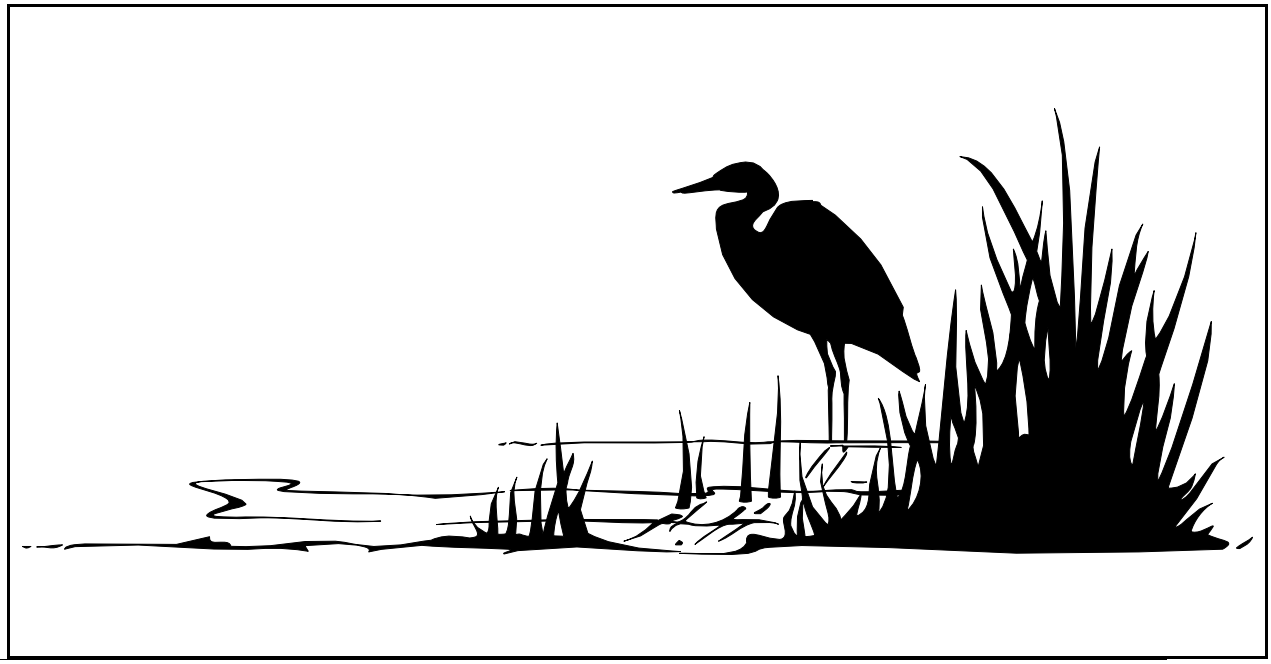
APPLE RIVER FLOWAGE
AQUATIC PLANT SURVEY REPORT



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Summary

In the summer of 2002, Al Snyder, representing the interests of the Apple River Flowage P&R District, and Harvey Stower, Mayor of Amery, requested technical assistance with aquatic plant management issues. A current assessment and characterization of existing conditions was needed as a basis for decision making. In an attempt to facilitate this, the Polk County LWRD and the DNR entered into a partnership to conduct two detailed aquatic plant surveys. The first survey was conducted in the first two weeks of June 2003 to characterize and assess the current distribution and density of curlyleaf pondweed (Potamogeton crispus). The second survey was conducted during the last week of July and the first week of August 2003 to assess the current native aquatic plant species density and distribution at peak growth form. The information will be used to develop the requested aquatic plant management strategy. Management strategies will need to balance the needs for recreational access with those of habitat protection, water quality, and overall ecological health.

Past complaints have focused on several aspects of aquatic plant management (APM) including:

- *Curlyleaf pondweed influence and dominance of the community structure in selected shallow flats in late May and early June.*
- *Nuisance problems associated with coontail, duckweed, and other native species within navigational access channels.*
- *Management options and ecological priorities which need to be carefully considered for the areas dominated by rice on the north end of the flowage west of Hwy 46.*
- *Documenting the presence or absence of Eurasian Water Milfoil, zebra mussels, or other exotic species within the Apple River Flowage.*
- *Identifying management strategies needed to maintain, protect, and enhance habitat and water quality while helping the existing high quality fishery achieve its full biological potential.*

Often with aquatic plant control strategies we focus on the symptom (lush or dense aquatic plant growth) rather than the cause (excess nutrients and their sources). Curlyleaf pondweed and other problem or nuisance densities of aquatic plants are often caused or made worse by excess nutrients. The 1978 OILR study proficiently summarized problem sources within the watershed at the time of the survey. An updated watershed nutrient source and quantification survey would help the county and state resource protection staff (LWRD, DNR, and DATCP) work with the Apple River Flowage P&R District to target nutrient control in an attempt to reduce excess vegetation.

Curlyleaf Pondweed - Summary

Curlyleaf pondweed was the third most abundant plant found within the flowage

during the early June survey, occurring at 63% of the sampled sites. By August curlyleaf pondweed had died back considerably, occurring at less than 6% of the sampled sites.

The ability to effectively control the overall population of curlyleaf pondweed within the flowage with existing control techniques is unpromising. Even if current techniques are implemented over a broad area, it is likely they would create more ecological consequences than the exotic itself and still provide no meaningful long-term control. Continued monitoring of new and developing techniques that will provide true long-term control of the population should be a high priority. As new techniques are discovered, a small-scale test plot with intensive monitoring of the technique could be set up to evaluate its long term effectiveness while assessing how it integrates into the overall program. Monitoring should document both the level of long-term control and any impacts associated with the treatment on non-target organisms and plant species.

Routine Herbicide Treatments in Priority Navigational Access Channels

Since long-term control of curlyleaf pondweed is unlikely with existing control techniques, control strategies need to balance recreational access with critical habitat protection. Management efforts should focus on identifying specific areas where curlyleaf pondweed is resulting in user conflicts. Herbicide treatments should be limited to high use areas such as priority navigational access channels, beaches, and boat ramps because of cost effectiveness and environmental disruption. First herbicide applications should occur when rooted aquatic plant densities first begin to obstruct navigation. Mechanical harvesting should be used to remove free-floating coontail within priority navigational access channels between herbicide treatments. As rooted aquatic plant densities begin to again reach the surface and obstruct navigation, a second herbicide treatment may be needed by early to mid July. Herbicide treatments after the first of August should be avoided as they have limited benefits as many native species begin to die back by early August.

Coontail & Duckweed - Summary

Coontail is the dominant aquatic plant within the flowage and occurred at over 90% of the sampled sites in both the June and August surveys. Coontail is a unique aquatic plant because it does not need to be rooted to grow. It can be found floating in the water column. It often creates problems within treated channels as prevailing winds can move it from untreated areas readily into treated channels a day or two after an effective herbicide application, thus, compromising the benefits of costly control measures. This plant grows well in the conditions of the Apple River Flowage and serves as a resting spot for many invertebrates important in the food chain. Coontail also has the ability to draw nutrients from the water, reducing phosphorus levels and

thereby inhibiting algae growth.

Duckweed does not appear to be controllable within the priority navigational access channels because the systemic species-selective herbicides that are required for control do not have adequate contact times to be effective in flow-through systems (Sundeen, pers com 2004). Contact herbicides such as Diquat could kill duckweed, but are highly toxic to important parts of the aquatic food chain including amphipods and Daphnia and should not be considered an acceptable management option (APM in WI Ch IV; Helsel, 1997). Although unsightly, given the nutrient content of the Apple River Flowage, the absence of duckweed would promote algae growth. Duckweed serves as food to waterfowl and other organisms and offers shade and cover for fish and invertebrates.

Wild Rice –Summary

The large bed of wild rice at the north end of the flowage is a critical habitat area. Any active management or manipulations would have to be approved through the Voight Task Force. The Voight Task Force has made it a high priority to maintain or enhance rice coverage throughout northern Wisconsin and it is doubtful that any large-scale removals or reductions would be approved. Wild rice is valued both for its economic and cultural importance. Within the aquatic ecosystem, wild rice plants help stabilize soft sediments and provide food and shelter for many creatures.

Drawdowns also pose a serious threat to the wild rice stands in the flowage and for this reason should not be considered a viable management alternative. A drawdown could kill or destabilize the rice beds, allowing nutrient-rich sediments deposited under their roots to resuspend and enter the flowage resulting in large-scale algae blooms and dramatic reductions in water clarity and quality (Engel, S. and S.A. Nichols, 1991).

Exotic Species Assessment- Summary

No new exotic species were documented within the Apple River Flowage at the time of the 2003 survey. Of particular importance, no Eurasian Water Milfoil or Zebra Mussels were found. Curlyleaf pondweed and purple loosestrife have been documented on the flowage in past surveys and were found again. Purple loosestrife is present in isolated wetland fringes, but continued control efforts by County Land and Water Resources staff and other active conservation groups or individuals have kept densities to a low to moderate level in most wetland areas.

The P&R District should develop a rapid response volunteer exotics monitoring team that can monitor boat launches, beaches, and other access points (where exotics could be introduced into the system) at least every few weeks throughout the normal summer

growing season (May to September). On high use weekends or special events, volunteer monitors should inspect watercraft at access points for exotics and educate users about exotic species threats and proper prevention measures. Grant moneys are available to help support the development of such volunteer monitoring programs (Clean Boats - Clean Water and AIS grants).

Volunteers should be trained on the identification of exotic species of concern with an emphasis on Eurasian Water Milfoil and Zebra Mussels. Boat launches and immediately surrounding areas (out to 5' in the water and one to two hundred feet on each side of the launch) should be carefully inspected by wading or diving at least every other week. Rake sampling can be used to extend exotics inspections to deeper areas around launches where plants are less visible from the surface. Monthly to bimonthly inspections throughout the rest of the flowage would help ensure early detection of exotic species and increase the likelihood of controlling pioneering stands of exotics before they become well established.

Studies have indicated that if Eurasian Water Milfoil (EWM) is not identified and eliminated in the early stages of pioneering infestation, the ability to control it could be lost. After EWM is well established, extensive harvesting and herbicide control measures have been largely ineffective. In fact, little difference was noticed between extensive control efforts and doing nothing in the Helsel, et al.study (1999).

A <u>rapid action plan</u> for the Apple River Flowage should be established in the event that exotics are discovered. This should include the ability to pay for emergency treatments of early pioneering plants or stands of EWM. Follow up diving and hand removal efforts should also be integrated with any herbicide treatments aimed at early pioneering stands of EWM. If EWM is discovered in the flowage, all mechanical control strategies should be halted to prevent the spread from plant fragments created by the harvester. Once EWM has been eliminated from the system, mechanical harvesting strategies can be reinitiated. Elimination of EWM should be confirmed by at least 2 or 3 separate inspections, a week or more apart, of the entire flowage with an emphasis on ensuring Eurasian Water Milfoil is absent from harvested channels before reinitiating harvesting activities. The harvester should also be fully cleaned to remove all organic material before re-entering the flowage.

Protection and Enhancement of existing Fisheries – Summary

When trying to prioritize where limited protection and rehabilitation funds should be spent, it is important to remember that protecting a resource before an impact occurs is more cost-effective than trying to rehabilitate or restore things after an impact occurs. Acquisition and protection of critical habitat areas is always one of the highest priorities. The map of sensitive areas will help the P&R District target areas where

acquisition dollars would best be spent. Agencies and trusts have been established to help conservation organizations through the process of acquisition. These trusts may be a possible resource to secure assistance and funds.

When deciding where to spend limited monies on the Apple River Flowage, it should be emphasized that attempts to control curlyleaf pondweed once it is so well established on a flow through system are largely ineffective. Monies may be better spent monitoring for pioneering plants or stands of Eurasian Water Milfoil. Other high priority projects should include the protection of native shorelines and aquatic plant sensitive areas and the reduction of nutrient sources.

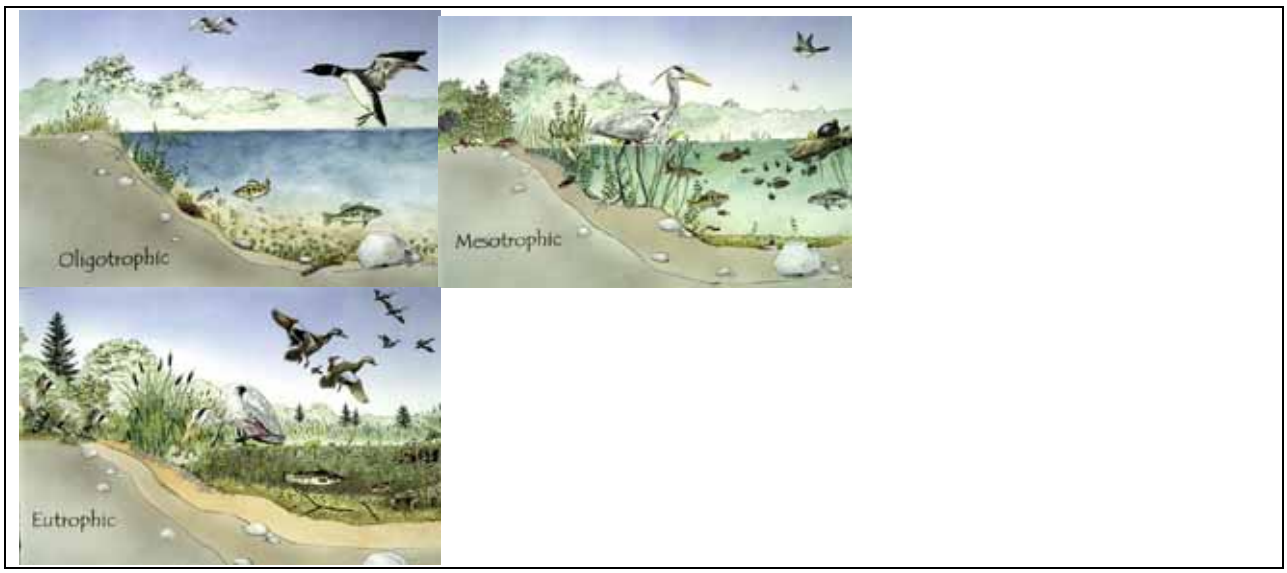
If problem sources of sediments and nutrients are identified near the shoreline or in direct delivery areas within the watershed and voluntary implementation of BMPs does not occur, purchase of land to restore proper vegetative cover may be required to eliminate problem sources. Projects should include extensive quantitative monitoring to ensure negative impacts to non-target organisms are not resulting and the exotic itself is significantly controlled within a few treatments (treatments should provide at least 75% to 80% reduction of curlyleaf pondweed).

FISHERIES REPORT

Existing fisheries appear to be in good condition. Muskies, Northern Pike, largemouth bass, and bluegills are the dominant fish species with perch and crappie also present. High density aquatic plant communities can reduce the ability of upper level predators from acquiring prey, but current condition factors for Musky and Largemouth Bass support that they are not having problems acquiring prey.

Introduction

The Apple River Flowage in Polk County, Wisconsin is recognized by riparian property owners, village of Amery residents, Polk County residents, and people across portions of Wisconsin and Minnesota as an excellent recreational water body with an outstanding musky, northern pike, and largemouth bass fishery and abundant pan fishery. Like many productive flowages, aquatic vegetation provides excellent fishing opportunities as well as presenting challenges to maintain navigational access channels. Concerns for balancing recreational access with habitat protection drove members of the P&R District to request technical support from the Department of Natural Resources and the County Land and Water Resources Department.



Trophic Status – *illustrations taken from UW-Extension Lakes Program*

The Apple River watershed above the Amery Dam drains over 200 square miles from the headwaters near Staples Lake to Amery. Land use is mainly forest and wetland with some agricultural and residential land. The cumulative nutrient load from such a large watershed can impact water quality even if nutrient inputs from individual properties are relatively low.

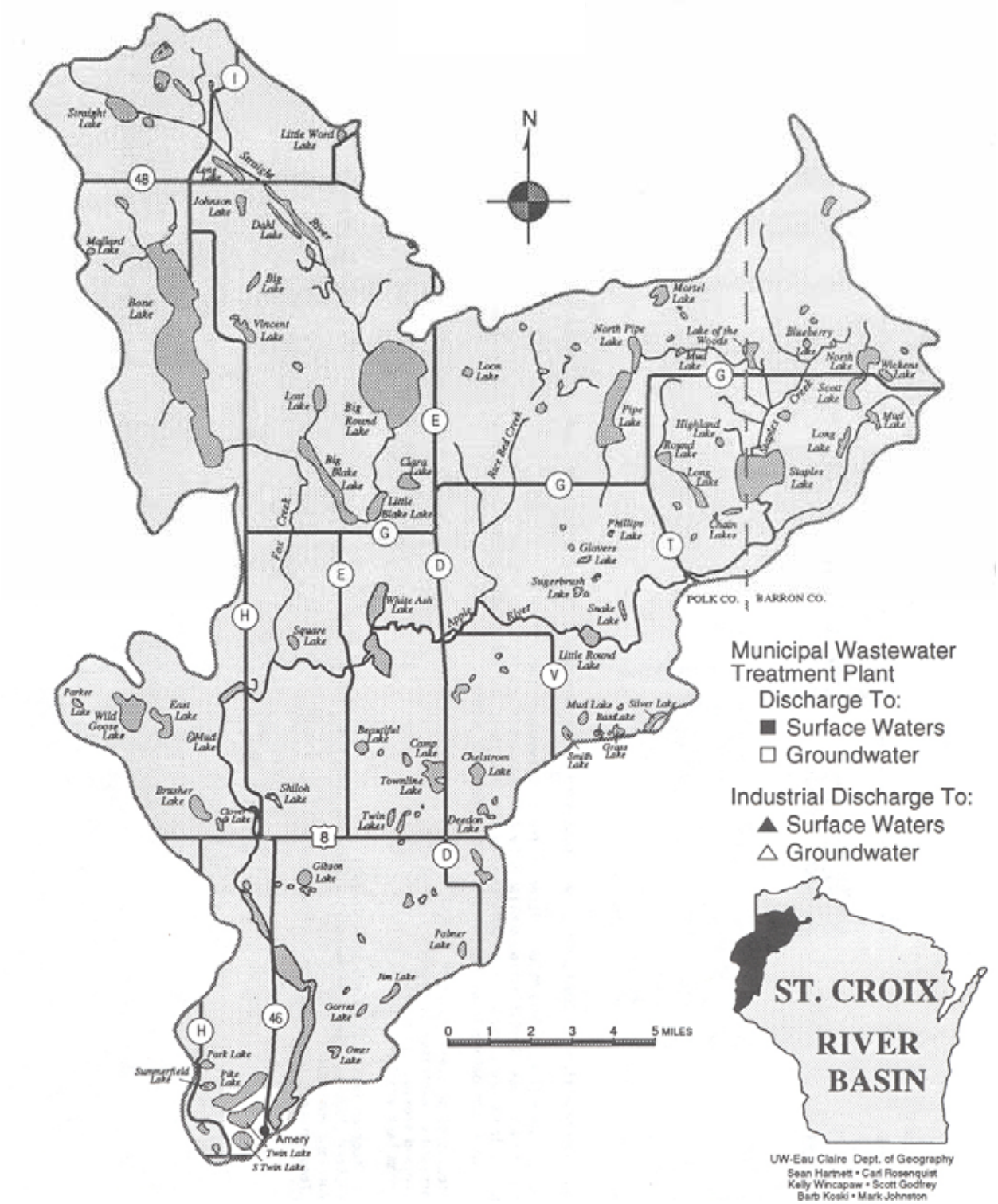


Figure 1. Upper Apple River Watershed

In 1973 a leak at the Amery Dam was discovered. A drawdown of the flowage revealed the dam

to be unsafe, and extensive repairs were needed before the flowage could be refilled. Repair costs were substantial, and the owner, Northern Supply Company, formally abandoned the dam. The City of Amery and the Town of Lincoln secured ownership and began repairs. The drawdown lasted from fall 1973 to spring 1975.

A detailed watershed study was conducted in 1977 and 1978 by the Office of Inland Lake Renewal (OILR) and included post-drawdown aquatic plant surveys to document the short-term consequences and effectiveness. Long-term aquatic plant monitoring data was not collected making it difficult to determine patterns of recolonization or successional changes that resulted from the drawdown. Curlyleaf pondweed was present in the system in the 1977 surveys, but the lack of long-term monitoring data makes it difficult to know if the drawdown created dramatic opportunities for its expansion and colonization of areas where native plants had existed. Fisheries were impacted by the drawdown and stocking of Musky and Largemouth Bass were necessary to restore larger predator populations. Larger predators such as Musky and Northern Pike are known to take a decade or more to fully rebound to pre-drawdown quality size structures. Though this drawdown was conducted in response to dam safety and repair issues, the resulting OILR study established an important baseline of information to guide current management and land use issues.

The Apple River Flowage covers approximately 644 acres. Of this area, approximately 416 acres or 65% was covered with aquatic vegetation at the time of the survey in 2003. Most of the flowage is less than 10' deep with a few deeper segments reaching 16' to 18' near the central channel. Residence time for water passing through the flowage is relatively short (7 to 11 days assuming an inflow of 130 to 140 cfs). The Apple River watershed above the Amery Dam drains over 200 square miles. Land use is mainly forest and wetland with some agricultural land. Nutrients inputs from such a large watershed can still have a cumulative impact on water quality even if nutrient loadings from most properties land uses are relatively low.

In an attempt to facilitate resource protection efforts, the DNR agreed to conduct two intensive aquatic plant surveys in 2003 with the Polk County LWRD, compile results, and write portions of the comprehensive lakes planning grant report. The first survey was conducted during the first week of June to characterize the density and distribution of curlyleaf pondweed and how this correlates to the native aquatic plant densities distribution. The second survey was conducted during the first week of August to characterize the native aquatic plant community structure during peak growth and correlate this to possible influences of curlyleaf pondweed. The results are mapped and analyzed and are the basis of the APM plan.

METHODS SECTION

The Apple River Flowage, starting one mile north of the Highway 46 bridge and south to the Amery Dam, was sampled at 22 randomly selected transects. A modified Jessen and Lound's sampling technique was used to characterize the aquatic plant community and structure at four depth zones along each transect (0-<1.5', 1.5-<4', 4-<7', 7'-<10'). A narrow tined rake head was mounted on an aluminum rake handle, which had 5-foot extensions to reach water depths up

to 15'. Four iterations were made to sample the range of depths within each transect. A total of 360 sites were sampled on the flowage (4 iterations x 4 depths x 22 transects plus additional samples as needed.) Had significant plant growth occurred at depths greater than 10', the depth zones would have been adjusted accordingly. Latitude and longitude data was collected with a hand-held GPS unit with differential at each sampling point. Maximum rooting depth (MRD) or maximum depth of colonization (MDC) was determined at the end of each transect. Maximum rooting depth is defined as the maximum depth in water where plants are found to grow from the substrate. This depth is limited by light penetration within the water column due to suspended matter or stained or heavily colored water, which affects plant growth.

At each of the four depth zones along the transect, a 2-meter circle was visualized and divided into four equal-sized quadrants. Within each quadrant, the rake was drug along the bottom one meter then inverted and the plants on the rake were brought to the surface for analysis. A density rating for each species was assigned between 0 and 5 depending on how many tines of the rake the species occurred and how full the tines were. The species' frequency of occurrence and average density was then calculated. The frequency of occurrence (FO) for each species is calculated as the number of occurrences of the species divided by the total number of sampling points with vegetation. An average density (AD) is the sum of the density ratings for the species divided by the total number of sampling points with vegetation (Nichols, 1994a).

Areas where plants were growing to the surface thick enough to restrict navigation (termed "topping out") were also mapped using a GPS unit. Sediment type (described as rock rubble, gravel, sand, silt, and organic debris or detritus) was annotated for each depth zone of each transect.

GENERAL FINDINGS – Macrophyte Survey

Twenty-three (23) plant species were found in the June aquatic macrophyte survey, and twenty-five (25) species were found in the August survey. Coontail *(Ceratophyllum demersum)* was by far the densest species in the flowage. The relative amount was almost two fold denser than any other species in the survey. The five most frequently occurring species, not including algae or duckweed, are summarized in graph format (Figure 2). The most frequently occurring species are the species most often targeted for control.

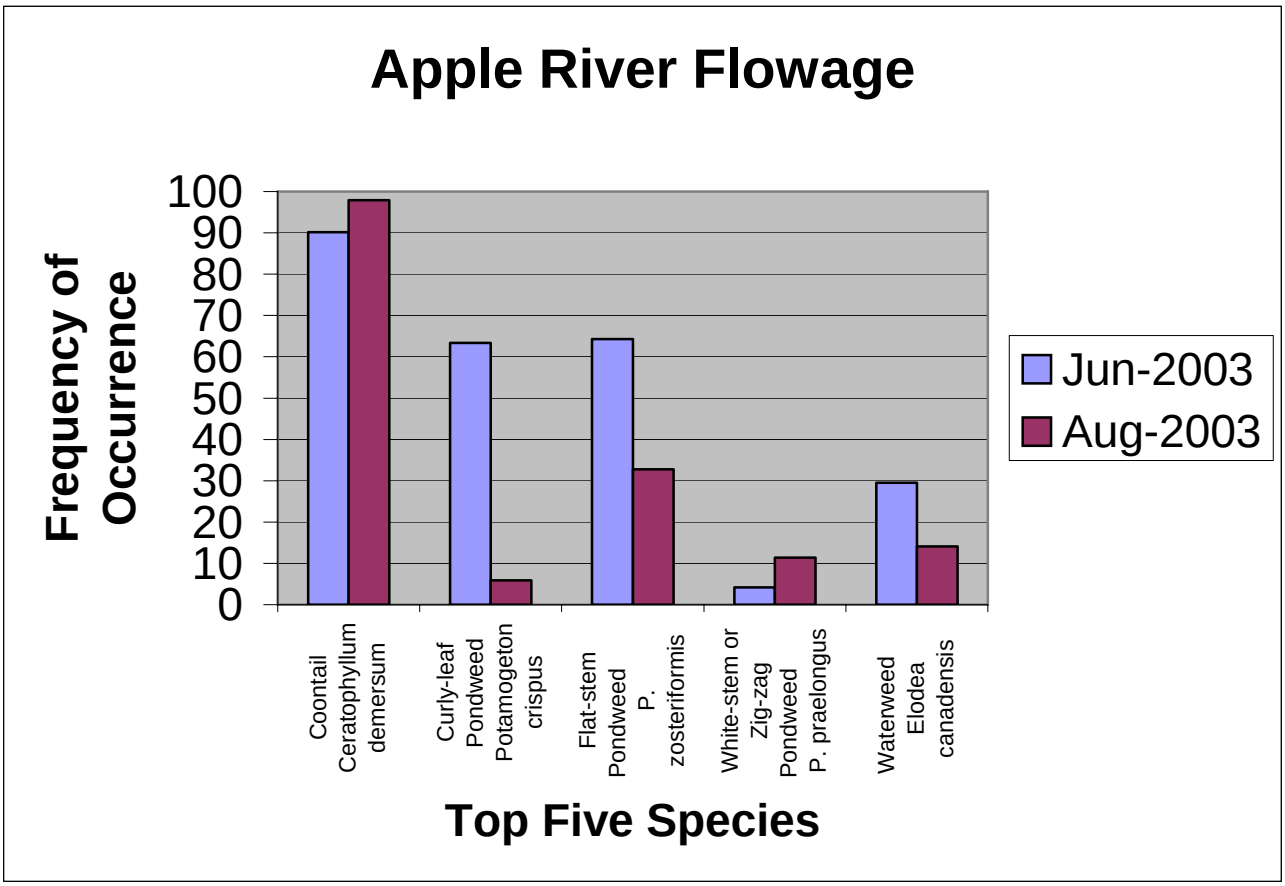


Figure 2. *The Frequency of Occurrence of the five most-encountered species during the June and August 2003 aquatic plant surveys on the Apple River Flowage*

It was determined that the flowage has approximately 416 acres of macrophyte coverage (Figure 3). This is close to 65% of the total surface area of the flowage; scientific literature advises waterbody should have at least 40% plant coverage to facilitate a healthy ecosystem. In extreme situations where the percent open water habitat within a lake or flowage begins to drop below 10-20% (over 80-90% plant coverage) fish may begin to have problems acquiring prey. Existing conditions of musky and largemouth bass evince that aquatic plant densities are not impeding top-level predators from acquiring prey. In productive systems with adequate nutrients to support fish growth, small size structure is more often related to harvest dynamics than limitations of food or an inability to acquire food.

The areas where plants "topped out" were mapped. Plants were reaching the surface of the lake up to a depth of approximately 9 feet. The deep-water boundary of where plants were topping out was very similar to the maximum rooting depth throughout the flowage.

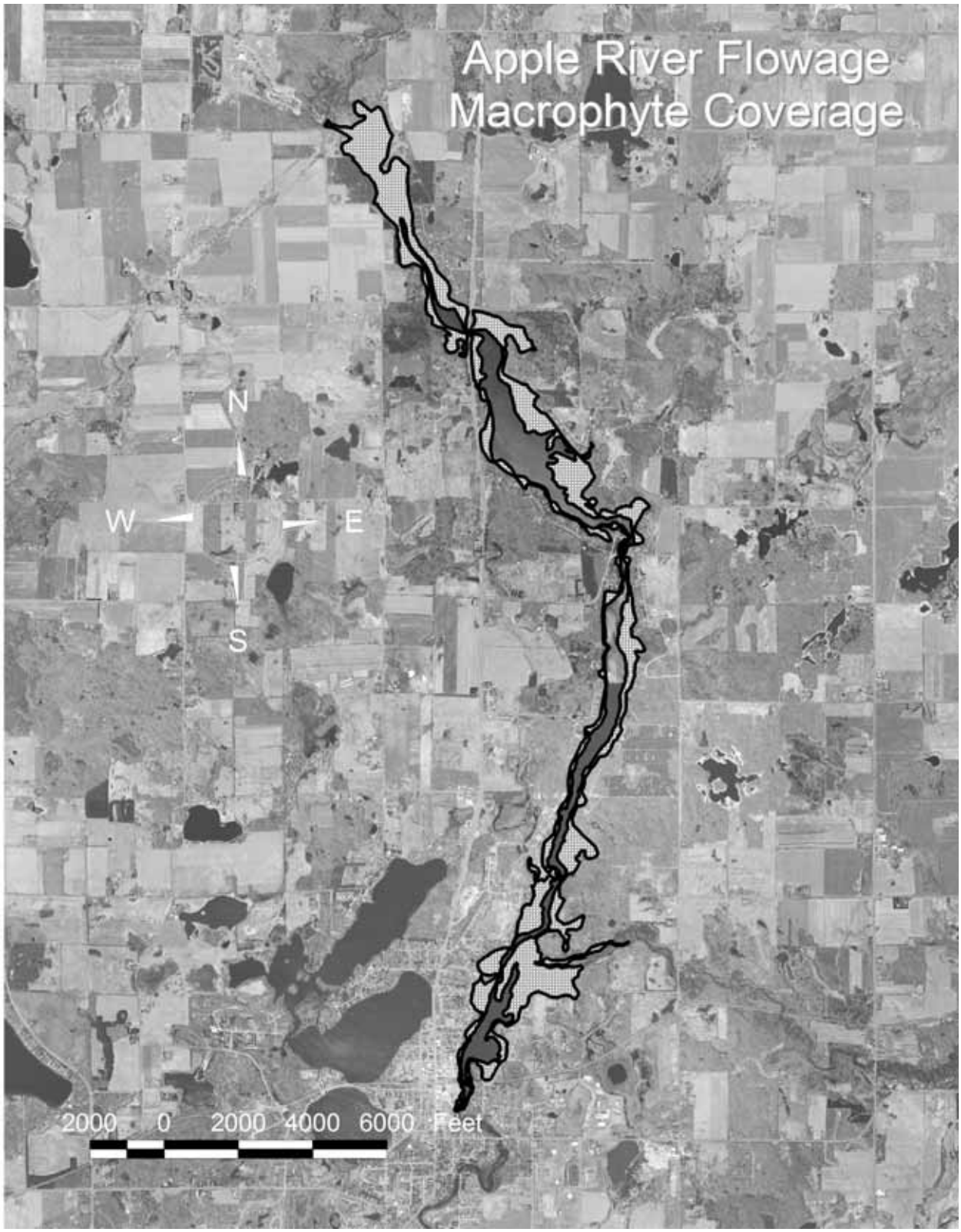


Figure 3. *ARF Aquatic Plant Distribution based on June & August 2003 Aquatic Plant Surveys*

The Frequency of Occurrence (FO) is defined as the number of sites along all transects that the species occurred in divided by the total number of sites in the lake with vegetation, expressed as a percent. The FO and AD for each survey are shown in Appendix A. The FO showed that Coontail (*Ceratophyllum demersum*) was the dominant species occurring at 90.2% of the intervals in June and 97.9% in August. However, there were a few other species with a high FO including curlyleaf pondweed (*Potamogeton crispus*) at 63.4.4% in June, flat-stem pondweed (*Potamogeton zosterformis)* at 64.3% in June and 32.8% in August, and the duckweeds (*Lemna minor, Spirodella sp., and Wolffia sp.)* at 45.8% in June and 77.1 % in August. Curly-leaf pondweed gains a competitive advantage over many of our native species as increases in nutrients reduce water clarity. This could explain the dramatic decline of native milfoil species from the 1977 surveys.

The 1977 study conducted by Environmental Resource Assessments documented that coontail, duckweed, elodea, whorled milfoil, and flat-stem pondweed were present and most prevalent at that time. Curlyleaf pondweed was also documented as being present within the system during the 1977 survey. The 1979 study by the Office of Inland Lake Renewal of the DNR reported plant coverage at 94% of samples points in the June survey and 96% in August. Dominant open water species were elodea, coontail, water plantain, star duckweed, milfoil, clasping leaf pondweed and flatstem pondweed during June. Elodea, coontail, and milfoil took over by August. The Flowage has a long history of aquatic plant abundance brought on by nutrients from the watershed.

Given the plant frequency of occurrence in 2003, plant diversity was next calculated. The Shannon-Wiener diversity index determines how difficult it would be to correctly predict the next individual collected. This, in turn, tells us how diverse the plant community is. A number close to 1 indicates the next plant collected could easily be predicted, meaning there is low diversity in the lake. A higher number indicates a more diverse lake. Because the total number of individuals was not determined in this survey, the density of the species was substituted for the total number.

The Shannon-Wiener diversity index was 2.4 in June and 2.2 in August. The flowage has a lot of human impact and a large watershed with diverse land uses resulting in a moderate diversity rating. The actual diversity rating is probably lower than calculated because coontail has such a dominant role in this system. Additional monitoring of the plant community would improve our understanding of the aquatic plant community.

The Floristic Quality Index was determined to assess the quality of the macrophyte community in the Apple River Flowage. The Floristic Quality Index is designed to evaluate the closeness of the flora in an area to that of an undisturbed condition. The index can be used to identify natural areas, compare the quality of different sites or locations within a single lake, monitor long-term floristic trends, and monitor habitat restoration efforts. This is an important assessment in Wisconsin because of the demand by the Department of Natural Resources (DNR), local governments, and riparian landowners to consider the integrity of lake plant communities for planning, zoning, sensitive area designation, and aquatic plant management decisions (Nichols, 1999).

The Floristic Quality of the flowage was determined to be 26.22 in June and 26.06 in August. The average for this area of Wisconsin (North Central Hardwood Forest) is 17 to 24.4 with a median of 20.9. The Apple River Flowage appears to be a high quality plant community. The floristic quality index of the flowage was boosted by the presence of high quality species such as Farwell's water milfoil (*Myriophyllum farwellii*) and wild rice (*Zizania aquatica*), which are sensitive to disturbance. These species were collected on the north end of the flowage.

The rich aquatic plant community of the Apple River Flowage is an invaluable part of the reservoir's ecosystem, particularly to invertebrates, fish, waterfowl, and shore birds. In order to protect the flowage, the aquatic plant community needs to be protected. Maintaining and enhancing the existing populations of high quality plant species such as Farwell's Water Milfoil, Largeleaf Pondweed species, and Wild Rice should be a high priority for the Apple River Flowage P&R District. The aquatic plant community should continue to be monitored to ensure a healthy ecosystem and gauge the effectiveness of management techniques. A major disturbance to the macrophyte community of the Apple River Flowage could be detrimental to its fishery and the entire ecosystem.

A sociological landowner survey was sent in the summer of 2001 to property owners within the Apple River corridor. The survey, part of the Apple River Association Planning Grant, was designed to assess landowner objectives, concerns, and perceptions about river health and threats to the quality of the river. One thousand nine hundred fifty-eight (1,958) surveys were sent out, and four hundred four (404) were returned (21%).

Forty-nine percent (49%) of the respondents indicated they were 60 years of age or older. The employment status of the primary wage earner was 35.3% year-round retired, 33.2% works locally year-round, and 22.3% year-round commuter.

When asked the most important reason that you own property on or near the Apple River, 42% of the respondents stated scenic beauty or viewing nature as the most important, 19% cited rural lifestyle, and 10% replied lake lifestyle. The picturesque and natural setting of the Apple River is important to the residents. When asked about the landscaping/land use of their property, 34.6% of the respondents replied that they have an even mix of turf (mowed grass) and trees, 30.6% replied mostly trees, shrubs, or meadow, and 20.8% replied mostly mowed turf. Let it be said that turf grass and impervious surfaces provide little habitat for wildlife and increase sediment and nutrient additions, which degrade water quality. In fact, it is estimated that 26% of the landowners would not meet the Polk County Impervious Rating given the current land use on the property.

When asked if the respondent would be willing to provide financial support to maintain or improve the quality of the Apple River and its associated land resources, 53.5% of the respondents said **no** and 46.5% replied **yes**. Of the yes responses, 81.7% indicated they would be willing to contribute $100 or less.

Shoreline vegetation is the nexus between water habitat and terrestrial habitat. Vegetated

shorelines are not only valuable for wildlife and privacy, but also infiltration of water, a filter from watershed sediments, protection from wave erosion, and abatement of ice dams. Given these benefits for water quality, wildlife management, and personal property, re-establishing shoreline vegetation to a minimum 35-foot depth should be a priority to the Apple River Flowage P&R District. Shoreline restorations are a relatively cheap management practice, and cost-sharing may be available. These impacts can have a profound influence on shoreline property values that would warrant the investment of the informed property owner now.

GENERAL DISCUSSION OF MANAGEMENT PRIORITIES

When trying to formulate an APM plan, there are many of factors to consider: resource use, feasibility, laws, available resources, past and current condition of the waterbody, and current technology and tried methods. Not all techniques listed will be useful to the Apple River Flowage because of the system it has come to be. Not all techniques will be affordable or desirable. When considering a management technique, one must also look long term and consider the unintended consequences or possible impacts on other parts of a system, because, indeed, the flowage comes full circle and one change could manipulate or worsen another feature that is currently in balance. It is unrealistic to think that we can eliminate or control the overall population of curlyleaf pondweed within the Apple River Flowage after it has become so well established. The system includes numerous backwater bays, and CLP has had adequate time to build a turion bank within the sediments. Goals for plant control should include keeping below nuisance levels and preventing spread to other areas by maintaining native plant populations. The Flowage is a nutrient-rich water. Because of this, autotrophs will continue to grow. The two types of autotrophs are macrophytes or algae, with macrophytes being a much more desirable form of growth both for aesthetic reasons and for the fishery.

With these factors in mind, we will start discussion of the management goals and evaluate possible methods to treat the said problem.

Issue I: Assess potential management strategies to alleviate Curlyleaf pondweed dominance of the community structure in selected shallows.

Management strategies to control curlyleaf pondweed have had limited success. Well-established within the Apple River Flowage, curlyleaf pondweed (*Potamogeton crispus*) is one of the more hardy plants with a very effective life cycle to ensure its success. In late May and early June, the plant begins to grow small vegetative buds called turions. When mature, the turions drop in the sediment and can remain viable up to 5 years. Turion density can reach upwards of 1,600 per square meter on the lake bottom. These turions can quickly recolonize manipulated areas, minimizing the long-term effectiveness and merits of these kinds of treatments.

Curlyleaf pondweed was the third most dominant species of aquatic plants found in the Apple River Flowage during May and early June, occurring at 63.4 % of the sites. Curlyleaf pondweed densities were greatest in the 3'to 7' depth range. Because of its early season growth cycle, curlyleaf pondweed occurred at less than 6% of the same sites sampled in early August. With

less competition, native species in these same areas appeared to fill in or replace niches formerly occupied by *crispus* (Appendix C & D).

It is unrealistic to set a goal of eliminating curly leaf pondweed from the Apple River Flowage with existing control technologies. Mechanical harvesting does not reduce the turion stock in the sediments nor does chemical treatment. Present herbicide control does not provide long-term control and requires annual, disruptive treatments early season during a sensitive time of year when fish are spawning and native vegetation is dormant or scarce. Repeated treatments eliminate much of the food and cover with major impacts on the aquatic food chain and ecology of the flowage. Early season treatments may suppress native species, which further enhances the colonizing opportunities for curlyleaf pondweed.

The negative impacts from broad scale early season curlyleaf pondweed treatments need to be carefully considered. First, curlyleaf pondweed is actively growing at a time of year when most native aquatic plants are dormant or scarce. Spawning fish, fry, fingerlings, and forage species including minnows and invertebrates are drawn to the remaining actively growing plant habitat (which is curlyleaf pondweed). Many invertebrates are relatively immobile and unable to migrate to find suitable replacement habitats if vegetation is eliminated. The chemicals directed at the aquatic plants would also directly impact the fish and invertebrates. Others would be impacted by the absence of food and cover within treated areas. This could result in starvation and poor recruitment, creating long-term impacts on the fishery and ecological health of the Apple River Flowage beyond just treated areas. Management strategies that are driven solely to eradicate a well-established exotic species pose a greater threat to the health of the flowage than the exotic itself.

A successful strategy to alleviate curlyleaf pondweed density would be to address high use recreation areas where it prevents access or suitable use. Swimming areas and beaches, boat launches, and priority navigational access channels are prime areas to target control efforts to restore recreational use. These areas have been identified and have been treated in the flowage. These priority navigational access channels approach one mile in length. This strategy will not only reduce curlyleaf pondweed, but also other aquatic plants that grow in these designated areas.

There are two basic types of herbicides commonly used in aquatic plant treatment -- systemic and contact herbicides. Systemic herbicides usually require prolonged contact time (30-60 days) to allow the chemical to be absorbed and transported within the plant tissue to disrupt normal growing functions and ultimately kill the plant. Contact herbicides, as the name implies, act on contact and result in the death of the portions of the plant tissues within 12–36 hours, but can leave viable root systems, allowing perennial plants to resprout in the subsequent year. The Apple River Flowage is a flow-through system with a relatively short residence time (the amount of time water stays in the flowage before passing through). Low-dose systemic herbicides (Fluridone) are not viable because the water flows through the central channel portions quickly, not allowing adequate contact time for slower-acting systemic herbicides. This limits us to contact herbicides, which tend to be broad spectrum and also impact native species growing at the time of treatment (Sundeen, 2003). Several high quality native species (*Potamogeton praelongus, P. amplifolias, P. richardsonii)* were observed in May in advanced stages of growth,

making them susceptible to early season *crispus* treatments with broad-spectrum contact herbicides.

Traditional Navigational Channel Maintenance Overlapping with Curlyleaf Pondweed Control Issues

The maintenance of navigational access channels has been used as nuisance relief apart from the curlyleaf pondweed control issue. The use of broad spectrum herbicides to maintain navigational access channels eliminates the need to consider the exotics control potential or strategy within this management area. Traditional channels widths have been 50' wide and some approaching a mile in length. If a trial period low dose 1.5 PPM endothol treatment strategy was to be tested, wider widths of 100' would be needed to ensure target concentrations are maintained within a majority of the treatment area. It is felt that if narrower widths were used for these lower concentration dilution may quickly compromise their effectiveness. The wider widths could be justified if it can be proven that minimal impacts to native species occur within these trail areas.

ENDOTHOL EARLY SEASON TREATMENT AS A PILOT STUDY

An experimental early season (before surface water temperatures reach 50 Fahrenheit) Endothol treatment at 1.5 ppm could be tried and evaluated for its effectiveness at creating a navigational channel. This would best be tested in the center of one of the larger backwater bays where residences need access to open water areas with unanimous resident approval. These treatments should be confined to areas 3-7' in depth where *crispus* densities were greatest. Detailed evaluation monitoring must accompany any such test pilots. Trial navigational lanes should be only an acre or two in size (100'wide by 400' long or 100' wide by 800' long) and will require monitoring to document the long-term effectiveness on the site and the long term effects on non-target organisms and other native species.

Temperature requirements for early season Endothol treatments must be followed closely. Early season treatments must occur within the first few weeks after ice out. Target temperatures are as soon as the surface water temperature reaches 50 degrees Fahrenheit. If the surface water temperature reaches 60 degrees Fahrenheit within the treatment area, early season treatments will be halted for the remainder of the season.

Selection of an early season test treatment site must include several important factors. This site should not be near the central channel within the flowage to avoid the flushing of the main flow of the Apple River. The bay in front of the mouth with Beaver Brook is fairly large and has established residences that could benefit from the presence of a navigational channel if the flow or current velocity is low enough to allow adequate contact time and concentrations for Endothol following application. Shoreline property owners within any bay being considered for a potential early season pilot project using Endothol must be provided a full summary of costs including evaluation monitoring. If there is unanimous support among all the shoreline property owners within or adjacent to the pilot project and they have provided written approval, this

strategy could be implemented. If they do not desire a navigational channel created by the use of chemicals, alternative sites could be pursued. A dye study may be needed to ensure adequate contact time will occur within any potential treatment channels.

Selection of a parallel control site – A parallel control site must be selected to reflect similar densities and site conditions to the treatment site. If the treatment site dimensions are 100' by 400', the control site should have the same dimensions. The best control site would be in the same immediate area as the treatment site, but should be at least 100' away and upstream if possible to avoid any possible influence from drift of the herbicide. Sampling sites should be selected by first developing a GPS map of the intended treatment and control sites. A grid system should be developed for both areas and sampling sites selected through the use of a random number generator or chart.

Pre-Treatment monitoring – A minimum of 6-10 sites must be sampled in each of the treatment and control areas using the point intercept method. For multiple acre treatment areas, at least 2-3 sites per acre must be sampled for each sampling period. Parallel control sites will also have to be sampled at the same frequency and intensity. It is assumed that treatments will occur in the first week of May in most years. Pre – treatment monitoring will have to be completed early enough to allow treatment to occur before maximum surface water temperatures reach 60 degrees Fahrenheit.

Post treatment monitoring – At a minimum 6-10 sites must be sampled in each of the treatment and control areas using the point intercept method. For multiple acre treatment areas at least 2-3 sites per acre must be sampled for each sampling period. Parallel control sites will also have to be selected and sampled at the same frequency and intensity. It is assumed that treatments will occur in the first week in May in most years. Post treatment monitoring must be accomplished between May 20th and June 10th to ensure that data reflects declines associated with the treatment and not the natural senescence or death of *crispus* which usually begins to take place by June 10th. If post treatment monitoring samples are not collected within the approved time window, the ability to properly evaluate the impact and effectiveness of the treatment will be compromised and may result in the loss of permit privileges.

Evaluation monitoring will have to be conducted for each year of treatment and at least two to three years post treatment to evaluate long term effectiveness. Treatments will be conducted for two or three seasons before final evaluation. Target average densities and frequency of occurrence data must support at least a 75-80% reduction within the treatment site by the second or third year of treatment. If a 75% to 80% reduction in FO or AD cannot be achieved at the end of the two to three year trial treatment period, future treatments should be halted. Data reported must also include frequency of occurrence data and average density for native species. If significant impact or reductions occur to desirable native species, the merits of doing early season species selective treatments should be questioned.

Again, minimizing the loss of native plant coverage needs to be a goal when an aggressive exotic colonizer already exists within the system. The exotic is the most-likely species to recolonize after the treatment. Early season herbicide treatments may not be an effective option for overall

exotic species control, but treatments to provide and maintain priority navigational access channels within identified areas of the flowage is a valid management option.

With current methods still largely in the testing phase, a slower small scale test plot with detailed quantitative data makes more sense. If there is a chance that the treatment will result in more impacts than doing nothing, the Aquatic Plant Management Guidelines recommend delaying or rejecting treatment until suitable methods are available.

A fundamental rule of ecology is that ecosystems tend to develop a balance with existing energy inputs and exports. If there is a shift in inputs, exports, or energy pathways, the system will attempt to develop a new balance and shifts in community structure will result. If continued disruptions occur in the energy pathways, instability within the ecosystem can result with impacts to desirable native species. As native species are impacted, the stability of the ecosystem is further reduced and the opportunities for exotics to become established or expand their distribution is increased. These continued disruptions also pose a threat to the algae/macrophyte balance and could push the system towards an algae-dominated system.

Although biologists and aquatic macrophyte managers are in limited supply, evaluation monitoring is very technical and needs to be carried out by an advanced biologist. Timing as well as proper techniques and adequate expertise are needed when monitoring, and efforts to conduct herbicide treatment projects may interfere or conflict with the timing of proper monitoring. A watch of new and developing technologies which may provide effective long-term control of curlyleaf pondweed with minimal impacts on nontarget organisms and native species should be continued.

Again, any such testing of treatment strategies should include monitoring the impacts of the treatment on native aquatic plants, sensitive aquatic insects and other invertebrates, fisheries, and the length of time the treatment provides effective control for curlyleaf pondweed (multiple years of control with linked quantitative monitoring data) (AERF, 2004). Wisconsin DNR's APM guidance requires that in lakes with greater than 50% coverage by an exotic species Point-intercept samples of the aquatic plant community should be collected for three years to evaluate the effectiveness of a specific control technique (year of treatment and two years post treatment) (WI APM Plan; pg 36, 2004).

Until methods exist which have been carefully tested and proven to be effective for several years without repeated follow up treatments, treating large areas with little consideration for the negative impacts does not make ecological sense.

Issue 2: Nuisance problems associated with duckweed, coontail, and other native species within navigational access channels.

Coontail and duckweed in particular are difficult to treat in certain situations. Neither of them need to be rooted in the substrate to acquire nutrients for growth. They freely drift around the system with the prevailing winds or flood events. Costly control efforts can be quickly sabotaged by a simple shift in the wind or heavy precipitation event which results in an increased

flush of duckweed and coontail from upstream wetlands and backwater areas.

While these coontail and duckweed plants create problems within high use areas such as boat ramps, beaches, and priority navigational access channels, it must be recognized that they provide critical habitat to a variety of fish, invertebrates, and wildlife. Elimination from the majority of areas, especially undeveloped back water bays, is an unacceptable management objective.

The herbicides used for duckweed control are systemic herbicides (which require 30-90 days contact time) or contact herbicides. Diquat is a contact herbicide which has significant toxic effects to amphipods and daphnia that are important food items for the high quality fishery in the system (Helsel, 1997).

It was discussed with board members at the 11/13/2004 meeting that the most effective strategy to deal with coontail problems in navigational channels may be a two pronged approach. Treat priority navigational access channels as nuisance rooted aquatic plant densities appear with contact herbicides. Use mechanical harvesting within herbicide treated channels to remove drifting and free-floating coontail. If rooted plant densities begin to compromise navigation in channels, a second herbicide application in mid July may be warranted. Mechanical removal can again be used to reduce coontail problems within established navigational channels.

Mechanical removals should be limited to the upper half of the water column within specified navigational access channels. Mechanical harvesting should be halted if Eurasian Water Milfoil is identified in the flowage. Mechanical harvesting dramatically increases the likelihood of EWM spreading throughout a system by the plant fragments created by harvesting.

Harvesting and chemical applications equipment brought in from an outside source should be carefully inspected by a representative of the P&R District to ensure that no Eurasian Water Milfoil or other exotics are present prior to each launching. Proper exotics/invasive species decontamination procedures must be followed for all harvesting and spraying equipment before and after each launching.

Issue 3: Management options and ecological priorities need to be carefully considered for the areas dominated by wild rice.

The extensive rice beds in the upper basin stabilize a large amount of sediments in the north end. The rice prevents nutrients from driving undesirable algae blooms. A study of Rice Lake near Milltown documented serious water quality declines after expansive rice beds were impacted by high water levels. The sediments they had stabilized were agitated by wave action and resuspended into the water column to drive algae blooms (Engel, S. & Nichols, S., 1994).

Management of wild rice requires a formal review and approval process which must include the Voight task force (a tribal organization representing Indian treaty interests, Peter David contact), the DNR, and local residents. Rice removals have been historically limited in an attempt to protect overall rice coverage within the state.

It is unlikely that significant removal of wild rice for non-navigational areas would be approved and would be very limited within priority navigational access channels as approved by the joint task force. Dredging in this area is also an unlikely option as it would directly and indirectly limit rice coverage in the affected areas. Wild rice should be valued as a cultural and water quality asset. Management priorities should seek to protect and enhance its presence.

Issue 4: Documenting the presence / absence of Eurasian Water Milfoil, zebra mussels, or other exotic species within the Apple River Flowage.

At the time of this survey (summer 2003) no additional exotic species were encountered or documented beyond curlyleaf pondweed. The milfoil species encountered were native, desirable species. No zebra mussels were observed or reported during the survey. Purple Loosestrife (*Lythrum salicaria*) was documented in some of the wetland fringes in back bays, but control efforts are actively being pursued.

Volunteers should be trained on the identification of exotic species with an emphasis on Eurasian Water Milfoil and Zebra Mussels. Boat launches and immediately surrounding areas (out to 5' in the water and one to two hundred feet on each side of the launch) should be carefully inspected by wading or diving at least every other week. Rake sampling can be used to extend exotics inspections to deeper areas around launches where plants are less visible from the surface. Monthly to bimonthly inspections throughout the rest of the flowage would help ensure early detection of exotic species and increase the likelihood of controlling pioneering stands of exotics before they become well established. It is critical that once Eurasian Water Milfoil (EWM) is identified within the flowage, a rapid response control program be initiated.

However, a detailed exotics monitoring program should be developed for the Flowage with an implementation plan. This plan could allow fast response treatments to eliminate early pioneering stands or removal of individual exotic plants if they are found and documented.

Developing a rapid response control or action plan should be a high priority for the Apple River Flowage P&R District. The plan should include funds to pay for emergency treatments of early pioneering stands of EWM if it were ever found. Follow up diving and hand removal efforts should also be integrated with any herbicide treatments aimed at early pioneering stands of EWM. If EWM is discovered in the flowage, all mechanical control strategies should be halted to prevent the spread from plant fragments created by the harvester. Once EWM has been eliminated from the system, mechanical harvesting strategies can be reinitiated. Elimination of EWM should be confirmed by at least 2 or 3 separate inspections, a week or more apart, of the entire flowage with an emphasis on ensuring Eurasian Water Milfoil is absent from all previous pioneering stands and harvested channels. The harvester should also be fully cleaned to remove all organic material before re-entering the flowage.

Rapid response monitoring- The P&R District should develop a volunteer monitoring team that monitors boat launches, beaches, and other access points where exotics are mostly likely to be introduced into the system. The monitoring should occur every few weeks throughout the

normal summer growing season (May to September). On high use weekends or special events, volunteers should inspect watercraft at access points for exotics and use the opportunity to educate users about exotic species threats and proper prevention measures. Grant moneys are available to help support the development of such volunteer monitoring programs (Clean Boats - Clean Water and AIS grants).

Studies have indicated that if Eurasian Water Milfoil (EWM) is not identified and eliminated in the early stages of pioneering infestation, the ability to control it could be lost. After EWM is well established, extensive harvesting and herbicide control measures have been largely ineffective. In fact, little difference was noticed between extensive control efforts and doing nothing in the Helsel, et al. study (1999).

Issue 5: Identify habitat and water quality protection strategies to protect and enhance the existing high quality fishery.

Much of the protection strategies needed to accomplish this important task can be reviewed in the document "Guideline to Understanding, Maintaining, and Protecting Aquatic Plant Sensitive Areas and Critical Habitat."

Specific management strategies that apply to the Apple River Flowage and are not covered within the guide will be presented at the end of this report. See also the Sensitive Area Study.

REVIEW OF IN-LAKE MANAGEMENT ALTERNATIVES

Algae Treatments – Planktonic and filamentous algae treatments have not been done and should not be considered worthwhile because, as stated in Chapter III (WDNR APM Plan Guidance, 2005), chemical algae (algaecides) treatments are generally very ineffective. Spot treatments are very temporary and entire lake treatments are not practical or environmentally sound. Algae quickly return and the danger from toxic copper build-up in the lake sediments is great. Long term nutrient reduction strategies are the only practical solution.

Lime Slurry Treatments – Lime Slurry Treatments should not be considered a viable management alternative. In order for lime slurry to be effective, a large scale pH spike of 10 to 11 within the application area will occur which will result in mortality of sensitive native species.

Water Level Manipulation -– Drawdowns have been used to suppress aquatic plant density and distribution, but this strategy is environmentally disruptive to the aquatic ecosystems. Drawdowns provide minimal or short-term control of aquatic plants. However, species responses to drawdown can vary greatly. Realistically, drawdowns change the composition of the plant community, enhancing the growth of some species and destroying the seeds of others.

A drawdown poses serious risks to the rice beds at the north end of the flowage. Management strategies which impact the rice beds could destabilize sediments under the rice, adding an influx of nutrients which could result in dramatic declines in water quality.

Dewatering has serious implications for aquatic food webs and ecosystems that developed and are dependent upon water. High quality larger predator fisheries may take a decade or longer to rebound to previous quality size structures after an extensive draw down.

Dredging – Dredging activities can be very costly and provide short term benefits if incoming sediments or internal shifts of sediments are not addressed. Dredging can destabilize adjacent lakebed sediments which can slump and fill in dredged areas. The 1978 OILR study identified two kinds of potential dredging projects, hydraulic dredging and mechanical excavation. Hydraulic dredging is costly and requires that suitable depositional areas be located near the dredging project. This appears to be the only viable dredging option for sediment challenged areas within the Apple River Flowage.

Dredging requires a drawdown to provide access to heavy earth moving equipment and is not a viable option with the potential impacts to rice beds and sensitive shallow water habitats. This may become a viable option if it can be linked to drawdowns that must be conducted to accomplish dam replacement or extensive repairs.

Two sediment depositional areas stand out as impaired navigational areas where dredging may be a viable management alternative. The largest area is where Beaver Brook enters the flowage and the second area is just down stream from where the main flowage thalweg is joined by that from Beaver Brook. Navigation is restricted and recreational attributes compromised.

Planning and implementation of any potential dredging projects require permits and a clearly laid out plan which identifies appropriate disposal sites, costs, and other logistics.

Biological Control -- At this time, a biological control has not been found to treat curlyleaf pondweed.

Alum Treatment -- Aluminum sulfate (alum) has been applied to lakes in an attempt to reduce available nutrients which drive algae blooms. Although treatments are often sold as a long term control technique, several existing conditions can limit their overall effectiveness. Bathymetry, watershed nutrients, water flow, and lake water composition all play a part in how long an alum treatment may last. Continued or uncontrolled nutrient sources within the watershed can compromise the long-term effectiveness of alum treatments. For these reasons, alum treatments should not be considered a viable alternative until an intensive watershed nutrient control effort has been successfully completed reducing the uncontrolled nutrient sources through proper installation of BMPs. Consequently, alum will result in increased growth of aquatic plants because reduced algae and improved water clarity increase light penetration and depth of plant colonization.

Iron Filing Treatments – Iron filings should not be considered a viable nutrient reduction

management alternative. First, iron itself can be toxic to sensitive aquatic organisms. Second, it can result in oxidation/reduction reactions which can inhibit normal ion transport of native species within the sediments. Third, the source of iron filings and the potential for secondary contamination is highly likely. Oils, toxic cutting compounds, and other sources of potential contamination are likely to be present within any applied iron filing treatments.

Sediment Screens – Sediment screens provide specific site control for aquatic plants, but are difficult to install, are fairly expensive, and directly harms the benthic invertebrates in the area. Permits are required to install sediment screens and do not see to be a likely option for the Apple River Flowage.

Herbicides and Mechanical Harvesting – Please see the discussion in Pages 16 -19 of this report.

Nothing Alternative -– In setting the management goals, there is one option that should always be considered: the "do nothing option". When a problem(s) arises, solutions are sought. As mentioned earlier, selecting a control technique without firmly establishing management goals and then trying to sell it to the community is a recipe for failure. Similarly, the community must know that management options were reviewed and the do nothing option posed less threats than the other options and the other options were likely to be ineffective overall and could result in impacts worse than the do nothing scenario.

MANAGEMENT RECOMMENDATIONS

- ☒ A 1977-78 study characterized nutrient and sediment loadings from upland soil loss and identified specific problem sources of streambank erosion. A review of the sources identified in the report and the BMPs implemented to correct these sources should be conducted. An updated survey of the watershed for upland soil loss and eroding streambanks should also be conducted to identify potential problem areas to be targeted for BMP implementation. An updated watershed nutrient source and quantification survey would help the county Land and Water Resources staff and state resource protection staff in DNR and DATCP work with the Apple River Flowage P&R District to target nutrient control and reduction efforts where needed. While excess nutrients did not directly result in the establishment of curlyleaf pondweed within the Apple River Flowage, they could result in conditions which favor curlyleaf pondweed over many of our more sensitive native species.

- ☒ Create a task force to pursue critical sites for improvement. This task force

should include active members of the P&R District who are willing to invest time into the future tasks, member of the Apple River Association, DNR personnel, county staff, and other interested groups or individuals.

- ☒ Early season herbicide treatments may not be an effective option for overall exotic species control, but treatments to provide and maintain priority navigational access channels within identified areas within the flowage is a valid management option.

- ☒ Continued monitoring of flowage and control techniques to identify true long-term control of aquatic vegetation populations.

- ☒ Allow emergent and free floating plants to exist in shallow water areas.

- ☒ Access channels should be identified and developed for navigational purposes and other high use areas (beaches and boat ramps). The Apple River Flowage P&R District has been actively involved in managing four priority navigational access channels and two boat ramp access points. These have remained fairly consistent for the last decade. Three of these channels are over a half mile in length with some approaching a mile in length.

- ☒ Herbicide treatment is not feasible or environmentally acceptable for the whole flowage. Timely application of treatments should be exercised.

- ☒ Develop a volunteer exotics monitoring team at boat launches, beaches, and other access points to inspect flowage watercraft and educate users of the impacts of exotics.

- ☒ Establish a rapid action plan in the event exotic species are discovered, including emergency funds and action plan.

- ☒ Continue to provide information and education to P&R District members, riparian owners, and local residents to the value of native aquatic plants and their benefit to habitat and water quality. Work to change behaviors to develop more stewardship on the flowage.

- ☒ Continue water quality monitoring (Self-Help) and purple loosestrife control efforts.

- ☒ Management strategies should always promote prevention of pollution rather than trying to "fix" the problem afterwards. A proactive approach is more cost effective. Deed restrictions to protect property (conservation easements), shoreline restorations, action plans, and continued monitoring are the best course to protect the Flowage.

- ☒ Follow local ordinances including observing the phosphorus fertilizer ban within the City of Amery and shoreland areas of Polk County.

- ☒ Install rain gardens, use rain barrels, and restore native shorelines to limit stormwater runoff.

- ☒ The P&R District should coordinate all private treatments in accordance with overall management objectives of a written aquatic plant management plan. Management objectives should attempt to coordinate private requests for herbicide treatments of public lakebed to ensure that they occur only where needed and minimize overall loss of critical habitat. In 2004 there were a total of 19 private property owners requesting herbicide treatment over approximately 1000' feet of shoreline. Each request should be looked at on a case-by-case basis evaluating the needs of the site and the importance of the habitat.

  If less intensive or less disruptive methods of removal as feasible, they should be implemented. Sites with firm substrates and quickly sloping shorelines should be managed with hand raking or pulling eliminating the need for herbicide treatments in suitable sites (as required by the NR107 feasibility determination).

  Sites with excessive aquatic plant growth occurring in front of poorly buffered shorelines should require landowners to restore the cause of excessive plant growth (the lack of filtering) before herbicide treatments are allowed. Approving herbicide treatments while still causing nutrient

loading is a losing battle against the aquatic plants.

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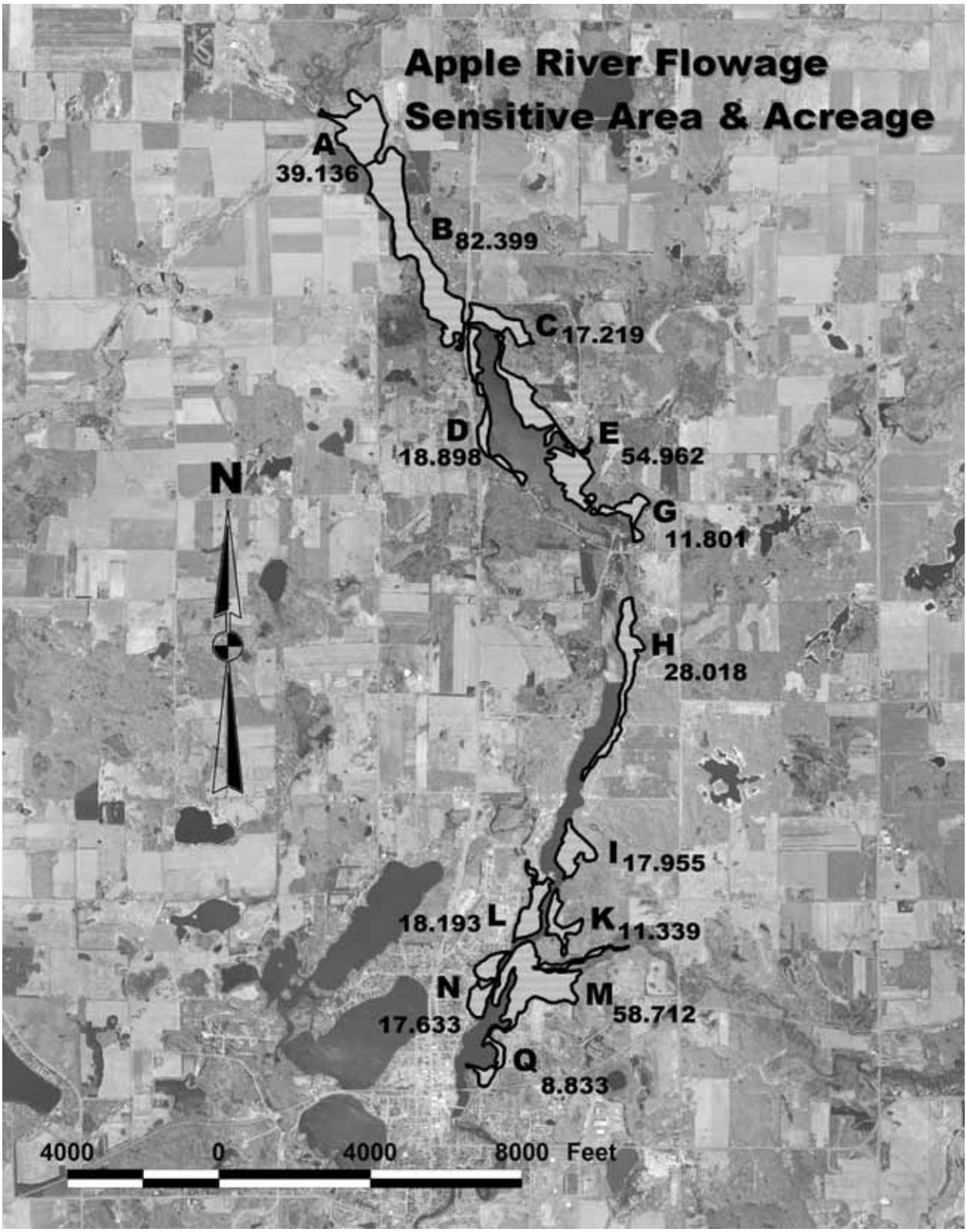

Figure 4. Sensitive Areas (with acreage) Designated on the Apple River Flowage

Specific location and resource value of individual sites

Sensitive Area - A (Transect 1w)

Site A is located at the most upstream portion of the flowage west of Hwy 46. Because of the unique critical habitat it provides on the flowage it has been designated as a **sensitive area**. A large wild rice bed exists at the very upper end of the flowage covering approximately a quarter mile stretch of impounded river bed where the Apple River and Marquee Creek first enters the flowage until reaching a narrow finger of land that extends southwestward from the northeast shore restricting flows and enhancing sediment deposition above this point (Figure 4). Most of this area is only 1.0' to 2.0' in depth and has almost no open water habitat by mid July (virtually 100% coverage of emergent aquatic plants). The bottom substrate is dominated by silt and organics. Wildlife and fishery values make this a unique yet critical habitat found within the Apple River Flowage. This area covers approximately 39 acres.

Rice was the dominant emergent aquatic plant with some burr reeds and arrowheads occupying the near shore areas. Submergent species included coontail and flat-stemmed pondweed with scattered water crowfoot or buttercup. Curlyleaf pondweed was present during the June sampling, but did not dominate any of this area and did not appear to be displacing native species.

Other species encountered within this area included: the major duckweeds including *Lemna minor, Spirodela polyrhiza, Wolffia columbiana, and Lemna trisulca*. Some filamentous algae were also common and readily identifiable to genus with the naked eye which included *Hydrodiction* or water-net which forms unique nets which resemble a spider web.

The lack of developed shorelines with established residences and the overall character of bottom substrate and water depth favor wild rice and preclude the need for herbicide or mechanical manipulation of the aquatic plant community within this area. Chemical treatments on lakes and impoundments are limited to waters along developed shorelines by NR 107.08(3) unless the Department approves the project for reasons of greater public benefit.

This area should be considered a higher quality wildlife habitat for waterfowl, furbearers, amphibians, reptiles, and other sensitive nongame species. Aquatic plants in this area also perform a critical role in stabilizing nutrient rich soft lakebed sediments and sensitive shoreline areas.

Sensitive Area- B (Transects 2E, 3w, and 4E)

Site B is a large shallow flat with some open water areas extending downstream from area A to the Highway 46 Bridge. Because of the high quality habitat over such a large area it has been designated as a **sensitive area**. This area is prime spawning and nursery area habitat. The existence of developed shorelines with established residences within this area of the flowage create a challenge to balance recreational access with habitat protection. Currently the P&R

District has been paying to treat a 4400’ long 50’ wide priority navigational access channel within this area with broad-spectrum herbicides. It appears as though this strategy has been providing navigational access while still protecting the remaining high quality habitat within site B.

Curly-leaf pondweed occurred in much of the site, but dominated none of it. Coontail was the most abundant species found within this area. Since coontail doesn’t need to be rooted to grow and easily drifts around with prevailing winds or flood events treated channels will likely become compromised with drifting coontail making it difficult to maintain larger open water priority navigational access channels completely free of aquatic vegetation.

Since coontail freely drifts around additional costly herbicide treatments directed at coontail within priority navigational access channels should be avoided. The Department receives numerous complaints from people who thought a herbicide treatment would provide some form of long-term control in a specific area only to be continuously compromised by free floating coontail.

Mechanical removal of free floating coontail within priority navigational access channels using conventional aquatic plant harvesting equipment should bridge the gap between herbicide treatments. The size of the harvesting equipment can limit the depths to which equipment can operate without disturbing bottom sediments. These shallow areas North of Hwy 46 may not be suitable for larger harvesters which require at least 2’ of water to operate without disturbing bottom sediments. Harvesting for free floating coontail will be limited to the top half of the water column and restricted to areas with water depths greater than 2’.

This area should be considered one of the higher quality Musky and Northern Pike spawning and nursery areas. Aquatic plants in this area also perform a critical role in stabilizing soft lakebed sediments and sensitive shoreline areas.

Sensitive Area - C (Transect 5E)

Site C includes the north shore east of the Highway 46 bridge into and around the small bay where Burns creek enters the flowage. This high quality habitat has been designated as a **sensitive area**.

The majority of the shoreline around this bay functions as a deposition area where organic plant matter is broken down and the energy within recycled into the aquatic food chain/web. Depositional shorelines are often dominated by rich aquatic plant growth with a wetland transitional zone. Aquatic plants provide important stabilization for these loose flocculent sediments through direct root structures, but also help reduce the overall erosive force of waves in these delicate shorelines areas.

Site C provides high quality spawning and nursery area habitat. It also provides high quality wildlife habitat for waterfowl, reptiles, amphibians, and furbearers. Aquatic plants in this area also perform a critical role in stabilizing soft lakebed sediments and sensitive shoreline areas.

Curlyleaf pondweed dominated the aquatic plant community within the 4-7' depth zone in June with coontail prevalent in the other depth zones and dominating all depth zones in August. Minimal navigational access needs exist within this bay.

Larger flats dominated by curlyleaf pondweed with greater potential for exotics control and required treatment monitoring to document long-term effectiveness and effects of treatments exist at the south end of the flowage near transects 17E, 20E, and 22E. These larger flats also have legitimate navigational access issues which make them higher priorities for limited control dollars and required monitoring costs.

This area covers approximately 17 acres. This area, though relatively small in size, should still be considered a higher quality Musky and Northern Pike spawning and nursery area. Aquatic plants in this area also perform a critical role in stabilizing soft lakebed sediments and sensitive shoreline areas.

Senstive Area D -Transect 6w

Site D covers a small point bar on the southeast side of the Highway 46 Bridge. This point bar provides high quality habitat in the form of large leaf pondweeds adjacent to deeper open water which create excellent ambush habitat for large predators including Musky, Northern Pike, and Largemouth Bass.

Sensitive Area - E (Transect 7E)

Site E is a large long flat on the east shore with dense aquatic plant habitat extending westward from the east shore several hundred feet from shore. This high quality habitat has been designated as a **sensitive area**.

This area provides important lush aquatic plant growth rich in aquatic insects which attract large numbers of baitfish and panfish. These in-turn attracts the larger predators. Pockets and open water areas are interspersed along the deeper water edges providing good predator ambush points. Aquatic plants in this area also perform a critical role in stabilizing soft lake bed sediments and sensitive shoreline areas while providing good travel corridors for fish moving up and down the shoreline.

Transect 8w

This area is a good example of a narrower littoral area along the west shoreline. While the area does not have the wider lush growth of other areas in the flowage the available aquatic plant habitat does provide important travel corridors for small panfish and younger predators to move up and down the shoreline with at least some protective cover. This vegetation also reduces the erosive energy in wind or boat driven waves reducing shoreline erosion potential.

These areas with less dense aquatic plant growth are often associated with firmer substrates which are desirable for nest builders such as Bass and panfish.

Sensitive Area G - Transect 9E

Site G is another backwater bay. This high quality habitat has been designated as a **sensitive area**.

Sensitive Area H - Transects 10w, 11E, 12w

Site H covers a large portion of the mid section of the flowage. Aquatic plant community structure is not all that dense and coverage is not over larger broader areas. The existing aquatic plant cover does provide important travel corridors with panfish spawning also occurring throughout selected areas of the shoreline. This vegetation also reduces the erosive energy in wind or boat driven waves reducing shoreline erosion potential.

Sensitive Area - I (Transect 13E)

Site I is another backwater bay with lush aquatic plant growth. This high quality habitat has been designated as a **sensitive area**.

Transect 14W

This area is relatively small with quickly sloping bottom which limits available light to support aquatic plant growth. Developed residences appear to be managing some aquatic plant removal by hand pulling and raking.

Sensitive Area - K (Transect 15E)

Site K is a small backwater bay with high quality aquatic plant habitat. This high quality habitat has been designated as a **sensitive area**.

Sensitive Area - L (Transect 16W)

Site L is a deposition bar with lush aquatic plant growth. This high quality habitat has been designated as a **sensitive area**.

Sensitive Area - M (Transect 17 E and 20 E)

Site M is one of the largest shallow water flats found within the southern half of the flowage. It is a large depositional area receiving nutrients and sediments from Beaver Brook. It also

provides some of the most important habitat for a broad array of fish species during different stages of their life cycle. This high quality habitat has been designated as a **sensitive area**.

Sensitive Area - N (Transect 18W and 19W)

Site N includes two small bays on the northeast side and southeast side of Northwood Park in the City of Amery. Dense lush aquatic plant growth provides critical habitat for bass and panfish. This high quality habitat has been designated as a **sensitive area.**

Transect 21W

Transect 21 is located at the bottom end of the flowage. It appears sediment deposition is compromising the ability to navigate larger boats through these lower reaches. Aquatic plants are abundant and maintaining defined open water navigational channels by late summer difficult.

Sensitive Area - Q (Transect 22E)

Site Q is the last bay within the flowage. Dense lush aquatic plant growth provides critical habitat for bass and panfish. This high quality habitat has been designated as a **sensitive area**.

Appendix A
Frequency of Occurrence and Average Density calculated from the Apple River Flowage Macrophyte Surveys

	CERDE	POTCR	POTZO	POTPR	POTAM	POTNA	POTRI	POTPU	RANSP	ZOSDU	MYRFA	MYRSI	ELOCA	NYMSP	NUPSP	LEMMI	SPIRO	WOLF	LEMTR	ALGAE	SPASP	SAGSP	ZIZAQ
Frequency of Occurrence =(# of depth intervals species occurrs / Total # of sites w/veg.	**90.2**	**63.4**	**64.3**	**4.2**	**0.9**	**1.2**	**1.2**	**2.6**	**5.1**	**1.5**	**0.3**	**0.6**	**29.5**	**8**	**0.3**	**45.8**	**43.5**	**43.5**	**8.3**	**32.7**	**4.8**	**2.1**	**4.2**
Relative Frequency= Frequency/sum of Freq	0.197	0.139	0.141	0.009	0.002	0.003	0.003	0.006	0.011	0.003	0.0007	0.001	0.065	0.017	0.0007	0.1	0.095	0.095	0.018	0.072	0.0104	0.005	0.009
Sum of Frequencies =	**457.2**																						
Sum of Densities	**756**	**311**	**233**	**17**	**5**	**4**	**5**	**10**	**21**	**5**	**1**	**2**	**103**	**27**	**2**	**238**	**229**	**229**	**28**	**169**	**17**	**7**	**17**
Average Density = Sum of density ratings for sp. / # of sites w/veg.	**2.25**	**0.93**	**0.69**	**0.051**	**0.015**	**0.012**	**0.015**	**0.03**	**0.063**	**0.015**	**0.003**	**0.006**	**0.31**	**0.08**	**0.006**	**0.71**	**0.68**	**0.68**	**0.083**	**0.5**	**0.051**	**0.021**	**0.051**
# of depth intervals species occurs	**303**	**213**	**216**	**14**	**3**	**4**	**4**	**9**	**17**	**5**	**1**	**2**	**99**	**27**	**1**	**154**	**146**	**146**	**28**	**110**	**16**	**7**	**14**

Total number of depth intervals sampled = **344**

Total # of depth intervals (along the transects) sampled veg. occurs = **336**

May/June 2003 survey: **CERDE=*Ceratophyllum demersum*, POTCR=*Potamogeton crispus*, POTZO=*Potamogeton zosterformis*, POTPR=*Potamogeton praelongus*, POTAM=*Potamogeton amplifolius*, POTNA=*Potamogeton natans*, POTRI=*Potamogeton richardsonii*, POTPU=*Potamogeton pusillus*, RANSP=*Rnaunculus sp.*, ZOSDU=*Zosterella dubia*, MYRFA=*Myriophyllum farwellii*, MYRSI=*Myriophyllum sibiricum*, ELOCA=*Elodea canadensis*, NYMSP=*Nymphaea sp.*, NUPSP=*Nuphar sp.*, LEMMI=*Lemna minor*, SPIRO=*Spirodella polyrhriza*, WOLF=*Wolffia sp.*, LEMTR=*Lemna trisulca*, ALGAE=*algae*, SPASP=*Sparganium sp.*, SAGSP=*Sagittaria sp.*, ZIZAQ=*Zizania aquatica.***

	CERDE	POTCR	POTZO	POTPR	POTAM	POTNA	POTRI	RANSP	ZOSDU	MYRSI	NAJFL	VALAM	ELOCA	NYMSP	NUPSP	TYPLA	LEMMI	SPIRO	WOLF	LEMTR	ALGAE	SPASP	SAGSP	SAGRI	ZIZAQ
Frequency of Occurrence =(# of depth intervals species occurrs / Total # of sites w/veg.	**97.9**	**5.9**	**32.8**	**11.4**	**2.1**	**1.8**	**0.3**	**0.3**	**0.9**	**0.6**	**1.2**	**0.3**	**14.1**	**15.5**	**3.5**	**0.6**	**77.1**	**77.1**	**77.1**	**1**	**16.1**	**6.5**	**0.6**	**0.9**	**0.6**
Relative Frequency= Frequency/sum of Freq	0.22	0.013	0.07	0.03	0.005	0.004	0.0007	0.0007	0.002	0.001	0.003	0.0007	0.03	0.035	0.008	0.001	0.17	0.17	0.17	0.002	0.04	0.015	0.001	0.002	0.001
Sum of Frequencies =	**446.2**																								
Sum of Densities	**869**	**26**	**121**	**48**	**10**	**7**	**1**	**1**	**3**	**2**	**5**	**1**	**53**	**70**	**13**	**2**	**839**	**839**	**839**	**37**	**70**	**23**	**2**	**4**	**2**
Average Density = Sum of density ratings for sp. / # of sites w/veg.	**2.54**	**0.08**	**0.35**	**0.14**	**0.03**	**0.02**	**0.003**	**0.003**	**0.009**	**0.006**	**0.015**	**0.003**	**0.16**	**0.21**	**0.04**	**0.006**	**2.46**	**2.46**	**2.46**	**0.11**	**0.21**	**0.07**	**0.006**	**0.01**	**0.006**
# of depth intervals species occurs	**334**	**20**	**112**	**39**	**7**	**6**	**1**	**1**	**3**	**2**	**4**	**1**	**48**	**53**	**12**	**2**	**263**	**263**	**263**	**34**	**55**	**22**	**2**	**3**	**2**

Total number of depth intervals sampled = **360**

Total # of depth intervals (along the transects) sampled veg. occurs = **341**

August 2003 survey: **CERDE=*Ceratophyllum demersum,* POTCR=*Potamogeton crispus,* POTZO=*Potamogeton zosterformis,* POTPR=*Potamogeton praelongus,* POTAM=*Potamogeton amplifolius,* POTNA=*Potamogeton natans,* POTRI=*Potamogeton richardsonii,* RANSP=*Ranunculus sp.,* ZOSDU=*Zosterella dubia,* MYRSI=*Myriophyllum sibiricum,* NAJFL=*Naja flexilis,* VALAM=*Vallisneria americana* ELOCA=*Elodea canadensis,* NYMSP=*Nymphaea sp.,* NUPSP=*Nuphar sp.,* TYPLA=*Typha latifolia* LEMMI=*Lemna minor,* SPIRO=*Spirodella polyrhriza,* WOLF=*Wolffia sp.,* LEMTR=*Lemna trisulca,* ALGAE=*algae,* SPASP=*Sparganium sp.,* SAGSP=*Sagittaria sp.,* SAGRI=*Sagittaria rigida* ZIZAQ=*Zizania aquatica.***

CODE	Genus Species *Name*	Common Name
ALGAE	*Algae*	Algae
CERDE	*Ceratophyllum demersum*	Coontail
ELOCA	*Elodea canadensis*	Common waterweed
LEMMI	*Lemna minor*	Duckweed
LEMTR	*Lemna trisulca*	Forked Duckweed
MYRFA	*Myriophyllum farwellii*	Farwell's water-milfoil
MYRSI	*Myriophyllum sibiricum*	Northern water-milfoil
NAJFL	*Naja flexilis*	Slender naiad
NUPSP	*Nuphar sp.*	Yellow water-lily
NYMSP	*Nymphaea sp.*	White water-lily
POTAM	*Potamogeton amplifolius*	Large-leaf pondweed
POTCR	*Potamogeton crispus*	Curly-leaf pondweed
POTNA	*Potamogeton natans*	Floating-leaf pondweed
POTPR	*Potamogeton praelongus*	White-stem pondweed
POTPU	*Potamogeton pusillus*	Small pondweed
POTRI	*Potamogeton richardsonii*	Clasping-leaf pondweed
POTZO	*Potamogeton zosterformis*	Flat-stem pondweed
RANSP	*Ranunculus sp.*	Buttercup
SAGRI	*Sagittaria rigida*	Stiff arrowhead
SAGSP	*Sagittaria sp.*	Common arrowhead
SPASP	*Sparganium sp.*	Bur-reed
SPIRO	*Spirodella polyrhriza*	Duckweed
TYPLA	*Typha latifolia*	Broad-leaf cattail
VALAM	*Vallisneria americana*	Water Celery
WOLF	*Wolffia sp.*	Duckweed
ZIZAQ	*Zizania aquatica*	Wild rice
ZOSDU	*Zosterella dubia*	Water star-grass

Key to Codes, *Genus Species* name, and Common names of aquatic macrophytes found in the Apple River Flowage

Appendix B – State and Local Regulations protecting Lakes, Shorelines, and Aquatic Habitat

NR107 – Aquatic Plant Management

NR107 specifies what can and cannot be done to control an aquatic nuisance species through application of pesticides, herbicides, and other chemicals with or without a permit. This regulation requires that chemicals used for aquatic nuisance species control be approved by the EPA for aquatic uses against approved target species. Most chemical applications require a DATCP approved and certified applicator. People applying chemicals must be able to identify the species present within a treatment area and insure that they are listed as approved target

species on the label of the controlling agent. People must also be able to properly demonstrate their ability to correctly calculate and apply label-approved doses. Over- or under-applying pesticides or treating areas where approved target species don't occur will result in an enforcement action.

NR109

Recent changes in aquatic plant rules have resulted in limitations to the amount of shoreline vegetation which can be removed by hand pulling or raking without a permit. I would encourage anyone requesting a herbicide or harvesting permit to make sure they are in compliance with these existing aquatic plant rules before requesting additional permit controlled activities. Currently lakeshore residents are allowed to remove aquatic vegetation up to a 30' width around their docks without a permit providing they are not removing wild rice or a floating bog and the vegetation pulled or raked is removed from the lake and deposited on a suitable upland compost site. This 30' width must include the area under the dock and cannot be moved to a different portion of their shoreline until the previously maintained areas are fully restored to natural plant densities. If residents are removing or maintaining more than a 30' width around their docks I would encourage them to hault removal in areas outside of the approved 30' width to avoid possible future citations. The department may decline approval of specific areas requested in permits until the 30' width rule is complied with for an individual property owner. If regulations are not complied with in a timely manner enforcement actions may become necessary.

NR115

NR115 requires the establishment of a shoreline buffer and limits the activities which can be implemented on the near shore and inshore area. These standards include setbacks for structures from waterways and property lines, minimum lot sizes and land division review, controls on cutting shoreline vegetation, standards for earth moving activities, protection of wetlands, regulations governing septic systems and wells, and restrictions for improving older nonconforming structures which do not meet current shoreline standards.

The most obvious of these is the shoreline buffer requirements which require shoreline property owners to maintain a strip of unaltered vegetation including trees, shrubs, and unmowed ground cover 35' back from the waters edge with the exception of a 30' access and viewing corridor which can be mowed.

Polk County Shoreland Protection Zoning Ordinance

The Shoreland Protection Zoning Ordinance establishes the minimum setback for waterfront property based on lake classification in Polk County. Please see
http://www.co.polk.wi.us/landinfo/PDFs/Ordinances/shorlandord.pdf
for more information.

NR216

Stormwater Discharge Permits are required for any groundbreaking activities which exceed an acre in size. The State regulations have also been made more stringent by the County's Stormwater and Erosion Control Ordinance. Please see http://www.co.polk.wi.us/landwater/Stormw%20Ord_wfee%20sch.12-20-05.pdf for more information on the County ordinance.

Appendix C –
June 2003 Aquatic Plant Survey Data summary sheet
(please see Excel file on accompanying disk)

Appendix D –
August 2003 Aquatic Plant Survey Data summary sheet
(please see Excel file on accompanying disk)