LPL-422

COON FORK LAKE MANAGEMENT PLAN

August, 2001

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COON FORK LAKE

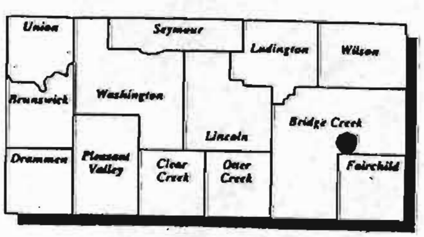
Executive Summary

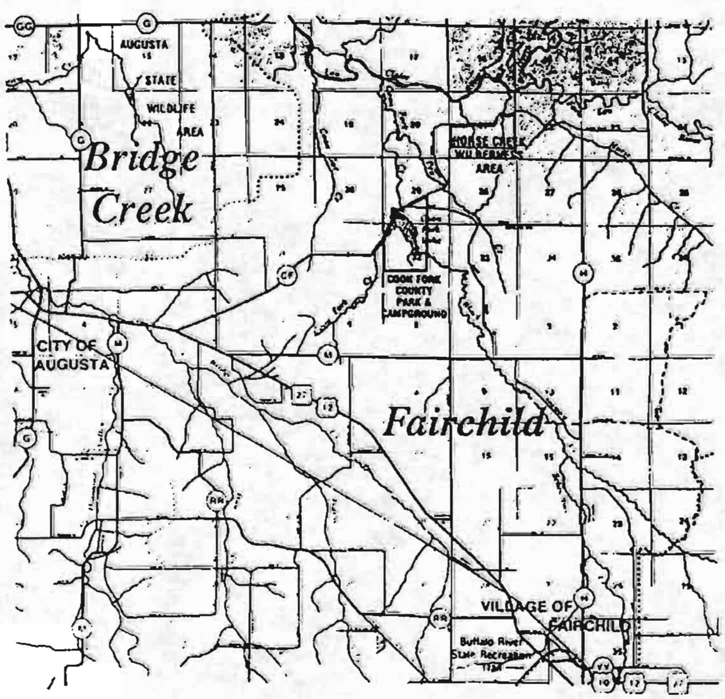
The land surrounding Coon Fork Lake is all publicly owned. It is considered eutrophic, although at the low end of this water quality indicator. Its water quality receives protection from the extensive forest and wetlands in its watershed area. There is no significant sedimentation, which is a positive indicator for an impoundment.

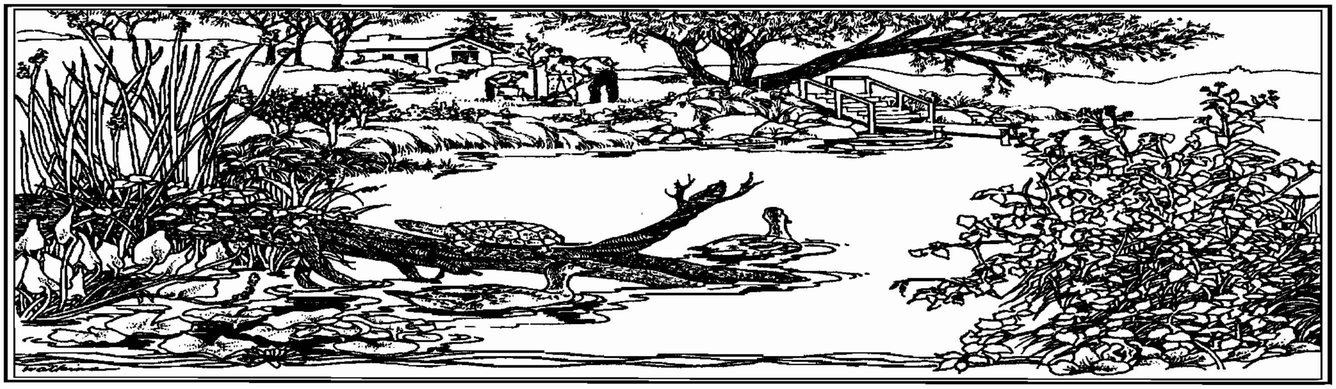
Due to the water residence time in the flowage of 7-13 days, lower levels of chlorophyll 'a' are detected. These low levels help keep good water quality rankings. However, tannin from woods/wetlands run-off stains the water a dark brown and limits rooted plant growth to depths of 6.5 feet or less. Plant growth is most abundant in the 0-1.5 foot depth zone. Elevated fecal coliform bacteria levels after 1-3 inch rainfalls have resulted in closing the public beaches during the swimming season. The fecal coliform bacteria are primarily due to runoff from agricultural sources.

Management strategies that protect the vegetated shoreland, maintain public ownership of the shoreland, and improve fish and wildlife habitat will add to the quality of this public park. Improvements in the watershed will help the water quality in the lake.

In order to do that, several steps need to be undertaken. Practices that reduce phosphorus inputs, continue water monitoring of surface/groundwater, and protect the extensive wood and wetland land uses in the watershed are the place to start.







COON FORK LAKE

Coon Fork Lake is at the confluence of the Black and Coon Fork Creeks in eastern Eau Claire County. A dam constructed in 1964 formed the flowage. It is a 75-acre impoundment with surrounding land entirely owned by Eau Claire County. Many public recreational opportunities exist such as camping, skiing, hiking, canoeing, fishing, swimming, picnicking, and mountain biking.

The park experiences heavy use. In 1992 the camper days[1] were 13,500 while in 1997 that figure rose to over 17,000 camper days. The Parks & Forest Department has a five-year Management Plan that delineates future development. In 1998 the extended electricity to nine (9) more campsites, chip sealed the day side road, and replaced one boat landing slab. Development in 1999 included an additional 20 electrical campsites. Current development includes 20 new recreational vehicle campsites with electricity.

It is the largest County campground (108 sites) in Eau Claire County. Being located close to a large population center - the cities of Eau Claire and Chippewa Falls - attracts large numbers of day users and campers. Surveys show that typically 60% of the campers are Eau Claire County residents and 40% are non-County residents.

Highlights of the park include:

- Three beaches
- Paddle boat, canoe & row boat rentals
- Barrier-free fishing pier
- Picnic area
- 88 Campsites with electricity at 28 sites
- Showers & flush toilets
- Nature trails for hiking
- Cross-country skiing
- Mountain biking
- Playground equipment
- Volleyball & Horseshoe Areas
- Picnic shelter

In 1995 the Health Department closed the swimming beach due to high counts of fecal coliform bacteria. They regularly test the public beaches and found high bacteria levels after a large rainfall event, probably indicating an agricultural runoff impact. The Parks & Forest Committee and staff contacted the Land Conservation Office for assistance in learning the impact the watershed has on the lake. This led to a cooperative effort with Clark and Jackson Counties, the Wisconsin DNR, Augusta High School Biology class, Fall Creek High School, and City-County Health Department. This Management Plan is a direct result of these efforts. Together these groups tested the water in the lake and tributary streams, identified land uses, ran a computer water quality analysis, and formulated management strategies.

[1]Camper days: The number of campsites occupied, multiplied by the number camping at each site.

THE WATERSHED

The Coon Fork Lake watershed comprises about 31,700 acres, or almost sixty square miles, in Clark, Eau Claire and Jackson Counties in west central Wisconsin. The topography is level to gently rolling with depressions near streams. Four streams contribute to the watershed. Black Creek is 13 miles in length with its headwaters in Clark and Jackson counties--it is the main tributary. Schoolhouse Creek is 3.8 miles in length, originating in Jackson County. It flows through the Village of Fairchild and Fairchild Pond before joining Black Creek. McGaver Creek is 1.8 miles and is a small spring feeder stream to Schoolhouse Creek. Lastly, Coon Fork Creek flows for 1.2 miles, with a sandy bottom and drains a meadow area before flowing into the lake.

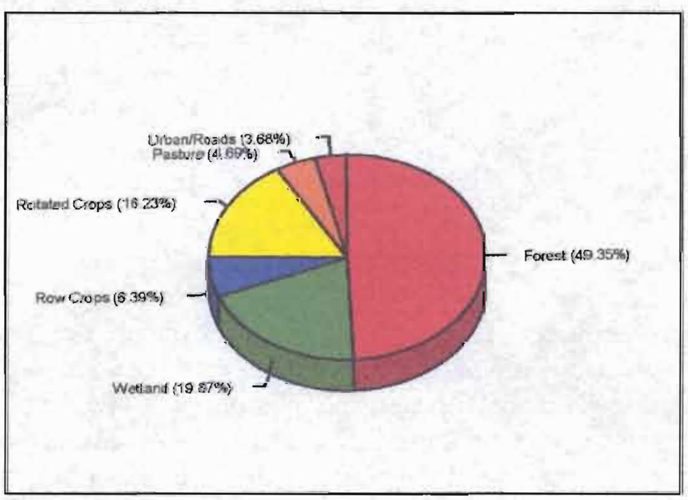
Fairchild Pond has 18 surface acres and is an impoundment on Schoolhouse Creek. It was treated in 1963 for carp. Today large mouth bass and bluegills support the fish population. The Village Park and the Rod & Gun Club provide public access on the north end of the pond.

The land use in the watershed is 49% forested and mostly managed by Clark and Eau Claire Counties. Twenty (20) percent is in wetlands. This is significant because almost 70% of the land use helps in protecting the lake from excessive nutrient input. Wetlands filter out nutrients carried in runoff water that otherwise cause weed and algae blooms in water bodies. Forested land has extensive canopy cover from the trees and low fertilizer inputs that lessens the nutrient loading into the lake. Runoff from wetlands and forest land contains tannin. This results in dark brown water that causes low light penetration that limits aquatic plant growth to the shallower portions of the lake (see Figure 1).

We need to direct our efforts toward the 25% agricultural land use to manage the lake for long-term water quality. The remaining 5% is open land, urban or roads, and open water.

Data obtained for the *Eau Claire County Erosion Control Plan* in 1988 show the average soil loss on agricultural land is only 1.2 tons per acre. This is well below tolerable soil loss limits and is beneficial to the lake. However, 34% of the agricultural land use is in Eau Claire County. Clark County land in crops and pasture accounts for 16%, while Jackson County farms have 50% of the total agricultural land use in the watershed. This provided the incentive for these three counties to work cooperatively on a lake management plan.

Figure 1. Land Use in the Coon Fork Lake Subwatershed.



Source: Coon Fork Reservoir Lake Monitoring & Modeling Results, 1997
WI-DNR, Lower Chippewa Basin Water Team; Erik Kampa

Land uses change over time. Of concern are the development patterns because population increases can place additional pressure on the lake. With a larger population, increased runoff may contain lawn fertilizer and sediment from construction sites. Both sediment and nutrients will adversely affect the lake. Figure 2 depicts the relationship between land use and phosphorus loads. Agriculture in the watershed contributes the highest load.

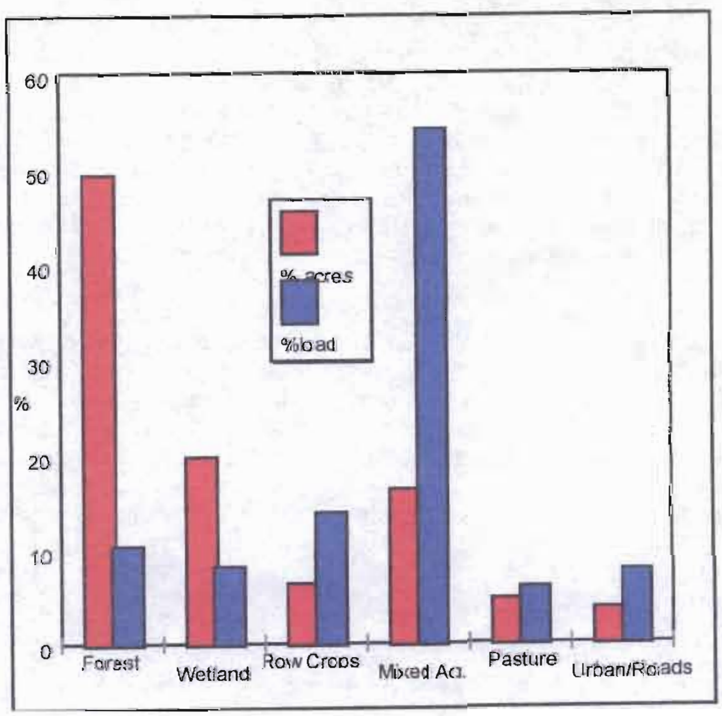
The following table projects the population growth for this area and a comparison from the last two decades.

Year	**1970**	**1980**	**1990**	**2000**	**2010**	**2020**
Village of Fairchild	562	577	504	553	600	649
Town of Fairchild	238	278	312	342	376	407

Source: West Central Wisconsin Regional Planning Commission

Population projections show a growth rate at a manageable level that will help in our undertaking to protect the lake. The urban portion comprises a small percent of the land use in the watershed, and projections are that this will remain steady.

Figure 2. Coon Fork Lake subwatershed comparison of land use & phosphorous loads



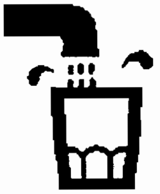
Source: Coon Fork Reservoir Lake Monitoring & Modeling Results, 1997
WI-DNR, Lower Chippewa Basin Water Team; Erik Kampa

Public utilities such as sewage treatment are of concern because they can affect water quality. The Village of Fairchild replaced their treatment system in 1998. Previously they had a groundwater discharge system within the watershed. The new treatment facility is outside the Coon Fork Lake watershed and consists of three biologic treatment cells that discharge water twice per year to the Eau Claire River.

PHYSICAL CHARACTERISTICS

Soils in the watershed consist of five generalized soil associations, four of which are sandy. The Ludington-Elm Lake-Fairchild series in Eau Claire County are found in low and nearly level areas. They are loamy sands, which are well drained to poorly drained. Forestry and wildlife habitat are better uses unless improvements are undertaken to provide drainage and raise the fertility level for cultivated crops.

The Menahga-Plainfield association consists of sands on broad, nearly level and gently sloping glacial outwash plains. They are excessively drained and need irrigation, increased organic matter and fertility levels to produce cultivated crops of average yield.



In Jackson County, the Boone-Eleva association is a sand and loamy soil type respectively. Both are excessively drained. The Tarr association similarly is excessively drained, sandy soil with low available water capacity. These both have similar needs for use as farmland as the previously described sandy soil types.

In Clark County, the soil texture changes to a loam and silt loam in the Eleva-Meridian-Gale series. These are deep, well-drained soils found on uplands. Areas of moderate slopes are suitable for crops but pasture, woods, or wildlife habitat are preferable on steep slopes.

Information from the *Eau Claire County Groundwater Management Plan* shows the geology of the watershed's aquifer as Drift-Paleozoic. This is a glacial drift material overlaying the sandstone aquifer. Precipitation that recharges the groundwater must first percolate through the drift material before reaching the sandstone aquifer. While this provides some filtering, there are activities within the Eau Claire County portion that indicate a need for concern.

The Village of Fairchild has a licensed landfill on 18 acres but has a closure agreement. Although groundwater monitoring wells will detect leaks, none are required. One Leaking Underground Storage Tank (LUST) site, two hazardous waste generators, one Volatile Organic Compound (VOC) detect, and two hazardous material spills are known of in the area. One licensed pesticide applicator and 24 active underground storage tanks (containing 27,700 gallons) also exist according to the *Eau Claire County Groundwater Management Plan.* Because the soils are sandy, they are not able to attenuate or absorb and use all pollutants that can easily pass through the sand into the groundwater. Most of the watershed area also has bedrock close the land surface. For these reasons, groundwater quality is a concern in this area, as it provides the drinking water for the population residing and recreating there. Watershed management needs to include groundwater testing to periodically test for these aforementioned hazards. These 34 identified sites may all be managed to protect groundwater. We recommend monitoring to ensure this.

WETLANDS

Wetlands play an important role in this watershed. There are several complex swamps and marshes in the area. Most are predominantly a shrub-timber swamp with large portions of lowland forest and some open water. Woods surround the marsh meadows. These provide wildlife habitat for deer, beaver, and other species. A variety of birds such as mallards, grouse, bluejays, sparrows, flickers, and woodpeckers find their home here.

The shrub and tree types commonly found in the wetlands are tagalder, willow, birch, red maple, aspen, and white pine. Surrounding tree species are often oak, pine, and maple. Numerous wetland plant types are found. These include cattails, sedges, grasses, ferns, canary grass, water hemlock, and swamp milkweed.

ENDANGERED SPECIES

Endangered and rare species present in the watershed include:

Karner Blue Butterfly
Persuis Duskywing Butterfly
Northern Harrier

According to the DNR, the following rare species are suspected to occur in the area:

Wood Turtle
Redside Dace
Phlox Moth
Dusted Skipper Butterfly

NATURAL AREAS

Nearby are two DNR Natural Areas. Just north of Coon Fork Lake is the Coon Fork Barrens State Natural Area # 313. East of the lake is the Pea Creek Sedge Meadow State Natural Area # 315. Both are outside the actual watershed.

FISH

The fishery was established in 1964 when the dam formed the lake. Wisconsin DNR stocked muskellunge, largemouth bass, black crappie, and bluegill. Unfortunately, an oil spill in 1970 resulted in a significant fish kill. Mainly crappies and bluegills survived. Restocking has occurred during the 1970's and 1980's.

In 1993 the DNR surveyed the lake to collect fish data. Nine fish species were collected. This information is not considered comprehensive due to the low catch (game fish observed but eluding capture). Few fish are found by rock riprap installations, as they provide little habitat. This is consistent with known fish habitat needs. Young fish captured suggest natural reproduction of musky and largemouth bass. Efforts to improve fish habitat include 75 fish cribs installed by the County's Wisconsin Conservation Corps in 1986, 1987, and 1998.

Fish species found in the shocking survey include: black crappie, bluegill, pumpkinseed, yellow perch, muskellunge, largemouth bass, redhorse, white sucker, and yellow bullhead. Because the fish survey results are inconclusive, we can only state there is a fair fishing population in the lake. The indication of some natural reproduction of musky and largemouth bass is encouraging, as is the presence of panfish.

AQUATIC PLANT COMMUNITY
(1998 Report - Konkel/Kampa)

Wisconsin DNR staff conducted a comprehensive study of the aquatic macrophytes in Coon Fork Lake during 1997. We will only highlight the summary of that report and refer interested readers to the full report by Deborah Konkel and Eric Kampa found in the appendix.

This study provides valuable information in characterizing the water quality of the lake itself. Aquatic plants are indicators that tell us if the water quality is good or poor depending on which species are present. What the investigators found is that the plant community is slightly above average for Wisconsin lakes. Coon Fork Lake has a moderate diversity of species (20 species found) and a low frequency of occurrence. The tannin that stains the water a dark brown causes low water clarity. This affects what plant species can live under reduced light.

The reduction in light restricts plant growth to the zone that is less than seven (7) feet deep. Consequently, an abundance of plants only exists in the 0 to 1.5 foot depth. Vegetation is found at 56% of the sample sites with a sand sediment, which is the predominant sediment in the lake. A sand-silt base is more favorable to plant growth but only 30% of the sites with this sediment type were vegetated. This is probably due to the sand/silt sediment being in deeper water locations and having less available light.

The basis for determining the trophic state of a lake is the phosphorus and chlorophyll concentrations and the water clarity. Phosphorus is a nutrient that feeds algae and causes excessive plant growth. The study classifies Coon Fork Lake as eutrophic. This usually means it is high in nutrients and while this is true, the levels are lower than projected.

The shoreland cover is important because plant life affects rates of erosion and nutrient runoff into the water. The shoreline is vegetated with wooded, shrub and herbaceous vegetation for approximately 88% of the shoreline. This type of cover provides diverse riparian habitat and water quality protection. The remaining shoreline is lawn (5%), rock riprap (4%), beach (3%), and structures (1%).

To maintain a healthy aquatic plant community, the lake management plan needs to advocate the preservation of the shoreline vegetative cover. This helps reduce erosion, trap nutrients, stabilize the banks, and is important for fish and wildlife habitat.

WATER TESTING

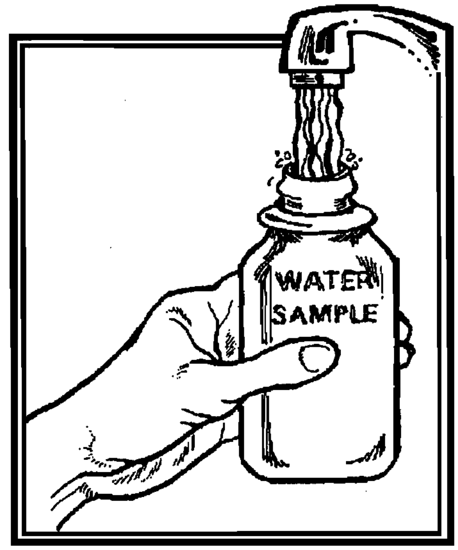
Several parameters help us understand water quality. To verify Coon Fork Lake's status, different groups of people conducted tests. A brief summary of each of these studies is presented first, followed by a comparison of the findings. (See *References* for listing of reports/authors).

We conducted tests on these parameters: fecal coliform bacteria, phosphorus, water clarity, chlorophyll 'a', temperature, dissolved oxygen, pH, turbidity, nitrates, and depth. The Wisconsin Trophic State Index combines data from secchi disk, chlorophyll, and phosphorus to determine if a lake is oligotrophic (below 40), mesotrophic (40-50), or eutrophic (over 50).

City-County Health Department

The Eau Claire City-County Health Department tests the public beaches weekly during the swimming season. In 1995 high fecal coliform counts closed the Coon Fork Lake beaches. The guidelines consider less than 400 fecal coliform per 100 ml of water is safe for swimming. Expansion of the testing program that year includes water samples from the three major contributing streams. Appendix maps show the locations of sample sites taken by Health Department staff. Three samples exceeded the bacteria standard safe level in three streams. Testing for E. Coli 0157:H7 was negative.

Weekly testing continued in 1996. A pattern of high fecal coliform levels emerges which relates directly to rainfall events over one inch. Within 24 hours of this type of event, the lake will exceed the standard. Black Creek, the largest contributory stream, has significant impacts as it discharges closest to the campground beach.



The application of the fecal coliform to fecal strep ratio, as done in 1996, is useful in assessing sources of bacteria contamination. Ratios less than 0.7 suggest agricultural runoff while ratios over 4.0 indicate domestic waste is present. These are general guidelines but show animal waste is the major contributor after rainfall events. The Health Department followed-up on four samples in the Fairchild area indicating domestic waste contamination.

Data collected in 1997 repeated these results. Following a one inch rainfall, bacteria levels exceeded the standard in Schoolhouse Creek at two test sites. Other conclusions show that rainfall frequency (every three to four days) is likely to raise the bacteria counts to unsatisfactory levels for swimming in the lake. They generally are back down to acceptable levels within 24 to 72 hours. Fecal coliform bacteria levels exceeding 1,000/100 ml water will usually occur at the beaches after a 3" rainfall event. These bacteria levels may take 3-5 days to return to acceptable counts.

Augusta Science Research Team

The Augusta High School Biology class provides a team of trained students, under the guidance of two instructors, who collected water tests and samples in 1996. Testing occurred on seven sites, on the four tributary streams, and downstream of the lake. The testing parameters include secchi disk readings, chlorophyll 'a', phosphorus, water temperature, and dissolved oxygen. Other parameters also collected include turbidity, fecal coliform, pH, nitrate, velocity, total solids, and biological oxygen demand. Their extensive data provides us a eutrophic state index of 61.24 for secchi disk, 52.29 for chlorophyll 'a', and 61.04 for phosphorus. Their data contained very useful information needed for the computer model run by DNR, discussed later in this report.

The team ran transect surveys and compared their readings to data from 1964 that coincides with the lake formation. They found no significant sedimentation. Being an impoundment lake, it has a constant flow and the estimated turnover is 7 to 13 days (Konkel & Panuska). This is less than the average of 14 days needed to produce algae blooms.

Fall Creek High School - Adopt-A-Lake Program
The Adopt-A-Lake Program is a self help monitoring system. Interested persons can perform a variety of simple water tests and, by tracking the data collected, draw some conclusions about their lake. Students from Fall Creek High School adopted Coon Fork Lake and collected samples. They use a secchi disk to measure depth and clarity, take temperatures, dissolved oxygen, phosphorus and chlorophyll samples.

Combining secchi disk, phosphorus and chlorophyll data gives us the trophic state index. Their 1995 data shows secchi disk of 58, chlorophyll of 43, and phosphorus of 59. These exceed 50 on the index, showing us the lake is eutrophic.

Department of Natural Resources (DNR)
Modeling results performed by Erik Kampa conclude that the chlorophyll "a" levels are relatively low. He confirms the "flushing rate" and staining in the water limit the phosphorus levels to the moderate range. The dark water color limits algae growth and the less than 14 day residence time of the flowage limit phosphorus response.

The following are excerpts from "The Aquatic Plant Community of Coon Fork Flowage...1997" by Deborah Konkel and Eric Kampa.

Physical Data
Many physical parameters are important determinants of the type of macrophyte community that will ultimately inhabit a lake. Water quality (nutrient levels, algal levels, turbidity, pH, hardness) impact the macrophyte community as the macrophyte community can, in turn, modify these parameters. Lake morphology, sediment composition and shoreland land use also impact the macrophyte community.

Nutrients
Phosphorus is a limiting nutrient in many Wisconsin lakes. So, increases in phosphorus in a lake can feed algal blooms and excess plant growth.

1995-1997 mean summer phosphorus in Coon Fork Flowage was 67 ug/l. This level of phosphorus in Coon Fork Flowage was indicative of a eutrophic lake.

Algae
Measuring the level of chlorophyll in the water gives an indication of algal levels. Algae are natural and essential in lakes, but high algal levels can cause problems, increasing the turbidity and reducing the light available for plant growth.

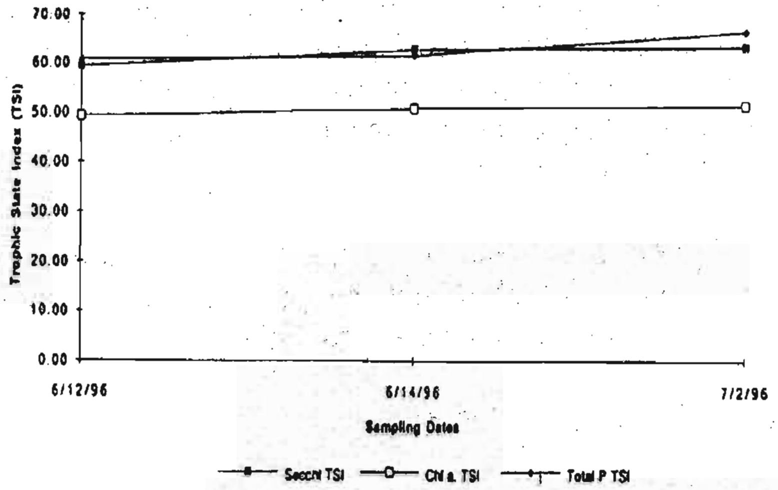
1995-1997 mean summer chlorophyll in Coon Fork Flowage was 21 ug/l. The chlorophyll levels are in the eutrophic range, but less than predicted based on modeling (Panuska, 1998).

There were variations in the phosphorus and chlorophyll levels from year-to-year and during the year. The phosphorus levels appear to increase steadily during the summer to a high point in July and then decline. Chlorophyll also increases during the summer but, on average, reaches a high point in August before declining.

Comparison of Results
Data from Augusta High School, Fall Creek High School, and DNR are consistent. They all conclude the lake is eutrophic, based upon the Wisconsin Trophic State Index, although there are variations in the ranges for each parameter.

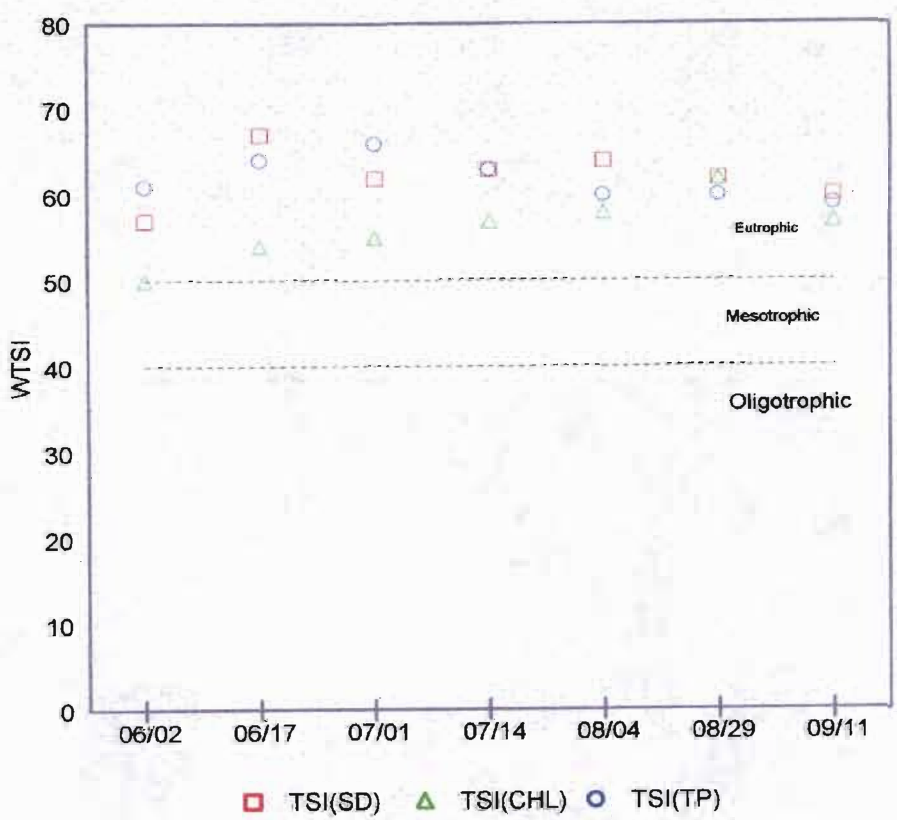
Figure 3.

Wisconsin Trophic State Index for Coon Fork Lake, Summer, 1996



Source: Augusta Science Research Team

Figure 4. Wisconsin Trophic State Index for Secchi depth, chlorophyll a, and total phosphorus levels.



Source: Coon Fork Reservoir Lake Monitoring & Modeling Results, 1997
WI-DNR, Lower Chippewa Basin Water Team; Erik Kampa

Observed 1997 Seasonal Lake Water Quality and TSI

Parameter	Total Phosphorus (ug/l)	Chlorophyll a (ug/l)	Secchi Depth (m)
Observed Mean	High 75	Low 18	0.9
TSI*	62	57	61

* Calculated using Lillie et al, 1993 Source: Panuska

Coon Fork Trophic Status, 1995-1997

	Quality Index	Phosphorus ug/l	Chlorophyll ug/l	Secchi Disc ft.
Oligotrophic	Excellent	<>1	<>1	>19
	Very Good	1-10	1-5	8-19
Mesotrophic	Good	10-30	5-10	6-8
	Fair	30-50	10-15	5-6
Eutrophic	Poor	50-150	15-30	3-4
Hypereutrophic	Very Poor	>150	>30	<>3
Coon Fork Flowage 1995-97	Poor	67	21	3.2

After Lillie & Mason (1983)
Shaw et al (1993) Source: Kampa/Konkel

Both the City-County Health Department and Augusta High School Team collected fecal coliform samples. Their water samples were collected on different days, and at different locations, to provide us with information on the sources of bacteria. The Augusta data were all under the 400 fecal coliform/ml safe swimming standard. The Health Department found excessive levels of fecal coliform on 06/04/96 in Schoolhouse Creek and Fairchild Pond that is an impoundment on this creek. On 6/18/96, Schoolhouse Creek and Fairchild Pond again had high levels of fecal coliform. The fecal coliform to fecal strep ratio for these same samples indicate the source for Schoolhouse Creek is from animal waste. Ratios found in Fairchild Pond indicate a possible domestic waste contamination source.

WATER QUALITY MODEL
1997 - John Panuska

Water quality monitoring on Coon Fork Lake and its tributaries, as well as Land Use data, are part of the information the DNR uses to run a computer modeling study. A brief summary of the study conducted by John Panuska is presented here. The study uses the Army Corps of Engineers FLUX Model for tributary flow and loading, and the Army Corps of Engineers BATHTUB Model for reservoir trophic response. Both are accredited to Dr. William Walker.

The chlorophyll 'a' response to phosphorus loading is lower than predicted by the model. Staining effects of tannin[2] in the water and the flushing of the reservoir contribute to this result. The retention time of the reservoir is 7 to 13 days, which is less than the 14 day retention time needed for a chlorophyll response to phosphorus. The reservoir is not considered phosphorus sensitive under low and normal flow conditions based upon the 1997 data. In order to verify the non-responsiveness during low flow years, we need additional data collection.

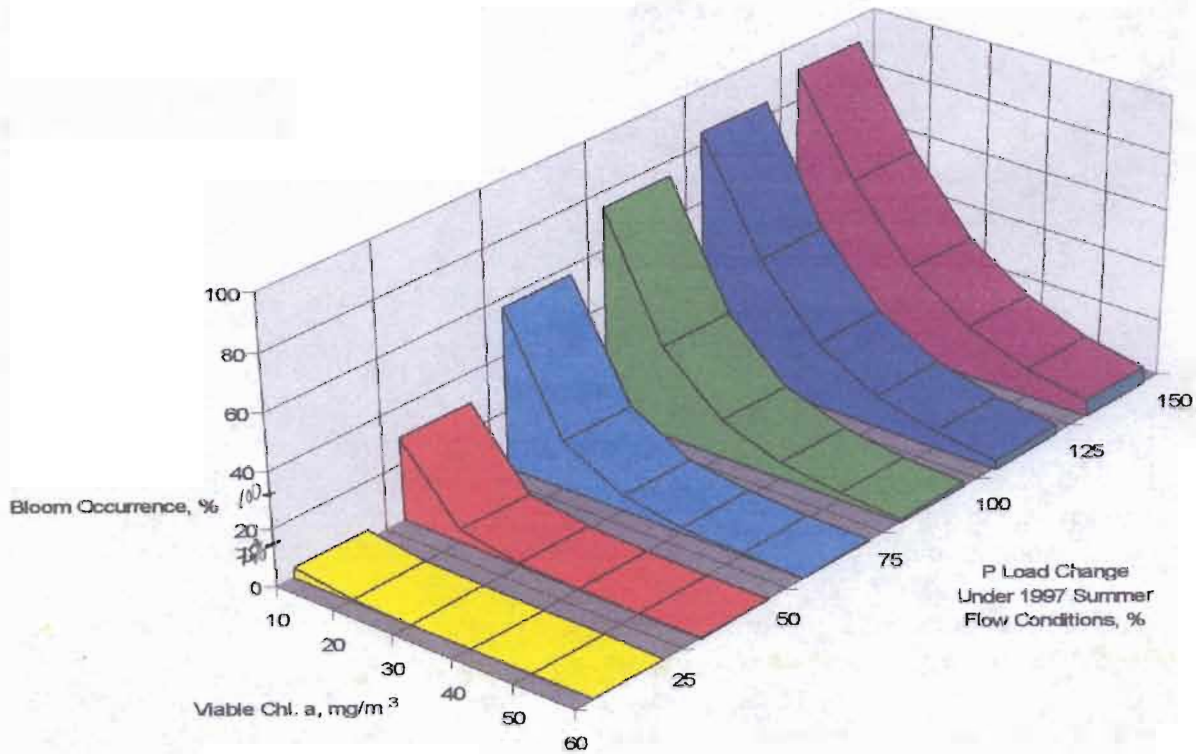
The estimated annual agricultural export also shows a lower result than the model would predict, especially for Wisconsin Watersheds. He attributes this to the large percentage of forested and wetland land use within the watershed. Applying this data to the Wisconsin Trophic State Index, the conclusions confirm other applications by the Augusta Science Research Team and Fall Creek Adopt-A-Lake Team. Panuska's calculations rate Coon Fork Lake as eutrophic with 62 for total phosphorus, 57 for chlorophyll 'a', and 61 for secchi disk.

Based on the computer model results, this study recommends additional flow monitoring to quantify the low flow rate and to continue water quality monitoring to establish a historical record. **The greatest reduction of phosphorus can be gained by installing practices on agricultural land. This will help trap the phosphorus at the site rather than letting it enter the water system and flowing to Coon Fork Lake where it could contribute excessive plant growth.**

Modeling results compiled by Erik Kampa, DNR, concur with Panuska's data. Figure 5 illustrates how the BATHTUB model uses phosphorus loading to predict blooming of algae. If phosphorus can be reduced by 25%, the number of blooms would be cut in half. But, if phosphorus loads increased to 125%, the algae blooms would increase during the growing season by 9%, compared to current conditions.

[2] Effects of tannin: Tannin is a natural stain from wooded/wetland runoff.

Figure 5. Estimated Bloom Frequency in Coon Fork Lake, Summer, 1997



Source: Coon Fork Reservoir Lake Monitoring & Modeling Results, 1997
WI-DNR, Lower Chippewa Basin Water Team; Erik Kampa

Kampa recommends targeting agricultural sites, where phosphorus is concentrated, and controlling this load at its source.

MANAGEMENT STRATEGIES

The purpose of the Coon Fork Lake Management Plan is to identify the resources and threats within its watershed. Our goal is to protect and enhance Coon Fork Lake for future use by an increasing public population who enjoys the multitude of recreational resources it provides.

Eau Claire, Clark, and Jackson Counties are committed to a cooperative effort to improve the Coon Fork Watershed. Over the next five years, we plan to continue our efforts to work with:

- Augusta Science Research Team
- City/County Health Department
- Fall Creek High School Adopt-A-Lake volunteers
- County Parks & Forest Department
- Wisconsin DNR

The sixty (60) square mile watershed knows no political boundaries. It is imperative we cross county lines to cooperate. We must cross school district lines for recruiting research. Local and state boundaries must blur to build a strategy that protects Coon Fork Lake.

Eau Claire City/County Health Dept.

Eau Claire County Parks & Forest Dept.

Clark County Forest & Parks Dept

Fall Creek High School Adopt-A-Lake Volunteers

Augusta Science Research Team

Clark Co. Land Conservation

Eau Claire Co. Land Conservation

Jackson Co Land Conservation

Wisconsin DNR

STRATEGIES

Our overall objective is to maintain or improve water quality in Coon Fork Lake. This sets our course to implement policies and practices that allow us to reach the goal of maintaining a level of water quality that ensures continued public use.

There are four areas we propose:

- Land Use policies
- Installation of conservation practices
- Water quality monitoring
- Education

Land Use

Today, almost 70% of the watershed is in forest or wetlands. The lake shore is 88% vegetated. This is a strength. Vegetation traps sediment and nutrients. This keeps levels of phosphorus and chlorophyll 'a' at the low end of the eutrophic spectrum. This helps keep sediment from filling in the impoundment. There are several land use mechanisms to keep this level of protection.

Policy decisions will help ensure long-term protection of the lake. The County Committees that have authority to set land use policies affecting the lake are the Parks & Forest Committee and County Boards of Clark and Eau Claire Counties. Our goal is to meet with these committees and request their consideration/approval of the following items:

- Coon Fork Park
  Work with the Committees to approve a long-range goal of placing all future park development inland to preserve the high level of shoreline vegetation. Respecting a setback along the shoreline ensures the vegetation will continue to act as a filter. This type of shoreline provides the added benefit of aesthetics. With minimal development, the lake retains its natural beauty. It can also be used as an outdoor educational display if signs are placed explaining the use of the vegetation along the shoreline.

- Coon Fork Park
  Approve a policy that the County will retain ownership of the lake and park in perpetuity.

- County Forest Land
  Work with the Committees to approve a long-term policy to retain ownership of the County forest land in the watershed. This ensures the land use will continue to provide protection for the lake by filtering nutrients and sediment.

- County Forest Land
  Approve a policy of following/applying the DNR Forestry BMP Handbook when forest land is disturbed.

- Wetlands in the Watershed
  Work with the Committees to set a long-range goal of preserving the wetlands in the watershed that are under public ownership.

- Natural Areas
  Investigate if areas exist that are eligible for designation as a State Natural Area, which will provide long-term protection.

Conservation Practices

While the current level of land use in woods and wetlands helps Coon Fork Lake, we know 25% of land use in the watershed is in agricultural use. We view agriculture as a partner in helping protect the lake. Water testing shows us that agricultural run-off contributes phosphorus and sediment that comes from two sources--animal waste and cropland. In order to reduce phosphorus and sediment inputs to the lake and watershed, there are several conservation practices and strategies we need to implement:

Reduce animal waste inputs by:

- Applying for State grants to offer cost-sharing assistance for conservation practices.
- Contacting all livestock farmers about developing Nutrient Management Plans. These plans balance animal manure and commercial fertilizer inputs with soil test results.

- Identifying and offer assistance to farms that are eligible for barnyard run-off and manure storage practices. Provide technical and financial assistance for installing the needed conservation practices.
- Identifying sites where cattle have access to tributary streams and offer farms stream fencing, cattle watering ramps, and managed grazing incentives.

Reduce cropland sediment and fertilizer inputs by:
- Contacting farms to maintain grass buffer strips with information about the Continuous Conservation Reserve Program sign-up. This program offers Buffer Strip Incentives.
- Identifying and assisting farms with grass waterway installation.
- Providing incentives for farms to plant more acres of crops with reduced tillage methods.

Improve fish and wildlife habitat by:
- Working with DNR Fisheries staff to identify if habitat improvements are needed in either the lake or streams. Investigate means to implement their suggestions.
- Working with DNR Wildlife Management staff to identify how wildlife habitat could be improved in the watershed.

Water Quality Monitoring

Water Quality Monitoring is an important component in analyzing the current state of Coon Fork Lake's water quality. It is also an important component to continue for two reasons. We need to know if conservation practices and land use policies are protecting the lake. Before we can realize those long-term benefits, we need to continue to monitor water quality to identify changes in the short-term. The sooner we detect changes in parameters such as phosphorus, chlorophyll, bacteria, or dissolved oxygen, the sooner we can adjust the management plan. Monitoring helps us respond in time to changes in the watershed that could be detrimental to the lake. Several monitoring areas need to continue:

Expanded Self-Help

- The Augusta Science Research Team provides comprehensive water testing. It also is an educational forum for the High School Biology Class. This information gets assimilated to the community nearest to Coon Fork Lake. It provides ownership by the local community.

- The Fall Creek High School Adopt-A-Lake program provides water quality testing to validate other samples. It likewise provides education in a nearby community.

- Water flow monitoring and readings taken by the Parks & Forest staff provide inputs to the computer model. The Panuska Study identifies the need to check the low flow level to verify the current findings.

- Collect and collate groundwater monitoring results by City/County Health Department, Wisconsin DNR, etc. Single events affect groundwater. Together they affect the watershed and lake. We need to continually put the data together to get an overall picture of the groundwater quality in order to protect the lake.

- Request the results of the City/County Health Department's water testing on an annual basis. This continues to build on several year's data that provides a measure of effectiveness of implementing this plan.

- Collect samples from selected stream locations in the watershed to test for fecal coliform and fecal strep bacteria.

Education
The information we have today is of interest to many people besides those involved in generating this plan. We need to disseminate information about Coon Fork Lake and its watershed in a marketable fashion. Avenues available are:

- Local news stories, libraries, town and city halls.
- Fliers and posters.
- Newsletters to watershed residents.
- County Park brochures for day users and campers.
- Lake Festival or related community involvement in an educational Lake Fair.
- High School displays depicting the water quality monitoring its students are providing.
- Health displays depicting how the general public benefits from clean lakes.
- One-on-one contact with farmers in the watershed.

All this takes financial backing. It is our intent to implement the Coon Fork Lake Management Plan with Wisconsin DNR Lake Management Funds. Other sources include:

- County staff for local management and implementation.
- Contact private organizations that have an interest in fish & wildlife projects, i.e. Ducks Unlimited, Fish America.
- USDA Riparian Buffer Program.

We will know the success of these strategies through monitoring results. If the phosphorus loading increases into the lake, the water quality will decline. Our efforts need to focus on measures, both long- and short-term, that address the sources of phosphorus and enact practices to reduce the amount of this nutrient entering the watershed. We need to evaluate the project in three years to assess the effectiveness of implementing the plan. Over the period of 2001-2003, we can inventory, rank, install and collect water samples to tell us if any significant changes are occurring. From there, as of 2004, a continued emphasis on maintaining good land use practices and testing the tributary water can direct our course.

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APPENDIX

A) Coon Fork Subwatershed (Map)

B) Coon Fork Watershed Land Use (Map)

C) Sample Site Maps:

   1) Coon Fork Watershed Study, Summer, 1996, Augusta Science Research Team

   2) City/County Health Department Sample Sites

D) Coon Fork County Park (Map)

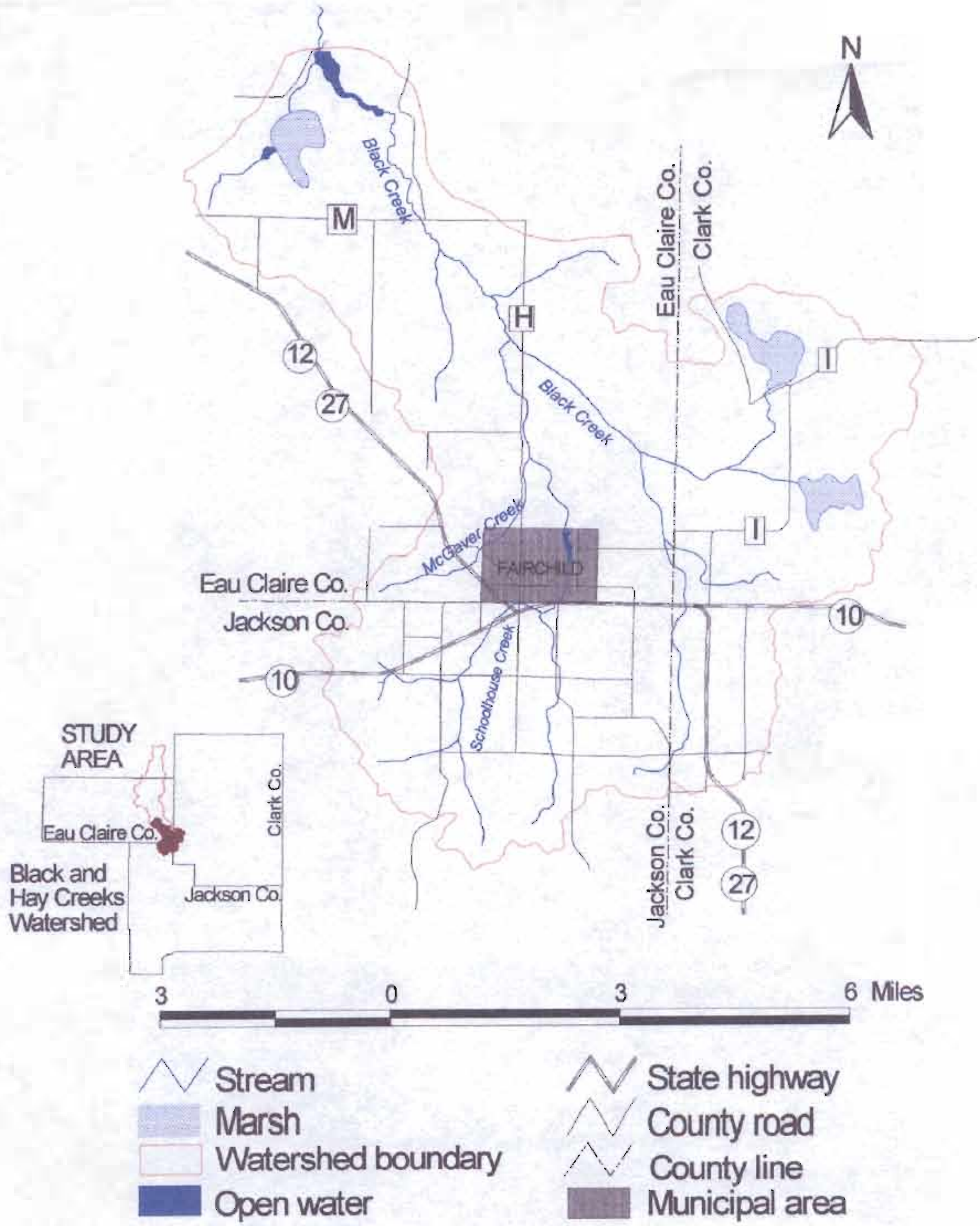
E) *The Aquatic Plant Community of Coon Fork Flowage, Eau Claire County, Wisconsin* (Report)

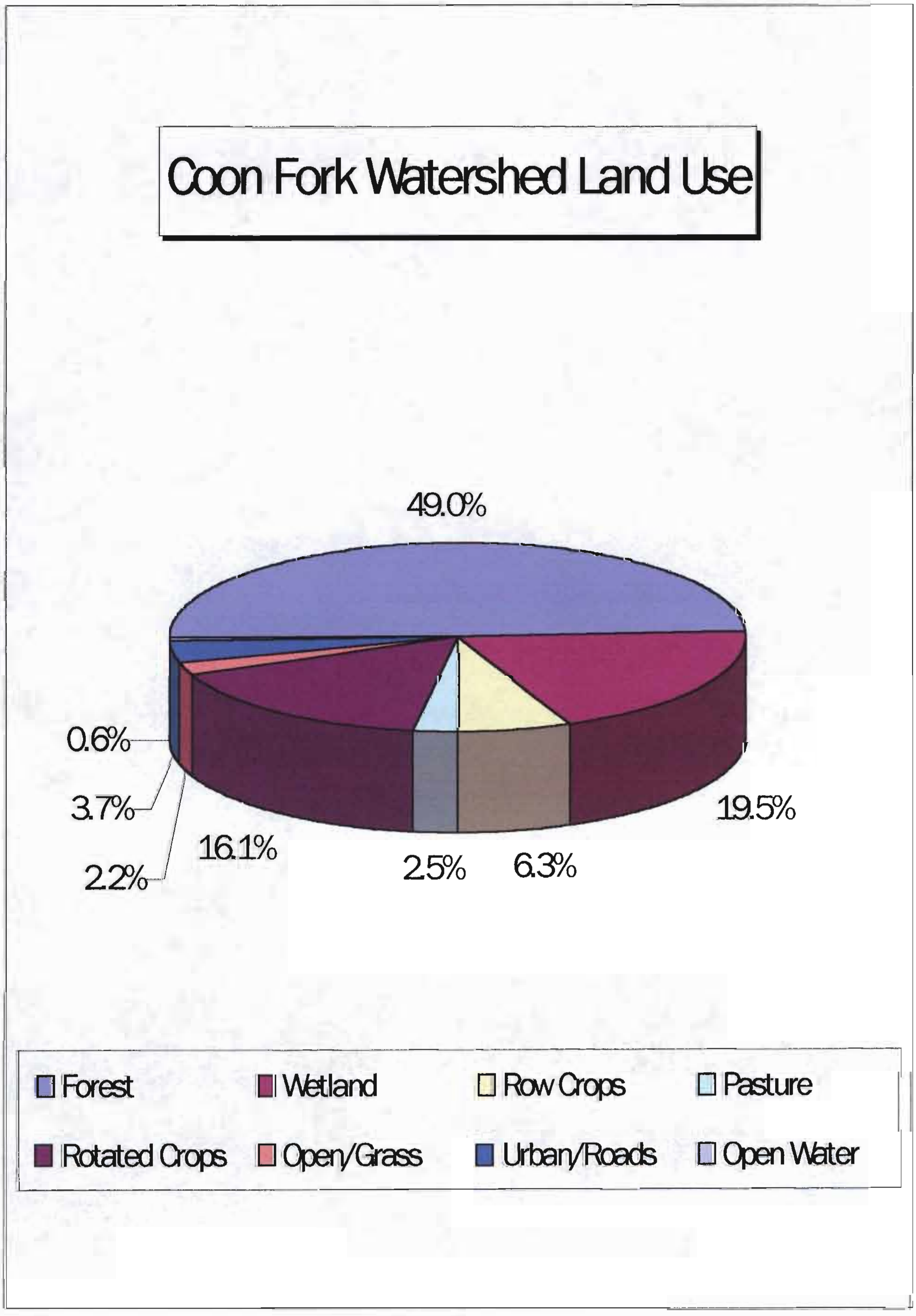
F) Water Quality Model Study for Coon Fork Reservoir, Eau Claire County (Report)

G) Natural Heritage Inventory Review..., 1998, DNR (Rob Strand)

APPENDIX A

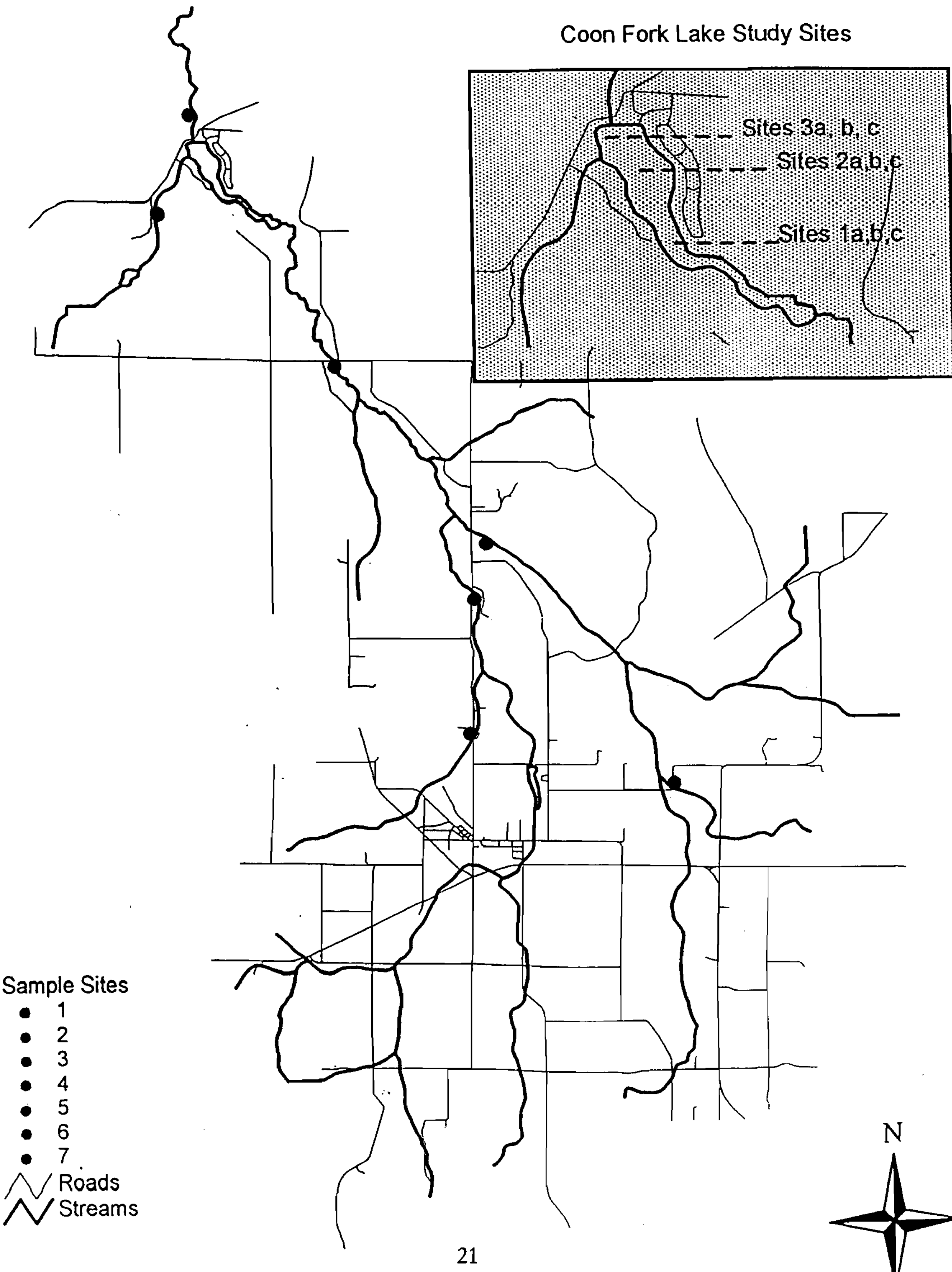
COON FORK SUBWATERSHED




Coon Fork Watershed Land Use
49.0%
0.6%
3.7%
2.2%
16.1%
2.5%
6.3%
19.5%
Forest
Wetland
Row Crops
Pasture
Rotated Crops
Open/Grass
Urban/Roads
Open Water

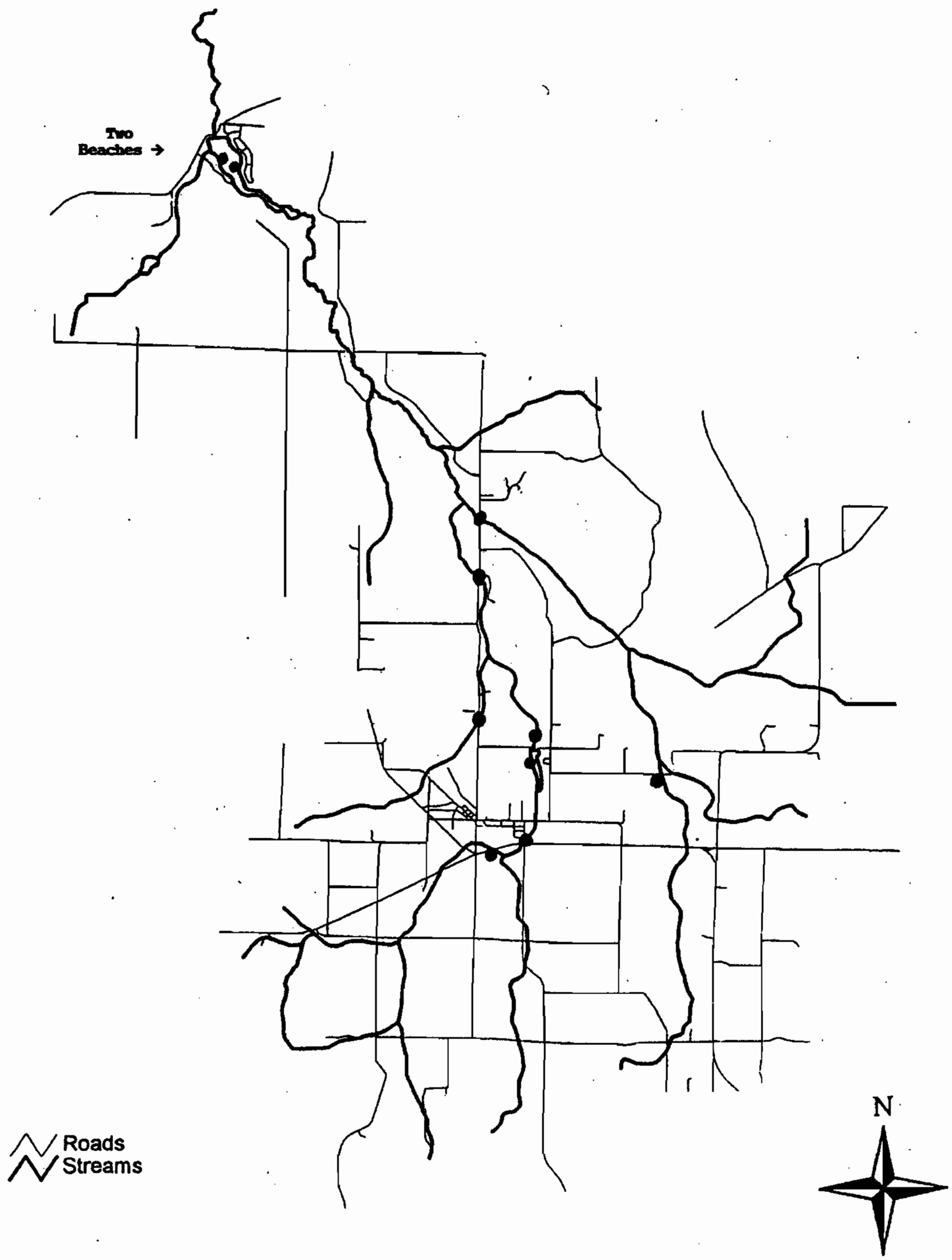
APPENDIX C-1

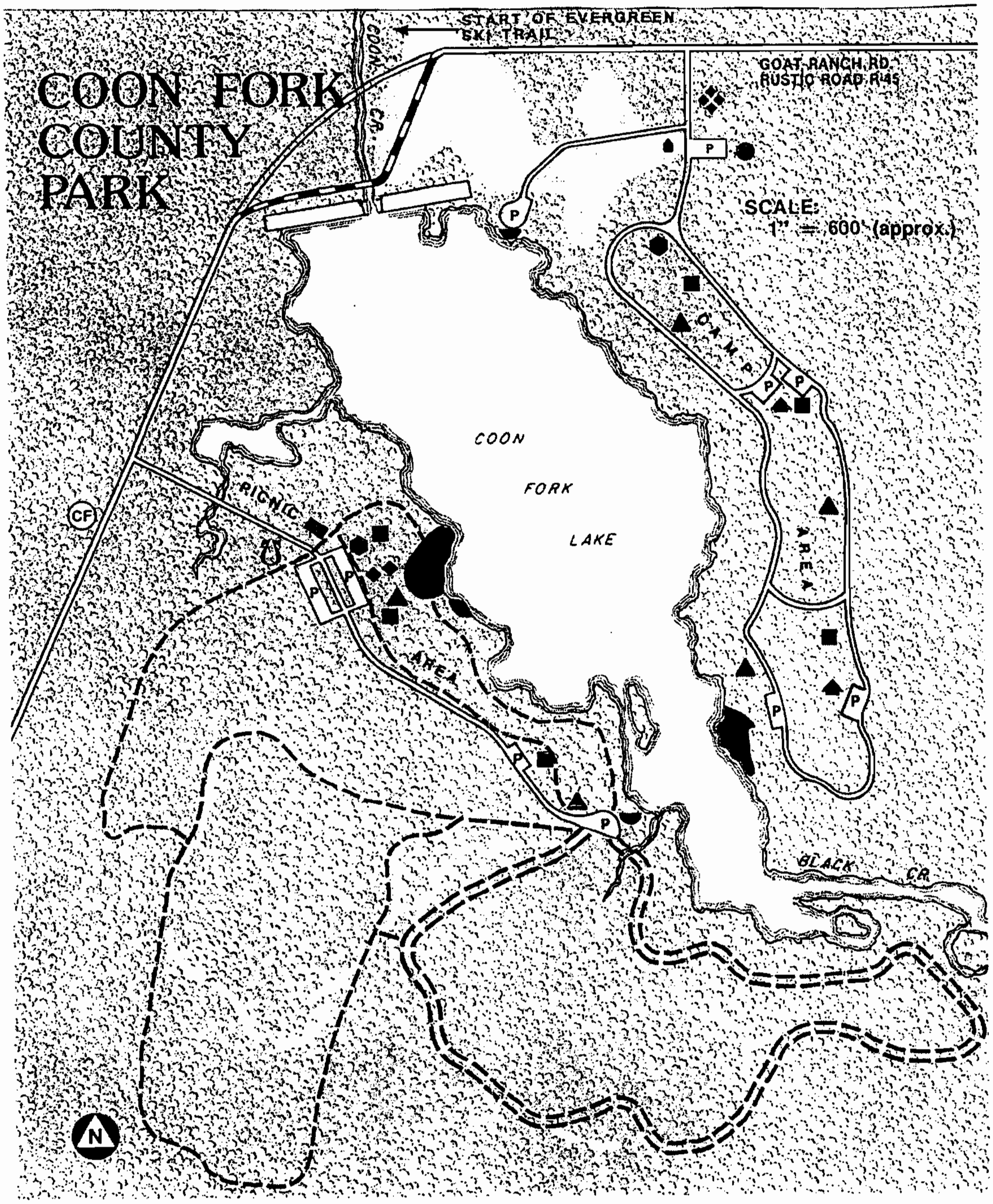
Coon Fork Watershed Study
Summer 1996
Augusta Science Research Team



APPENDIX C-2

City/County Health Department Sample Sites





LEGEND

- INFORMATION STATION
- FIREWOOD
- DRINKING WATER
- PIT TOILETS
- SHOWERS/FLUSH TOILETS
- BOAT OR CANOE LANDING
- PICNIC SHELTER
- CHANGING HOUSE (FOR SWIMMING)
- BEACH
- FOREST COVER
- PARK OFFICE
- PARKING
- NATURE TRAIL/SKI TRAIL
- SKI TRAILS
- HORSE HITCHING AREA
- SEWAGE DUMPING STATION

The Aquatic Plant Community

of

Coon Fork Flowage

Eau Claire County, Wisconsin

1997

submitted by

Deborah Konkel
and
Erik Kampa

April 1998

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The Aquatic Plant Community in Coon Fork Flowage

I. INTRODUCTION

A study of the aquatic macrophytes (plants) in Coon Fork Flowage was conducted during July 1997 by Water Resources staff of the West Central Region - Department of Natural Resources (DNR). This was the first quantitative vegetation study of Coon Fork Flowage by the DNR.

A study of the diversity, density, and distribution of aquatic plants is an essential component of understanding a lake due to the important ecological role of aquatic vegetation and the ability of the vegetation to characterize the water quality (Dennison et al. 1993).

Ecological Role: All other life in the lake depends on the plant life (including algae) - the beginning of the food chain. Aquatic plants provide food and shelter for fish, wildlife, and the invertebrates that in turn provide food for other organisms. Plants improve water quality, protect shorelines and lake bottoms, add to the aesthetic quality of the lake, impact recreation, and serve as indicators of water quality.

Characterize Water Quality: Aquatic plants serve as indicators of water quality because of their sensitivity to water quality parameters, such as water clarity and nutrient levels (Dennison et. al. 1993).

The present study will provide information that is important for effective management of the lake including fish habitat improvement, protection of sensitive wildlife areas, aquatic plant management, and water resource regulations. The baseline data that it provides will be compared to future plant inventories and offer insight into any changes occurring in the lake.

Background and History: Coon Fork Flowage is a 75-acre impoundment on the Black Creek in Eau Claire County, Wisconsin. The maximum depth of Coon Fork Flowage is 20 feet, the average depth is 8 feet and the basin volume is 600 acre feet (Figure 1).

Coon Fork Flowage was created in 1964 by a dam below the confluence of Coon Fork Creek and Black Creek. The flowage is completely within Coon Fork County Park and Eau Claire County Forest and is a popular recreation resource.

The watershed of Coon Fork Flowage includes approximately 31,701 acres. This gives a drainage area/lakes size ratio of 420:1. Lakes with drainage area/lake size ratios greater than 10:1 tend to have water quality problems (Field 1994). However, the landuse in the watershed is predominantly forest, which protects the flowage from excessive nutrient input. Though a small portion of the watershed landuse, cropland in the watershed is the largest contributor of phosphorus (Table 1). If a larger portion of the watershed was used as cropland, Coon Forks Flowage could have severe water quality problems.

Table 1. Land Use in the Coon Fork Watershed and Phosphorus Contribution of Each Landuse Type

	Acres in Watershed	Percent of Watershed	Phosphorus Contribution in Pounds	Percent of Phosphoru s Load
Forest	15,548	49%	694	10%
Cropland	7126	22%	4576	68%
Wetland	6197	20%	553	8%
Pasture/ Grassland	1477	5%	398	6%
Urban	1158	4%	519	8%
Water	195	1%		
Totals	31,701		6740	

(Sorge 1997)

In 1970, there was an oil spill on the Black Creek that contaminated Coon Fork Flowage with oil. Booms were used to contain the oil after it had already entered the lake. Absorbent material was applied to the lake in an effort to remove oil from the surface, but oil had already entered the sediment and adhered to plant material and other objects in the lake. In the early spring of 1971, the lake was drawndown 5 feet to speed the oxidation of oil in the sediment.

This macrophyte survey will provide information that will aid in formulating future management of the lake.

II. METHODS

Field Methods

The study design was based primarily on the rake-sampling method developed by Jessen and Lound (1962), using stratified random placement of the transect lines.

The shoreline was divided into 12 equal segments and a transect, perpendicular to the shoreline, was randomly placed within each segment, using a random numbers table.

One sampling site was randomly located in each depth zone (0-1.5ft., 1.5-5ft., 5-10ft., and 10-20ft.) along each transect. Using a long-handled steel thatching rake, four rake samples were taken at each sampling site. The four samples were taken from each quarter of a 6-foot square quadrat. The aquatic plant species that were present on each rake sample were recorded. Each species was given a density rating (0-5) based on the number of rake samples on which it was present at each sampling site. (A rating of 1 indicates that a species was present on one rake sample...a rating of 4 indicates that it was present on all four rake samples and a rating of 5 indicates that it was abundantly present on all rake samples at that sampling site.) The sediment type at each sampling site was also recorded.

The type of shoreline cover was recorded at each transect. A section of shoreline, 50 feet on either side of the transect intercept with the shore and 30 feet back from the shore, was evaluated. The percentage of each cover type within this 100' x 30' rectangle was visually estimated.

Visual inspection and periodic samples were taken between transect lines in order to record the presence of any species that did not occur at the sampling sites. Specimens of all plant species present were collected and saved in a cooler for later preparation of voucher specimens. Nomenclature was according to Gleason and Cronquist (1991).

Data Analysis

The percent frequency of each species was calculated (number of sampling sites at which it occurred / total number of sampling sites) (Appendix I). Relative frequency was calculated based on the number of occurrences of a species relative to total occurrence of all species (Appendix I). The mean density was calculated for each species (sum of a species' density ratings / number of sampling sites) (Appendix II). Relative density was calculated based on a species density relative to total plant densities. A "mean density where present" was calculated for each species (sum of a species' density ratings / number of sampling sites at which the species occurred) (Appendix II). The relative frequency and relative density was summed to obtain an importance value (Appendix III). Simpson's Diversity Index was calculated (Appendix I).

III. RESULTS

PHYSICAL DATA

Many physical parameters are important determinants of the type of macrophyte community that will ultimately inhabit a lake. Water quality (nutrient levels, algal levels, turbidity, pH, hardness) impact the macrophyte community as the macrophyte community can in turn modify these parameters. Lake morphology, sediment composition and shoreland land use also impact the macrophyte community.

WATER QUALITY - The trophic state of a lake is an indication of its water quality. Phosphorus concentration, chlorophyll concentration, and water clarity data are collected and combined to determine the trophic state. Eutrophic lakes are high in nutrients and therefore support a large biomass. Oligotrophic lakes are low in nutrients and support limited plant growth and smaller fish populations. Mesotrophic lakes have intermediate levels of nutrients and biomass.

Nutrients

Phosphorus is a limiting nutrient in many Wisconsin lakes. So, increases in phosphorus in a lake can feed algal blooms and excess plant growth.

1995-97 mean summer phosphorus in Coon Fork Flowage was 67 ug/l. This level of phosphorus in Coon Fork Flowage was indicative of a eutrophic lake (Table 2).

Table 2 Trophic Status

	Quality Index	Phosphorus ug/l	Chlorophyll ug/l	Secchi Disc ft.
Oligotrophic	Excellent	<1	<1	> 19
	Very Good	1-10	1-5	8-19
Mesotrophic	Good	10-30	5-10	6-8
	Fair	30-50	10-15	5-6
Eutrophic	Poor	50-150	15-30	3-4
Hypereutrophic	Very Poor	>150	>30	>3
Coon Fork Flowage 1995-97	Poor	67	21	3.2

After Lillie & Mason (1983)
Shaw et. al. (1993)

Algae

Measuring the level of chlorophyll in the water gives an indication of algal levels. Algae is natural and essential in lakes, but high algal levels can cause problems, increasing the turbidity and reducing the light available for plant growth.

1995-97 mean summer chlorophyll in Coon Fork Flowage was 21 ug/l. The chlorophyll concentration in Coon Fork Flowage indicates that it was a eutrophic lake (Table 2). The chlorophyll levels are in the eutrophic range, but less than predicted based on modelling (Panuska 1998). The lower than predicted levels are probably due to 1) the tanin stained water that reduces light penetration and light available for algal growth and 2) the short residence time of the water in Coon Fork Flowage (7 days, less than the average time needed for algal reproduction).

There were variations in the phosphorus and chlorophyll levels from year-to-year and during the year. The phosphorus levels appear to increase steadily during the summer to a high point in July and then decline.(Figure 2). Chlorophyll also increases during the summer, but on average, reaches a high point in August before declining (Figure 2).

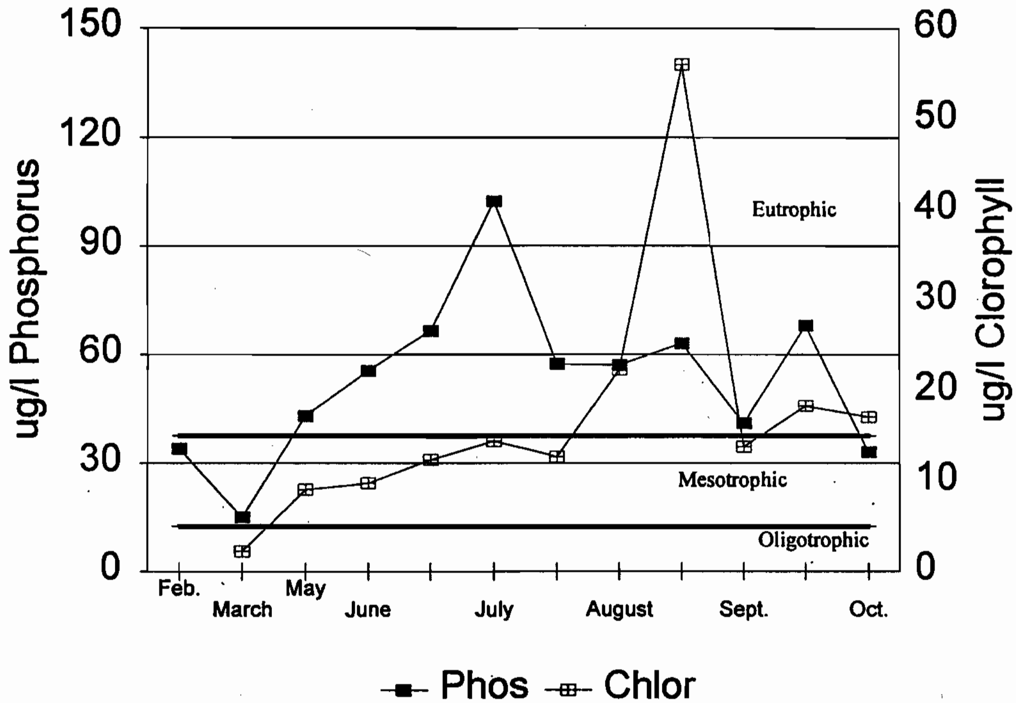

Figure 2. Seasonal change in phosphorus and chlorophyll levels.

The mean levels of phosphorus have increased slightly since 1995, from a mesotrophic level to an eutrophic level (Figure 3) but the chlorophyll levels have not shown a similar trend. Chlorophyll concentrations dropped from eutrophic levels to mesotrophic levels and increased to eutrophic levels again (Figure 3). The change in algae (chlorophyll) levels are not correlated to phosphorus levels, so algae growth may be influenced by other factors such as low light availability in stained water, short residence time of the water in the flowage, nitrogen input, summer temperatures or rainfall.

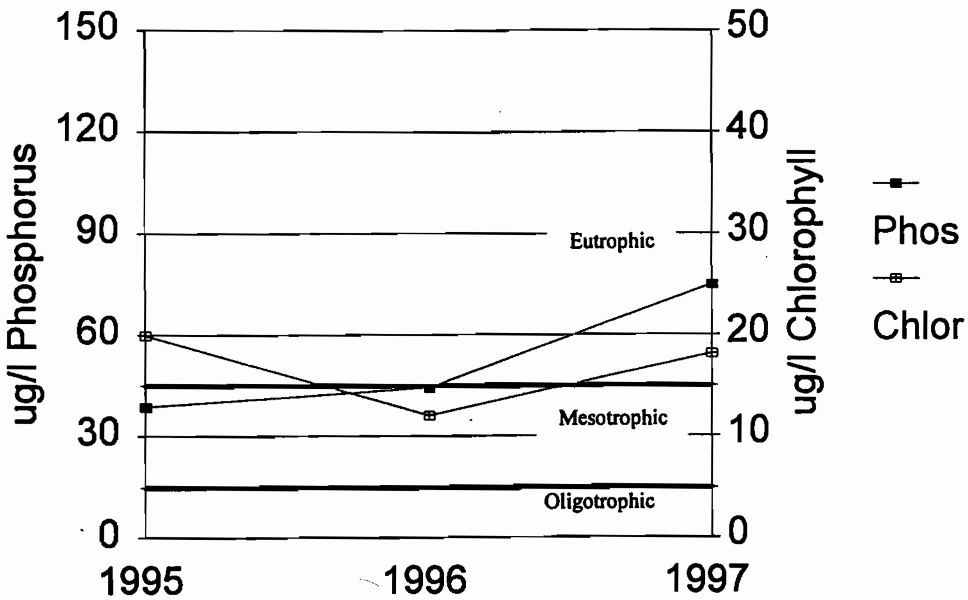

Figure 3. Change in phosphorus and chlorophyll levels 1995-1997

Students at Fall Creek High School working with Todd Kohlhepp have monitored Coon Fork Lake in 1995 and 1996 with the Self-Help Volunteer Lake Monitoring Program. Their data for phosphorus and chlorophyll concentrations were within the same range as the data collected by the DNR (Table 3). Temperature and dissolved oxygen data that the students collected indicated that the lake stratifies during the summer and results in dissolved oxygen loss in the bottom layer during late June and July. This could trigger a release of phosphorus from the sediments.

Table 3.

1995-1996 Self Help Monitoring

1995	1996	Secchi (ft.) 1995	Secchi (ft.) 1996	Chlorophyll (ug/l) 1995	Chlorophyll (ug/l) 1996	Phosphorus (ug/l) 1995	Phosphorus (ug/l) 1996	Bottom Phosphoru
May 12		3.25		13.7		39		
May 24		3.75						
June 5	June 10	3	4.33		13.3		56	45
June 20		4.5		16.3		87		
July 7		4						
July 17		3.5		0.13		37		
August 15	August 29	3.5	5.5		7.8		35	
	October 1		5					
	October 28		3.25		25.6		31	

1995 May 12			June 20			July 17		
Depth	Temp (F)	D.O. mg/l	Depth	Temp (F)	D.O. mg/l.	Depth	Temp (F)	D.O. mg/l.
1	57	12.3	1	85	8.8	1	78	8.2
4	57	10	4	76	7	4	78	6.2
7	56	10	7	75	6	7	75	6
10	53	9	10	60	0.6	10	65	0
13	50	8	13	59	0.2	12	62	0

1996 June10			Aug28					
Depth	Temp (F)	D.O. mg/l	Depth	Temp	D.O.	Depth	Temp	D.O.
1	68	9.2	1	75	9.2	1	48	11.2
4	64	7.4	4	72	9.2	4	48	11.3
7	60	6	7	70	7.6	7	48	11
10	57	5	10	68	4.8	10	48	10.6
11	57	5.5	11	65	3.4	12	48	10.2

Turbidity

Water clarity is a critical factor for plants. When plants receive less than 1 - 2% of the surface illumination, they can not survive. Water clarity is reduced by turbidity (suspended materials such as algae and silt) and dissolved organic chemicals that color the water. Water clarity can be measured with a Secchi disc that shows the combined effect of turbidity and color. Secchi disc readings can be used to calculate a predicted maximum rooting depth for plants in the lake (Dunst 1982).
1995-97 Mean summer Secchi Disc Clarity was 3.2 Ft.
Based on the Mean 1995-97 Secchi Disc Clarity, the predicted maximum rooting depth was 6.6 ft. in the lake.
The water clarity data also indicates that Coon Fork Flowage was a eutrophic lake that had poor clarity in 1995 (Table 2).

The water clarity varied during the year; water clarity was greatest in spring and fall (Figure 4).

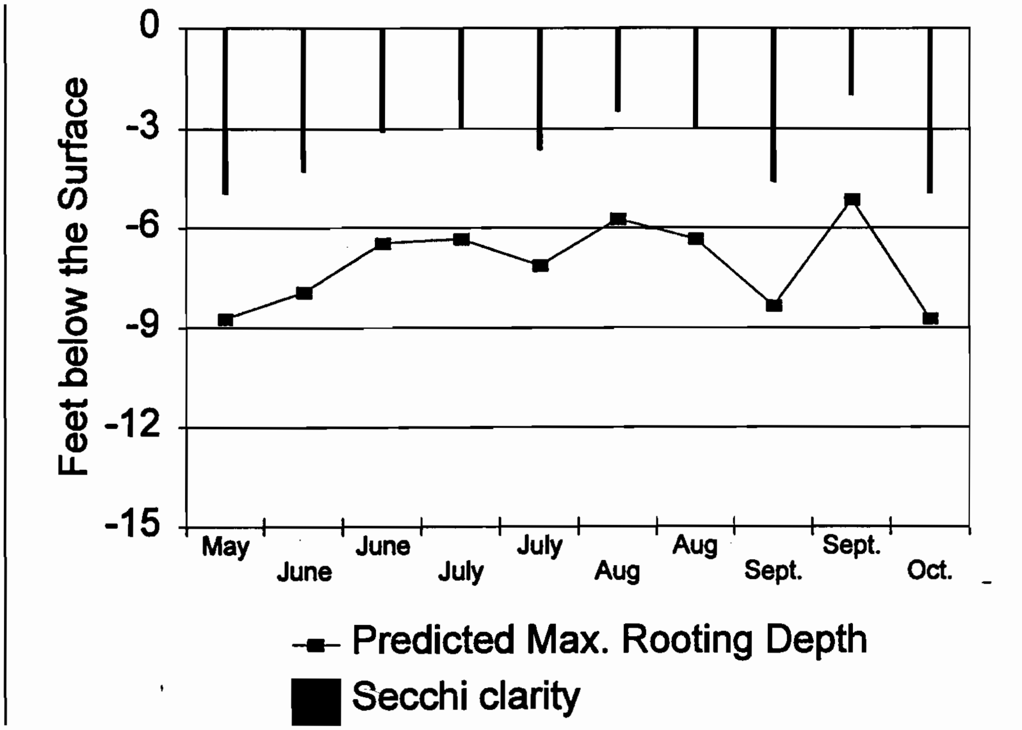

Figure 4. Water clarity in Coon Fork Flowage during the summer

Water clarity data was also collected since 1995 by students at Fall Creek High School working with Todd Kohlhepp. The clarity data collected by the Fall Creek students fall within the same range as data collected by the DNR (Table 3).

The combination of the phosphorus levels, chlorophyll levels, and clarity values indicates the trophic status of the lake. These values for Coon Fork Flowage indicate that it was a eutrophic lake. This trophic state favors abundant levels of plant or algae growth with periods of turbidity possible.

pH

The pH of a lake indicates the acidity or alkalinity of the water.

The 1995-96 mean summer pH of the surface water in Coon Fork Flowage was 7.3.

This would favor plants adapted to neutral conditions.

Hardness

The alkalinity as measured by mg. of $CaCO_3$/l indicates the hardness of the water.

The 1995-96 mean $CaCO_3$/l in Coon Fork Flowage was 16.5.

Hardness levels less than 60mg$CaCO_3$/l are considered soft water. Soft water lakes tend to have lower levels of plant growth.

LAKE MORPHOMETRY - The morphometry of a lake is an important factor in determining the distribution of aquatic plants. Duarte and Kalff (1986) found that the slope of the littoral zone could explain 72% of the observed variability in the growth of submerged plants. Gentle slopes support more plant growth than steep slopes (Engel 1985). Coon Fork Flowage has a narrow basin and a mean depth of 8 feet (Figure 1). Most of the basin has a gradually sloped littoral zone. The gradual slope and shallow depths in the upper end and inlet of Coon Fork Creek should favor plant growth.

SEDIMENT COMPOSITION - Sand, a hard (high density) sediment was the predominant (64% frequency of occurrence) sediment at the sample sites (Table 4). Sand was found throughout the lake, more commonly at depths less than 5ft.

Mixed sediments were found at 35% of the sample sites. Sand sediments mixed with silt were common throughout the lake, at depths greater than 5ft. Sand mixed with peat or other plant detritus was found in bays along the west shore. One bay was next to the dam.

Table 4. Sediment Composition

		0-1.5' Depth	5-10' Depth	Percent of all Sample Sites
Hard Sediments	Sand	92%	25%	64%
Mixed Sediments	Sand/Silt		67%	28%
	Sand/Peat	8%	8%	7%
Soft Sediments	Silt			
	Muck			

SHORELINE LAND USE - There has been an increasing awareness that land use practices strongly impact the aquatic plant community and, therefore, the entire aquatic community. Practices on shore can directly impact the plant community through increased sedimentation from erosion, increased nutrient levels from fertilizer run-off and soil erosion and increased toxics from farmland and urban run-off.

Wooded cover was the most frequently encountered shoreline cover at the transects and had the highest mean coverage. Shrub and native herbaceous growth and bare soil were also commonly encountered (Table 5).

Natural shoreline (wooded, shrub, native herbaceous) was found at 100% of the sites and had a mean coverage of 88%. Disturbed shoreline (bare soil, cultivated lawn, rip-rap, and hard structures) was found at 46% of the sites and had a mean coverage of 12%.

Table 5. Shoreline Land Use

Cover Type	Frequency of Occurrences at Transects	Mean % Coverage
Wooded	100%	53%
Shrub	69%	17%
Native Herbaceous	46%	18%
Bare Soil/Beach	30%	3%
Cultivated Lawn	15%	5%
Rip-rap	15%	4%
Hard Structures	8%	1%

MACROPHYTE DATA

SPECIES PRESENT

A total of 20 species was found in Coon Fork Flowage. Of the 20 species, 9 were emergent species, 2 were a floating-leaf species, and 9 were submergent species (Table 6). No endangered or threatened species and no non-native species were found. Two species of special concern were found: *Callitriche heterophylla, Ceratophyllum echinatum.*

Table 6. Coon Fork Flowage Aquatic Plant Species

Scientific Name	Common Name	I. D. Code
Emergent Species		
1) *Asclepias incarnata* L.	swamp milkweed	ascin
2) *Carex aquatilis* Wahlenb.	sedge	caraq
3) *Carex* sp.	sedge	carsp
4) *Glyceria canadensis* (Michx.) Trin.	rattlesnake mannagrass	glyca
5) *Iris versicolor* L.	northern blue-flag	irive
6) *Juncus tenuis* Willd.	path rush	junte
7) *Sagittaria latifolia* Willd.	common arrowhead	sagla
8) *Scirpus validus* Vahl.	softstem bulrush	sciva
9) *Typha latifolia* L.	common cattail	typla
Floating-leaf Species		
10) *Lemna trisulca* L.	forked duckweed	lemtr
11) *Spirodela polyrhiza* (L.) Schleiden.	greater duckweed	spipo
Submergent Species		
12) *Callitriche heterophylla* Pursh.	water-starwort	calhe
13) *Ceratophyllum echinatum* A. Gray.	hornwort	cerec
14) *Drepanocladus* sp.	water moss	dresp
15) *Eleocharis acicularis* (L.) Roemer & Schultes.	needle spikerush	eleac
16) *Elodea canadensis* Michx.	common water-weed	eloca
17) *Najas gracillima* (A. Braun.) Magnus	slender water-nymph	najgr
18) *Potamogeton amplifolius* Tuckerman.	large-leaf pondweed	potam
19) *Potamogeton epihydrus* Raf.	ribbon-leaf pondweed	potep
20) *Utricularia vulgaris* L.	common bladderwort	utrvu

FREQUENCY OF OCCURRENCE

Of the 20 species found in Coon Fork Flowage, 16 occurred at sampling sites. Overall, the frequency of plant growth in Coon Fork Flowage was low. The species with the highest frequency of occurrence were *Ceratophyllum echinatum* and *Elodea canadensis*, both (23%) (Figure 5).

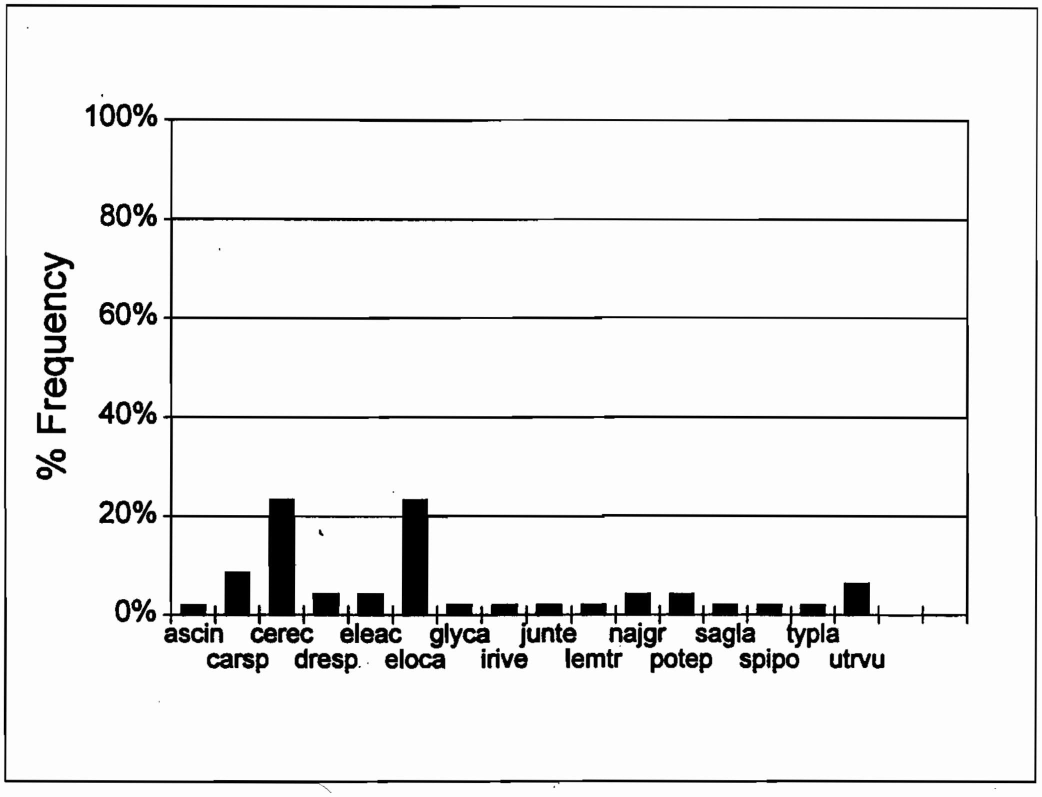

Figure 5. Macrophyte Frequencies in Coon Fork Flowage

Filamentous algae occurred at 13% of the sample sites.
38% of the 0-1.5ft. depth zone sites had filamentous algae.
0% of the 1.5-5ft. depth zone sites had filamentous algae.
8% of the 5-10ft. depth zone sites had filamentous algae.
0% of the 10-20ft. depth zone sites had filamentous algae.

DENSITY

Density of plant growth in Coon Fork Flowage was low. *Elodea canadensis* had the highest mean density (0.66 on a density scale of 1-4) of any species in Coon Fork Flowage (Figure 7). *Typha latifolia* had the highest mean density at sites at which it was present (5.0). A high density at sites at which it was present indicates that these species had dense growth form in Coon Fork Flowage (Figure 6).

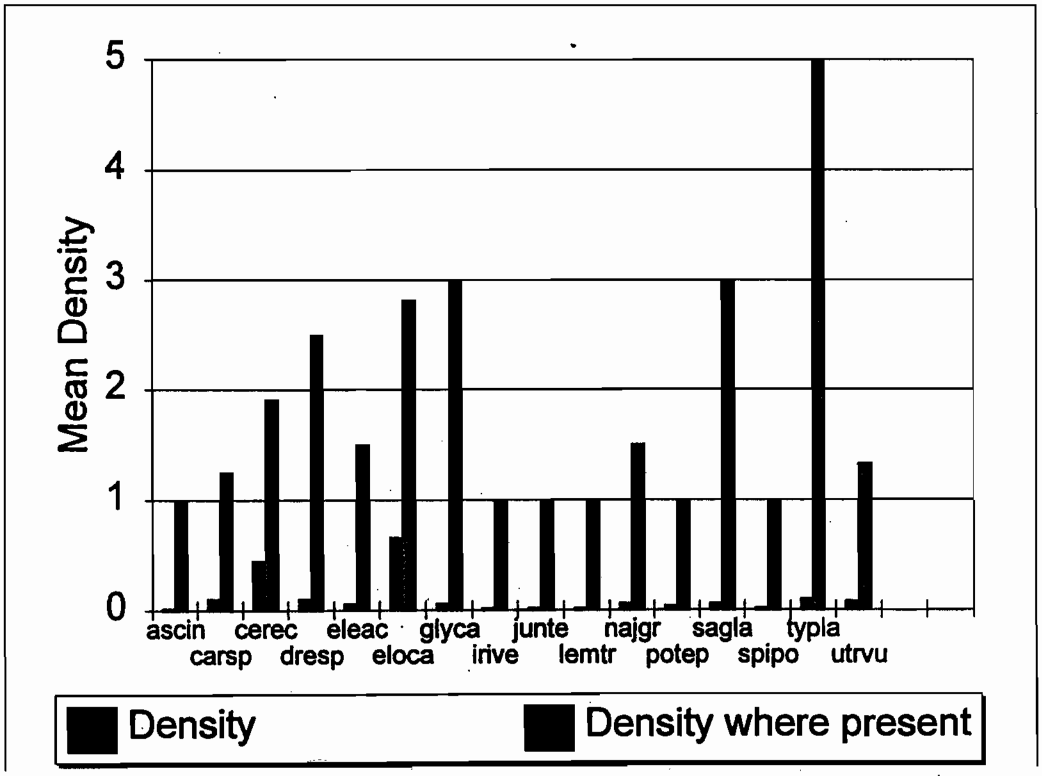

Figure 6. Densities of Macrophytes in Coon Fork Flowage

DOMINANCE

Combining relative frequency and relative density into an importance value indicates the dominance of species within the macrophyte community (Appendix III). Based on the importance value, *Elodea canadensis* was the dominant species within the macrophyte community (Figure 7). *Ceratophyllum echinatum* was sub-dominant.

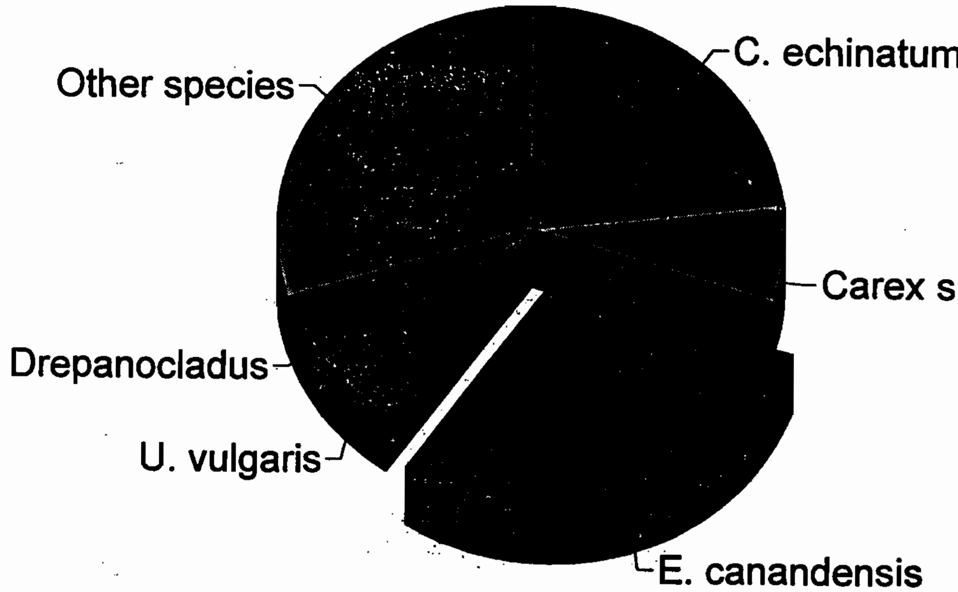

Figure 7. Dominance within the Macrophyte Community, of the Most Prevalent Macrophytes, based on Importance Value.

DISTRIBUTION

The dominant species, *Elodea canadensis* and *Ceratophyllum echinatum,* were found throughout the lake up to depths of 6.5 ft. and 8.5 ft. except along the west shore. The remainder of the species were found at low frequencies, at scattered locations.

Aquatic plants were found growing at 43% of all sampling sites. Rooted vegetation was found at 34% of the sampling sites. The maximum rooting depth was 6.5 ft., *Elodea canadensis*.

69% of the sites in the 0-1.5 ft. depth zones were vegetated.
54% of the sites in the 1.5-5 ft. depth zone were vegetated.
33% of the sites in the 5-10 ft. depth zone were vegetated.
None of the sites in the 10-20 ft. depth zone were vegetated.

The mean number of species found at each sampling site was 0.9.
In the 0-1.5' depth zone, the mean number of species per sample site was 2.4.
In the 1.5-5' zone, mean number of species per site was 0.7.
In the 5-10' depth zone, mean number of species per site was 0.3.
In the 10-20' depth zone, mean number of species per site was 0.

27 sites had 0 species
9 sites had 1 species
6 sites had 2 species
1 sites had 3 species
1 sites had 4 species
1 sites had 5 species
2 sites had 6 species

The 0-1.5 ft. depth zone had the highest total occurrence and total density of macrophytes (Figure 8). The occurrence and density of macrophyte growth decreased with increasing depth. Plant growth was not found in the 10-20ft. depth zone.

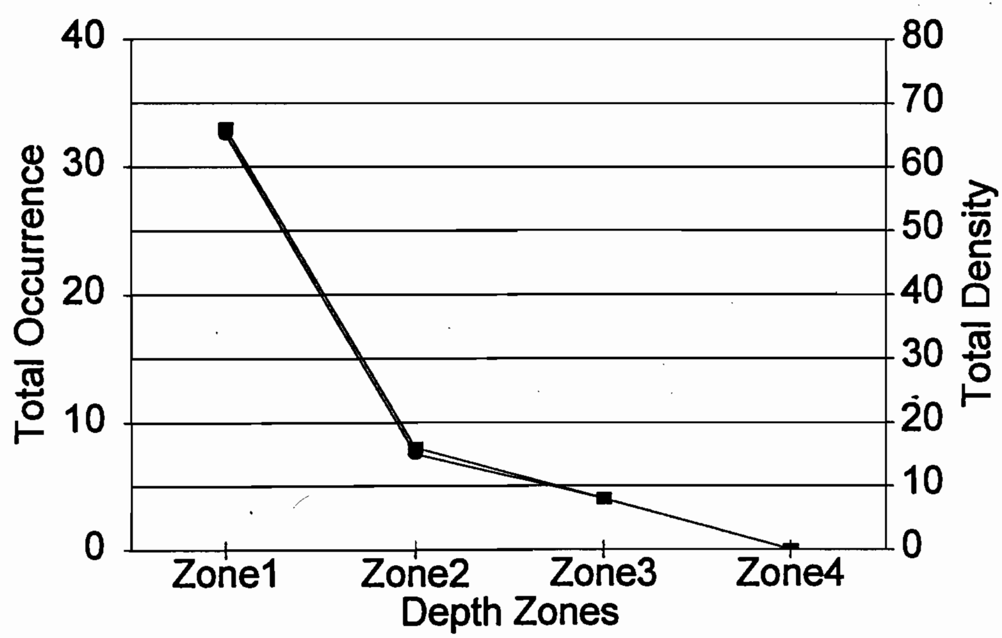

Figure 8. Total Occurrence and Density of Macrophytes by Depth Zone

The frequencies and densities of individual species varied with depth zone. *Ceratophyllum echinatum* was the most frequent and *Elodea canadensis* the most dense species in the 0-1.5 ft. depth zone (Figure 9). Both species occurred at their highest frequency and density in this depth zone (Figure 10). Their frequency and density decreased with increasing depth.

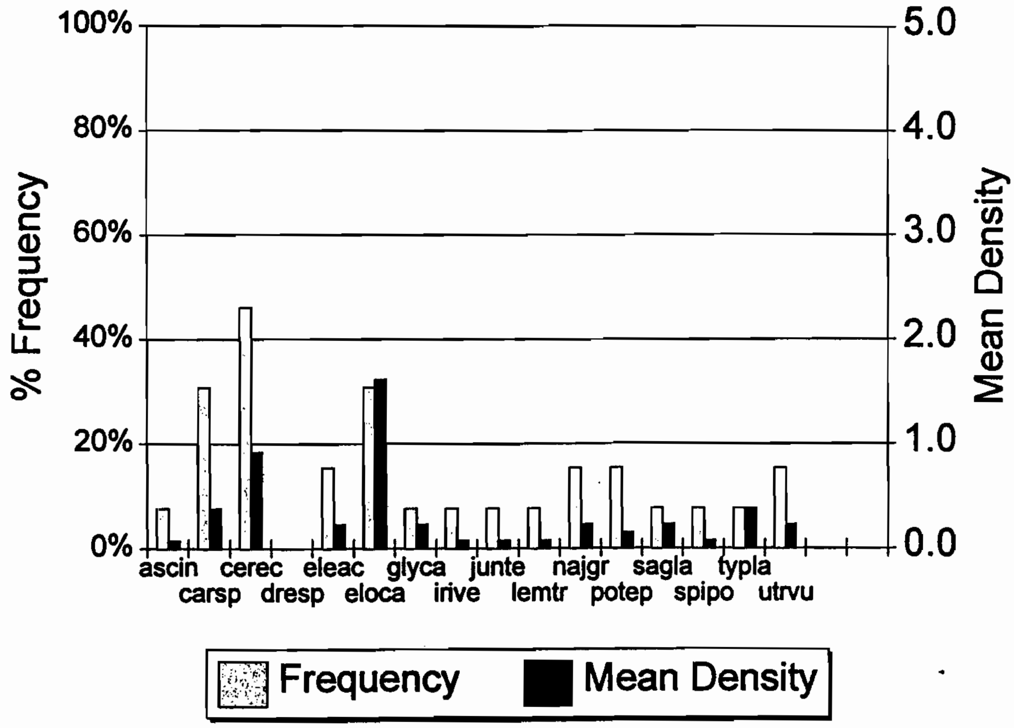

Figure 9. Macrophyte Frequencies in the 0-1.5 Foot Depth Zone.

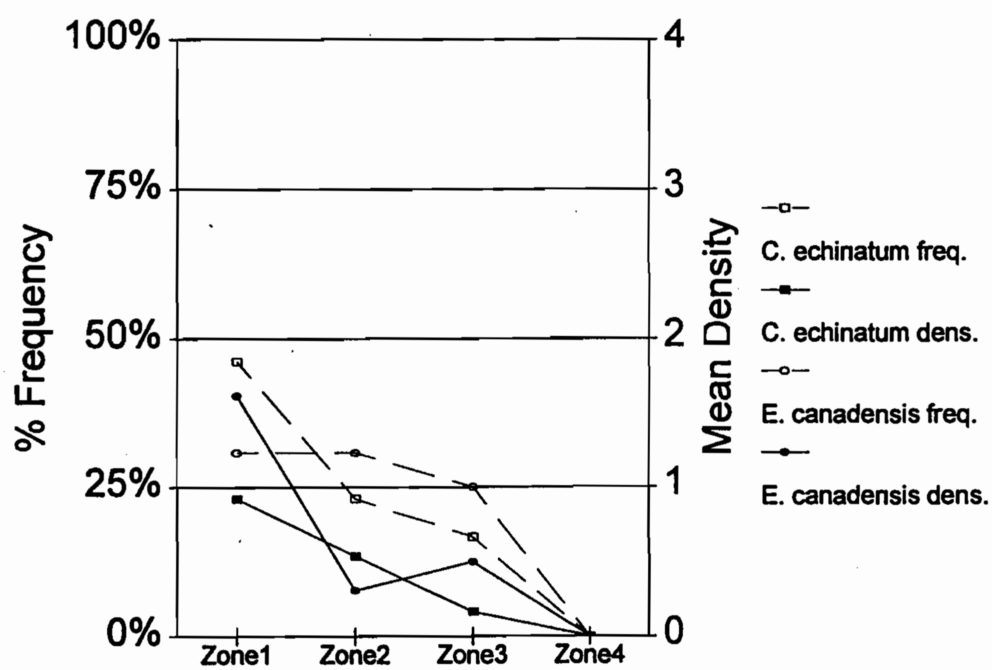

Figure 10. Frequency and density of *Ceratophyllum echinatum*, *Elodea canadensis* by depth.

Elodea canadensis was the most frequent species in the 1.5-10ft. depth zones and the most dense species in the 5-10ft. depth zone. *Ceratophyllum echinatum* was the most dense species in the 1.5-5 ft. depth zones (Figure 11).

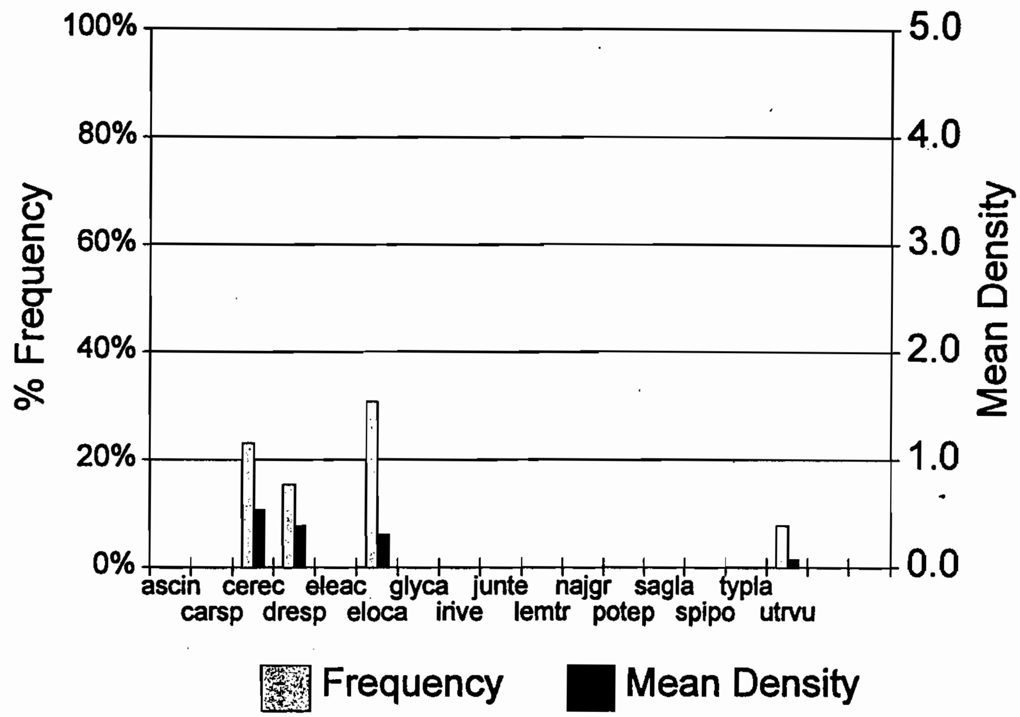

Figure 11. Macrophyte Frequencies in the 1.5-5 Foot Depth Zone.

SEDIMENT COMPOSITION - Some plants depend on the sediment in which they are rooted for their nutrients. The richness or sterility of the sediment will determine the type and abundance of macrophyte species that can survive in a location.

The availability of mineral nutrients for growth is highest in sediments of intermediate density, such as silt (Barko and Smart 1986). Highly organic muck sediments are low density; sand, gravel and rock are high density sediments.

Sand sediment was the predominant sediment found in Coon Fork Flowage. Sand mixed with silt was also commonly found. Sand sediments may limit plant growth because of the high density. In Coon Fork Flowage, 56% of the sites with sand sediment were vegetated (Table 7). Sand/silt sediments would be more favorable for plant growth, yet only 30% of these sites were vegetated. The lower vegetation rate on sand/silt sediments was probably because these sites were more predominant at deeper locations at which light conditions would not be as favorable for plant growth.

Table 7. Sediment Influence

		Percent of all sample sites	Percent vegetated
Hard Sediments	Sand	64%	56%
Mixed Sediments	Sand/Silt	28%	38%
	Sand/Peat	7%	50%
Soft Sediments	Silt		
	Muck		

THE COMMUNITY

Simpson's Diversity Index was 0.86, indicating a moderate diversity. A rating of 1.0 would mean that each species in the lake would be a different species (the most diversity achievable).

The Aquatic Macrophyte Community Index (AMCI) developed by Weber et. al. (1995) was applied to Coon Fork Flowage (Table 8). Values between 0 and 10 are given for each of six categories: maximum rooting depth, % of littoral zone vegetated, Simpson's Diversity Index, relative frequency of submersed vegetation, relative frequency of sensitive species, and ratio of native to non-native species. The highest value for this index is 60. AMCI for Coon Fork Flowage is 43. This is slightly above average (40) for lakes in Wisconsin.

Table 8. Aquatic Macrophyte Community Index

Category		Value
Maximum Rooting Depth	2.0 meters	4
% Littoral Zone Vegetated	43%	8
Simpson's Diversity	0.86	9
# of Species	20	8
% Submersed Species	71% Rel. Freq.	8
% Sensitive Species	31% Relative Freq.	6
Totals		43

V. DISCUSSION

Based on the clarity, chlorophyll and phosphorus levels in 1995-97, Coon Fork Flowage is a eutrophic lake with poor water clarity. Some of this lack of clarity is due to tanin staining, the result of wetland drainage and forests in the watershed. Stratification and periods of depleted dissolved oxygen may be allowing phosphorus to be released from the sediments. The trophic status, the gradual-sloped littoral zone and shallow depths over much of the lake would favor macrophyte growth. The soft water, limited clarity and predominance of high density sand sediments could limit macrophyte growth.

The occurrence and mean coverage of natural shoreline (wooded, shrub and native herbaceous growth) on Coon Fork Flowage was high. Preserving the buffer of natural vegetation along the shore will protect the water quality of the lake from erosion and nutrient/chemical run-off that could feed algal blooms and increase sedimentation.

Simpson's Diversity Index indicates that the macrophyte community had a moderate diversity. The Aquatic Macrophyte Community Index (AMCI) indicates that the macrophyte community in Coon Fork Flowage is slightly above average for Wisconsin lakes.

The frequency and density of plant growth in Coon Forks Flowage was low. *Elodea canadensis* was the dominant macrophyte species and *Ceratophyllum echinatum* was the sub-dominant macrophyte species in Coon Fork Flowage, based on their higher frequency of occurrence and higher mean density as compared with other species. *E. canadensis* is adapted to lower clarity conditions due to the placement of its chloroplasts near the leaf surface. Filamentous algae occurred at 13% of the sites, mostly in the shallow depth zone (0-1.5ft.).

The dominant and sub-dominant species were found throughout the lake except along the west shore. The remainder of the species were found at low frequencies in scattered locations. The predicted maximum rooting depth (6.6ft.) agrees with the actual maximum rooting depth (6.5ft.).

The highest occurrence and density of macrophytes, the highest percentage of vegetated sites and the highest mean number of species at each sample site was found in the 0-1.5 foot depth zone, the shallowest depth zone. Macrophyte occurrence, macrophyte density, percent of vegetated sites and mean number of species decreased with increasing water depth.

Many of the species in Coon Fork Flowage (*Eleocharis acicularis, Elodea canadensis, Lemna trisulca, Spirodela polyrhiza, Utricularia vulgaris, Sagittaria latifolia* and other emergents) are tolerant of lower water clarity. *Elodea canadensis* and *Spirodela polyrhiza* have been known to grow to over-abundance when there is an excess of nutrients in the lake (Nichols and Vennie 1991). Since *Elodea canadensis* is already a dominant species in Coon Fork Flowage, it is important to prevent increases of nutrients.

VI. CONCLUSIONS

Coon Fork Flowage is a eutrophic lake with algae growth common in the shallow water. The macrophyte community is slightly above average for Wisconsin lakes and characterized by moderate diversity, low frequency and low density of turbidity tolerant species. The macrophyte community is restricted to portions of the littoral zone less than 7 feet deep, but really only abundant in the 0-1.5ft. depth zone. *Elodea canadensis* is the dominant species within the plant community and *Ceratophyllum echinatum* is sub-dominant.

The low water clarity and its impact upon the macrophyte community is indicated by the turbidity tolerant species and the concentration of the macrophyte community within the 0-1.5 ft. depth zone. The lower water clarity is largely due to the natural tanin staining in the water that is common in watersheds with a high percentage of wetland and forest coverage.

A healthy aquatic plant community plays a vital role within the lake community. This is due to the role plants provide play in 1) improving water quality 2) providing valuable resources for fish and wildlife 3) resisting invasions of non-native species and 4) checking excessive growth of tolerant species that could crowd out the more sensitive species, therefore reducing the diversity.

1) Macrophyte communities improve water quality in many ways: they trap nutrients, debris, and pollutants entering a water body; they absorb and break down some pollutants; they reduce erosion by damping wave action and stabilizing shorelines and lake bottoms; they remove nutrients that would otherwise be available for algae blooms (Engel 1985).

2) Aquatic plant communities provide important fishery and wildlife resources. Plants (including algae) start the food chain that supports many levels of wildlife, and at the same time produce oxygen needed by animals. Plants are used as food, cover and nesting/spawning sites by a variety of wildlife and fish. Cover within the littoral zone should be about 25-85% to support a healthy fishery.

Compared to non-vegetated lake bottoms, macrophyte beds support larger, more diverse invertebrate populations that in turn will support larger and more diverse fish and wildlife populations (Engel 1985). Additionally, mixed stands of macrophytes support 3-8 times as many invertebrates and fish as monocultural stands (Engel 1990). Diversity in the plant community creates more microhabitats for the preferences of more species. Macrophyte beds of moderate density support adequate numbers of small fish without restricting the movement of predatory fish (Engel 1990).

The macrophytes in Coon Fork Flowage provides 43% cover within the littoral zone and woody structure provided 23% cover for fish habitat, more common in the 1.5-10ft. depth zone (23%). This amount of macrophyte growth and woody structure provides adequate cover without limiting fish and wildlife use because of over-abundance. The plants in Coon Fork Flowage provide many other benefits to wildlife and fish (Table 9).

As part of the Eau Claire County Park System, it is important to protect the resources and water quality in Coon Fork Flowage. Important measures to protecting water quality would be to:

1) preserve the forested character of the watershed to prevent nutrient enrichment from erosion, agricultural runoff, and the increased runoff that results from increased of hard surface development. This is especially important since the ratio of watershed size to lake size is high and could have overwhelming impacts on the lake water quality.
2) preserve the natural buffer zones of native vegetation along the shore. Unmowed native vegetation reduces and filters the run-off into the lake.
3) prevent any other increase in nutrients from entering the lake. Since the dominant species, *Elodea canadensis*, can grow to nuisance conditions when nutrients increase, Coon Fork Flowage could quickly turn into a lake with dense plant growth if nutrients increased.

These practices will protect the water quality and wildlife habitat in Coon Fork Flowage, a popular public recreation resource in Eau Claire County.

Table 9. **Wildlife Uses of Aquatic Plants in Coon Fork Flowage**

Aquatic Plants	Fish	Water Fowl	Shore Birds	Upland Birds	Muskrat	Beaver	Deer
Submergent Plants							
Eleocharis acicularis	S	F			F		
Elodea canadensis	C, I	F, I					
Najas gracillima	F, C	F*					
Potamogeton amplifolius	F, I, C	F*					
Potamogeton epihydrus	F, C	F			F		
Floating-leaf Plants							
Lemna trisulca		F*, I					
Spirodela polyrhiza	F	F		F			
Emergent Plants							
Carex aquatilis		F					
Glyceria sp.		F			F*		F*
Iris versicolor		F, C	F		F		
Sagittaria latifolia		F	F	F	F	F	
Scirpus validus	F, C, I	F*	F	F	F		
Typha latifolia	F, I	F, C	F, C		F*, C*	F	

F=Food, I= Shelters Invertbrates, a valuble food source C=Cover, S=Spawning
***=Valuable Resource in this category**

*Current knowledge as to plant use. Other plants may have uses that have not been determined.

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APPENDICES

Aquatic Plant Frequency Spreadsheet

Species	Total Occur.	Occurrence DepthZone1	Occurrence DepthZone2	Occurrence DepthZone3	Occurrence DepthZone4	%Freq.	%Freq. w.veg.	Relative Freq.	Freq. Zone1	Freq. Zone2	Freq. Zone3
Asclepias incarnata	1.00	1.00				2.13%	5.00%	0.02	7.69%		
Carex sp.	4.00	4.00				8.51%	20.00%	0.09	30.77%		
Ceratophyllum echinatum	11.00	6.00	3.00	2.00		23.40%	55.00%	0.24	46.15%	23.08%	16.67%
Drepanocladus sp.	2.00		2.00			4.26%	10.00%	0.04		15.38%	
Eleocharis acicularis	2.00	2.00				4.26%	10.00%	0.04	15.38%		
Elodea canadensis	11.00	4.00	4.00	3.00		23.40%	55.00%	0.24	30.77%	30.77%	25.00%
Glyceria canadensis	1.00	1.00				2.13%	5.00%	0.02	7.69%		
Iris versicolor	1.00	1.00				2.13%	5.00%	0.02	7.69%		
Juncus tenuis	1.00	1.00				2.13%	5.00%	0.02	7.69%		
Lemna trisulca	1.00	1.00				2.13%	5.00%	0.02	7.69%		
Najas gracillima	2.00	2.00				4.26%	10.00%	0.04	15.38%		
Potamogeton epihydrus	2.00	2.00				4.26%	10.00%	0.04	15.38%		
Sagittaria latifolia	1.00	1.00				2.13%	5.00%	0.02	7.69%		
Spirodela polyrhiza	1.00	1.00				2.13%	5.00%	0.02	7.69%		
Typha latifolia	1.00	1.00				2.13%	5.00%	0.02	7.69%		
Utricularia vulgaris	3.00	2.00	1.00			6.38%	15.00%	0.07	15.38%	7.69%	
Totals	45.00	30.00	10.00	5.00		95.74%		1.00			

Number sample sites	47.00
Sample sites/veg	20.00
Number open sites	27.00
%Open	0.57

Simpson's Diversity	0.86	7.40	0.14	0.86

Zone1 sites	13.00
Zone2 sites	13.00
Zone3 sites	12.00
Zone4 sites	9.00

Appendix II. Coon Fork Flowage

Aquatic Plant Density Spreadsheet

Species	Total Density	Density DepthZone1	Density DepthZone2	Density DepthZone3	Density DepthZone4	Mean Density	MeanDens w.pres.	Relative Density	Density Zone1	Density Zone2	Density Zone3
Asclepias incarnata	1.00	1.00				0.02	1.00	0.01	0.08		
Carex sp.	5.00	5.00				0.11	1.25	0.06	0.38		
Ceratophyllum echinatum	21.00	12.00	7.00	2.00		0.45	1.91	0.23	0.92	0.54	0.17
Dreapnocladus sp.	5.00		5.00			0.11	2.50	0.06		0.38	
Eleocharis acicularis	3.00	3.00				0.06	1.50	0.03	0.23		
Elodea canadensis	31.00	21.00	4.00	6.00		0.66	2.82	0.34	1.62	0.31	0.50
Glyceria canandensis	3.00	3.00				0.06	3.00	0.03	0.23		
Iris versicolor	1.00	1.00				0.02	1.00	0.01	0.08		
Juncus tenuis	1.00	1.00				0.02	1.00	0.01	0.08		
Lemna trisulca	1.00	1.00				0.02	1.00	0.01	0.08		
Najas gracillima	3.00	3.00				0.06	1.50	0.03	0.23		
Potamogeton epihydrus	2.00	2.00				0.04	1.00	0.02	0.15		
Sagittaria laltifolia	3.00	3.00				0.06	3.00	0.03	0.23		
Spirodela polyrhiza	1.00	1.00				0.02	1.00	0.01	0.08		
Typha latifolia	5.00	5.00				0.11	5.00	0.06	0.38		
Utricularia vulgaris	4.00	3.00	1.00			0.09	1.33	0.04	0.23	0.08	
Totals	90.00	65.00	17.00	8.00		1.91		1.00			

Aquatic Plant Importance

Species	Importance Value
Asclepias incarnata	0.03
Carex sp.	0.14
Ceratophyllum echinatum	0.48
Dreapnocladus sp.	0.10
Eleocharis acicularis	0.08
Elodea canadensis	0.59
Glyceria canandensis	0.06
Iris versicolor	0.03
Juncus tenuis	0.03
Lemna trisulca	0.03
Najas gracillima	0.08
Potamogeton epihydrus	0.07
Sagittaria laltifolia	0.06
Spirodela polyrhiza	0.03
Typha latifolia	0.08
Utricularia vulgaris	0.11
Total	2.00

Appendix IV. COON FORK FLOWAGE Macrophyte Data - July 22, 1997
Species Found at Transects and Density Ratings
(Density rating range: 1=sparse; 5=over abundant)

Transect	Species Density Depth: 0-1.5'	Species Density Depth: 1.5-5'	Species Density Depth: 5-10'	Species Density Depth: 10-20'
1	**1' sand** lemtr1 spipo1 (fa)	**4'** no vegetation	**5.5' sand/silt** eloca1	**11'** no vegetation
2	**0.5' sand** cerec2 eleac2 eloca4 potep1 sagla3 utrvu2 (fa)	**3'** eloca1	**6' sand/silt** eloca3 (fa)	no depth > 10'
3	**1' sand** no vegetation	**3'** dresp1 eloca1	**5.5' sand/silt/rubble** no vegetation	**13'** no vegetation
4	**1' sand** eleac1	**4.5'** no vegetation	**9' sand** no vegetation	**10'** novegetation
5	**0.5' sand** carsp2 cerec1 eloca3 irive1 potep1 (fa)	**4'** cerec1 eloca1	**8.5' sand** cerec1	**10.5'** no vegetation
6	**1.5' sand** cerec1 najgr1typla5 (fa)	**4.5'** no vegetation	**6.5' sand/silt** cerec1 eloca2	**13.5'** no vegetation
7	**0.5' sand/rubble/peat** carsp1 cerec1	**3'** cerec5	**7' sand/silt** no vegetation	**10.5'** no vegetation
8	**1' sand** carsp1 cerec3 eloca4 najgr2	**4'** cerec1	**9' sand/silt** no vegetation	no depth > 10'
9	**1' sand** no vegetation	**2.5'** dresp4	**8' sand/silt** no vegetation	**10.5'** no vegetation
10	**0.5' sand** glyca1 junte1	**3.5'** no vegetation	**7' sand/silt** no vegetation	**11'** no vegetation
11	**1' sand** no vegetation	**3.5'** no vegetation	**9' sand/detritus** no vegetation	no depth > 10'
12	**1' sand** no vegetation	**3.5' sand** no vegetation	no depth > 5'	no depth >5'
12a	**1' sand** ascin1 carsp1 cerec4 eloca3 glyca2 utrvu1 (fa)	**4' sand** eloca1 utrvu1	**8' sand** no vegetation	**13' sand** no vegetation

APPENDIX F

Water Quality Model Study

for

Coon Fork Reservoir, Eau Claire County

Prepared By:

John Panuska

WI Department of Natural Resources

December 1997

Description of Study Area

The Coon Fork Lake subwatershed is an approximately 61,000 acre subwatershed of the Black and Hay Creeks watershed. It lies at the junction of Eau Claire, Clark, and Jackson counties in west central Wisconsin (Figure 1).

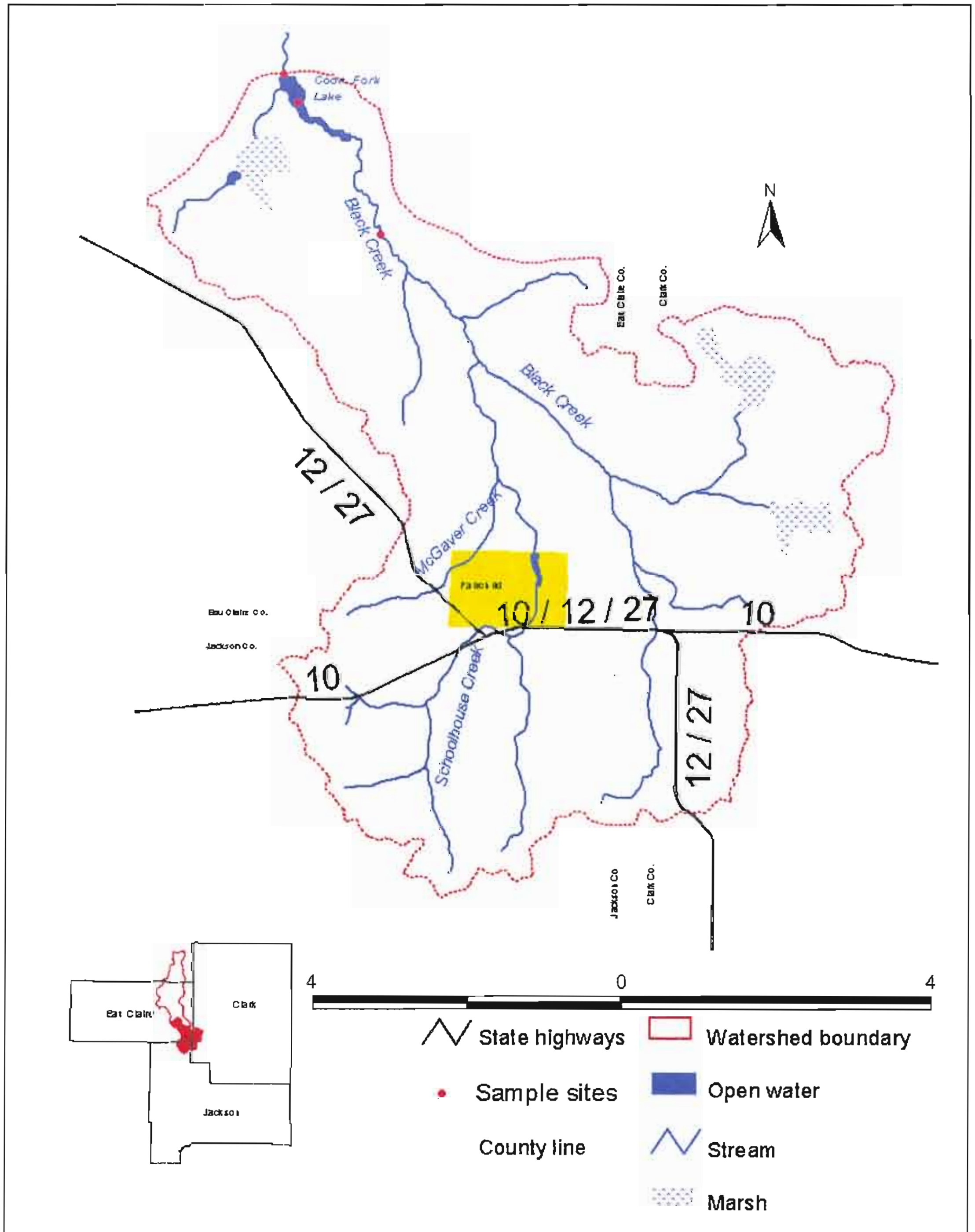


Figure 1. The Coon Fork Lake subwatershed

Forests and wetlands make up a majority (69%) of the land use within the watershed (Figure 2). There is also a significant percentage of land use in agriculture (26%).

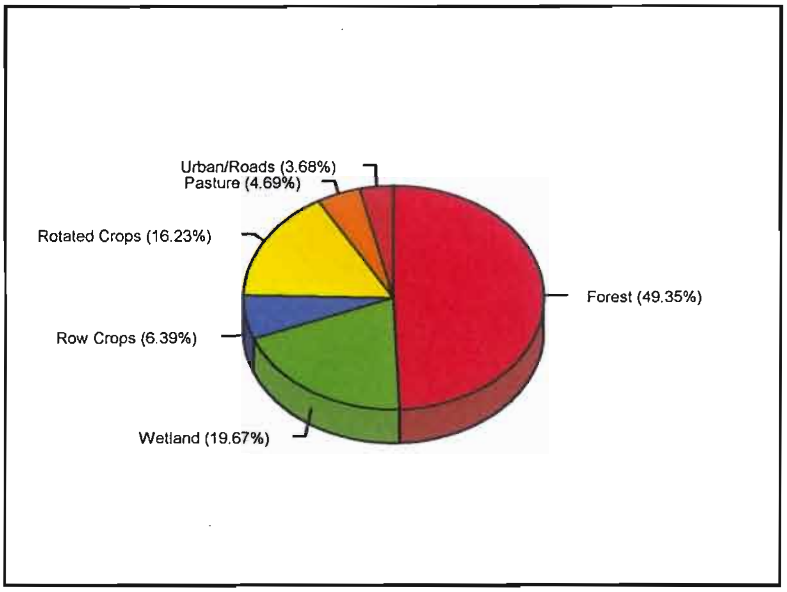


Figure 2. Land use in the Coon Fork Lake subwatershed

The Coon Fork flowage was created in 1964 as an impoundment below the confluence of the Coon Fork and Black Creeks. The flowage has an area of 75 acres, a maximum depth of 20 feet, and an average depth of 8 feet. Previous water chemistry monitoring indicated that the lake had moderate to high phosphorous levels and relatively low chlorophyll a levels.

Background

Coon Fork Lake is a regionally important recreational resource. There are limited open water resources in close geographic proximity to the lake. The lake lies near several small (Augusta, Fall Creek, Osseo) and one moderately (Eau Claire) sized communities. Development by Eau Claire County around the lake includes a day beach with handicapped accessible facilities, a large campground with amenities, and hiking trails. Internal combustion motors are not allowed on the lake.

Recent monitoring by the Eau Claire City-County health department have resulted in occasional beach closing due to high bacteria levels including *E. coli* . The lake has also experienced occasional late summer algae blooms (Farmer, 1998).

The Village of Fairchild proposed a POTW discharge to Black Creek upstream of Coon Fork Lake. Water quality monitoring predicted this discharge would significantly increase nutrient loading to Coon Fork Lake and degrade water quality. This assessment indicated water quality was threatened from existing nutrient loading conditions.

In order to adequately assess the existing nutrient inputs and in-lake nutrient dynamics, models with an appropriate level of sophistication were selected (Sorge, 1997). The models used in this analysis included a tributary flow and loading model and a reservoir trophic response model (Panuska, 1997). The tributary loading model used was the Corps of Engineers (COE) FLUX model, while the reservoir was modeled using the COE BATHTUB model (Walker, 1996) and the WILMS model (Panuska, 1996).

Following model selection, necessary data inputs for modeling were enumerated. The general data types included: in-lake water quality, daily lake level and influent/effluent, daily rainfall data, and water chemistry and flow data for the main tributary (Black Creek).

It was also determined early in development of the study design that volunteers would be necessary to collect a significant portion of the data. The use of volunteers was dictated by both the amount and type of data required for input into the selected models. Both the FLUX and BATHTUB models are data intensive (e.g. daily flow and precipitation data). Additionally, the logistics of data collection were prohibitive. It was necessary to monitor the stream dynamics and collect data during rainfall "events".

Data was collected by WDNR - West Central Region staff, Eau Claire County Parks and Forests and City-County Health Department staff, and student volunteers from Augusta High School.

Methods

The study was conducted from May through October of 1997. Lake data was collected at a single mid-lake site during turnover (spring and fall) and bimonthly during the growing season (June through August). In-lake water quality parameters included Secchi depth and a profile of dissolved oxygen, temperature, pH, and conductivity. Additionally, samples were collected and shipped to the Wisconsin State Lab of Hygiene (SLOH) for analysis of chlorophyll a, total phosphorous, and the nitrogen series (including inorganic and organic forms). Lake level data was collected daily with a staff gauge placed in the lake, near the dam.

Eighteen (18) grab samples and instantaneous flow readings were collected from Black Creek (approximately 100 feet downstream of the County Road M bridge crossing, Figure 1) between May 14th and October 16th. Twelve (12) biweekly base flow samples and six (6) event samples were collected. A flow rating curve was developed for Black Creek to estimate flows during events when the flow was too great to be safely measured. Grab samples were collected, iced, and shipped to the SLOH for total phosphorous, ortho phosphorous, and total suspended solids analysis. A number of flow readings were also taken downstream of the dam to be used to develop the dam's outflow rating curve.

Daily precipitation was monitored at the Coon Fork County Park, the Fairchild Ranger Station, and the Eau Claire airport. The park site is adjacent to the reservoir and the Fairchild site lies within the tributary drainage area (approximately six miles upstream). The Eau Claire site was not within the drainage area but provides data to be used for comparing rainfall to a long-term record.

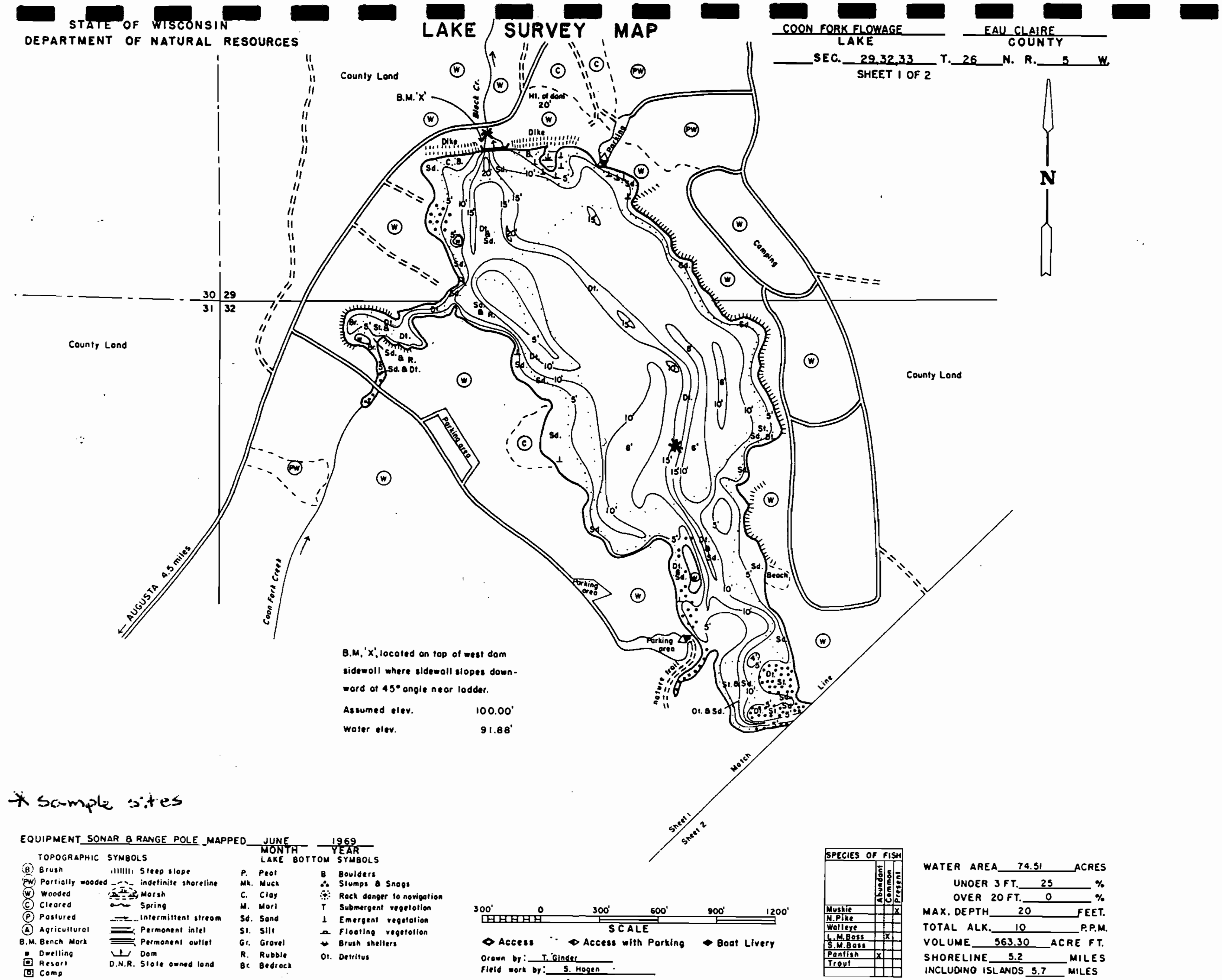
One primary objective of this study was to provide adequate quality assurance / quality control (QA/QC) procedures. This was a particularly important consideration in this study because of the diverse group of people collecting data. QA/QC procedures included extensive training, careful selection of gauge placement, providing all necessary materials, and providing detailed instructions (hardcopy). Additionally, a random portion of the data collected by volunteers was replicated by department staff for verification.

Results and Discussion

Lake monitoring results confirmed that Coon Fork Lake has moderate phosphorous levels and relatively low chlorophyll a levels (Figure 3, Appendix A). Average total phosphorous levels during the growing season were 80 ug/l. The average level for impoundments in Wisconsin is between 60 and 70 (Lillie and Mason, 1983).

Model calibration indicated that the *chlorophyll a* response is about 41% of what would be expected in a non-stained reservoir (Panuska, 1997). The staining in Coon Fork Lake is due to the organic acids (especially tannins) leached from the wetlands within the watershed. The dark color of the water limits the amount of light that penetrates the water column. The reduced light availability limits algae, as well as macrophyte, growth.

Additionally, the residence time, or "flushing rate", of the flowage plays a role in the trophic response to phosphorous loading (Panuska, 1997). Coon Fork Lake has an approximate residence time of seven days during normal flow years (Sorge, 1997). Based on analysis conducted by William Walker, systems with hydraulic detention time less than fourteen days would not be responsive to phosphorous.


STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES
LAKE SURVEY MAP
COON FORK FLOWAGE
LAKE
EAU CLAIRE
COUNTY
SEC. 29,32,33 T. 26 N. R. 5 W.
SHEET 1 OF 2
N
County Land
B.M.'X'
Black Cr.
Ht. of dam 20'
Dike
Parking
Camping
Parking area
Parking area
Parking area
nature trail
Beach
Coon Fork Creek
AUGUSTA 4.5 miles
30 29
31 32
Match Line
Sheet 1
Sheet 2
B.M. 'X', located on top of west dam sidewall where sidewall slopes downward at 45° angle near ladder.
Assumed elev. 100.00'
Water elev. 91.88'
* sample sites
EQUIPMENT SONAR & RANGE POLE MAPPED JUNE 1969
MONTH YEAR
TOPOGRAPHIC SYMBOLS
(B) Brush
(PW) Partially wooded
(W) Wooded
(C) Cleared
(P) Pastured
(A) Agricultural
B.M. Bench Mark
Dwelling
Resort
Camp
Steep slope
indefinite shoreline
Marsh
Spring
Intermittent stream
Permanent inlet
Permanent outlet
Dam
D.N.R. State owned land
LAKE BOTTOM SYMBOLS
P. Peat
Mk. Muck
C. Clay
M. Marl
Sd. Sand
St. Silt
Gr. Gravel
R. Rubble
Bc. Bedrock
B Boulders
Stumps & Snags
Rock danger to navigation
T Submergent vegetation
Emergent vegetation
Floating vegetation
Brush shelters
Dt. Detritus
300' 0 300' 600' 900' 1200'
SCALE
Access
Access with Parking
Boat Livery
Drawn by: T. Ginder
Field work by: S. Hogen
SPECIES OF FISH
Abundant Common Present
Muskie X (Present)
N.Pike
Walleye
L.M.Bass X (Common)
S.M.Bass
Panfish X (Abundant)
Trout
WATER AREA 74.51 ACRES
UNDER 3 FT. 25 %
OVER 20 FT. 0 %
MAX. DEPTH 20 FEET.
TOTAL ALK. 10 P.P.M.
VOLUME 563.30 ACRE FT.
SHORELINE 5.2 MILES
INCLUDING ISLANDS 5.7 MILES