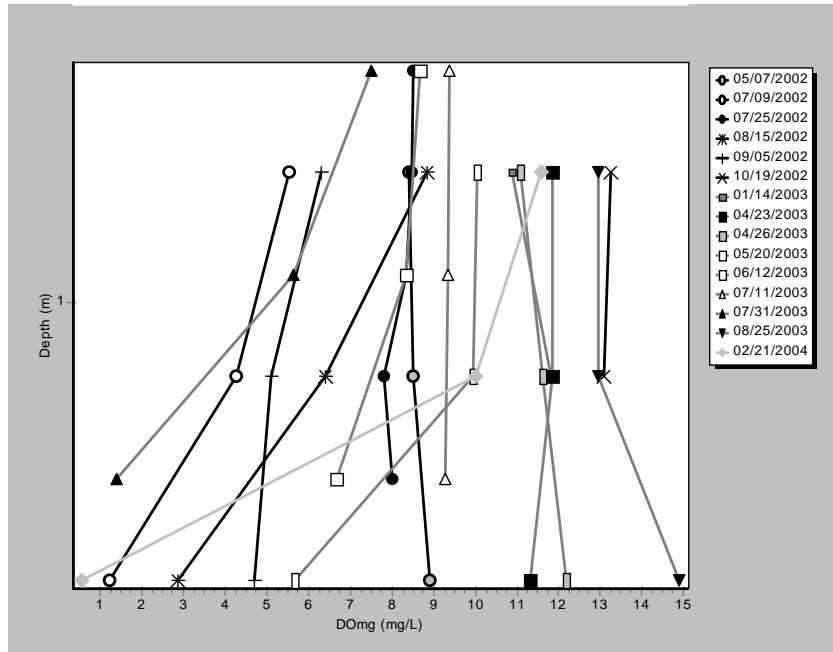
Water quality in lakes is assessed by measuring different characteristics including temperature, dissolved oxygen, water **clarity**, **chlorophyll a**, water chemistry, and the algal community. During this study temperature and dissolved oxygen were measured with depth on each sampling date. As would be expected in a shallow **impoundment**, temperature was the same from top to bottom (Figure 6). During July and September dissolved oxygen was less than 5 **mg/L** at a depth of one foot. It is unusual to see dissolved oxygen concentrations so low at such shallow depths; this is clearly related to the excessive **algae** growth during this period (Figure 7). Dissolved oxygen is necessary for many aquatic organisms. It is consumed by decomposers in the breakdown of tissue from **algae** and aquatic plants.

Figure 6. Profile of temperature in Rosholt Millpond 2002-2004.



*Terms in bold, see glossary pp 13-18

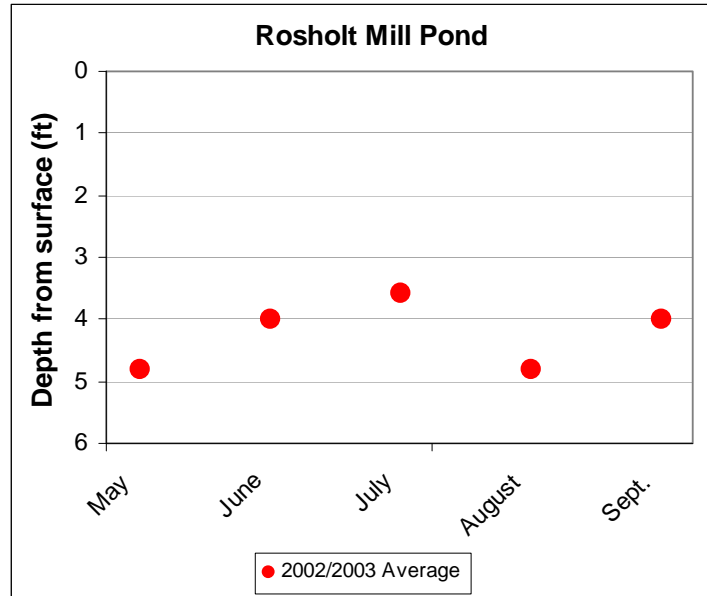
Figure 7. Profile of dissolved oxygen in Rosholt Millpond 2002-2004.



Water **clarity** is a measure of how deep light can penetrate. It is an aesthetic measure and is related to how deep **rooted aquatic plants** can grow. Water **clarity** is affected by water **color** and suspended materials in the water (**turbidity**). **Turbidity** consists of **suspended solids**, such as suspended sediments and **algae (chlorophyll a)**. **Turbidity** was low in samples collected from Rosholt Millpond, but **color** was high. This brown staining is due to the natural tannins associated with wetlands. **Chlorophyll a** concentrations were quite high, ranging from 3.2 to 35.1 **mg/L**. In Rosholt Millpond water **clarity** measures correlated with **chlorophyll a** concentrations. The water **clarity** in Rosholt Millpond is considered fair when compared with other local **impoundments**. The average **Secchi disc** depth for similar ponds in the region is 5 feet. Rosholt Millpond has slightly poorer **clarity** than this. During the 2002-03 growing season, the water **clarity** of Rosholt Millpond was the best during the months of May and August and the worst during July. Fluctuations throughout the summer are normal as **algae** populations and **sedimentation** increase and decrease.

*Terms in bold, see glossary pp 13-18

Figure 8. Monthly average water clarity measurements in Rosholt Millpond 2002-2003.



Nutrients (**phosphorus** and **nitrogen**) are important measures of water quality in lakes because they are used for growth by **algae** and aquatic plants (similar to houseplants and crops). Common sources of **nitrogen** and **phosphorus** include fertilizers, animal waste, and septic systems/waste treatment plants. Nutrients can also move into a lake attached to soil particles. **Nitrogen** in the pond is partially in the form of **nitrate** and partially as organic N (Table 2). Of the two forms, **nitrate** is most readily available for use by **algae** and aquatic plants. **Nitrate** appears to be entering the lake system via **groundwater** as the highest concentrations existed during periods of low runoff in the winter. **Nitrate** concentrations ranged from 0.5 to 3.9 **mg/L**. **Phosphorus** for the most part was high, but some variability was observed with TP concentrations ranging from 11 to 65 **ug/L**. Significant **phosphorus** may already be in the pond and re-releasing from sediment during periods of low dissolved oxygen.

Chloride levels, and to a lesser degree **sodium** and **potassium** levels, are commonly used as an indicator of how strongly a lake is being impacted by human activity. **Chloride** and **sodium** concentrations were elevated throughout much of the year (Table 3). Although these constituents are not detrimental to the aquatic ecosystem, they indicate that sources of contaminants (road salt, fertilizer, animal waste, and/or septic system effluent) are entering the lake from either surface runoff or via **groundwater**. **Atrazine** was found in low concentrations in the lake water (0.09 **ug/L**), however some toxicity studies have indicated that reproductive system abnormalities can occur in frogs near these levels. The presence of **atrazine** indicates that other agri-chemicals may also be entering Rosholt Millpond

*Terms in bold, see glossary pp 13-18

Table 2. 2002-2003 water quality seasonal averages in Rosholt Millpond.

Rosholt Millpond	TP (ug/L)	RP (ug/L)	TN (mg/L)	NO2+NO3 (mg/L)	NH4 (mg/L)	Alkalinity (mg/L)	Total Hardness (mg/L)	Calcium Hardness (mg/L)	Color (CU)	Turbidity (NTU)	Chlorophyll a (ppm)
Spring Averages	29.8	11.7	1.62	0.84	0.08	91.0	116.0	61.7	87	1.4	4.1
Summer Averages	49.8	7.7	2.20	0.77	0.04	188.0	210.0	112.4	34	3.5	13.8
Fall Averages	20.0	20.0		1.94	0.04	152.5	181.0	101.5	51	1.9	
Winter Averages	18.7	10.0		3.77	0.09						
2002-2004 Averages	36.8	11.8	1.91	1.62	0.06	136.3	161.4	87.5	62	2.1	12.6

TP=total **phosphorus**; RP=reactive or soluble **phosphorus**; TN=total **nitrogen**; NO2+NO3=**nitrite** and **nitrate** **nitrogen**; NH4=**ammonia nitrogen**

Table 3. 2002-2003 Rosholt Millpond average water chemistry and reference value.

Rosholt Millpond	<i>Low</i>	<i>Medium</i>	<i>High</i>	Reference Values	<i>Low</i>	<i>Medium</i>	<i>High</i>
Sulfate	9.21			Sulfate	<10	10-20	>20
Chloride		7.90		Chloride	<3	3-10	>10
Potassium	1.27			Potassium*	<2.16	2.16-4.30	>4.30
Sodium		3.09		Sodium*	<2.28	2.28-5.09	>5.09

*Ranges of low, medium, high defined by taking the median values from the lake study and dividing into thirds.

Algal Community

The algal community in Rosholt Millpond was somewhat diverse. The dominant groups were the yellow-green **algae** and **diatoms** (Ochrophyta, 35% of all cells counted), **blue-green algae** (Cyanobacteria, 26% of all cells counted), and green **algae** (Chlorophyta, 21% of all cells counted) (Table 4). These three phyla represented 82% of all cells counted over the 2003 sampling season. In the 2581 cells counted during this period there were 5 genera of Cyanobacteria, 12 genera of Chlorophyta, 8 genera of Ochrophyta (including 7 diatom genera), 3 genera of Euglenophyta, 1 genus of Dinophyta, and 1 genus of Cryptophyta identified.

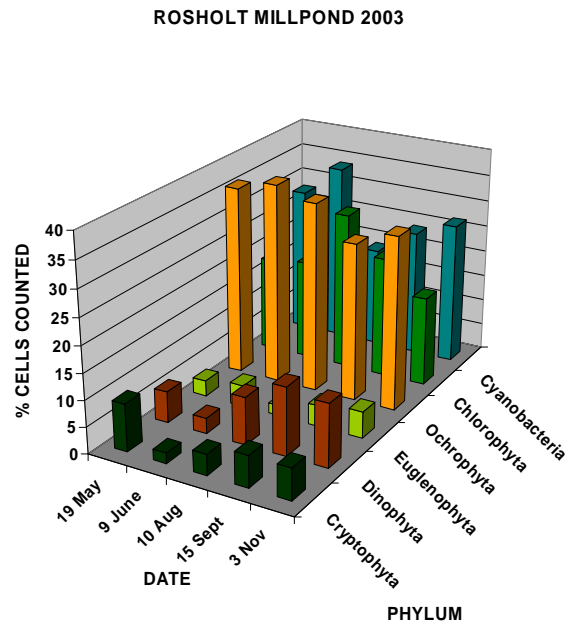
There was very little cycling of the algal community during the 2003 sampling period. The ochrophytes were dominant in every sampling period with the cyanobacteria second, and the greens third in all periods except August. The remaining phyla accounted for 18% of all cell counted, but never more that 13%/phylum in any sampling period (Figure 9).

Table 4. Algal phyla and mean seasonal composition in Rosholt Millpond from May to November 2003.
ROSHOLT MILLPOND

PHYLUM	% CELLS COUNTED BY PHYLUM AND DATE					MEAN
	19 May	9 June	10 Aug	15 Sept	3 Nov	
Cyanobacteria	28	34	19	24	27	26
Chlorophyta	18	19	30	23	17	21
Ochrophyta	36	38	36	30	33	35
Euglenophyta	3	4	2	4	5	4
Dinophyta	6	3	9	13	12	9
Cryptophyta	9	2	4	6	6	5

*Terms in bold, see glossary pp 13-18

Figure 9. Algal community composition by date in Rosholt Millpond from May to November 2003 (total phylum cells counted divided by total cells counted).



Three diatom genera dominated the individual taxa analysis (Figure 10). *Achnanthes* dominated in Jay and June while *Fragilaria* was a subdominant in June and dominant in August. The filamentous diatom genus *Melosira* was dominant in September and November. The potential nuisance and toxin forming blue-green alga *Anabaena* was subdominant in four of five sample periods and third most common in the fifth sample period. The only other taxa found in the top 15 abundance slots (and always third most common) were the dinoflagellate genus *Peridinium* (September, November) and the cryptophyte genus *Chroomonas* (Table 5).

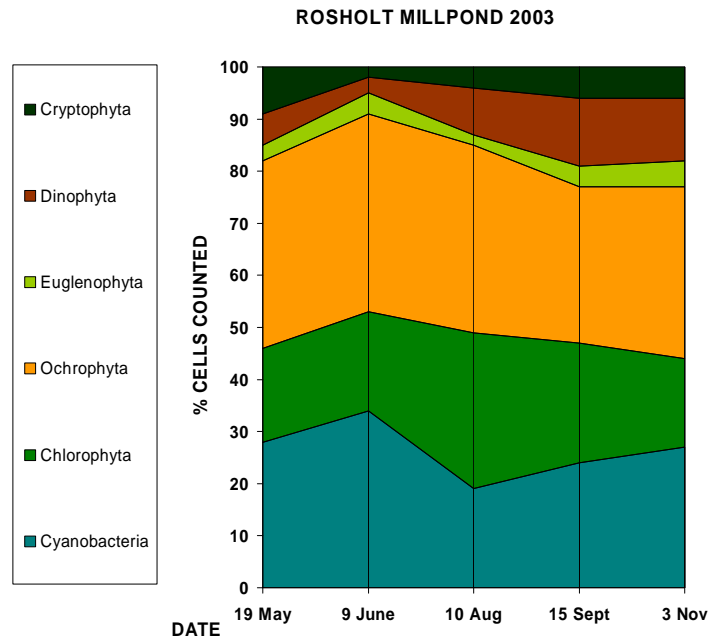
The algal community when considered relative to the **chlorophyll**, **phosphorus**, and **nitrogen** values for Rosholt Millpond presents a picture of a **eutrophic** lake. The 30 genera identified during the sample periods were relatively common, and none of those that reached numerical dominance in the sample counts are associated with toxins or health issues with the exception of the above mentioned *Anabaena*. The dominance of blue-greens and mat-forming **diatoms** could be the result of increasing cultural **eutrophication** in the **watershed** and should be considered a warning sign. Mats of blue-greens and **diatoms** can carpet the shallow reaches, and as they trap photosynthetically-produced oxygen in the interwoven mat material, they will lift off the bottom and float to the surface. At the surface they get too much sunlight, bleach to yellow/white and then decay. The decay can be aesthetically displeasing and in some cases the bacterial decomposition of this material leads to oxygen depletion and perhaps to fish kills.

*Terms in bold, see glossary pp 13-18

Table 5. Most common algal genera by date in Rosholt Millpond from May to November 2003.

DATE	TOP THREE TAXA (MOST ABUNDANT, LEFT TO RIGHT)		
19 May	<i>Achnanthes</i>	<i>Anabaena</i>	<i>Chroomonas</i>
9 June	<i>Achnanthes</i>	<i>Anabaena</i>	<i>Fragilaria 2</i>
10 August	<i>Fragilaria 2</i>	<i>Selenastrum</i>	<i>Anabaena</i>
15 September	<i>Melosira</i>	<i>Anabaena</i>	<i>Peridinium</i>
3 November	<i>Melosira</i>	<i>Anabaena</i>	<i>Peridinium</i>

Figure 10. Algal community composition by phylum in Rosholt Millpond from May to November 2003.



*Terms in bold, see glossary pp 13-18

Rosholt Millpond Study Highlights

- The upland sensitive area for Rosholt Millpond focuses on the natural area west and north of the pond that includes the Rosholt school wetland and upland forest. This undisturbed area provides habitat for many plant and animal species. The north bank, along the Village Park, is noted as sensitive because it is mowed to the edge of the pond making it more susceptible to **erosion** and likely to contribute contaminants to the pond during rain and snow melt events.
- Four frog species were identified during the survey of Rosholt Millpond (wood frog, spring peeper, gray treefrog, and green frog). The primary amphibian habitat is located on the west side of the pond. Some of the key features of this habitat include protected areas of marsh with large amounts of submergent, emergent, and floating-leaf vegetation. The good news is that the nature preserve is present on the northwest side of the pond which provides ideal amphibian habitat. The bad news is that some sections of the pond have been altered and are managed in a way that has resulted in loss of habitat.
- The number of aquatic plant species found in Rosholt Millpond or on the adjacent wet parts of the shoreline is below average for Portage County lakes. The average **coefficient of conservatism** and the **floristic quality index** are below average. The aquatic flora of Rosholt Millpond is very small. The wet portions of the shoreline are generally narrow, crowded by trees and development on the south shore and by mowed areas on the north shore.
- Dissolved oxygen concentrations were low at very shallow depths during July and September; this is clearly related to the excessive **algae** growth during this period. **Chlorophyll a** concentrations were quite high. In Rosholt Millpond water **clarity** measures correlated with **chlorophyll a** concentrations. The water **clarity** in Rosholt Millpond is considered fair when compared with other local **impoundments**.
- **Nitrate** appears to be entering the lake system via **groundwater** as the highest concentrations existed during periods of low runoff in the winter. **Phosphorus** was high. Significant **phosphorus** may be all ready be in the pond and re-releasing from sediment during periods of low dissolved oxygen.
- **Chloride** and **sodium** concentrations were elevated throughout much of the year. Common sources of **chloride** include road salt, fertilizer, animal waste, septic systems. **Atrazine** was found in low concentrations in the lake water (0.09 ug/L), however some toxicity studies have indicated that reproductive system abnormalities can occur in frogs near these levels. The presence of **atrazine** indicates that other agri-chemicals may also be entering Rosholt Millpond.

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- Based on water quality measures, Rosholt Millpond is clearly in the poorest condition of the lakes in this study. The algal community when considered relative to the **chlorophyll**, **phosphorus**, and **nitrogen** values for Rosholt Millpond presents a picture of a **eutrophic** lake. The **algae** were relatively common and none of those that reached numerical dominance in the sample counts are associated with toxins or health issues with the exception of *Anabaena*. The dominance of blue-greens and mat-forming **diatoms** could be the result of increasing cultural **eutrophication** in the **watershed** and should be considered a warning sign. The decay can be aesthetically displeasing, and in some cases the bacterial decomposition of this material leads to oxygen depletion and perhaps to fish kills.

Glossary

Algae:

One-celled (phytoplankton) or multicellular plants either suspended in water (plankton) or attached to rocks and other substrates (periphyton). Their abundance, as measured by the amount of chlorophyll a (green pigment) in an open water sample, is commonly used to classify the trophic status of a lake. Numerous species occur. Algae are an essential part of the lake ecosystem and provides the food base for most lake organisms, including fish. Phytoplankton populations vary widely from day to day, as life cycles are short.

Alkalinity:

A measure of the amount of carbonates, bicarbonates, and hydroxide present in water. Low alkalinity is the main indicator of susceptibility to acid rain. Increasing alkalinity is often related to increased algae productivity. Expressed as milligrams per liter (mg/L) of calcium carbonate (CaCO₃), or as microequivalents per liter (ueq/l). 20 ueq/l = 1 mg/L of CaCO₃.

Ammonia, Ammonium:

A form of nitrogen found in organic materials and many fertilizers. It is the first form of nitrogen released when organic matter decays. It can be used by most aquatic plants and is therefore an important nutrient. It converts rapidly to nitrate (NO₃) if oxygen is present. The conversion rate is related to water temperature. Ammonia is toxic to fish at relatively low concentrations in pH-neutral or alkaline water. Under acid conditions, non-toxic ammonium ions (NH₄⁺) form, but at high pH values the toxic ammonium hydroxide (NH₄OH) occurs. The water quality standard for fish and aquatic life is 0.02 mg/L of NH₄OH. At a pH of 7 and a temperature of 68° F (20° C), the ratio of ammonium ions to ammonium hydroxide is 250:1; at pH 8, the ratio is 26:1.

Atrazine:

The nation's most widely used weedkiller for both grassy and broadleaf weeds.

Blue-Green Algae:

Algae that are often associated with problem blooms in lakes. Some produce chemicals toxic to other organisms, including humans. They often form floating scum as they die. Many can fix nitrogen (N₂) from the air to provide their own nutrient.

Chloride (Cl-):

Chlorine in the chloride ion (Cl⁻) form has very different properties from chlorine gas (Cl₂), which is used for disinfecting. The chloride ion (Cl⁻) in lake water is commonly considered an indicator of human activity. Agricultural chemicals, human and animal wastes, and road salt are the major sources of chloride in lake water.

*Terms in bold, see glossary pp 13-18

Chlorophyll a:

Green pigment present in all plant life and necessary for photosynthesis. The amount present in lake water depends on the amount of algae and is therefore used as a common indicator of water quality.

Clarity:

see "Secchi disc."

Coefficient of Conservatism (c-value):

Indicates on a scale of 0 to 10 the degree to which a species can tolerate disturbance to a native plant community; a species with a c value of 10 is found only in relatively undisturbed areas of native plant community, whereas a species with a c value of 0 never grows in undisturbed areas of native plant communities. Plants with low numbers tend to occur in a wide range of more-or-less disturbed plant communities. Alien species are also assigned a c value of 0. The c values are used in this report in calculating the Floristic Quality Index for each lake.

Color:

Measured in color units that relate to a standard. A yellow-brown natural color is associated with lakes or rivers receiving wetland drainage. The average color value for Wisconsin lakes is 39 units, with the color of state lakes ranging from zero to 320 units. Color also affects light penetration and therefore the depth at which plants can grow.

Concentration Units:

Express the amount of a chemical dissolved in water. The most common ways chemical data is expressed is in milligrams per liter (mg/L) and micrograms per liter (ug/L). One milligram per liter is equal to one part per million (ppm). To convert micrograms per liter (ug/L) to milligrams per liter (mg/L), divide by 1000 (e.g. 30 ug/l = 0.03 mg/L). To convert milligrams per liter (mg/L) to micrograms per liter (ug/L), multiply by 1000 (e.g. 0.5 mg/L = 500 ug/L). Microequivalents per liter (ueq/L) is also sometimes used, especially for alkalinity; it is calculated by dividing the weight of the compound by 1000 and then dividing that number into the mg/L.

Diatoms:

A major group of eukaryotic algae, which are one of the most common types of phytoplankton. Diatom communities are a popular tool for monitoring environmental conditions, past and present, and are commonly used in studies of water quality; often the brown stuff attached to rock surfaces.

Drainage Lakes:

Lakes fed primarily by streams and with outlets into streams or rivers. They are more subject to surface runoff problems but generally have shorter retention times than seepage lakes. Watershed protection is usually needed to manage lake water quality.

Erosion:

The lowering of the land surface by weathering, corrosion, and transportation, under the influence of gravity, wind, and running water.

Eutrophic:

Eutrophic lakes are high in nutrients and support a large biomass (all the plants and animals living in a lake). They are usually either weedy or subject to frequent algae blooms, or both. Eutrophic lakes often support large fish populations, but are also susceptible to oxygen depletion. Small, shallow, eutrophic lakes are especially vulnerable to winterkill which can reduce the number and variety of fish. Rough fish are commonly found in eutrophic lakes.

*Terms in bold, see glossary pp 13-18

Eutrophication:

The process by which lakes and streams are enriched by nutrients, and the resulting increase in plants and algae. The extent to which this process has occurred is reflected in a lake's trophic classification: oligotrophic (nutrient poor), mesotrophic (moderately productive), and eutrophic (very productive and fertile).

Fen:

A fen is a type of wetland fed by surface and/or groundwater. Fens are characterized by their water chemistry, which is neutral or alkaline, unlike bogs, which are generally acid.

Floristic Quality Index (FQI):

The FQI is a standardized method for evaluating natural plant communities by multiplying the average coefficient of conservatism (c-value) for all species by the square root of the total number of species found at that lake; an additional point is added to the index for each state-listed special concern species, two points added for a threatened species, and three points added for an endangered species. A higher floristic quality index, such as FQI=60, indicates a higher floristic quality and biological integrity and a lower level of disturbance impacts. A lower floristic quality index, such as FQI=20, indicates a lower floristic quality and biological integrity and a higher level of disturbance impacts.

Groundwater:

Water found below the land surface in pore spaces between soil particles or in cracks in rock. It moves slowly from higher to lower areas on the landscape and may provide water to a lake.

Groundwater Drainage Lake:

Often referred to a spring-fed lake, has large amounts of groundwater as its source, and a surface outlet. Areas of high groundwater inflow may be visible as springs or sand boils. Groundwater drainage lakes often have intermediate retention times with water quality dependent on groundwater quality.

Hardness, Hard Water:

The quantity of multivalent cations (cations with more than one +), primarily calcium (Ca⁺⁺) and magnesium (Mg⁺⁺) in the water expressed as milligrams per liter of CaCO₃. Amount of hardness relates to the presence of soluble minerals, especially limestone, in the lake watershed. Soft water has 60 mg/L CaCO₃ or less, moderately hard water has 61-120 mg/L CaCO₃, hard water has 121-180 mg/L CaCO₃, and very hard water has more than 180 mg/L CaCO₃.

Impoundment:

Manmade lake or reservoir usually characterized by stream inflow and always by a stream outlet. Because of nutrient and soil loss from upstream land use practices, impoundments ordinarily have higher nutrient concentrations and faster sedimentation rates than natural lakes. Their retention times are relatively short.

Littoral:

The shallow water zone near the shoreline that is home to most aquatic plants.

Macrophytes:

see "Rooted aquatic plants."

Macrophytic Algae:

Algae that resemble true plants in that they appear to have stems and leaves, and are attached to the bottom.

*Terms in bold, see glossary pp 13-18

Marl:

White to gray accumulation on lake bottoms caused by precipitation of calcium carbonate (CaCO_3) in hard water lakes. Marl may contain many snail and clam shells, which are also calcium carbonate. While it gradually fills in lakes, marl also precipitates phosphorus, resulting in low algae populations and good water clarity. In the past, marl was recovered and used to lime agricultural fields.

Mesotrophic:

Mesotrophic lakes lie between the oligotrophic and eutrophic trophic stages. In late summer, they lose oxygen at depth, limiting cold water fish and causing phosphorus release from sediments.

mg/L:

see "Concentration units"

Nitrate (NO_3^-):

An inorganic form of nitrogen important for plant growth. Nitrogen is in this stable form when oxygen is present. Nitrate often contaminates groundwater when water originates from manure pits, fertilized fields, lawns or septic systems. High levels of nitrate-nitrogen (over 10 mg/L) are dangerous to infants and expectant mothers. A concentration of nitrate-nitrogen ($\text{NO}_3\text{-N}$) plus ammonium-nitrogen ($\text{NH}_4\text{-N}$) of 0.3 mg/L in spring will support summer algae blooms if enough phosphorus is present.

Nitrite (NO_2^-):

A form of nitrogen that rapidly converts to nitrate (NO_3^-) and is usually included in the NO_3^- analysis.

Nitrogen:

A chemical element that is an essential plant nutrient and may occur in the form of nitrate, nitrite, ammonium, or organic nitrogen in lakes.

Oligotrophic:

A trophic state in which lakes are generally clear, deep and free of weeds or large algae blooms. Though beautiful, they are low in nutrients and do not support large fish populations. However, oligotrophic lakes often develop a food chain capable of sustaining a very desirable fishery of large game fish.

Phosphorus:

Key nutrient influencing plant growth in more than 80% of Wisconsin lakes. Soluble reactive phosphorus is the amount of phosphorus in solution that is available to plants. Total phosphorus includes the amount of phosphorus in solution (reactive) and in particulate form.

Photosynthesis:

The process by which green plants convert carbon dioxide (CO_2) dissolved in water to sugar and oxygen using sunlight for energy. Photosynthesis is essential in producing a lake's food base, and is an important source of oxygen for many lakes.

Potassium:

A chemical element that is an essential plant nutrient and may enter lakes from runoff of agricultural fertilizers and animal wastes.

*Terms in bold, see glossary pp 13-18

Retention Time: (Turnover Rate or Flushing Rate)

The average length of time water resides in a lake, ranging from several days in small impoundments to many years in large seepage lakes. Retention time is important in determining the impact of nutrient inputs. Long retention times result in recycling and greater nutrient retention in most lakes. Calculate retention time by dividing the volume of water passing through the lake per year by the lake volume.

Rip Rap (Rip-Rap):

Hard rock, commonly granite or concrete rubble recycled from construction sites, used inland on lakes, rivers, coastlines, and other waterways to prevent bank erosion. Generally rip rap is not considered good management in lakes, due to its inability to provide adequate habitat, and is no longer commonly used.

Rooted Aquatic Plants: (Macrophytes)

Refers to higher (multi-celled) plants growing in or near water. Macrophytes are beneficial to lakes because they produce oxygen and provide substrate for fish habitat and aquatic insects. Overabundance of such plants, especially problem species, is related to shallow water depth and high nutrient levels.

Secchi Disc (Secchi Disk):

An 8-inch diameter plate with alternating quadrants painted black and white that is used to measure water clarity (light penetration). The disc is lowered into water until it disappears from view. It is then raised until just visible. An average of the two depths, taken from the shaded side of the boat, is recorded as the Secchi disc reading. For best results, the readings should be taken on sunny, calm days.

Sedimentation:

Accumulated organic and inorganic matter on the lake bottom. Sediment includes decaying algae and weeds, marl, and soil and organic matter eroded from the lake's watershed.

Seepage Lakes:

Lakes without a significant inlet or outlet, fed by rainfall and groundwater. Seepage lakes lose water through evaporation and groundwater moving on a down gradient. Lakes with little groundwater inflow tend to be naturally acidic and most susceptible to the effects of acid rain. Seepage lakes often have long retention times, and lake levels fluctuate with local groundwater levels. Water quality is affected by groundwater quality and the use of land on the shoreline.

Sodium:

A chemical element that may enter lakes from runoff of road salt, fertilizers, and human and animal wastes.

Stratification, Stratified:

The layering of water due to differences in density. Water's greatest density occurs at 39°F (4°C). As water warms during the summer, it remains near the surface while colder water remains near the bottom. Wind mixing determines the thickness of the warm surface water layer (epilimnion), which usually extends to a depth of about 20 ft. The narrow transition zone between the epilimnion and cold bottom water (hypolimnion) is called the metalimnion or thermocline.

Sulfate (SO₄²⁻):

The most common form of sulfur in natural waters. The amounts relate primarily to soil minerals in the watershed. Sulfate (SO₄²⁻) can be reduced to sulfide (S²⁻) and hydrogen sulfide (H₂S) under low or zero oxygen conditions. Hydrogen sulfide smells like rotten eggs and harms fish. Sulfate input from acid rain is a major indicator of sulfur dioxide (SO₂) air pollution. Sulfate concentration is used as a chemical fingerprint to distinguish acid lakes acidified by acid rain from those acidified by organic acids from bogs.

*Terms in bold, see glossary pp 13-18

Substrate:

The material found at the bottom of a lake, such as silt, mud, sand, clay, marl, gravel, etc.

Suspended Solids:

A measure of the particulate matter in a water sample, expressed in milligrams per liter. When measured on inflowing streams, it can be used to estimate the sedimentation rate of lakes or impoundments.

Turbidity:

The “cloudiness” or “murkiness” of water, caused by total suspended solids.

Vascular Plants:

Vascular plants are those plants that have tissues for conducting water, minerals, and food through the plant. Vascular plants include the ferns, clubmosses, flowering plants, and conifers.

Watershed:

The total land area that drains either surface water or groundwater toward a lake.

*Terms in bold, see glossary pp 13-18