McCASLIN LAKE

MANAGEMENT PLAN

JUNE, 1997

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McCaslin Lake
Management Plan

McCaslin Lake is a shallow 74-acre lake located in northwestern Marinette County. The lake is moderately developed with 29 cottages and homes located on the shoreline. The property owners of McCaslin Lake have a long history of working to protect and improve their lake, including the formation of a Lake District in 1980. The District contracted with the Marinette County Land & Water Conservation Department (LWCD) in 1995 to produce a comprehensive Lake Management Plan. The purpose of this plan is to explore lake management options and assist the McCaslin Lake District in future management decisions.

Geology & Setting

McCaslin Lake is a mixed drainage lake, which means it receives most of its water from overland drainage. With a maximum depth of 10 feet the lake remains well mixed throughout the year. McCaslin Lake has a volume of almost 347 acre feet, or 113 million gallons of water. More than 75% of the lake is less than 6 feet deep (see figure 1).

McCaslin Lake is fed by Smith Creek which drains much of the southern slope of McCaslin Mountain. The entire area draining to the lake, known as the watershed, is approximately 1,140 acres in size. The watershed is primarily forested land (981 acres) and wetland (133 acres). Approximately 26 acres of residential development and roads drain to the lake.

The outlet of McCaslin Lake drains to the Three Little Lakes located north of McCaslin Lake along Harvey's Lane. These lakes drain not only McCaslin Lake, but several hundred acres of additional watershed area. Three Little Lakes are groundwater recharge lakes. All of the water draining to them seeps into the ground and replenishes the groundwater supply.

Past Management Efforts

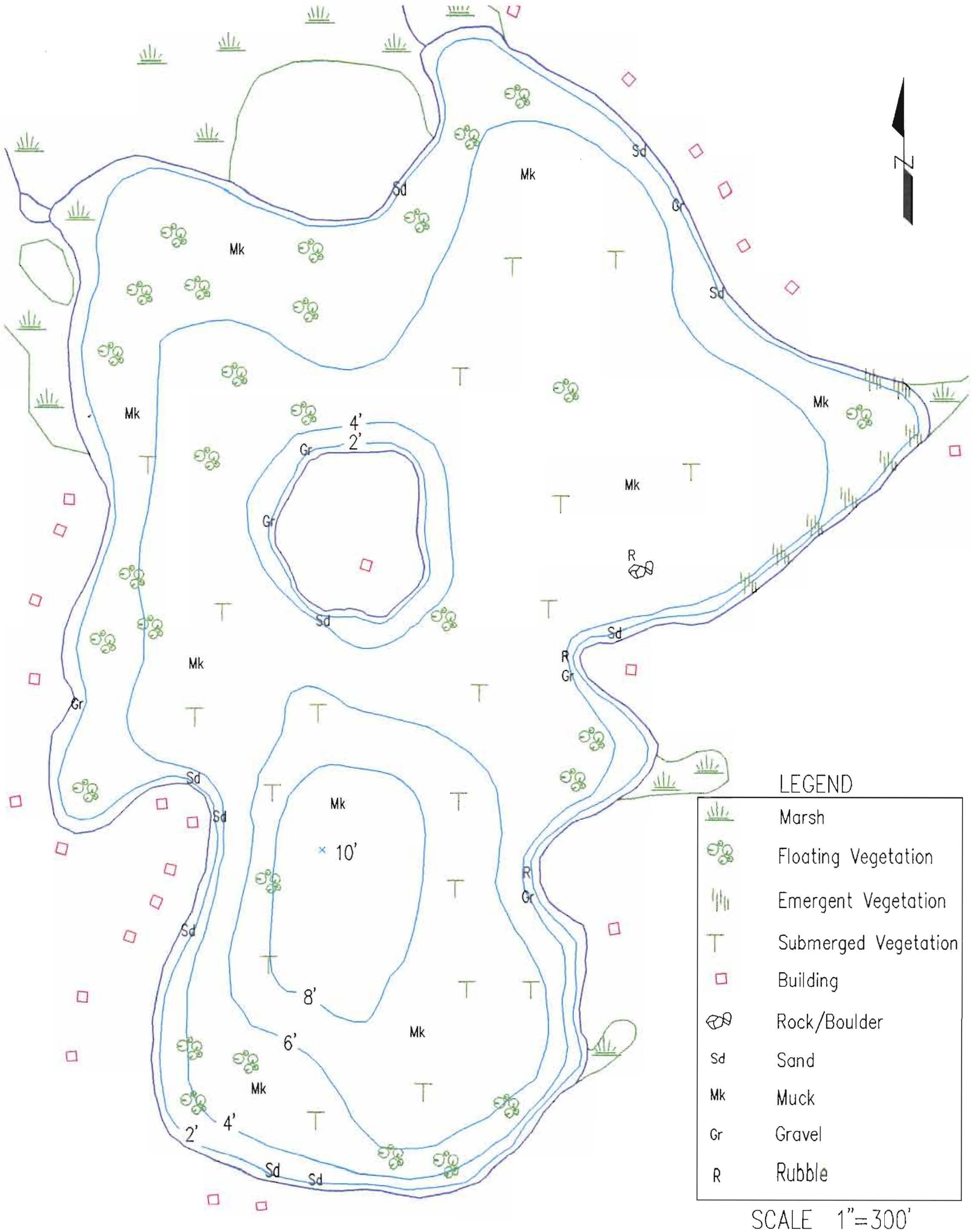
The McCaslin Lake District has made considerable effort to improve the lake and protect it for future generations. These efforts include the installation of aerators in 1979, hiring a consultant to complete a fisheries survey of the lake, operating a weed cutter and purchasing environmentally sensitive lands. These management efforts will be discussed in detail throughout the report. The District has cooperated with state and local resource management agencies and participated in grant programs for the benefit of McCaslin Lake.

McCaslin Lake User Survey

On May 27, 1995, a meeting was held to introduce District members to the lake planning grant process. The LWCD also conducted a "nominal group process" meeting to rank-order the major concerns of lakefront property owners. Major concerns voiced at this meeting included:

- Too much muck
- Too many aquatic plants
- Poor fishing
- Lake too shallow
- Poor water quality
- Unattractive shoreline development
- Public access

Figure 1. McCaslin Lake Hydrographic Map (Marinette County LWCD-1997)



These concerns and others were included in a questionnaire which was mailed in April of 1996. Twenty-four of the thirty-one surveys mailed out were completed and returned. Figures 2 - 5 detail some interesting survey results. Approximately 78% of the respondents are weekend visitors to McCaslin Lake, while only 13% are permanent residents. It is clear from the survey that most residents come to McCaslin Lake to enjoy the lake's natural beauty and for peace and quiet (96% of residents listed these as their primary reasons for coming to the lake) .

Top concerns of District members are excessive aquatic weed growth, poor water quality and excessive muck. More than 87% of the respondents described weed growth as heavy or choked, and 67% thought the problem has been getting worse. Water quality was rated as good or very good by 33% of the respondents, and 38% thought the water quality has improved over the years. Preventing public access was also rated as one of the top concerns of lake residents. Detailed results of the survey care found in appendix A.

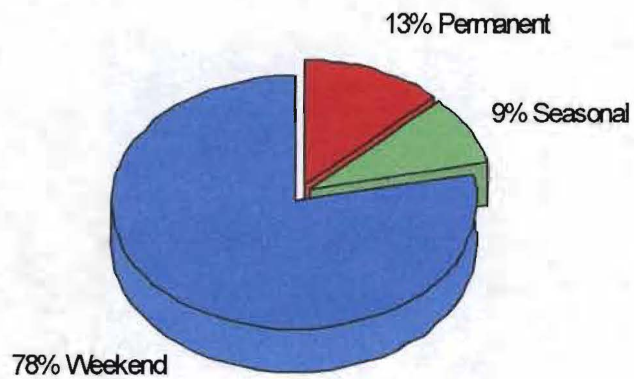
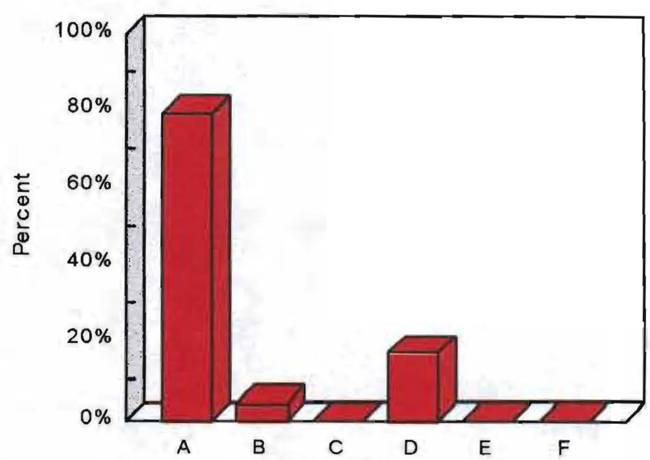


Figure 2. Residency status of District members.

Water Quality

Water quality is actually a very subjective term. As the survey of District members shows, the perceived water quality of McCaslin Lake can be considered poor or excellent depending on individual points of view (see figure 4). Water "quality" as perceived by lake residents is affected by many factors which have little to do with the actual physical properties of the water itself. These include the depth and shape of the lake, recreational pressure, shoreline development and quality of the fishery.

For this lake study we investigated many physical and chemical properties of McCaslin Lake. The results were interpreted and compared to values found on similar lakes throughout the state. A summary of these results and a discussion concerning each parameter is presented in this section. A detailed listing of water quality results is found in Appendix B.



A. Peace and quiet
B. Fishing/Hunting
C. Motorized recreation
D. Natural beauty
E. Non-motorized recreation
F. Other

Figure 3. Why Residents Enjoy McCaslin Lake.

Dissolved Oxygen and Temperature From a biological point of view, dissolved oxygen is one of the most important water quality parameters. Dissolved oxygen is required by all fish and most other aquatic life. A lake's oxygen content is determined by a number of factors, including lake basin shape (morphometry), water temperature, weather patterns, nutrient inputs, and biological activity within the lake. The water quality standard for dissolved oxygen is 5 mg/l (milligrams per liter or parts per million). Below this level many fish become stressed and reproduction may be impaired.

The solubility of oxygen in water varies with temperature. When 100% saturated, water at 32^0F can contain 14.6 mg/l of oxygen. At 70^0F the same water can only hold 8.8 mg/l of oxygen. The primary source of oxygen in water is gas exchange with the atmosphere. Ice cover, thermal stratification and windless periods all reduce mixing and can lead to oxygen depletion in a lake.

Stratification is the divison of the lake water into distinct layers which do not mix. Summer stratification occurs when the surface of the lake warms quickly and forms layer of less dense warm water (epilimnion) above a cold deep layer (hypolimnion). These layers of water resist mixing and stay separate until the temperature of the upper layer decreases in the fall. Often shallow lakes do not stratify because wind and wave energy is enough to overcome these forces and keep the lake mixed. An exception to this rule occurs on warm windless days when shallow lakes can weakly stratify until the next windy day causes the lake to re-mix.

Winter stratification occurs when water near the surface approaches the freezing point and becomes less dense than the water below. There is only a slight temperature difference in the winter, and the layers are weakly stratified. However, ice cover shields the lake from the mixing effect of wind.

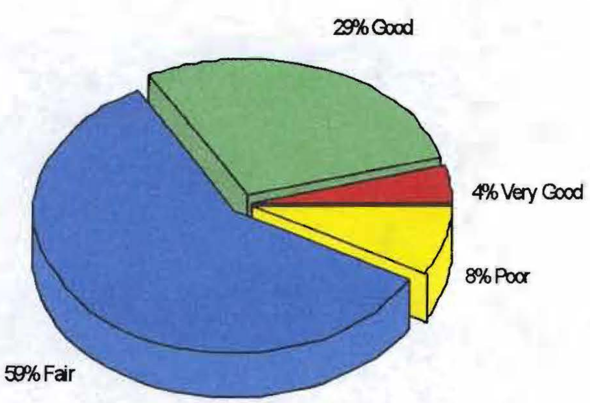


Figure 4. How residents see the water quality of McCaslin Lake.

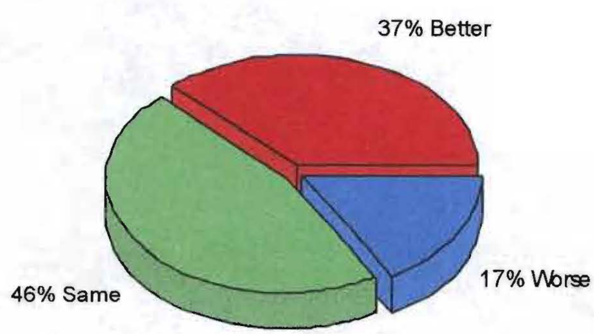


Figure 5. How residents feel water quality has changed over the years.

Aquatic plants add oxygen to the water column through photosynthesis and consume oxygen through respiration. On calm sunny days the upper waters of the lake can experience high rates of photosynthesis and oxygen production leading to super-saturation. During nighttime hours plant respiration can lead to localized oxygen depletion. Shallow weedy lakes often experience this diurnal shift in oxygen levels.

Decomposition of dead plants and algae also depletes oxygen. In lakes which stratify this decomposition leads to oxygen depletion in the hypolimnion. This process can result in total oxygen depletion of the lower waters. Due to its shallow nature, McCaslin Lake does not experience long periods of oxygen depletion in the lower water column.

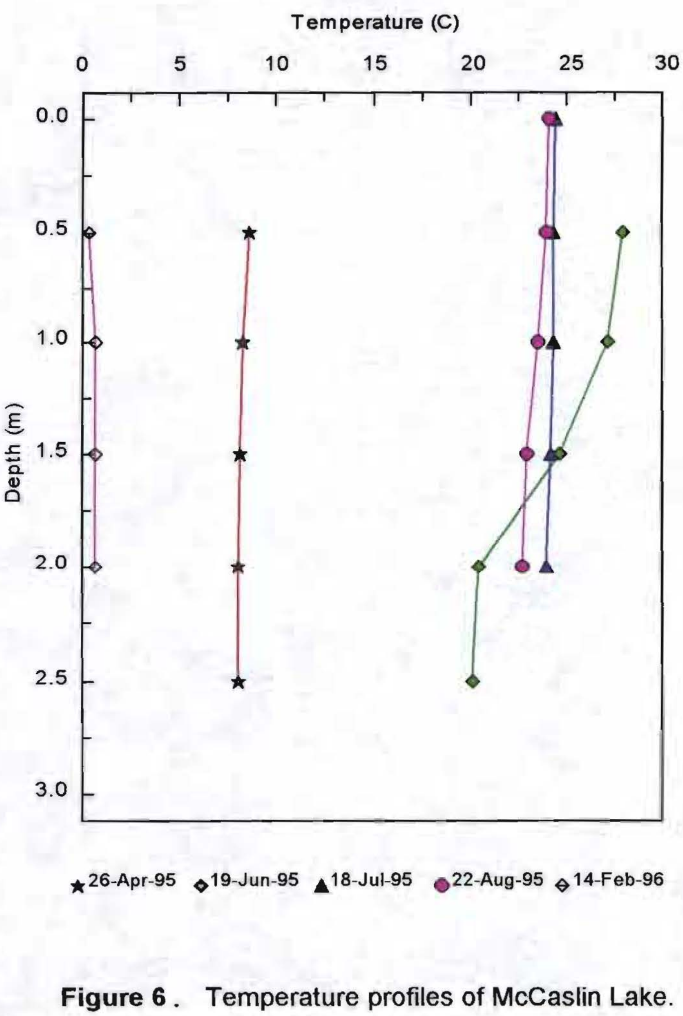


Figure 6. Temperature profiles of McCaslin Lake.

Winter is a critical time for oxygen stress in lakes. Ice cover prevents oxygen exchange with the atmosphere. Heavy snow cover reduces photosynthetic oxygen production and plants begin to die. The decomposition of plants and algae can reduce oxygen to critical levels, resulting in winter kill. McCaslin Lake had experienced winter fish kills prior to installation of the aeration system.

The temperature and oxygen profiles of McCaslin Lake confirm that the lake remains well mixed throughout the open water period (figure 6). Continuous mixing and an abundance of aquatic plants maintain adequate oxygen concentrations (figure 7) . Temperature profiles also remain uniform during most of the year. An exception can be seen in the June sample period when weak stratification occurred and oxygen depletion could be seen below the 5 foot level. The June measurements were recorded following several hot windless days.

Aeration The McCaslin Lake District operates an aeration system throughout the year. The effects of this aeration can clearly be seen in the dissolved oxygen profiles of McCaslin Lake during the winter and summer months. Dissolved oxygen saturation remained above 80% throughout the year except during the June sampling when hot still weather combined with an aerator shutdown resulted in low dissolved oxygen in the lower meter of the lake (see appendix B). Spring and fall D.O. profiles fit what would be expected at this time of the year due to natural mixing of the lake water.

Dissolved oxygen monitoring in February of 1996 was conducted approximately 50 feet from a cluster of aerators. At this location the dissolved oxygen level was 12.4 mg/l, or 80% of the saturation level. Approximately 550 feet from the aerators, the dissolved oxygen reading was 5.2 mg/l (36% saturation). The oxygen concentration 650 feet north of the aerators was down to 3.9 mg/l (27% saturated). Approximately 900 feet from the nearest aerator, the dissolved oxygen concentration had fallen to 2.75 mg/l (18% saturated).

Late winter monitoring in 1997 confirmed the presence of adequate winter oxygen concentration within 500 feet of the aerators. This well oxygenated area provides a "winter refuge" in McCaslin Lake. Although dissolved oxygen levels in the shallow weedy bays may fall to dangerous levels, fish and aquatic life can migrate to these better oxygenated waters.

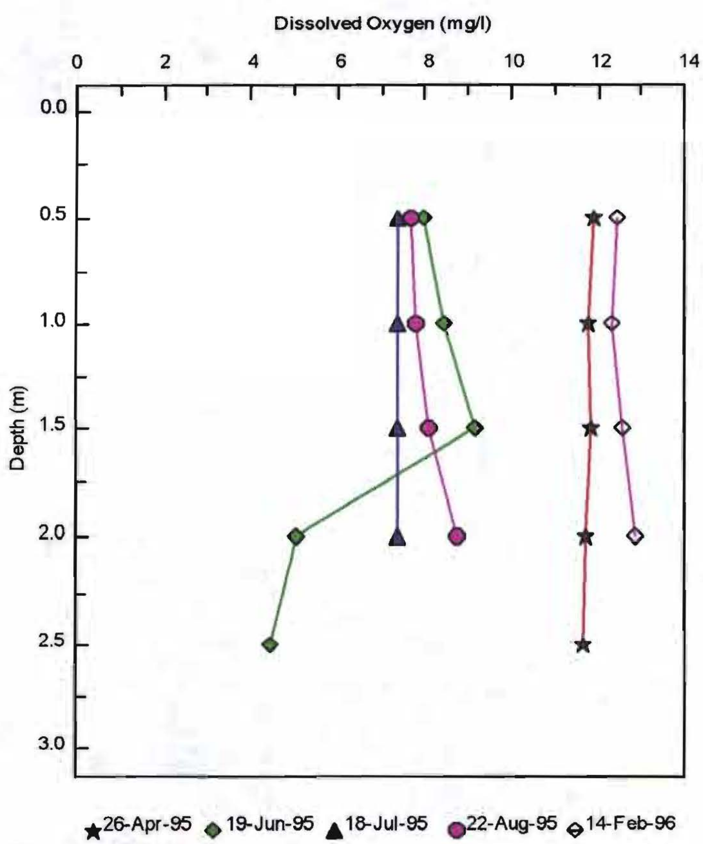


Figure 7. Oxygen Profiles of McCaslin Lake.

Without winter aeration, fish kills in McCaslin Lake would be likely during severe winters.

The benefits of summer aeration are less certain. Some researchers suggest that preventing oxygen depletion in the overlying water will reduce sediment phosphorus release and decrease algae production. Summer aeration has also been shown to cause a shift in algae production from floating blue green algae to the more desirable green algae. The McCaslin Lake aerators appear to keep the lake mixed and prevent oxygen depletion during the "dog days" of summer. However, aeration during the cooler months of spring and fall is not necessary and provides little benefit to the biotic community of the lake.

Some aeration systems have been installed with the assertion that they will reduce soft sediment depth. The systems supposedly work by increasing biological activity within the sediment which "digests" the organic portion of the sediment. However, a review of pertinent literature did not reveal any studies which support this claim. The United States Geological Survey (USGS) studied an aeration system on Little Muskego Lake which was installed to reduce sediment depth and found no sediment reduction after 5 years of aeration (Field, 1995). A similar study using enclosures on Austin Lake in Michigan found no sediment reduction with intensive aeration and the addition of additional "digesting" microorganisms (Little, 1996).

Phosphorus Phosphorus is an essential nutrient required for the growth of all plants. In natural waters phosphorus is generally found in very low concentrations in relation to other major plant nutrients and is therefore the limiting factor controlling aquatic plant growth. As a growth limiting factor, small inputs of phosphorus can cause significant increases in the growth of algae and aquatic plants.

Phosphorus comes from many natural sources including phosphorus bound to soil particles, decaying vegetation, and rainfall. People also generate many sources of phosphorus including septic systems, detergents and fertilizers. Many of the land use changes we make to a lake's watershed also lead to increased phosphorus delivery. Disturbance of natural vegetation, cultivation, and shoreline alteration can all increase runoff and the amount of phosphorus delivered to the lake.

The fate of the phosphorus after it reaches the lake is a very complicated process. Most of the phosphorus is tied up in aquatic plants and algae. As aquatic plants die and decompose much of the phosphorus is released to the overlying waters. A smaller fraction is trapped in the sediment where it forms compounds with iron and other elements. In the presence of oxygen these compounds are relatively stable. However, when water overlying the sediment becomes depleted of oxygen, phosphorus can be released and recycled into the water column. In deep lakes with an anoxic hypolimnion this nutrient recycling can be the major source of phosphorus each spring and fall during turnover. Shallow lakes such as McCaslin often experience temporary oxygen depletion at the sediment water interface during calm weather and at night. At these times sediment release of phosphorus is highest.

Sedimentation and release of phosphorus in shallow lakes is a continuous and balanced process. This balance can be interrupted in a variety of ways. Sediment disturbance by motorboats, wave action and dredging can cause increased phosphorus release. Studies have shown that motorboat activity can cause sediment disturbance in as much as 15 feet of water (Boreman, 1996). Large scale removal or destruction of aquatic plant beds can also lead to increased sediment resuspension and phosphorus release.

Phosphorus concentration is commonly reported in micrograms per liter of water (ug/l) which is equal to parts per billion (ppb). Lakes with total phosphorus concentrations below 20 ug/l typically do not experience nuisance algae blooms. The average annual surface total phosphorus concentration for McCaslin Lake was 19.6 ug/l. This level will produce some algae, but should not be sufficient to produce nuisance algae blooms. This level is also considerably less than the 70 ug/l average for Wisconsin mixed drainage lakes (Shaw, 1994). Because McCaslin Lake is near the level of concern, it is especially important to control phosphorus inputs wherever possible.

Ortho-phosphorus, a form of phosphorus which is readily available for plant uptake, was found in low concentrations. This indicates that most of the biologically available phosphorus is tied up in the aquatic plants and unavailable for algae production

Chlorophyll-a All green plants contain the pigment chlorophyll-a which is used in photosynthesis. The chlorophyll-a concentration in a water sample is used as a measure of the amount of algae in water. Low levels of chlorophyll-a indicate low levels of algae production and usually correspond to clear water. Chlorophyll-a concentrations greater than 10ug/l indicate a eutrophic or nutrient rich condition in the lake.

The average chlorophyll-a concentration in McCaslin Lake was 6.4 ug/l. This is less than would be expected based on the phosphorus concentration, and is an indicator that much of the phosphorus is tied up by rooted plants and is unavailable for algae production.

Secchi Disk Depth Secchi disk depth is a measure of water clarity. A black and white disk measuring 20 cm in diameter is lowered into the water until it is no longer visible. This measurement, the secchi depth, is affected by a number of factors including the amount of algae in the water column, the amount of suspended solids in the water and natural staining of the water by organic compounds such as tanins.

The average Secchi disk depth in McCaslin Lake was 6.9 feet (2.1 meters). The water clarity is better than would be expected based on the phosphorus levels. This also indicates that most of the phosphorus in the lake is tied up in macrophyte production.

The average Secchi disk depth for 1995 was significantly better than the 4.8 foot average recorded by Norm Kratz from 1986-1990. Although some of this variation may be explained by different people taking the measurements, it appears that the water clarity of McCaslin Lake has improved during the last 5 years. The fact that 38% of the survey respondents felt water clarity has improved supports this conclusion. The improvement in water clarity may be due to a reduction in blue green algae production due to aeration.

Trophic State Index Trophic state indices (TSI's) are popular water quality indicators used to classify lakes based on phosphorus concentration, chlorophyll-a concentration and secchi disk depth. Lakes classified as oligotrophic are nutrient poor and have clear unproductive water. Mesotrophic lakes have moderate nutrient levels, are productive and have occasional algae blooms. Lakes classified as eutrophic are nutrient rich and often exhibit water quality problems such as frequent algae blooms, severe oxygen depletion and poor water clarity.

The phosphorus TSI for McCaslin Lake was consistently in the eutrophic range, while the chlorophyll and secchi disk TSI values were most often in the mesotrophic range (figure 8). This discrepancy in TSI values indicates that available nutrients are tied up in aquatic plants allowing the lake to remain in a clear water condition. The alternative is an algae dominated lake where algae concentrations are much higher, the water is much less clear, and macrophytes are shaded out.

Nitrogen Nitrogen is another important nutrient required for plant growth. However, due to its relative abundance, nitrogen does not typically limit algae growth. In most cases the nitrate level in lake water corresponds to local land use. Surface runoff and groundwater high in nitrogen

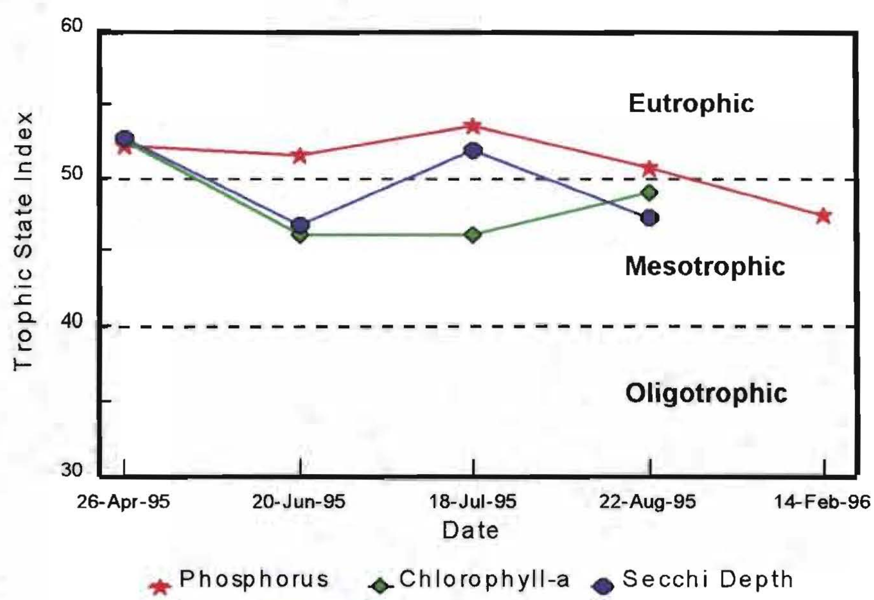


Figure 8 . McCaslin Lake Trophic State Indices.

may come from a variety of sources including agricultural land, fertilized lawns, and septic systems. Nitrogen levels in McCaslin Lake averaged 550 ug/l. This level is typical for Wisconsin drainage lakes.

Although nitrogen in the water column seldom limits algae production, recent research shows that aquatic macrophytes increase in response to elevated sediment nitrogen levels (Rasman pers. com.). A likely source of nitrogen in lake sediment is shallow groundwater contaminated by poorly functioning septic systems.

Inlet Chemistries Phosphorus loading to McCaslin lake comes from the watershed through Smith Creek, and from direct runoff from the near shore area. Inlet water samples were analyzed monthly for phosphorus concentration. The average total phosphorus concentration in Smith Creek was 43.5 ug/l. The lowest nutrient readings occurred in May when runoff is the greatest, indicating dilution from spring rains and snowmelt. The higher readings during summer low flow reflects internal loading from wetlands which are drained by the inlet.

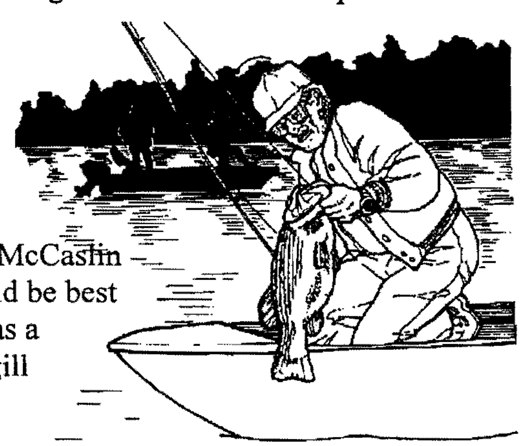
Sediment Depth Soft sediment depth in McCaslin Lake varies from a thin layer near shore to greater than 20 feet near the inlet on the northwest side of the lake. The sediment profile in McCaslin Lake is characterized by a very fine flocculent layer up to 3 feet thick over a more dense layer containing large amounts of partially decomposed plant fragments. Underlying the organic sediment is a sand and gravel layer identical to the soil parent material surrounding the lake.

The main source of organic sediment in McCaslin Lake is the large wetland complex northwest of the lake. For over tens thousand years runoff from McCaslin Mountain has carried partially decomposed organic matter from these wetlands and deposited it in the lake. The greater depth of organic sediment near the mouth of Smith Creek is a result of this loading. Additional sediment buildup comes from macrophytes dying and sinking to the bottom of the lake where they decompose and accumulate.

Fish Community A fisheries survey was not conducted as part of this lake management planning grant. However, previous fisheries evaluations and DNR stocking reports were reviewed. The most recent fisheries survey of McCaslin Lake was conducted in 1993 by a private consultant hired by the District. According to DNR fish manager Greg Kornelly, the survey showed a good size structure for both bass and bluegill (Kornelly, 1997).

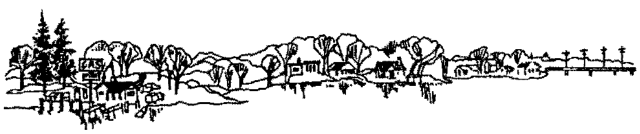
DNR stocking records indicate that largemouth bass were stocked in 1944 and 1952. Permits were issued for private fish stocking in 1980 (perch & bluegill), 1981 (walleye & perch) and 1982 (walleye & bass). According to District members, northern pike have also been released in the lake and have maintained a successfully reproducing population. It has been reported by District members that the average size of perch and bluegill has declined in recent years.

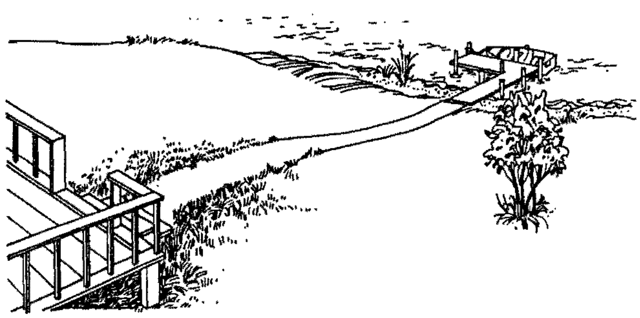
Fish management efforts in McCaslin Lake should be designed to maximize the potential of the lake. According to DNR fish manager Greg Kornelly, McCaslin Lake would be best managed as a bass/bluegill lake.



Specific fishery improvement suggestions are discussed in the section on management alternatives.

Riparian Development It is clear from the results of the survey and talking to district members that most people come to McCaslin Lake to relax and enjoy the natural scenic beauty of the area. However the natural beauty of the lake is threatened by activities which detract from the natural shoreline setting.



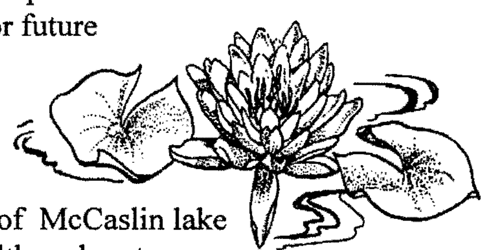


As is the case across northern Wisconsin, people have trouble leaving behind the habits and trappings of urban life. The desire to modify the environment has led to urban style lawns, conspicuous houses, and all manner of decks, patios, docks and unnatural lighting. Many of these modifications do not fit into the natural setting and add to the shoreline clutter. Of greater concern is the effect these changes can have on the delivery of nutrients to the lake and the loss of important natural habitat.

A recent study has shown that riparian development has an effect on the adjacent aquatic plant community (Weber 1994). Septic system discharge, and increased runoff of nutrients and sediment from developed lots are believed to be responsible for a change in species assemblages. Low growing native species are replaced by less desirable canopy forming varieties such as Eurasian water milfoil (*Myriophyllum spicatum*). Destruction of shoreline habitat also reduces fish feeding activity in the shallow near-shore area (Nicholas, 1996). Aquatic insects, amphibians and many species of birds and small mammals also use this shoreline habitat during critical stages of their lives.

A survey of waterfront properties on McCaslin Lake shows that 55% do not conform to current Marinette County shoreland zoning standards. The most common violation of the standard is exceeding shoreline vegetation cutting restrictions, followed by inadequate setback and non-conforming decks or docks. Although some of these violations precede the shoreland zoning standards of 1967 and are "grandfathered in", many have occurred since that time.

Aquatic Plant Communities An aquatic macrophyte (plant) survey of McCaslin Lake was completed on August 8, 1995. Seven transects across the lake were surveyed using SCUBA gear. Species observations and relative density were recorded and specimens were collected for positive identification (See Appendix D). Many aquatic plant specimens were laminated for future reference.



The aquatic plant community of McCaslin lake is healthy, although not very diverse. Twelve species of aquatic plants were recorded during the survey. This limited diversity is due to the lack of variability in bottom type and water depth in the lake. The macrophyte population is dominated by leafy pondweed, variable pondweed, floating leaf pondweed and white and yellow water lilies.

Although more than 90% of the lake bottom supports aquatic vegetation, plant density is only moderate over most of the lake. Soft bottom sediment limits the type and number of aquatic plants able to grow in the lake. Shallow areas with loose flocculent sediment are dominated by plants such as bladderwort and coontail which do not require roots to grow, or water lilies which form large tuberous roots to anchor in the soft sediment. Deeper waters (3 to 5 feet) are dominated by floating leaf pondweed, spiny naiad and fern leaf pondweed. Aquatic plants are sparse in the deepest part of the lake (greater than 5 feet). Large leaf, fern leaf and floating leaf pondweeds are the most common plants in this zone.

Although many people see aquatic plants as a nuisance, they play a vital role in maintaining good water quality in shallow lakes. Aquatic plants bind loose organic bottom sediments together and prevent sediment resuspension by wave and boat action. They also tie up nutrients in the lake that would otherwise be available for algae growth. All shallow lakes fall into one of two categories, macrophyte dominated and algae dominated. Macrophyte dominated shallow lakes are by far the most desirable.

Exotic Species No exotic species were identified during the aquatic plant survey or monthly lake monitoring visits. The absence of exotic species is not due to a lack of suitable habitat. In fact, the soft organic sediment found in McCaslin Lake is an ideal substrate for Eurasian water milfoil. This species of milfoil is one of the most troublesome aquatic plants found in Wisconsin. Similarly, the exotic Zebra mussel prefers shallow nutrient rich waters such as McCaslin Lake. Transferring boats between lakes and improperly disposing of bait bucket or live-well contents are common avenues for invasion by exotic species. These practices should be avoided to preserve the biotic integrity of the lake.

Shallow Lakes - Alternative Steady States

There has been a considerable amount of research on shallow lake systems focusing on nutrient dynamics and the alternate "steady states" of these lakes (Scheffer, et. al. 1993). There are two possible steady states for a shallow lake: a clear water macrophyte dominated state, and a turbid state where algae blooms cloud the water and limit aquatic plant growth. Shallow lakes which are nutrient poor will always be clear and dominated by aquatic plants, while shallow lakes with excessive nutrients will be turbid and algae dominated.

McCaslin Lake lies between these extremes of nutrient enrichment. At this level a lake can be either clear or turbid and will tend to remain in that state until some disturbance forces the lake into the alternate state. Shifts in the steady state of lakes from macrophyte to algae domination have been caused by nutrient and sediment loading, increased boat traffic, chemical removal of macrophytes and increases in water level (Bachmann & Canfield, 1996). Unfortunately it is much more difficult to move the lake back to the clear water state once it has become turbid.

The key to preventing the shift to a turbid water state is to prevent major watershed disturbances, reduce nutrient inputs to the extent possible and maintain a healthy aquatic macrophyte community.

Land Use Survey & Watershed Analysis

The water quality of a lake is directly related to land cover types found in the lake's watershed. This is especially true of drainage lakes such as McCaslin which receive much of their water from runoff of snowmelt and rainfall. As a rule, the amount of nutrients in this runoff increases as the natural forested landscape is converted to agricultural or urban land. A watershed land use map (figure 9) was developed for McCaslin Lake based on the UW-Extension publication *Land Use Survey - A Protocol for Lake Management Planning Purposes* (Klessig, 1990).

Forest land comprises 981 acres (86%) of McCaslin Lake's 1,140 acre watershed. The majority of this acreage is industrial forest land owned by Goodman Forest Industries. Forested land in its natural state is very stable and delivers very little phosphorus. However, poor timber harvesting practices can lead to increased erosion, phosphorus delivery and stream habitat destruction. The most common sources of phosphorus from timber harvest areas are eroded logging roads and skid trails and poorly designed stream crossings. Failure to leave adequate buffer areas near streams during timber harvesting can also result in increased phosphorus loading and destruction of vital riparian habitat.

There are approximately 133 acres of wetlands in the McCaslin Lake watershed. These vary from small potholes less than an acre in size to the large wetland complex at the lake inlet. Wetlands can act as both a sink and a source for phosphorus. During periods of active wetland plant growth phosphorus is taken up by the plants. During the winter and spring, decomposing wetland plants can release phosphorus.

The balance of the watershed area (26 acres) is developed land surrounding the lake. This area has the greatest concentration of roads, driveways and homes in the watershed. All of these structures increase the volume of runoff and decrease the infiltration of surface water. This increased volume of water also carries five to ten times more phosphorus than the surrounding woodlands. Manicured lawns also increase the amount of phosphorus and sediment delivery to the lake. Additional threats to water quality come from septic discharge and hazardous home and lawn care products which can enter the lake runoff.

Water Quality Modeling

Land cover information from the land use survey was used to model phosphorus loading to McCaslin Lake and predict changes in water quality due to land use conversion and disturbance. Phosphorus loading was predicted using the Wisconsin Lake Model Spreadsheet (WILMS) developed by the Wisconsin DNR. The WILMS model is calibrated against measured water chemistry data from McCaslin Lake.

Approximately 15% of the phosphorus loading to McCaslin Lake comes directly from the atmosphere as dry fall and with precipitation that falls directly on the lake. This is a natural background source of phosphorus and is not controllable.

An estimated 9% of the annual phosphorus load to McCaslin Lake is from wetlands which represent approximately 12% of the total watershed area. Wetlands deliver an average of 0.09 lbs\acre annually.

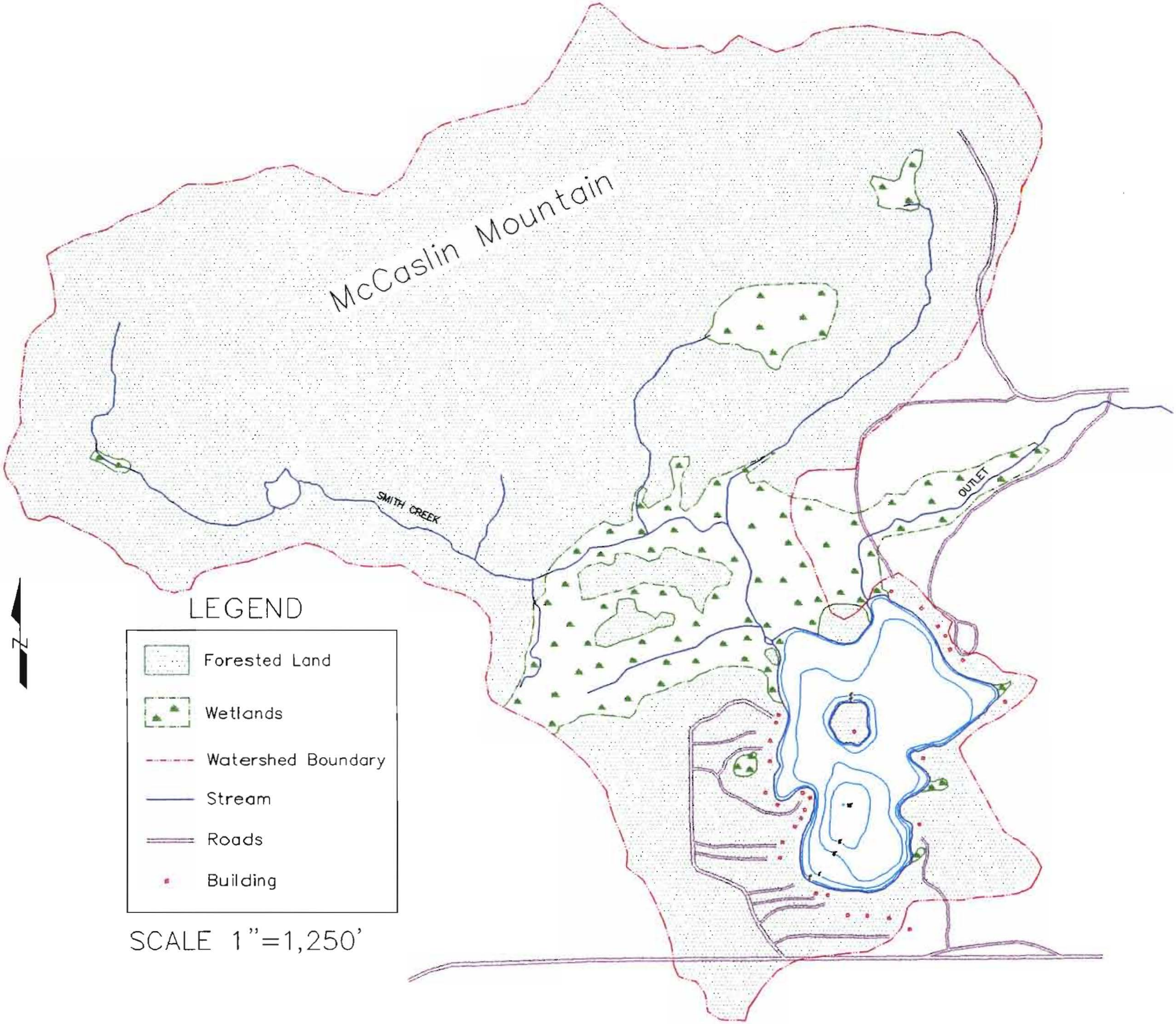


Figure 9. McCaslin Lake watershed & land cover types

Phosphorus export from the 981 acres of forested land is approximately .08 lbs of phosphorus per acre annually, or 54% of the total phosphorus load to McCaslin Lake. This level may be higher if poor timber management practices are used during timber harvesting operations.

Nutrient loading from septic systems is estimated at 7.5 lbs of phosphorus to the lake every year, or 6% of the total. The loading from septic systems is very difficult to estimate. The efficiency of a system at removing nutrients is dependent upon the age of the system, the amount of use and the type of soils in which it is installed. Many of the systems around McCaslin Lake are quite old and likely were not constructed to meet current standards, further increasing the probability that they are not functioning properly. For the purposes of the model it was estimated that the soils were retaining approximately 60% of the phosphorus.

Although the narrow band of development surrounding McCaslin lake is only 2% of the watershed area, it represents the largest "controllable" source of phosphorus and sediment to the lake (17%). When the septic phosphorus load is factored in, the impact from the riparian area around McCaslin lake is conservatively estimated at 23% of the total phosphorus load.

Model Outcome The WILMS model can be used to predict changes in lake water quality due to changes in land use or the addition of point sources of phosphorus. As discussed above, the largest controllable source of phosphorus to McCaslin Lake is riparian development. According to the water quality model, reducing by half the amount of phosphorus from riparian development will lead to a 9% reduction in the spring turnover phosphorus level. Doubling the amount of development around the lake would result in a corresponding 10% increase in the spring turnover phosphorus level of the lake. An increase of this magnitude would likely be sufficient to increase the frequency and severity of algae blooms in the lake.

Management Alternatives

This report has detailed the current state of McCaslin Lake, trends in water quality and other related issues. However, the future of McCaslin Lake lies with the McCaslin Lake District and the actions of each and every landowner on McCaslin Lake.

It is obvious that most District residents care deeply about the quality of McCaslin Lake and want to maintain the resource for the future enjoyment of their families. It is also clear that many residents have serious concerns about the present state of the lake. Major concerns include the level of aquatic macrophyte growth, excessive sediment, and maintaining the wild character of the lake. The following options were developed in response to these concerns.

Do Nothing This is the easiest management alternative to implement. It does not require personal or financial sacrifice, cooperation, or effort. In the short term it allows everyone to enjoy the lake rather than worry about the future. However, this option is clearly short sighted and will only lead to declining water quality and degradation of the riparian environment.

Implement Forestry Best Management Practices The Wisconsin DNR recommends that forestry best management practices (BMP's) be followed when harvesting timber. These practices are aimed at preventing erosion and the destruction of stream, lake and wetland habitat during timber harvest. The implementation of forestry BMP's by private and industrial landowners will ensure that phosphorus loading from forested lands is kept to a minimum.

a. *Lake District members should be aware of forestry activities in the watershed and ensure that forestry practices are not causing excessive erosion or habitat destruction.*

Implement Lakefront BMP's The riparian zone of McCaslin Lake represents the largest "controllable" source of phosphorus to McCaslin Lake. Although an individual home, road or lawn may not appear to be a problem, the cumulative impact of this development on the chemistry and ecology of the lake is significant. To protect McCaslin Lake from the effects of current and future development the following management actions should be implemented:

a. *Reduce the use of lawn fertilizers. Runoff from fertilized lawns can transport phosphorus to the lake which feeds weed and algae growth.*

b. *Maintain septic systems with regular pumping. Inspect septic systems regularly and replace those that are not functioning properly.*

c. *Restore natural buffer areas around the lake to reduce the amount of runoff from developed areas and to filter nutrients and other pollutants from the runoff.*

d. *Maintain natural buffer areas where they already exist. Contact new landowners to educate them concerning the importance of natural buffers.*

Implement "Lake Friendly" Home and Garden Practices Many of the household cleaning products we use every day contain hazardous and/or persistent toxic substances which can be harmful to the environment. Often these products are not broken down by on-site septic systems and can contaminate groundwater. Also, many automotive products such as oil, grease and radiator fluid are hazardous to the environment.

Extra care should be taken when using and disposing of toxic substances near the lakeshore. Proximity to the lake combined with the sensitive nature of riparian systems increases the risk of environmental contamination. To reduce this risk the following practices should be implemented.

a. *Reduce dependence on harmful household products by reading labels and choosing environmentally friendly alternatives. Non-toxic alternatives to many cleaning products are commercially available or can be made at home from common ingredients.*

b. *Dispose of used or unwanted household chemicals properly. Take advantage of household "clean sweeps". Clean sweeps are locally sponsored events where residents can take hazardous substances to be properly disposed of for no charge. A*

household clean sweep will be held in Crivitz on August 1, 1997.

c. *Take automotive products such as oil, radiator fluid and batteries to garages or local collection centers. Never dispose of these products in septic systems or on the ground.*

Maintain and/or improve lake aesthetics and quality of life on the lake Most District members come to McCaslin Lake primarily to relax and enjoy the natural beauty. Maintaining the wild character and peaceful nature of the lake is vital to ensure that future generations can also enjoy the lake. To accomplish this, people have to resist the urge to "improve" their property with unnecessary structures and landscapes that are more at home in the suburbs than on the lake. The following recommendations are designed to ensure that present and future development does not take away from the aesthetics of McCaslin Lake and the ability of all lake residents to enjoy this resource.

a. *All lake residents must make an effort to consider how their actions effect the aesthetics of the lake and the ability of their neighbors to enjoy the lake.*

b. *The District should adopt a "courtesy code" to help avoid conflicts between lake residents. This code can address such things as outdoor lighting, noise, boat usage, etc. A complaint process should be developed utilizing officers of the board to relay concerns and maintain anonymity.*

c. *The McCaslin Lake District should support stronger enforcement of current zoning regulations which are designed to protect the beauty and water quality of lakes. By acting as a group the District can influence local political decisions.*

d. *The District should set voluntary standards for development and communicate the need for these standards to district members. A policy to remove nonconforming decks and boat houses from the shoreline should be adopted.*

Maintain the Strength of the McCaslin Lake District The McCaslin Lake District is currently involved in the purchase of lakefront property to protect the scenic beauty of the lake and prevent further development. This and other activities clearly demonstrate concern for the future well-being of McCaslin lake. This level of concern must be maintained. Although state and local government have certain responsibilities for lake and watershed management, the future of McCaslin Lake ultimately lies in the hands of the McCaslin Lake District and its members.

A strong Lake District with concerned and committed members can greatly influence lake development, conservation and lake management efforts. An active district will also foster teamwork and friendship among members. The Lake District should remain active and continue to participate in projects and speak up on issues which effect McCaslin Lake and other lakes in this area. Examples include:

a. *The McCaslin Lake District should become a member of the Wisconsin Association of Lakes (WAL). The association lobbies for laws and programs which protect and benefit lakes in Wisconsin.*

b. *Every year a few different members should attend the annual Wisconsin Lakes Convention sponsored by WAL. The annual convention features workshops and* *presentations to educate and assist lake residents in managing their lakes. The convention is also a great place to meet people from other lakes and discuss problems and solutions they are experiencing.*

c. *Plan ahead for future lake management efforts. A fund should be established to ensure that local matching dollars are available for future grants or lake management efforts.*

d. *Invite local Wisconsin DNR, Zoning and UW-Extension lake experts to annual meetings to educate residents about lake ecosystems and management.*

e. *Introduce new landowners to the McCaslin Lake District as soon as possible. Educating new members about the lake and the work being done to protect it will give them a sense of ownership and responsibility.*

Protect sensitive areas from development McCaslin Lake still retains much of its wild character and natural beauty due to the presence of large stretches of undeveloped shoreline. The Lake District has recently purchased one of these parcels to protect it from development. The District should continue to promote the protection of natural areas. There are many methods available to protect these natural areas from future development including formal agreements, easements, deed restrictions, donations and outright purchase. Through deed restrictions and easements, the landowner retains title to the property and may be able to receive some tax benefits. These agreements can also be structured to allow for sale and development of the property with restrictions on density, type of development etc.

a. *The District should encourage long term protection of undeveloped shoreline areas. Interested landowners should contact the Marinette County LWCD or the Northeast Wisconsin Land Trust to explore alternatives for protection.*

b. *Natural areas and wetlands on developed properties should be protected. Further development and disturbance near the shoreline of these properties should be discouraged by the Lake District.*

Participate in County Lakes Association The Marinette County LWCD supports the formation of a Marinette County Association of Lakes. The purpose of this group will be to support lake management activities and programs in Marinette County and represent lake users at the local level. This new group would have a member assigned to the Land & Water Conservation Committee, a standing committee of County Board which sets policy for the Land & Water Conservation Department.

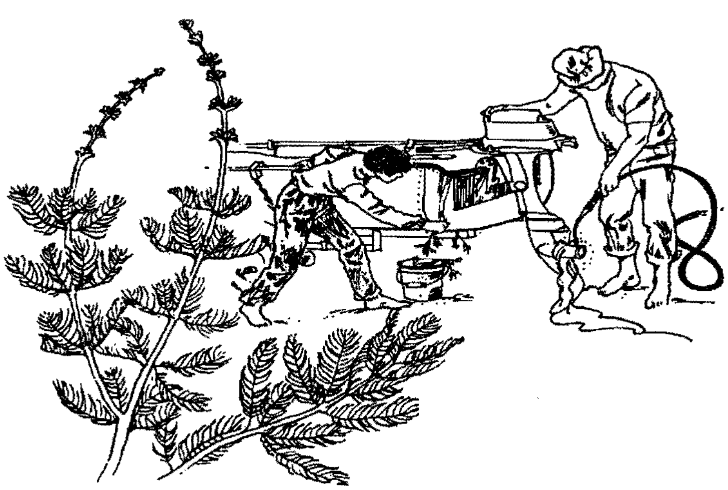
A County Lakes Association could provide many beneficial services to its member districts including financial and technical assistance, education and support and assistance for grant programs. Other possibilities include coordinating services such as weed harvesting and water quality monitoring programs.

a. *The McCaslin Lake District should support the formation of a Marinette County Association of Lakes and become a member.*

Prevent introduction of exotic species The introduction of exotic plants and animals to a lake can have a devastating effect on the aquatic ecosystem. Most exotic plant species out-compete native vegetation and have little or no wildlife value. Many exotic macrophytes have growth forms which interfere with boating and fishing. An example is Eurasian water milfoil which forms dense floating mats that shade out native vegetation. McCaslin lake is particularly susceptible to invasion by Eurasian water milfoil which prefers shallow waters and soft organic sediment.

Most exotic species are introduced to lakes on boats, trailers or in live-wells and bait buckets. The lack of public access on McCaslin Lake will help prevent the unintentional introduction of exotics. Lake District members can help by adopting the following recommendations.

a. *Boats which are used on other waters should be checked carefully before use in McCaslin Lake. Any plant material from other lakes should be removed from boats and trailers. Water and fish from live-wells and bait buckets should never be transferred to another lake. Many exotic species can be introduced in this way.*



b. *A healthy aquatic plant species structure should be maintained in the lake. A healthy community will help prevent invasion by exotic plants.*

Fisheries enhancement The results of the landowner survey showed that many lake residents are concerned with the quality of the fishery in McCaslin Lake. When attempting to manipulate the fish population, it is important to recognize the lake's potential and accept its limitations. The abundant vegetation and shallow depth of McCaslin Lake make it ideally suited for a bluegill/bass fishery. The lake is not well suited to walleye or cold water species. A variety of projects can be undertaken to improve in-lake habitat for the fish population, including:

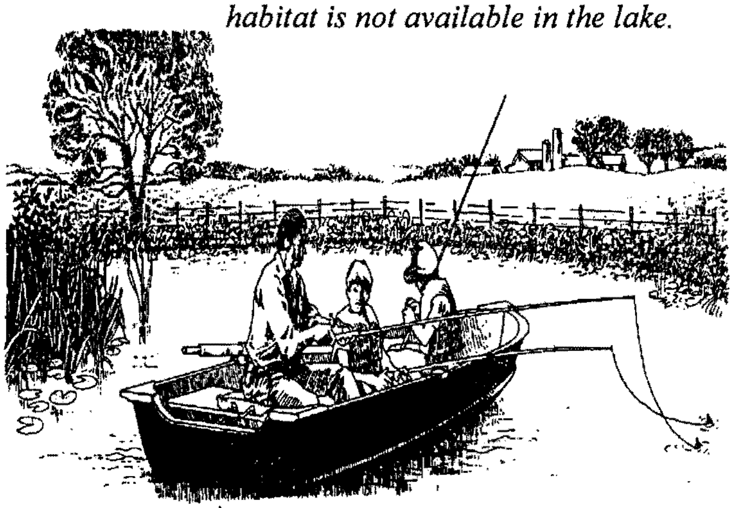
a. *Stop destruction of the near-shore littoral zone habitat. McCaslin Lake currently has a high percentage of undisturbed shoreline. The key to maintaining a healthy fishery is protecting important fish habitat.*

b. *Leave trees and shrubs which are leaning over the water or have fallen in. This provides shade and cover for predator fish and a feeding area for many young fish. Also, according to WDNR fish manager Greg Kornelly, fallen large woody debris is important spawning habitat for perch as it suspends their eggs above the silty sediment.*

c. *Consider the fishery in any harvesting plan. Limit heavy aquatic plant harvesting to areas in front of docks and in swimming areas. Cutting lanes through dense aquatic plant beds can benefit predator fish which use these lanes to reach smaller prey that hide in the weed beds.*

d. *Protect spawning habitat in the lake. The best spawning substrate is firm sand or gravel. The District could explore the possibility of adding spawning substrate to the lake.*

e. *Stock the lake with larger bass to increase the predator population and reduce the number of smaller bluegills. Stocking walleye is not recommended because the appropriate habitat is not available in the lake.*



f. *Continue aerating in the winter to prevent winter kill due to oxygen depletion.*

g. *Work with WDNR fish managers to improve the fishery. Invite them to come to an annual meeting to talk about the fishery and management options.*

Middle Peshtigo & Thunder Rivers Priority Watershed Project In 1995 the Middle Peshtigo & Thunder Rivers watershed area was selected as a priority watershed based on threats to surface and groundwater from increasing development. McCaslin Lake lies within the watershed project area. During project implementation the Marinette County LWCD will offer technical and financial assistance to lakefront property owners for the purpose of shoreline stabilization and installing shoreline buffers for pollution reduction and habitat restoration. Project implementation should begin in 1998.

a. *The McCaslin Lake District and its members should participate in the Middle Peshtigo & Thunder Rivers Priority Watershed Project.*

Sediment deactivation of phosphorus
Sediment loading of phosphorus to the overlying water of a lake can be reduced by treating the sediment with alum. Alum is an aluminum salt which combines with phosphorus to form an insoluble precipitate. It is most often used in deep lakes where oxygen depletion in the hypolimnion leads to increased phosphorus cycling. Alum treatment has been used successfully to treat shallow lakes and reduce phosphorus loading from the sediment. However the goal of these treatments is always the reduction of algae and re-establishment of a healthy aquatic plant population in the lake.

Sediment deactivation of phosphorus would not greatly benefit McCaslin Lake. Algae blooms are not a problem and macrophytes already dominate. Macrophytes derive most of their nutrients from the sediment, not the overlying water.

a. *An alum treatment of McCaslin Lake would be of little benefit and is not recommended.*

Diversion of Water to Deep Hole Some District members have inquired about the feasibility of diverting water to the depression on the northeast side of the lake to create a deep water area attached to the lake. Although it would not be difficult to accomplish, the result of such a diversion could have disastrous consequences for McCaslin Lake. It is very likely that this depression would not hold water, and would in fact drain McCaslin Lake and cut off the water supply to Three Little Lakes.

a. *Diversion of water to create a deep water area of McCaslin Lake is not recommended.*

Sediment Removal Excessive sediment in McCaslin Lake was the number one concern with lake residents according to the landowner survey. The soft organic sediment is unpleasant for swimmers and provides a substrate for aquatic plants.

Dredging is the only proven way to remove large amounts of sediment. There are two primary methods of dredging, mechanical and hydraulic. Mechanical dredging is accomplished with the use of a dragline, clamshell bucket or backhoe which scoops sediment from the lake bottom. Hydraulic dredging employs a cutter head to suck up a sediment and water slurry through a hose. Both methods of dredging require a dewatering area where dredged material is deposited to settle and dry. Typically, water which drains from the dredged material is pumped back to the lake.

Mechanical dredging removes far less water than hydraulic dredging and requires a smaller dewatering area. This method is best suited to removing well consolidated sediment. Mechanical dredging to remove soft flocculent sediments, such as those found in McCaslin Lake, would be very inefficient.

Hydraulic dredging is best suited to removing the type of sediment found in McCaslin Lake. Soft organic sediment is readily mixed up and easy on the pumping equipment. Hydraulic dredging would be less costly than mechanical methods. Small portable hydraulic dredges are also available for purchase or hire. The main drawback to hydraulic dredging is the need for a large dewatering area to handle the dredge spoils. Also, temporary lake level drawdowns are possible if the water from the dewatering site is not returned to the lake.

The minimum depth to dredge is determined by the desired outcome of the dredging project. The removal of all flocculent sediment down to the stable parent material is not a realistic goal. As previously mentioned, there are areas where the soft sediment is greater than 20 feet deep. A more realistic goal is to provide deep areas where vegetation will no longer grow, and to uncover some of the sand and gravel areas near shore. Exposing some of the thinly covered sand and gravel areas would provide benefits for people as well as spawning fish.

Dredging to reduce aquatic macrophyte growth has been accomplished with varying results in Wisconsin. Success has been poor in several small impoundments with high sediment loading. However, Lilly Lake in southeast Wisconsin was dredged in 1979 increasing the maximum depth from 6 feet to 20 feet. Little filling has occurred since the dredging and the area of heavy aquatic plant growth has been greatly reduced (Cooke, et. al. 1993).

Based on the current Secchi disk depth, the maximum depth of macrophyte growth in McCaslin Lake would be 12 feet. To allow for in filling, the minimum depth to dredge for elimination of macrophyte growth should be 15 feet. Removing 3 feet of soft sediment from many near shore areas would expose firm sand and gravel.

For illustrative purposes, the amount of dredge spoil to be removed and the estimated cost have been calculated for creating two 12'-15' deep basins in the lake covering 21 acres, and removing 3 feet of sediment from another 30 acres of the lake. Near-shore areas would only be dredged until a firm sand and gravel bottom was achieved. This dredging plan would remove an estimated 340,000 cu. yds. of sediment from the lake. Three dredging companies were contacted for cost estimates. The price range quoted by the contractors ranged from $1.00 to

$3.50 per cubic yard. Assuming the material could be removed for $1.00 per cu. yd., the hypothetical dredging project would cost approximately $340,000.

All dredging contractors consulted stressed that finding an adequate dewatering area near the lake was the key to minimizing dredging costs. It may be possible to reduce dredging costs by using one or more of the natural depressions east of the lake as a dewatering basin. Using these depressions, the dredge slurry water will infiltrate into the ground and not be returned to the lake. This will result in a temporary lake level drawdown during the dredging project. This drawdown may actually aid the dredging process.

The permitting procedure for a dredging project of this scale is a complicated process. According to WDNR Water Management Specialist Robert Rosenberger, any dredging project removing more than 3000 cu. yds. of material may require contaminant testing of the dredged material and an environmental impact statement. A U.S. Army Corps of Engineers permit is also required. Dredge spoils may not be deposited in a wetland.

a. *The McCaslin Lake District should appoint a committee to further explore the dredging alternatives. Dredging contractors can be solicited to visit the lake and offer cost estimates.*

Drawdown Water level drawdowns are commonly used as a management tool on reservoirs and lakes with water level control structures. The benefits of controlled drawdowns can include reduction of some species of aquatic vegetation, reduction of ice damage and compaction of loose flocculent sediment.

Although McCaslin Lake has no outlet control structure, a drawdown might be possible using some combination of pumps and the depressions east of the lake to lower the water level. However, the shape of the lake basin and the lack of a deep hole would ultimately limit the effectiveness of a drawdown.

To illustrate this problem, consider a drawdown of six feet in McCaslin Lake. This would restrict fish to an area less than 14 acres in size with an average depth of only two and one-half feet. While this six foot drawdown would expose more than 80% of the lake bed, it may not be sufficient to achieve drying and consolidation of sediment over the majority of the lake basin. A large portion of the lake (36 acres) is between four and six feet deep. This area is covered by more than 3 feet of soft organic muck which will be only partially dewatered. A drawdown of more than 6 feet would have very detrimental effects on the lakes fish population.

a. *A drawdown of McCaslin Lake cannot be recommended. It appears unlikely that a drawdown for sediment consolidation could be achieved without severely affecting the fish population.*

Aeration The aeration system installed in McCaslin Lake has done an excellent job of preventing winter kill due to low dissolved oxygen. Summer aeration also appears to have improved water clarity, probably through a reduction in blue green algae concentration. However, intensive aeration has not been shown to reduce soft sediment depth (Little, 1996).

a. *Aeration during the winter should be continued to prevent winter kill. Summer aeration also appears to increase water clarity and should be continued if financially feasible.*

b. *Aeration during the spring (Ice out - June) and fall (September - November) are less beneficial and can be eliminated if practical. Maintenance of the system should be scheduled during these times.*

Aquatic Plant Management The two most popular methods of aquatic plant management are chemical treatment and harvesting. Each method has its good and bad points, and each method has many secondary effects on the fish and plant community of the lake.

Chemical treatment is fast and efficient, however a WDNR permit is required and any liquid herbicide application must be performed by a licenced applicator. Chemical treatment also kills the entire plant. This opens up the bottom to increased wave action and leaves openings for invasion by less desirable species. Plants killed through chemical treatment also stay in the lake

to decompose. The nutrients released from the decomposing plants can stimulate algae blooms and cause increased plant growth. Although aquatic plants vary in their susceptibility to different herbicides, it is still difficult to accurately target certain species or areas with chemical treatment.

Harvesting removes the upper portions of the plant, leaving the roots to bind the sediment and allow for plant regrowth. Harvesting also removes the nutrients tied up in the plant material from the lake. In addition, harvesting allows for more precise management of species and areas to be conserved.

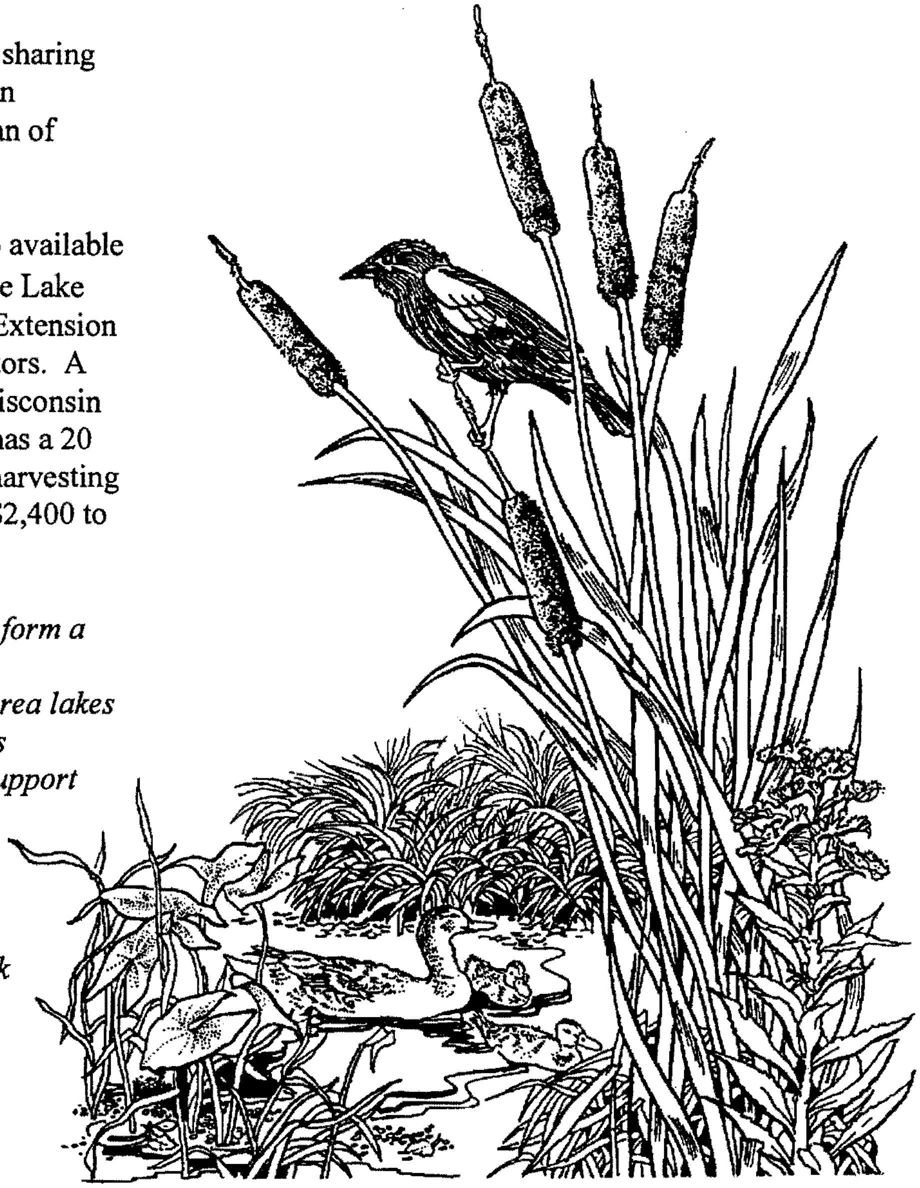
The McCaslin Lake District currently cuts aquatic plants with a Hockney weed cutter. The main drawback of the Hockney type cutter is its small size and inability to collect or "harvest" the cut vegetation. Without removing the vegetation, much of the benefit is lost. The cut plants will remain in the water and decay or wash up on the shoreline and become a nuisance. Wisconsin law requires that cut vegetation be removed from the water.

The main drawback of harvesting is the capital cost of the equipment. A 5 foot wide harvester, conveyor and transport trailer may cost upwards of $50,000. However there are Wisconsin Waterways Commission grants available to help defray the cost of purchasing a harvester. The grant pays 50% of the cost of the equipment. Grant recipients must have an approved aquatic plant management plan for the waters to be harvested and at least 40 acres of harvestable area.

The small number of landowners and the requirement for 40 acres of harvestable area limits the ability of many lakes groups such as the McCaslin Lake District to obtain a Waterway Commission grant. However, if several area lakes cooperated and pooled resources a grant could be received and a harvester purchased.

The operation of a successful harvester sharing agreement would require a paid crew, an operating/maintenance budget and a plan of operation.

Aquatic plant harvesting for hire is also available through several private contractors. The Lake List, an annual publication of the UW-Extension Lakes Program lists harvesting contractors. A contractor that harvests in northeast Wisconsin charges $120.00/hr for harvesting and has a 20 hour minimum. At the average stated harvesting rate of ½ acres per hour, it would cost $2,400 to harvest 10 acres.



a. *The McCaslin Lake District should form a Harvesting Committee to explore a cooperative agreement with other area lakes to apply for a Wisconsin Waterways Commission harvester grant, and support such efforts through a County Association of Lakes.*

b. *Prior to application for a harvester grant, the Lake District should work closely with the Marinette County LWCD and WDNR to develop an aquatic plant harvesting plan.*

c. *The Harvesting Committee should explore contracting aquatic plant harvesting to private contractors.*

ACTIVITY	YEAR COMPLETED OR CONTINUING								
	1997	1998	1999	2000	2001	2002	2003	2004	2005
1. Monitor forestry BMP's									
2. Restore natural buffer areas									
3. Implement "lake friendly" home practices									
4. Set voluntary standards for development									
5. Develop a "courtesy code" to avoid conflicts between lake users.									
6. Join Wisconsin Association of Lakes									
7. Establish lake management fund									
8. Invite local water quality and fisheries experts to annual meetings									
9. Participate in Marinette County Association of Lakes									
10. Form fish management committee to develop fish management plan									
11. Continue aeration program during winter months									
12. Form dredging committee to solicit cost estimates from dredging contractors									
13. Form a harvesting committee to explore harvester purchase or rental									

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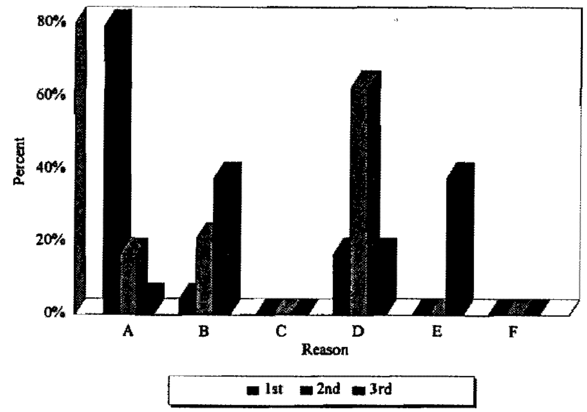
APPENDIX A

Water Resources Questionnaire

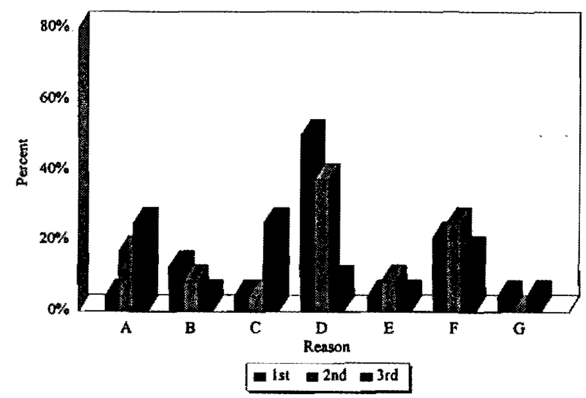
#1. Why do you enjoy McCaslin Lake?

REASON		NUMBER 1st	NUMBER 2nd	NUMBER 3rd	PERCENT 1st	PERCENT 2nd	PERCENT 3rd
A	Peace and quiet	19	4	1	79%	17%	4%
B	Fishing/hunting	1	5	9	4%	21%	38%
C	Motorized recreation: boating/skiing/etc.	0	0	0	0%	0%	0%
D	Natural beauty	4	15	4	17%	63%	17%
E	Non-motorized recreation: swimming/canoeing/etc.	0	0	9	0%	0%	38%
F	Other	0	0	0	0%	0%	0%



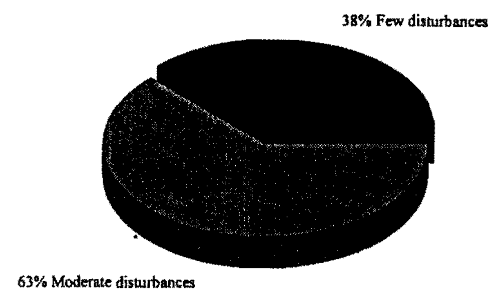
#2. Why did you choose property on McCaslin Lake?

REASON		NUMBER 1st	NUMBER 2nd	NUMBER 3rd	PERCENT 1st	PERCENT 2nd	PERCENT 3rd
A	Distance from home	1	4	6	4%	17%	25%
B	Family tradition	3	2	1	13%	8%	4%
C	Investment	1	1	6	4%	4%	25%
D	Privacy of lake	12	9	2	50%	38%	8%
E	Because of neighbors	1	2	1	4%	8%	4%
F	Ability to meet the needs from Question #1	5	6	4	21%	25%	17%
G	Other	1	0	1	4%	0%	4%



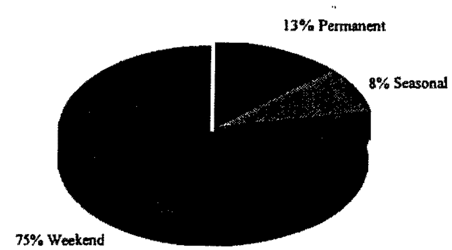
#3. Which statement best describes the peace and tranquility at McCasin Lake

REASON		NUMBER	PERCENT
A	Few disturbances	9	38%
B	Moderate disturbances	15	63%
C	Heavily used	0	0%
D	Over used	0	0%
E	Unusable	0	0%



#4. How often is your lakefront residence used?

REASON		NUMBER	PERCENT
A	Permanent	3	13%
B	Seasonal	2	8%
C	Weekend	18	75%

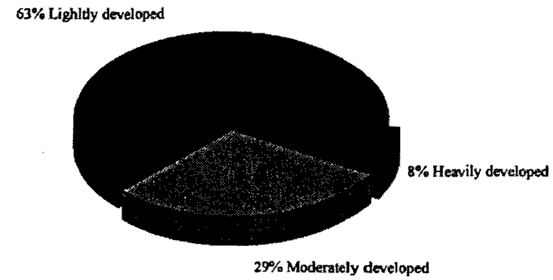


#5. How long have you been coming to McCaslin Lake? Average = 23.7 years

#6. How many people use your lake residence on a regular basis? Average = 4.2 people

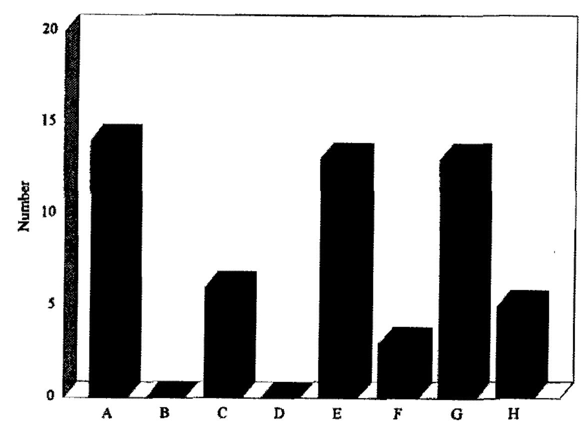
#7. Which statement do you feel best describes the shoreline of McCaslin Lake?

REASON		NUMBER	PERCENT
A	Lighltly developed	15	63%
B	Moderately developed	7	29%
C	Heavily developed	2	8%
D	Over developed	0	0%



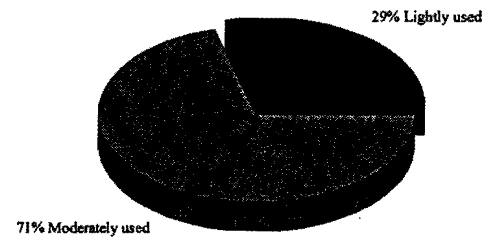
#8 How many of the following watercraft are kept at your property?

REASON		NUMBER	PERCENT
A	Canoe	14	58%
B	Jet Ski	0	0%
C	Raft	6	25%
D	Power boat over 25hp	0	0%
E	Power boat under 25 hp	13	54%
F	Sail boat	3	13%
G	Row boat	13	54%
H	Paddle boat	5	21%



#9 Which statement best describes the boat traffic on McCaslin Lake?

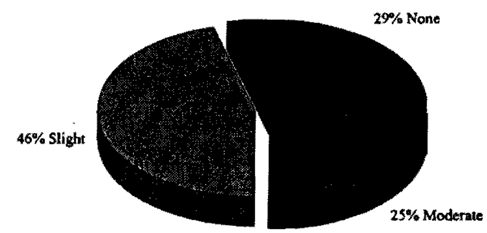
REASON	NUMBER	PERCENT
A Lightly used	7	29%
B Moderately used	17	71%
C Heavily used	0	0%
D Over used	0	0%



#10. Approximately how many feet of lake frontage do you own? Average = 375.6 feet

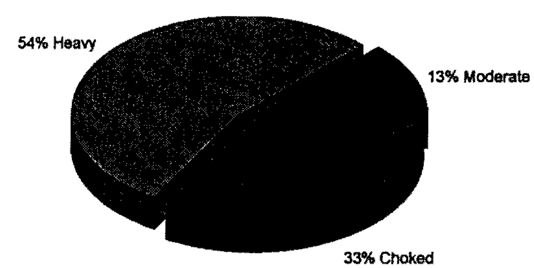
#11. How whould you describe the severity of shoreline erosion or loss on your lake frontage?

REASON	NUMBER	PERCENT
A None	7	29%
B Slight	11	46%
C Moderate	6	25%
D Heavy	0	0%
E Severe	0	0%



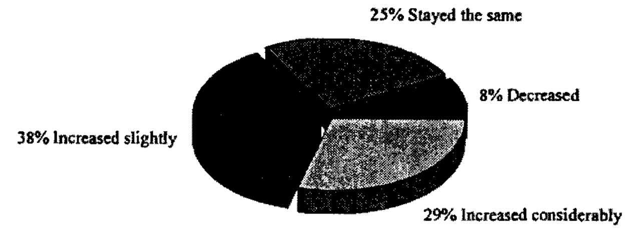
#12. Which statement best describes the level of aquatic plant (weed) growth in the lake?

REASON	NUMBER	PERCENT
A Light	0	0%
B Moderate	3	13%
C Heavy	13	54%
D Choked	8	33%



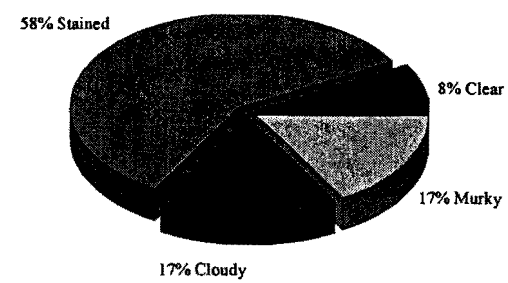
#13. In your experience, how has the level of aquatic plant (weed) growth changed over the years?

REASON	NUMBER	PERCENT
A Decreased	2	8%
B Stayed the same	6	25%
C Increased slightly	9	38%
D Increased considerably	7	29%



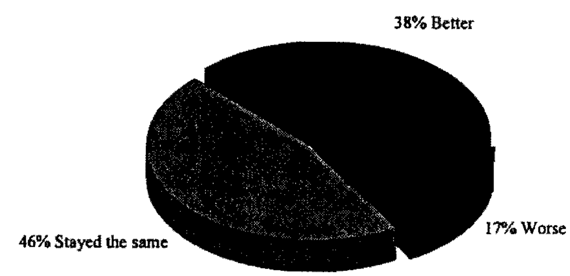
#14. Which term best defines what you consider the water "clarity" of McCaslin Lake to be?

REASON	NUMBER	PERCENT
A Crystal clear	0	0%
B Clear	2	8%
C Stained	14	58%
D Cloudy	4	17%
E Murky	4	17%



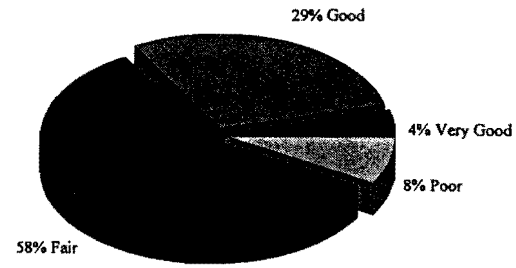
#15. In your experience, how has the water clarity changed over the years?

REASON	NUMBER	PERCENT
A Better	9	38%
B Stayed the same	11	46%
C Worse	4	17%



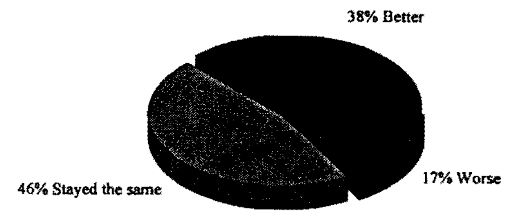
#16. Which term best describes what you consider the water "quality " of McCaslin Lake to be?

REASON	NUMBER	PERCENT
A Very Good	1	4%
B Good	7	29%
C Fair	14	58%
D Poor	2	8%
E Seriously polluted	0	0%



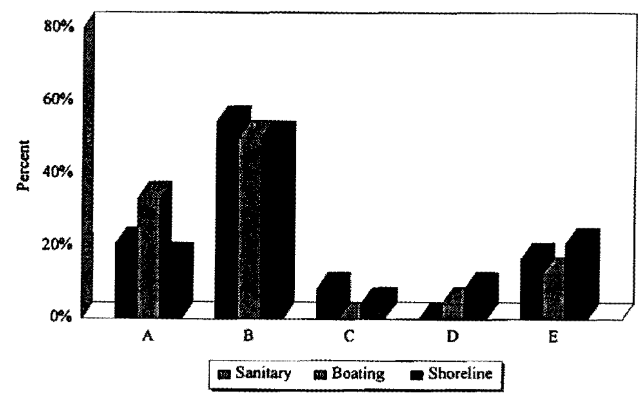
#17. In your experience, how has the water quality changed over the years?

REASON	NUMBER	PERCENT
A Better	9	38%
B Stayed the same	11	46%
C Worse	4	17%



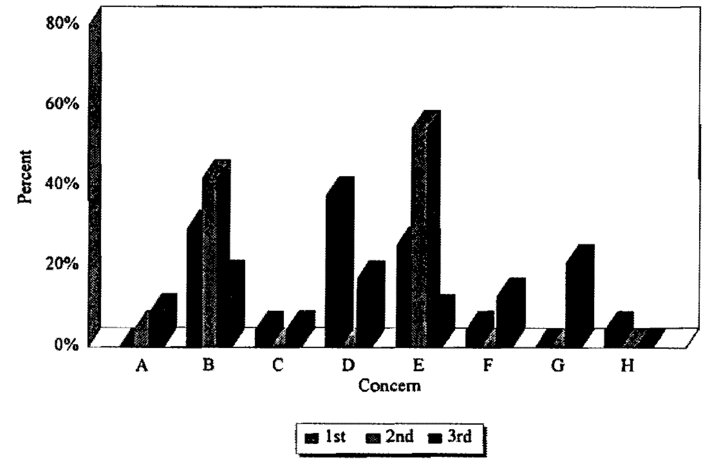
#18. How would you rate the enforcement of the following existing regulations?

REASON	NUMBER 1st	2nd	3rd	PERCENT San.	Boat	Shore
A Excellent	5	8	4	21%	33%	17%
B Good	13	12	12	54%	50%	50%
C Fair	2	0	1	8%	0%	4%
D Poor	0	1	2	0%	4%	8%
E Not familiar with regulations	4	3	5	17%	13%	21%



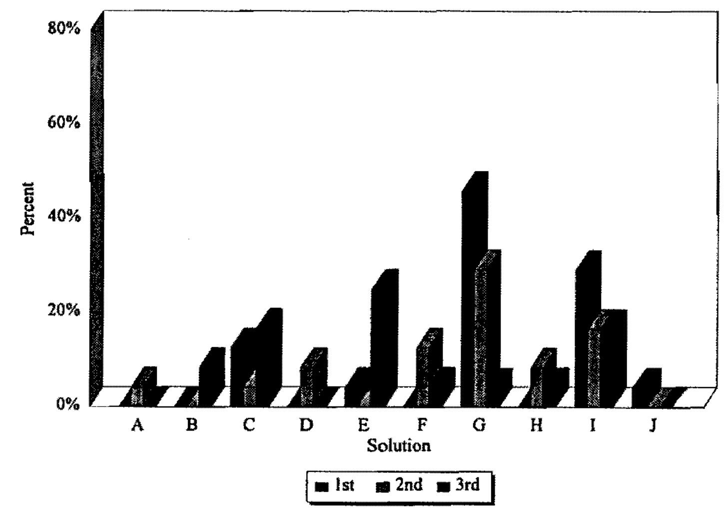
#19. The most serious problems or concerns regarding McCaslin Lake are?

REASON		NUMBER 1st	2nd	3rd	PERCENT 1st	2nd	3rd
A	Poor fishing	0	1	2	0%	4%	8%
B	Excessive aquatic plant growth	7	10	4	29%	42%	17%
C	Unattractive shoreline development	1	0	1	4%	0%	4%
D	Preventing public access	9	0	4	38%	0%	17%
E	Excessive sediment on the lake bottom	6	13	2	25%	54%	8%
F	Over development of the shoreline	1	0	3	4%	0%	13%
G	Poor water quality	0	0	5	0%	0%	21%
H	Other	1	0	0	4%	0%	0%



#20. What solutions do you favor to deal with the issues facing McCaslin Lake?

SOLUTION		NUMBER 1st	2nd	3rd	PERCENT 1st	2nd	3rd
A	Strengthen the McCaslin Lake District	0	1	0	0%	4%	0%
B	Stronger regulation of shoreline development	0	0	2	0%	0%	8%
C	Education about environmentally friendly lake living and	3	1	4	13%	4%	17%
D	Increase environmentally sound management of the lakes'	0	2	0	0%	8%	0%
E	Continue current management practices	1	0	6	4%	0%	25%
F	Stock lake and manage fish population	0	3	1	0%	13%	4%
G	Manage (remove) aquatic plants	11	7	1	46%	29%	4%
H	Update septic systems to reduce pollution	0	2	1	0%	8%	4%
I	Remove excessive sediment deposits	7	4	4	29%	17%	17%
J	Other	1	0	0	4%	0%	0%



APPENDIX B

Water Quality Monitoring Data

McCASLIN LAKE SURFACE SAMPLES (0.5 m from surface)

Date	Total P (ug/l)	Ortho P (ug/l)	TKN (ug/l)	No2-No3 (ug/l)	NH3 (ug/l)	Chlor-a (UG/L)	Secchi (ft)	Phosporus TSI	Chlor-a TSI	Secchi TSI
26-Apr-95	22	ND	500	ND	ND	10.3	5.5	52.1	52.5	52.5
20-Jun-95	20	ND	500	15	ND	4.4	8.2	51.4	46.0	46.8
18-Jul-95	26	3	600	ND	ND	4.39	5.8	53.4	46.0	51.8
22-Aug-95	18	3	600	ND	52	6.51	8	50.6	49.0	47.1
14-Feb-96	12	3						47.5		

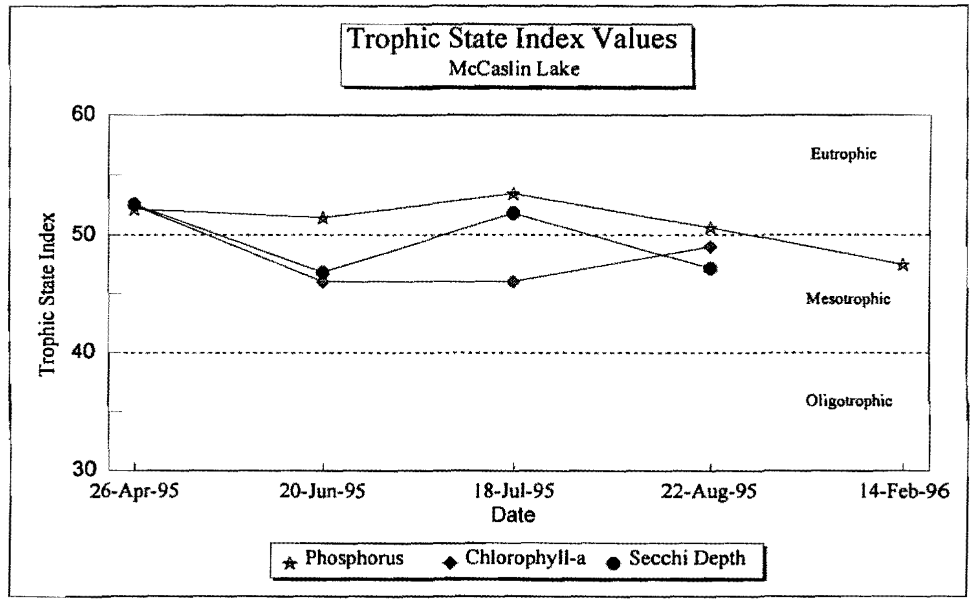
McCASLIN LAKE INLET SAMPLES

Date	Total P (ug/l)	Ortho P (ug/l)	TKN (ug/l)	No2-No3 (ug/l)	NH3 (ug/l)
15-May-95	13	3	400	ND	ND
20-Jun-95	45	22	600	ND	ND
18-Jul-95	55	37	400	45	74
22-Aug-95	61	31	500	45	132

McCASLIN LAKE BOTTOM SAMPLES (0.5 m from bottom)

Date	Total P (ug/l)	Ortho P (ug/l)	TKN (ug/l)	No2-No3	NH3
26-Apr-95	21	ND	500	ND	ND
19-Jun-95	27	ND	500	ND	ND
18-Jul-95	22	-	600	ND	ND
22-Aug-95	16	3	600	ND	32
14-Feb-96	10	3			

ND = No Detect (below detection limit)



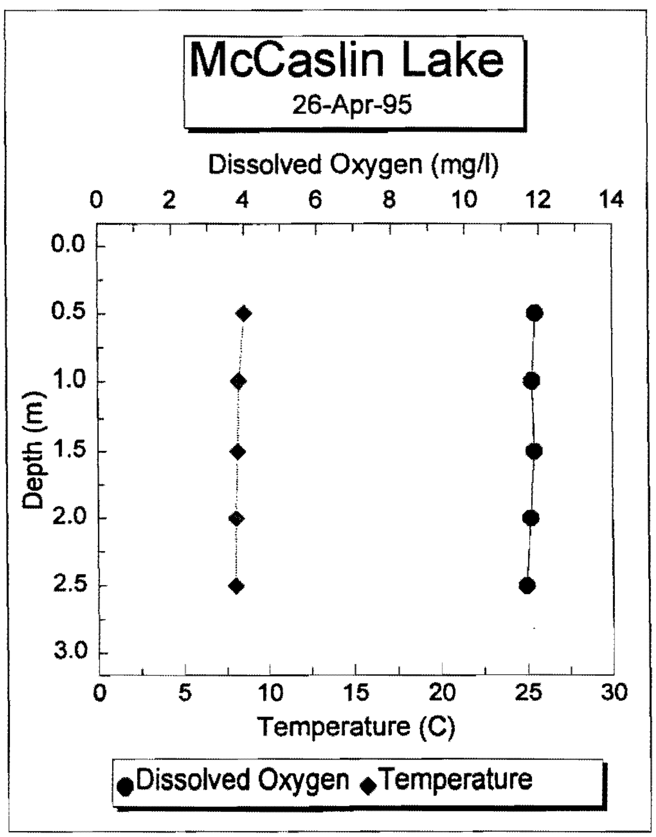
McCASLIN LAKE WATER QULITY MONITORING PROFILES

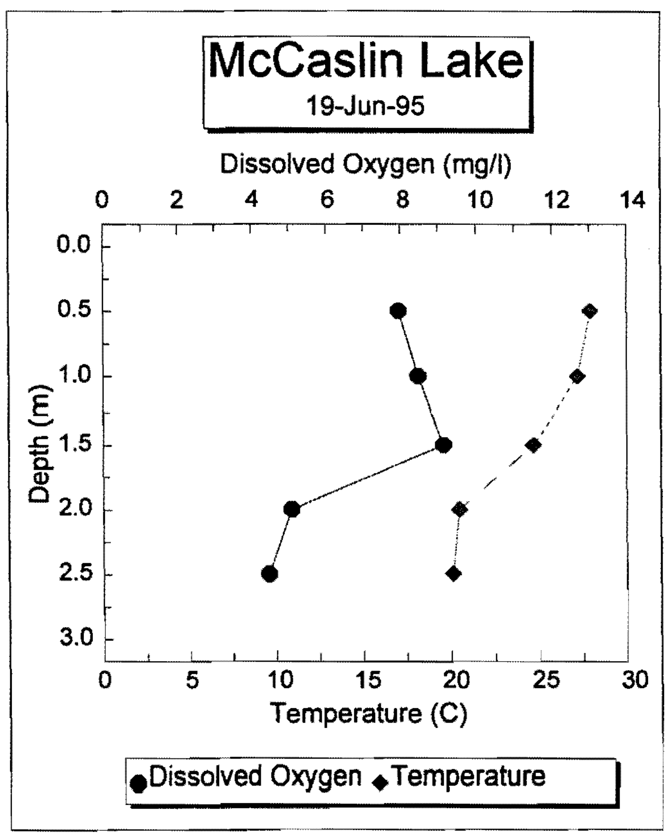
McCaslin Lake
26-Apr-95

Depth (m)	Temp (C)	D.O. (mg/l)	Cond. (mS/cm)	pH	TDS (g/l)	Oxygen (%sat.)
0.0						
0.5	8.58	11.89	0.069	8.05	0.044	101.0
1.0	8.23	11.80	0.069	7.98	0.044	100.0
1.5	8.15	11.86	0.069	7.91	0.044	100.5
2.0	8.04	11.75	0.069	7.84	0.044	99.5
2.5	8.03	11.64	0.069	7.73	0.044	98.5
3.0						

McCaslin Lake
19-Jun-95

Depth (m)	Temp (C)	D.O. (mg/l)	Cond. (mS/cm)	pH	TDS (g/l)	Oxygen (%sat.)
0.0						
0.5	27.91	7.96	0.073	7.5	0.047	101.1
1.0	27.17	8.48	0.073	7.6	0.047	104.4
1.5	24.67	9.14	0.072	7.63	0.046	110.8
2.0	20.47	5.08	0.073	6.83	0.047	55.8
2.5	20.10	4.47	0.076	6.74	0.049	43.3
3.0						





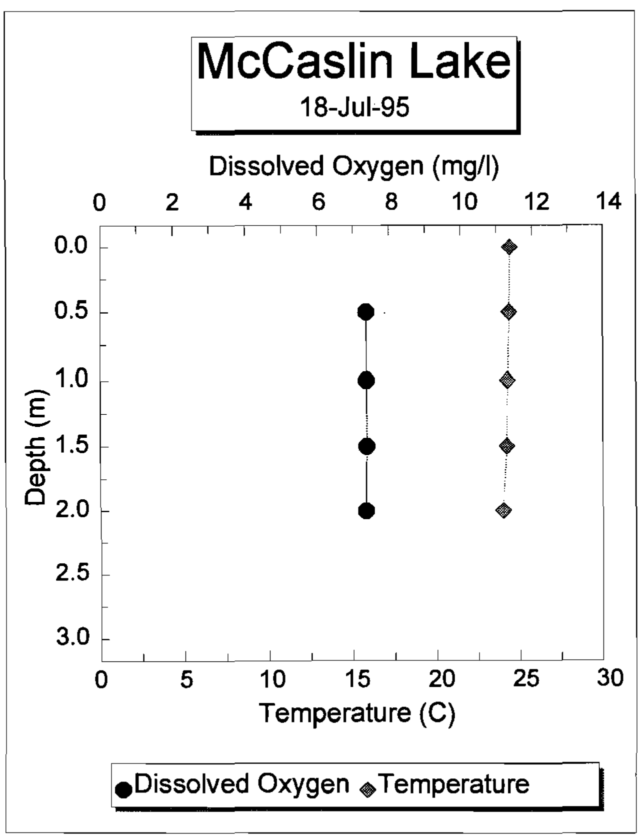
McCASLIN LAKE WATER QULITY MONITORING PROFILES

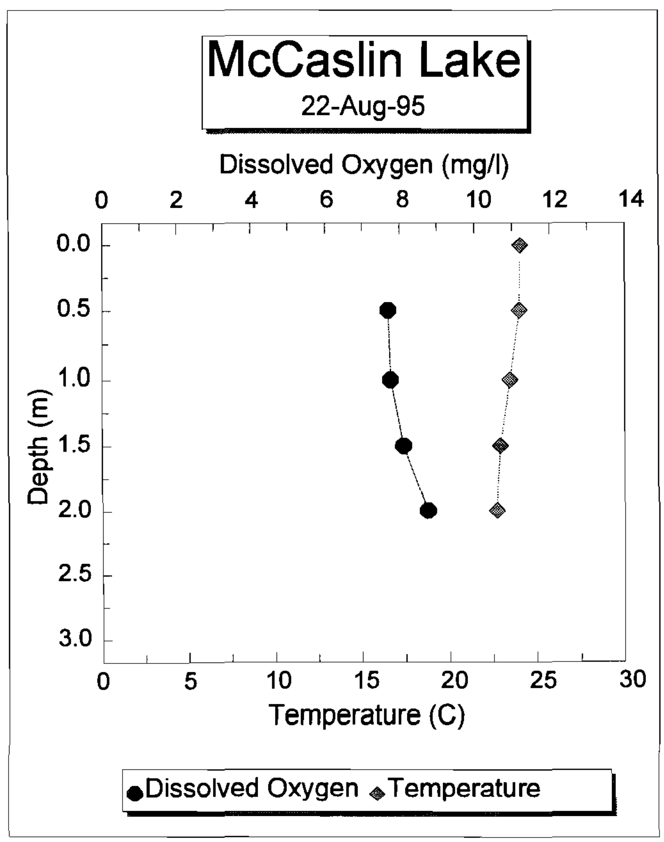
McCaslin Lake
18-Jul-95

Depth (m)	Temp (C)	D.O. (mg/l)	Cond. (mS/cm)	pH	TDS (g/l)	Oxygen (%sat.)
0.0	24.4					
0.5	24.37	7.37	0.080	7.65	0.051	88.5
1.0	24.27	7.38	0.080	7.6	0.051	85.7
1.5	24.22	7.39	0.080	7.58	0.051	87.1
2.0	23.98	7.37	0.079	7.53	0.051	86.2
2.5						
3.0						

McCaslin Lake
22-Aug-95

Depth (m)	Temp (C)	D.O. (mg/l)	Cond. (mS/cm)	pH	TDS (g/l)	Oxygen (%sat.)
0.0	24.05					
0.5	24.01	7.70	0.080	7.77	0.051	90.6
1.0	23.49	7.77	0.080	7.77	0.051	90.8
1.5	22.93	8.11	0.079	7.9	0.051	94.9
2.0	22.71	8.75	0.078	8.04	0.050	101.1
2.5						
3.0						

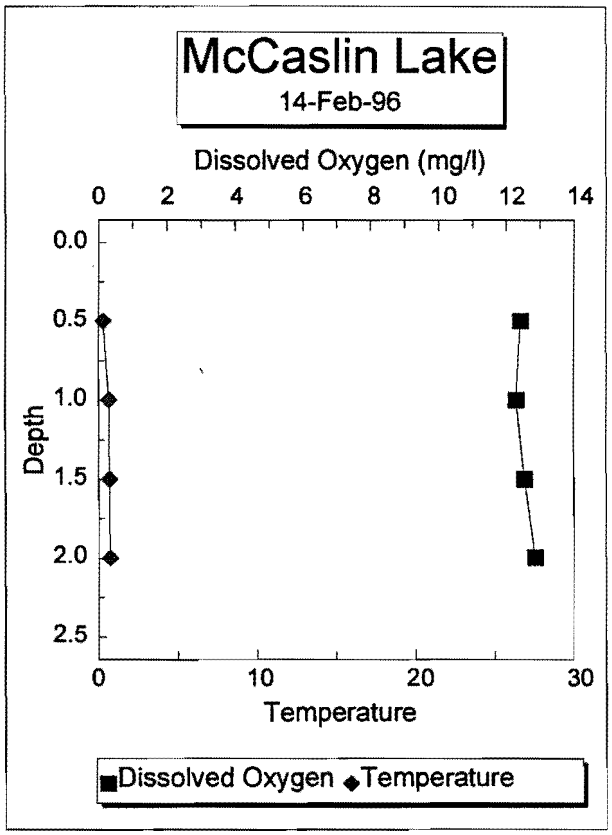




McCASLIN LAKE WATER QULITY MONITORING PROFILES

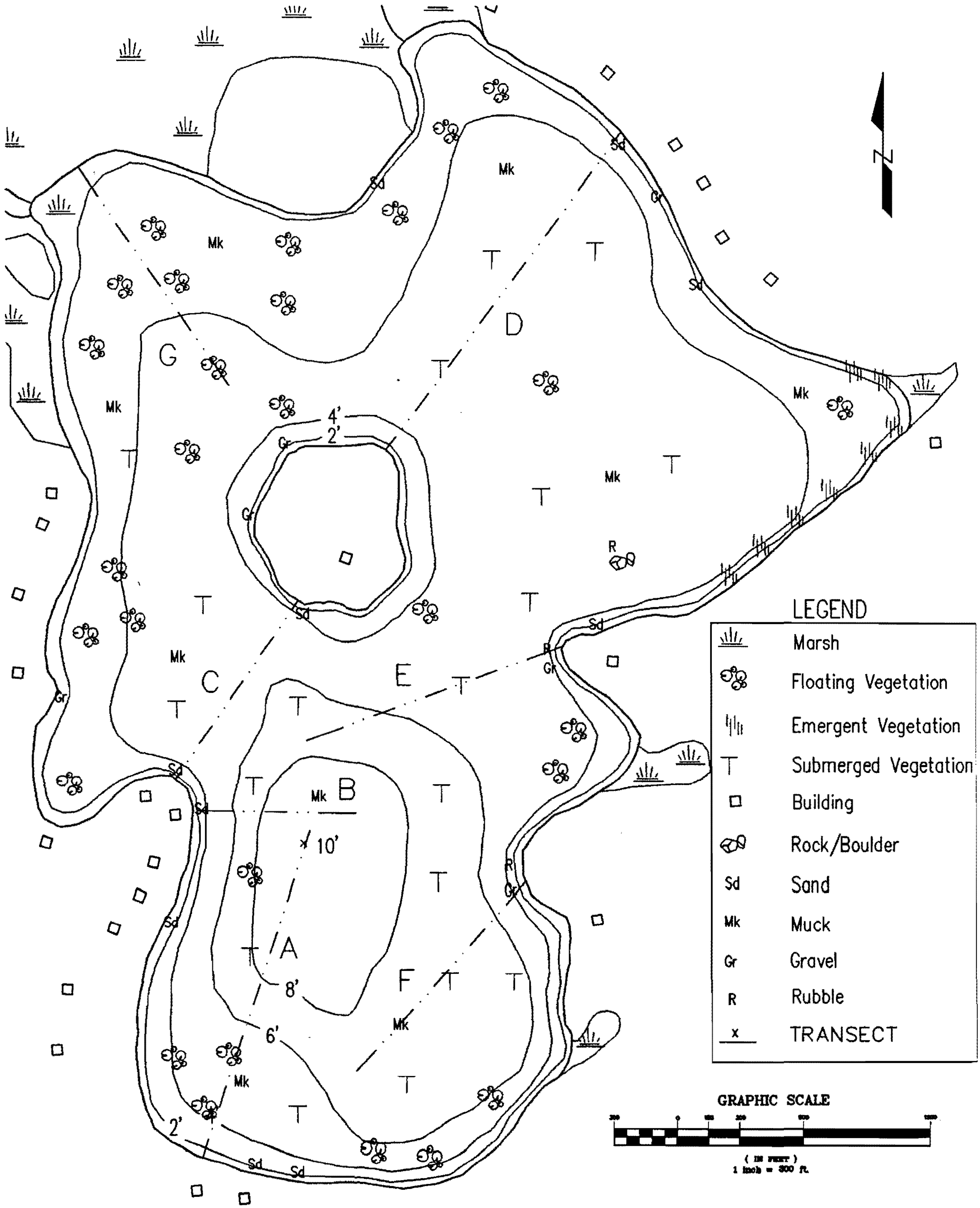
McCaslin Lake
14-Feb-96

Depth (m)	Temp (C)	D.O. (mg/l)	Cond. (mS/cm)	pH	TDS (g/l)	Oxygen (%sat.)
0.0						
0.5	0.29	12.42	0.113	6.42	0.072	83.2
1.0	0.65	12.30	0.113	6.44	0.073	86.0
1.5	0.70	12.54	0.113	6.44	0.073	88.8
2.0	0.74	12.86	0.114	6.45	0.073	91.5
2.5						
3.0						



APPENDIX C

Aquatic Macrophyte Survey Data



Aquatic Macrophyte Survey Transects

Lake Name: McCaslin Lake
Survey Date: August 8, 1995
Surveyors: C. Druckrey, B. Kowalski, T. Rasman

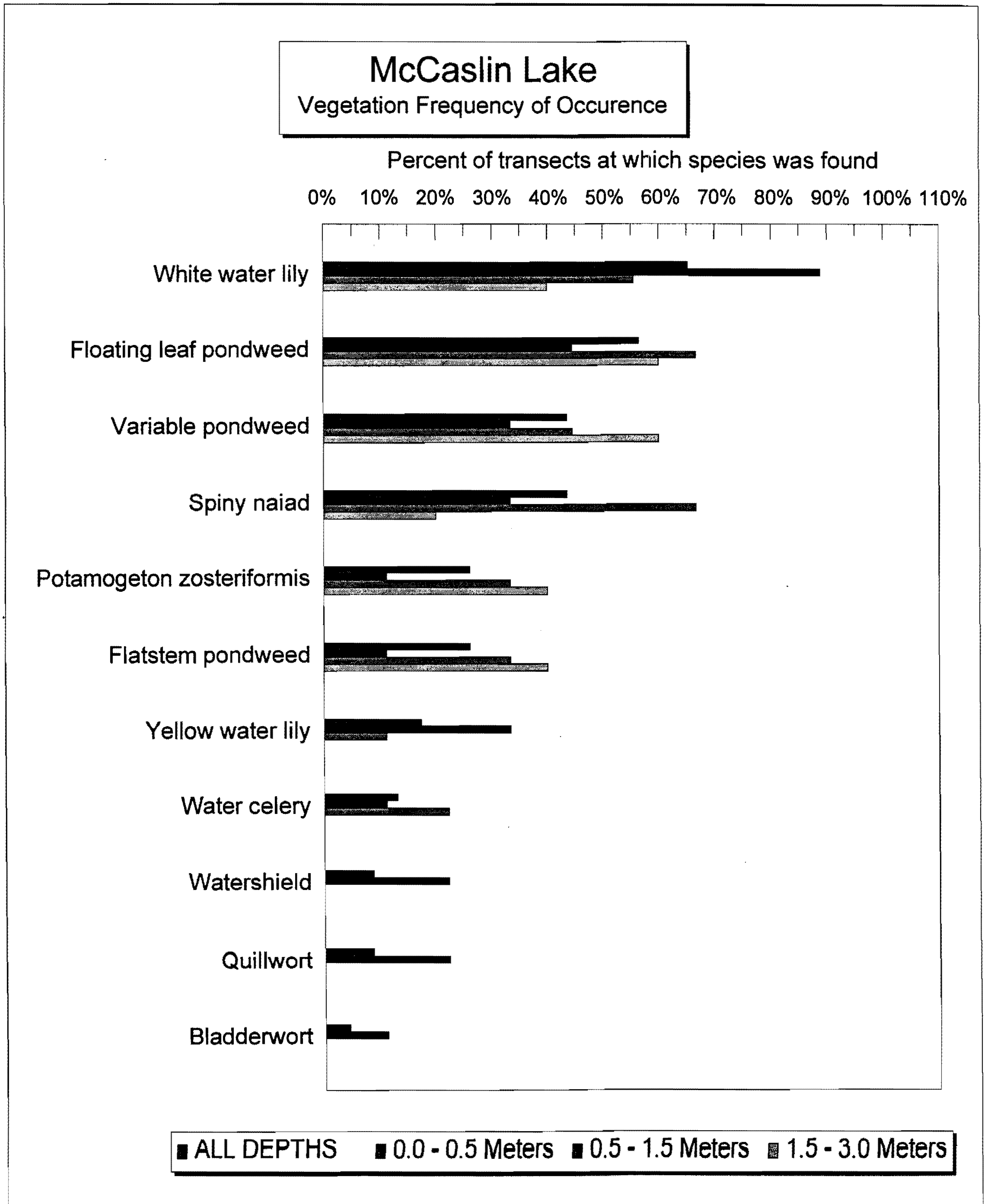
	Transect	A			B			C			C'		D	
SPECIES	Depth Range	1	2	3	1	2	3	1	2	3	1	2	1	2
White water lily (Nymphaea odorata)			2	1	1	1	1	1			1	2	1	1
Floating leaf pondweed (Potamogeton natans)		1	2	3	1	1		3	1			3		
Variable pondweed (Potamogeton graminaeus)		2	3	1					1				2	
Spiny naiad (Najas flexilis)			2		1				2	3		4		4
Flatstem pondweed (Potamogeton zosteriformis)			1									2		1
Bigleaf pondweed (Potamogeton amplifolius)												1		1
Yellow water lily (Nuphar spp.)					1									
Water celery (Vallisnaria americana)														2
Watershield (Brasenia schreberi)														
Quillwort (Isoetes spp.)													5	
Bladderwort (Utricularia spp.)														

Depth Range
1 = 0-0.5 meters
2 = 0.5-1.5 meters
3 = 1.5-3.0 meters

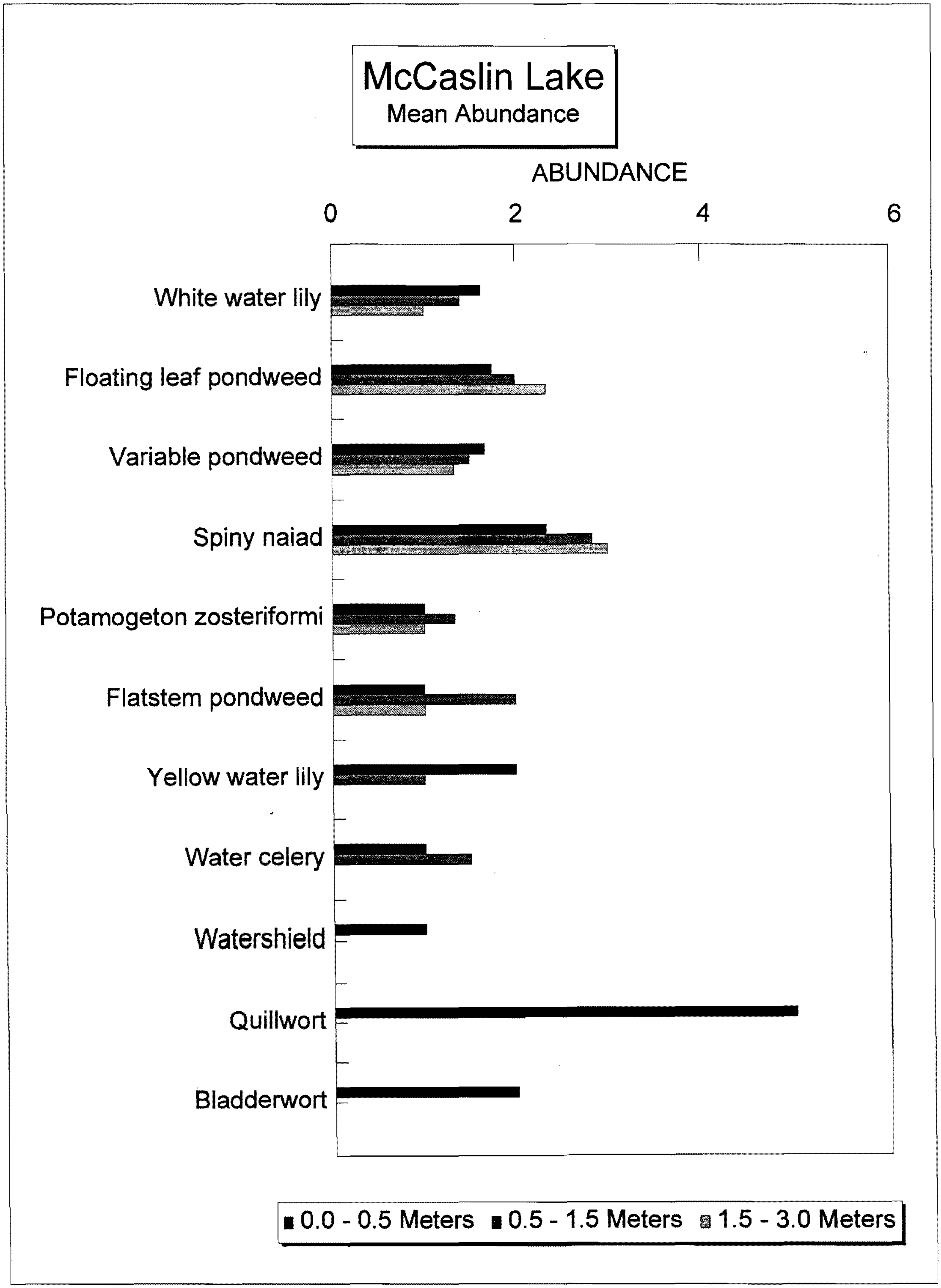
Species Density
1 = ABUNDANT
2 = COMMON
3 = PRESENT

SPECIES	D'		E			E'	F			G
	1	2	1	2	3	2	1	2	3	1
White water lily (Nymphaea odorata)	3		1	1			1			4
Floating leaf pondweed (Potamogeton natans)				2	2	3			2	2
Variable pondweed (Potamogeton graminaeus)		1			2			1	1	1
Spiny naiad (Najas flexilis)	1			3				2		5
Flatstem pondweed (Potamogeton zosteriformis)					1				1	1
Bigleaf pondweed (Potamogeton amplifolius)					1	4			1	1
Yellow water lily (Nuphar spp.)		1					1			4
Water celery (Vallisnaria americana)			1	1						
Watershield (Brasenia schreberi)							1			1
Quillwort (Isoetes spp.)							5			
Bladderwort (Utricularia spp.)										2

SPECIES	PERCENT OCCURENCE				AVERAGE DENSITY RATING		
	TOTAL	0 - 0.5 M	0.5 - 1.5 M	1.5 - 3.0 M	0 - 0.5 M	0.5 - 1.5 M	1.5 - 3.0 M
White water lily (Nymphaea odorata)	65%	89%	56%	40%	1.6	1.4	1.0
Floating leaf pondweed (Potamogeton natans)	57%	44%	67%	60%	1.8	2.0	2.3
Variable pondweed (Potamogeton graminaeus)	43%	33%	44%	60%	1.7	1.5	1.3
Spiny naiad (Najas flexilis)	43%	33%	67%	20%	2.3	2.8	3.0
Flatstem pondweed (Potamogeton zosteriformis)	26%	11%	33%	40%	1.0	1.3	1.0
Bigleaf pondweed (Potamogeton amplifolius)	26%	11%	33%	40%	1.0	2.0	1.0
Yellow water lily (Nuphar spp.)	17%	33%	11%		2.0	1.0	
Water celery (Vallisnaria americana)	13%	11%	22%		1.0	1.5	
Watershield (Brasenia schreberi)	9%	22%			1.0		
Quillwort (Isoetes spp.)	9%	22%			5.0		
Bladderwort (Utricularia spp.)	4%	11%			2.0		



McCaslin Lake
Vegetation Frequency of Occurence
Percent of transects at which species was found
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% 110%
White water lily
Floating leaf pondweed
Variable pondweed
Spiny naiad
Potamogeton zosteriformis
Flatstem pondweed
Yellow water lily
Water celery
Watershield
Quillwort
Bladderwort
ALL DEPTHS
0.0 - 0.5 Meters
0.5 - 1.5 Meters
1.5 - 3.0 Meters


McCaslin Lake
Mean Abundance
ABUNDANCE
0
2
4
6
White water lily
Floating leaf pondweed
Variable pondweed
Spiny naiad
Potamogeton zosteriformi
Flatstem pondweed
Yellow water lily
Water celery
Watershield
Quillwort
Bladderwort
0.0 - 0.5 Meters
0.5 - 1.5 Meters
1.5 - 3.0 Meters