A Proposed Plant Community Management Strategy for:

The Huron River Chain of Lakes
Livingston and Washtenaw Counties, MI
2017

The primary goal of any reasonable Lake Management Plan is to enhance and if possible, improve ecosystem stability. This is accomplished by implementing management intervention strategies and technologies (MIST) that ultimately lead to the establishment of a more biologically and structurally diverse ecosystem. These conditions will cause the lake to become more resilient to weather and exotic species invasions. Furthermore, they will result in better conditions for recreation and cause the lake to become more aesthetically pleasing. This premise is used to develop guidance for MIST applications that will help to improve conditions; in the Huron River Chain of Lakes (HRCL). LakeScan™ Category 700 monitoring will be critical to select appropriate annual management objectives and to assess the efficacy of the annual aquatic plant and macroalgae community management program.

OVERVIEW

Current Assessments

Residents of the HRCL expressed concerns for the quality and character of the aquatic plants and macro-algae that dominate the entire lake and channel system. This was considered most appropriate since most of the lakes are small and are dominated by plant growth. Sediment character and quality, depth, and the nature of the plant, algae, and microbial communities that inhabit the bottom of lakes such as these provide the only rationale basis for lake assessment. Standard water quality trophic indices are important, but they are only peripherally related to the plant community systems in lakes.1 The plant and macro-algae communities clearly appear to be the primary determinants of lake quality in this system. Aquest performed LakeScan™ Category 700 surveys on the HRCL in June and September 2016. LakeScan™ Category 700 surveys are used to characterize aquatic plant communities in the lakes and channels. The first step in performing this analysis was to create maps that delineate observations sites in all of the lakes and the channels. Various measures and observations were collected at each observation site (AROS). The different lakes and the channels that connect the lakes were considered individually because they represent distinct ecosystems and management challenges. There were a total of 14 areas that were individually surveyed and subjected to assessment.

		Total Acres	Total AROS	MZL 1 Acres	MZL 2 Acres	MZL 3 Acres	MZL 4 Acres
1	BaseLine	254	254	32		44	
2	Gallagher Island	17				17	
3	Gallagher	65	108	8		10	
4	Long	12	44			6	
5	Little Portage	97	289	47		26	
6	Portage	655	356	202		88	
7	Portage Canals	40				40	
8	Portage Baseline Connector	10				10	
9	Strawberry	259	183	27		37	
10	Strawberry Channel	17				17	
11	Tamarack	19	137	6		3	
12	Tamarack Channel	13				13	
13	Whitewood	67	108	8		15	
14	Zukey	143	254	35		48	
	Total Acres	1666	1733	365		372	

Background

Each lake was divided into individual assessment sites that are numbered and referred to as aquatic resource observation sites or AROS. There is a wide range of assessments or observations that can be made at each AROS, but for the purposes of this evaluation, only observations of the plant community were made. The size of individual AROS ranged from 0.1 acre to 1.4 acre. There were no obvious water quality concerns that might have been independent of the influence of the large plant communities. The data that was collected can be used to calculate a variety of characteristic metric values. Some of the key metrics used in this analysis are listed below.

A List of LakeScan™ Category 700 Metrics

Aquatic Plan Species Richness (total species present)
Aquatic Plant Morphological Richness (total plant shapes present)
Aquatic Plant Community Biodiversity (total species present and distribution in system)
Aquatic Plant Community Morphodiversity (total plant shapes present and distribution in system)
Aquatic Plant Community Weediness (density and distribution weighted estimate of biodiversity)
Aquatic Plant Community Perceived Nuisance Level (a four level nuisance assessment)

Note: Each metric can be calculated for the entire lake/channel or discrete areas of the lakes/channels such as distinct management zones or biological tiers. These data can be used to compare one lake to another or for seasonal and historical comparisons in a single lake. These kinds of data are necessary to establish appropriate management objectives and to evaluate the effectiveness of the management program (or lack thereof).

Critical Considerations

Common Invasive and Nuisance Species: There are some plant species that are notoriously weedy in Michigan Lakes. Most of these species invaded North America from other continents and are nearly always invasive and very weedy. They are recognized by the Michigan Department of Environmental Quality as being invasive and in this report, they are referred to as LakeScan™ T1 species. All of the lakes and channels are infested with one or more T1 species that are present at various perceived nuisance levels. These species include:

HRCL T1 Species

Ebrid Milfoil
(Various Eurasian watermilfoil genotypes and Eurasian x Northern watermilfoil hybrids)
Curly Leaf Pondweed
Flowering Rush (submersed form)
Starry Stonewort (macro algae)

Occasional Invasive and Nuisance Species: There are also a number of native Michigan species that can and are often considered to be invasive and create a nuisance. These are not generally recognized by State agencies as being nuisance aquatic plants. They are referred to and categorized as LakeScan™ T2 species and include:

HRCL T2 Species

Variable Milfoil
Wild Celery
Weedy Hybrid Pondweeds (various pondweed hybrids)

Nuisance Conditions: Despite the presence of some notoriously nuisance aquatic weed species, the HRCL is relatively free of nuisance conditions. One or more of the T1 or T2 species do indeed create extreme nuisance conditions in some discrete areas of the system; however, they were not present at nuisance levels in many other areas of the lake/channel system. A full analysis of perceived nuisance level (PNL) data is currently being processed because it is important to understand the level of nuisance conditions in different parts of the HRCL. However, simple means help to illustrate where the nuisance conditions are the greatest.

LakeScan™ PNL Levels

LakeScan™ Perceived Nuisance Levels (PNL) in the Huron River Chain of Lakes (HRCL) in September 2016. PNL 0 = No nuisance conditions observed. PNL 1 = Weeds observed at a level that constitutes an ecological concern, but there is no obvious recreational or aesthetic impairment. PNL 2 = Equivocal nuisance conditions where some may believe that conditions would impair recreation or utilitarian and aesthetic value, but others may not agree. PNL 3 = Nuisance conditions were observed and are likely to be perceived by all observers.

BaseLine	0.48
Gallagher Island	0.38
Gallagher	1.00
Long	2.50
Little Portage	1.09
Portage	0.78
Portage Canals	2.50
Portage Baseline Connector	1.05
Strawberry	1.28
Strawberry Channel	2.15
Tamarack	2.39
Tamarack Channel	1.08
Whitewood	0.83
Zukey	0.62

LAKE AND CHANNEL SUMMARY OBSERVATIONS, 2016

Baseline Lake

Nuisance plant or weed conditions have been a persistent problem along the southern shoreline for years and reports suggest that some MIST have been applied to these areas in past years. Milfoil and starry stonewort present and conspicuous in many of the lake AROS, but were found at PNL 3 levels in only a few AROS. Flowering rush was observed at PNL 2 in many AROS. Various T2 species, including hybrid pondweeds, wild celery, and variable milfoil were present in numerous lake AROS at PNL levels that were typically 2 but occasionally 3. Weather conditions in 2016 were very "abnormal" and it is entirely possible that nuisance conditions could be more intense in future years. The growth of the T1 species needs to be closely monitored and MIST should only be applied when it appears that the formation of nuisance conditions is imminent.. Several T2 species were observed to grow at nuisance levels in many of the AROS and these could potentially be the target of control near boat docks and swimming areas as allowed by MI DEQ permit. Some nuisance growth may occur outside areas where control is typically permited by the MI DEQ. Some T2 nuisance plant prodution could also be harvested. Flowering rush was observed to form a dense strip of growth near the drop off zone along the southern shore of the lake (LakeScan™ Tier 5). Some may consider plant to be a nuisance in some areas of BaseLine Lake, but it was usually assigned a PNL of 2 rather than 3.

Gallagher Island Canals

The Gallagher Island Canals are infested with ebrid milfoil and starry stonewort. It is clear that starry stonewort is potentially the greatest nuisance threat to this part of the HRCL. The mean PNL number was low for this region in the system in September 2016, but only because it appears that starry stonewort may have collapsed in the channel. Boom and crash growth of starry stonewort is common and it is expected that it still has the potential to choke off this part of the system. Frequent algaecide applications may be necessary to keep this area free of nuisance conditions and eliminate impairments to naviagation. An early season, targeted treatment for ebrid milfoil and curly leaf pondweed is also recommended.

Gallagher Lake

The basin shape and depths of Gallagher Lake seem to keep nuisance plant growth at a relative low level. However, there are many areas of the lake that are infested with ebrid milfoil. This was not nearly as obvious in June as it was in September. This suggests that there may be a relatively herbicide resistant strain of ebrid milfoil in this part of the system. Prudent treatment of some of these areas is recommended to protect species biodiversity (ecological rationale for treatment) and to prevent the formation of nuisance conditions that can interfere with common lake uses.

Long Lake

Long Lake is small and shallow. Starry stonewort was observed to grow at extremely invasive and nuisance levels and was considered to be a very significant impediment to navigation and the enjoyment of this part of the lake. Management technologies are improving for this invasive species, but the growth is so dominant in Long Lake that several algaecide applications may be required during the course of a typical summer to maintain acceptable conditions.

Little Portage

Little Portage Lake is bounded by a large amount of undeveloped shoreline and appears at first glance to be among the least disturbed by cultural influence of any of the lakes in the chain. However, there are vast shallow areas of the lake that have become severely infested by ebrid milfoil and to a lesser degree, starry stonewort. There is a concern that the ebrid milfoil strain in Little Portage Lake may be different from the strains found in other parts of the chain and that this strain could invade other lakes and channels and become an extreme nuisance. Ebrid milfoil dominance was the greater in Little Portage Lake than

any other part of the system in 2016. Targeted management will be required to maintain acceptable conditions from an ecosystem and recreational use perspective. The near shore developed areas of the lake shoreline were also inhabited by wide range of T1 and T2 species that were observed at lower PNL's, but could become problematic in the future. The channel on the north end of the lake appears to be particularly susceptible to the higher PNL levels.

Portage Lake

Citizens reported that there had been a very significant bloom of a filamentous macro algae known as Spirogyra in the spring and early summer of 2016. The bloom conditions that were observed this year are probably the result of unusual weather conditions. Mild winters and long cool springs conspire to create conditions that are most favorable for nuisance spirogyra growth. This form of algae is known to mine sediments for nutrients and therefore, it's growth does not correlate well with the results of typical water quality testing. Similar blooms may not form in the future if the weather conditions that were present in 2016 are not repeated. Should blooms occur, they can be easily managed with relatively low algaecide application rates. T1 nuisance plant growth in the main body of the lake seemed to be largely confined to off-shore and drop-off areas. Ebrid milfoil was particularly conspicuous in September and appeared to be capable of forming a significant nuisance, even if it was not observed at those levels anytime in 2016. These conditions need to be closely monitored and highly selective, targeted ebrid milfoil control should be implemented if it begins to show signs of growing at nuisance levels.

Portage Lake Canals

There are numerous canals or channels around the Portage Lake Shoreline. Nearly all of these channels were were severely infested with starry stonewort, except for a few where starry stonewort was observed to have declined as a result of natural phenomenon or treatment. Several algaecide applications may be required each year to maintain acceptable conditions. In the Portage Lake Canals Various other nuisance plant species were observed in some of the canals/channels and these too, may require some management interventions to prevent the formation of nuisance conditions.

Portage Baseline Connector

There were parts of this part of the system that were severely impacted by starry stonewort and there is a concern that it could grow to levels that have been observed in upstream reaches of the Huron River. Starry stonewort has been observed to grow to the water surface in these reaches of the river and form unimaginable nuisance conditions. Water flows will certainly complicate the management of starry stonewort in this part of the HRCL, but a strategy must be developed to prevent the rampant growth of this invasive species from nearly choking off any navigation in that part of the system. Flowering rush was also very abundant in the Portage Baseline Connector in September, but it appears that water flows prevent this plant from growing higher in the water column where it will interfere with boating. Wild celery was also very abundant in this part of the system. Management strategies for both of these species are in development. Unfortunately, there is currently no reliable way to management the nuisance product ion of either species in MI.

Strawberry Lake

Nuisance conditions in Strawberry Lake were largely confined to the off shore, drop off zone. Ebrid milfoil was the dominant nuisance. Targeted management of ebrid milfoil and starry stonewort is recommended to maintain the ecological integrity of this lake.

Strawberry Gallagher/Long Connector

The bifurcated channel that connects Strawberry Lake to Gallagher and Long Lakes is colonized by a variety of plants. Starry stonewort was dominant in some areas of the channel and appears to be capable of creating significant nuisance conditions. Ebrid milfoil, flowering rush, and wild celery were also

present at nuisance or near nuisance levels. Suppression of these species may be necessary in some year to prevent the formation of conditions that would significantly obstruct navigation through the channels.

Tamarack Lake

Starry stonewort has been a very significant nuisance in Tamarack Lake for many years where it now dominates the plant community. Ebrid milfoil is also present in the lake; however, it appears that the misapplication of certain management strategies has resulted in "selective pressures" that have resulted in the total domination of the lake by starry stonewort. Several targeted and selective management interventions will be required each year to begin to move this lake to a more stabile conditions where there is higher plant community biodiversity.

Tamarack Lake Connector

Some of the Tamarack Lake Connector channel is very shaded and nuisance plant growth was not extreme in these areas. Other areas, where there is more light, were completely dominated by starry stonewort production. Ebrid milfoil was also observed to grow at nuisance levels in the channel. Selective and targeted management interventions will be required to improve the ecological stability and biodiversity of this area of the lake each year.

Whitewood

Whitewood Lake is also known as Whiteford Lake. The off-shore drop-off areas of this lake are similar to those observed in Strawberry lake, where ebrid milfoil was found to grow in invasive patches that may have created a nuisance for boating. Targeted ebrid milfoil control will be necessary to protect the ecological stability and biodiversity of this lake. However, further observations may reveal that there are some ebrid genotypes in this lake that will not grow at nuisance of destabilizing levels. Monitoring must be done and is particularly critical to guide the management program in this lake. Starry stonewort is also believed to be capable of being invasive and a nuisance in Whitewood Lake.

Zukey

Zukey lake is characterized by extensive shallow areas that are for a variety of reasons, devoid of dense plant growth. However there are many areas in this lake that are seriously dominated and threatened by the growth of ebrid milfoil. Again, this lake needs careful monitoring to manage ebrid milfoil in the most effective way. Starry stonewort is also believed to be capable of being invasive and a nuisance in Zukey lake.

Management Objectives for the HRCL

Despite the presence of some of the most notorious invasive aquatic plant species known to inhabit Michigan inland lakes, the level of nuisance created by these species was surprising low in the HRCL in 2016. There are certainly areas where nuisance conditions are severe, but many areas of the lake and river system were relatively unencumbered by nuisance conditions, despite the "reputation" of some of the weeds that were discovered in the lakes and channels. Conditions in the HRCL will be difficult to manage and careful monitoring should guide the application of any management interventions. Plant community biodiversity appears to be fairly good in the HRCL and only the most selective and targeted management interventions should be used to suppress the production of undesirable plant growth. There are many, many, highly desirable plant species found in the lake system and these need to be protected to contribute to greater stability of the ecosystem. Consequently, the proposed plan if focused on the application of selective herbicides and herbicide algaecide combinations that can be used as antibiotic therapies are applied in human and animal medicine. Mechanical management strategies are not as species selective and can have other undesirable impacts on aquatic ecosystems; however, these strategies

may be justified for use in some instances in the lake channel system. Should mechanical strategies be applied to the lake, the cost of the application of these strategies may be offset by monies that would otherwise be budgeted for the use of biocides.

Most aquatic systems are divided into various LakeScan™management zone level (MZL's) where different treatment and intervention strategies may be applied, depending upon the objectives that have been established for those zones each year. Even thought the lakes and channels have been divided into MZL 1 and 3 areas, the following budgets have been created to allow for moderately aggressive management of nuisance and invasive species in both MZL's categories.

The following tables are constructed to reflect worse case scenarios. Weed conditions are very likely to be different from year to year in this system. Consequently, there will be some years where multiple interventions will be required to prevent the formation of extreme nuisance conditions in the lake. The cost of management is expected to vary considerably from year to year.

Lake/Channel Size (Acres) and Total AROS

	Lake/Channel/Canal	Total Acres	Total AROS
1	BaseLine	254	254
2	Gallagher Island	17	
3	Gallagher	65	108
4	Long	12	44
5	Little Portage	97	289
6	Portage	655	356
7	Portage Canals	40	
8	Portage Baseline Connector	10	
9	Strawberry	259	183
10	Strawberry Channel	17	
11	Tamarack	19	137
12	Tamarack Channel	13	
13	Whitewood	67	108
14	Zukey	143	254
	Total Acres	1666	1733

Lake/Channel Management Zone Areas

	Lake/Channel/Canal	MZL 1 Acres	MZL 2 Acres	MZL 3 Acres	MZL 4 Acres
1	BaseLine	32		44	
2	Gallagher Island			17	
3	Gallagher	8		10	
4	Long			6	
5	Little Portage	47		26	
6	Portage	202		88	
7	Portage Canals			40	
8	Portage Baseline Connector			10	
9	Strawberry	27		37	
10	Strawberry Channel			17	
11	Tamarack	6		3	
12	Tamarack Channel			13	
13	Whitewood	8		15	
14	Zukey	35		48	
	TOTALS	365		372	

Summary Cost Estimates

5 Year Assessment Period Cost Estimates

	Item	Total Single Events	Total Recurring Events	Estimated Cost By Event	Recurring Annual Estimated Item Cost	5 Year Estimated Item Cost	Total Estimated Cost
1	Treatment & Permit		5		$270,251	$1,351,253	$1,621,503
2	Monitoring and Guidance		5		$37,489	$187,446	$224,935
3	Program Administration		5		$4,000	$20,000	$24,000
4	Hearings and Communications	2		$1,200			$1,200

		Percentage	Recurring Annual Estimated Tmt Cost	5 Year Estimated Tmt Cost	Total Estimated Cost
5	Contingencies	5%	$15,586.98	$77,934.90	$93,581.88

Item	Recurring Annual Estimated Cost	5 Year Estimated Cost	Total Estimated Cost
TOTALS	$327,327	$1,636,633	$1,965,219

Lake/Channel Summary Tmt. Cost Estimates

	Lake/Channel/Canal	Total Acres	Total AROS	Total Tmts	Totals
1	BaseLine	254	254	2	$24,360
2	Gallagher Island	17		4	$13,430
3	Gallagher	65	108	3	$7,560
4	Long	12	44	3	$3,630
5	Little Portage	97	289	3	$31,930
6	Portage	655	356	2	$92,400
7	Portage Channels	40		4	$31,600
8	Portage Baseline Connector	10		4	$7,268
9	Strawberry	259	183	2	$20,160
10	Strawberry Channel	17		3	$9,628
11	Tamarack	19	137	4	$6,425
12	Tamarack Channel	13		4	$6,210
13	Whitewood	67	108	2	$7,350
14	Zukey	143	254	2	$16,800
	TOTALS	1,666	1,733		$261,951

TmtZ 10 Early Season Intervention (Post Memorial Day)

	Lake/Channel/Canal	Target	Tmt Acres	Cost per Acre	SubTotal
1	BaseLine	T1	76	$210	$15,960
2	Gallagher Island	T1	17	$210	$3,570
3	Gallagher	T1	18	$210	$3,780
4	Long	T1	6	$210	$1,260
5	Little Portage	T1	73	$210	$15,330
6	Portage	T1	290	$210	$60,900
7	Portage Channels	T1	40	$210	$8,400
8	Portage Baseline Connector	T1	9.5	$210	$1,995
9	Strawberry	T1	64	$210	$13,440
10	Strawberry Channel	T1	16.6	$210	$3,486
11	Tamarack	T1	8.5	$210	$1,785
12	Tamarack Channel	T1	13	$210	$2,730
13	Whitewood	T1	23	$210	$4,830
14	Zukey	T1	60	$210	$12,600
	TOTALS				$137,466

TmtZ 20 Late July Intervention

	Lake/Channel/Canal	Target	Tmt Acres	Cost per Acre	SubTotal
1	BaseLine				
2	Gallagher Island	StSt	17	$185	$3,145
3	Gallagher				
4	Long	StSt	6	$185	$1,110
5	Little Portage				
6	Portage				
7	Portage Channels	StSt	40	$185	$7,400
8	Portage Baseline Connector	StSt	9.5	$185	$1,758
9	Strawberry				
10	Strawberry Channel				
11	Tamarack	StSt	8	$185	$1,480
12	Tamarack Channel	StSt	6	$185	$1,110
13	Whitewood				
14	Zukey				
					$16,003

TmtZ 30 Late July/Early August Intervention

	Lake/Channel/Canal	Target	Tmt Acres	Cost per Acre	SubTotal
1	BaseLine				
2	Gallagher Island	T1	17	$210	$3,570
3	Gallagher	T1	9	$210	$1,890
4	Long				
5	Little Portage	T1	35	$210	$7,350
6	Portage	T1	150	$210	$31,500
7	Portage Channels	StSt	40	$185	$7,400
8	Portage Baseline Connector	StSt	9.5	$185	$1,758
9	Strawberry	T1	32	$210	$6,720
10	Strawberry Channel	StSt	16.6	$185	$3,071
11	Tamarack	T1	8	$210	$1,680
12	Tamarack Channel	T1	6	$210	$1,260
13	Whitewood	T1	12	$210	$2,520
14	Zukey	T1	20	$210	$4,200
					$68,719

TmtZ 40 August Interventions

	Lake/Channel/Canal	Target	Tmt Acres	Cost per Acre	SubTotal
1	BaseLine	T1	40	$210	$8,400
2	Gallagher Island	StSt	17	$185	$3,145
3	Gallagher	T1	9	$210	$1,890
4	Long	T1	6	$210	$1,260
5	Little Portage	StSt	50	$185	$9,250
6	Portage				
7	Portage Channels	T1	40	$210	$8,400
8	Portage Baseline Connector	StSt	9.5	$185	$1,758
9	Strawberry				
10	Strawberry Channel	StSt	16.6	$185	$3,071
11	Tamarack	StSt	8	$185	$1,480
12	Tamarack Channel	StSt	6	$185	$1,110
13	Whitewood				
14	Zukey				
					$39,764

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