INTRODUCTION

The purpose of this report is to relay information regarding the Eurasian water milfoil (EWM) herbicide treatment that was completed on Upper Gresham Lake during May 2008. It includes a description of the methods used to evaluate the treatment and the criteria used to determine if it was successful. Its frame of reference begins with the spring pretreatment surveys completed during May 2008. The report goes on to discuss the condition of the EWM in the treatment areas following the herbicide application. The data used in that section were collected during August 2008 (summer post treatment survey). During that same time, the 2008 peak biomass survey was completed to gather information used in creating the 2009 proposed treatment areas, which are discussed near the end of the report. Once agreed upon by the Gresham Lake Association and the Wisconsin Department of Natural Resources (WDNR), the proposed treatment areas will be used to obtain a conditional treatment permit for the May 2009 treatment.

TREATMENT MONITORING

Determining the success or failure of chemical treatments on Eurasian water milfoil (EWM) is often a difficult task because the criteria used in determining success or failure is ambiguous. Most people involved with EWM management, whether professionals or laypersons, understand that the eradication of EWM from a lake, or even a specific area of a lake, is nearly, if not totally, impossible. Most understand that achieving control is the best criteria for success. Similar to the 2007 treatment report, two different methods of evaluation were used to understand the level of control that was achieved by the chemical treatment. A qualitative assessment was determined for each treatment site by collecting spatial data with a sub-meter Global Positioning System (GPS), in addition to, comparing detailed notes from the pre- and post treatment observations.

Quantitative monitoring of the treatments were completed following protocols disbursed by the Wisconsin Department of Natural Resources (WDNR) in April 2007. This protocol calls for the monitoring of target plants (EWM) and native plants before and after treatments. Pretreatment surveys are completed the summer before treatment and the spring of the treatment. Post treatment surveys are completed the summer following treatment and the next spring following the treatment. The Gresham Lakes Association successfully applied for an Aquatic Invasive Species (AIS) Education, Planning, and Prevention Grant and implemented this protocol starting with the 2008 spring pretreatment survey. A quantitative assessment of the treatment was made by collecting data at 34 point-intercept sample locations on Upper Gresham Lake (Appendix A). At these locations, EWM presence and rake fullness were documented as well as water depth and substrate type. Native plant abundances were also determined at each plot during the post treatment surveys. Comparative data is available for three of the treatment sites from the 2007 and 2008 post treatment surveys and are discussed in further detail within the conclusion section.

Statistical Analysis of Pre- and Post Treatment Survey Data

Scientists often rely on the use of statistical analysis to understand whether the observed differences in nature are merely a product of chance or can be attributed to a particular factor. In the case of the pre- and post treatment monitoring surveys completed on Upper Gresham Lake, the particular factor we are concerned with is the herbicide treatment. The desired result is a decrease in EWM within the treatment areas. The amount of EWM within a treatment site is

measured with the sub-sampling surveys and expressed in terms of percent frequency of occurrence. The EWM frequency is a percentage of sub-sampling sites that contain EWM relative to the total sub-sampling sites in the treatment area. For example if a treatment site has 20 sub-sampling locations and 5 of those locations contained EWM, then the EWM frequency would be 25%.

As a part of the treatment monitoring, the sub-sampling sites are visited before and after the treatments to produce the pre- and post treatment data. By comparing those data, we can see if there is more, less, or the same amount of EWM before and after the treatment. As mentioned above, the desired result is to have less EWM after treatment. If there is a difference between the pre- and post treatment data, statistical analysis is used to determine if the difference is sufficient to be attributed to the treatment or if the difference may have occurred randomly. If the difference is sufficient, it is considered to be *significantly different*, if it is not sufficient, it is considered to be *insignificantly different.* In the end, a significant difference can be attributed to some factor, while an insignificant difference can only be attributed to random chance.

With guidance from WDNR Integrated Sciences, a Chi-square distribution analysis (alpha = 0.05) was used to determine if the quantitative data collected before the treatment are statically different from the data collected after the treatment. The alpha value is set such that we consider the results statistically significant when the test is 95% confident that the results are truly different and non-random.

The number of sub-sample sites within a treatment area must be considered when evaluating the treatment impacts on that particular site. A higher sample size (N), leads to more credible results and conclusions. In general, sites containing 6 or less sub-sample locations are not considered sufficient for analysis; however, those data are considered valuable when pooled (combined) with the other sub-sample sites within the lake for the lakewide analysis. A 20-meter spacing (resolution) between sub-sample locations is considered the closest that hand-held GPS technology can accommodate effectively allow. Because many of the 2008 treatment areas on Upper Gresham Lake were relatively small, only a few sub-sample locations could be placed within their boundaries using this resolution. Therefore, all of the 2008 treatment sites on Upper Gresham Lake have six or less sub-sample locations. This data can only be appropriately analyzed when combined for analysis.

The caveat to all of this is that we assume that the differences observed were caused by the herbicide treatment, but truly, without having comparable data from a non-treatment site (control group), this cannot be absolutely certain. For example, was the reduction in EWM caused by inter-annual variations caused by competitive dynamics between species, fluctuating water levels, natural plant cycles, or changes due to climatic conditions? Without a true experimental design that uses a control site, we cannot absolutely answer that question. In the end, it is impractical to take the risk of not treating a colony of EWM within a lake just to make sure that the results of the studies are scientifically sound; therefore making the educated-assumption that the difference is caused by the herbicide treatment is reasonable.

Pretreatment Survey – 05/8/08

The purpose of this survey was to refine the treatment areas used in the conditional permit (based on the 2007 peak biomass survey) to more accurately and effectively coordinate the control method. These areas were accepted by the Gresham Lakes Association and the WDNR, and considered the *final* treatment areas. These data were then provided to the herbicide applicator.

The weather conditions on the day of the survey were sunny with light wind. Viewing the EWM on Upper Gresham Lake from the surface was effortless because of the optimal weather conditions and the clarity of the water. An aqua scope and submersible video camera were used to aid in the survey. The ambient air temperature was 60°F and the surface water temperature was approximately 56°F.

The final treatment areas changed slightly from the areas defined in the conditional permit (Map 1). Some of the sites (Sites A-08, K-08, I-08, and D-08) were expanded slightly to encompass EWM observed growing outside the proposed treatment sites (Map 1). Sites J-08 and O-08 were combined because a few EWM plants were found in between the sites. There was no EWM found at Site N-08 so it was removed and Site R-08 was added because a small colony of EWM was found.

Post Treatment & Peak biomass EWM Survey – 07/21/08

During this survey, all treatment areas were visited to determine the efficacy of the chemical application. The conditions were mostly sunny with a slight breeze. At this time of year the EWM has reached its peak biomass, so the plants have nearly reached the surface, making viewing this plant optimal. All point-intercept sample locations were also revisited and data were collected in the same manner as during the pretreatment survey. Native plant occurrences were also documented at the sub-sample locations during this survey for comparison with past and future summer surveys.

As outlined within the Gresham Lakes Aquatic Plant Management Plan – Draft (May 2008), success of the herbicide treatments would be evaluated in multiple ways. Qualitatively, a successful treatment on a particular site would include a reduction of EWM density as demonstrated by a decrease in density rating (e.g. highly dominant to dominant). In terms of a treatment as a whole, at least 75% of the acreage treated that year would decrease by one level of density as described above for an individual site.

Quantitatively, a successful treatment on a specific site would include a significant reduction in EWM frequency following the treatments as exhibited by at least a 50% decrease in EWM frequency based upon the sub-sampling. In other words, if the EWM frequency of occurrence before the treatment was 80%, the post treatment frequency would need to be 40% or lower for the treatment to be considered a success for that particular site. Evaluation of the treatment-wide effectiveness would follow the same criteria based upon pooled sub-sample data from all treatment sites. Further, there would be a noticeable decrease in rake fullness ratings within the fullness categories of 2 and 3. Preferably, there would be no rake tows exhibiting a fullness of 2 or 3 during the post treatment surveys.

During this field survey, a peak biomass EWM survey was conducted to provide an accurate account of all EWM locations within the lake to aid in coordinating the 2009 management actions. These recommendations are provided within this section.

Site A-08 During the post treatment survey a large clump of EWM and a few scattered single plants within the treatment site were found (Map 2). Qualitatively, this is a slight reduction in the density of EWM found last year. A follow-up treatment is recommended for 2009 to further reduce the EWM within this isolated area.

Site C-08 There was a reduction of EWM within this site after the treatment. Last year the EWM was dominant to highly dominant and this year after the treatment, only a large clump and a few scattered plants were found in the site (Maps 1 and 2). This site is recommended for treatment in 2009 (Map 2).

Site D-08 EWM was not found from the surface or with the submersible camera at this site, after the treatment. Site D is not recommended for treatment in 2009 (Map 2).

Site E-08 & P-08 The treatment had a noticeable effect on the density of EWM at this site. The EWM was not visible from the surface, but the camera revealed a few scattered plants. This site is recommended for treatment in 2009 (Map2). Site P-08 had a few scattered clumps of EWM before the treatment and no EWM was could be located after the treatment using both surface visual observations and a submersed video camera. This site is not recommended for treatment in 2009.

Site F-08 After the treatment the density of EWM within Site F-08 was reduced from EWM matting at the surface to two small clumps and a few scattered EWM plants. To continue to impact the EWM within this area, this site is recommended for treatment in 2009 (Map 2, F-09).

Site G-08 Overall, the treatment had an affect at this site. There are 2-3 clumps of EWM that remain in the northeast portion and a clump in the southwest corner of the treatment site. This site is recommended for treatment in 2009.

Site I-08 The EWM colony within this site was reduced by one density level, from surface matting to highly dominant. However, clumps of EWM were found just southwest of the site; hence this treatment site has been proposed to encompass these expanded colonies (Map 2, I-09).

Sites J-08 The treatment had little or no affect on the EWM within this site. The density of EWM has remained largely the same from last year. This site is proposed for treatment in 2009 at a higher dosage (200 lbs/acre) and an expanded buffer to account for the steep slopes and deep water in which the EWM is observed growing in at this site (Map 2).

Site K-08 Although the EWM within Site K-08 decreased in density from 2007 where it was observed to be dominant (Map 1), after the treatment a large dense clump, a few smaller clumps, and some scattered single plants of EWM were found at this site (Map 2). Therefore this site is proposed for treatment in 2009 including an expansion west to encompass multiple other EWM plants observed outside the 2008 treatment area.

Site L-08 In 2007, the EWM within this site was dominant throughout and after the treatment was reduced to one dominant clump and a few small clumps after the treatment. This site is recommended for treatment in 2009 (Map 2, L-09).

Site Q-08 Overall the treatment was successful at this site. The dominant area of EWM was reduced to just a clump after the treatment. However the site is proposed to expand in 2009 to include three other large clumps of EWM located on this relatively shallow (5-feet deep) shoal (Map 2).

Site R-08 EWM was not found at this site after the treatment and therefore is not proposed for treatment in 2009.

CONCLUSIONS AND RECOMMENDATIONS

Before the treatment on Upper Gresham Lake, 38.2% of the point-intercept locations contained EWM and 31.3% contained EWM after the treatment indicating an 18.3% reduction in EWM occurrence within the 2008 treatment areas. Although a reduction was observed, it was not found to be statistically significant using the Chi-square analysis and may be a result of random variation. As mentioned earlier, all of the 2008 treatment sites had six or less sub-sample locations, so the data could not be analyzed on a site-by-site basis for statistical significance.

A rake fullness rating of 1-3 was used to determine abundance of EWM at each location. Figure 1 displays the number of point-intercept locations exhibiting each of the rake fullness ratings within the areas treated on Upper Gresham Lake. The figure shows that of the 13 locations that contained EWM before the treatment, 2 sub-sample locations had a rake fullness of two, and none were observed to be rated a 3 after the treatment (Figure 1).

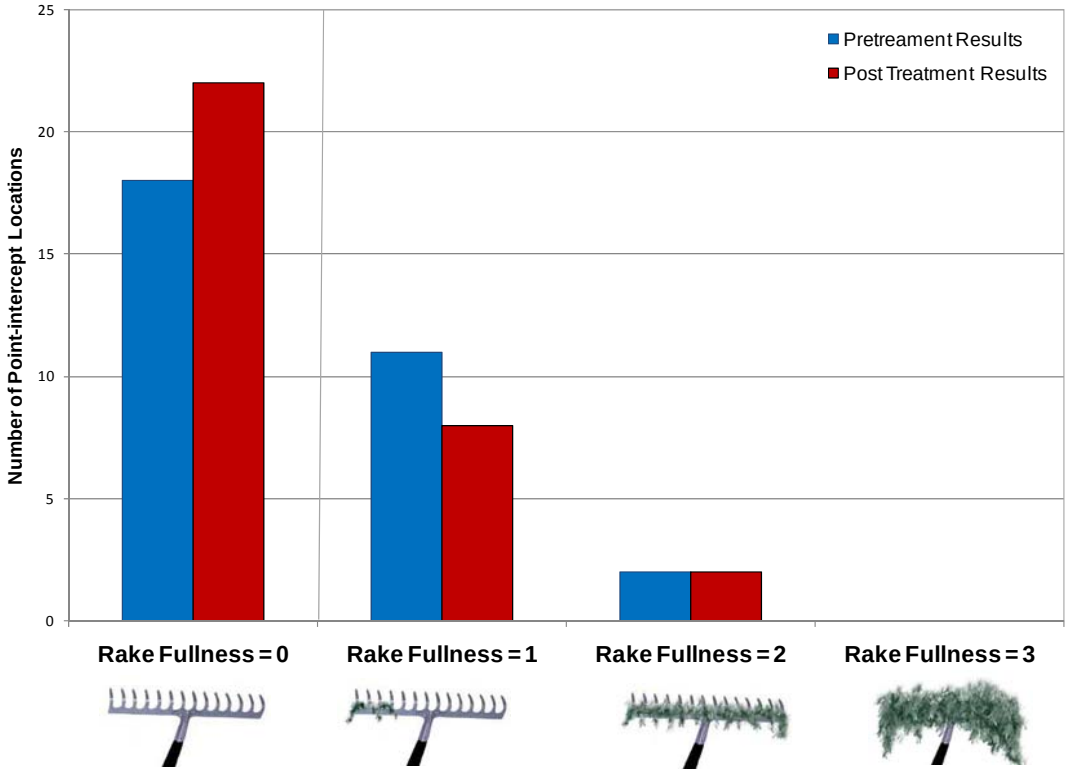


Figure 1. EWM rake fullness distribution within treated areas on Upper Gresham Lake.

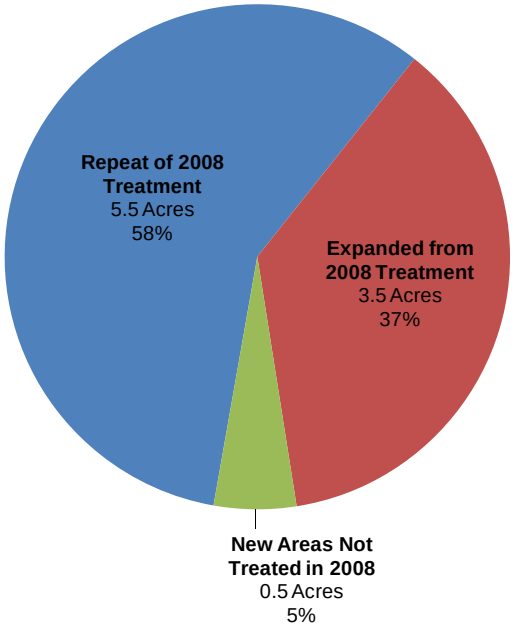


Figure 2. Common acreage comparison between 2008 treatment and proposed treatment for 2009.

More than 75% of the treatment areas were reduced by at least one density rating, which meets the qualitative success criteria for the 2008 treatments. The 2008 peak biomass survey revealed that none of the 2008 treatment areas had EWM matting at the surface.

As indicated on Map 2, there are approxiamtely 9.5 acres of treatable EWM in Upper Gresham Lake. Only three sites treated in 2008 (Sites D-08, P-08, and R-08)) are not proposed for treatment in 2009 (Map 2), resulting in 58% of the 2009 treatment being common to areas treated during May 2008. Only five percent of the 9.5 acres is comprised of newly discovered areas completely independent from previously treated areas (Figure 2). The remaining 37% are new areas adjacent to 2008 treatment sites. These could be expanded populations since the 2007 peak biomass survey or could have been present, but went undetected during that survey.

This would result in an incomplete treatment. Incomplete treatments are difficult to evaluate as there is a nearby source population of the exotic that can easily recolonize the area before the natives are empowered long enough to expand their population and reclaim the area.

The reality is that we are in line to retreat the majority of the 2008 treatment areas in 2009. That scenario is not uncommon in EWM management as dense areas often require multiple years of the treatment to drastically decrease the site's density.

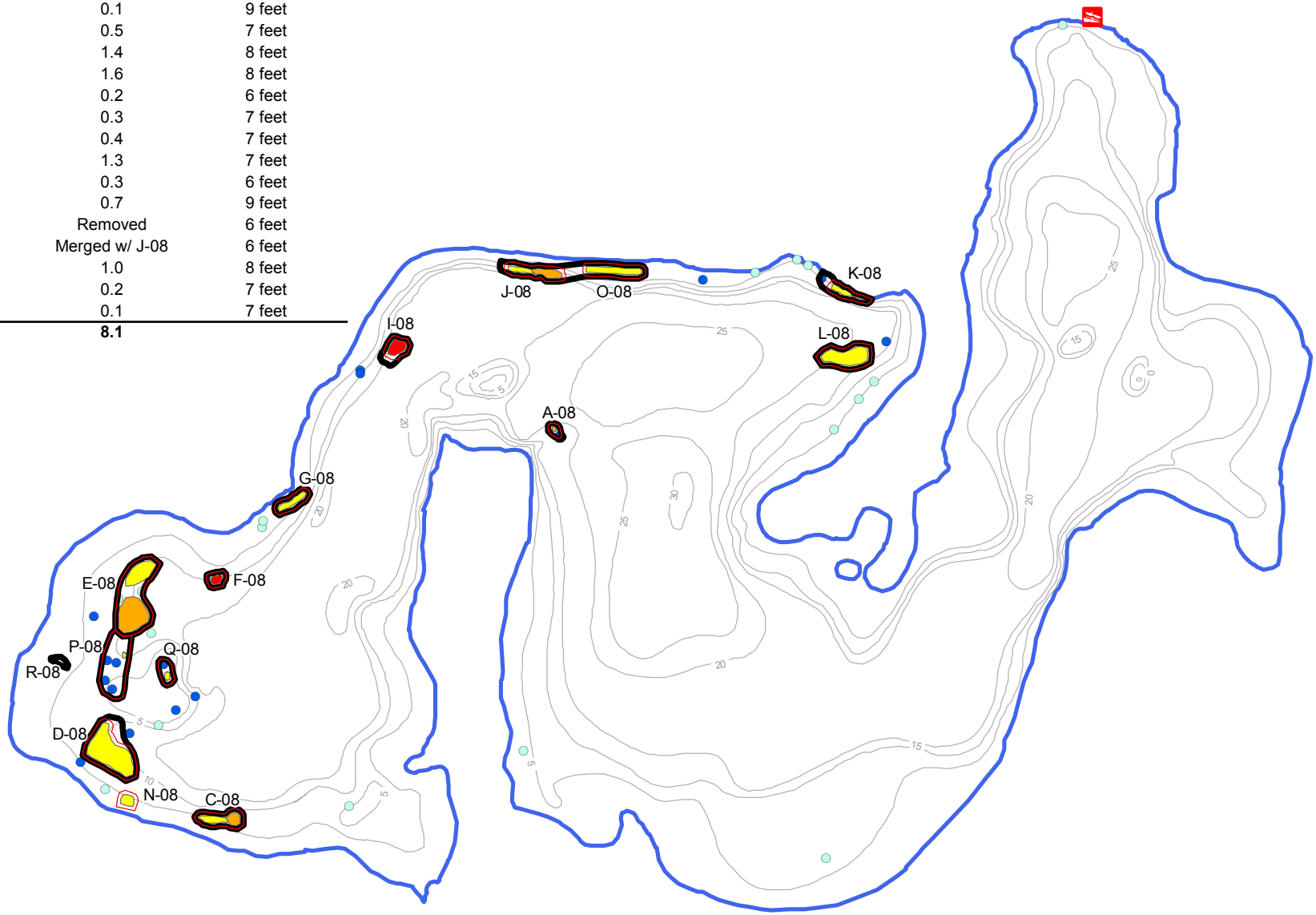
It is believed that the steep slopes of Upper Gresham Lake, particularly along the north shore of the lake, are a factor reducing the efficacy of the treatments. The target herbicide concentration may be met in some parts of the treatment area and not others due to increased water volume with depth. Although the validity of the following statement is unknown, it is also theorized that either the granular formulation itself or the dissolved chemical may move downhill, outside of the area in which it was intended. A proposed treatment strategy for 2009 includes a higher herbicide concentration within these areas and an expanded treatment buffer around the known colonies to account for possible outlying plants (Map 2).

Due to the lifecycle of most of our region's native plants, they should be at very low biomass (or not even started growing yet) during the spring survey and therefore are not monitored at this time of the year. Native plant frequencies are monitored during the summer post treatment surveys, when most of the plants are at their peak biomass. It is particularly important to monitor the broad-leaf (dicot) native aquatic plants, as these are the species that could be affected by 2,4-D. There were three 2008 treatment sites on Upper Gresham Lake that overlapped areas that were treated in 2007; therefore contained sub-sample locations that were sampled during both the summers of 2007 and 2008. However, since there were so few locations, a statistically significance difference in the native plant occurrences between the two years was not detectable.

Approximately 45 point-intercept sub-sample locations were placed over the proposed 2009 treatment areas and sampled during the late-summer of 2008. This survey will serve as a summer pretreatment survey to compare against a summer post treatment survey to be conducted next year (2009). This type of data is the most comparable because it surveys the plants when they are at their peak growth (biomass). As stated earlier, native plant occurrences were also documented during this survey to evaluate the unintended effects of the dicot-specific herbicide on some of the native plants within the lake.

2008 Final Treatment Areas

Site	Preliminary Acres	Final Acres	Average Depth
A-08	0.1	0.1	9 feet
C-08	0.5	0.5	7 feet
D-08	1.2	1.4	8 feet
E-08	1.6	1.6	8 feet
F-08	0.2	0.2	6 feet
G-08	0.3	0.3	7 feet
I-08	0.3	0.4	7 feet
J-08	0.5	1.3	7 feet
K-08	0.3	0.3	6 feet
L-08	0.7	0.7	9 feet
N-08	0.2	Removed	6 feet
O-08	0.5	Merged w/ J-08	6 feet
P-08	1.0	1.0	8 feet
Q-08	0.2	0.2	7 feet
R-08	0.0	0.1	7 feet
Total	**7.6**	**8.1**	

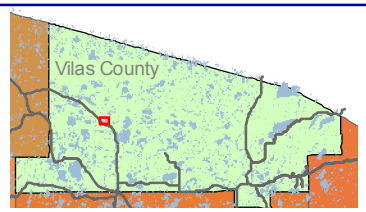


N
W E
S

810
Feet

Onterra LLC
Lake Management Planning
135 South Broadway Suite C
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Roads & Hydro: WDNR
Aquatic Plants: Onterra, 2007
Bathymetry: WDNR, Digitized by Onterra
Map date: December 3, 2007
File Name: Map1_UGL_Proposed_EWMTreat_08.mxd



Extent of large map shown in red.

Legend

2008 Proposed Treatment Area
2008 Treatment Area

EWM Small Colony
(Mapped August 2007)
Clumps of Plants
Single or Few Plants

EWM Large Colony
(Mapped August 2007)
Highly Scattered *(none found)*
Scattered *(none found)*
Dominant
Highly Dominant
Surface Matting

Map 1
Upper Gresham Lake
Vilas County, Wisconsin
2008 Proposed & Final EWM Treatment Areas

2009 Proposed Treatment Areas

Treatment Areas - 150 lbs/acre

Site	Acres	Average Depth
B-09	0.2	5 feet
C-09	0.5	7 feet
E-09	1.6	8 feet
F-09*	0.4	7 feet
Q-09	0.9	5 feet
Sub Total	***3.6***	

Treatment Areas - 200 lbs/acre

Site	Acres	Average Depth
A-09*	0.3	9 feet
G-09*	0.6	8 feet
I-09*	1.1	8 feet
J-09*	2.0	8 feet
K-09*	0.9	8 feet
L-09	0.7	9 feet
M-09*	0.3	8 feet
Sub Total	***5.9***	
Grand Total	***9.5***	

** Indicates expanded buffer on EWM colony to account for steep bathymetry.*

Please Note:

1. Entire area of lake used for fishing.
2. Proposed Treatment areas are used for all boating activities.

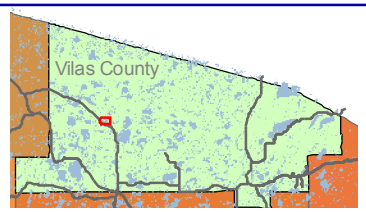
N W E S

800

Feet

Onterra LLC
Lake Management Planning
135 South Broadway Suite C
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Roads & Hydro: WDNR
Aquatic Plants: Onterra, 2008
Bathymetry: WDNR, Digitized by Onterra
Map date: September 2, 2008
File Name: Map3_UGL_EWM_Proposed_T09.mxd



Extent of large map shown in red.

Legend

- Proposed 2009 Treatment Area
- 2008 Treatment Area
  (Site names are the same as the Proposed 2009 Treatment area unless otherwise indicated)

EWM Small Colony
(Mapped July 2008)
- Clumps of Plants
- Single or Few Plants

EWM Large Colony
(Mapped July 2008)
- Highly Scattered *(none found)*
- Scattered
- Dominant
- Highly Dominant
- Surface Matting *(none found)*

Map 2

Upper Gresham Lake

Vilas County, Wisconsin

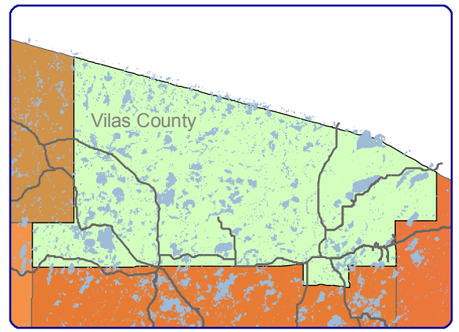
2009 Proposed Eurasian Water Milfoil Treatment Areas v.1

Appendix A

Upper Gresham Lake

Vilas County, Wisconsin

2008 Eurasian Water Milfoil Treatment Point-Intercept Monitoring Locations



Extent of large map shown in red.

Legend

- # EWM Point-Intercept Location
- 2008 Treatment Area
- Public Access

Sources:
Roads & Hydro: WDNR
Bathymetry: WDNR -Digitized by Onterra
Aquatic Plant Data: Onterra, 2008

Map Date: December 11, 2008

File Name: AppA_UGL_2008_EWM_PI.mxd

N
W E
S

600
Feet

Onterra LLC
Lake Management Planning
135 South Broadway Suite C
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	Depth (ft)	Sediment type	Rope (R); Pole (P); Visual (V)	*Myriophyllum spicatum*	Notes
1	46.069456	-89.739709	10	-	R		No Exotic
2	46.063640	-89.746599	8	M	P		No Exotic
3	46.063640	-89.746858	11	-	R		No Exotic
4	46.064498	-89.748948	12	-	R	1	
5	46.064499	-89.749207	12	-	R		No Exotic
6	46.064678	-89.748947	13	-	R	1	
7	46.064679	-89.749206	13	-	R		
8	46.064679	-89.749465	12	-	R		
9	46.066637	-89.748602	12	-	R	2	
10	46.066638	-89.748861	11	-	R	2	
11	46.066817	-89.748601	13	-	R	1	
12	46.066818	-89.748860	12	-	R	1	
13	46.067343	-89.748395	13	-	R	1	
14	46.067344	-89.748653	12	-	R	1	
15	46.068401	-89.745185	9	M	P		No Exotic
16	46.068329	-89.745422	9	M	P	1	
17	46.068401	-89.745185	7	M	P	1	
18	46.070684	-89.742910	13	-	R		No Exotic
19	46.070685	-89.743169	10	-	R		No Exotic
20	46.071803	-89.740026	10	-	R	1	
21	46.071803	-89.740285	9	M	P		No Exotic
22	46.071465	-89.733433	8	M	P	V	
23	46.071541	-89.733667	8	M	P	V	large colony d=1
24	46.070491	-89.733198	8	M	P		No Exotic
25	46.070492	-89.733456	8	M	P		No Exotic
26	46.070492	-89.733715	12	-	R		No Exotic
27	46.063958	-89.748838	13	-	R		No Vegetation
28	46.071820	-89.738381	7	M	P		No Exotic
29	46.071820	-89.738639	6	M	P	1	
30	46.065923	-89.748943	11	-	R		No Exotic
31	46.065924	-89.749201	11	-	R		No Exotic
32	46.066103	-89.748942	11	-	R	1	
33	46.066104	-89.749200	11	-	R		No Exotic
34	46.065787	-89.747983	5	M	P	V	

Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	Depth (ft)	Sediment type (M=muck, S=Sand, R=Rock)	Rope (R); Pole (P); Visual (V)	Myriophyllum spicatum	Potamogeton robbinsii	Ceratophyllum demersum	Vallisneria americana	Potamogeton zosteriformis	Elodea canadensis	Potamogeton pusillus	Myriophyllum sibiricum	Chara sp.	Megalodonta beckii	Najas flexilis	Potamogeton praelongus	Heteranthera dubia	Potamogeton amplifolius	Notes
1	46.069456	-89.739709	10	M	P		1	1	1											
2	46.063640	-89.746599	5	M	P	1		1												
3	46.063640	-89.746858	11	M	P			1												
4	46.064498	-89.748948	11	M	P					1										
5	46.064499	-89.749207	10	M	P		2			1										
6	46.064678	-89.748947	9	M	P			1	1			1	1							
7	46.064679	-89.749206	10	M	P		2	1												
8	46.064679	-89.749465	9	M	P		2			1	1									
9	46.066637	-89.748602	11	M	P			1												
10	46.066638	-89.748861	10	M	P		1	1		1										
11	46.066817	-89.748601	11	M	P	1				1		1								
12	46.066818	-89.748860	10	M	P		2													
13	46.067343	-89.748395																		Missing Data
14	46.067344	-89.748653																		Missing Data
15	46.068401	-89.745185	10	M	P	1			1	1					1	1				
16	46.068329	-89.745422	9	M	P			1												
17	46.068401	-89.745185	5	M	P	1		1										1		
18	46.070684	-89.742910	7	M	P	1			1				2							
19	46.070685	-89.743169	5	M	P	1	1		1		1		1				1			
20	46.071803	-89.740026	8	M	P	2		1												
21	46.071803	-89.740285	6	M	P	1		1			1			1						
22	46.071465	-89.733433	5	M	P						1	1		1	1	1		1		
23	46.071541	-89.733667	6	S	P	1		1				1								
24	46.070491	-89.733198	6	R	P		1		1											
25	46.070492	-89.733456	7	R	P			1	1			1								
26	46.070492	-89.733715	8	M	P			1	1			1								
27	46.063958	-89.748838	11	M	P			1			1									

Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	Depth (ft)	Sediment type (M=muck, S=Sand, R=Rock)	Rope (R); Pole (P); Visual (V)	Myriophyllum spicatum	Potamogeton robbinsii	Ceratophyllum demersum	Vallisneria americana	Potamogeton zosteriformis	Elodea canadensis	Potamogeton pusillus	Myriophyllum sibiricum	Chara sp.	Megalodonta beckii	Najas flexilis	Potamogeton praelongus	Heteranthera dubia	Potamogeton amplifolius	Notes
28	46.071820	-89.738381	5	M	P		1	1		1					1					
29	46.071820	-89.738639	4	M	P	2		1	1	1	1	1								
30	46.065923	-89.748943	8	M	P		2			1										
31	46.065924	-89.749201	8	M	P		3	1			1									
32	46.066103	-89.748942	8	M	P		2				1									
33	46.066104	-89.749200	8	M	P		2													
34	46.065787	-89.747983	3	M	P		1	1						1			1		1	