Bentley Pond

Introduction

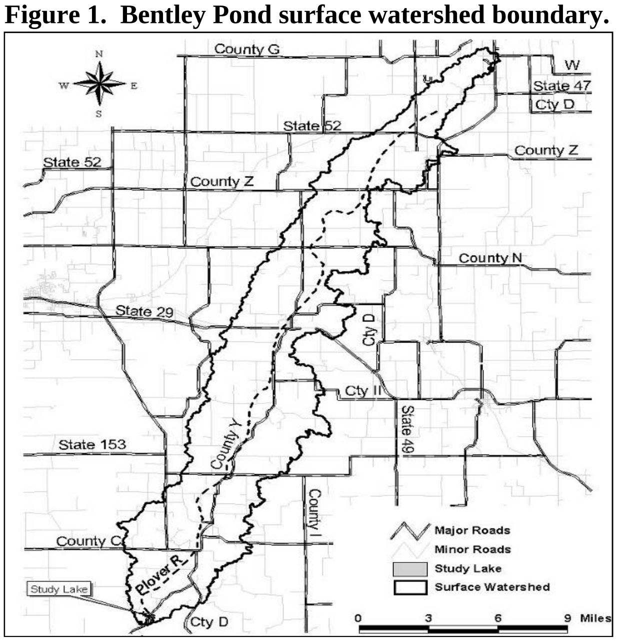
Bentley Pond is an 86 acre **impoundment** on the Plover River ten miles northeast of Stevens Point. The dam was built to provide power to a woodworking mill. The pond has a maximum depth of ten feet, and the bottom is covered with a heavy layer of silt. The estimated volume of the pond is 133 acre-feet. The Plover River is navigable above and below the dam, and the pond is very scenic; however, public access to the pond is limited to County Hwy Y. Northern pike and panfish make up much of the fishery.

Land Use and Watershed

The surface **watershed** for Bentley Pond is the Plover River **watershed** north of the **impoundment**, encompassing 74,175 acres in Portage, Marathon, and Langlade Counties (Figure 1). Detailed historic land use data are not available for the **watershed** because it continues outside of Portage County. The land use data available is the 1992 WISCLAND coverage of the state of Wisconsin (which is older and not as detailed). These records show that forest (40%), agriculture (22%), and grassland (20%) dominate the **watershed**. When they are combined, forested wetlands and wetlands comprise another 16.5% of the land use. Urban land use barely registers at less than 1%; however; the classification of ‘urban’ fails to account for all of the rural homes in the **watershed. D**epending upon their land use practices, they can produce significant impact to water quality and habitat (Figure 2 and Figure 3).

As with the other **impoundments**, data on the **groundwater watershed** for Bentley Pond is beyond the scope of this study. However, based on the hydrology of the Plover River region, the **groundwater watershed** is likely very similar to the surface **watershed**. An inventory of the records in 2002 indicate that there are 16 potentially failing septic systems, but no landfill sites in the Portage County area of the **watershed**. It is not known how many systems may be failing outside of Portage County, or how many landfill sites there may be.

Figure 1. Bentley Pond surface watershed boundary.



*For terms in bold, see glossary pp. 11-16

Figure 2. Land use in the Bentley Pond watershed (WISCLAND - 1992).

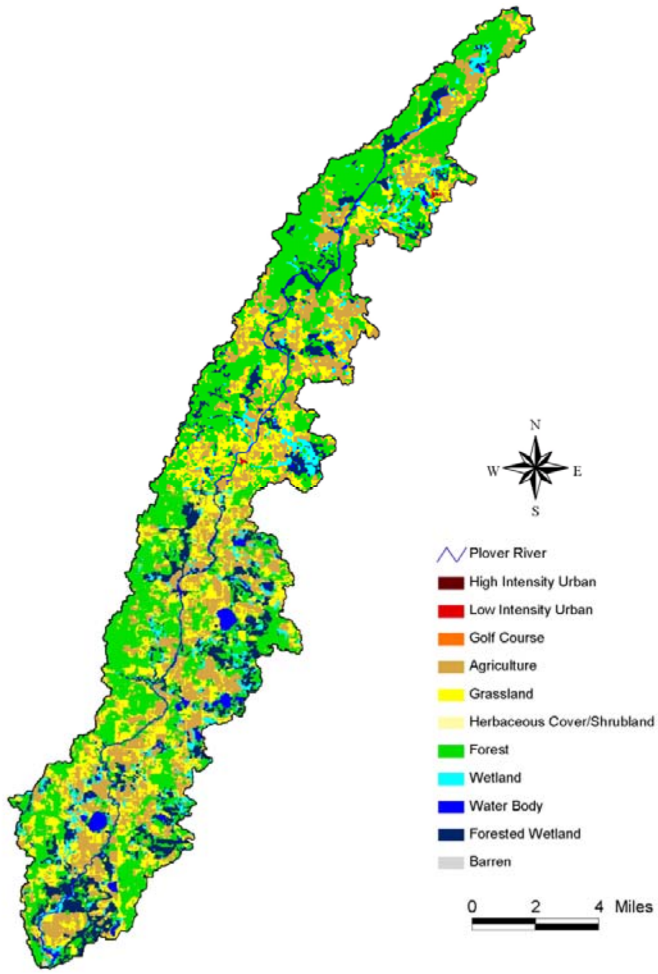
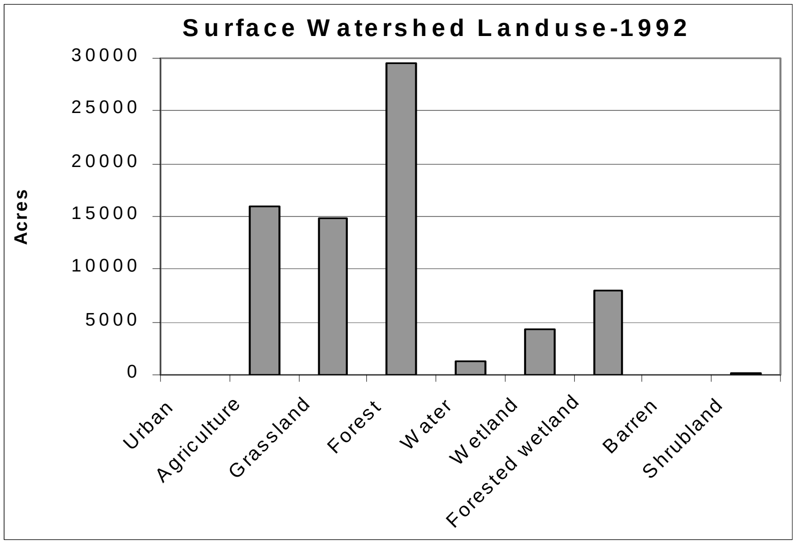


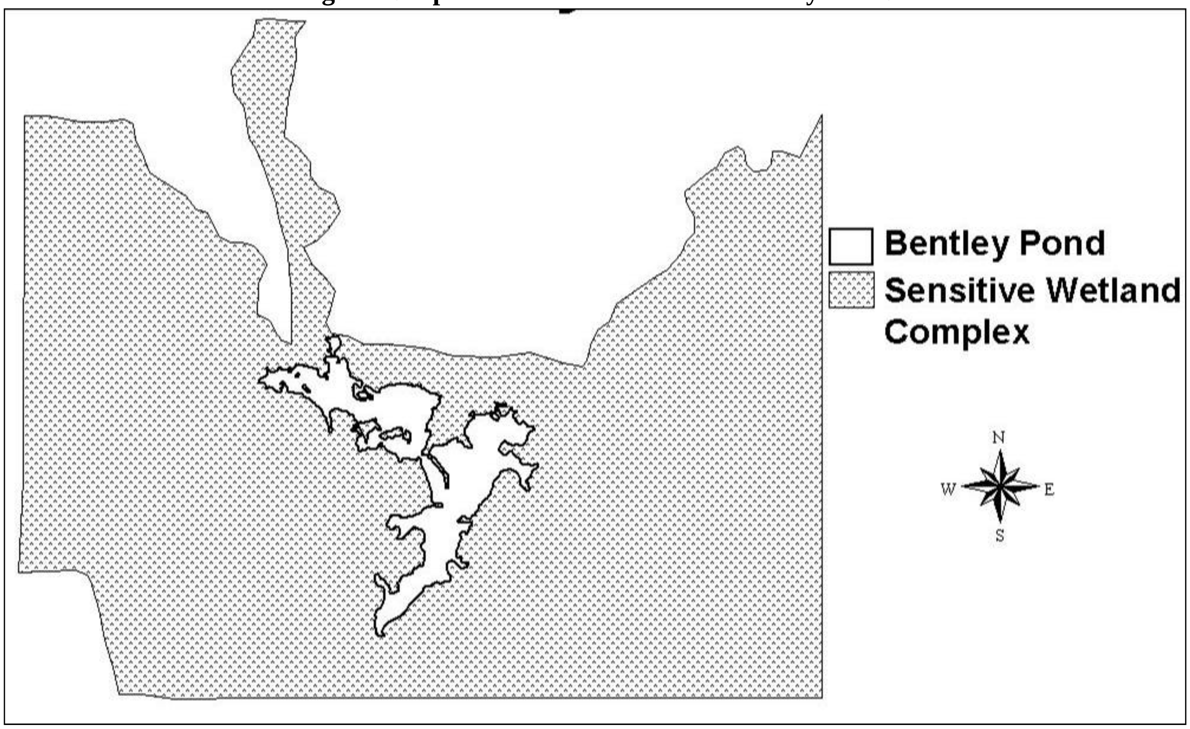
Figure 3. Land use in the Bentley Pond surface watershed (1992).



*For terms in bold, see glossary pp. 11-16

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. Bentley Pond has a large undeveloped, contiguous wetland complex adjacent to the pond that extends beyond the boundaries of the image below. This is a valuable resource (Figure 4). In addition the shoreline and set back areas are valuable nesting sites for waterfowl. Portions of nearby forests may also be unique. However, since this is private property researchers could not verify this supposition.

Figure 1. Upland sensitive areas near Bentley Pond.



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.

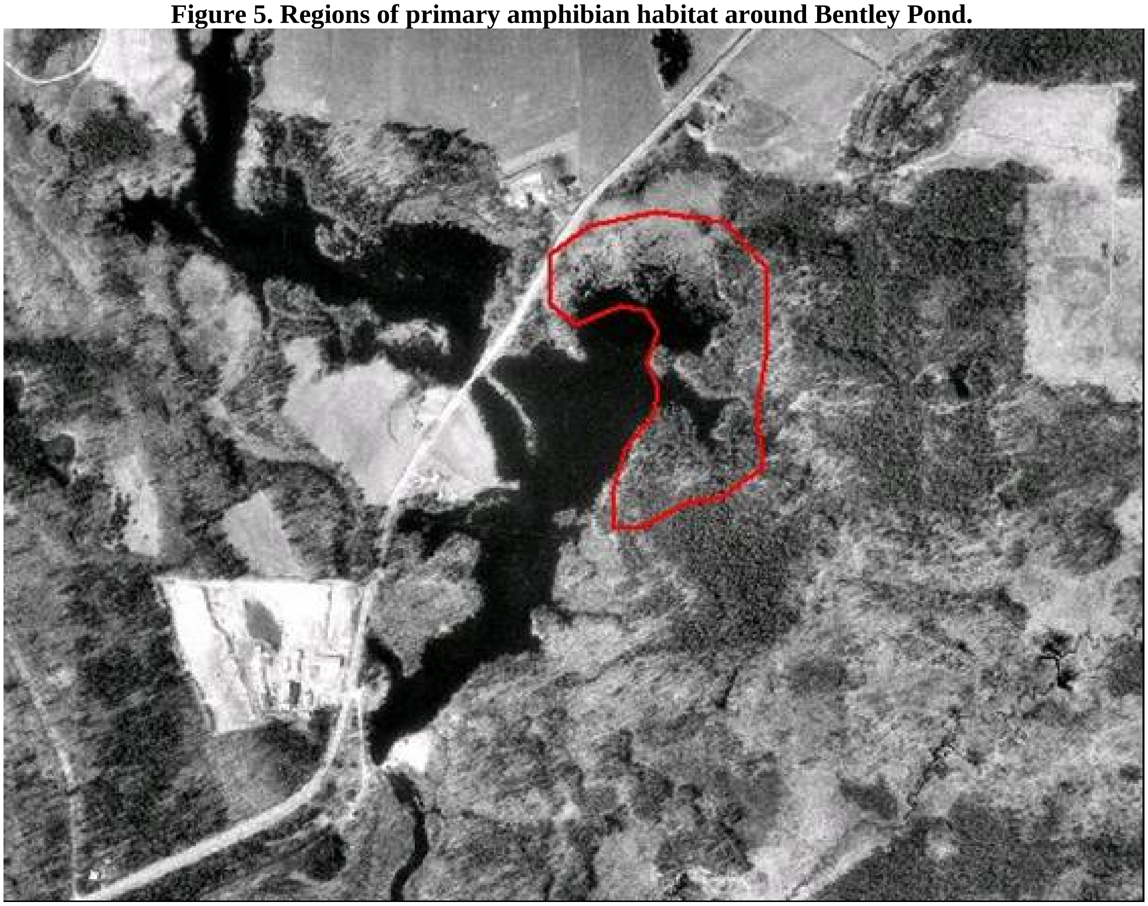
Large sections of continuous natural shoreline on lakes are ideal habitats for many frog species. Natural areas with large amounts of submergent, emergent, and floating-leaf vegetation provide protection and a place for attachment of eggs during the breeding season. The upland areas surrounding these 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 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,

*For terms in bold, see glossary pp. 11-16

both turtles and amphibian are intimately associated with lakes and the associated habitats of a **watershed**.

Three frog species were identified during the survey of Bentley Pond [spring peeper (*Pseudacris crucifer*), northern leopard frog (*Rana pipiens*), and green frog (*Rana clamitans*)]. The primary amphibian habitat can be found in numerous areas around 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 as well as downed trees. The good news is that numerous, large areas of suitable amphibian and reptile habitat surround the pond. Unfortunately, some areas of altered shoreline do also exist due to development. Reptile surveys were not conducted on Bentley Pond.

Figure 5. Regions of primary amphibian habitat around Bentley Pond.



Aquatic Plants

There are 27 species of aquatic and wetland plants that have been found on Bentley Pond, which is below average for the Portage County lakes. The average **coefficient of conservatism (c-value)** is 4.7 which is average for Portage County lakes. The **floristic quality index** is 24.4, which is below average when compared to the county's lakes.

Bentley Pond has dense submersed vegetation of relatively few species, primarily waterweed (*Elodea* spp.), coontail (*Ceratophyllum demersum*), and variable pondweed (*Potamogeton*

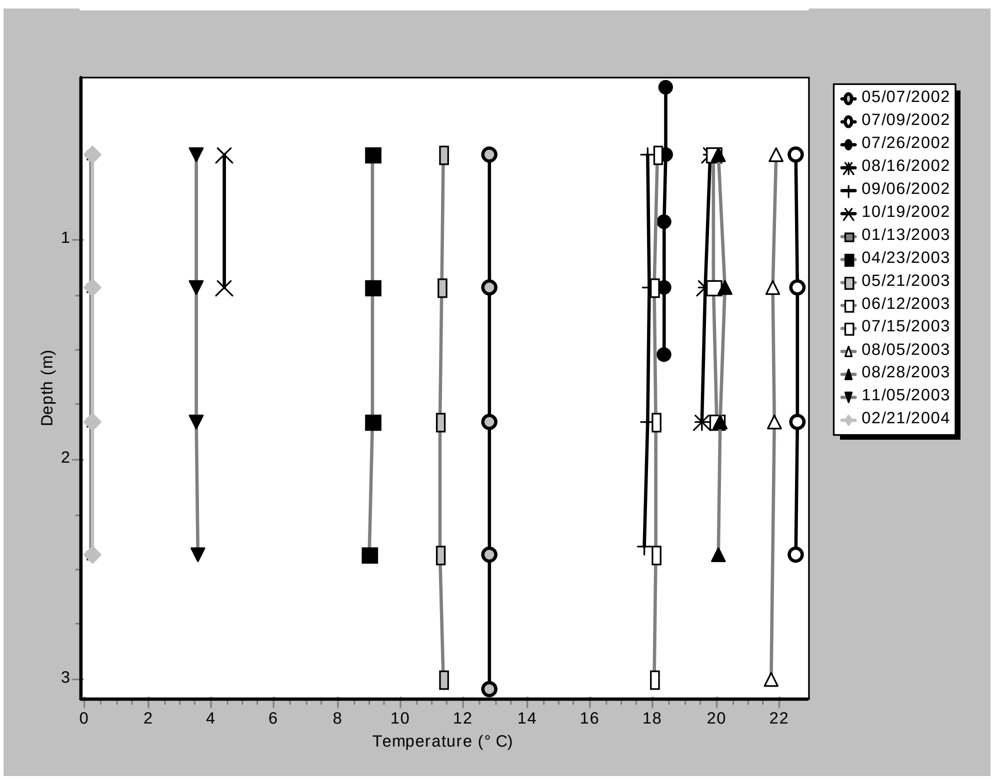
*For terms in bold, see glossary pp. 11-16

gramineus). Much of the pond is shallow enough to be dominated by emergent plants, especially cattail (*Typha* spp.), burreed (*Sparganium* spp.), wild rice (*Zizania* pp.), and sedges (*Carex* spp.). The UWSP has no collections or studies made on Bentley Pond before 2003, so historic references can not be made.

Current Water Quality Conditions

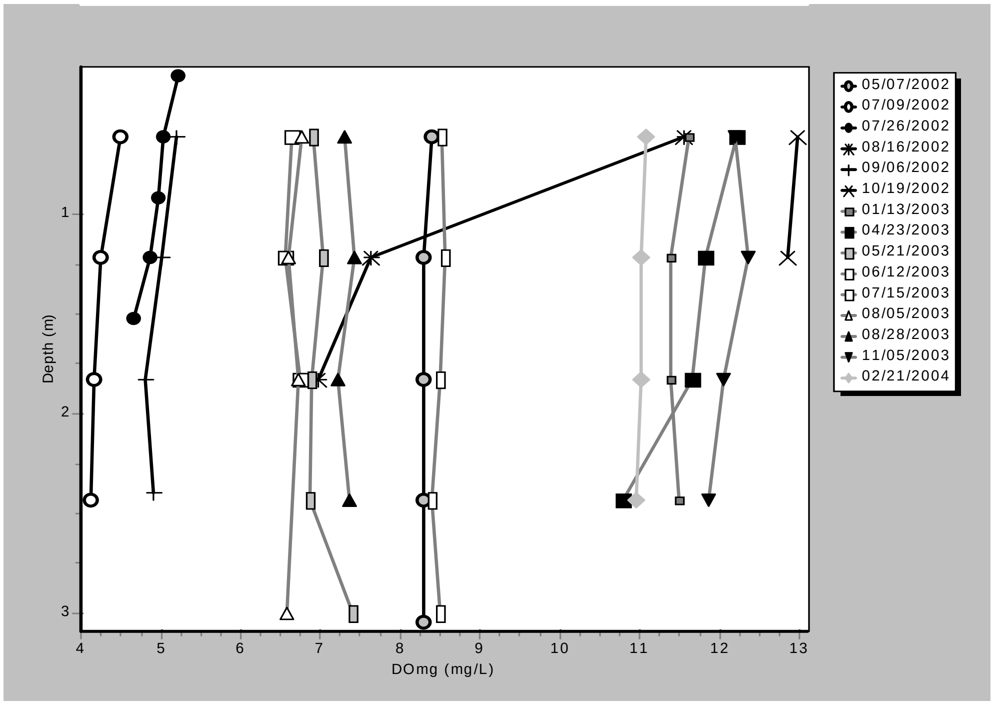
Water quality in lakes is assessed by measuring different characteristics including temperature, dissolved oxygen, water **clarity**, **chlorophyll *a***, water chemistry, and the algal community. During each sampling period, temperature and dissolved oxygen data were collected approximately every 2 feet into the water. Both temperature and dissolved oxygen were the same from the top to the bottom of the water column. This would be anticipated in an **impoundment** like Bentley where the water is quickly moving though and there is minimal build up of organic materials on the bottom.

Figure 6. Profile of temperature in Bentley Pond 2002-2004.



*For terms in bold, see glossary pp. 11-16

Figure 2. Profile of dissolved oxygen in Bentley Pond 2002-2004.

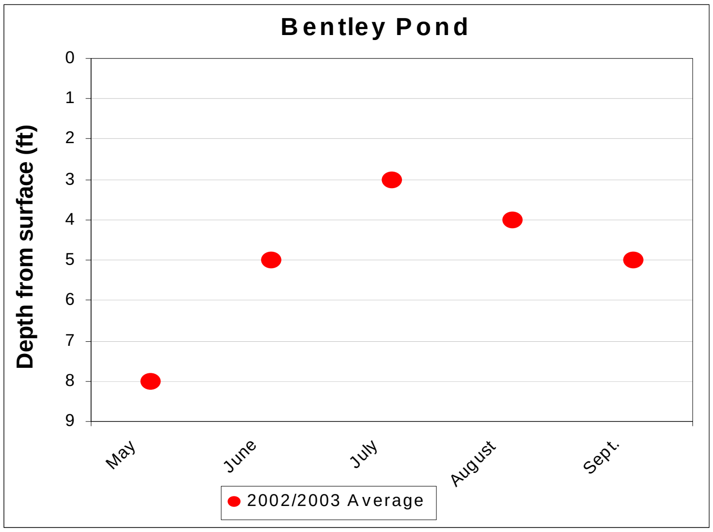


Water **clarity** is a measure of how deep light can penetrate. It is an aesthetic measure and is related to how deep **rooted aquatic plants** can grow. Water **clarity** is affected by water **color** and suspended materials in the water (**turbidity**). **Turbidity** consists of **suspended solids**, such as suspended sediments and **algae** (**chlorophyll *a***). **Chlorophyll *a*** concentrations were not terribly high in Bentley Pond, ranging from 2-7.3 **mg/l**. **Turbidity** was low and **color** was generally high but did range from 13 to 67 CU. **Color** in Bentley Pond is predominantly from tannic acids (from associated wetlands) staining the water brown.

The water **clarity** in Bentley Pond is considered fair. Natural water **color** of the Plover River somewhat decreases light penetration, but **algae** are also reducing water **clarity**. The average **Secchi disc** depth for similar ponds in the region is 5 feet. During 2002-03, the water **clarity** of Bentley Pond was the best during the month of May, and the worst during July (Figure 8). Some fluctuation throughout the summer is normal as **algae** populations and **sedimentation** increase and decrease.

*For terms in bold, see glossary pp. 11-16

Figure 8. Monthly average water clarity measurements in Bentley Pond, 2002-2003 and historic average, maximum and minimums.



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). For a lake system, the **nitrogen** measured in Bentley Pond is high. It is in the form of **nitrate**, which is easily utilized by **algae** and aquatic plants. **Phosphorus** is high through much of the year, but concentrations ranged from 19-229 ug/L (following a storm event). The average concentrations (over 30 ug/L) in spring and summer are enough to produce **algae** blooms and support significant aquatic plant growth (Table 1). These concentrations are typical of many **impoundments** in Wisconsin.

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. **Potassium** concentrations were low, but **chloride** and **sodium** were somewhat elevated (Table 2). 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 water (0.11 and 0.13 µg/L). Some toxicity studies have indicated that reproductive system abnormalities can occur in frogs at these levels. The presence of **atrazine** indicates that other agri-chemicals may also be entering Bentley Pond.

Table 1. 2002-2003 water quality seasonal averages in Bentley Pond.

Bentley Lake	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	38.3	15.5	1.84	1.13	0.10	134.5	159.0	86.5	61	2.1	7.0
Summer Averages	67.1	15.0	2.17	1.12	0.06	204.5	220.5	118.3	18	2.4	6.7
Fall Averages	27.5	5.5		1.78	0.03	186.5	208.5	117.0	30	2.4	
Winter Averages	36.0	10.5		2.56	0.10						
2002-2004 Averages	50.9	12.0	2.01	1.59	0.07	175.2	196.0	107.3	36	1.8	6.8

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

*For terms in bold, see glossary pp. 11-16

Table 2. 2002-2003 Bentley Pond average water chemistry and reference value

Bentley Pond	*Low*	*Medium*	*High*	**Reference Values**	*Low*	*Medium*	*High*
Sulfate	9.12			*Sulfate*	<10	10-20	>20
Chloride		8.17		*Chloride*	<3	3-10	>10
Potassium	1.57			*Potassium**	<2.16	2.16-4.30	>4.30
Sodium		4.30		*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 Bentley Pond was diverse (both in phyla and genera) but seasonally monotonous. All six phyla of **algae** found in the samples represented at least 11% of the community, and the most abundant phylum only accounted for 20% of all cells counted. The dominant group (barely) was the green **algae** (Chlorophyta, 20% of all cells counted), followed by the **blue-green algae** (Cyanobacteria, 18% of all cells counted), euglenoids (Euglenophyta, 17% of all cells counted), dinoflagellates (Dinophyta, 17% of all cells counted), yellow-green **algae** and **diatoms** (Ochrophyta, 16% of all cells counted), and the cryptophytes (Cryptophyta, 11% of all cells counted) (Table 3). In the 2,964 cells counted during this period there were 3 genera of Cyanobacteria, 9 genera of Chlorophyta, 8 genera of Ochrophyta (including 5 **diatom** genera), 3 genera of Euglenophyta (5 species), 2 genera of Dinophyta, and 2 genera of Cryptophyta identified (Table 3).

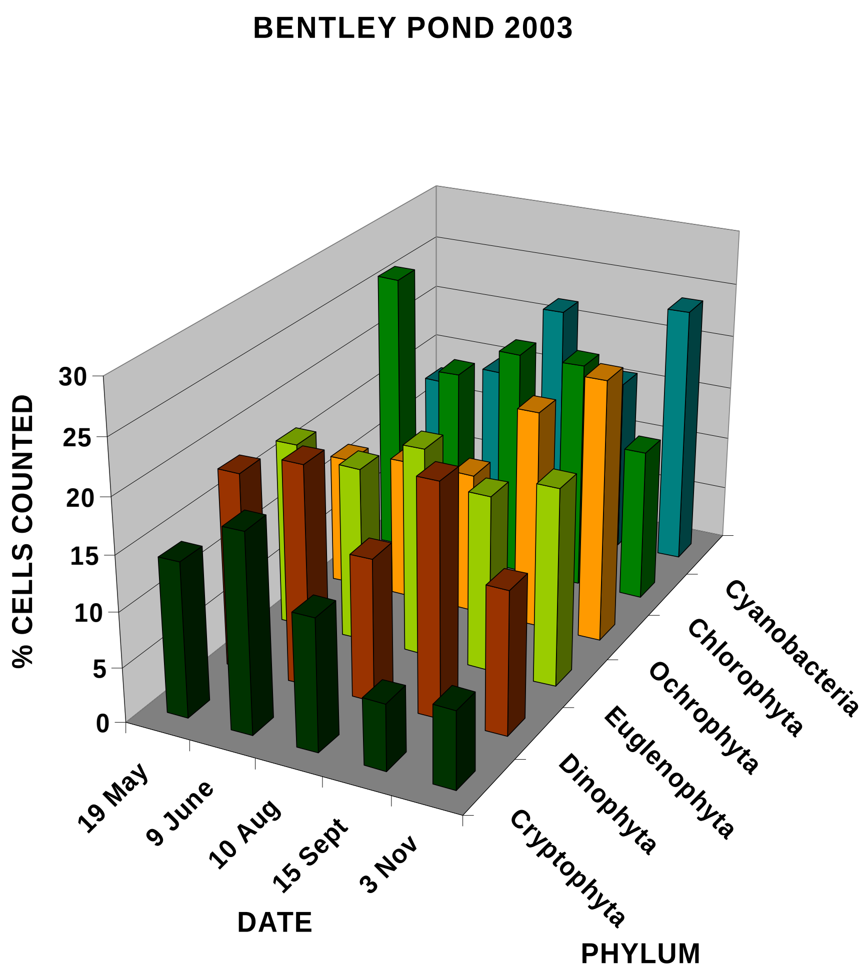
There was very little cycling of the algal community during the 2003 sampling period. There was a slightly dominant group in each sampling period but never for long or by much. In May the greens represented one in four cells counted with all other phyla contributing at least 12% of all cells counted. In June the dinoflagellates were the slight dominant at one in five cells counted and no phylum contributed less that 13% of all cells counted. The blue-greens and were the most abundant in August (22%) with the other phyla being present at 12% or more. In September the blue-greens, greens, and ochrophytes were all at 20-21%, while in November the blue-greens and ochrophytes were co-dominants as 24% of all cells counted for each phylum (Figure 9).

Table 3. Algal phyla and mean seasonal composition in Bentley Pond from May to November 2003.

BENTLEY PHYLUM	% CELLS COUNTED BY PHYLUM AND DATE					**MEAN**
	19 May	9 June	10 Aug	15 Sept	3 Nov	
Cyanobacteria	13	15	22	16	24	18
Chlorophyta	26	18	21	21	14	20
Ochrophyta	12	13	13	20	24	16
Euglenophyta	17	16	19	16	18	17
Dinophyta	18	20	13	21	13	17
Cryptophyta	14	18	12	6	7	11

*For terms in bold, see glossary pp. 11-16

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



The large, armored, motile unicellular dinoflagellate genus *Peridinium* dominated the genus counts (Figure 10). This fast-swimming alga was present in 5 of 15 top slots including twice as the most abundant genus (June, September) and three times as the next most abundant (May, August, November). The colonial blue-green alga *Coelosphaerium* was twice the most abundant organism (August, November) and was also abundant in September. The small, loricate, motile unicellular green algal genus *Phacotus* was most abundant in May but never again while the large, coenobic, non-motile green alga *Scenedesmus* was abundant in August and November. Euglenoids (*Euglena*) and cryptophytes (*Cryptomonas*) were each abundant in two of the 15 most common slots.

The algal community when considered relative to the **chlorophyll**, **phosphorus**, and **nitrogen** values for Bentley Pond presents a picture of a fairly **mesotrophic** lake. The 29 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. The dark, shallow

*For terms in bold, see glossary pp. 11-16

nature of Bentley Pond may have influenced the seasonal dynamics of the algal community. Shallow water bodies like Bentley can have algal-related problems as algal mats of blue-greens and **diatoms** can carpet the bottom, 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.

Figure 10. Algal community composition by phylum in Bentley Pond from May to November 2003.

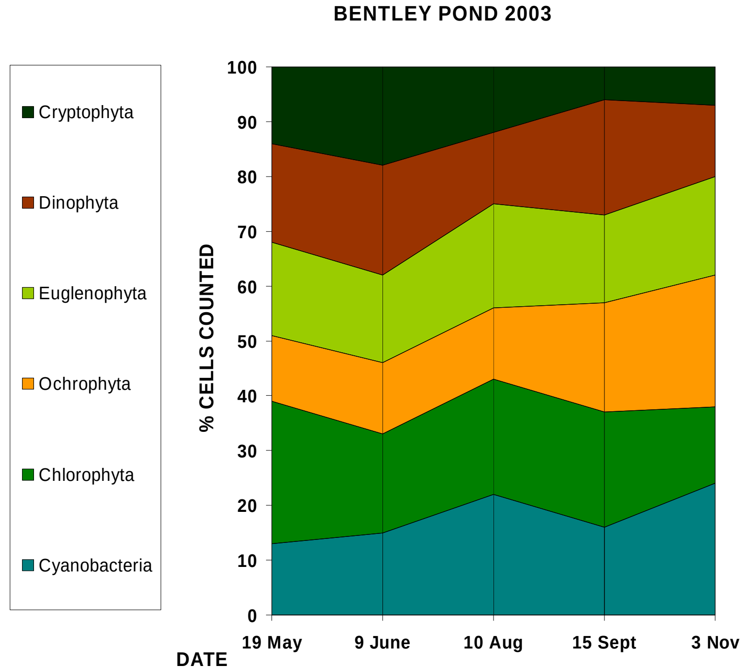


Table 4. Most common algal genera by date in Bentley Pond from May to November 2003.

DATE	TOP THREE TAXA (MOST ABUNDANT, LEFT TO RIGHT)		
19 May	*Phacotus*	*Peridinium*	*Cryptomonas*
9 June	*Peridinium*	*Cryptomonas*	*Euglena 2*
10 August	*Coelosphaerium*	*Peridinium*	*Scenedesmus*
15 September	*Peridinium*	*Euglena 1*	*Coelosphaerium*
3 November	*Coelosphaerium*	*Peridinium*	*Scenedesmus*

*For terms in bold, see glossary pp. 11-16

Bentley Pond Study Highlights

- The number of species of aquatic and wetland plants that have been found on Bentley Pond is below average for the Portage County lakes. The average **coefficient of conservatism** is average for Portage County lakes. The **floristic quality index** is below average when compared to the county's lakes.
- Bentley Pond has dense submersed vegetation of relatively few species, primarily waterweed, coontail, and variable pondweed. Much of the pond is shallow enough to be dominated by emergent plants, especially cattail, burreed, wild rice, and sedges.
- Bentley Pond has a large undeveloped, contiguous wetland complex adjacent to the pond that is a valuable resource. In addition the shoreline and set back areas are valuable nesting sites for waterfowl. Portions of nearby forests may also be unique.
- Three frog species were identified during the survey of Bentley Pond (spring peeper, northern leopard frog, and green frog). The primary amphibian habitat can be found in numerous areas around the pond. Numerous, large areas of suitable amphibian and reptile habitat surround the pond.
- The water **clarity** in Bentley Pond is considered fair. Natural water **color** of the Plover River somewhat decreases light penetration, but **algae** are also reducing water **clarity**.
- For a lake system, the **nitrogen** measured in Bentley Pond is high. It is in the form of **nitrate**, which is easily utilized by **algae** and aquatic plants. **Phosphorus** is high through much of the year and is enough to produce **algae** blooms and support significant aquatic plant growth.
- **Potassium** concentrations were low, but **chloride** and **sodium** were somewhat elevated. **Atrazine** was found in low concentrations in the water, and some toxicity studies have indicated that reproductive system abnormalities can occur in frogs at these levels. The presence of **atrazine** indicates that other agri-chemicals may also be entering Bentley Pond.
- The algal community when considered relative to the **chlorophyll**, **phosphorus**, and **nitrogen** values for Bentley Pond presents a picture of a fairly **mesotrophic** lake. The **algae** 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.

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 provide 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 $CaCO_3$.

*For terms in bold, see glossary pp. 11-16

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 (NO_3) 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 (NH_4^+) form, but at high pH values the toxic ammonium hydroxide (NH_4OH) occurs. The water quality standard for fish and aquatic life is 0.02 mg/L of NH_4OH. At a pH of 7 and a temperature of 68^o F (20^o 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 (N_2) from the air to provide their own nutrient.

Chloride (Cl-):

Chlorine in the chloride ion (Cl^-) form has very different properties from chlorine gas (Cl_2), 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.

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.

*For terms in bold, see glossary pp. 11-16

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 Basin:

The total land area that drains toward the lake.

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.

Endocrine:

An integrated system of small organs that involve the release of extracellular signaling molecules known as hormones. The endocrine system is instrumental in regulating metabolism, growth, development and puberty, tissue function, and also plays a part in determining mood.

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.

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.

*For terms in bold, see glossary pp. 11-16

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 $CaCO_3$. Amount of hardness relates to the presence of soluble minerals, especially limestone, in the lake watershed. Moderately hard water has 61-120 mg/L $CaCO_3$, hard water has 121-180 mg/L $CaCO_3$, and very hard water has more than180 mg/L $CaCO_{3.}$

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.

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 (NO_3-N) plus ammonium-nitrogen (NH_4-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.

*For terms in bold, see glossary pp. 11-16

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.

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.

*For terms in bold, see glossary pp. 11-16

Soft Water:

Water with less than 60 mg/L CaCO3 (see Hard water).

Stratification, Stratified:

The layering of water due to differences in density. Water's greatest density occurs at 39^{o}F (4^{o}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 (SO_4^{--}):

The most common form of sulfur in natural waters. The amounts relate primarily to soil minerals in the watershed. Sulfate (SO_4^{--}) can be reduced to sulfide (S^{--}) and hydrogen sulfide (H_2S) 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 (SO_2) 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.

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.

*For terms in bold, see glossary pp. 11-16