Bob Moe: *Bear Lake*, **1984**

Lake Management Plan for Bear Lake, Barron County, Wisconsin

June 2007
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Prepared by Steve McComas, Blue Water Science
with contributions from Wisconsin Department of Natural Resources and the Bear Lake Association

Funded in part by the Wisconsin Lake Management Planning Grants Program

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Members of the Bear Lake Association and many others contributed in various ways to the work effort on the projects that formed the basis for this Management Plan. They include:

BEAR LAKE CONTRIBUTORS:

Bear Lake Association

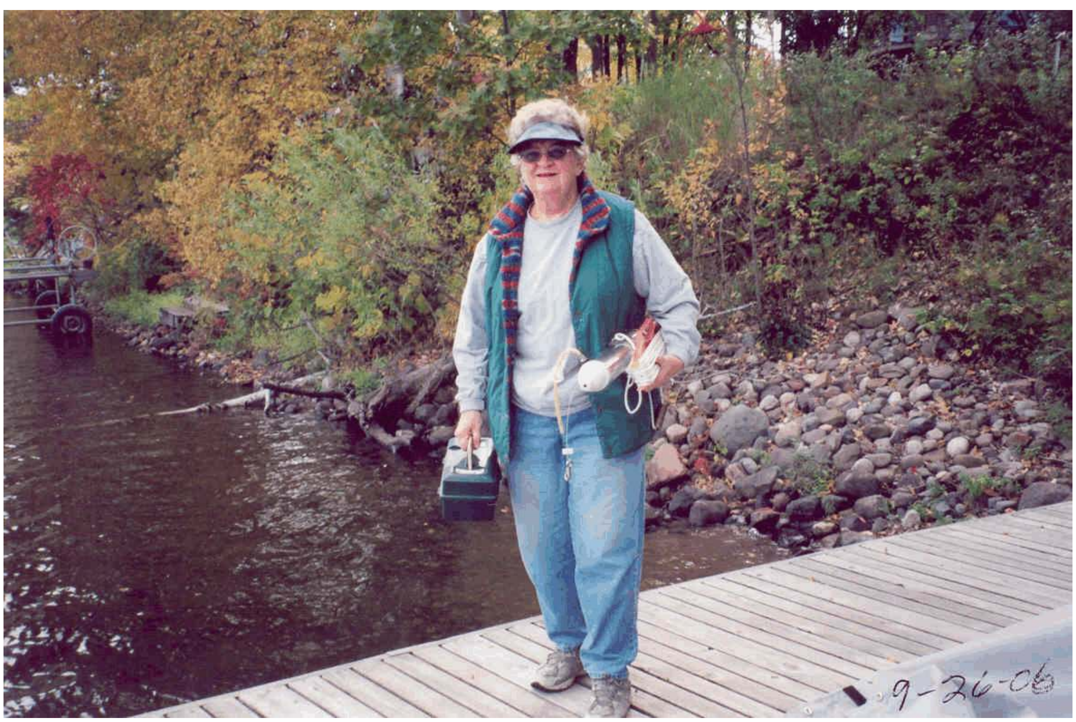
Bob Moe	Doug Peterson	Dick Sanner	George King
Dorothy Moe	Jane Landreth	John Knobloch	Bille Young

and all Bear Lake Association members and property owners who responded to our lake survey.

OTHER CONTRIBUTORS:

Wisconsin DNR

Barron County Land and Water Department



Dorothy Moe, volunteer from Bear Lake, Wisconsin

Lake Management Plan for Bear Lake, Barron County Wisconsin

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Lake Appears to Be in Good Shape

PROTECTION PROJECTS WILL SUSTAIN GOOD WATER QUALITY

Bear Lake is located in Barron County, Wisconsin. Bear Lake is 1,358 acres in size, has an average depth of 20 feet and a maximum depth of 87 feet.

A lake study was conducted in 2006 with two primary objectives.

* to characterize existing lake conditions, and,
* to develop a lake management plan that protects, maintains, and enhances Bear Lake' water quality.

Results found that lake summer water clarity conditions of about 7.9 feet were slightly better than expected compared to reference lakes in the area (see page 3 for more information).

Typically, phosphorus is the nutrient that has the biggest influence on algae growth. Phosphorus levels on Bear Lake were on the low side at 23 parts per billion. This accounts for the low algae growth and relatively good water clarity that is found in Bear Lake.

Aquatic plants were also studied in 2006. When the plant survey results of 2006 are combined with other plant data collected in years past, an aquatic plant picture emerges.

Bear Lake was found to have a good diversity of plants with 18 plant species. The most common plant was flatstem pondweed, a native species.

Results of lake and watershed data collection indicate Bear Lake's water quality is about where it should be compared to reference lakes in this area (or ecoregion).

This means less expensive protection projects rather than expensive restoration projects are the preferred approach as long as Bear Lake maintains good quality.

Bear Lake Statistics

Bear Lake	
Lake size (acre):	1,358
Mean depth (feet):	20
Maximum depth (feet):	87
Volume (acre-feet):	27,160
Watershed area (acre): (including the lake)	30,464
Watershed : Lake surface ratio	7
Clarity in 2006 (feet):	7.9
Lake phosphorus in 2006 (parts per billion)	23

This special newsletter was prepared by Blue Water Science, St. Paul, Minnesota and is part of a lake management program conducted on Bear Lake. The program was funded by a grant from the Wisconsin DNR with volunteer assistance from the Bear Lake Association.

Summary of Lake and Watershed Conditions

Geology and Soils

Bear Lake is a glacial lake formed during the last retreat of the Superior lobe starting about 10,000 years ago. The soils deposited by the glacier are primarily sands and loamy sands.

Watershed Characteristics

The watershed area draining to Bear (including the lake) is 30,464 acres (based on USGS data). Land use is primarily forests and wetlands, with residential use accounting for a small percent of the total watershed area.

Water Inflows and Outflows

The water inflow to Bear is from Boyer Creek, Sucker Creek, and Bear Creek. The outflow is through Bear Creek and into Rice Lake.

Lake Dissolved Oxygen & Temperature

Bear Lake thermally stratifies during the summer. This means that wind action will mix the warmer upper lake water which sits on top on the denser cold water in the bottom of the lake. Oxygen concentrations may fall in the bottom water and become temporarily depleted during the summer. The lake is reaerated during spring and fall overturn, when the whole lake mixes.

Lake Clarity

Lake water clarity in Bear Lake is good with a summer average around 8 feet.

Lake Nutrients

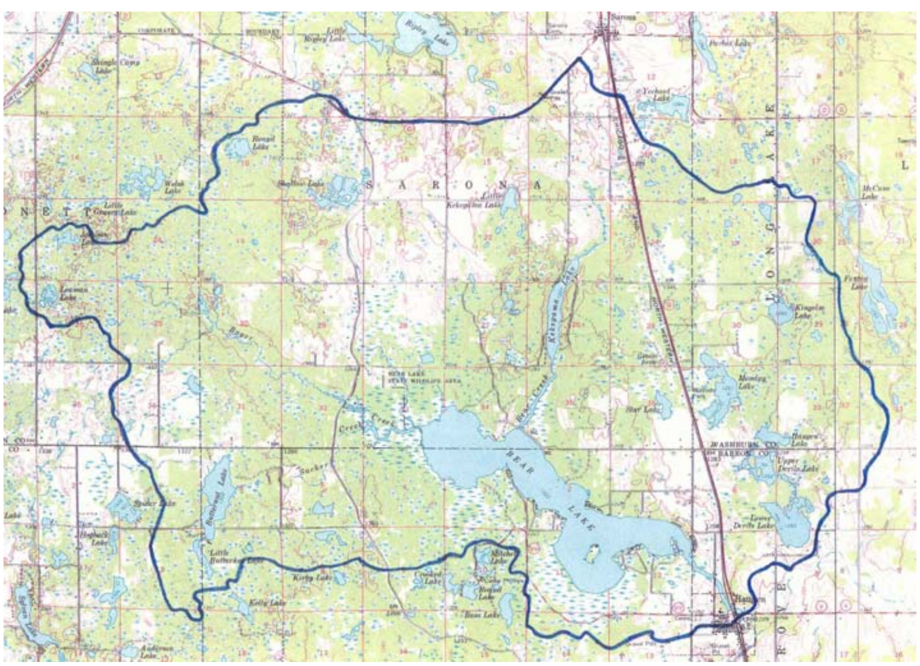
Phosphorus concentrations in Bear Lake are better then predicted when compared to other lakes in the North Central Hardwood Forest ecoregion with an equivalent watershed area. A growing season phosphorus average for 2006 for Bear Lake was 23 ppb. A predicted phosphorus concentration using ecoregion values is higher at about 45 ppb.

Lake Algae

Bear Lake has algae species that are common to lakes in this part of the state with green algal species present in early summer and some blue-green species present in late summer..

Lake Aquatic Plants

There is good coverage of submerged aquatic plants covering about 45% of the lake bottom (611 acres). Plants are beneficial as a filter for nutrients and as fish and wildlife habitat. Aquatic plant diversity is good with 18 submerged or floatingleaf plant species identified in Bear Lake in 2006. While aquatic plant coverage remains stable, several aquatic plant species appear to have declined in abundance since the last plant survey in 1992. The species that declined include coontail and naiads. Largeleaf pondweed increased in occurrence.



The watershed drainage area to Bear Lake is about 30,464 acres and is outlined in blue.

What is a watershed?

A watershed is the land area around the lake that captures rainfall and where all the drainage and runoff goes into the lake. It is also called a drainage basin. If the watershed has pollution sources, then the pollution will be carried into the lake with runoff. It is important to reduce the source of pollution in the watershed because this in turn will reduce the amount of pollution that gets into the lake.

Lake Assessment

Water quality of Bear is within range of lakes found in the North Central Hardwood Forest Ecoregion. Water quality parameters consisted of transparency, phosphorus, and chlorophyll measurements.

Lake water quality in Bear is about what would be expected based on it's watershed size and the ecoregion setting. Although Bear Lake resides in the North Central Hardwood Forest ecoregion, most of it's watershed is in the Northern Lakes and Forests Ecoregion. This ecoregion typically has low concentrations of phosphorus in runoff. Therefore long term prospects for ongoing good water quality are high.

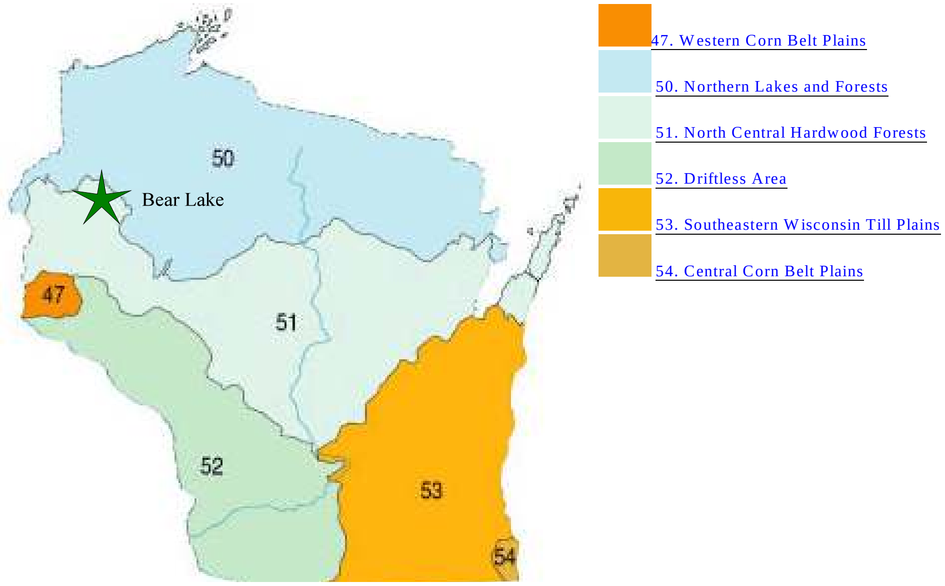
Lake management efforts should be directed to protect the existing good water quality.

Ecoregions of Wisconsin

Revised April 2000

National Health and Environmental Effects Research Laboratory

U.S. Environmental Protection Agency



Bear Lake is located in the North Central Hardwood Forest Ecoregion. However, much of its watershed is located in Northern Lakes and Forest Ecoregion.

Aquatic Plants Are Key to Good Water Quality

Aquatic plants are very important to lakes. They act as nurseries for small fish, refuges for larger fish, and they help to keep the water clear. Currently Bear Lake has a high diversity (number of species) of aquatic plants with a total of 18 species identified in 2006. Common plants found in the Bear Lake include: flatstem pondweed, northern watermilfoil, and water celery, all native plants.

In August of 2006, aquatic plant distribution was estimated to be at 611 acres. If this coverage can by maintained, the odds are good that clear water conditions will be sustained as well.

Here is a picture of largeleaf pondweed from Bear Lake. This is a desirable aquatic plant species. Bear Lake has relatively good aquatic plant diversity and should promote good water clarity.

Recommended Lake Management Projects

1. Watershed projects - forests, wetlands, and new construction

Maintain some type of surveillance on watershed conditions. For example, stream sampling will give some insight to potential water quality problems and serves as a benchmark for future reference. Also, alert the County if excessive erosion is observed at construction sites.

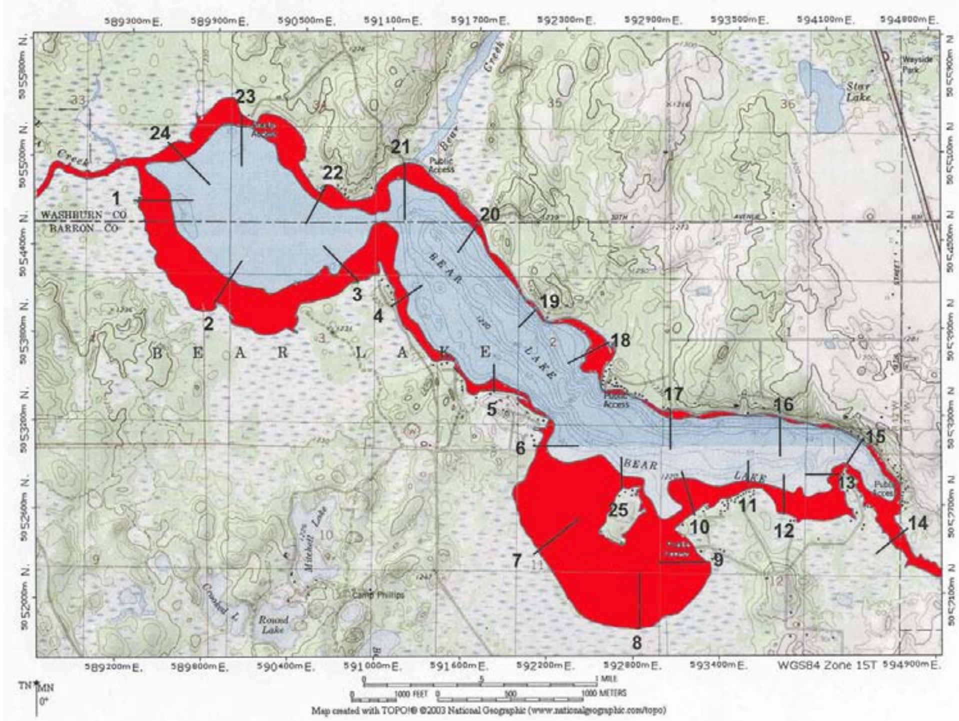
2. On-site system maintenance

On-site wastewater treatment systems operate satisfactorily when they are properly installed and maintained. Several activities can be implemented to assist in proper operation of the system. These activities include workshops, septic tank pumping campaigns, and ordinance implementation. However, much of the education can be conveyed through Lake Association newsletters.

There is little evidence of failing onsite systems based on shoreland setback distances and the good water quality of the lakes. An option would be to contract with the County to randomly select 10% of the systems around the lake and conduct an onsite inspection and publish the results in a newsletter.

3. Aquascaping projects

Bear Lake has stretches of natural shoreline conditions but vegetative buffers and natural conditions could be improved along some of the developed parcels. The challenge is to protect the existing natural conditions and to enhance shorelands that lack native vegetative buffers. A volunteer lakescaping program should be implemented. Set up a Bear Lake Shoreland model describing how to design, install, and maintain a natural shoreland. Publish it in the lake's newsletter.



Plant coverage for Bear Lake for August 2006. The red shaded area represents coverage by submerged, floatingleaf, and emergent aquatic plants.

4. Aquatic plant projects

Based on the aquatic plant survey results from 2006, non-native aquatic plants are not a problem. The question is: what would milfoil do if it got into Bear Lake. A new technique of using lake sediment analysis to gage the potential for nuisance growth of Eurasian watermilfoil is available. A sediment survey could be conducted for the Bear Lake for a cost of $3,000.

5. Ongoing education program

The Lake Association's newsletter should be an ongoing instrument to provide lake protection information. Abundant material is available from the WDNR on the internet and from a variety of books, including the book "Lake and Pond Management Guidebook" written by Steve McComas. This material can be inserted into newsletters.

A variety of educational opportunities are available that go beyond newsletter articles. Lake fairs and demonstration projects could be useful for advancing lake information. A good time for special events is in conjunction with the annual meeting.

6. Watershed and lake monitoring program

Ongoing lake testing should include: Secchi disk, total phosphorus, and chlorophyll a. Testing once per month from May through September is adequate to characterize lake conditions. Sampling twice per month would be better. An aquatic plant survey should be conducted every three to four years. The level of effort for a monitoring program depends on the availability of volunteers and funding levels.

In addition, stream sampling should be considered as well with monitoring occurring over the growing season. Monitoring every two years would be sufficient.

1. Introduction and Project Setting

Bear Lake is located in Barron County, Wisconsin (Figure 1). Bear Lake characteristics are shown in Table 1.

The objectives of this study were to characterize existing lake conditions and to make recommendations to protect and improve the lake environment where feasible.

Table 1. Lake statistics (WDNR 1995).

	Bear Lake
Size (acres)	1,358
Mean depth (ft)	20
Maximum depth (ft)	87

Figure 1. Bear Lake is located in Barron County, Wisconsin.

2. Lake History: Glaciers and Soils

Glaciers: Bear Lake was formed approximately 10,000 years ago during the last glacial retreat of the Superior Lobe (Figure 2). The soils deposited by the Superior Lobe glacier were primarily sands and loamy-sands. Beneath these soils, at depths of about 50-350 feet, is Precambrian bedrock that is over one billion years old. The bedrock is referred to as the North American shield.

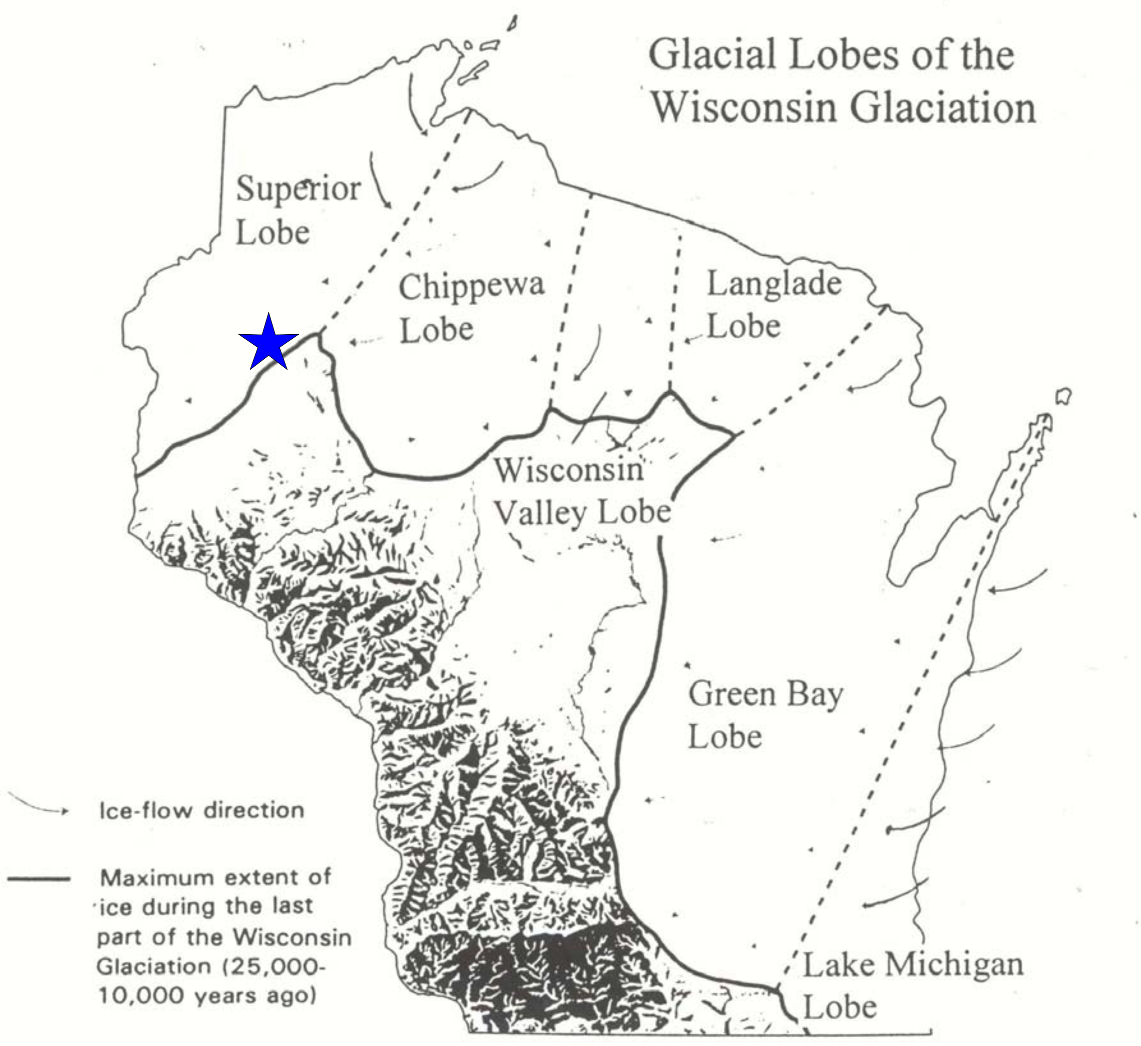


Figure 2. Glacial lobes of the Wisconsin glaciation. Bear Lake is located in the Superior Lobe.

Soils: Soil composition reflects the parent material that is present. Bear Lake is located in an area dominated by forested silty soils and adjacent to forested loamy soils (Figure 3).

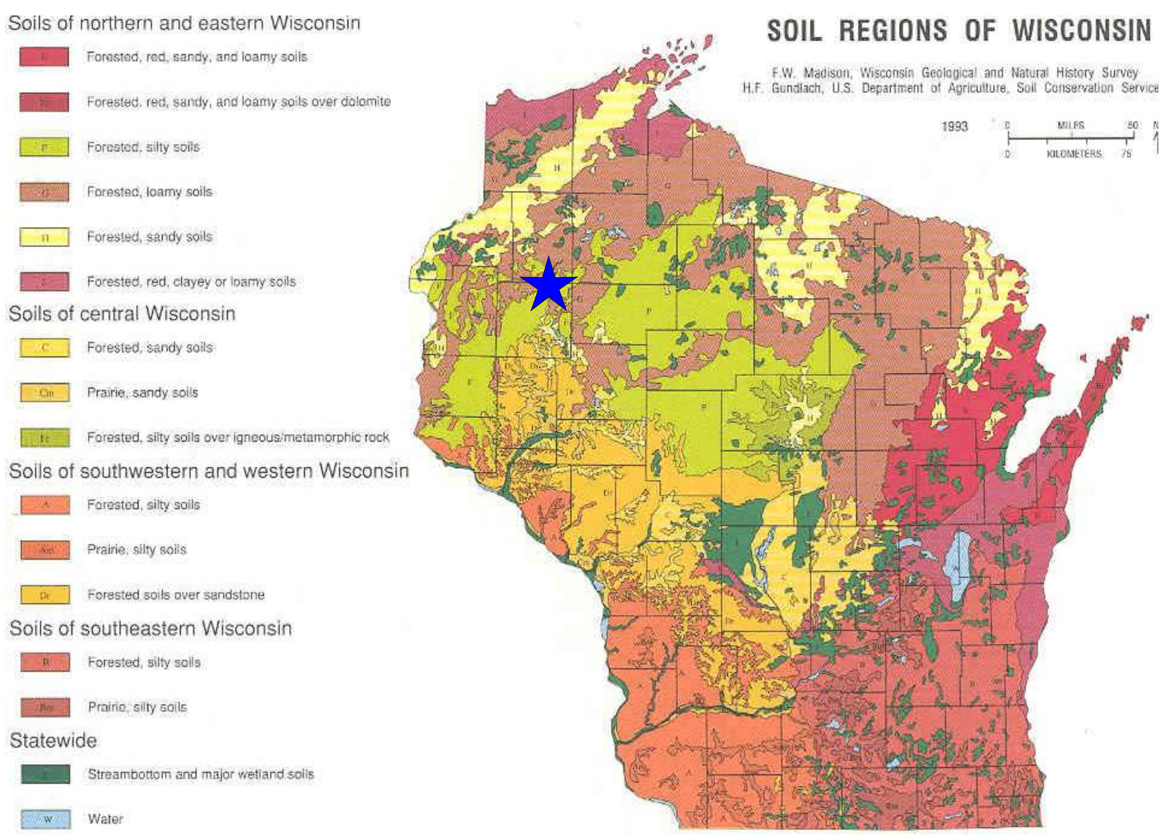


Figure 3. Bear Lake is located within a soils group characterized as forested silty soils.

2.1. Recent Lake History (as told by Lake Residents)

1600 - Present (compiled by Dorothy Moe)

- Around the 1600's there were virgin pine and hardwood forests, an abundance of fur bearing animals especially beaver, and from what we have observed; there are still a number of beaver as they keep trying to block the Boyer Creek inlet culverts, and the lower lake at the Plecity Avene bridge north of Haugen. Now, there's a resurgence of coyote, muskrat, weasel, red and gray fox, and beaver trapping (from "The Chronotype" outdoor page). Wild rice was more predominant then as well and there were plenty of wild blueberries, long blackberries, and raspberries. Later, three branch lines of the "Soo" railroad (R.R.) Were all called, "The Blueberry" (from the book, Four Corners).

- The Washburn County, "The Source" booklet, claims French voyageurs arrived in the "1660's to find Objibwa Indians" and "the two cultures traded and existed side by side". The "Barron County Today", claims "the Dakota (Sioux) and Chippewa Indians were visited by Anglo-Sapons around 1766".

- During "the mid 1800's", logging operations began (Barron County Today, 2006). Before 1868 Knapp, Stout, and Co. sent out timber cruisers to check out the pine. So then, "Bear Lake with a stream that fed into Rice Lake", was one of the many lakes in the area to be chosen. "By clever plans of erecting dams on small streams it was possible to float these logs to the big mill at Menominee which was operated by Knapps, Stout, and Co.".

- The dam in Haugen was blown up every year to open Bear Creek outlet for floating logs to Rice Lake for the Shell Lake Logging Co. (Judy Juza of the "Haugen Area Historical Museum). "There used to be a dam south of Kekegama Lake" (Dr. John Fee) along the Bear Lake inlet. One can see evidences of it to this day. Vinita Lemler says their road/drive was once a Knapp-Stout tote road to the lake.

- Fur trading was more prevalent in the earlier/mid 1800's. Trading posts were set up here and there along lakes and rivers. The Indians made birchbark baskets, canoes, beadwork, and mats from pond lily stems and also traded wild rice. They knew how to use the bark from birch trees without killing the tree! Around "1875 the fur trade had declined" ("The Source" booklet for Washburn County).

- "The R.R. rolled in from the south and southwest in 1879 bringing people to settle the land and tap the bountiful resources particularly the plentiful timber-the whistle of the trains was heard far and wide". "The Omaha hauled a destiny tot he wilds of northern Wisconsin". With the advent of the R.R., settlements grew along those lines. The trains transported people, logs, freight, mail, agricultural, and other products. Some settlements had a hotel, homes, blacksmith shop, livery, store, post office, school, and church ("The Source").

- From 1896 to 1900, "four logging camps were located in the town of Saroma". "Their logs were landed at Bear Lake and transported down Bear Creek". Most of the logging camps had a horse barn, and oxen barn, blacksmith shop, sleeping shanty, and a cook shanty. ("Four Corners").

- At some point in the earlier R.R. times, a branch narrow gauge line same from Shell Lake south across Boyer Creek and continued. The pilings are still visible southwest of Shallow Lake Road at the Boyer Creek inlet crossing. "Narrow Gauge Road" is a local term used for the 13 3/4 16 St. Barron County continuing as Shallow Lake Road in Washburn County. It was probably the "Crescent Springs Railroad", (Judy Juza). September 17, 1901 the last load was taken out via the "Crescent Springs Railroad" by the Shell Lake Logging Company. "That company did not have a lot of water for which to move logs" (Bob Juza). It is unknown for sure which R.R. built it. This branch live or spur does not show up on any plat book, newspaper clipping, photos, or maps per Judy and Bob Juza. So perhaps it was a very short-lived R.R.

- According to Dr. John Fee, around the 1890's, some of the first cabins would have been built along the Bear Lake shores and lands. Not sure of the dates but “some of the earlier ones were Lebkieker’s, Bakers, Kohls, and Martin’s Resort.”.

- Also from around the 1890's on, per the “Four Corners” book, “old timers tell that forest fires were very common hitting every fall and spring”. There was no fire protection and no fire look out towers yet:. Many homes of the early settlers were wiped out and lives were lost during those fires.

- By 1900 the pine harvest ended so then the hardwood logging took over. Knapp, Stout, and Co. closed their logging “after their last logs were sent down the rivers”, (“Four Corners” book). Late summer of 1900 the last log drive started from Bear Lake and four other lakes. There’s a quote by Paul Kirkendall, “I went up thru Haugen and joined the crew as a helper for the cook and cookee on the drive down Bear lake to Rice Lake where we joined those from the other lakes”.

- The Knapp, Stout, and Co. broke up their camps too, “after logging 85,000 acres around Rice Lake, Cedar Lake, Birch Lake, Long Lake, Bear Lake, Big Chetac, Balsam, and Hemlock”. The numerous huge oxen and horses an may items were gathered/moved such as chains, “Oh yokes, harnesses for oxen and horses, huge sleds, dishpans, large camp stoves, cutlery, and blankets, etc” (“Four Corners” book).

- These were exciting times in the growth of this area due to the world hearing of great fishing and beautiful vistas and land. August 10, 1906: “Bear Lake is becoming a prominent resort for summer residents” (from Rice Lakes, “the Chronotype” “100 Years Ago”). A featured article in “the Chronotype” June 28, 2006 on “the century old Haugen Area Historical Museum” tells of a “John Plain, a Haugen businessman who turned the sparsity of roads to economic advantage by transporting tourists in his boat on Bear Creek to the resorts on Bear Lake in the early 1900's”. His “outboard motor with a crank starter” is on display at the museum. More and more resorts along beautiful lake shores were built. With more trains, people were able to travel easier.

- From Dr. John Fee: the first cabins built in our area here was in 1907. They were by the founders, Bert and Fred Gifford. They were where the Dr. John and Joan Fee cabin is and then out by the present, “Chippewa Valley Council, Inc. Camp Phillips” hereafter referred to as “Camp Phillips”. Bert and Fred Gifford built a cabin and started a sheep farm. They had farms in Monroe, WI and various other locales. After the pine was cut, grass grew so some people started sheep farms”.

- “Shortly after 1912", according to the “Four Corners” book, “(Dynamite Ole) of the town of Madge, and the farmers were soon blowing up stumps”.

- From an Abstract, “Dam is now constructed and maintained on the 21st day of June 1902. Said dam being located on and across Bear Creek and situated on NW-NE 18-36-11". The dam sold to Wisconsin Power Company. Regards the Haugen Dam is 1915, Ardyce Kodesh of Haugen has a story. Her Mother, Clara Svacina, “was at a dance up on the hill in Haugen” they heard a hugh explosion, and heard someone say, “the dam blew up!”. So all ran over and Clara was able to get some fantastic photos of the water rushing through. Adyco Kodesh shared this story and photos. This incident would not have been for floating logs.

- According to the December, 1964 letter from Bog Wegg, the Wegg ice house (which was eventually made into a concrete floored bunk house) was “not enough for the needs as Gifford owned and rented the far south cottage (Pierce-Moon-Williams) and they used from the yellow ice house”. So the making of ice involved cutting blocks of ice by hand from the lake and transporting it someway up and then into an ice house. An ice house was double walled wood building with plenty of sawdust to hold the ice into August. Blocks of ice were handled using “ice tongs” to place into the “ice box” in a cabin. That particular ice house was dismantled to make room for our home here.

- In the December 1964 letter of Bob Wegg, he tells of how a township road was acquired. “The property owners of the island paid for the right of way)through the Town Board) to the owner of the farm (now Camp Phillips). This farm also had lake shore (between us and Kohls Resort), that would benefit from the road and our Islander payments were principally to pay the farm for a “sheep tight” fence installation along the west side of the right of way. We Islanders cleared the brush out the way pretty much where the road now is”. “At least some th the payments were made in July or 1935 to Mrs. Ed Novotny, Town Clerk of Bear Lake, Barron County. “The gravel road went in 1936".

- From Chic Stauffers, there were about 13-15 resorts on Bear Lake at one time. They had wooden boats so it was a “rite of spring” to take them out to soak the wood. There were more boats on Bear Lake, but they were much smaller and not all had motors. Rita Durand came up with some resorts in the 1950's. There was, “Brandemuehl’s Resort” now owned by Dale and Rita Brandemuehl Durand, “Sazana’s Resort, now C-J’s Lakeview Resort”, “Martin’s Resort became Wyka’s Bear lake Resort”, “Kolar’s Resort”, Joe and Marie Kolar, “Schauer’s Resort on Dubsky’s Island known as “Island of Whispering Pines”, “Kohl’s Resort”, Ole and Blanche Graver now Dee and Dick Prince, “Stauffer’s Resort”, in 1915 D.W. West owned that property, now Chic Stauffer “Linger Longer Resort” per Judy Juza, Doris Lebkieker had it, “Bear Lake Resort” now the original 1906 house owned by Helen and Harris Hallgren, “Sunset Resort”, and then “Flaming Sum” by Kubes per Judy Juza name changed to “Back to the Moon Resort” now Joann and Larry Porschien.

- Electricity probably was brought in the late 1930's or early 1940's. There used to be a power line that dropped off the pole at the sand bar point and was submerged in the water north across the lake. One can still see some anchor points. Later a large electric cable went from Kohl’s point to Stauffers. Once in a while one would catch the cable when drifting with the boat anchor down, resulting in a good anchor.

- In the earlier years, the lake level seemed much lower. And some said if fluctuated a lot. In the, 1927-1930 photo one would pull their boat sufficiently on shore. In the 1940's the boat docks were made up of wooden posts with tree limbs nailed to the posts and small lumber nailed across. Later pipes with a cross bar and planks the length of one or two dock sections were used. Docks here have to be taken out in the fall. Now we have ready made docks with some on wheels and some docks have floatation. As a rule docks are larger and longer.

I end my 2006-2007 Bear Lake History with a thank you to all who have contributed, to all those who have volunteered, to all those who gave financial support for this Bear lake DNR Grant, and to the Bear Lake Association for making this Great Lake Study possible.

Dorothy M. Moe
2-13-07

1900s

Narrative by John Knobloch: My Grandfather, John Robert Knobloch of Eau Claire along with 3 other co workers at the railroad office in Eau Claire would take a summer fishing trip to Bear Lake. The time was in the early 1900's. The three persons were King, Atter and ? They stayed at Kohls resort. I understand that at that time there was no road from Haugen to Khols and everything travel by launch/boat.

The fishing was good and the lake was beautiful so four of them decided to buy four lots next to each other from Frank Juza who had the farm on the south side of the lake just east of Kohls. The first lot was Charles Atter, then Stephen Keating, Charles King and John Knobloch. This covers section 2, lots number 5,7,8,and 9, 9 being Knobloch. Here is what I know about each of the lots.

Starting in about 1913, my grandfather had our cottage built. I remember my father, Robert John, telling me of being a helper, His job was to fetch water for the workers. My grandfather was in a wheel chair as a result of a train accident. Something about logs rolling off a car onto the workers. He, my grandmother, Ida, and there two children, Ruth and Robert, would take the train to Hagen and spend time at the lake. I could never determine how the lots were assigned but at the time the land was not good for farming.

I remember Charlie Juza owning/residing in the farm house which is currently the winter quarters for the scout camp. Would take evening walks to the barn and watch him milk the cows. Time was in the late 30's and then during the war years.

I was born in 1932 and Mother told me of "washing my diapers in the lake". Hope that did not cause pollution. So, you can see I have spent many years at the lake, since my current age is 74.

Getting back to the cottages. I remember the first cottage was the Atters. Again, Mr. Atter was with the railroad but it was his son, John Atter that I knew. John was an owner of a music store in Eau Claire and sometime in the 70/80 he came by to visit the location. The Atter cottage is no longer on the property as it was physically moved to its currently location on the road, close to Haugen. I remember the move, not the year.

The next piece of land was owned by Stephen Keating but nothing was built on the property until 1950. At that time the land was transferred to the Hooper family. Through marriage it is now Poate and Young. They are sisters, with Poate residing in England and Young in Chicago.

Next is the King cottage. This cottage was built in 1921 by Charles King, again working for the railroad. His son Walter had the cottage for many years and it is currently owned by his nephew George King, Jr.

The scout camp was completed in 1950 and until that time the only road to these cottages was gravel from Haugen. Black top must have been put in place just about that time.

Everyone used the dump, in fact there were two dumps, on the way from Haugen to the cottages. I often thought what could be dug up from the oldest as far as artifacts etc. are concerned.

My Dad was an electrical engineer with Northern States Power in Montevideo Minnesota. Every summer his two week vacation consisted of going with my Mother and brother, Robert to the Lake. Sometime in the mid 30s, Dad wired the cottage for DC voltage and each evening he would go to the garage and kick start the motor that generated electricity. That was quite an improvement until the REA came along and brought power to the area. Must have been in the early 40's.

My grandfather died in the 20s so my grandmother and Dads sister Ruth would spend the entire summer at the lake. They both lived in Eau Claire. Ruth never married and was a school teacher in one school in Eau Claire for 40 years. Taught 1,2 and 3 grades and on many occasions had second generation students in her class. I might add that her first teaching job was in the Haugen grade school, again early 20s.

One other cottage was the Whitfields. That was lot 5. They were also from Eau Claire but don't recall much about them.

Workers building our cottage stayed at Kohls resort and all the lumber, cement, etc were brought by boat from Haugen.

Narrative by George King: My grandfather, Charles G. King, purchased the property from Albert Juze on July 30, 1921. I have the warranty deed showing that date.

My Uncle Walter M. King purchased the cottage from his father and mother on November 2, 1937.

I, George R. King, inherited the cottage on October 16, 1981 on the death of my Uncle Walter M. King.

My wife Elaine and I transferred the property by Quit Claim Deed on Jun 8, 2004 to Kathy Dunlop, Jeffrey King, Gary King, Steven King, and Phillip Morris with life estate provision for Elaine and George King.

Stories I was told by my father George S. King and Uncle Walter M. King.

Four friends, all railroad employees, agreed to buy lake property next to each other - Knobloch, Cuddy, King, and Adlor(?).

Knobloch and King kept boats at Haugen to make the trip to their cottages. My grandfather lived at Altoova and made the trip by train.

There was a fancy resort on Dubsky's Island. Bear lake had large flocks of wild ducks come into the wild rice bed in the fall.

My first memories are from about 1932 to 1935. The milk cows from the Juza farm had free run by the King and Knobloch cottages. While at the cottage we would walk up to the Juza barn to buy milk - this is the barn on the Boy Scout winter camp.

Uncle Walter kept his cedar strip boat in a wet swamp area just south of our cottage - now a boat slip on the Silver Springs property.

My earliest memory of our family cottage was a small building with no electric service, hand water pump and the outhouse about 30 feet from the cottage. The ice house was next to the outhouse and a very small garage was located down the hill on the westside of the property. The cottage had a small kitchen, with hand water pup next to the sink, two small bedrooms, and fairly large main room with a large metal wood or coal heater.

Uncle Walter modernized the cottage about 1956-1959 with electric service, indoor plumbing, and a propane wall furnace. He also finished the interior of the cottage with plywood walls and ceilings. The kitchen was also modernized with a propane water heater, cooling stove, and electric refrigerator. One of the bedrooms became a full bathroom.

An enclosed screened porch was added to the cottage some time from 1936 to 1956. A 14 ft metal boat and 5 ½ hp motor replaced the cedar strip boat in the late 1950s. Our growing families of children, in-laws, grand children, and a great grand daughter caused t anew garage in 1989 and a large kitchen and eating area in 1993. Our great granddaughter is the sixth generation of the King family to use our cottage.

Narrative by Bille Young: Bear Lake Lot 7 section 2 on 1942 Plot Book. My father Wm E. Hooper purchased this property in 1946 from Mr. Cuddy. Mr. Keating who was quite elderly brought the property to our attention. He told us he had owned this beautiful lot on Bear Lake. "Where the water was so clear you could watch the fish take your bate." He bought the land in 1914 but never built and had given the land to his Nephew Mr. Cuddy. Mr. Cuddy wanted to sell and Dad bought it for $300 with taxes $20 per year.

Because the war was on we did not build until 1950 and the title was put in three names: Wm E Hooper, Bille Hooper Young, and Patricia Hooper. When Dad died I inherited his share. The title is now in the names Bille Hooper Young and Patricia Hooper Poate.

In the summer of 1944 and 1945 we rented the cottage on lot6 from Charles Juza. Our row boat was docked on very clear Bear Lake where we swam, fished and enjoyed a sandy beach with very clear water. We built our cabin in 1950. As our families grew the lake became a real joy. A small island just out from Lot # 6 was named Frog Island but today you can walk out to the island on the sand and silt that has washed in over the years. Lily pads and weeds make boat docking difficult. Bloodsuckers and a mucky bottom make swimming a challenge. In 1949 we piled rocks along the shore line for a sandy beach but today the water is up to the rocks and weeds and muck are just 6 feet from the shore.

Today we still have days when the lake is clear and fishing as a whole is still good. Pleasure and recreational boats have become more numerous taking away from the peace and tranquility of the area. It is still a very desirable lake and vacation area.

Bear Lake Resorts:

Notes on back of resort map:
Tuscohia Rail line ran to Park Falls was called the “Blueberry Line”. But narrow gauge railroad at end of lake was always referred to as the narrow gauge.

Flaming Sun - not sure about this one. May have been a secondary home for one of them.

Ole and Blanche Graven - Kohl’s Resort.

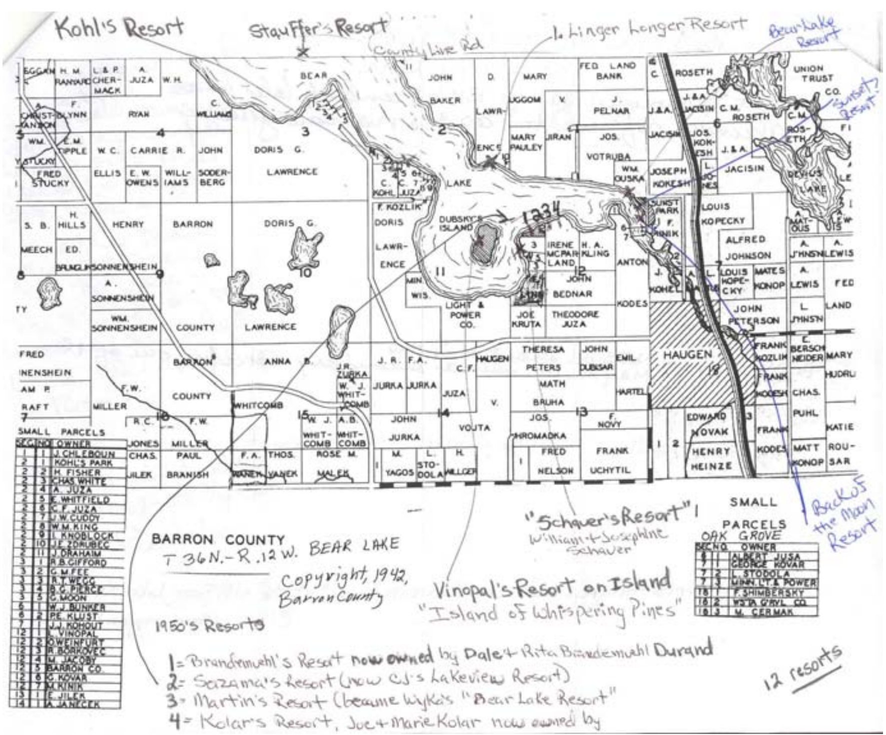
Harris Halgren now owns the main “house” of the old Bear Lake Resort (American plan).

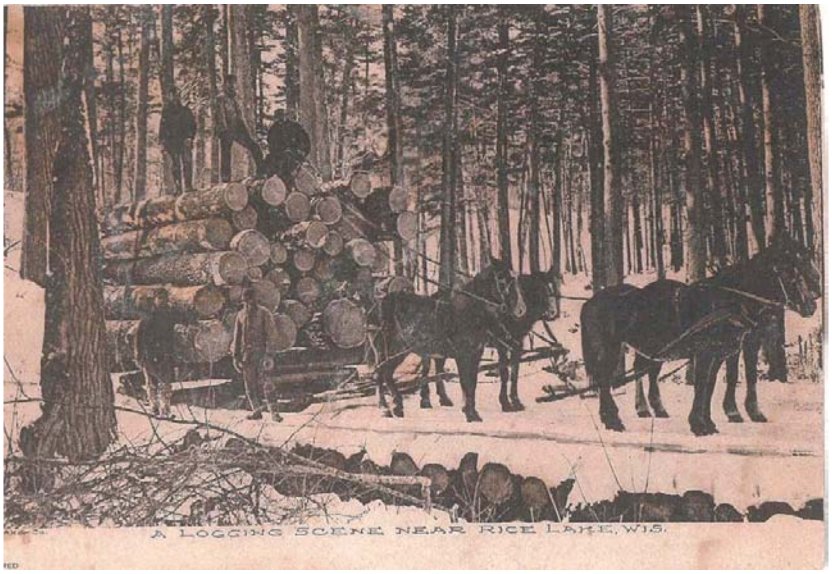
More resort notes:
The map with the 1950's resorts we’ll give a copy to “Chic” Stauffer as it had a different name when they bought it - Washburn County north end. Chic may be able to fill in some of the blank spaces or maybe she’s already sent to you.

Kohl’s Resort
Blanche Graven of Kohl’s Resort was a Kohl. Her parents operated the resort before 1950. When my husband and I arriveed in 1950, Ole and Blanche were running the resort - catering to mean from Chicago. This property is no longer a resort and belongs to Blanche’s sister Dee Kohl Prince.

Stauffer’s Resort (Washburn County)
Functioned from 1950 to 1970.

Previously it was owned and operated by Mart Lindgren and known as Mart’s Lodge. Mart bought it from Doris Laurence Libkicker (sp?) In 1941. Doris had rented out one cabin before that - but it probably wasn’t designated as a resort.





1910: Sent to “Miss Clara Svacina”.

Donated by: Ardyce Kodesh, Haugen, WI.

Railroad pilings from “Crescent Springs RR”. Sept 17, 1901 last load logs taken out for Shell Lake Logging company. As seen from Boyer Creek outflow area wetlands to the south. From Shallow Lake Road, Washburn County, that road referred to “The Narrow Gauge Road”. RR built 1878? By Northwestern RR (North WI RR Co). 1880 Chicago, St. Paul & MPLS with North WI RR Co. 1882 formed Chicago, St. Paul & MPLS & Omaha RR Co., “The Omaha” Branch Line

1915: Haugen Dam
Photos by Clara Svacina
(b. 1891)(from her daughter, Ardyce Kodesh).

1927-1930:
Foreground: SW to NW cabins
Glady Moon
Berton G. Pierce
(later cabin was burned)
Wm. F. Kiester
(now Bob & Dorothy Moe)
Robert Temple Weggs
(the cottage Moe)
Gladys M. Fee
Robert B. Gifford
(1926 cabin burned,

1950: Robert O. Moe and his father Oscar Moe in SW yard of their cottage on Bear Lake, WI. Note clothesline on ash tree left side photo. Note tall grass lakeside of Wegg property, now Dorothy and Robert Moe property.

3. Watershed Features

3.1. Drainage Area and Land Use of Bear Lake

Bear Lake and its watershed is located within Barron and Washburn Counties and is composed of wetlands and forested land. The Bear Lake outflow drains to Bear Creek and eventually to Rice Lake to the southeast.

The direct drainage area to Bear Lake is 297 acres but the entire watershed size is 30,464 acres (USGS 1993 in Aron & Associates, 1994). The watershed delineation is shown in Figure 4. The watershed to lake ratio of Bear Lake is 22 to 1. Typically a large watershed like this yield high phosphorus loads to the lake resulting in poor water clarity. However, the overall watershed is dominated by wetland and forest acreage. Runoff from this type of land use commonly is low in nutrients and Bear Lake does not appear to have excessive nutrient inputs from the watershed.

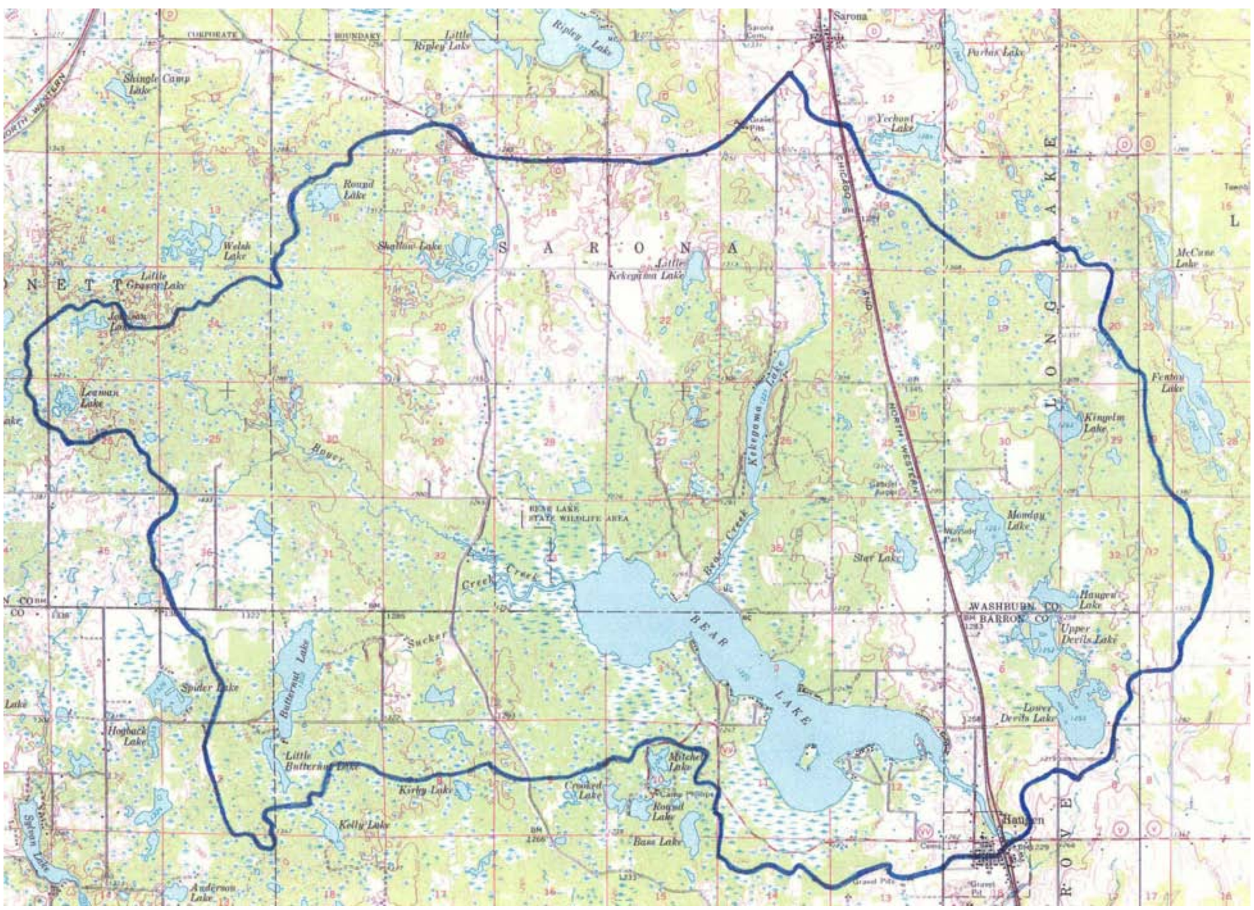


Figure 4. The watershed area for Bear Lake is outlined in blue (source: Aron & Associates 1994).

3.2. Source of Water and Nutrients to Bear Lake

Water: The source of water to Bear Lake is from a combination of surface runoff, rainfall, and groundwater. The amount of water flowing into and out of Bear Lake is estimated to be about 34 cubic feet per second. Flows were estimated based on runoff amounts listed for Barron County in the Wisconsin Spreadsheet Lake Model (Table 2). Much of the flow is from two streams, Boyer Creek and Bear Creek (Figure 5).

Table 2. Average annual water flow into Bear Lake.

Drainage area (including the lake) (acre)	30,464
Average yearly runoff for Barron County (feet)(from WDNR WILMS Model)	0.81
Total water inflow (acre-feet)	24,676

The estimated 24,676 acre-feet of water flowing into Bear Lake in one year would be enough water to fill a swimming pool the size of a football field to a depth of 20,000 feet. It would also be enough drinking water to supply a town of 200,000 for a year.

Although this is a lot of water coming into Bear Lake, the volume of Bear Lake is 27,160 acre-feet. If Bear Lake completely dried up, it would take 13 months to fill.

Figure 5. (Left) Boyer Creek inflow to Bear Lake on July 19, 2006. (Right) Bear Creek being sampled by Bob Moe on September 26, 2006 (photos by Dorothy Moe).

Watershed Nutrients: The primary source of phosphorus to Bear Lake is from the watershed of Bear Lake. The watershed area is composed of forested and wetland land use. There is little agricultural acreage contributing phosphorus to Bear Lake. Phosphorus inputs from groundwater and other sources are considered to be minor. Phosphorus concentrations were monitored in the two inflowing streams once per month in 2006. Phosphorus concentrations were about what would be expected for streams draining forested and wetlands areas. In a future study, flow measurements should be taken with the water samples, and a nutrient loading estimate could be calculated.

Table 3. Bear Lake stream sampling results for total phosphorus for 2006. Data are shown as parts per billion (samples were collected by Bob Moe).

2006	Bear Creek Road Crossing (ppb)	Boyer Creek at Town Road Crossing (ppb)
May 22	51	34
June 20	28	58
July 19	63	192
August 23	43	82
September 26	124	65
May - Sept Average	62	86

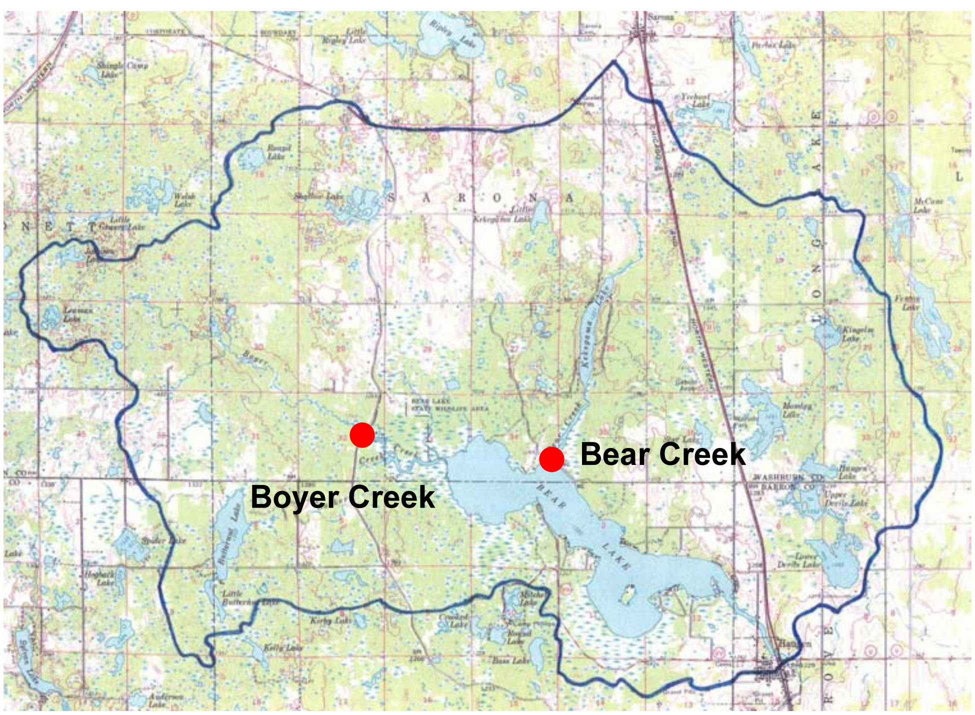


Figure 6. Stream sampling locations for 2006.

3.3. Shoreland Inventory

The shoreland area encompasses three components: the upland fringe, the shoreline, and shallow water area by the shore. A photographic inventory of the Bear Lake shoreline was conducted on September 1, 2006 by lake resident volunteers and Blue Water Science. The objectives of the survey were to characterize existing shoreland conditions which will serve as a benchmark for future comparisons.

For analysis, each photograph was evaluated by Blue Water Science staff for shoreline and upland conditions. Our criteria for natural conditions were the presence of 50% native vegetation in the understory and at least 50% natural vegetation along the shoreline in a strip at least 15 feet deep. Although the shoreline recommendations for new development is a 35-foot deep buffer, a 15-foot deep buffer is about the minimum needed to achieve some degree of runoff water quality treatment. We evaluated shorelines and uplands at the 75% natural level as well (Figure 7 illustrates the methodology).

A summary of the inventory results is shown in Table 4. Based on our subjective criteria over 80% of the parcels in the Bear Lake shoreland area meet the natural ranking criteria for shorelines and upland areas. This is above average for “country lakes”. Country lakes are defined as lakes found about 1 to 2 hours driving time outside of a major Metropolitan area such as Minneapolis/St. Paul or Milwaukee.

In the next 10 years proactive volunteer native landscaping can maintain or improve the natural aspects of a number of parcels.

A comparison of Bear Lake conditions to other lakes in Minnesota and Wisconsin is shown in Table 5 and in Figure 8.

Table 4. Summary of shoreline buffer and upland conditions in the shoreland area of Bear Lake. Approximately 200 parcels were examined.

ID #	Natural Upland Condition		Natural Shoreline Condition		Shoreline Erosion		# of Lots	Undev. Lots	Shoreline Structure		
	>50%	>75%	>50%	>75%	No	Yes			No	Yes	
										riprap	wall
	161 (81%)	141 (71%)	169 (85%)	141 (71%)	200 (100%)	0 (0%)	200 (100%)	55 (28%)	192 (96%)	6 (3%)	1 (1%)

Figure 7. [top] This parcel would rate as having a shoreline with a buffer greater than 50% of the lot width and an understory with greater than 50% natural cover.
[bottom] This parcel would not qualify as having a natural shoreline buffer greater than 50% of the lot width. Also understory in the upland area would be rated as having less than 50% natural cover.

Table 5. Summary of shoreland inventories from Bear Lakes and other lakes in Minnesota and Wisconsin.

Lake	Eco-region	Date of Survey	Total Number of Parcels (#)	Undevel. Parcels % (#)	Natural Upland Condition		Natural Shoreline Condition		Parcels with Erosion % (#)	Parcels with Shoreline Revetment % (#)
					> 50% % (#)	>75% % (#)	> 50% % (#)	>75% % (#)		
NORTHWOODS LAKES										
Ballard chain Vilas Co, WI	LF	7.23.99	110	--	98 (108)	96 (106)	96 (106)	95 (105)	--	0
Kimball Lakes Washburn Co, WI	LF	7.16-8.13.04	121	46 (38)	94 (114)	88 (107)	99 (120)	95 (115)	0 (0)	1 (1)
Pike Chain Price & Vilas Co, WI	LF	2001	722	380	92 (633)	87 (626)	95 (684)	91 (654)	--	5 (34)
Bear Oneida Co, WI	LF	6.8.99	115	6 (7)	93 (107)	78 (90)	84 (97)	77 (89)	1 (1)	8 (9)
Van Vliet Vilas Co, WI	LF	6.04	100	20 (20)	93 (93)	65 (65)	82 (82)	68 (68)	8 (8)	11 (11)
Muskellunge Vilas Co, WI	LF	8.7.04	129	8 (10)	81 (104	62 (80)	88 (114)	76 (98)	2 (2)	18 (23)
Big Bear Lake Burnett Co, WI	LF	9.11.02	87	13 (11)	82 (71)	62 (54)	86 (75)	76 (66)	0	9 (8)
Nancy Lake Washburn Co, WI	LF	9.21.00	217	19 (41)	77 (167)	65 (141)	80 (174)	72 (156)		5 (11)
Plum Lake Vilas Co, WI	LF	7.26.01	225	13 (30)	75 (169)	58 (130)	81 (182)	708(158)	--	9(4)
Big Bearskin Oneida Co, WI	LF	8.10.99	130	--	73 (95)	63 (82)	80 (104)	67 (87)	--	0
COUNTRY LAKES										
North Pipe Lake Polk Co, WI	CHF	8.03	80	45 (36)	100 (80)	96 (77)	94 (75)	91 (73)	0	1 (1)
Bear Lake, Barron Co, WI	CHF	9.1.06	200	28 (55)	81 (161)	71 (141)	85 (169)	71 (141)	0	4 (7)
Upper Turtle Lake Barron Co, WI	CHF	7.23-24.02	309	28 (85)	72 (224)	58 (178)	76 (234)	68 (209)	0	20 (63)
Lower Turtle Barron Co, WI	CHF	7.23.04	127	9 (12)	43 (54)	29 (37)	82 (104)	71 (90)	1 (1)	6 (8)
Pipe Lake Polk Co, WI	CHF	8.03	217	8 (17)	67 (144)	50 (108)	63 (137)	56 (121)	0	22 (48)
Little Pelican Otter Tail Co, MN	CHF	9.16.04	119	33% (39)	55% (65)	61% (51)	66% (79)	61% (73)	33 (39)	23 (27)
Comfort Chisago Co, MN	CHF	10.9-11.2.98	100	--	62 (62)	--	50 (50)	--	--	12 (12)
Lake Volney Le Sueur Co, MN	CHF	9.21.02	79	25 (20)	54 (43)	42 (33)	56 (44)	47 (37)	0	30 (24)
Rush Lake Chisago Co, MN	CHF	9.16.00	524	11 (58)	48 (253)	28 (147)	51 (267)	38 (201)	1 (3)	18 (92)
West Rush Lake, Chisago Co, MN	CHF	9.16.00	332	12 (40)	52 (171)	31 (103)	55 (184)	43 (142)	1 (2)	15 (50)
East Rush Lake, Chisago Co, MN	CHF	9.16.00	192	9 (18)	43 (82)	23 (44)	43 (83)	31 (59)	1 (1)	22 (42)
Fish Otter Tail Co, MN	CHF	9.16.04	95	21% (20)	38% (36)	36% (34)	43% (41)	36% (38)	48 (46)	7 (7)
Big Round Lake, Polk Co, WI	CHF	8.03	74	14 (10)	27 (20)	24 (18)	39 (29)	34 (25)	1 (1)	14 (10)
Bass Otter Tail Co, MN	CHF	9.16.04	22	0% (0)	6% (27)	3% (14)	41% (9)	41% (9)	68 (15)	2 (2)
Pelican Otter Tail Co, MN	CHF	9.16.04	881	14% (2)	21% (183)	14% (123)	21% (181)	16% (142)	2 (14)	80 (706)

Table 5. Concluded.

Lake	Eco-region	Date of Survey	Total Number of Parcels (#)	Undevel. Parcels % (#)	Natural Upland Condition > 50% % (#)	Natural Upland Condition >75% % (#)	Natural Shoreline Condition > 50% % (#)	Natural Shoreline Condition >75% % (#)	Parcels with Erosion % (#)	Parcels with Shoreline Revetment % (#)
Green Lake Kandiyohi Co, MN	CHF	9.19.01	721	1 (9)	20 (146)	12 (88)	19 (140)	14 (100)	0	62 (446)
Diamond Lake Kandiyohi Co, MN	CHF	8.13 & 14.02	344	2 (7)	13 (44)	11 (39)	16 (56)	12 (42)	1 (5)	49 (168)
METROPOLITAN LAKES										
Ravine Lake Washington Co, MN	CHF	7.19.01	9	100 (9)	100 (9)	100 (9)	100 (9)	100 (9)	0	0
Pike Lake, City of Maple Grove, MN	CHF	9.30 - 10.12.99	9	56 (5)	100 (9)	100 (9)	100(9)	100 (9)	0	0
Powers City of Woodbury, MN	CHF	1998	30	90 (27)	90 (27)	90 (27)	97 (29)	97 (29)	0	0
Lake Edward, City of Maple Grove, MN	CHF	9.30 - 10.12.99	34	12 (4)	91 (31)	88 (30)	76 (26)	71 (24)	6 (2)	3 (1)
Rice Lake, City of Maple Grove, MN	CHF	9.30 - 10.12.99	137	33 (45)	71 (97)	64 (87)	81 (111)	74 (102)	0	19 (25)
Lee Lake Dakota Co, MN	CHF	5.31.02	30	37 (11)	73 (22)	50 (15)	77 (23)	67 (20)	0 (0)	10 (3)
Fish Lake, City of Maple Grove, MN	CHF	9.30 - 10.12.99	170	7 (12)	74 (126)	44 (75)	57 (97)	41 (70)	1 (1)	20 (34)
Alimagnet Lake Dakota Co, MN	CHF	8.6.03	108	37 (40)	54 (58)	47 (51)	69 (75)	61 (66)	0	16 (17)
Eagle Lake, City of Maple Grove, MN	CHF	9.30 - 10.12.99	90	14 (13)	64 (58)	52 (47)	47 (42)	41 (37)	0	35 (32)
Cedar Island Lake, City of Maple Grove, MN	CHF	9.30 - 10.12.99	93	5 (5)	62 (58)	35 (33)	55 (51)	39 (36)	0	22 (21)
Orchard Lake Dakota Co, MN	CHF	9.17.01	109	4 (4)	47 (51)	30 (33)	53 (58)	32 (35)	0	54 (59)
Lac Lavon Dakota County, MN	CHF	9.9.03	110	7 (8)	54 (59)	44 (48)	42 (46)	30 (33)	0	8 (9)
Upper Prior Scott Co, MN	CHF	9.30 - 10.12.99	366	10 (37)	51 (187)	36 (132)	35 (128)	31 (113)	4 (15)	46 (168)
Weaver Lake, City of Maple Grove, MN	CHF	9.30 - 10.12.99	111	5 (5)	47 (52)	28 (31)	44 (49)	29 (32)	0	14 (16)
Lower Prior Scott Co, MN	CHF	9.24-30.99	691	10 (66)	36 (249)	24 (166)	22 (152)	17 (117)	5 (35)	54 (373)
Cobblestone Dakota Co, MN	CHF	8.31.06	40	0 (0)	30 (12)	30 (12)	30 (12)	30 (12)	0 (0)	8 (3)
Maple Grove Lake Summary, MN	CHF	9.30 - 10.12.99	644	14 (89)	67 (431)	48 (312)	60 (385)	48 (310)	1 (3)	20 (129)

* CHF = Central Hardwood Forest Ecoregion
** LF = Lake and Forests Ecoregion

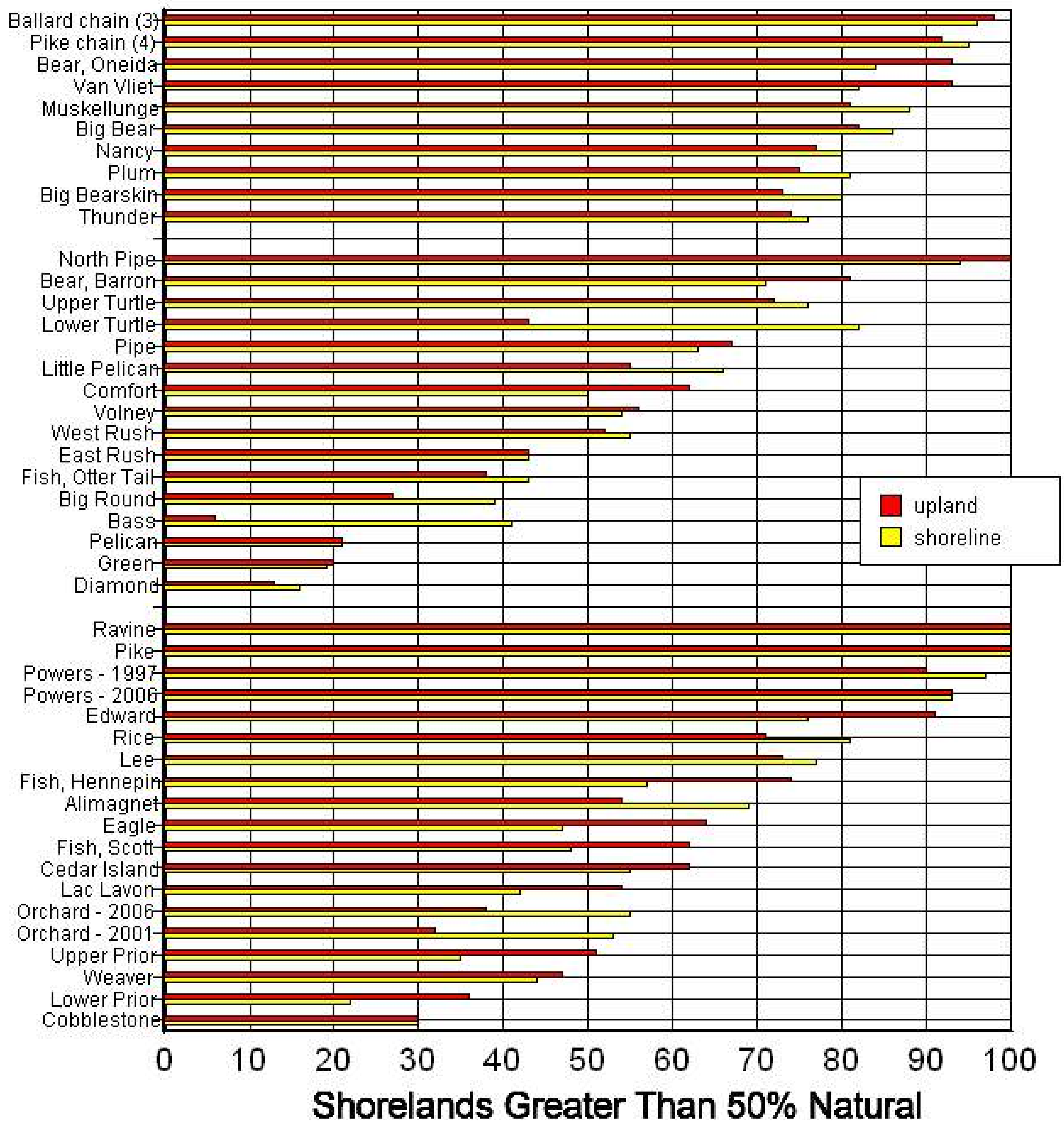


Figure 8. A summary of shoreland inventory results for lakes using an evaluation based on shoreland photographs. For each lake the percentage of shoreline and upland conditions with greater than 50% natural conditions is shown. The first tier of lakes are located in northern Wisconsin. The lower tier of lakes are in the Twin City Metropolitan area and are considered urban lakes. Although several lakes are "urban" lakes most of the shoreland is owned by the city and there is a high percentage of natural conditions. The middle tier of lakes are about an hour or two drive from the Twin Cities, and are not considered to be urban lakes, but are referred to as "country" lakes.

Bear Lake is in the country tier of lakes. It's natural shoreland conditions are above average compared to the other country lakes.

3.4. Bear Lake Wildlife Inventory

A list of wildlife observations in 2006 was compiled by Bear Lake residents and is shown in Table 6.

Table 6. Wildlife were observed in the Bear Lake shoreland area through 2006. Reports were sent in by Jane Landreth, Dorothy and Robert Moe, and Dick Sanner.

	June	July	Aug	Sept	Oct	Nov	General Observations from People Reported at Annual Meeting and Picinic
Amphibians							
Brown water snake	X		X				
Frogs	X		X				
Green		X		X			
Leopard	X				X		
Snapping		X		X			
Tree	X	X	X				
Ribbon snake	X	X	X				
Salamander			X				
Toad		X	XX				
Turtles							
Box	X						
Leatherback	X						
Mud	XX						
Birds							
American robin	X						X
Bald Eagle	X	X				X	X
Baltimore orioles	X						X
Bluebirds	X	X					X
Blue jay			X				X
Canadian geese	X				X		
Cardinal							X
Chick-a-dees							X
Chipping sparrows							X
Crows							X
Doves							X
Ducks - variety					X		
Finches - variety							X
Grackles	X						X
Great blue heron			X				X
Homing pigeon			X				
Hummingbirds	X	X	X				X
Kildeer							X
Kingfishers							X
Loons	X				X		X
Loons & chicks	XX	XX	X				

Table 6. Concluded.

	June	July	Aug	Sept	Oct	Nov	General Observations from People Reported at Annual Meeting and Picinic
Mallard ducks & ducklings							X
Martins			X				
Nuthatch							X
Osprey		X					X
Phoebe	X						X
Raven	X						
Redtail hawk					X		
Redwing blackbirds	X						X
Sandhill cranes		X					X
Scarlet tanager							X
Swallows - variety	X						X
Tree shallow		X					
Turkey	X						
White gull		X	X				X
Wood ducks	X						
Woodpecker	X						
Downy	X						
Hairy	X						
Pileated	X						
Woodcock							X
Yellow bellied sapsucker							X
Yellow finch							X
Mammals							
Beaver			X				
Black bear		X					
Chipmucks	X	X	X				
Gray squirrel	X		X				
Muskrats							X
Otter				X			
Porcupine			X				
Rabbit			X				
Raccoons	XX		X				
Red fox				X			
Skunks							X
Weasel				X			
Whitetail doe	XX						
Fawn	XX						
Miscelleous							
Bees	X	X	X				
Dragonflies	X			X			
Monarch butterflies	X	X					

3.5. Onsite Systems Status

Onsite systems appear to be in mostly good condition based on the surrounding soils which are conducive to good infiltration, and the setback of the cabins and homes. A conventional onsite system is shown in Figure 9. With proper maintenance (such as employing a regular pumping schedule) onsite systems are an excellent wastewater treatment option. The challenge is to maintain systems in good working condition.

Based on this setting, onsite system functions should be comparable to many other lake settings in the county. Most of the systems are probably operating satisfactorily but there are a few old systems or undersized systems that are probably operating poorly. It was not the aim of this study to evaluate individual onsite systems. That could be a future project but it does not appear to be necessary at this time.

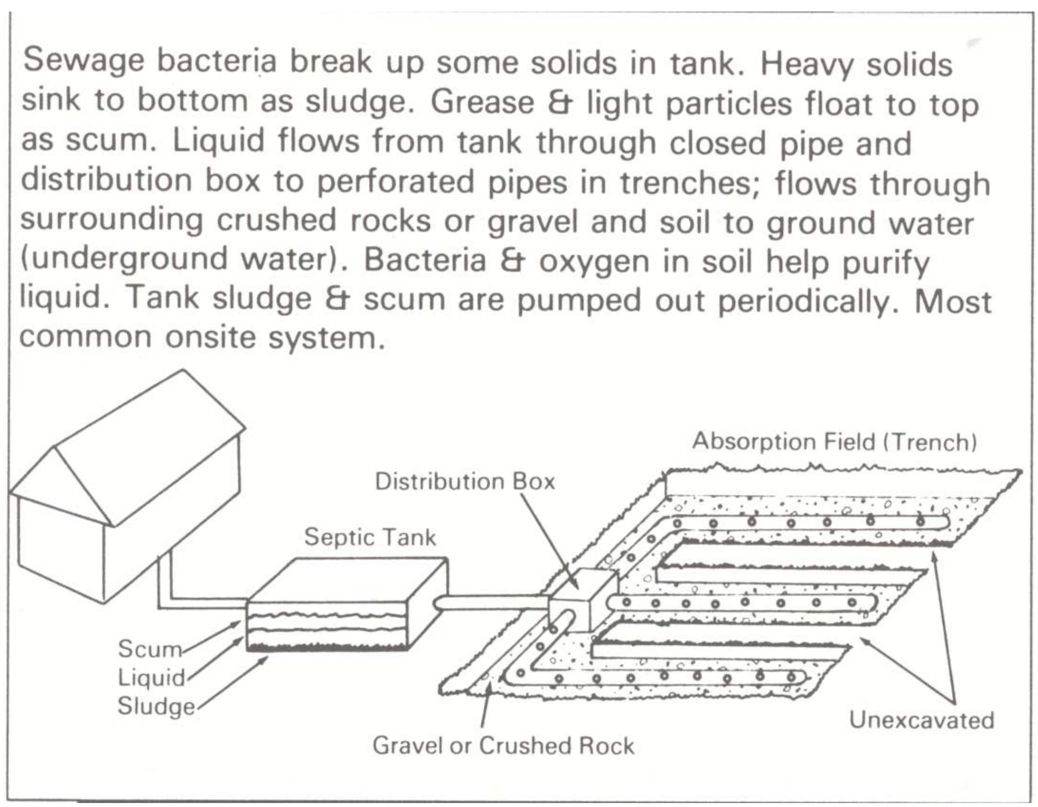


Figure 9. Typical onsite wastewater treatment system found in the Bear Lake watershed.

4. Lake Features

4.1. Lake Map and Lake Statistics

Bear Lake is approximately 1,358 acres in size, with a watershed of 30,464 acres. The average depth of Bear Lake is 6.1 meters (20 feet) with a maximum depth of 26.4 meters (87 feet) (Table 7). A lake contour map is shown in Figure 10. Bear Lake is located in an area of Wisconsin that is dominated by forests and wetlands.

Table 7. Bear Lake Characteristics

Area (Lake):	1,358 acres (550 ha)
Mean depth:	20 feet (6.1 m)
Maximum depth:	87 feet (26.4 m)
Volume:	27,160 acre-feet
Watershed area (including lake area):	30,464 acres (12,329 ha)
Watershed: Lake surface ratio	22:1
Public accesses (#):	5
Inlets:	2 streams

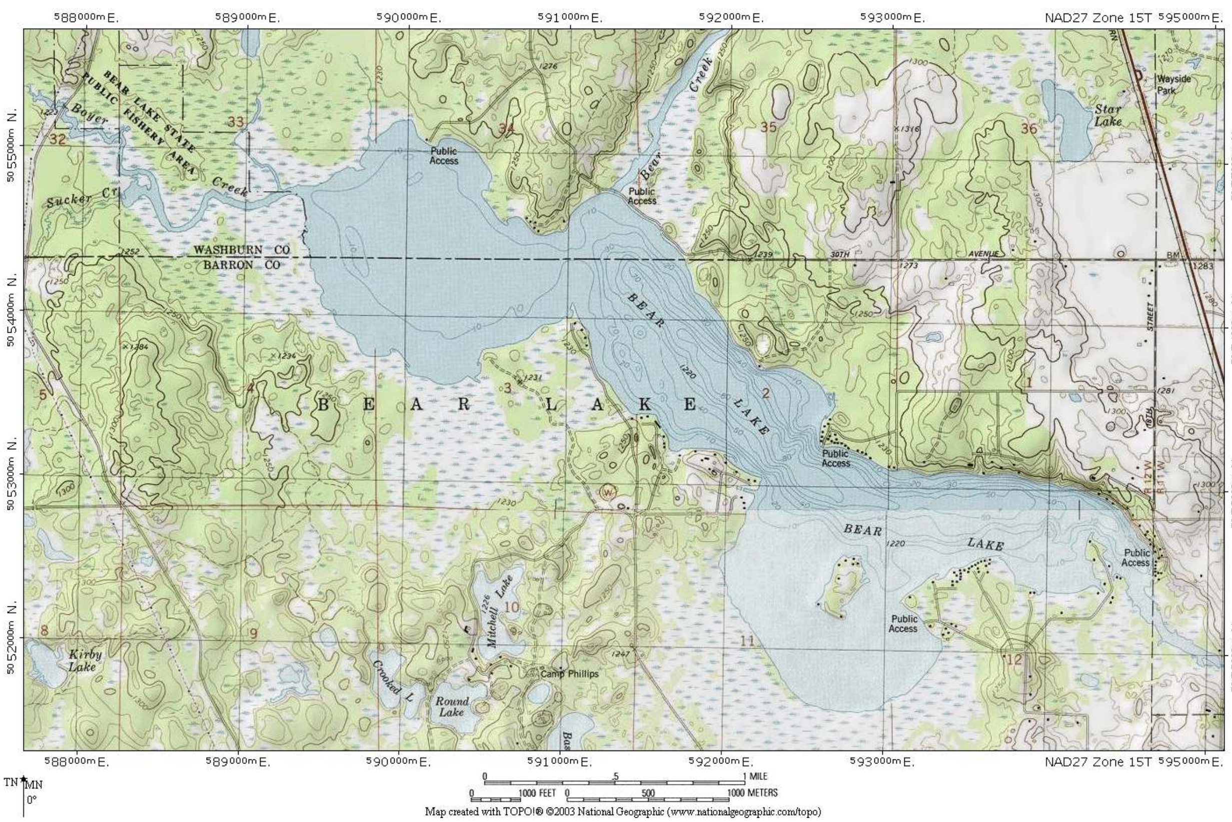


Figure 10. Bear Lake, Barron County, Wisconsin.

4.2. Dissolved Oxygen and Temperature

Dissolved oxygen and temperature profiles have been acquired in 2005 and 2006. By examining the profiles, one can learn a great deal about the condition of a lake and the habitat that is available for aquatic life.

For example, the July profile shows that the lake was thermally stratified. **Thermally stratified** means that the water column of the lake is segregated into different layers of water based on their temperature. Just as hot air rises because it is less dense than cold air, water near the surface that is warmed by the sun is less dense than the cooler water below it and it "floats" forming a layer called the *epilimnion*, or *mixed layer*. The water in the epilimnion is frequently mixed by the wind, so it is usually the same temperature and is saturated with oxygen.

Below this layer of warm, oxygenated surface water is a region called the *metalimnion*, or *thermocline* where water temperatures decrease precipitously with depth. Water in this layer is isolated from gas exchange with the atmosphere. The oxygen content of this layer usually declines with depth in a manner similar to the decrease in water temperature.

Below the thermocline is the layer of cold, dense water called the *hypolimnion*. This layer is completely cut off from exchange with the atmosphere and light levels are very low. So, once the lake stratifies in the summer, oxygen concentrations in the hypolimnion progressively decline due to the decomposition of plant and animal matter and respiration of benthic (bottom-dwelling) organisms.

Table 8. Bear Lake - dissolved oxygen and temperature profiles for 2005

06/01/2005		
Depth	Temp	DO
0	65.1	
5	64.7	6
10	62.6	
15	57.5	6
20	56.6	6
25	55.5	6
30	54.5	5
35	51.9	5
40	48.3	
50	45.8	
60	45.6	
70	44.9	3
80	44.6	
85	44	2

07/05/2005		
Depth	Temp	DO
0	72.3	
5	71.7	6
10	71.4	
15	71	6
20	68	6
25	57.5	4.5
30	54.1	3
35	51.6	2.5
40	48.9	
50	47.4	
60	46.7	
70	46.5	1

08/08/2005		
Depth	Temp	DO
0	77.9	
5	77.1	8
10	76.8	
15	75	8
20	70.5	6
25	59.3	7
30	52.1	2
35	50	1
40	48.9	
50	47.6	
60	46.9	
70	46.7	6
80	46.5	

10/09/2005		
Depth	Temp	DO
0	58.4	
5	58.4	8
10	58.2	
15	58.2	8
20	58.2	7
25	58.2	7
30	58.1	7
35	55.7	7
40	51.8	
50	48.2	
60	47.4	
70	47.3	1.5
80	46.9	

Table 9. Bear Lake - dissolved oxygen and temperature profiles for 2006

05/07/2006		
Depth	Temp	DO
0	57	0
5	53.9	10
10	53.4	0
15	53.2	10
20	52.8	10
25	52.1	10
30	51.6	10
35	50.1	10
40	48.5	0
50	47.1	0
60	46.4	0
70	46.2	8
80	45.6	0

06/05/2006		
Depth	Temp	DO
0	74.4	
5	74.6	7
10	74.4	
15	66.5	6
20	57.2	6
25	54.8	6
30	53.4	6
35	51.4	5
40	50	
50	48.3	
60	48	
70	47.6	3
80	47.4	
85		3

07/05/2006		
Depth	Temp	DO
0	74.4	
5	74.4	8
10	74.3	8
15	73.3	8
20	61.4	5
25	54.9	4
30	53	3
35	50.3	2
40	49.6	
50	48.7	
60	48.3	
70	48	1
80	47.8	
90	47.4	1.5

08/15/2006		
Depth	Temp	DO
0	75.9	
5	73.7	6
10	73	
15	72.8	6
20	72.1	6
25	60.2	4
30	54.3	1
35	51.9	5
40	50.7	
50	49.4	
60	48.9	
70	48.3	3
80	48.2	
90	48	1

10/15/2006		
Depth	Temp	DO
0	50	
5	49.2	8
10	49.1	
15	48.9	8
20	48.9	8
25	48.9	8
30	48.9	6
35	48.9	6
40	48.9	
50	48.5	
60	48.3	
70	48	6
80	47.8	
90	47.6	6

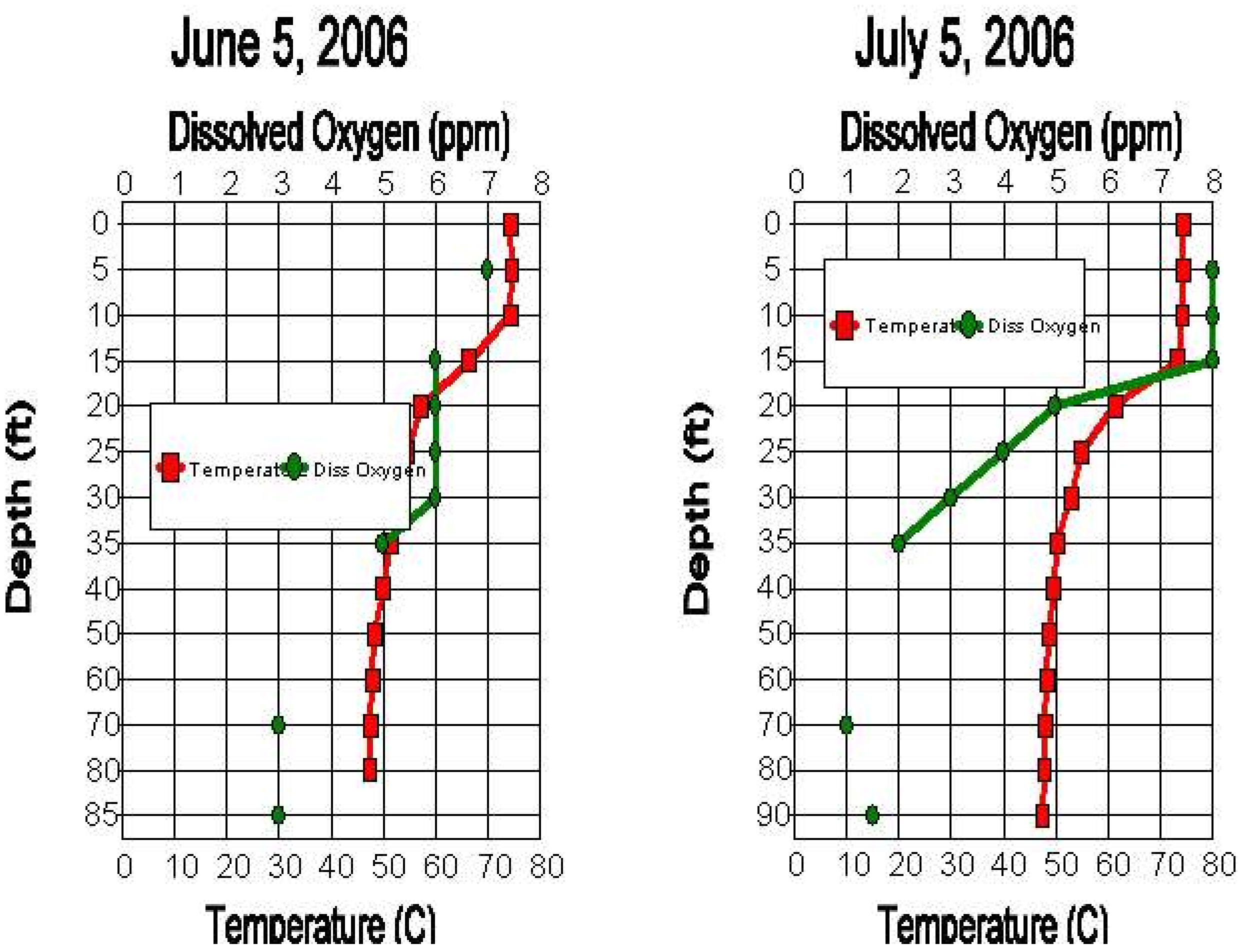


Figure 11. Dissolved oxygen and temperature profiles for Bear Lake in 2006.

4.3. Lake Water Quality Summary

Summer water clarity data are available from 1986 through 2006. Overall, the three water quality indicators (Secchi disc, total phosphorus, and chlorophyll a) indicate Bear is moderately fertile with water quality considered to be good.

Additional water quality evaluations are found in the next several sections.

Table 10. Bear Lake water quality data for 1992, and 1993 (from Aron and Associates 1994) and from 2005 and 2006 (Wisconsin Self Help Program).

Date	Secchi Disc (ft)	Total Phos - top (ppb)	Total Phos - bottom (ppb)	Chlorophyll a (ppb)
1992				
5.13	5.9	27	139	12
6.9	8.9	16	63	5
7.23	7.9	18	50	9
8.19	6.9	16	50	12
May-Aug Avg	***7.4***	***19***	***76***	***9.5***
1993				
5.6	5.9	4	10	4.5
6.24	7.9	15	35	8
7.16	4.9	19	20	16.1
8.12	4.9	18	50	17.6
May-Aug Avg	***5.9***	***14***	***29***	***11.6***
2005				
6.1	12	21		2
7.5	8.25	19		7.4
8.8	5.75	25		17.8
10.9	7.5	21		11
Jun-Aug Avg	***8.7***	***22***		***9.1***
2006				
5.7	9.3	33		
5.28			2	
5.29	9.3			
6.5		21		6.5
6.11	9.3			
6.23			17	
6.29	8.8			
7.5		16		9.2
7.18	8.8			
7.19			55	
8.10	6.0			
8.14	5.5			
8.15		23		17
8.23			74	
9.6	6.0			
9.26			22	
10.2	7.8			
May-Aug Avg	***8.1***	***23***	***37***	***10.9***

4.3.1. Secchi Disc Transparency

Water clarity is commonly measured with a Secchi disc. A typical seasonal pattern in lakes shows good clarity in May and June with a drop off in July and August. The low water clarity in late summer is usually due to algae growth (Figure 12).

Water clarity summer averages from 1986 through 2006 are shown in Figure 13. The summer average using July and August for clarity fluctuates from year to year and no apparent trend is noticeable, which indicates, water clarity is neither decreasing or increasing over a long term basis (Figure 13).

A graph showing the minimum Secchi disc reading for the summer is shown in Figure 13 (bottom). A Secchi disc reading of 3 feet or less often indicates a significant algae bloom. Bear Lake does not have a history of significant algae blooms.

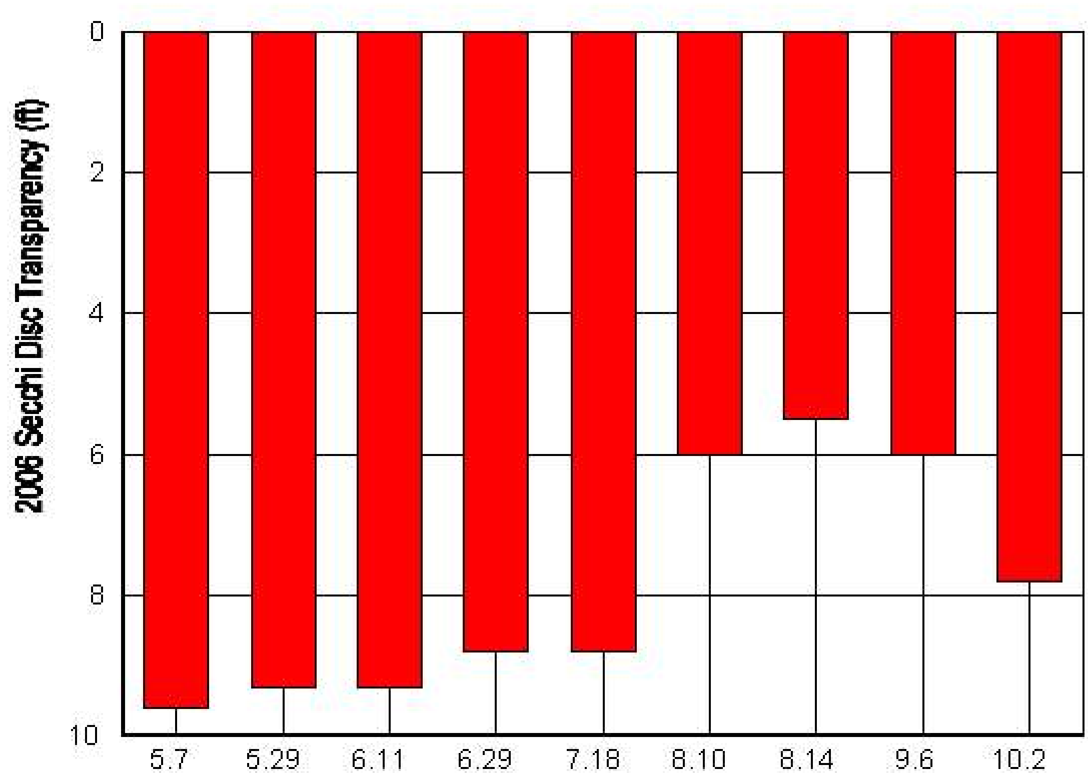
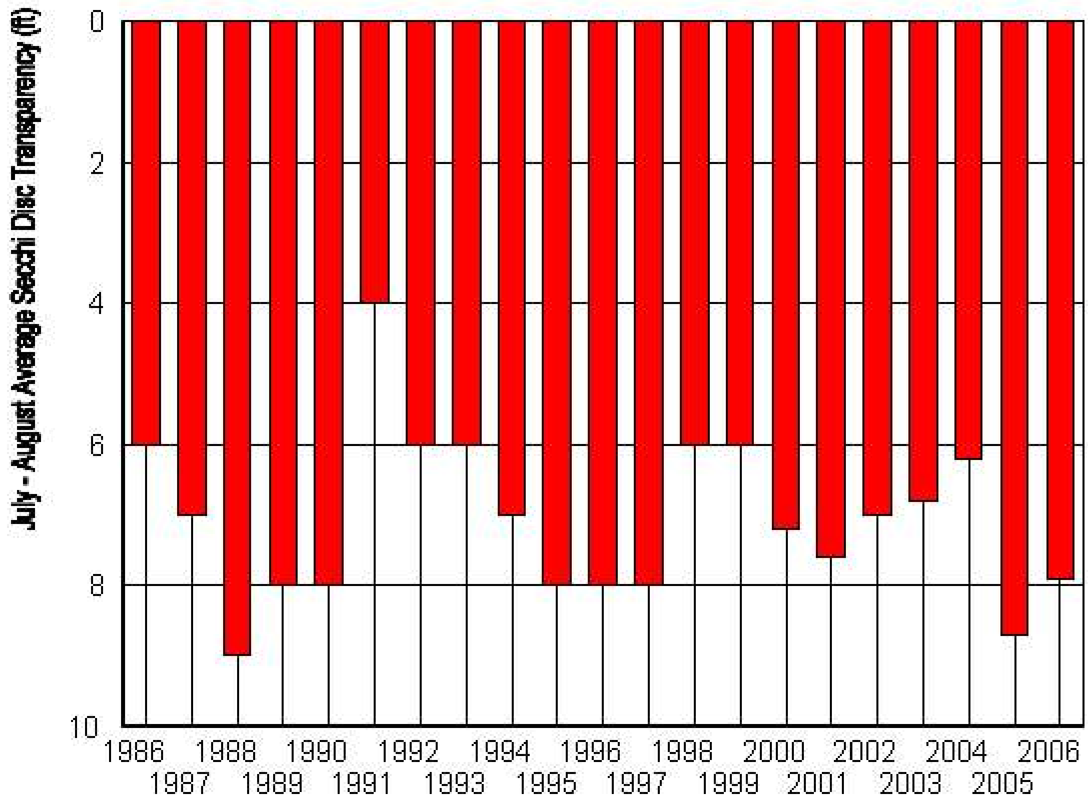


Figure 12. Monthly Secchi disc readings for Bear Lake in 2006.



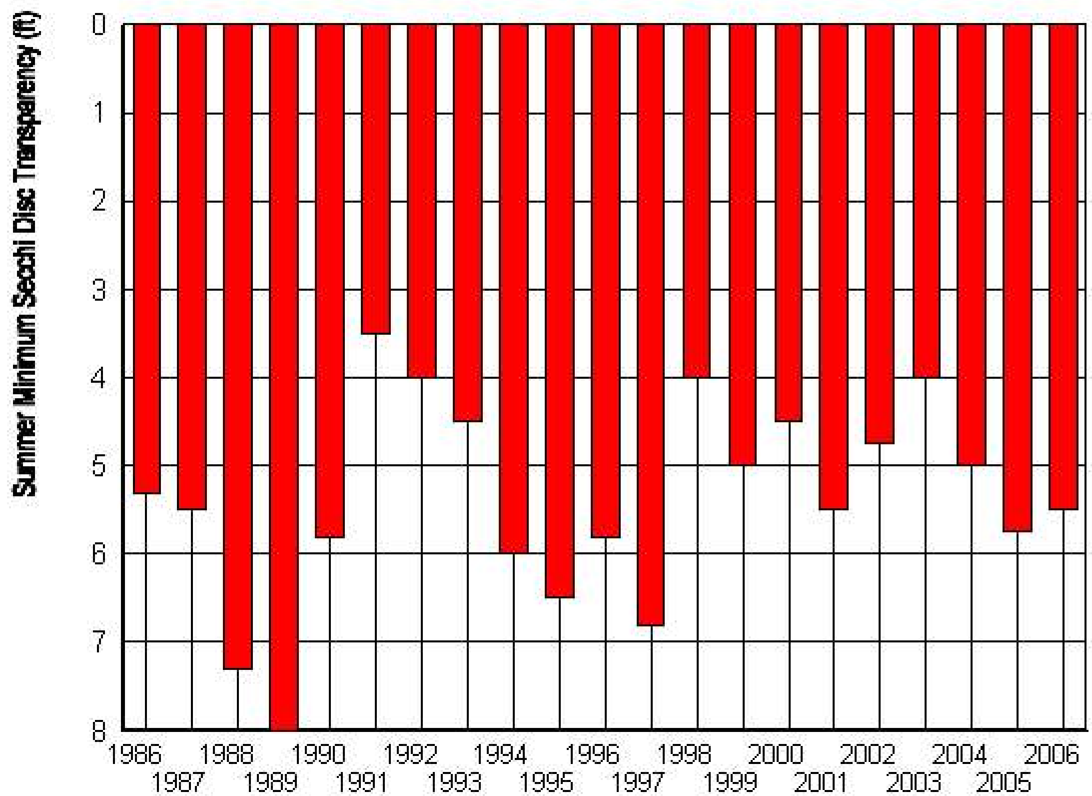


Figure 13. [top] Average yearly Secchi disc clarity for July - August readings. [bottom] The minimum Secchi disc readings for the summer.

4.3.2. Total Phosphorus

Phosphorus is the nutrient most often associated with stimulating nuisance algae growth. The more phosphorus in the lake, the more algae will be produced. Records of summertime lake phosphorus concentrations for Bear Lake in 2006 are shown in Figure 14. Phosphorus concentrations in Bear Lake are low to moderate. When phosphorus concentrations get over 30 parts per billion (ppb) of phosphorus, that is high enough to produce algae growth that results in water clarity of 4 to 5 feet.

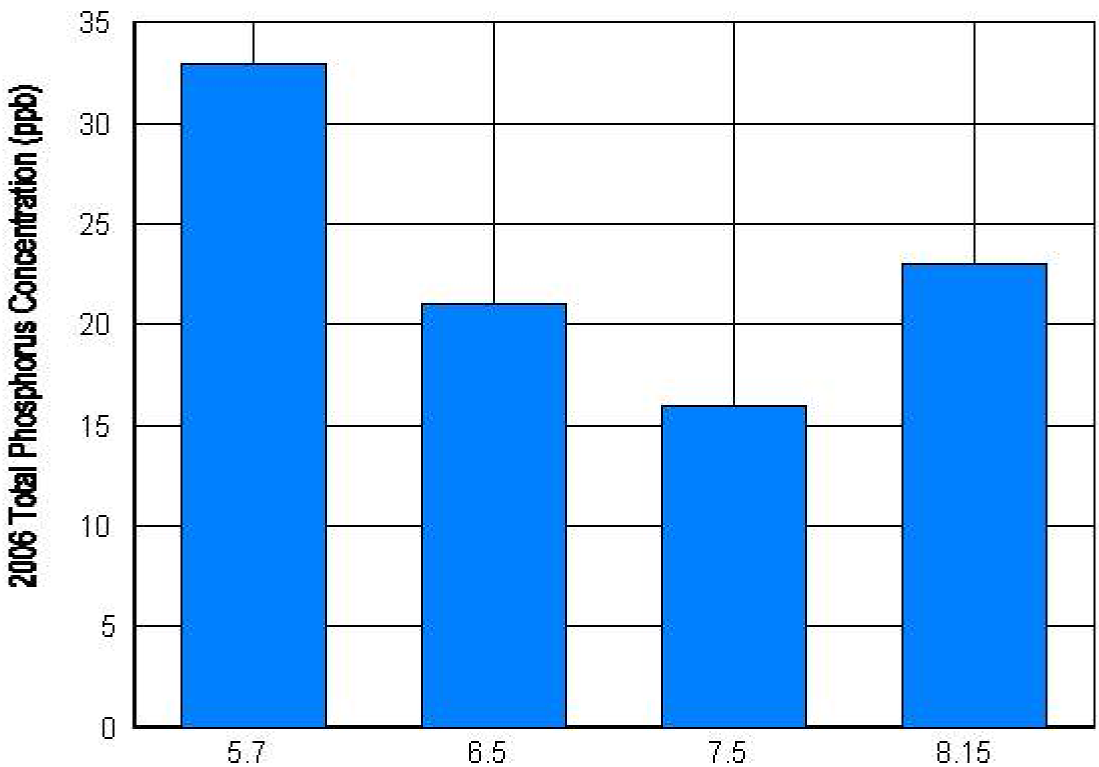


Figure 14. 2006 surface total phosphorus concentrations for Bear Lake.

4.3.3. Chlorophyll a (a measure of algae)

Algae are small green plants, often consisting of single cells or grouped together in filaments (strings of cells). Because algae have chlorophyll, the amount of algae in the water can be characterized by measuring the chlorophyll content in lake water.

The amount of algae, as determined using chlorophyll measurements is directly influenced by the amount of phosphorus in the lake. Chlorophyll results for 2006 are shown in Figure 15. Chlorophyll concentrations are moderate and this correlates with phosphorus concentrations which are also moderate .

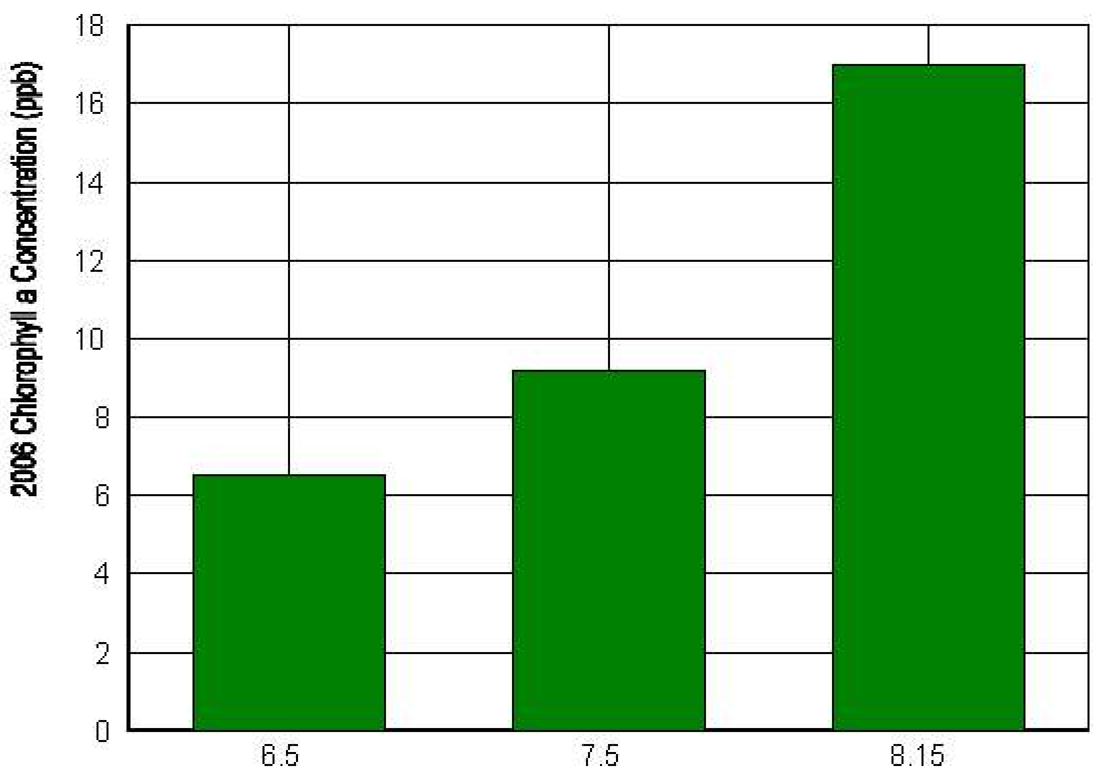


Figure 15. 2006 chlorophyll concentrations in Bear Lake.

4.4. Algae

In mid to late summer, algae numbers increase and reduce transparency in Bear Lake. The dominant late summer algal species in Bear Lake in 2006 were a combination of blue-green algae and green algae (Figure 16). Blue-green algae species had relatively higher densities in August compared to May conditions.

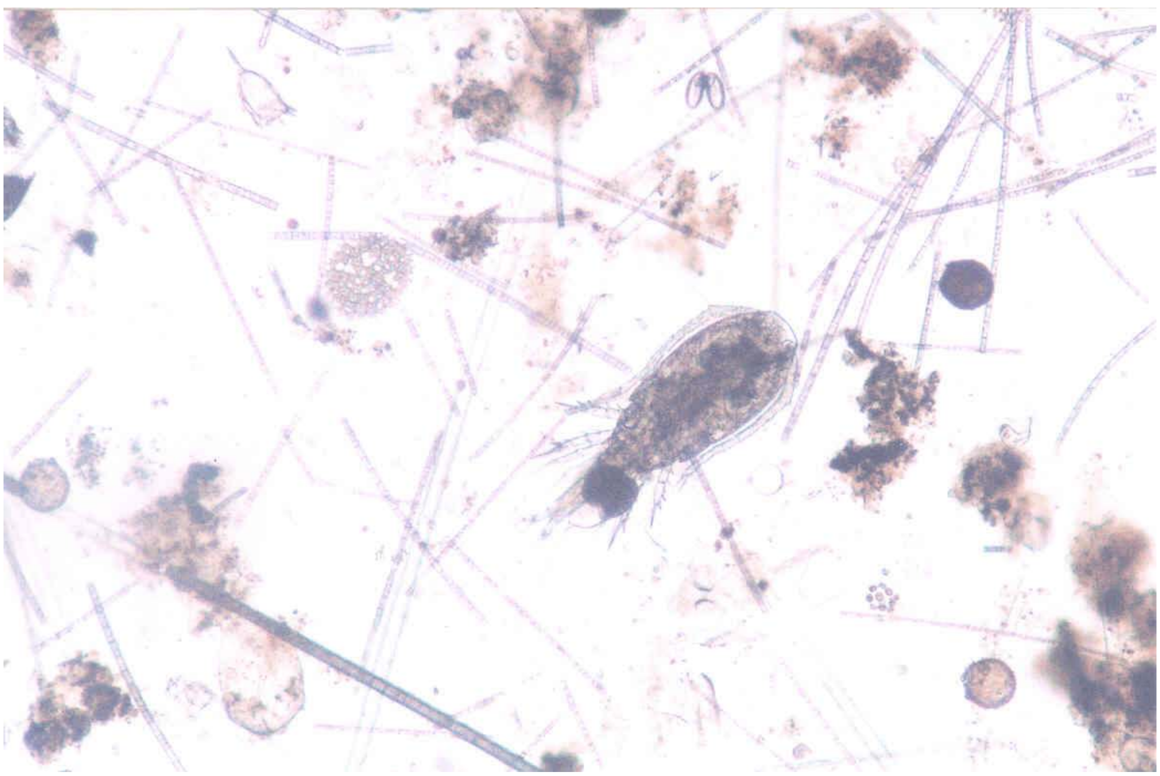


Figure 16. Green algae were common throughout the summer in Bear Lake. A copepod is shown in the center of the picture.

4.5. Zooplankton

Zooplankton are small crustaceans that can feed on algae. A variety of different zooplankton are commonly found in lakes. An example of zooplankton species from Bear Lake is shown in Figure 17. The zooplankton community in Bear Lake is typical for lakes in Northern Wisconsin. In the photo, the image is magnified 150 times.

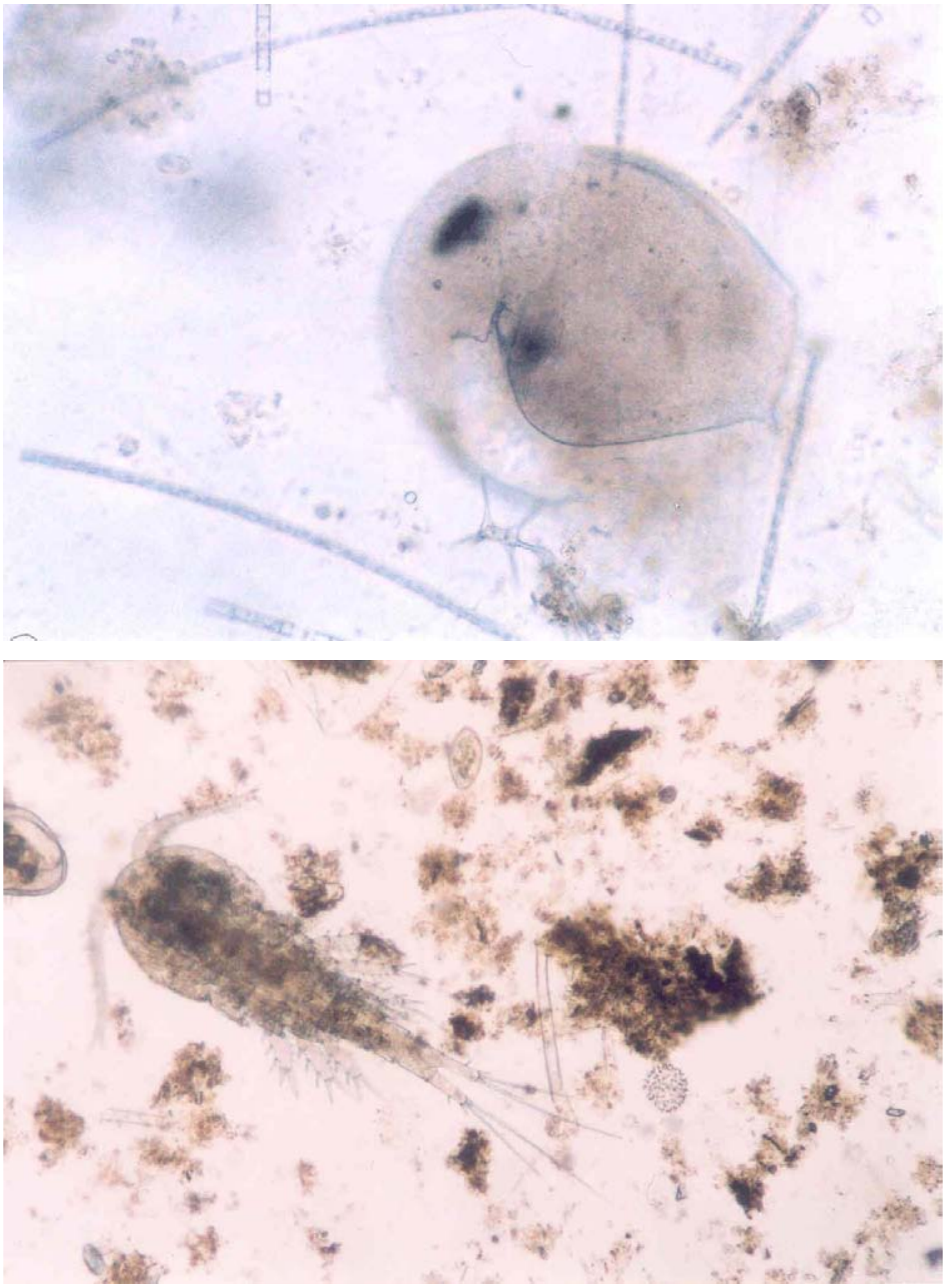


Figure 17. The animal in the upper picture is a *Bosmina*, a cladoceran zooplankton that feeds on algae. The animal in the lower picture is a copepod, a zooplankton that feeds on algae and other zooplankton.

Zooplankton in Bear Lake were sampled in August of 2006 and results are shown in Table 11. Copepods were the dominant zooplankton group. Large daphnids were present in August which is good because they are good grazers on algae and help keep algae numbers down.

Table 11. Zooplankton counts for Bear Lake (organisms/liter).

	August 15, 2006
(Tow length was feet)	**8**
Big Daphnids	2
Little Daphnids	1
Ceriodaphnia	0
Bosmina	1
Chydorus	1
Cladoceran	**5**
Calonoids	1
Cyclopoids	7
Nauplii	0
Copepods	**8**
Rotifers	**0**
Total Zooplankton	**13**

4.6. Bear Lake Aquatic Plants

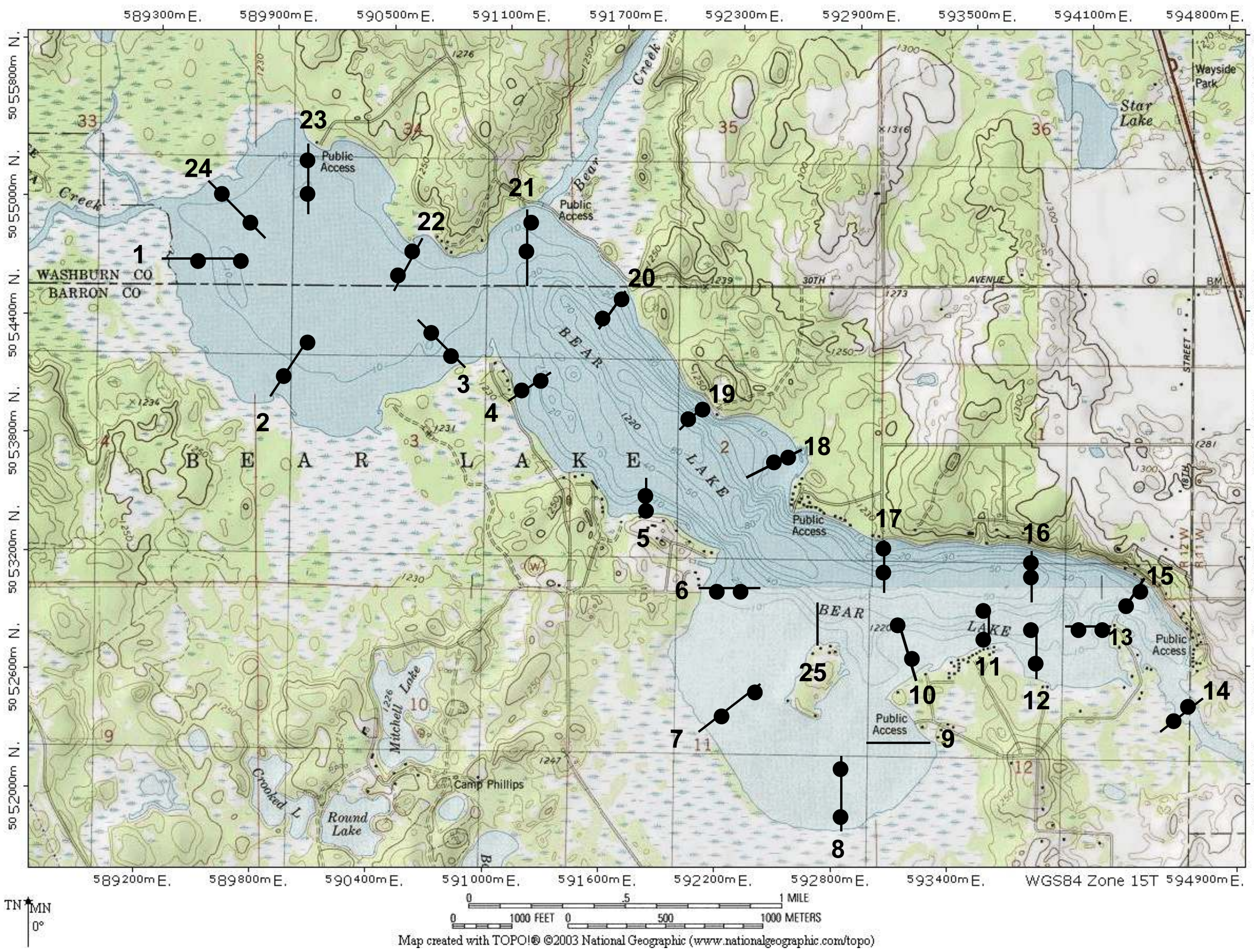
Aquatic plants are very important to lakes. They act as nurseries for small fish, refuges for larger fish, and they help to keep the water clear. Currently Bear Lake has a fair diversity of aquatic plants. Curlyleaf pondweed, a non-native aquatic plant, is present in Bear Lake.

Aquatic plants were evaluated in Bear Lake in 2006 and 2007.

Aquatic Plant Survey Methods: Two types of plant surveys were conducted. An early summer plant check was conducted in May of 2006 and in June of 2007 with the objective to determine the presence of curlyleaf pondweed. On May 22, 2006, Steve McComas of Blue Water Science along with Bear Lake residents covered most of the perimeter of Bear Lake with occasional rake samples being taken to look for curlyleaf pondweed. In the month of June, 2007, Dorothy and Bob Moe checked for curlyleaf pondweed again covering much of the perimeter of Bear Lake.

A more quantitative plant survey was conducted in late summer of 2006. A point intercept transect method was used to survey aquatic plants in Bear Lake on August 15, 2006. Twenty-eight transects were sampled around Bear Lake and two depths were sampled for each transect. The depth ranges were 0 - 5 feet and 6 - 10 feet. A total of 56 sites were visited. At each sample site, 2 to 4 samples were collected with a rake. All plant species were identified and a density rating from 1 to 3 was used, where 3 represents the densest growth and 1 represented a trace of the plant in the rakehead.

Because we were interested in changes in the plant community, we used the same transect locations that were used in the 1992 plant survey so that we could make comparisons on plant community structure from 1992 to 2006.



Transect	GPS Coordinates (WGS 84)		Description
	East	North	
1	05 89 587	50 54 674	(End of wild rice bed 89 412/ 54 615)
2	05 89 881	50 54 212	Right of tree lined knob.
3	05 90 412	50 54 022	
4	05 91 200	50 54 200	2nd house right of swamp.
5	05 91 800	50 53 505	Right of boy scout shoreline tower.
6	05 92 290	50 53 154	Left of house on point (really a garage).
7	05 92 463	50 52 383	
8	05 92 612	50 52 189	
9	05 93 148	50 52 228	Right of public access, right of 1st house next to access.
10	05 93 293	50 52 823	Big brown house with 2nd story deck, big wide chimney, 2nd house left of the point.
11	05 93 550	50 52 755	1st house to right of the point.
12	05 93 892	50 52 782	Right of two houses in the bay.
13	05 94 105	50 52 703	1st permanent house right of point. Rambler with bird house and gazebo.
14	05 94 917	50 52 600	Left of campground boat channel to house on stilts.
15	05 94 215	50 53 140	Left of old Bear Lake resort with white boathouse.
16	05 93 814	50 52 248	Large shoreline riprap - natural.
16.5	05 93 500	50 52 270	
17	05 93 110	50 52 290	Right of rock riprap and house.
17.5	05 92 618	50 53 435	Public access.
18	05 92 492	50 53 715	Middle of cove, on five birch trees.
19	05 92 100	50 53 950	Left of square house.
20	05 91 750	50 54 425	Left of point.
21	05 91 200	50 54 810	Left of Bear Creek inlet, left of culvert.
22	05 90 693	50 54 665	Left of house in cove.
23	05 90 219	50 55 056	Public access (also edge of wild rice bed - 5 ft, 200 ft x 200 ft).
24	05 89 830	50 54 931	Left of point, right of Boyer Creek.
25	05 92 700	50 52 765	Island.

Figure 18. Locations of the point intercept transects for Bear Lake, used on August 15, 2006. These were the same locations that were used in the July 1992 survey.

Early Summer Curlyleaf Pondweed Conditions - May (2006) and June (2007)

Curlyleaf pondweed was not considered to be a problem when the project work plan was developed in 2005. It was found at one location, in the outlet area, in a plant survey conducted in July in 1992 (Figure 19). For this project, a curlyleaf check was conducted on May 22, 2006. Curlyleaf was observed at only one location in the big bay (Figure 19). However, curlyleaf was found to be more widespread in June of 2007. Field observations were conducted by Bob and Dorothy Moe and the distribution of curlyleaf pondweed in 2007 is shown in Figure 19.

It is not clear if growing conditions were unique for 2007 which could account for the apparent increase in curlyleaf pondweed. If this is the case, then curlyleaf growth in 2007 may be a short-term effect. However, its also possible that curlyleaf has expanded its range and is now established over a much larger area than what was observed in 1992 and 2006. Additional plant monitoring in the ensuing years is recommended.

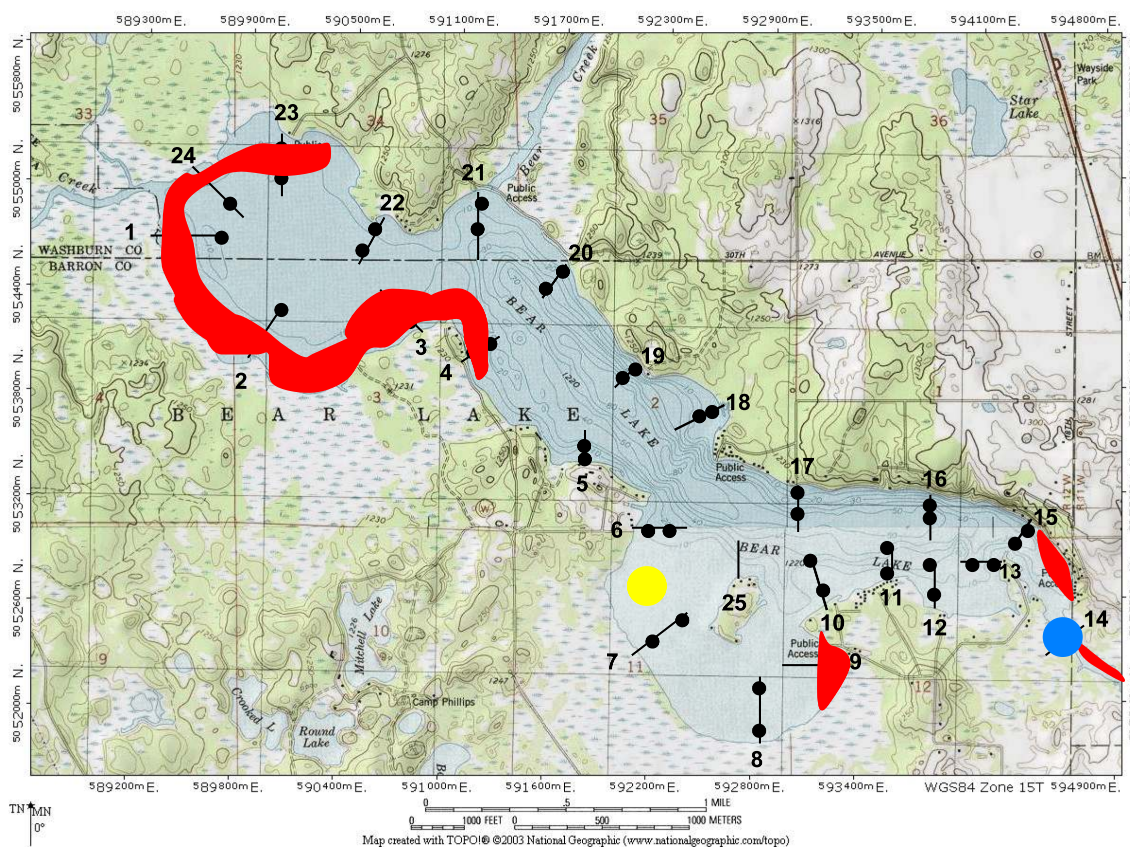


Figure 19. Locations of curlyleaf pondweed found by Bob and Dorothy Moe, Bear Lake residents, in June of 2007 (red shading). Curlyleaf location in 2006 is shown in yellow shading and the curlyleaf location found in 1992 is shown in blue shading.

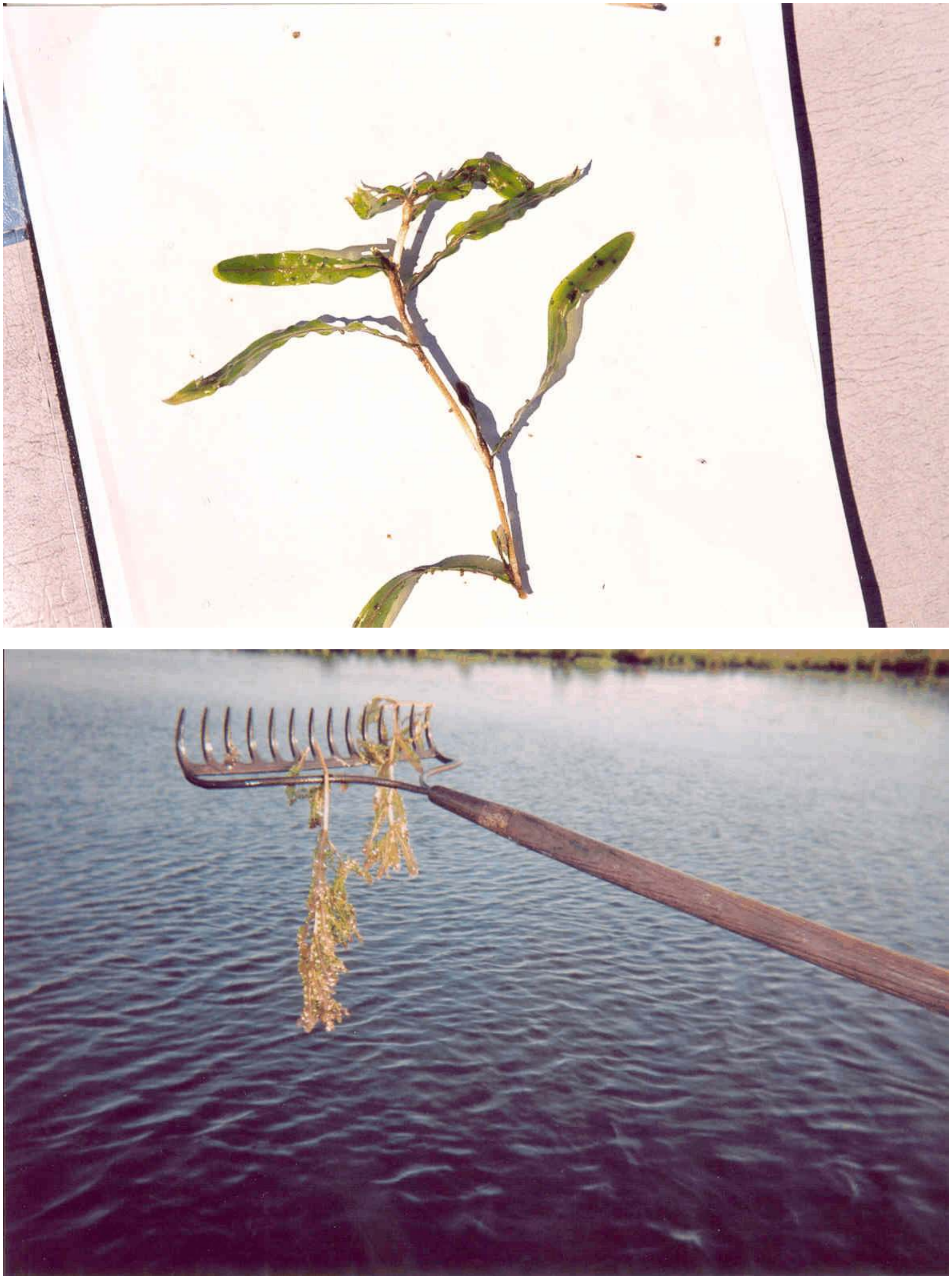


Figure 20. [top] Curlyleaf was found at one location in May of 2006.
[bottom] Curlyleaf was more widespread in June of 2007 compared to May of 2006.

Late Summer Survey - August 15, 2006: On August 15, 2006 the dominant aquatic plant was fern pondweed (Table 12). In August 2006 aquatic plant distribution was estimated to be at 611 acres (Figure 21). Of that coverage, there were only a few areas where native plants grew to the lake surface.

Table 12. Bear Lake aquatic plant occurrences and densities for the August 15, 2006 survey based on 28 transects and 2 depths, for a total of 56 stations. Density ratings are 1-5 with 1 being low and 5 being most dense.

	Depth 0 - 5 feet (n=28)			Depth 6 - 10 feet (n=28)			All Stations (n=56)		
	Occur	% Occur	Density	Occur	% Occur	Density	Occur	% Occur	Density
Purple loosestrife (*Lythrum salicaria*)	1	4	0.5	--	--	--	1	2	0.5
Pickerel plant (*Pontederia cordata*)	3	11	1.8	--	--	--	3	5	1.8
Arrowhead (*Sagittaria sp*)	4	14	0.5	--	--	--	4	7	0.5
Bulrush - hardstem (*Scirpus acutus*)	3	11	0.4	--	--	--	3	5	0.4
Cattails (*Typha sp*)	1	4	0.5	--	--	--	1	2	0.5
Wild rice (*Zizania aquatica*)	3	11	0.9	--	--	--	3	5	0.9
Spatterdock (*Nuphar variegatum*)	7	25	0.9	--	--	--	7	13	0.9
White waterlily (*Nymphaea sp*)	3	11	0.9	1	4	1.0	4	7	1.0
Water marigold (*Bidens Beckii*)	2	7	0.8	1	4	1.0	3	5	0.8
Coontail (*Ceratophyllum demersum*)	11	39	1.3	11	39	1.6	22	39	1.5
Chara (*Chara sp*)	2	7	1.0	--	--	--	2	4	1.0
Elodea (*Elodea canadensis*)	3	11	0.8	--	--	--	3	5	0.8
Star duckweed (*Lemna trisulca*)	4	14	0.8	1	4	1.0	5	9	0.8
Northern watermilfoil (*Myriophyllum sibiricum*)	9	32	1.0	11	39	1.6	20	36	1.3
Naiads (*Najas flexilis*)	12	43	1.3	4	14	1.2	16	29	1.3
Nitella (*Nitella sp*)	1	4	0.7	1	4	0.5	2	4	0.6
Largeleaf pondweed (*Potamogeton amplifolius*)	19	68	1.4	5	9	0.7	24	43	1.2
Variable pondweed (*P. gramineus*)	5	9	0.8	1	4	0.5	6	11	0.8
Illinois pondweed (*P. Illinoensis*)	--	--	--	2	7	0.4	2	4	0.4
Whitestem pondweed (*P. praelongus*)	2	7	1.1	2	7	0.5	4	7	0.8
Claspingleaf pondweed (*P. Richardsonii*)	6	21	0.7	7	25	0.9	13	23	0.8
Fern pondweed (*P. Robbinsii*)	8	29	1.9	3	11	0.8	11	20	1.6
Snailseed pondweed (*P. Spirillus*)	4	14	1.5	1	4	1.0	8	14	0.9
Stringy pondweed (*P. strictifolius*)	3	11	1.2	9	32	1.2	12	21	1.2
Flatstem pondweed (*P. zosteriformis*)	9	32	1.1	19	68	1.7	28	50	1.5
Wild celery (*Vallisneria americana*)	17	61	1.2	9	32	1.7	26	46	1.4

A summary of aquatic plant statistics is shown in Table 13 and a coverage map of Bear Lake aquatic plants is shown in Figure 21.

Table 13. Summer aquatic plant survey summary.

	All Stations
Number of submerged aquatic plant species found	18
Common plant species	Flatstem pondweed
Rare submerged plant	chara, nitella, Illinois pondweed
Maximum depth of plant growth	12 feet

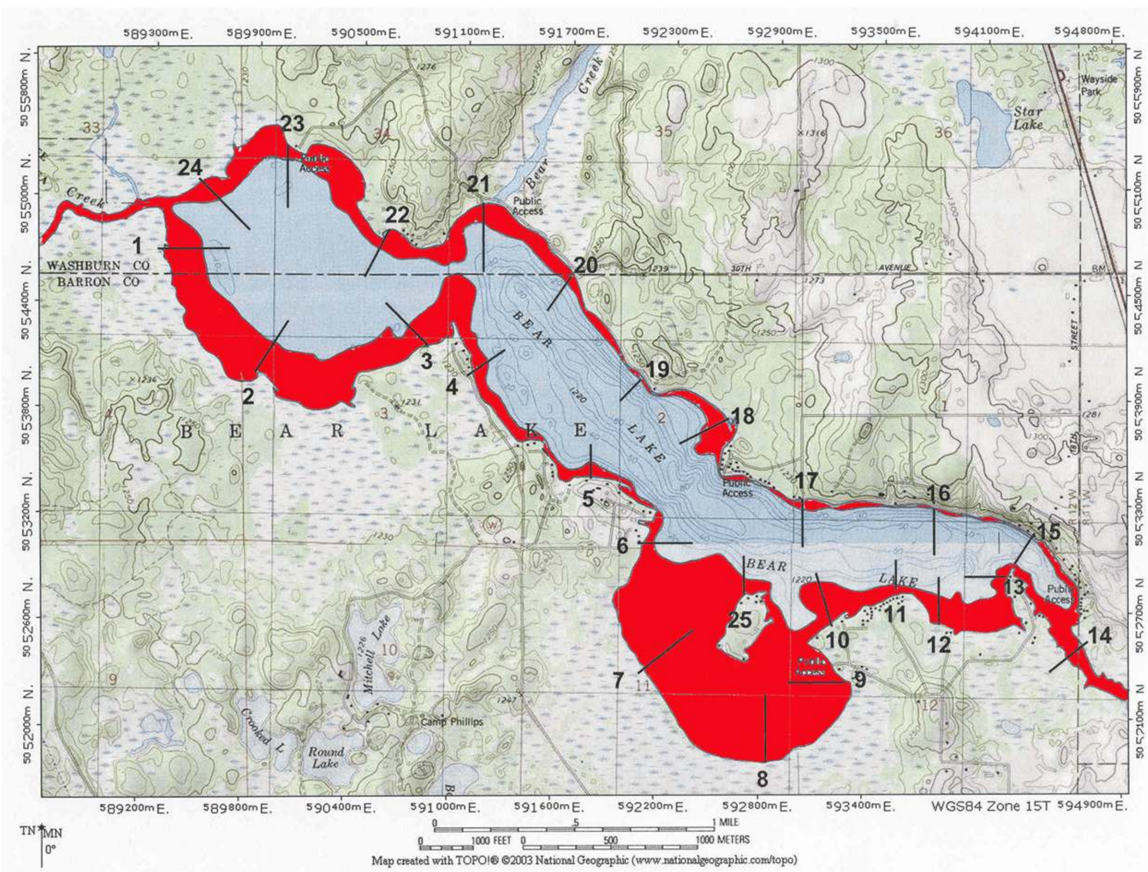


Figure 21. Aquatic plant coverage on Bear Lake on August 15, 2006 is shown in red.

Figure 22. Largeleaf pondweed on a sample rake on August 15, 2006.

Figure 23. Fern pondweed was common in the August 15 Bear Lake aquatic plant survey.

Table 14. Individual transect data for Bear Lake on August 15, 2006.

	T1		T2		T3		T4		T5		T6		T7		T8		T9		T9.5	
	0 - 5	6 -10	0 - 5	6 -10	0 - 5	6 -10	0 - 5	6 -10	0 - 5	6 -10	0 - 5	6 -10	0 - 5	6 -10	0 - 5	6 -10	0 - 5	6 -10	0 - 5	6 -10
Purple loosestrife																				
Pickerel plant			2.5																	
Arrowhead																	0.7			
Bulrush - hardstem																				
Cattails																				
Wild rice	1																1.3			
Spatterdock	2		1.5																	
White waterlily			0.5																	
Water marigold					0.5															
Coontail																	0.7			2
Chara									1											
Elodea													0.7		1					
Star duckweed					1															
Northern watermilfoil				2	0.5		1.5		1	2		2	0.3		0.5		0.7			
Naiads							1		1	1	1						1			
Nitella																	0.7			
Largeleaf pondweed	0.5	0.5	1	1	1.5		0.7		1				2.5		1		0.7			
Variable pondweed																				
Illinois pondweed		0.3						0.5												
Whitestem pondweed															1.5		0.7			
Claspingleaf pondweed		0.5			1		0.3								1		0.3			2
Fern pondweed	2		1.5		0.5								3		3		1.7			
Snailseed pondweed									1											
Stringy pondweed										1	2									
Flatstem pondweed		1.5		2	0.5	2.5		1		2		2					0.3			1
Wild celery	1				2		1	1.5	1		0.5	1	2		2		1			

	T10		T11		T12		T13		T14		T15		T16		T16.5		T17		T17.5	
	0 - 5	6 -10	0 - 5	6 -10	0 - 5	6 -10	0 - 5	6 -10	0 - 5	6 -10	0 - 5	6 -10	0 - 5	6 -10	0 - 5	6 -10	0 - 5	6 -10	0 - 5	6 -10
Purple loosestrife							0.5													
Pickerel plant							2.5													
Arrowhead									0.3											
Bulrush - hardstem									0.3											
Cattails							0.5													
Wild rice																				
Spatterdock					1				0.3											
White waterlily					1				1.3											
Water marigold																				
Coontail	0.5				1			1.7	1.4			0.3		0.5			1	0.3		1
Chara																				
Elodea																				
Star duckweed																				
Northern watermilfoil	1.8				1.8	3						0.3				1		1.7		
Naiads	1.3		1.5	2							2	0.7					1			
Nitella																				
Largeleaf pondweed		0.5	0.5		0.5						1	0.7					1			
Variable pondweed	1	0.5					0.5				1		1							
Illinois pondweed																				
Whitestem pondweed								0.7												
Claspingleaf pondweed								0.3		0.8				0.5			1			
Fern pondweed								1				0.3					1			
Snailseed pondweed			3	1																
Stringy pondweed					0.5	1						0.3	1	0.5		1		0.3		
Flatstem pondweed		0.5			1.5	1		1	1							1	1			3.5
Wild celery					2.3		0.5		1.3			1		2.5			1	0.7		

Table 14. Individual transect data for Bear Lake on August 15, 2006.

	T18		T19		T20		T21		T22		T23		T24		T25	
	0 - 5	6 -10	0 - 5	6 -10	0 - 5	6 -10	0 - 5	6 -10	0 - 5	6 -10	0 - 5	6 -10	0 - 5	6 -10	0 - 5	6 -10
Purple loosestrife																
Pickerel plant													0.3			
Arrowhead									0.5				0.3			
Bulrush - hardstem	0.3								1							
Cattails																
Wild rice											0.5					
Spatterdock	0.3								1				0.5			
White waterlily														1		
Water marigold		1	1													
Coontail	1.3	2					3	3	1.5	3	1.5	2	1.8	2	0.5	
Chara					1											
Elodea	0.7															
Star duckweed	0.7										1		0.3	1		
Northern watermilfoil		1				0.5				1			1			3
Naiads			2	1	1						0.5				2	
Nitella						0.5										
Largeleaf pondweed	0.7		2	1			0.5		1		1		0.8		2	
Variable pondweed															0.5	
Illinois pondweed																
Whitestem pondweed								0.3								
Claspingleaf pondweed		1		1									0.3			
Fern pondweed	0.7			1												
Snailseed pondweed											1				1	
Stringy pondweed		4				2										1
Flatstem pondweed		2				0.5	2.5	1	1.5	3	1	2.5	0.8	2		2
Wild celery	0.3			3	1	1	1.5				0.5	2.5	0.8	2		

Figure 24. Bob Moe holding a rake full of aquatic plants on August 15, 2006.

Aquatic Plant Conditions from 1992 compared to 2006

The area of plant coverage appears to remain essentially the same from 1992 to 2006 (Figure 25). However the occurrence of a number of aquatic plant species appears to have decreased. Also the number of aquatic plant species was less in 2006 compared to 1992 (Table 15).

Although aquatic plant coverage remains about the same, a loss of aquatic plant species or a decline in occurrence of several species raises some concern. An aquatic plant survey should be conducted every few years to track plants and determine if a plant species decline is a trend.

Table 15. Bear Lake aquatic plant occurrences for July 1992 and August 15, 2006.

	July 1992 (52 sites)	August 15, 2006 (56 sites)
	%Occur	% Occur
Water horsetail (Equisetum fluviatile)	2	--
Purple loosestrife (*Lythrum salicaria*)	--	2
Pickerel plant (*Pontederia cordata*)	--	5
Arrowhead (*Sagittaria sp*)	12	7
Bulrush - hardstem (*Scirpus acutus*)	8	5
Cattails (*Typha sp*)	--	2
Wild rice (*Zizania aquatica*)	2	5
Small duckweed (*Lemna minor*)	4	--
Spatterdock (*Nuphar variegatum*)	6	13
White waterlily (*Nymphaea sp*)	6	7
Water marigold (*Bidens Beckii*)	8	5
Coontail (*Ceratophyllum demersum*)	71	39
Chara (*Chara sp*)	--	4
Elodea (*Elodea canadensis*)	21	5
Star duckweed (*Lemna trisulca*)	67	9
MIlfoil		
(*Myriophyllum sibiricum*)	--	36
(*M. verticillatum*)	37	--
Naiads (*Najas flexilis*)	73	29

Table 15. Concluded.

	July 1992 (52 sites)	August 15, 2006 (56 sites)
	%Occur	% Occur
Nitella (*Nitella sp*)	38	4
Largeleaf pondweed (*Potamogeton amplifolius*)	38	43
Curlyleaf pondweed (*P. crispus*)	2	--
Leafy pondweed (*P. foliosus*)	38	--
Fries pondweed (*P. Friesii*)	10	--
Variable pondweed (*P. gramineus*)	25	11
Illinois pondweed (*P. Illinoensis*)	19	4
Floatingleaf pondweed (*P. natans*)	2	--
Whitestem pondweed (*P. praelongus*)	--	7
Stringy pondweed (*P. pusillus*)	42	--
(*P. strictifolius*)	--	21
Claspingleaf pondweed (*P. Richardsonii*)	23	23
Fern pondweed (*P. Robbinsii*)	40	20
Snailseed pondweed (*P. Spirillus*)	--	14
Flatstem pondweed (*P. zosteriformis*)	75	50
Water crowfoot (*Ranunculus longirostris*)	2	--
Sago pondweed (*Stuckenia pectinata*)	2	--
Great bladderwort (*Utricularia vulgaris*)	13	--
Wild celery (*Vallisneria americana*)	69	46
Water stargrass (*Zosterella dubia*)	2	--
Number of submerged aquatic plants species	23	18

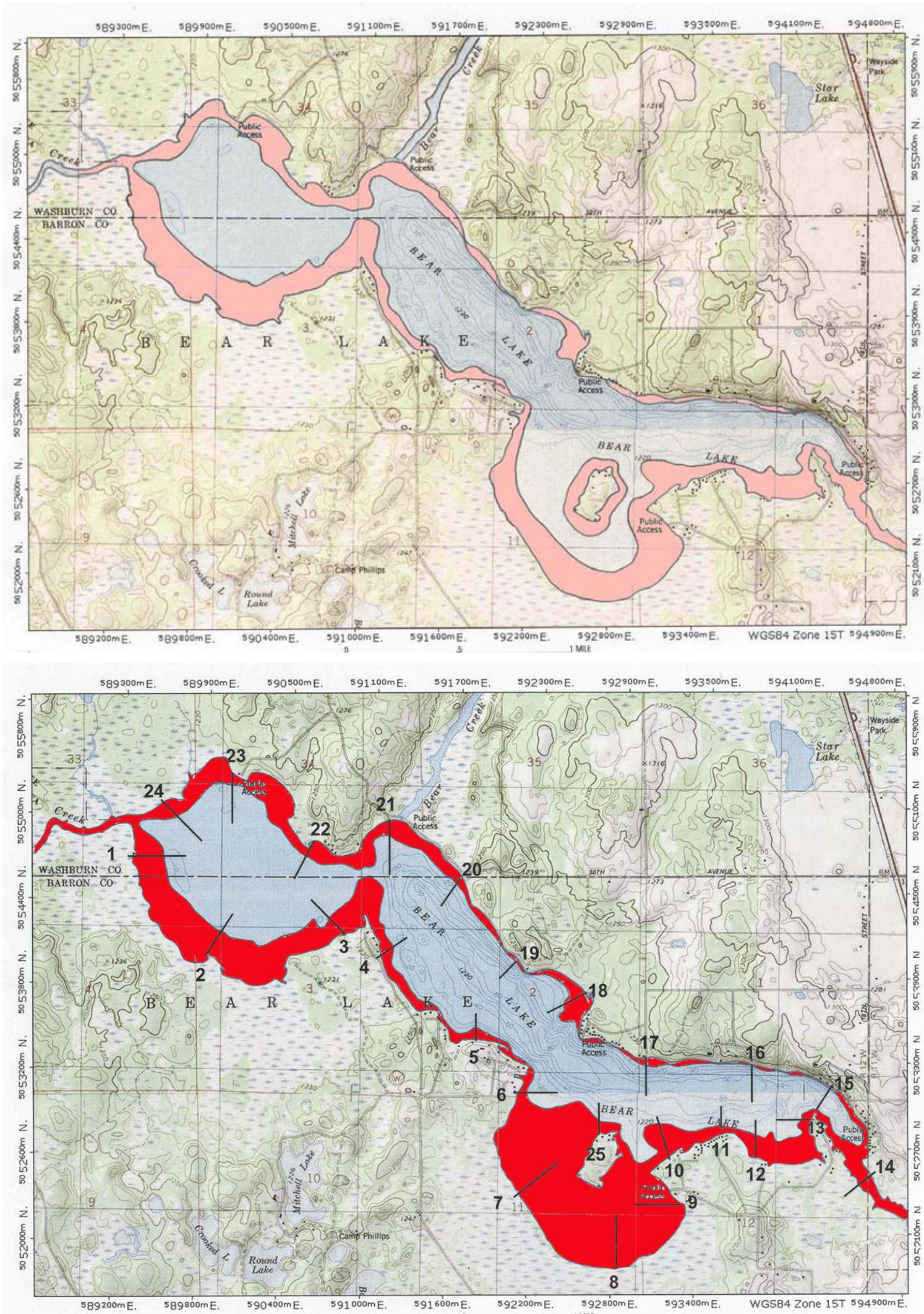


Figure 25. [top] Aquatic plant coverage from 1992. Map was drawn by Blue Water Science based on data from plant survey conducted by Aron and Associates and included in the 1994 lake management report.
[bottom] Aquatic plant coverage from August 2006. Map was drawn by Blue Water Science based on data from the Blue Water Science plant survey.

4.7. Fishery Status and Sensitive Area Map (prepared by WDNR)

The fishery status of Bear has been characterized by the WDNR. Currently, the lake is managed for walleyes. Stocking records from 1973 through 2006 are shown in Table 16.

Table 16. Walleye stocking records for Bear Lake.

Year	Age Class	Number Stocked	Avg Fish Length (in)
1973	Fingerling	13,124	3.00
1974	Fingerling	20,056	3.00
1975	Fingerling	20,090	3.50
1976	Fingerling	67,920	3.00
1978	Fingerling	67,908	3.00
1980	Fingerling	64,492	3.00
1982	Fingerling	68,340	3.00
1984	Fingerling	67,323	3.00
1986	Fingerling	68,064	3.00
1988	Fingerling Fry	36,701 1,358,000	3.80 1.00
1989	Fingerling Fry	67,894 1,358,000	3.00 3.00
1991	Fingerling	68,593	3.00
1993	Fingerling	67,900	2.00
1997	Small fingerling	67,900	1.70
1998	Large fingerling	12,845	3.33
1999	Small fingerling	89,005	1.60
2001	Small fingerling	101,850	1.70
2003	Small fingerling	101,825	2.0
2004	Fry Small fingerling	525,000 102,326	0.20 1.10
2006	Large fingerling	13,578	6.95
1985*	Fry	204,000	1.00

* Northern pike were stocked, no walleyes.

Fish Survey Summary and Conclusions (prepared by WDNR 2002)

As found in previous surveys, northern pike were the most abundant gamefish in Bear Lake (4.8 adults/acre), with modest populations of walleyes (1.2 adults/acre) and largemouth bass (1.5 adults/acre), and a low smallmouth bass population. Spring electrofishing CPE's of past surveys show no clear trends for walleyes and northern pike, a possible upward trend for largemouth bass, and a possible downward trend for smallmouth bass. Growth rates of all gamefish species showed no large deviations from average growth rates for northwest Wisconsin.

Black crappies, pumpkinseeds, and bluegills were the panfish captured in the great numbers during the survey. Size distributions were fair (bluegills) to good (crappies, pumpkinseeds). Panfish growth rates were slightly above average for all species.

Except for walleyes, all species of gamefish and panfish experienced higher angler harvest in 2000 compared to 1996. In some cases, harvest was substantially more in 2000, such as largemouth bass harvest (307% increase), northern pike (126% increase), and bluegills (69% increase). Increased fishing pressure in 2000 played a significant role in increased harvest, although total fishing pressure on Bear Lake in 2000 was not as high as on some other large area lakes.

Over-harvest of any species is not presently a concern, although harvest could be impacting the size distribution of the northern pike population. If it is estimated that there are approximately 3,000 northern pike 18.0 inches or larger in Bear Lake, and harvest was 1,836 northerns in 2000, this would result in a probable exploitation rate of over 50% for northerns in the 18.0 inch or larger size range. This in turn could help explain why only 4% of northern pike captured during spring fyke netting were 22.0 inches or larger, even though northern pike growth rates were average to slightly above average. A slot length limit to protect mid-sized northern pike (i.e. 20 to 24 inches) might improve the northern pike size distribution. Such a special regulation would only be implemented with the strong support of the public and the lake association. Aside from possible consideration of a future change in northern pike length limits, other current fishing regulations appear to be appropriate.

As in past surveys, the 2000 survey is inconclusive regarding the benefits of walleye fingerling stocking. Comparing year class strength to stocking years gives mixed results. Because walleye fishing on Bear Lake is popular, and because maintaining and hopefully improving the walleye population is desirable, walleye fingerling stocking should continue at the rate of 75 per acre.

Walleye natural reproduction produces at least modest year classes some years. In 2000, when no stocking was done until late fall, the entire shoreline was shocked in September and no walleye young of the year were found. However, weather related spawning conditions were poor in the spring of 2000. Because walleye natural reproduction does occur, the protection of gravel, rock, and rubble walleye spawning areas is important.

Similarly, the shallow, heavily vegetated bay and associated wetlands used by northern pike for spawning should not be degraded. There are considerable wetlands associated with Bear Lake that provide valuable habitat for fish, waterfowl, furbearers, reptiles, and amphibians.

Sensitive Area Survey (prepared by WDNR 2002)

Protection of fish spawning areas and fish and wildlife habitat through the water regulation permit system and the aquatic plant management permit system is critical. To aid in this effort, habitat sensitive areas have been identified on Bear Lake (Figure 26). Areas shaded yellow are aquatic plant communities which provide important fish and wildlife habitat. Areas shaded with red provide gravel and coarse rock rubble habitat important for walleye spawning.

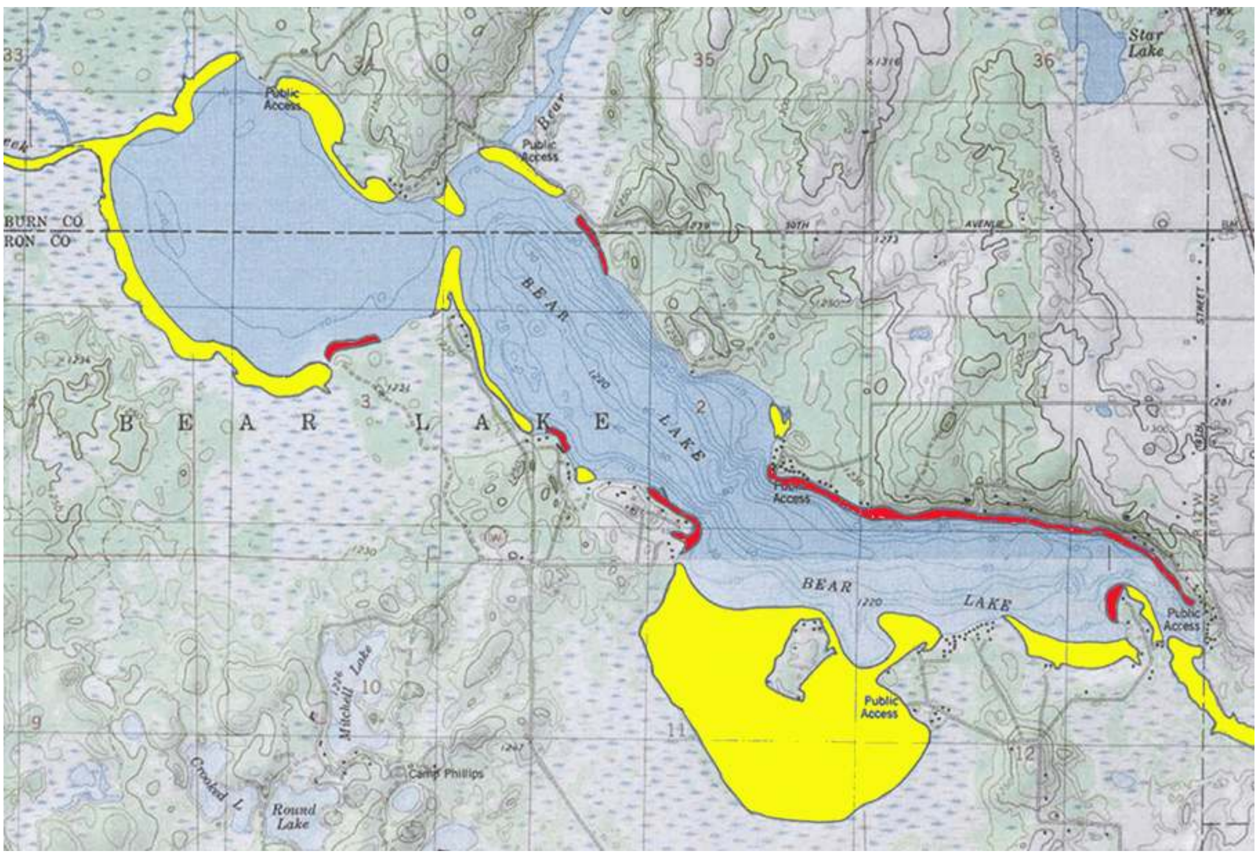


Figure 26. Sensitive habitat areas around Bear Lake. Areas were determined by the Wisconsin Department of Natural Resources. Yellow areas represent aquatic plant communities that provide fish and wildlife habitat. Red areas represent gravel and coarse rock rubble that provide habitat for walleye spawning.

5. Lake and Watershed Assessment

5.1. Bear Lake Status

The status of Bear Lake is mesotrophic meaning it has moderate fertility. Bear has phosphorus concentrations that are slightly lower compared to many of the surrounding lakes. One way to compare the status of Bear Lake is to compare it to other lakes in a similar setting or ecoregion.

Ecoregions are geographic regions that have similar geology, soils, and land use. The continental United States has been divided into 84 ecoregions, and there are six ecoregions in Wisconsin. A map of Wisconsin ecoregions is shown in Figure 27. Bear Lake is on the border of the Northern Lakes and Forests Ecoregion and the North Central Hardwood Forest Ecoregion (Figure 27). Lakes in this area of the state have some of the best water quality values in the State. A range of ecoregion values for lakes in the ecoregion along with actual Bear Lake data is shown in Table 17.

Table 17. Bear Lake data are compared to summer average quality characteristics for lakes in the Northern Lakes and Forest ecoregion (Minnesota Pollution Control Agency, 1988).

Parameter	Northern Lakes and Forests	North Central Hardwood Forest	Bear (2005)	Bear (2006)
Total phosphorus (ug/l) - top	14 - 27	23 - 50	22	23
Algae [as Chlorophyll (ug/l)]	<10	5 - 22	9	11
Chlorophyll - max (ug/l)	<15	7 - 37	17.8	17.0
Secchi disc (ft)	8 - 15	4.9 - 10.5	8.7	7.9

These comparisons indicate that the water quality of Bear Lake is within range compared to relatively unimpacted lakes within the Northern Lakes and Forests Ecoregion or the North Central Hardwood Forest Ecoregion. The challenge will be to protect the good water quality of Bear Lake.

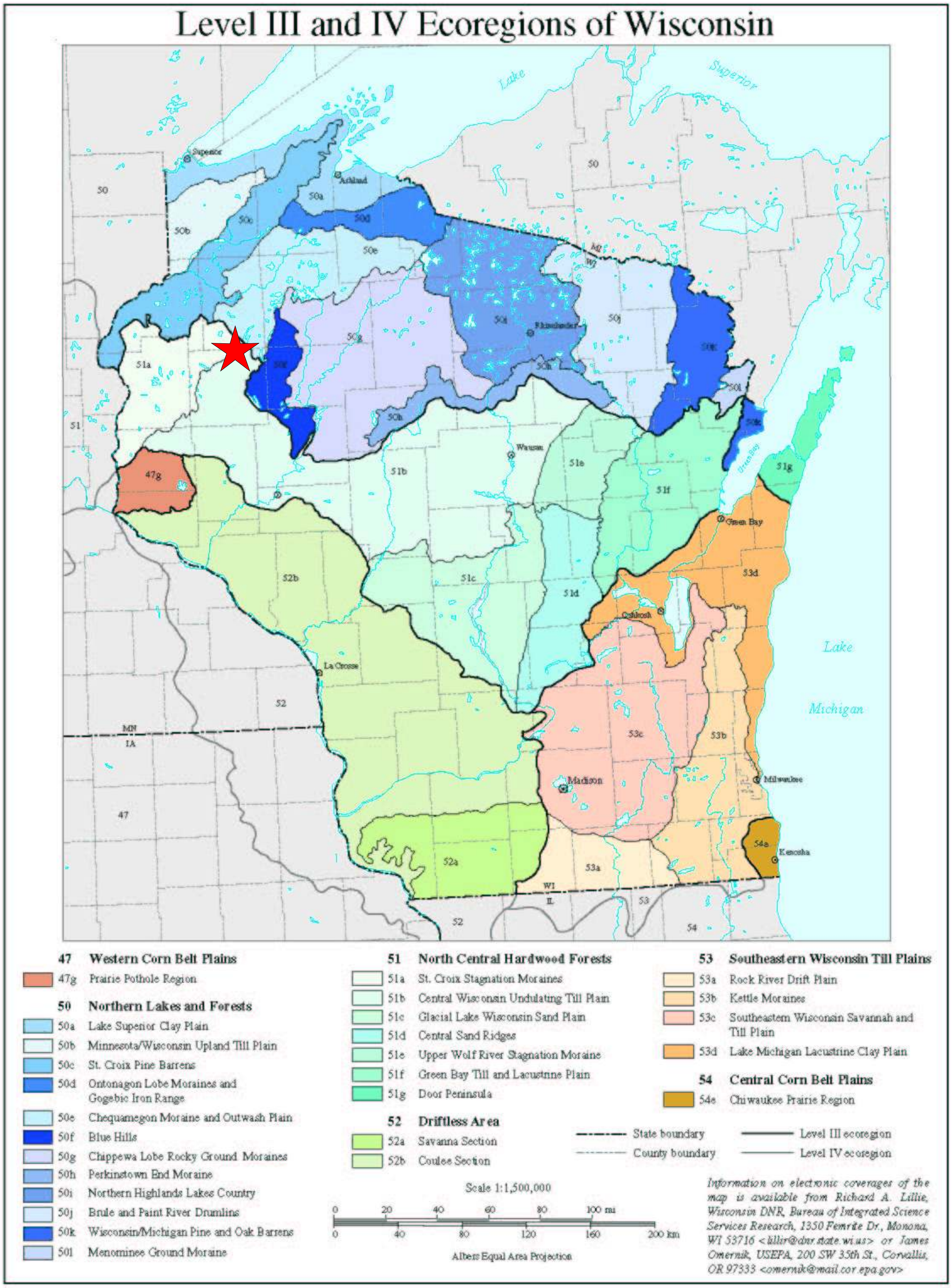


Figure 27. Ecoregion map for Wisconsin. Areas that are labeled with a "50" are within the Northern Lakes and Forest Ecoregion. Areas labeled with a "51" are in the Central Hardwood Forest Ecoregion. Bear Lake, located in central Barron County is officially in the Central Hardwood Forest Ecoregion but close to the Northern Lakes and Forest Ecoregion.

5.2. Nutrient Inputs to Bear Lake

Based on either the North Central Hardwood Forest Ecoregion or the Northern Lakes and Forests Ecoregion ranges, Bear Lake has phosphorus levels that are within range of lakes in this ecoregion.

A representation of sources of phosphorus loads to Bear Lake is shown in Figure 28. Using a lake model, a total annual phosphorus load of 2,933 pounds of phosphorus is estimated based on a lake phosphorus concentration of 23 ppb and a contributing watershed size of 30,464 acres.

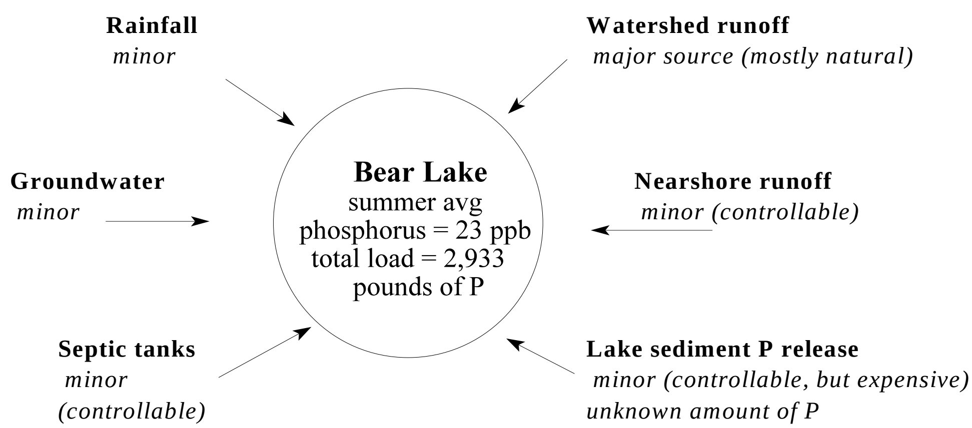


Figure 28. Sources of watershed phosphorus (P) that feed into Bear Lake are shown above. It is estimated that approximately 2,933 pounds (1,333 kg) of phosphorus enter Bear Lake on an annual basis.

5.3. Setting Water Quality Goals for Bear Lake

It appears water quality in Bear Lake is slightly better than expected based on the ecoregion setting. Lake models were run to help determine feasible water quality goals for Bear Lake. A lake model is a mathematical equation that uses phosphorus inputs along with lake and watershed characteristics to predict what a lake phosphorus concentration should be. Once a lake phosphorus concentration is determined, then seasonal water clarity and algae concentrations can be calculated as well.

Lake models were run for conditions that would occur in the Northern Lakes and Forest Ecoregion as well as for the North Central Hardwood Forest Ecoregion and then compared to existing observed conditions. Existing conditions in 2005 and 2006 for Secchi clarity, phosphorus, and algae compare favorably with what would be predicted from relatively unimpacted lakes in the ecoregion (Table 18 and Figures 29 and 30).

Table 18. Summary of predicted lake water quality conditions for Bear Lake using ecoregion watershed runoff values of 50 ppb and 150 ppb and then compared to the water quality predictions to actual Bear Lake data for 2005 and 2006.

Estimated or Measured Parameters	Northern Lakes and Forests Ecoregion	North Central Hardwood Forest Ecoregion	Bear 2005	Bear 2006
Average Stream Phosphorus Concentration	50 (given)	150 (given)	46 (estimated)	47 (estimated)
Secchi disc (ft)	7.9 (predicted)	4.6 (predicted)	8.9 (actual)	7.9 (actual)
Total Phosphorus (ppb)	26 (predicted)	46 (predicted)	22 (actual)	23 (actual)
Algae (as chlorophyll)(ppb)	8 (predicted)	18 (predicted)	9 (actual)	11 (actual)
Watershed Phosphorus Loading (kg/yr)	1,557 (estimated)	2,537 (estimated)	1,330 (estimated)	1,358 (estimated)

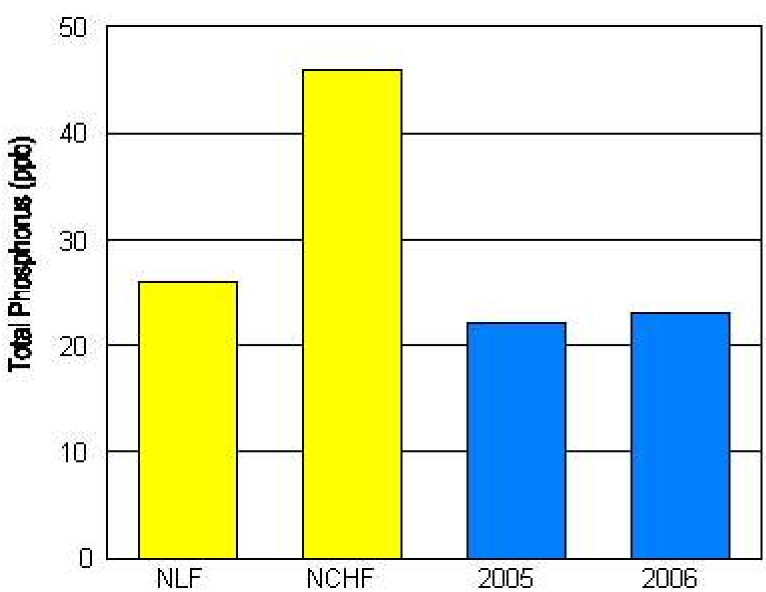
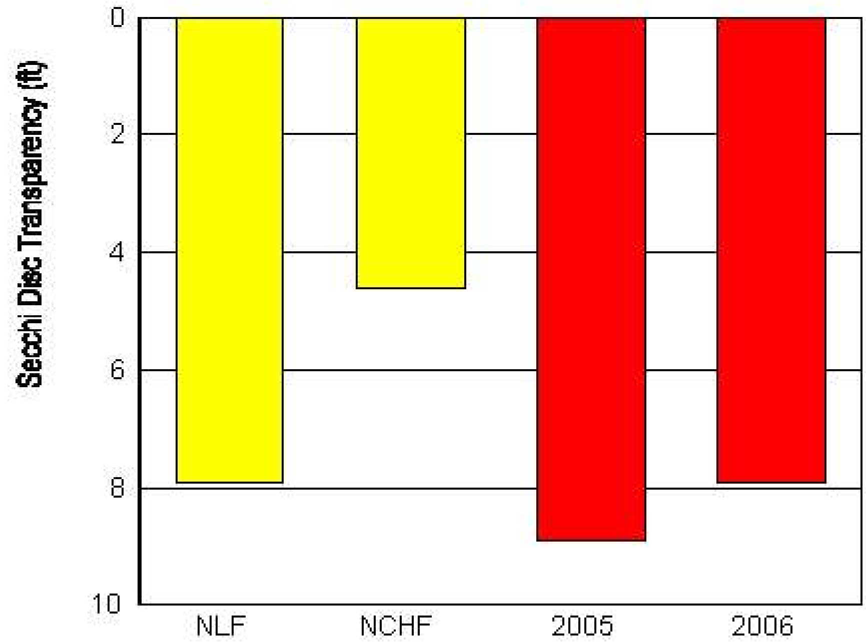


Figure 29. Comparison of total phosphorus (TP) conditions for Bear Lake in 2005 and 2006 to predicted conditions for a watershed and a lake the size of Bear Lake situated in the Northern Lakes and Forest (NLF) and the North Central Hardwood Forest (NCHF) ecoregion.



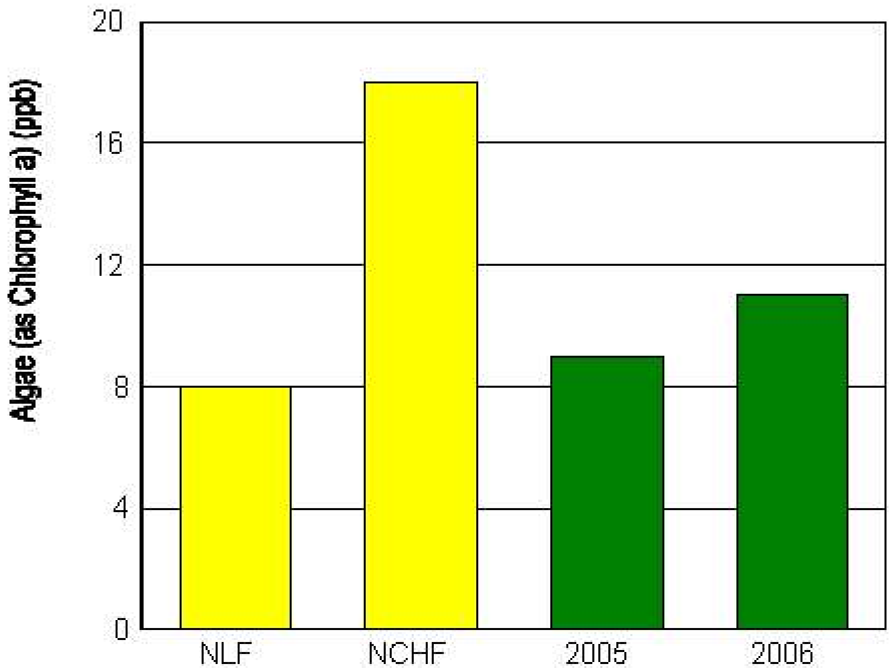


Figure 30. Comparison of Secchi disc transparency (meters) and algae (chlorophyll a – ppb) conditions for Bear Lake in 2005 and 2006 to predicted conditions for a lake the size of Bear Lake situated in the Northern Lakes and Forest (NLF) ecoregion and North Central Hardwood Forest (NCHF) ecoregion.

Lake Goals

Based on lake modeling considerations it appears Bear Lake has water quality conditions that are slightly better than expected based on ecoregion runoff phosphorus concentrations.

The proposed water quality goals for lake phosphorus concentration is to use the Northern Lakes and Forest ecoregion estimate of 26 ppb. Currently, Bear lake is meeting this goal.

The water clarity goal is an 8-foot summer average from May - September. Bear Lake is currently meeting this goal as well.

The key to maintaining these lake goals will be to maintain low nutrient inputs into Bear Lake.

5.4. Significant Findings of this Study

- The lake is located in the North Central Hardwood Forest (NCHF) Ecoregion but most of the watershed is in the less fertile Lake and Forest Ecoregion (LF). The water quality in the lake is in good shape compared to other unimpacted lakes in the Lake and Forest ecoregion.

- The watershed is in relatively good shape and does not appear to contribute excessive amounts of phosphorus to Bear Lake.

- The nutrients in Boyer Creek and Bear Creek are at the level they should be.

- Water quality is stable. It is not declining.

- Aquatic plant distribution is stable. The acreage of submerged plants has remained about the same from 1992 to 2006. The plant diversity is good. There is some concern with the possible decline in occurrence of several species. Future plant surveys will help determine if this is a trend.

- In 2007, curlyleaf pondweed was found to be more widespread than previously noted (compared to 1992 and 2006 evaluations). It may be a temporary phenomena or it could be a long term trend. Future monitoring will help determine what the trend is.

- Wild rice beds appear to be stable, although the reed beds (*Phragmites*) might be expanding.

- Purple loosestrife is present in scattered locations around Bear Lake.

- At this time, no expensive lake restoration projects are proposed, rather sustaining water quality is the objective. Thus ongoing preventative programs are the key to continued long-term good water quality.

6. Lake Project Ideas for Protecting the Lake Environment

Project ideas for Bear Lake are geared toward long-term protection of water quality.

A list of projects has seven main components:

1. Watershed projects.
2. On-site system maintenance.
3. Aquascaping projects.
4. Aquatic plant projects.
5. Ongoing education program.
6. Watershed and lake monitoring program.

Details for these projects areas are given in the next few pages.

Project 1. Watershed Projects

The main goal of the watershed projects program is to protect the natural character of the watershed which helps maintain good runoff water quality.

Although majority of the watershed is forested, the surrounding wetlands probably contribute phosphorus, by way of groundwater, to Bear Lake. However, this is a natural pathway. Watershed project areas to monitor in the future involve erosion control for new development as well as with forest harvesting activities.

Project 2. On-site System Maintenance

The septic tank/soil absorption field has been one of the most popular forms of on-site wastewater treatment for years. When soil conditions are proper and the system is well maintained, this is a very good system for wastewater treatment. The on-site system is the dominant type of wastewater treatment found around Bear Lake today.

However, problems can develop if the on-site system has not been designed properly or well-maintained. Around Bear Lake there are probably some on-site systems that need maintenance or upgrades. At the same time, it is good practice to ensure that systems that are functioning adequately now will continue to do so in the future.

This project calls for an organized program to be developed that makes homeowners aware of all they can do to maintain their on-site systems.

A description of possible activities associated with the on-site maintenance program are described below:

- **Ordinance Implementation**
  Work to maintain enforcement of the county ordinance, where septic systems must be "evaluated" at the time a property is transferred. The seller would obtain a septic system evaluation from Barron County at the time of property transfer. The evaluation would determine if the septic system was "failing", "non-conforming", or "conforming". A "failing" septic system includes septic systems that discharge onto the ground surface, discharges into tiles and surface waters, and systems found to be contaminating a well. The county would require a "failing" system to be brought into compliance with the Barron County ordinance within 90 days of property transfer.

Project 3. Aquascaping Projects

Controls are in place at the county level to guide new shoreland development. A number of excellent reference publications are available to assist in promoting shoreland stewardship. For existing shoreland properties, it is important to either maintain or to improve the natural vegetative buffer.

The shoreland area is valuable for promoting a natural lake environment and a natural lake experience for lake users. The shoreland is defined as the upland area about 300 to 1,000 feet back from the shoreline, and out into the lake to about the end of your dock (Figure 31). A shoreland with native vegetation offers more wildlife and water quality benefits than a lawn that extends to the lake's edge. A summary of attributes and functions of native plants in the shoreland area is shown in Table 19.

Figure 31. Cross section of the lake shoreland habitat.

Table 19. Attributes and functions of native plants in the shoreland area (Source: Henderson and others, 1999. Lakescaping for Wildlife and Water Quality. MnDNR)).

Important functions of plants in and around lakes

Submergent and emergent plants

- Plants produce leaves and stems (carbohydrates) that fuel an immense food web.
- Aquatic plants produce oxygen through photosynthesis. The oxygen is released into lake water.
- Submerged and emergent plants provide underwater cover for fish, amphibians, birds, insects, and many other organisms.
- Underwater plants provide a surface for algae and bacteria to adhere to. These important microorganisms break down polluting nutrients and chemicals in lake water and are an important source of food for organisms higher in the food chain.
- Emergent plants break the energy of waves with their multitude of flexible stems, lessening the water's impact on bank and thus preventing erosion.
- Plants stabilize bottom sediments, which otherwise can be resuspended by currents and wave action. This reduces turbidity and nutrient cycling in the lake.

Shoreline and upland plants

- Shoreline and upland plants provide food and cover for a variety of birds, amphibians, insects, and mammals above the water.
- The extensive root systems of shoreline plants stabilize lake-bank soils against pounding waves.
- Plants growing on upland slopes that reach down to lake hold soil in place against the eroding forces of water running over the ground, and help to keep lake water clean.
- Upland plants absorb nutrients, like phosphorus and nitrogen, found in fertilizers and animal waste, which in excessive concentrations are lake pollutants.

Improving Upland Native Landscape Conditions: In the glacial lake states, three broad vegetative groups occur: pine forests with a variety of ground cover species including shrubs and sedges: hardwood forests with a variety of understory species, including ferns: and tallgrass prairie with a variety of grasses as well as bur oaks and willow trees. Residences around Bear Lake are in the hardwood forest group.

Reestablishing native conditions in the shoreland area not only improves stormwater runoff quality, it also attracts a variety of wildlife and waterfowl to the shoreland area. Benefits multiply when other neighbors naturalize because the effects are cumulative and significant for water quality and wildlife habitat.

When installing native vegetation close to the shoreline residents are actually installing a buffer. A buffer is a strip of native vegetation wide-enough to produce water quality and wildlife improvements. Much of the natural vegetative buffer has been lost in shoreland areas with development where lawns have been extended right down to the shore.

Lawns are not necessarily bad for a lake. However they can be over fertilized and then runoff carries phosphorus to the lake. Also, lawns function as a low grade open prairie, with poor cover for wildlife and a food supply that is generally poor, except for geese who may find it attractive. Replacing lawn areas with native landscaping projects reduces the need for fertilizer, reduces the time it takes to mow, increases the natural beauty of a shoreland area, and attracts wildlife.

Lawns do not make very good upland buffers. With runoff, short grass blades bend and do not serve as a very effective filter. Tall grass that remains upright with runoff is a better filter. Kentucky bluegrass (which actually is an exotic grass) is shallow-rooted and does not protect soil near shorelines as well as deep-rooted native prairie grasses, shrubs, or other perennials. Grass up to the shoreline offers poor cover, so predators visit other hiding areas more frequently reducing the prey food base and limiting predator populations in the long run. Also with short ground cover, ground temperatures increase in summer, evapotranspiration increases and results in drying conditions, reducing habitat for frogs and shoreline dependent animals.

Buffer Strip Considerations: A functional upland buffer should be at least 15 feet deep. With this you start getting water quality and wildlife habitat benefits. But a 35 foot deep buffer is recommended. In the past, before lakeshore development, buffers ringed the entire lake. For lakeshore residents it is recommended the length of the buffer extend for 75% of the shoreline, although 50% would produce buffer benefits.

A buffer strip can address two problem areas right away. Geese are shy about walking through tall grass because of the threat of predators. There will always be a few who charge right through but it is a deterrent for most of them. Also, muskrats shouldn't be a problem. They may burrow into the bank, but generally not more then 10 feet. With a buffer going back 15 to 25 feet, you won't be mowing over their dens. An occasional den shouldn't produce muskrat densities that limit desirable aquatic vegetation.

Several types of buffers can be installed or propagated that offer nutrient removal as well as wildlife benefits. Examples include:

Tall grass, sedge, flower buffer: Provides nesting cover for mallards, blue-winged teal and Canada geese. Provides above ground nesting habitat for sedge wrens, common yellow throat and others.

Shrub and brush buffer: Provides nesting habitat for lakeside songbirds such as yellow warblers, common yellowthroat, swamp sparrows, and flycatchers. It also provides significant cover during migration.

Forested buffers: Provides habitat for nesting warblers and yellow-throated vireo, Diamond herons, woodducks, hocked mergansers, and others. Upland birds such as red-winged blackbirds, orioles, and woodpeckers use the forest edge for nesting and feeding habitat.

Even standing dead trees, which are referred to as snags, have a critical role. When they are left standing they serve as perching sites for kingfishers and provide nesting sites for herons, egrets, eagles, and ospreys. In the midwest over 40 bird species and 25 mammal species use snags. To be useful, they should be at least 15 feet tall and 6-inches in diameter.

The initial step for lake residents to get started is to simply make a commitment to try something. Just what the final commitment is evolves as they go through a selection process. The next step in the process is to conduct a site inventory. On a map with lot boundaries, house and buildings, driveway, turf areas, trees, shrubs, and other features are drawn. If there is a chance, the property is checked during a rainstorm. Look for sources of runoff and even flag the routes. Find out where the water from the roof goes, and see if there are temporary ponding and infiltration areas. Are the paths down to the lake eroding? Then the next step is to consider a planting approach.

Native Landscaping for Buffers: Three Approaches: Native landscaping efforts can be put into three categories:

1. Naturalization
2. Accelerated Naturalization
3. Reconstruction

1. Naturalization: With this approach, the resident is going to allow an area to go natural. Whatever is present in the seedbank is what will grow. If they want to install a buffer along the shoreline, let a band of vegetation grow at least 15 feet deep from the shoreline back and preferably 25 feet or deeper. Just by not mowing will do the trick. Residents can check how it looks at the end of the summer. It will take up to three years for flowers and native grasses to grow up and be noticed. Residents can also select other spots on their property to "naturalize".

2. Accelerated Naturalization: After developing a plant list of species from the area, residents may want to mimic some features right away. They can lay out a planting scheme and plant right into existing vegetation. Several Wisconsin nurseries can supply native plant stock and seeds. The nurseries can also help select plants and offer planting tips. Wildflowers can be interspersed with wild grasses and sedges. Mulch around the new seedlings. With this approach lake residents can accelerate the naturalization process. Contact the Wisconsin Department of Natural Resources for a nursery list.

3. Reconstruction: To reestablish a native landscape with the resident's input and vision, another option is to reconstruct the site with all new plants. Again plant selection should be based on plants growing in the area. Site preparation is a key factor. Residents will want to eliminate invasive weeds and eliminate turf. This can be done with either herbicides or by laying down newsprint or other types of paper followed by 4 to 6 inches of hardwood mulch. Plantings are made through the mulch. This is the most expensive of the three native landscaping categories. Residents can do the reconstruction all at once, or phase it in over 3 to 5 years. This allows them to budget annually and continue evolving the plan as time goes by.

Also mixing and matching the level-of-effort categories allows planting flexibility. Maybe a homeowner employs naturalization along the sides of the lot and reconstruction for half of the shoreline and accelerated naturalization for the other half. Examples of the three approaches are shown in Figure 32.

1. Naturalization: The easiest way to implement a natural shoreline setting is to select an area and leave it grow back naturally.

2. Accelerated Naturalization: To accelerate the naturalization, plant shrubs, wild flowers, or grasses into a shoreland area.

3. Restoration: This involves removing existing vegetation through the use of paper mats and/or mulching and planting a variety of native grasses, flowers, and shrubs into the shoreland area.

Figure 32. Examples of three shoreland management options.

Project 4. Aquatic Plant Projects

Currently, Bear Lake has a variety of native emergent and submergent aquatic plant species. Aquatic plants are vital for helping sustain clear water conditions and contribute to fish habitat.

The primary aquatic plant goal is to maintain and/or protect native aquatic plants in Bear Lake. Three plant management ideas are given below:

1. Maintain natural shoreland conditions to sustain long-term shallow water plant communities. Ongoing shoreland maintenance and improvement will be important.

2. Check the distribution of curlyleaf pondweed on an annual basis. If curlyleaf becomes a nuisance, curlyleaf removal using manual methods is an option for maintaining an open area in front of your property. Mechanical harvesting is another option if channels out to open water are deemed necessary. However, only the minimum amount of plants needed to reduce navigational hindrences should be removed.

3. Conduct a lake sediment survey to determine the potential for future nuisance growth of curlyleaf pondweed (currently in the lake) and Eurasian watermilfoil (currently not found in the lake).

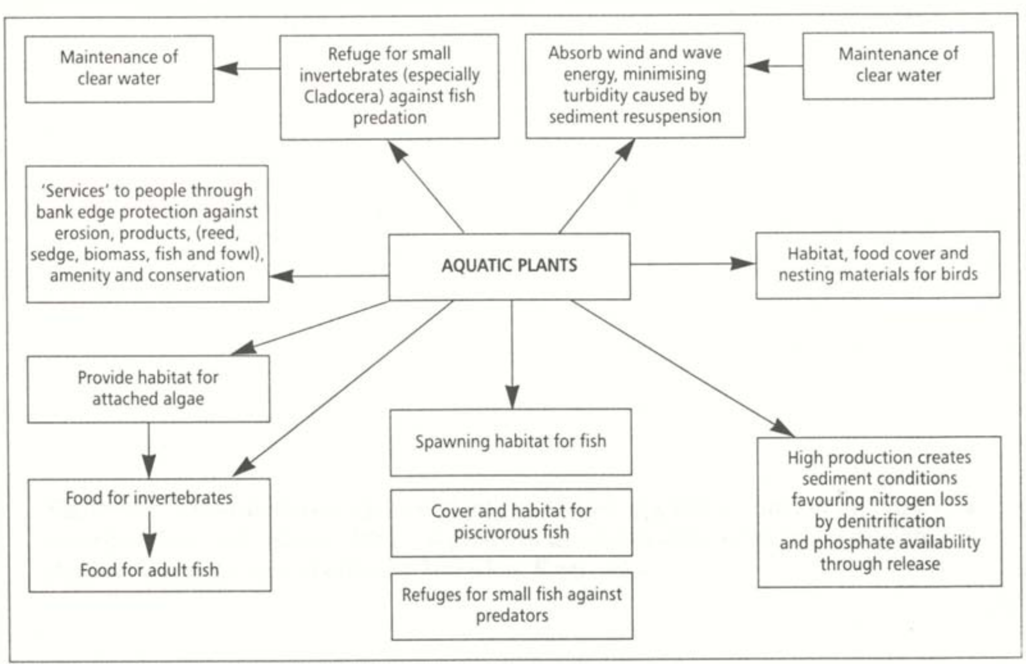


Figure 33. Links between aquatic plants and other organisms, including ourselves (source: Moss and others. 1996. A guide to the restoration of nutrient-enriched shallow lakes. Broads Authority Norwich, England).

Curlyleaf Evaluation Program

The extent of the distribution of curlyleaf pondweed should be monitored, probably on an annual basis. Several options are available.

One option is to conduct a point-intercept aquatic plant survey every year in June. A point-intercept survey is a grid pattern laid over the lake. The WDNR suggests monitoring about 600 sample sites. The cost for a consultant to conduct the survey would be about $6,000 per year. Wisconsin planning grants could help defray costs.

Another option is to conduct a survey where lake resident volunteers perform the survey. This approach uses a survey with a point-intercept transect method. A boat travels around the nearshore area of the entire lake and sites are officially sampled at the 28 established stations. In addition, a sonar along with visual observations are used between stations. The end result is the entire nearshore area is evaluated for curlyleaf pondweed and a curlyleaf pondweed map can be constructed.

At this point, treatment options are not recommended until the full extent of curlyleaf pondweed can be determined. A chart on the next page is used as a guide. No treatment is generally needed for non-nuisance conditions and treatment is a consideration for areas with a light-nuisance condition. Areas with heavy nuisance growth are candidates for management and control.

Curlyleaf Pondweed Growth Characteristics
(source: Steve McComas, Blue Water Science, unpublished)

Non-Nuisance Conditions

Plants rarely reach the surface.

Navigation and recreational activities are not generally hindered.

Stem density: 0 - 160 stems/m^2
Biomass: 0 - 50 g-dry wt/m^2
Estimated TP loading: <1.7 lbs/ac

Light Nuisance Conditions

Broken surface canopy conditions.

Navigation and recreational activities may be hindered.

Lake users may opt for control.

Stem density: 100 - 280 stems/m^2
Biomass: 50 - 85 g-dry wt/m^2
Estimated TP loading: 2.2 - 3.8 lbs/ac

Heavy Nuisance Conditions

Solid or near solid surface canopy conditions.

Navigation and recreational activities are severely limited.

Control is necessary for navigation and/or recreation.

Stem density: 400+ stems/m^2
Biomass: >300 g-dry wt/m^2
Estimated TP loading: >6.7 lbs/ac

Potential Curlyleaf Control Program

A variety of options are available for the creating channels through dense aquatic plant growth. Manual method, such as weed pullers, can be used to create a channel and remove plants at the same time. Rakes can also be used.

Another option is harvesting a channel about 20 to 30 feet wide through the surface matted growth would allow unrestricted navigation and should not harm the lake. Mechanical harvesters pick-up most of the plants that are cut (Figure 34). Hiring a mechanical harvester to cut channels or clear cut areas would cost about $600 - $800 per acre.

Figure 34. A mechanical harvester is a curlyleaf pondweed management option.

Predicting Future Growth of Non-Native Invasive Plants Based on Lake Sediment Fertility

Questions commonly come up about whether non-native plants will produce nuisance conditions in lakes and where that might occur.

The objective of a Bear Lake soil fertility survey is to characterize Bear Lake soils in the littoral zone in order to predict where nuisance areas of curlyleaf pondweed and Eurasian watermilfoil growth could occur in the future.

Based on other lake research, it appears that the potential nuisance growth of the non-native invasion plant, curlyleaf pondweed, can be predicted in a lake based on several key sediment parameters.

Although this curlyleaf evaluation method is still experimental, it has correctly predicted heavy nuisance growth for several lakes in the Central Hardwood Forest Ecoregion and in the lake and Forest Ecoregion (McComas, unpublished).

In addition to using lake sediments to predict the growth conditions of curlyleaf pondweed, lake sediments can also be used to predict the growth characteristics of Eurasian watermilfoil.

It is well established that nitrogen is often the limiting nutrient for terrestrial plants (Wedin and Tilman 1996; Stevens et al 2004). Based on results from other lakes, it appears sediment nitrogen (as exchangeable ammonium) is important for producing heavy growth of Eurasian watermilfoil (Anderson and Kalff 1986; Barko, pers comm). There appears to be a nitrogen threshold for nuisance milfoil growth (Wakeman and Les 1994). When sediment nitrogen concentrations (as exchangeable ammonia) are greater than about 10 ppm, nuisance milfoil conditions are found in these areas in many lakes (McComas, unpublished).

Organic matter is another leading indicator for potential nuisance milfoil growth and this is probably because organic matter and nitrogen are related so when there is also high organic matter there is also high nitrogen. However, at high levels of organic matter, and 20% or greater seems to be the threshold, Eurasian watermilfoil does not exhibit nuisance growth (Barko and Smart 1986; Barko et al 1991).

Based on results from other lakes it is predicted that the combination of organic matter and high nitrogen values (as exchangeable ammonium) will sustain nuisance milfoil growth in shallow water on an annual basis unless some other factor limits growth. Limiting factors include things such as herbicide use, milfoil weevils, light penetration, sediment density, and even lake bottom slopes. When lake bottoms have moderate fertility (less than 6 ppm of exchangeable nitrogen), it is predicted that potential nuisance growth could occur in some years, but not on a continuous basis.

The cost for a sampling program like this ranges from $3,000 to $6,000.

Project 5. Ongoing Education Program

Lake residents get an important amount of lake protection information from the lake newsletter. Each issue should offer tips on lake protection techniques. There is abundant material available. An example of an informational piece produced by the Bear Lake Association is shown below. An example of an informational piece from Polk County, Wisconsin is shown on the next page. Additional information on preventing the introduction of non-native plants and animals can be found on the internet.

Dear Boaters,

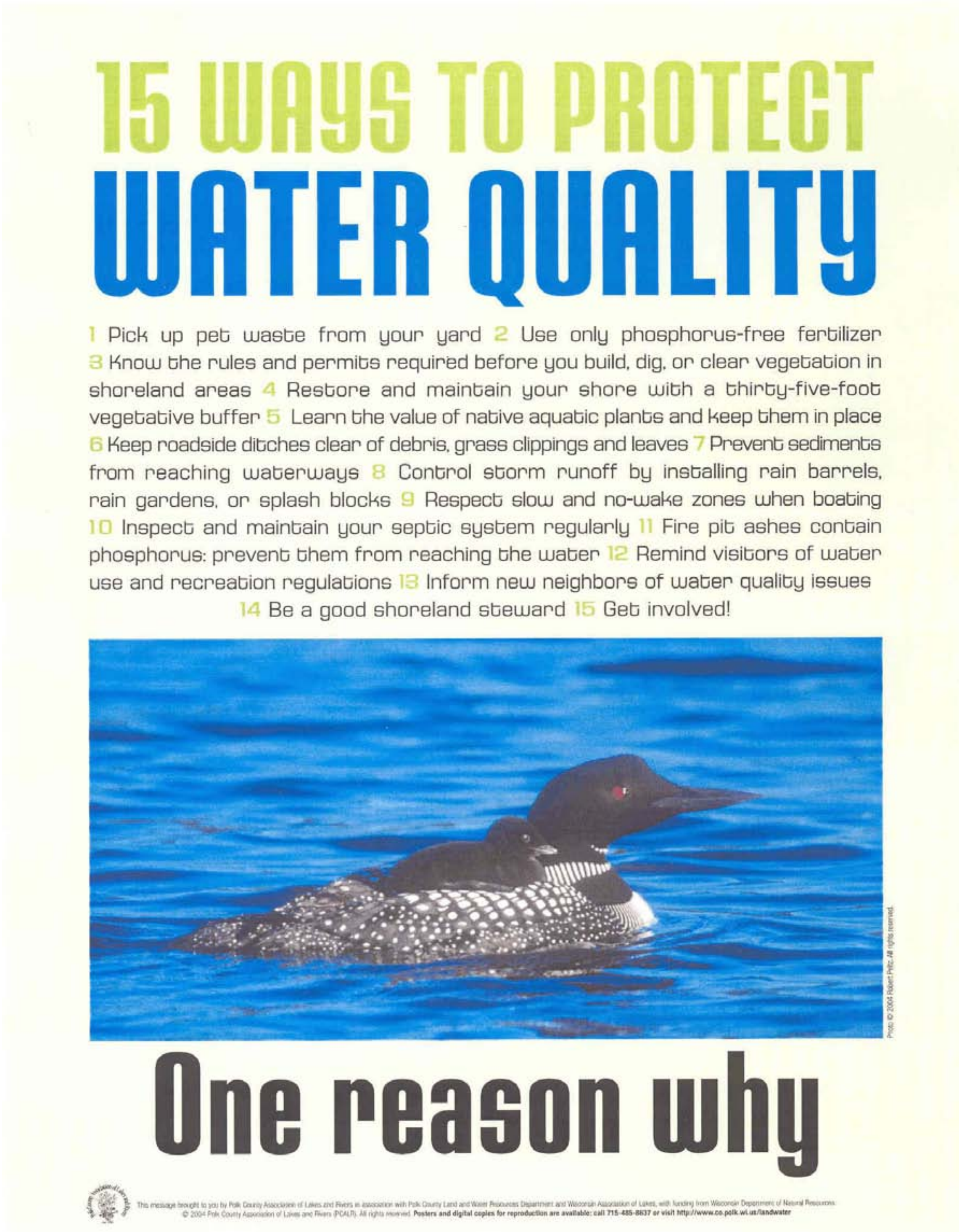
We hope you had a good time on the lake. It would be very much appreciated if you would take a second look to make sure there are no weeds stuck to or on your boat and trailer. Also, when you return to Bear Lake, please take a moment to check that no weeds from other lakes are being brought with you.

We are very concerned about Invasive Weeds, especially Eurasian Milfoil which is devastating!

Thank you,

Bear Lake Association

Project 6. Watershed and Lake Monitoring Program



At this time, because of good runoff water quality, new watershed water quality monitoring is not proposed. A lake monitoring program is outlined in Table 20. It is designed to be flexible to accommodate the volunteer work force and a fluctuating budget.

Table 20. Bear Lake Water Quality Monitoring Program.

Category	Level	Alternative	Labor Needed	Cost/Year
A. Dissolved oxygen and temperature profiles	1	Check dissolved oxygen in Bear Lake every two weeks in January, February, and March depending on winter conditions.	Moderate	$0
	2	Check dissolved oxygen in Bear Lake every one to two weeks in December, January, February, and March, depending on winter conditions and collect phosphorus samples.	Moderate	$0
	3	Check dissolved oxygen and temperatures once per month from May - September.		
B. Water clarity	1	Secchi disc taken at spring and fall turnover.	Low	$0
	2	Secchi disc monitoring once per month May - September.	Low to moderate	$0
	3	Secchi disc monitoring twice per month, May - October.	Moderate	$0
C. Water chemistry	1	Spring and fall turnover samples are collected and sent to UW-Stevens Point. Selected parameters for analysis include: TP and chlorophyll.	Low	$200
	2	Sample for phosphorus and chlorophyll once per month from May - September (surface water only) with the Self-Help Monitoring Program.	Low to moderate	$300
	3	Sample for phosphorus and chlorophyll twice per month from May - October.	Moderate	$600
	4	Sample for phosphorus, chlorophyll, Kjeldahl-N, nitrate-nitrite-N, and ammonia-N once per month (May-October)	Moderate	$960
	5	Sample for phosphorus, chlorophyll, Kjeldahl-N, nitrate-nitrite-N, and ammonia-N twice per month (May-October).	Moderate	$1,920
D. Special samples or surveys	1	Special monitoring: suspended solids, BOD, chloride, turbidity, sampling bottom water, and other parameters as appropriate. Aquatic plant surveys, etc.	Low to high	$100-$6,000

A recommended monitoring program consists of Level A3, B2, and C2 annually. An aquatic plant survey (Level D1) should be conducted every year until the status of curlyleaf pondweed is determined.

References

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Stevens, C.J., N. B. Dise, J.O. Mountford, and D.J. Gowing. 2004. Impact of nitrogen deposition on the species richness of grasslands. Science 303:1876-1878.

Wakeman, R.W. and D.H. Les. 1994. Optimum growth conditions for *Potamogeton amplifolius*, *Myriophyllum spicatum*, and *Potamogeton richardsonii*. Lake and Reservoir Management 9:129-133.

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Appendix

1992 Aquatic Plant Survey from Bear Lake Planning Grant Project, December 1994, by Aron and Associates, Wind Lake, Wisconsin

BEAR LAKE AQUATIC PLANT SURVEY, JULY, 1992

				whorled milf	coontail	nitella	fern	cabbage	flatstem	floatingleaf	illinois	variable	claspingleaf	leafy	elodea	star duckweed	small duckweed	water celery	slender naiads
LAKE	YEAR	TRAN	DEPTH	MYRVE	CERDE	NITSP	POTRO	POTAM	POTZO	POTNA	POTIL	POTGR	POTRI	POTFO	ELOCA	LEMTR	LEMMI	VALAM	NAJFL
BEAR	92	1	1.5																
BEAR	92	2	1.5																
BEAR	92	3	1.5						2							1		3	3
BEAR	92	4	1.5																
BEAR	92	5	1.5															2	
BEAR	92	6	1.5		1							2						2	2
BEAR	92	7	1.5		2										2				
BEAR	92	8	1.5																
BEAR	92	9	1.5	1	2		1	1		2			1			2			3
BEAR	92	10	1.5															1	2
BEAR	92	11	1.5		1	1						1				1		2	4
BEAR	92	12	1.5		1	1			3									2	4
BEAR	92	13	1.5									1							1
BEAR	92	S14	1.5						1		1								3
BEAR	92	N14	1.5		4				2					1	3				1
BEAR	92	15	1.5	1								1						1	4
BEAR	92	16	1.5																
BEAR	92	17	1.5																
BEAR	92	18	1.5	1	5				2						2	1	1		
BEAR	92	19	1.5						1			1						3	2
BEAR	92	20	1.5									2		2				2	4
BEAR	92	21	1.5		2												1		3
BEAR	92	22	1.5						1							3		2	3
BEAR	92	23	1.5		1											4		3	3
BEAR	92	24	1.5		1											3			
BEAR	92	25	1.5																

	MYRVE	CERDE	NITSP	POTRO	POTAM	POTZO	POTNA	POTIL	POTGR	POTRI	POTFO	ELOCA	LEMTR	LEMMI	VALAM	NAJFL
FREQUENCY	3	10	2	1	1	7	1	1	6	1	2	3	7	2	11	15
% FREQUENCY	12	40	8	4	4	28	4	4	24	4	8	12	28	8	44	60
SUM DENSITY	3	20	2	1	1	12	2	1	8	1	3	7	15	2	23	42
SPEC MEAN DENSITY	1.00	2.00	1.00	1.00	1.00	1.71	2.00	1.00	1.33	1.00	1.50	2.33	2.14	1.00	2.09	2.80
TOT MEAN DENSITY	0.12	0.80	0.08	0.04	0.04	0.48	0.08	0.04	0.32	0.04	0.12	0.28	0.60	0.08	0.92	1.68
TMD w/plants	0.16	1.05	0.11	0.05	0.05	0.63	0.11	0.05	0.42	0.05	0.16	0.37	0.79	0.11	1.21	2.21

BEAR LAKE AQUATIC PLANT SU

				arrowhead	bladderwort	Horsetail	Water Stargrass	hs bulrush	Spatterdock	white lilies	Sago	
LAKE	YEAR	TRAN	DEPTH	SAGGR	UTRVU	EQUFL	HETDU	SCIAC	NUPH	NYMPH	POTPE	TRANSECT DENSITY
BEAR	92	1	1.5									0
BEAR	92	2	1.5									0
BEAR	92	3	1.5									9
BEAR	92	4	1.5									0
BEAR	92	5	1.5									2
BEAR	92	6	1.5									7
BEAR	92	7	1.5									4
BEAR	92	8	1.5									0
BEAR	92	9	1.5			1		1				15
BEAR	92	10	1.5									3
BEAR	92	11	1.5									10
BEAR	92	12	1.5						1			12
BEAR	92	13	1.5									2
BEAR	92	S14	1.5	2	2		3			2		14
BEAR	92	N14	1.5		1					2		14
BEAR	92	15	1.5									7
BEAR	92	16	1.5									0
BEAR	92	17	1.5									0
BEAR	92	18	1.5		1			1				14
BEAR	92	19	1.5	1								8
BEAR	92	20	1.5									10
BEAR	92	21	1.5								3	9
BEAR	92	22	1.5					1				10
BEAR	92	23	1.5									11
BEAR	92	24	1.5									4
BEAR	92	25	1.5									0

	SAGGR	UTRVU	EQUFL	HETDU	SCIAC	NUPH	NYMPH	POTPE
FREQUENCY	2	3	1	1	3	1	2	1
% FREQUENCY	8	12	4	4	12	4	8	4
SUM DENSITY	3	4	1	3	3	1	4	3
SPEC MEAN DENSITY	1.50	1.33	1.00	3.00	1.00	1.00	2.00	3.00
TOT MEAN DENSITY	0.12	0.16	0.04	0.12	0.12	0.04	0.16	0.12
TMD w/plants	0.16	0.21	0.05	0.16	0.16	0.05	0.21	0.16

BEAR LAKE AQUATIC PLANT SURVEY, JULY, 1992

LAKE	YEAR	TRAN	DEPTH	MYRVE	CERDE	NITSP	POTRO	POTAM	POTZO	POTIL	POTGR	POTRI	POTPU	POTFO	POTFR	ELOCA	LEMTR	LEMMI	VALAM
				milfoil	coon tail	nitella	fern	cabbage	flatstem	illinois	variable	claspingleaf	small pondweed	leafy	fries	elodea	star dw	small dw	water celery
BEAR	92	1	4		5				5							1	1		
BEAR	92	2	4						1								4		2
BEAR	92	3	4		4		1		5			1				1	3		4
BEAR	92	4	4			3						1	4				1		4
BEAR	92	5	4	3		1						1	2	3					
BEAR	92	6	4			2			1		2	1							2
BEAR	92	7	4				5									3			1
BEAR	92	8	4	4	3									2	2	4	1		
BEAR	92	9	4		2	1	1		1		1			1					1
BEAR	92	10	4								2								
BEAR	92	11	4			2		1			4								
BEAR	92	12	4	1						1			2		1	1			4
BEAR	92	13	4						1		2								
BEAR	92	S14	4				1	1	1	2				1	1				
BEAR	92	N14	4		2				2				1				4		1
BEAR	92	15	4		2				1				1	2					
BEAR	92	16	4			2				1		1		2					4
BEAR	92	17	4			2							2	1			1		2
BEAR	92	18	4		4			3	2							2			
BEAR	92	19	4		2			1			2	2	1				1		3
BEAR	92	20	4		2		1	2	1				1	2			2		4
BEAR	92	21	4		3		1		2				1			1	2	1	4
BEAR	92	22	4		4		1	3	3				3				4		4
BEAR	92	23	4		2												4		4
BEAR	92	24	4		3			1	1								4		
BEAR	92	25	4							2	1								

	MYRVE	CERDE	NITSP	POTRO	POTAM	POTZO	POTIL	POTGR	POTRI	POTPU	POTFO	POTFR	ELOCA	LEMTR	LEMMI	VALAM
FREQUENCY	3	13	7	7	7	14	3	7	6	10	8	3	7	13	1	15
% FREQUENCY	12	52	28	28	28	56	12	28	24	40	32	12	28	52	4	60
SUM DENSITY	8	38	13	11	12	27	4	14	7	18	14	4	13	32	1	44
SPEC MEAN DENSITY	2.67	2.92	1.86	1.57	1.71	1.93	1.33	2.00	1.17	1.80	1.75	1.33	1.86	2.46	1.00	2.93
TOT MEAN DENSITY	0.32	1.52	0.52	0.44	0.48	1.08	0.16	0.56	0.28	0.72	0.56	0.16	0.52	1.28	0.04	1.76
TMD w/plants	0.32	1.52	0.52	0.44	0.48	1.08	0.16	0.56	0.28	0.72	0.56	0.16	0.52	1.28	0.04	1.76

BEAR LAKE AQUATIC PLANT SU

				slender	arrowhead	marigold	wild rice	bladderwort	hs bulrush	spatterdock	white lily	crowfoot	TRANSECT
LAKE	YEAR	TRAN	DEPTH	NAJFL	SAGGR	MEGBE	ZIZAQ	UTRVU	SCIAC	NUPH	NYMPH	RANLO	DENSITY
BEAR	92	1	4							2			14
BEAR	92	2	4	3	1								11
BEAR	92	3	4		1								20
BEAR	92	4	4	2									15
BEAR	92	5	4	3									13
BEAR	92	6	4	3									11
BEAR	92	7	4	2			2						13
BEAR	92	8	4					1					17
BEAR	92	9	4	2									10
BEAR	92	10	4	4									6
BEAR	92	11	4	3									10
BEAR	92	12	4	3						2			15
BEAR	92	13	4	1									4
BEAR	92	S14	4	4							2		13
BEAR	92	N14	4	3	1								14
BEAR	92	15	4	3									9
BEAR	92	16	4	4									14
BEAR	92	17	4	4								1	13
BEAR	92	18	4					2					13
BEAR	92	19	4	1									13
BEAR	92	20	4			1							16
BEAR	92	21	4	4									19
BEAR	92	22	4										22
BEAR	92	23	4	1									11
BEAR	92	24	4	1					1				11
BEAR	92	25	4										3

	NAJFL	SAGGR	MEGBE	ZIZAQ	UTRVU	SCIAC	NUPH	NYMPH	RANLO
FREQUENCY	19	3	1	1	2	1	2	1	1
% FREQUENCY	76	12	4	4	8	4	8	4	4
SUM DENSITY	51	3	1	2	3	1	4	2	1
SPEC MEAN DENSITY	2.68	1.00	1.00	2.00	1.50	1.00	2.00	2.00	1.00
TOT MEAN DENSITY	2.04	0.12	0.04	0.08	0.12	0.04	0.16	0.08	0.04
TMD w/plants	2.04	0.12	0.04	0.08	0.12	0.04	0.16	0.08	0.04

BEAR LAKE AQUATIC PLANT SURVEY, JULY, 1992

LAKE	YEAR	TRAN	DEPTH	MYRVE	CERDE	NITSP	POTRO	POTAM	POTZO	POTIL	POTGR	POTRI	POTPU	POTFO	POTFR	LEMTR	VALAM	NAJFL	SAGGR
				milfoil	coon	nitella	fern	largeleaf	flatstem	illinois	variable	claspingleaf	small pond	leafy	fries	star dw	water celery	naiads	arrowhead
BEAR	92	1	6		4		3	1	4	2		1				2			
BEAR	92	2	6						1							4	1	1	
BEAR	92	3	6		4		3		5							1			
BEAR	92	4	6		2	3	1									4	1	3	
BEAR	92	5	6	4			1	2	2			1	1	4					
BEAR	92	6	6			3					1			1			3	4	
BEAR	92	7	6				4		4									1	
BEAR	92	8	6				2		4	1							1	4	
BEAR	92	9	6	2					2				2	1		1	1	3	
BEAR	92	10	6			3					2		1			1		1	
BEAR	92	11	6			1		1	1		2		4				1	2	
BEAR	92	12	6	1			4		3								4	1	
BEAR	92	13	6			2		2			2		3			2	1	2	
BEAR	92	S14	6	1	2	3	2	2	2					3		1	1		
BEAR	92	N14	6		4		4	2	4							1			
BEAR	92	15	6	2					2					1			4	3	
BEAR	92	16	6	2		2							4	2				1	
BEAR	92	17	6	4	2	3		1	1				2	3	1	1	2	1	
BEAR	92	18	6	2	1		1	1	2	1			1	2		4	3	1	
BEAR	92	19	6	1		3		1	2				1	3		2	4	3	1
BEAR	92	20	6		2		1	2	1				1	2		2	4		
BEAR	92	21	6		4			2	3							4	2		
BEAR	92	22	6		4		1		4							3			
BEAR	92	23	6		2				1							2			
BEAR	92	24	6		4				3							2			
BEAR	92	25	6					2	1				2						

	MYRVE	CERDE	NITSP	POTRO	POTAM	POTZO	POTIL	POTGR	POTRI	POTPU	POTFO	POTFR	LEMTR	VALAM	NAJFL	SAGGR
FREQUENCY	9	12	9	12	13	21	3	4	1	11	10	1	17	15	15	1
% FREQUENCY	36	48	36	48	52	84	12	16	4	44	40	4	68	60	60	4
SUM DENSITY	19	35	23	27	19	52	4	7	1	22	22	1	37	33	31	1
SPEC MEAN DENSITY	2.11	2.92	2.56	2.25	1.46	2.48	1.33	1.75	1.00	2.00	2.20	1.00	2.18	2.20	2.07	1.00
TOT MEAN DENSITY	0.76	1.40	0.92	1.08	0.76	2.08	0.16	0.28	0.04	0.88	0.88	0.04	1.48	1.32	1.24	0.04
TMD w/plants	0.76	1.40	0.92	1.08	0.76	2.08	0.16	0.28	0.04	0.88	0.88	0.04	1.48	1.32	1.24	0.04

BEAR LAKE AQUATIC PLANT SU

LAKE	YEAR	TRAN	DEPTH	marigold MEGBE	bladderwort UTRVU	white lily NYMPH	curly leaf POTCR	TRANSECT DENSITY
BEAR	92	1	6					17
BEAR	92	2	6					7
BEAR	92	3	6					13
BEAR	92	4	6					14
BEAR	92	5	6	1				16
BEAR	92	6	6					12
BEAR	92	7	6					9
BEAR	92	8	6					12
BEAR	92	9	6					12
BEAR	92	10	6					8
BEAR	92	11	6					12
BEAR	92	12	6					13
BEAR	92	13	6					14
BEAR	92	S14	6		2	1	1	21
BEAR	92	N14	6		4			19
BEAR	92	15	6					12
BEAR	92	16	6					11
BEAR	92	17	6					21
BEAR	92	18	6	4				23
BEAR	92	19	6					21
BEAR	92	20	6	3				18
BEAR	92	21	6					15
BEAR	92	22	6					12
BEAR	92	23	6					5
BEAR	92	24	6					9
BEAR	92	25	6					5

	MEGBE	UTRVU	NYMPH	POTCR
FREQUENCY	3	2	1	1
% FREQUENCY	12	8	4	4
SUM DENSITY	8	6	1	1
SPEC MEAN DENSITY	2.67	3.00	1.00	1.00
TOT MEAN DENSITY	0.32	0.24	0.04	0.04
TMD w/plants	0.32	0.24	0.04	0.04

BEAR LAKE AQUATIC PLANT SURVEY, JULY, 1992

LAKE	YEAR	TRAN	DEPTH	MYRVE	CERDE	NITSP	POTRO	POTAM	POTZO	POTIL	POTGR	POTRI	POTPU	POTFO	POTFR	ELOCA	LEMTR	VALAM	NAJFL
				milfoil	coon	nitella	fern	large leaf	flatstem	illinois	variable	clasping leaf	small pondweed	leafy	fries	elodea	star dw	water celery	naiads
BEAR	92	1	9		3		1					1							
BEAR	92	2	9						1										
BEAR	92	3	9		1														
BEAR	92	4	9		2		1												
BEAR	92	5	9	3	4	1	1		3					1	1				
BEAR	92	6	9	1	1														
BEAR	92	7	9																
BEAR	92	8	9																
BEAR	92	9	9	3	2				4			1	1			1		3	
BEAR	92	10	9	4	1		1	3		1			3					1	
BEAR	92	11	9						1		1		1	1			2		
BEAR	92	12	9	3	3				4									1	
BEAR	92	13	9	4	2				1				3						
BEAR	92	S14	9																
BEAR	92	N14	9																
BEAR	92	15	9	2	1	2							4	1			1	4	1
BEAR	92	16	9	4	4				2				3	2				1	1
BEAR	92	17	9	2	4								1						
BEAR	92	18	9	2					2			2	1	1					2
BEAR	92	19	9	2		3			2				2	1			3		3
BEAR	92	20	9	1	2				2	1		2	1				1		
BEAR	92	21	9		1				3								1		
BEAR	92	22	9		1				1								1		
BEAR	92	23	9																
BEAR	92	24	9		1				1										
BEAR	92	25	9				1	1		1	1								

	MYRVE	CERDE	NITSP	POTRO	POTAM	POTZO	POTIL	POTGR	POTRI	POTPU	POTFO	POTFR	ELOCA	LEMTR	VALAM	NAJFL
FREQUENCY	12	16	3	5	2	13	2	2	3	10	6	1	1	6	5	4
% FREQUENCY	48	64	12	20	8	52	8	8	12	40	24	4	4	24	20	16
SUM DENSITY	31	33	6	5	4	27	2	2	5	20	7	1	1	9	10	7
SPEC MEAN DENSITY	2.58	2.06	2.00	1.00	2.00	2.08	1.00	1.00	1.67	2.00	1.17	1.00	1.00	1.50	2.00	1.75
TOT MEAN DENSITY	1.24	1.32	0.24	0.20	0.16	1.08	0.08	0.08	0.20	0.80	0.28	0.04	0.04	0.36	0.40	0.28
TMD w/plants	0.48	1.32	0.24	0.20	0.16	1.08	0.08	0.08	0.20	0.80	0.28	0.04	0.04	0.36	0.40	0.28

BEAR LAKE AQUATIC PLANT SU

LAKE	YEAR	TRAN	DEPTH	UTRVU (bladderwort)	NUPH (spatterdock)	TRANSECT DENSITY
BEAR	92	1	9			5
BEAR	92	2	9			1
BEAR	92	3	9			1
BEAR	92	4	9			3
BEAR	92	5	9			14
BEAR	92	6	9			2
BEAR	92	7	9			0
BEAR	92	8	9			0
BEAR	92	9	9			15
BEAR	92	10	9			14
BEAR	92	11	9			6
BEAR	92	12	9			11
BEAR	92	13	9		1	11
BEAR	92	S14	9			0
BEAR	92	N14	9			0
BEAR	92	15	9	1		17
BEAR	92	16	9			17
BEAR	92	17	9			7
BEAR	92	18	9			10
BEAR	92	19	9			16
BEAR	92	20	9			10
BEAR	92	21	9			5
BEAR	92	22	9			3
BEAR	92	23	9			0
BEAR	92	24	9			2
BEAR	92	25	9			4

	UTRVU	NUPH
FREQUENCY	1	1
% FREQUENCY	4	4
SUM DENSITY	1	1
SPEC MEAN DENSITY	1.00	1.00
TOT MEAN DENSITY	0.04	0.04
TMD w/plants	0.04	0.04