A Limnological Condition Assessment and Lake Management Plan Update for:

Whitmore Lake

Plant and Water Quality Assessments Prepared by:

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Executive Summary

Primary Goal of the Whitmore Lake Management Plan

The primary goal of Whitmore Lake Management Plan is to modify conditions within the lake to enhance species and habitat diversity and thereby stabilize the ecosystem by promoting the production of conservative species and inhibiting the production of those plants that are weedy or more opportunistic. The attainment of this goal is expected to foster conditions that will make Whitmore Lake more resilient to the rapid proliferation and domination of the aquatic ecosystem by invasive nuisance species. Success will also enhance recreational opportunities, including the fishery and the cultural utility of the resource. Any applied management strategy will focus on mitigating against the effects of cultural disturbance and be applied in a manner to minimize further disturbance of the ecosystem.

Proximal Management Goals

Nuisance Plant Production Management: The primary goal of the vegetation management plan is to mitigate against cultural and natural disturbances by modifying the quality of the Whitmore Lake flora through the prescriptive use of selective plant management agents and strategies. In recent years, the submersed flora of Whitmore Lake was dominated by the production of an opportunistic plant species, milfoil. Selective plant management agents are used to suppress the production of opportunistic and invasive species (bad plants) that are prone to form monocultures and suppress the production of preferred, conservative plant species (good plants).

A native pondweed or pondweed hybrid created nuisance conditions in offshore areas that are used for boating and water skiing in 2005. The density of these plants seemed to increase in 2006. These areas were too far from shore to be permitted for treatment with aquatic herbicides by the MI DEQ. Consequently, harvesting operations were used to suppress the nuisance conditions in 2005. No harvesting was used in 2006 due to lake user dissatisfaction with the results of the 2005 harvest. The pondweeds in these areas seem to be far more opportunistic than is considered normal an probably represent an emergent genotype that grows in a manner that is inconsistent with the overall management plan.

AQUEST TIP

Disturbed Aquatic Ecosystems

Characteristics

- Noxious Plants and Algae
- Compromised recreational and utilitarian values
- Loss of aesthetic value
- Rapidly changing conditions, such as blooms of algae, plant monocultures, fish kills.

Common Disturbances

- Lake shore development,
- Watershed development,
- Pollution inputs (plant nutrients and sediments),
- Introduction of exotic organisms,
- Boating in shallow areas,
- Non-selective, non-ecologically based management practices.

A exotic charoid alga was identified in Whitmore Lake in 2006. This plant was only discovered in inland Michigan lakes in 2006. It is extremely invasive and appears to be capable of out-competing all other submersed species, including milfoil. This plant appears to be spreading rapidly and is expected to seriously diminish plant biodiversity.

Water Quality Management: Water quality management is typically focused on matters related to lake fertility, and the production of suspended algae (phytoplankton) and the fishery. Anecdotal evidence gathered from lake shore residents, indicate that water clarity has historically been very good in Whitmore Lake. Water clarity continues to be very good in Whitmore Lake suggesting that phytoplankton production in the lake is relatively low. Plant nutrient concentrations and water transparency readings taken in 2004 affirm that the water clarity is excellent and that the lake seems to support relatively little phytoplankton production. The

proliferation and production of zebra mussel is likely to play a significant role as a determinant of water transparency, plant nutrient dynamics, and ultimately, fisheries production. The combination of relatively unproductive bottom sediments, low water column nutrient concentrations, and zebra mussel impacts suggest that fisheries production (total number of pounds produced) in Whitmore Lake may be limited by available nutrient resources. Typically, lake communities strive to limit nutrient (phosphorus) loading to as great a degree as possible; however, it appears that Whitmore Lake would not benefit from such programs which are designed to restrict the over production of phytoplankton. Although the water quality (clarity and phytoplankton production) of Whitmore Lake is not typical for a southeastern Michigan Lake the recommended water quality goals should be the same as other lakes in the region. Water quality conditions should be maintained or altered to favor the greatest degree of phytoplankton species diversity.

AQUEST TIP:

Blue Green Algae Concerns

Blue green algae are becoming an important issue for many riparian property owners. Recent studies have revealed disturbing findings regarding the toxicology of substances made and released into the water by these nuisance algae. These substances can seriously threaten the public health and poison pets and wildlife. Studies are in progress related to the potential risks that the lake users may encounter when exposed to blue green algae blooms. Riparian property owners are urged to not panic, but take some precautions. Until these studies are completed, it is recommended that persons not swim in waters where blue green algae blooms are evident. These conditions would include blooms where it appears that green latex paint has been spilled on the water, or that the water in enclosed bays is covered by an oil slick. Blue green algae blooms are usually temporal events and may disappear as rapidly as they appear. Riparian property owners should learn to recognize blooms and act accordingly.

The presence of starry stonewort appears to also enhance water clarity. The mechanism for the increase in water clarity is not know; however, lower suspended algae production is likely to negatively impact the production of the fishery.

Blue green algae production can be increased, relative to other more desirable species, by the expansion and filter-feeding activities of zebra mussel colonies in the lake. Unfortunately, technologies are only now being developed for the management of phytoplankton communities and these strategies are encumbered by the presence of zebra mussel. Whatever can be done to prevent the domination of the plankton community by blue green algae should be given high priority.

Other Considerations

The Whitmore Lake fishery is an important resource for Whitmore Lake and area anglers. The vegetation and water quality management programs are intended to benefit fisheries production and angling opportunities by improving the quality of the flora and mitigating against conditions that may lead to the proliferation of blue green algae. Swimming and boating represent other key resource uses. The primary goal of the Whitmore Lake Management Plan is consistent with the maintenance of conditions that will enhance opportunities for the pursuit of these recreational activities. More on the fishery is included in a separate report.

Summary Management Opinion

Primary Considerations

- Most major plant and fishery assessment indices for Whitmore Lake are considered to very good relative to other Michigan lakes. Biodiversity, “c” value, and species richness values are all high. The 2006 milfoil management program was considered to be effective even though more milfoil was found in more of the lake at the end of the summer. Preliminary test results suggest that the milfoil in Whitmore Lake is a hybrid genotype or cross between Eurasian watermilfoil and

northern watermilfoil. It did not respond to a common contact herbicide when it was applied to a small test area in the lake.

- The distribution and density patterns of plants in Whitmore Lake are considered to be good. The proliferation of preferred plant species is expected in 2007 as long as milfoil production is contained. The impact of the spread of starry stonewort is unknown but will be monitored closely.
- Total planktonic primary production appears to be low relative to other lakes. This limits the total production of the fishery; however, Whitmore Lake still supports an excellent fishery. There is currently an abundance of suitable habitat to support a vibrant warm water fishery; however, the unmitigated spread of starry stonewort may ruin spawning areas for panfish and bass.
- Whitmore Lake is occasionally subject to blue green algae blooms. Recent studies and anecdotal evidence indicate that the domination of plankton communities by blue green algae may be a result of filter feeding zebra mussel.

Management Recommendations

- Milfoil is expected to return at nuisance levels in Whitmore Lake in 2007 and widespread treatment, with selective herbicide combinations are recommended. Some native plant species may also be found to grow at nuisance levels in 2007. Problems are expected to be particularly acute near the water skiing course located along the western shoreline in the southern part of the lake. This area is particularly vulnerable to the proliferation and possible domination of starry stonewort. It is not known if starry stonewort will suppress nuisance pondweeds in 2007. The only permitable management strategy for this area, according to MI DEQ policy is the use of mechanical harvesting.
- Plant community monitoring must be continued in 2007 to monitor trends in ecosystem development. The preferred species that have dominated the lake since late 2004 are expected to continue to dominate the lake flora in 2007; however, they are also expected to grow to nuisance levels in some parts of the lake. A permit application for nuisance weed control should be submitted to the Michigan DEQ in case discrete treatment is required in areas of the lake.
- Although total fisheries production may be limited by lake fertility, the quality of the fishery is still considered to be excellent but may be threatened by the loss of algae production and spread of starry stonewort.

A SUMMARY OF CONDITIONS, 2003 - 2006

Aquest Aquatic Vegetation Community Assessment, 2006:

Aquatic vegetation grows in four distinct zones or Tiers in Whitmore Lake that roughly correspond with increasing depth. Vegetation community observation sites have been established in all four zones and are numbered to facilitate various analyses of plant community data by tier. The observation sites (BioAssessment Site = BAS) are depicted on Figure 1. By convention, the near shore areas are referred to as Tier 1 and are referenced by numbers ranging from 1 to 199 on Figure 1. Many of these areas are very shallow, sandy, and plant-free because of wind and wave action. The Tier 2 zone is characterized by deeper water and is generally more plant productive than the nearshore areas that are influenced by high energy waves and wind action. The Tier 2 observation sites are numbered from 200 to 299 on Figure 1. Tier 3 could be referred to as the “drop off” zone where the bottom slope is much greater that tier 1 and 2. The tier 3 observation sites are numbered from 300 to 399. Whitmore Lake also has vast areas, ranging in depth from 8’ to 12’, where slopes area very gradual and plant growth is significant. These areas are referenced as as tier 4 and the BAS in that area area numbered from 400 to 499.

Observations were made at each of the observation sites depicted on Figure 1. Codes are used to aid data analysis. Each plant species is assigned a specific number which are ordered according to the plant morphotype, which ranges along a scale from “bushy” to “leafy” to “grassy” to “floating” leaf plants. The position of the plant in the water column, density and distribution of plants are also noted on the survey map. A code form with descriptors is included in the appendix attached to this

document. These data were used to analyze the character of the plant community as follows:

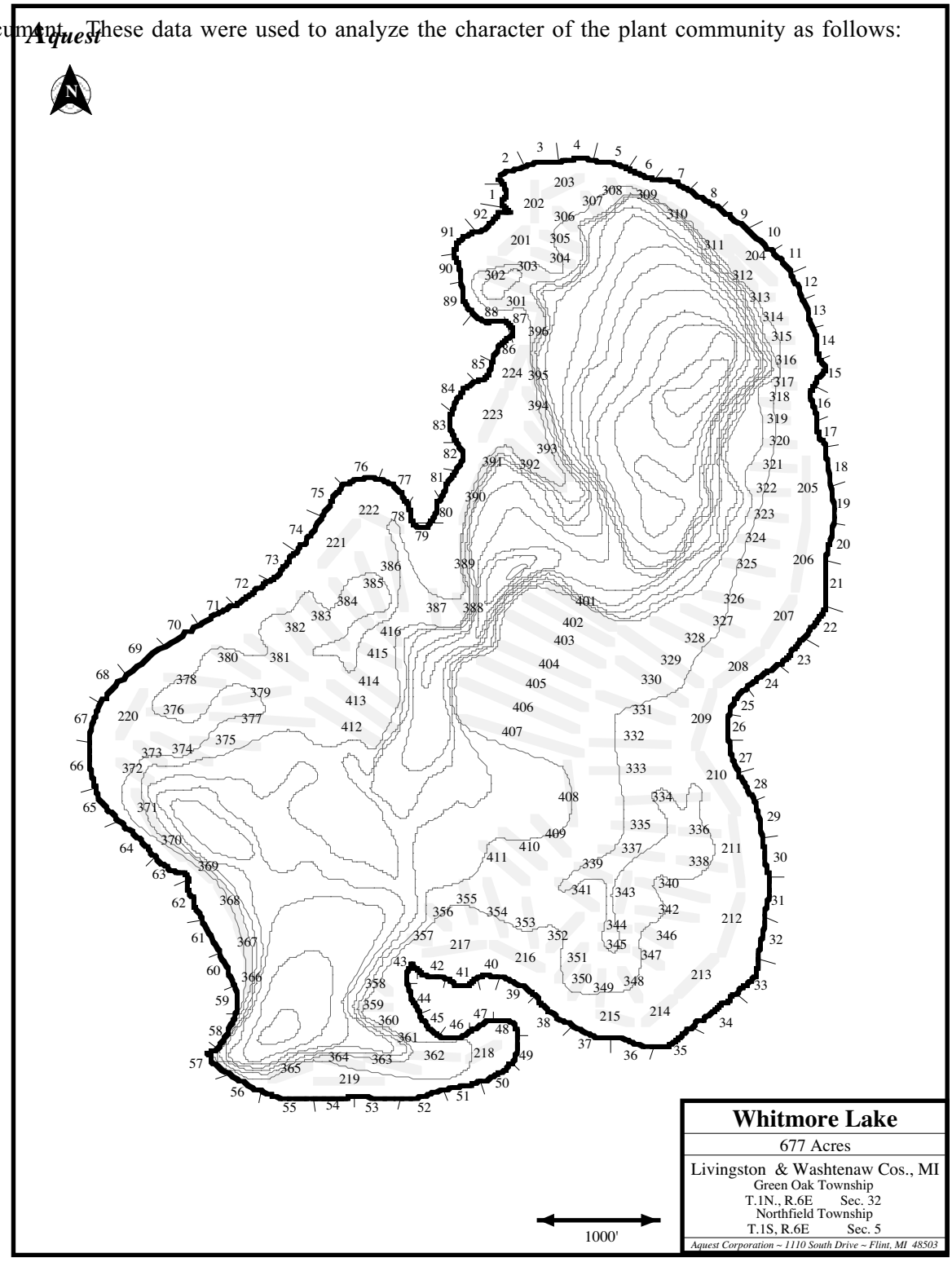

Table 2. Plant species observed in Whitmore Lake from 2003 to 2006. Value represent the percent total of BAS where each species was found.

	SPECIES NAMES		SURVEY DATE					
	COMMON NAME		Sept. 2003	June 2004	Sept. 2004	June 2005	Sept. 2005	June 2006
1	Coontail	*Ceratophyllum demersum L.*	8				3	
2	Chara	*Chara sp.*	77	59	75	86	90	28
3	Elodea	*Elodea canadensis Michaux*		7			4	
4	Eurasian Watermilfoil	*Myriophyllum spicatum L.*	16	85		3	24	52
5	Green/Variable Milfoil	*Myriophyllum sp.*	50					
6	Naiad	*Najas sp.*					10	17
7	Nitella	*Nitella sp.*						
8	Starry Stonewort	*Nitellopsis obtusa (Desv.) J.Groves*						12
9	Spadderdock	*Nuphar sp.*	3	1		5	6	2
10	Waterlily	*Nymphaea sp.*	3	15	13	12	25	21
11	Smartweed	*Polygonum amphibium L*						1
12	Broad Leaf Pondweed	*Potamogeton amplifolius Tuckerman*	62	48	76	42	57	16
13	Curly Leaf Pondweed	*Potamogeton crispus L*	12			18	8	13
14	Variable Pondweed	*Potamogeton graminius L.*	1				32	
15	Illinois Pondweed	*Potamogeton*		32			1	15
16	Floating Leaf Pondweed	*Potamogeton natans L.*			28	2	6	
17	White Stem Pondweed	*Potamogeton praelongus Wulfen*	5					2
18	Richardson's	*Potamogeton richardsonii (Benn.) Tydb.*	1	2			19	
19	Robbins Pondweed	*Potamogeton robbinsii Oakes*	29	11	32	36	28	7
20	Thin Leaf Pondweed	*Potamogeton sp.*		6		12	6	2
21	Flat Stem Pondweed	*Potamogeton zosteriformis Fern.*	43	4	9	3	12	11
22	Buttercup	*Ranunculus sp.*				3		53
23	Duck Potato	*Sagittaria sp.*	3					
24	Sago Pondweed	*Stuckenia pectinatus L.*	25	12	20	53	45	43
25	Common Bladderwort	*Utricularia vulgaris L.*	1					
26	Wild Celery	*Vallisneria americana Michaux*	43		45	14	66	28
27	Water Star Grass	*Zosterella dubia (Jacq.) Small*	18				11	4
TOTAL SPECIES NUMBER			18	12	8	13	19	18

Total % Vegetation Cover of Aquatic Vegetation Observation Sites:

Aquest Method Vegetation Surveys were performed in 2003, in June and September 2004, June and September of 2005, and June and September of 2006. Milfoil was found to inhabit nearly every conceivable habitat and depth zone in Whitmore Lake at the times of the 2003 and June 2004 surveys (82% and 87% respectively). When milfoil is considered, it seems that nearly all BAS are capable of supporting rooted plant growth. However, it is estimated that less than 80% of the BAS may be capable of supporting preferred species production since these species tend to not be as opportunistic as milfoil. The total number of vegetated BAS's declined sharply from 2003 to late 2004 as a result of milfoil control efforts, but had recovered remarkably by September 2005. The dense mats of milfoil that had formed in May 2004 dropped slowly into the water column, forming a barrier to other plant growth. This slow rate of decline is related to the low dose rate restrictions imposed by MI DEQ policy. Higher dose rates may have precipitated a more rapid decline of the milfoil mats and the subsequent release of desirable vegetation from milfoil shading. However, higher dose rates may have also imposed some inhibitory affects on the growth of these desirable species. Low dose rates have probably also contributed to the spread of fluridone tolerant genotypes in Whitmore Lake.

The September 2006 plant survey revealed that milfoil had recovered to a point to inhabit 64% of the observations sites. It is certain that milfoil growth will reach extreme nuisance proportions in 2007 unless aggressive management efforts are employed. It is expected that preferred species production will continue to increase 2007. Table 1 illustrates the percentage of the total aquatic vegetation observation units found on Figure 1 that support aquatic vegetation for each of 5 years.

Table 1. The percent aquatic vegetation observation sites that supported aquatic vegetation according to observation sites depicted on Figure 1.

SURVEY DATE	% BAS COVER
Sept 2003	98%
June 2004	97%
Sept 2004	77%
June 2005	89%
Sept 2004	93%
June 2006	66%
Sept 2006	76%

Plant Species Richness (Total Species Present):

Twenty-seven species have been found in Whitmore Lake since 2003; however, no more than 19 species have been found in any given year (Table 2.). The total number of species observed varied greatly from survey date to survey date. The greatest number of species, 19, was found in 2003 and the fewest number was found at the time of peak milfoil cover, June 2004. Whitmore Lake species richness appears to be declining as a result of the spread of milfoil and starry stonewort. This trend could continue into 2007.

Preferred species production is expected to increase in Whitmore Lake in in 2007 if invasive plant species are selectively suppressed. Again, the impact of starry stonewort could be significant and could be responsible for a loss in the area covered by preferred species. If the impact of starry stonewort is not significant in 2007, then the production of some preferred species is expected to reach nuisance levels in discrete areas.

Curly leaf pondweed would normally be expected to grow to nuisance levels in Whitmore Lake, but was found in only 8% of the BAS's in June, 2006. The production of this plant must be closely monitored. .

The species richness of tier 1 was the greatest of all the tiers on all of the survey dates, while species richness declined with increasing tier number except for Tier 4 in 2006. These findings are consistent with those found in other Southeastern Michigan lakes.

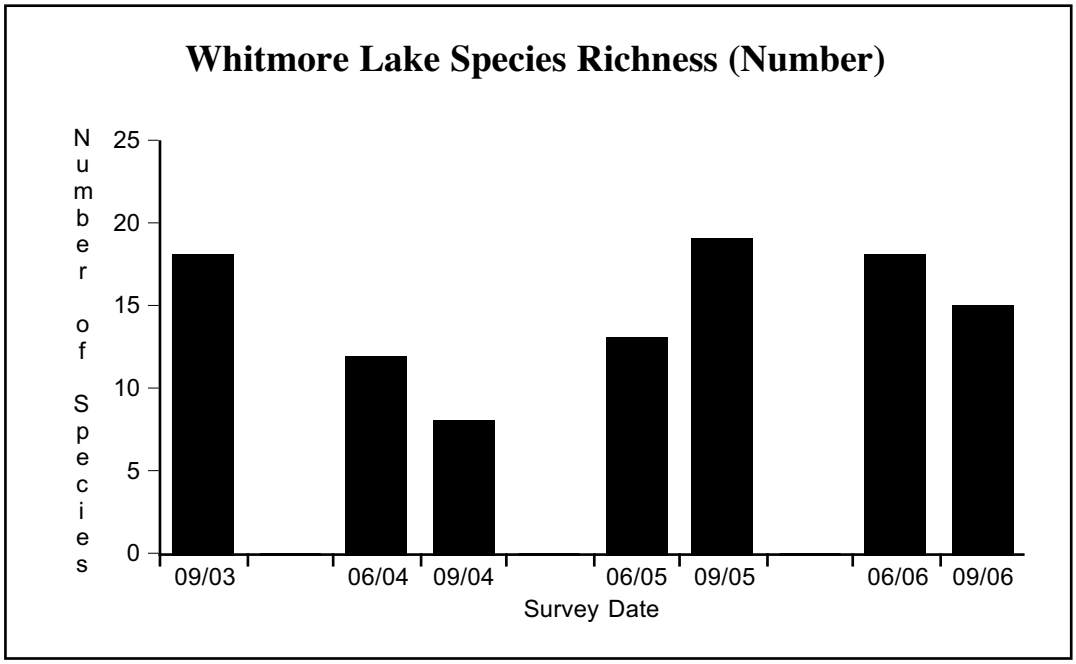

Figure 2. Whitmore Lake plant species richness (total number of plant species).

Plant Community Biodiversity:

The relative biodiversity of Whitmore Lake was extremely high in 2003 but declined sharply by September 2004 even when target nuisance species (milfoil) are factored into the consideration (Figure 3.). It is important to note that the total number of species present in September, 2004 was greater than observed in June, 2004; however, many of the species were found at a very low number of BAS. By 2005 preferred species production had increased significantly in many of the observation sites. Naiad, flat stem pondweed, water star grass, broad leaf pondweed and sago pondweed were all found in 10% or greater of the observation sites in 2005.

Many plant species were found at more than 10% of all BAS's observed in 2006. These include, Milfoil (64%), Naiad (12%), Chara, Nitella, and Starry Stonewort (~30%), Flat Stem Pondweed (15%), Water Star Grass (11%), Robins Pondweed (20%), Illinois Pondweed (20%), Variable Pondweed (45%), Broad Leaf Pondweed (35%), Sago Pondweed (45%), Wild Celery (54%), and Water Lily (12%). The expansion of this growth created nuisance conditions along parts of the western, northern, and southern shores.

The plant biodiversity in Whitmore Lake appears to be increasing as a result of prudent management. It is considered to be be better than many regional lakes.

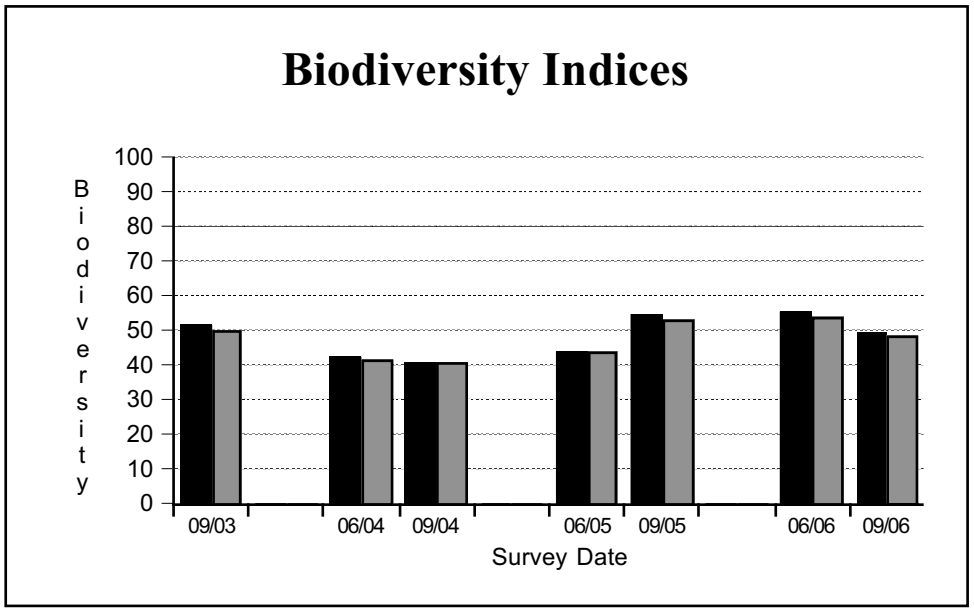

Figure 3. The total biodiversity (all plant species present = ■) and the biodiversity when milfoil and curly leaf pondweed are not factored into the calculation (sans target biodiversity = □).

Plant Community Quality:

"C" Values:

Submersed plant communities that are dominated by conservative, rather than opportunistic species are generally considered to be more desirable by persons who use lakes for a variety of purposes. Lakes that are dominated by opportunistic species are generally considered to be "too weedy". A "c" value, ranging from 1 to 10, is assigned to each species to describe how likely a plant is to be found in either disturbed or conservative (stable) ecosystems. Opportunistic plants, that are more tolerant of cultural disturbance are usually considered to be the worst weeds and are assigned lower "c" values. Plant species found in stable, less disturbed lakes are not usually considered to be "weedy" and are assigned higher values. The mean "c" value can be used to roughly estimate the quality of the lake flora. The quality of the plant community in Whitmore Lake in terms of "c" value has remained relatively constant since 2003. Mean "C" values are considered to be very good, relative to other lakes in the region. Higher "c" values suggest that the Whitmore Lake ecosystem is also more stable than other regional lakes. The spread of sago pondweed and milfoil have suppressed the average "C" value for Whitmore Lake.

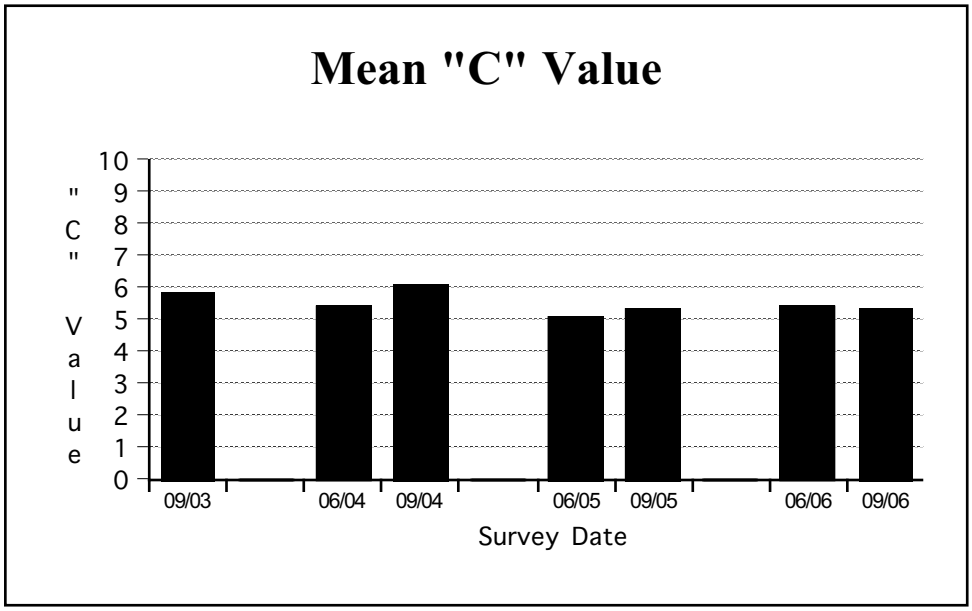

Figure 4. Whitmore Lake macroflora mean Coefficient of Conservatism or "C" values from 2003 to 2006.

Plant Morphotypes:

The variety of leaf type and morphometry of the plant plant species found in the plant community contributes to the complexity of the physical environment and can also be used as a measure of plant community quality. Studies have shown that fisheries production and quality is greater where plant communities are considered diverse in terms of leaf type and plant morphology. Structural complexity probably also contributes to the stability of aquatic ecosystems. Leafy species, such as pondweeds dominated the submersed flora of Whitmore Lake except in 2005. Grassy plants dominated the flora in June 2005 because of the explosive growth of sago pondweed. It is also expected that "grassy plants" such as wild celery could continue to cover greater area in the coming years. The expansion in the area covered by milfoil and charoid algae (chara, nitella, and starry stonewort) have more than compensated for the expansion in the area covered by leafy and grassy species and are responsible for declining morphotype values.

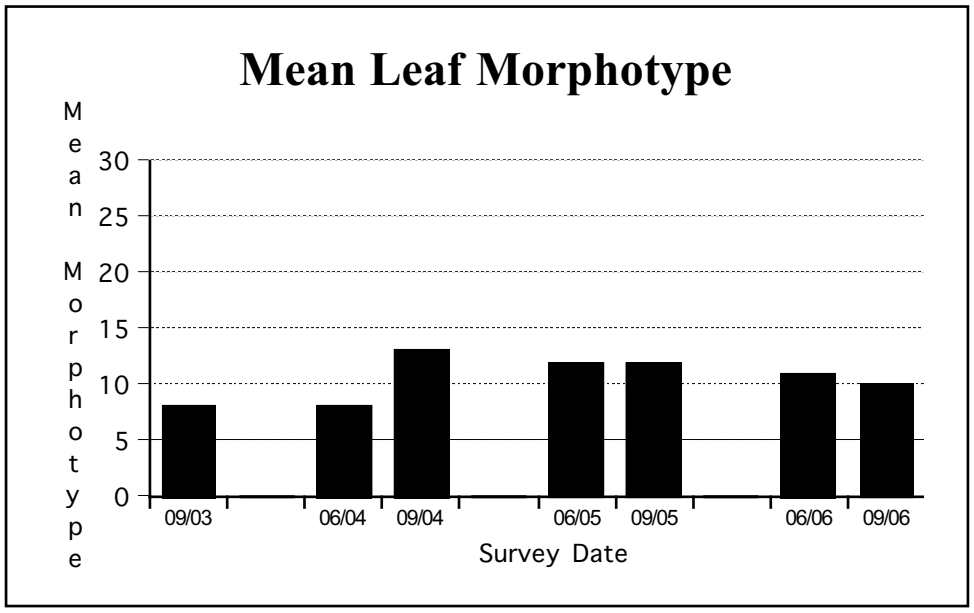

Figure 5a. Submersed macrophyte community mean leaf morphotype. Lower numbers represent "bushy plants, such as milfoil, while higher numbers are more "leafy".

Plant Morphotype Diversity:

Another measure of ecosystem stability is related to the diversity of leaf types considered around the entire lake. This measure is similar to species diversity, but is based on variable plant morphologies. This measure may be a important as plant species biodiversity.

Figure 5b presents plant morphotype data as a diversity index. Presumably, the greater the variation the better the plant community for the support of fisheries and wildlife values and ecosystem stabilization. It is difficult to compare this metric to regional lakes because it has only recently been applied to the data. The values reported for Whitmore Lake appear to be good; however, based on anecdotal observations of this lake and others. It is clear that these value were trending upward through 2005 but have begun to decline as milfoil and charoid algae dominate more of the lake. Prudent weed control should help to improve these values.

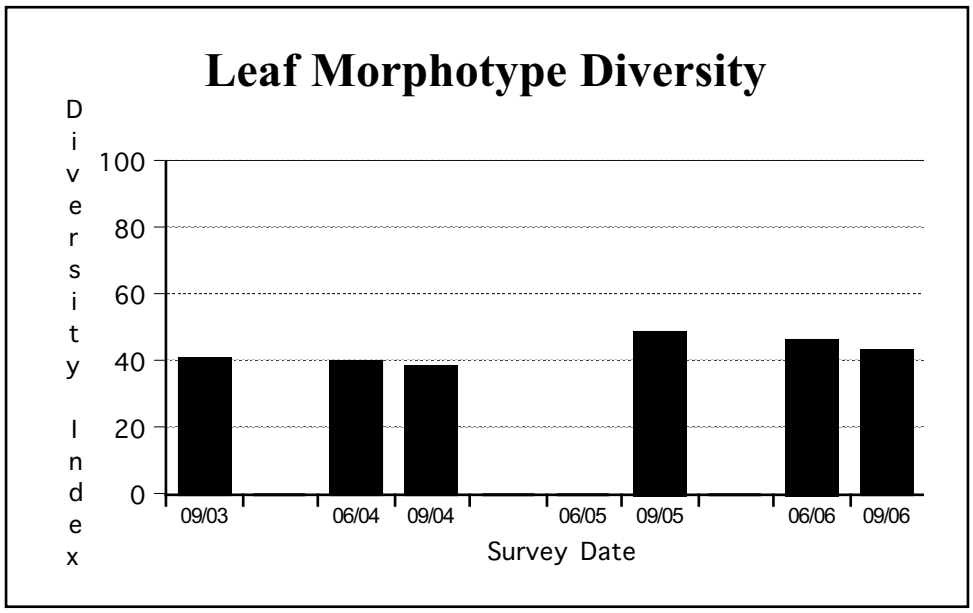

Figure 5b. Submersed macrophyte community leaf morphotype diversity.

Plant Distribution and Density:

The quality of the plant community in Whitmore Lake is also considered from the perspective of density and distribution. Density and Distribution are subjective values that are used to describe how much vegetation is observed per unit area and how it distributed within the BAS. Field data are evaluated as follows:

Density "a"	Rare: The plant species has been observed; however, it is unlikely that the plant could be found again if the observer were to return to the observation site.
Density "b"	Present: This designation is an artifact from methods used in the early 1990's and should not be used. It is listed here; however,

the observation site.

Density "b" — Present: This designation is an artifact from methods used in the early 1990's and should not be used. It is listed here; however, because the term is still used by the MI DEQ. The "b" value is used instead of the "c-" value that is used in the field. This value is used to describe plants that could be found if the observer were to return the observation site, but the plant is not common or dominant in the observation zone.

Density "c" — Common: This term is used to describe plant species that are common throughout the observation site.

Density "d" — Dense: This term is used to describe the production of a species or perhaps several species that totally dominate the observation site where they form dense low-growing meadows or impenetrable surface mats of vegetation.

Distribution "s" — Scattered: The plant is observed to be randomly scattered around the observation site, usually as a single plant or small clump of plants comprised of several stems.

Distribution "sp" — Scattered Patches: The plant is observed as clumps of several plants scattered around the observation site.

Distribution "p" — Patchy: The plant is observed to cover large patches or areas within the observation site; however, the plant does not cover more than 50% of the total area.

Distribution "cp" — Contiguous Patches: This term is used to describe plant growth that is usually dense and where places that are not occupied by the described species appear to be patches within the mass of vegetation produced by the described species.

Density:

It is preferred that most plant species be found at “b” or “c” level densities which indicate that most of the plant species present in the lake are capable of inhabiting many areas of the lake and that species richness numbers are not merely inflated by rare species confined to narrowly defined habitats. The mean density of plants in Whitmore Lake varied considerably from 2003 to 2005 but seems to have stabilized in 2006 (Figure 6). Most plants were found at “c” or common levels throughout the period.

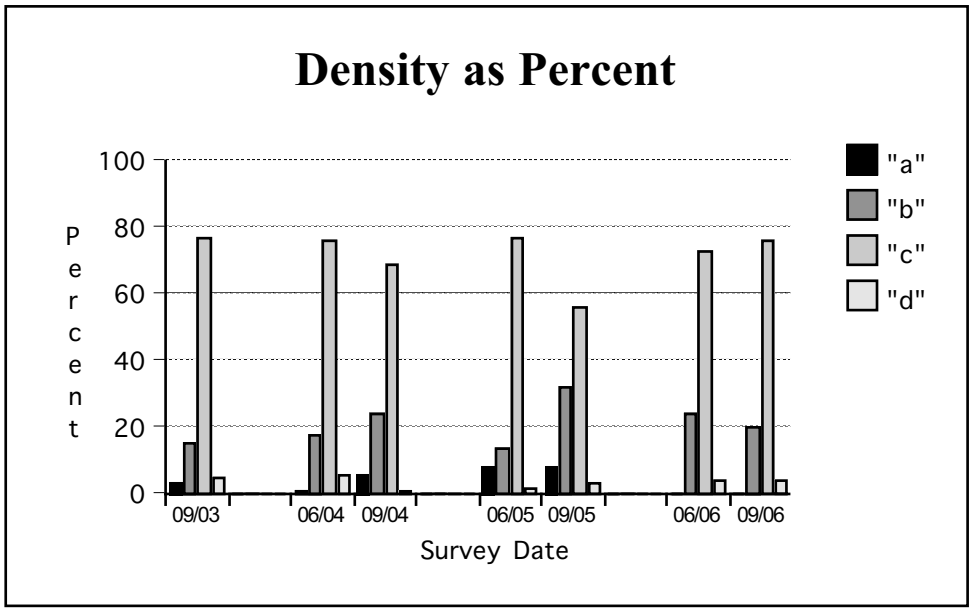

Figure 6. The mean density value expressed as percent of the total found in all BAS’s.

Distribution:

Open space is generally considered to be a desirable feature in plant communities because it can contribute to habitat complexity by creating more "edge". Plant distributions must be considered within the context of plant height and the diversity of leaf type. Scattered "s" and scattered patch "sp" distributions are generally considered to be the most desirable distribution patterns for recreation and fisheries and wildlife considerations. Contiguous patches "cp" of vegetation are not necessarily negative if the plant are forming dense meadows of low-growing vegetation that carpets the bottom of the lake. Contiguous patch distribution is extremely undesirable when the plants are growing at the water surface. The "p" or patchy distribution patterns dominated Whitmore Lake in 2006 because milfoil was generally found growing in that pattern (Figure 7). The preferred plants in Whitmore Lake appear to adopt a more scattered distribution pattern. Most plants were found as scattered individuals or patches of plants in 2005 and were generally considered to be good during survey period.

Charoid algae typically form contiguous patches of vegetation or dense carpets with no breaks. The spread of starry stonewort is likely to result in increased "cp" values for the lake. This could be problematic in shallow waters.

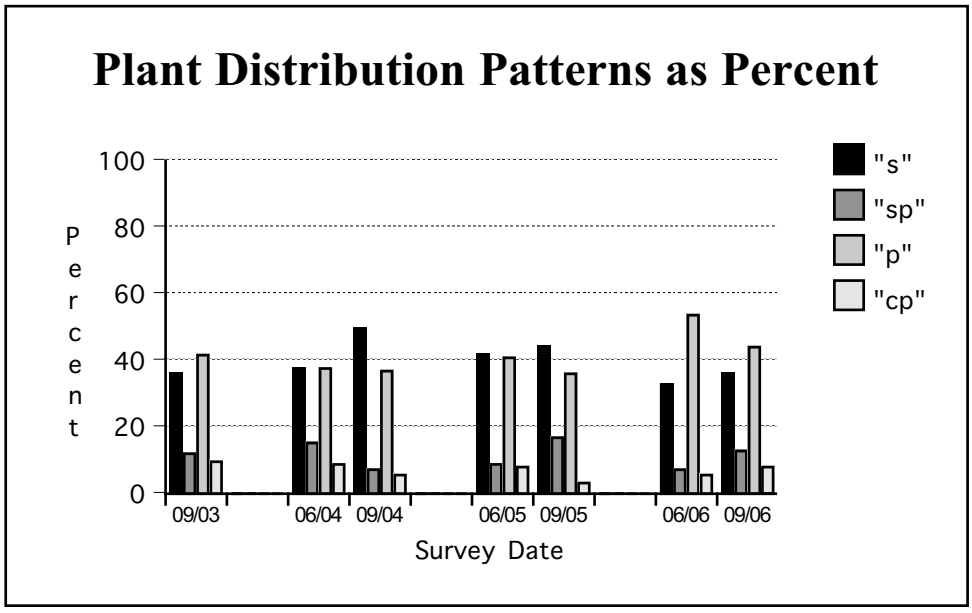

Figure 7. The mean plant distribution pattern value of the submersed flora at all BAS's.

Selected Plant Species and Other Considerations

Nuisance Plant Production:

Historically nuisance plant production in Whitmore has been rare, according to reports from lake side residents and persons who have frequented the lake for decades. Milfoil may have been present in the lake for more than a decade; however, it appeared to only become a significant nuisance in Whitmore Lake in 2002. Aquest Corp. discovered the presence of a hybrid milfoil in Michigan in 2003. Studies suggest that the hybrid genotype is the dominant milfoil found in Whitmore Lake even though the milfoil plants observed in Whitmore Lake do not appear to be hybrids. Milfoil hybrids are known to be more resistant to herbicide treatments and may be capable of more rapid recovery than the Eurasian type that initially invaded Michigan inland lakes. This may be occurring in Whitmore Lake as 24% of the observation zones contained milfoil by late 2005 and 64% by 2006. The rapid recovery of milfoil populations suggest that the milfoil in Whitmore Lake may be more herbicide tolerant than pure Eurasian watermilfoil communities. There are also some concerns regarding "native" Michigan species that are demonstrating an increasing propensity to grow at nuisance levels in Michigan inland lakes. Broad leaf pondweed is unusually troublesome in Whitmore Lake and may be an aggressive hybrid.

AQUEST TIP:

Rationale for Managing Aquatic Vegetation

The need to manage aquatic vegetation arises when vegetation cover and biomass become sufficiently high to disrupt the natural balance of a lake and interfere with recreation. This type of growth is often referred to as nuisance or invasive. Excessive growth of aquatic plants interferes with nearly all forms of recreation and causes many biological problems. Dense plant growth at the water surface impedes exchange of gases between the air and water, thereby contributing to nighttime dissolved oxygen depletion and large daily pH fluctuations, conditions which are detrimental to fish and other aquatic life. Production of desirable sport fish (e.g., largemouth bass) is maximized at intermediate levels of plant cover and biomass. Excessive plant cover makes it difficult for larger fish to capture smaller food fish, which can lead to reduced production of larger piscivorous fish and to stunted populations of small forage fish.

Invasive exotic aquatic plants (i.e., plants that do not naturally occur in the same geographical area) often produce particularly severe problems. Exotic species, such as Eurasian watermilfoil (*Myriophyllum spicatum* L.) and curly leaf pondweed (*Potamogeton crispus* L.), expand rapidly to supplant native vegetation and form dense monospecific beds. Compared with most native aquatic plants, these exotic species concentrate their stems and leaves at the water surface. Thus they interfere with recreation to a much greater degree than comparable quantities of native plants. Not all lakes are equally likely to be severely affected by invasive exotic plants. Generally lakes that are characterized by highly developed shorelines and lakes that are subjected to intense recreational use are most susceptible to invasive species problems.

At moderate density levels, aquatic plants provide important benefits to the lake, including sediment stabilization, invertebrate habitat and cover for small fish. Thus, management of problem aquatic plant growth should be carried in such a way as to preserve desirable aquatic vegetation or preferred plant species. Most preferred species are characteristic of stable, undisturbed ecosystems and are not usually considered to be nuisances. Effective aquatic plant management can preserve beneficial aquatic vegetation in a number of ways. Selective techniques control problem species with minimal effect on desirable ones. Desirable vegetation can also be preserved by limiting the application of control techniques to areas where they are needed. In general, some areas in every lake should be set aside for little or no management in order to preserve species that are sensitive even to selective controls.

The 2003 fluridone application appeared to have provided adequate control of milfoil and seemed to contribute to an increase in all major quality indices. However, the gains seem to have plateaued in 2005 as milfoil, starry stonewort, and a possible pondweed hybrid spread to nuisance or near nuisance levels in the lake.

Milfoil:

Milfoil dominated the flora of Whitmore Lake since 2003 and early 2004 when considered in terms of presence at the greatest number of aquatic vegetation observation sites and height in the water column. The emergence of a milfoil hybrid and uncertainty regarding the recovery of these genotypes make it difficult to predict the longer term outcomes of the 2007 program. It is expected that milfoil production will constitute a significant nuisance in 2007. Starry stonewort may also have a considerable impact on plant species and morphotype biodiversity.

A 5 acre area of the lake was selected to test the efficacy of a systemic herbicide, triclopyr (Renovate, SePRO Corp., Carmel, IN) for the selective control of milfoil. This herbicide can, in certain circumstances, provide longer term control of target species than can be achieved with contact herbicides. Unfortunately, the milfoil in Whitmore Lake appears to tolerate maximum application rates of this herbicide. Further testing may be conducted, but there are no current plants to do broader scale applications of this selective herbicide.

Contact herbicides can be used selectively and effectively for milfoil control. Any contact herbicide applications need to be implemented in all parts of the lake where milfoil is present prior to the Fourth of July Holiday. Contact herbicides do not always kill the plant roots; however, and plant regrowth can occur before the end of the summer season. A second herbicide application may be required to provide adequate control of milfoil in August.

Curly Leaf Pondweed:

The production of curly leaf pondweed can be as noxious as milfoil. The long-term control of curly leaf pondweed is virtually impossible unless fluridone is used in narrowly prescribed ways. This plant seems to “explode” in May and June and then, naturally collapses in early July. It has not been found at nuisance levels in Whitmore Lake. If it does grow to observable levels, contact herbicides should be applied at species selective rates protect before preferred plant species are suppressed by its production in the late spring and early summer. The contact herbicide that is proposed for use to suppress the production of milfoil is also effective at the same rates for the management of curly leaf pondweed.

Broad Leaf Pondweed:

The pondweeds (except the exotic curly leaf pondweed) are generally considered to be preferred species in Michigan inland lakes. Most pondweeds are considered to be conservative species with “c” values exceeding 5. They do not typically form large monotypic plant stands, grow at high densities, or contiguous distribution patterns as do many of the opportunistic, and invasive species. Broad leaf pondweed is usually considered to be a conservative species with a “c” value ranking of 7. However, broad leaf pondweed has been found to spread rapidly in some lakes where milfoil has been effectively suppressed. In some cases broad leaf pondweed has appeared to be far more invasive than expected and has formed large monotypic meadows where it has eliminated other plant species production. This growth pattern is inconsistent with the goals of the Whitmore Lake management plan. Pondweed species are known to freely hybridize and is quite possible that a broad leaf pondweed hybrid or genotype is emerging as a new invasive species in Michigan lakes. Broad leaf pondweed was observed at 63% of all BAS’s in Whitmore Lake in September 2004. Cover value peaked in June 2005 at 43%; however, growth was very dense in the water ski course area. Mechanical harvesting was used to alleviate nuisance conditions. Residents objected to the floating plant parts that floated into shore that were generated as part of the harvesting program. The broad leaf pondweed recovered quickly from harvesting and for this reason and resident objections, that harvesting was not employed in 2006. Starry stonewort

competes for area with broad leaf pondweed. The spread of this plant may eliminate the need for broad leaf pondweed control in the ski course area in 2007.

The broad leaf pondweed production must be closely monitored in Whitmore Lake and corrective actions are indicated if it is found to diminish biodiversity in the Whitmore Lake flora.

Nuisance Algae Production:

Starry stonewort was found in Whitmore Lake in 2007. It is an extremely aggressive and invasive exotic plant It has been observed to out-compete all plant species in several regional lakes. This has led to a precipitous loss of plant species and plant morphotypic biodiversity in these lakes. The plant also appears to cover spawning substrates and limit the production of sunfish and bass. It appears to be extremely easy to selectively control, like so many other opportunistic aquatic species. The growth of this plant will be closely monitored. Specific management plans will be developed based on the observed spread and impact associated with this plant.

Nuisance Algae Production:

The bio-geochemistry of Whitmore Lake does not appear to be predisposed to the production high phytoplankton concentrations. Springtime and midsummer phosphorus data were at non-detect levels (less than 6 ppb) indicating relatively low plant fertility in the lake. Consequently, the total production of fish would be expected to be low, relative to other southeastern Michigan Lakes, when considered on a fish per unit area basis. Unfortunately, the production of toxic blue green algae (Cyanobacteria) is enhanced by the presence of zebra mussel at any phosphorus levels. These algae represent a heath risk for swimmers and those who may be exposed to aerosols from irrigation systems that use water containing these noxious algae. Large-scale blue green algae blooms have not been observed; however, the presence of zebra mussel suggest that bloom conditions could easily be formed. Every effort must be prevent the domination of the Whitmore lake planktonic flora from being dominated by these noxious organisms although there are currently, now proven means available to control blue green algae.

2005 WHITMORE LAKE MANAGEMENT PLAN UPDATE

Large Submersed Plant Management Overview

Conditions in Whitmore Lake have changed dramatically since the 2004 fluridone application. However, the exotic, invasive species of milfoil has returned to dominate the Whitmore Lake flora and challenge recreation and the proliferation of more desirable species. The emergence of milfoil genotypes that exhibit differing responses to herbicides seem to have compromised the long-term effect of the 2004 management program and have created significant challenges for the future. Significant nuisance milfoil production is expected in 2007 and it is estimated that the total area that requires treatment may reach 320 acres. Broad leaf pondweed has the potential to grow to nuisance levels in 2007 and may require some control where permitted by the MI DEQ. Starry stonewort is new to Whitmore Lake. It is being monitored closely and management strategies will be developed and based on the results of the monitoring program. The following is provided as a plan to manage "worse case scenario" conditions. Generally, less effort is required to maintain acceptable conditions.

Invasive Plant Species Management:

The contact herbicide, Diquat dibromide, should be applied at a low dose for the selective control of milfoil as soon as water temperatures reach 60°F just above the bottom sediments in water that is 3' deep. Typically, these conditions are present in early June. Based on observations made late in 2006, the total number of acres that may required such a treatment are expected to be no greater than 320 acres. A secondary treatment of milfoil regrowth is anticipated for late July to early August. It is estimated that 80 acres may required a secondary treatment.

The importance and impact of starry stonewort in Whitmore Lake is unknown. As many as 100 acres may require treatment or suppression in 2007. This plant shall be closely monitored.

Other Nuisance Plant Species Management:

There are several species of submersed plants that are generally considered to be preferred species in lakes, but that are also known to grow at nuisance levels. Sometimes, the production of these plants can be so great that they are considered to be invasive and crowd out other plants resulting in a loss of biodiversity. The reasons for this abnormal growth are not clearly understood; however, anecdotal evidence suggest that nuisance growth may be attributed to specific genotypes. When preferred species growth attains nuisance proportions, action must be taken to insure that lake management goals are supported. Unfortunately, many of these species are difficult to control and even more difficult to control selectively. An invasive genotype of broad leaf pondweed is likely to grow to nuisance levels in Whitmore Lake in 2007.

Unfortunately, highly selective vegetation management strategies are not available for broadleaf pondweed. Consequently, management initiatives must be restricted to as small an area as possible. Combinations of contact herbicides can be used to suppress the production broad leaf pondweed, but these combinations of herbicides can also suppress the production of other preferred species. Still, these herbicide combinations are recommended if the total area of invasive plant growth does not exceed 50 acres. Broad leaf pondweed covers vast areas of the lake bottom at invasive levels near the ski course.

Water Quality Management.

Water clarity in Whitmore Lake is excellent and plant nutrient (phosphorus) levels are extremely low. Any measure taken to limit or curtail nutrient or sediment loading in Whitmore Lake is not likely to yield any perceivable benefit. Still, the lake should be protected from unnecessary nutrient loading from lawn fertilization and hard surface water runoff (roads, roofs, patios, etc.) because zebra mussel is present in the lake. The potential for blue green algae production is enhanced by the presence of zebra mussel, and any available phosphorus could be

channeled into production of these noxious organisms. Selective blue green algae control strategies are being investigated but are not yet available in Michigan. Consequently, it is important to limit any controllable inputs of plant nutrients into the lake.

It is recommended that lakeside (terrestrial) plant growth be maintained at dense levels to provide greater filtration of overland water flows and absorption of plant nutrients. Phosphorus should not be applied to the landscape near the lake. Nitrogen should be applied to sparse turf grasses near the lake to "thicken" the turf and make it a better filter for suspended particles and plant nutrients.