AQUATIC PLANT MANAGEMENT REPORT

TOMAHAWK LAKE ASSOCIATION

ONEIDA COUNTY, WISCONSIN

January 16, 2009

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TABLE OF CONTENTS

INTRODUCTION 1

PROJECT SUMMARY 1

METHODS 1

RESULTS 2

DISCUSSION 4

RECOMMENDATIONS 5

APPENDICES

Appendix A: Wisconsin Department of Natural Resources, Pre and Post Treatment Evaluation of Aquatic Plant Communities
Appendix B: Map, 2007 vs. 2009 Eurasian Watermilfoil, Tomahawk Lake
Appendix C: Aquatic Plant Management Herbicide Treatment Record, 2008 Tomahawk Lake
Appendix D: Map, Proposed 2009 EWM Treatment Areas, Tomahawk Lake
Appendix E: Data in a Microsoft Excel Spreadsheet

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INTRODUCTION

Tomahawk Lake is a 3,392 acre drainage lake located in northern Oneida County and is part of the larger Minocqua Chain of Lakes. Tomahawk Lake exhibits good water clarity and according to the Wisconsin Trophic State Index is an oligotrophic lake. Eurasian water-milfoil (*Myriophyllum spicatum* - EWM), curly-leaf pondweed *(Potamogeton crispus* - CLP), and purple loosestrife (*Lythrum salicaria* - PL), are all aquatic invasive species (AIS) which have been confirmed on Tomahawk Lake and the Tomahawk Lake Thoroughfare. Lake residents have become concerned about the presence of EWM and other AIS in the aquatic plant community of the Tomahawk Lake system. Residents and other supporters have formed the Tomahawk Lake Association (TLA) in order to raise funds and steer management of the aquatic plant community on the lake. In 2008, the TLA (then TLA, Inc.) submitted a draft Comprehensive Lake Management Plan (CLMP) to the Wisconsin Department of Natural Resources (WDNR). The CLMP has a section that outlines management goals for the aquatic plant community, and more specifically, targets for control of EWM.

PROJECT SUMMARY

Dating back to 1967, there have been numerous aquatic-herbicide treatments to control aquatic plant in Tomahawk Lake. The WDNR records indicate treatments in 1967, 1968, 1976, 1981, 1983, 1988, May 2005, September 2005, May 2007, and May 2008. A majority of the treatments were for private landowners and the location was only given as an address instead of a specific location in the lake. EWM was not discovered until 2003 and therefore, treatments occurring prior to 2005 targeted native aquatic plants. All treatments since 2005 have been focused on EWM management efforts.

The Draft CLMP for Tomahawk Lake puts forth the goal of reducing EWM by 80% over a five year period starting in 2008. There were two basic plans for dealing with EWM on Tomahawk Lake for the 2008 open-water season. The first course of action was to apply a granular form of the chemical herbicide 2, 4-D to most know beds of EWM on the lake. TLA decided to exclude select areas of EWM from chemical herbicide treatment to use as study sites for a hand removal demonstration project using a tool known as the Hydraulic Conveyor System (HCS). The HCS is the second basic plan for attacking the EWM on Tomahawk Lake.

METHODS

Following the WDNR protocol for point-intercept aquatic-plant sampling (Appendix A), Northern Environmental completed pre and post-treatment surveys in 2007 and 2008 along with fall EWM surveys in 2006 through 2008. The fall surveys are used to delineate any changes in EWM location, map new areas, and create potential treatment areas for the following year. The fall (September) survey map comparing EWM in 2007 to 2008 is attached to this report as Appendix B.

The results of the fall 2007 EWM survey provided the information on EWM bed locations and where 2008 spring chemical herbicide treatment (2, 4-D) could occur. Select areas were excluded from chemical herbicide treatment for use in the HCS research and demonstration project. Remaining areas targeted for treatment were enlarged by adding a 20-foot buffer area around the defined treatment polygons of EWM. The buffering was added at the request of the chemical applicator to account for unseen spread of EWM, movement of the boat, and inaccuracies with GPS and other equipment. The WDNR and TLA approved the additional acreage added to the treatment polygons. The pre-treatment aquatic plant survey and the chemical herbicide treatment of EWM areas occurred near the end of May, 2008. Granular 2, 4-D was added to the treatment areas at 100 lbs per acre for EWM in water depths of five feet or less, 150 lbs per acre for EWM in water depths greater than five feet up to ten feet, and 150 lbs per acre in water depths greater than ten feet (Appendix C – 2008 Aquatic Plant Management Herbicide Treatment Record). A post-treatment and fall EWM survey was completed in September, 2008 to gain information on the success of the 2008 treatment and to aid in planning the 2009 chemical treatment.

RESULTS

From the September 2007 (fall) survey and mapping, Northern Environmental determined there were approximately 33 acres of EWM in the lake. TLA decided to exclude approximately 7 acres for the HCS. TLA planned on treating the remaining areas of EWM (approximately 26 acres) with the chemical herbicide 2, 4-D. The total treatment area was then increased to approximately 38 acres by the addition of a 20-foot buffer area around the defined polygons of EWM. The buffering of the polygons accounted for approximately 12 additional acres.

Data was collected during fall 2007 according to the WDNR treatment protocol at sample sites within polygons treated during 2007 as well as those areas to be treated in 2008. In all, 84 sites were sampled across the 27 polygons. In 2007, EWM was sampled at 78 points, or 92.86% of all sampling points within the polygons. The average density rating for the EWM points was 1.14 (density ranges from 1 to 3). During April of 2008, the pre and post-treatment protocols were updated by the WDNR, requiring additional sample points during these surveys. This proportionately raised the 2008 post-treatment survey to 199 points across the same 27 polygons as were sampled in fall of 2007 (i.e. making the density of points greater within the same polygons). Of these 199 points, 104 or 52.26%, had EWM present with the average density being 1.2. There were 22 species detected during the survey and the Floristic Quality Index (FQI) was 29.46. The final FQI calculated from the 2007 Tomahawk Lake point-intercept aquatic plant survey data was 40.98.

When comparing between years using percentage of points with EWM (92.86 % for 2007 and 52.25% for 2008), a reduction of 43.72% across all polygons was noted. Table 1 contains changes within polygons between 2007 and 2008.

Table 1. Changes in twenty seven predetermined EWM polygons on Tomahawk Lake, Oneida County, WI.

POLY	pts 2007	pts EWM 2007	% EWM 2007	Avg. D 2007	pts 2008	pts EWM 2008	% EWM 2008	Avg. D. 2008	% Change (coverage)	% Change (D)
1	*4*	*3*	*75.00%*	*1.00*	*9*	*9*	*100.00%*	*1.00*	*33.33%*	*0.00%*
2	*2*	*2*	*100.00%*	*1.00*	*1*	*1*	*100.00%*	*1.00*	*0.00%*	*0.00%*
3	*7*	*7*	*100.00%*	*1.00*	*14*	*11*	*78.57%*	*1.18*	*-21.43%*	*18.18%*
4	*2*	*2*	*100.00%*	*1.00*	*1*	*1*	*100.00%*	*1.00*	*0.00%*	*0.00%*
5	*3*	*3*	*100.00%*	*1.00*	*2*	*2*	*100.00%*	*1.50*	*0.00%*	*50.00%*
6	3	1	33.33%	1.00	7	2	28.57%	2.00	-14.29%	100.00%
7	1	1	100.00%	2.00	3	3	100.00%	1.33	0.00%	-33.33%
8	3	2	66.67%	1.00	6	5	83.33%	1.60	25.00%	60.00%
9	7	7	100.00%	1.57	17	11	64.71%	1.82	-35.29%	15.70%
10	3	3	100.00%	1.00	11	6	54.55%	1.17	-45.45%	16.67%
11	2	2	100.00%	2.00	2	0	0.00%	0.00	-100.00%	-100.00%
12	4	4	100.00%	1.00	10	5	50.00%	1.00	-50.00%	0.00%
13	3	3	100.00%	1.00	7	3	42.86%	1.00	-57.14%	0.00%
14	8	8	100.00%	1.25	39	15	38.46%	1.00	-61.54%	-20.00%
15	2	2	100.00%	1.00	15	3	20.00%	1.33	-80.00%	33.33%
16	3	3	100.00%	1.00	6	3	50.00%	1.00	-50.00%	0.00%
17	1	1	100.00%	2.00	1	1	100.00%	1.00	0.00%	-50.00%
18	2	2	100.00%	1.00	6	5	83.33%	1.00	-16.67%	0.00%
19	2	2	100.00%	1.00	2	1	50.00%	1.00	-50.00%	0.00%
20	2	1	50.00%	1.00	5	1	20.00%	1.00	-60.00%	0.00%
21	3	3	100.00%	1.00	8	2	25.00%	1.00	-75.00%	0.00%
22	1	1	100.00%	1.00	2	1	50.00%	1.00	-50.00%	0.00%
23	5	5	100.00%	1.00	8	5	62.50%	3.00	-37.50%	200.00%
24	7	6	85.71%	1.00	11	5	45.45%	1.00	-46.97%	0.00%
25	1	1	100.00%	2.00	3	0	0.00%	0.00	-100.00%	-100.00%
26	2	2	100.00%	1.00	2	2	100.00%	1.00	0.00%	0.00%
27	1	1	100.00%	1.00	1	1	100.00%	2.00	0.00%	100.00%
Total lake	**84**	**78**	**92.86%**	**1.14**	**199**	**104**	**52.26%**	**1.20**	**-43.72%**	**5.51%**
Untreated	*21*	*18*	*85.71%*	*1.00*	*34*	*26*	*76.47%*	*1.19*	*-10.78%*	*19.23%*
Chemical	63	60	95.24%	1.18	165	78	47.27%	1.21	-50.36%	2.07%

Untreated indicates area (1-6) where the Hydraulic Conveyor System was sated to be used to facilitate more efficient hand pulling/manual removal of EWM
Chemical indicates areas where the chemical herbicide 2, 4-D was applied to EWM

Note: chemically treated polygons saw a higher reduction rate in EWM when compared to those polygons set aside for or managed with the hydraulic conveyor (-50.36% vs. -10.78% respectively). In total, 18 of 27 polygons indicated a decrease in EWM; two indicated an increase, while 7 remained unchanged.

	2007	2008
Entire Lake points containing EWM	92.86%	52.26%
Treatment Areas points containing EWM	95.24%	47.27%

Speaking in terms of estimated area, approximately 2 acres of new EWM was detected in 2008. Observations indicate that approximately 20 acres of EWM were reduced or controlled during the 2008 season. The estimated total EWM acreage for 2008 was approximately 15 acres. The total reduction in EWM throughout the lake was approximately 45% in 2008.

When using a Chi-square test with a type-1 error rate (P-value) of 0.05 evaluating the statistical significance of EWM coverage between the years (2007 and 2008), the overall lake change (reduction) is statistically significant. This statistical significance means that there is a 5% (0.05) chance of claiming there is significant change when no real change has occurred. The P-value of 0.05 is a standard measure of ecological studies and used in the WDNR aquatic plant analysis worksheets. The P-value, or chance of error, for the change across all treated polygons between 2007 and 2008 is well below 0.05 and was calculated at 0.0000000000474 or 4.47E-11 (Table 2). Some polygons did not contain enough sample points to confidently make a statistical conclusion (e.g. Polygon 1). This is due to the small size of the polygon limiting the number of sample points (20 points are required for WDNR statistic worksheet to calculate significance). When reviewing this data we assume the change is due to one of two factors (2,4-D treatment or hydraulic conveyor/hand pulling), although there may have been other factors, such as the long winter of 2007/2008, contributing to the outcome.

Table 2. Statistically significant change in twenty seven predetermined EWM polygons on Tomahawk Lake, Oneida County, WI.

Polygon	+, -, or SAME	Significant (.05)	Actual p-vale	Notes
1	*+*	*NO*		*
2	*SAME*	*NO*		*
3	*-*	*NO*		
4	*SAME*	*NO*		*
5	*SAME*	*NO*		*
6	*-*	*NO*		*
7	SAME	NO		*
8	+	NO		*
9	-	NO		
10		NO		
11	SAME	NO		*
12	-	NO		
13	-	NO		
14	-	YES	0.001515	
15	-	YES	0.019681	*
16	-	NO		
17	SAME	NO		*
18	-	NO		*
19	-	NO		*
20	-	NO		*
21	-	YES	0.02609	
22	-	NO		*
23	-	NO		
24	-	NO		
25	-	YES	0.0455	*
26	SAME	NO		*
27	SAME	NO		*
Total Lake	-	YES	4.74E-11	
Untreated	-	NO	0.405052	
Chemical	-	YES	3.45E-11	

* - denotes that there's not enough sample points within the polygon to confidently make a statistical conclusion

Untreated indicates area (1-6) where the Hydraulic Conveyor System was sated to be used to facilitate more efficient hand pulling/manual removal of EWM

Chemical indicates areas where the chemical herbicide 2, 4-D was applied to EWM

Total Lake 4.74E-11 = 0.0000000000474

Chemical 3.45E-11 = 0.0000000000345

Polygons that were chemically treated had a significant (P-value 3.45E-11) decrease in EWM due to chemical treatment. Though the polygons treated using the hydraulic conveyor did show a decrease of 12.09%, this decrease was not deemed statistically significant (P-value 0.40502). Incidentally, the polygon that physically had the greatest reduction in EWM removed by the hydraulic conveyor showed an increase in EWM. This illustrates the potential problem assessing any environmental parameter based on one particular sampling technique. What a researcher is looking for may literally fall through the cracks.

DISCUSSION

Using approximately 33 acres of EWM as a starting point, the Draft CLMP for Tomahawk Lake puts forth the goal of reducing EWM by 80% over a five year period starting in 2008 and is charted in Table 3. The plan states "New areas colonized by EWM would add to the 33.43 acres used to calculate the 80% reduction. The 80% reduction goal should be evaluated on a yearly basis. If 80% is too high of a goal based on annual AIS surveys, TLA will reconsider management efforts and if necessary, establish a new goal. If the 80% reduction goal is met, the EWM infestation should be considered maintenance activities instead of restoration."

Table 3. Goals for EWM Reduction over a 5 year period.

Year	Acreage Goals
2007	33.43
2008	24.23
2009	17.56
2010	12.73
2011	9.22
2012	6.68

Note: Based on recommendations from the Tomahawk Lake Comprehensive Lake Management Plan from 2007 Tomahawk Lake EWM Survey.

The reduction of EWM by approximately 45% in 2008 puts TLA ahead of its 2008 goal and somewhere between its 2009 and 2010 goal as noted in the Draft CLMP (based on 15 acres of surveyed EWM in fall of 2008). This is encouraging from a management perspective.

The CLMP further states "Highly used recreational areas, public boat launches or access points and/or areas with the highest AIS density should be given priority when considering management locations due to a greater potential for AIS spread from these areas…TLA will evaluate aquatic plant management efforts on an annual basis using the 2007 baseline aquatic plant data and annual AIS surveys. <u>If one or more of the management options is determined to be ineffective, TLA will increase management efforts using methods shown to be effective.</u>"

Since the chemical herbicide treatment was the most effective reduction method, it is prudent to focus on this control method (more details regarding the management of the Hydraulic Conveyor System can be found in the Hydraulic Conveyor System project summary report produced by Northern Environmental for TLA). Although the 20-foot buffering around EWM beds increased treatment costs, discussion between TLA representatives and Northern Environmental staff have produced a consensus in touting the mantra "if it ain't broke, don't fix it" and both parties support continuing that process when chemically treating. Addition of the 20-foot buffer area to the 15 acres of EWM would result in a total treatment area of approximately 24 acres. A proposed 2009 treatment map is included with this report (Appendix D). Following the approach of the 2008 treatment methods, the entire 24 acre treatment area should be treated with granular 2, 4-D, at 100 lbs per acre for EWM in water depths of five feet or less, 150 lbs per acre for EWM in water depths greater than five feet up to ten feet, and 150 lbs per acre in water depths greater than ten feet.

One alternative method to treating only the new areas where EWM was detected and mapped would be to treat all EWM polygons mapped the previous year and treated in 2008. This method would take the approach of treating any

potential lingering EWM that may not have been detected but persists in the 2008 treated areas. Treating these areas would increase the treatment cost and does not appear warranted based on the data collected during the 2008 post-treatment surveys.

The Hydraulic Conveyor System (inferring manual removal with the assistance of the HCS devise) is a useful tool for removal of EWM but lacks the ability to cover large areas in an efficient manner. The HCS is best utilized for assisting divers removing EWM in hard to access areas, such as under large permanent docks (e.g. those at Lakeside Landing), or in removing pioneering (new) infestations discovered after chemical treatment has occurred. The HCS could also be used, time permitting, to remove EWM that is persisting after chemical treatment. Such post-treatment removal may address the problem of EWM evolving and becoming resilient to chemical treatment, which is a concern of many managers and chemical applicators. Appendix E is a Microsoft Excel spreadsheet containing data.

RECOMENDATIONS

Below is a summary of the course of action Northern Environmental recommends for EWM control in 2009.

Recommendations for 2009:

- Treat all (15 acres) of EWM with 2,4-D according to manufacturer's label and following WDNR pre/post treatment protocol
- Expand EWM treatment areas with 20-foot buffers for a total treatment area of approximately 24 acres
- Use Hydraulic Conveyor System to remove EWM in hard to access areas or for removing pioneering infestations

If there are any questions about this report or the recommendations made please contact Northern Environmental at 1-800-776-7140.

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APPENDIX A

WISCONSIN DEPARTMENT OF NATURAL RESOURCES, PRE AND POST TREATMENT EVALUATION OF AQUATIC PLANT COMMUNITIES

Pre and Post Treatment Evaluation of Aquatic Plant Communities
(April 2008)

Purpose

This protocol is used to determine the need for, and evaluate the results of herbicide application or any other manipulation (but from here on called a chemical application or treatment) to reduce aquatic invasive plant species. The following protocol is applicable for introducing new treatments to lakes where the treatment size is greater than 10 acres or greater than 10% of the lake littoral area and more than 150 feet from shore*. It is designed to satisfy AIS grant-funded treatment conditions where restoration is a goal or where performance results are needed (i.e. for scientific or financial accountability). This protocol is written for Eurasian water-milfoil (EWM) but can be adapted for Curly-leaf Pondweed and other AIS. This protocol may be appropriately adapted to evaluate non-herbicide controls.

This protocol assumes that the lake group has an Aquatic Plant Management (APM) Plan in place with specific goals for the native and invasive species in the lake. The first step of the pre- and post-treatment protocol is to collect data on where EWM is found and where treatment is proposed in order to secure an APM permit. The second step is to perform a point intercept (P/I) survey within the proposed treatment areas to assess the presence of all species. The third step is to return to the same P/I sampling points just before a spring treatment to assess the presence of the target species in the defined treatment areas. Following treatment, all species are again assessed using the same treatment P/I points. If another treatment (the next spring) is deemed necessary, the sponsor will repeat this process until either the treatable area falls to less than 10 acres or less than 10% of the littoral zone or the goals of the APM plan change.

We are aware that this approach necessitates several visits to the lake per year. This work is necessary to assess the overall success of chemical treatments at reducing invasive species and enhancing native species. After we learn how each lake responds to the treatment, we hope and expect that we will be able to cut back on the annual evaluations. For now, we need rigorous data collection that will help best deal with invasive aquatic plants.

***Note that whole-lake scale treatment projects (those involving ≥160 acres or ≥50% of the lake littoral area) may follow a slightly different protocol, as described in the text. For newly discovered or pioneer populations of EWM (defined as a localized bed that has been present less than 5 years and is less than 5 acres in size or less than 5% of lake area which ever is greater), consult *Response for Early Detection of Eurasian Water Milfoil Field Protocol* available from the WDNR (http://dnr.wi.gov/org/water/fhp/lakes/EarlyDetectionFieldProtocol.pdf).**

Protocol

Year 1 Season before treatment

1. *Establish baseline information about plant community*.
    a. In the season prior to a chemical treatment, perform a whole-lake summer point/intercept (P/I) survey to characterize the entire plant community if it has not been done within 5 years.
    b. Details on the protocol for conducting plant surveys can be found in *Appendix B. Protocol of Aquatic Plant Survey – Collecting, Mapping, Preserving and Data*

Entry on the UW Extension Lakes *APM in Wisconsin* website: http://www.uwsp.edu/cnr/uwexlakes/ecology/APM/Appendix-B.pdf .

2. *Identify and map proposed treatment polygons***.**
    a. During the summer or early fall growing season prior to the chemical treatment, map the proposed treatment area*s* of EWM and identify these polygons using GPS to outline the beds.
        i. The initial P/I survey is unlikely to identify every stand of EWM. Map the invasive beds using a number of strategies such as:
            1. Use a meander search (boat out from shore to the maximum rooting zone and then head back to shore, a short ways down the shore from where you started) to find beds.
            2. If clarity is good (to the depth of rooted plants) and the EWM bed is topped out, identification can be visual but must be augmented with rake tosses to verify species identification and find the edges of the bed. Under glare conditions, brown polarized sun glasses are helpful.
            3. If visibility is limited, SCUBA, underwater video and an Aqua-View Scope are all highly recommended to make a complete assessment of the beds.
            4. Look for plant fragments wind-rowed on shore as an indication that plants may be growing off shore from this point.
        ii. Note that in order to secure a chemical treatment permit, the applicant must know the acreage and location of the treatment areas.

3. *Confirm EWM identification.*
    a. Collect one EWM plant from each large (> 5 acres) treatment polygon where these exist, but collect at least 3 plants per lake.
    b. These EWM plants may be collected in the summer/fall before the treatment year or spring just before treatment, but the identification of the fresh plants must be confirmed by the DNR or appropriate university personnel before treatment takes place. The DNR may ask to see a specimen from the spring survey.

4. *Conduct Proposed Treatment Polygon Survey*.
    a. In order to assess the effect of chemical treatment on natives, there must be a survey of <u>all</u> plant species in the treatment polygons before treatment. However, since natives will be largely absent at the time of the spring pre-treatment survey, the natives must be assessed the summer before treatment. Therefore, after defining the proposed treatment polygons (2a above), perform a presence/absence and rake fullness assessment of all plants at a sub-sample of points within and near the polygons as follows (see Table 1):
        i. Sample at least 100 points per lake among the beds
        ii. Sample a minimum of 4 points (to ensure enough detail of the plant beds) but a maximum of 10 points (the maximum resolution of many GPS units) per treated acre.

iii. The points needn't be spread evenly across all treatment polygons, but it will be most informative to distribute the points among the largest polygons.
iv. Record the point locations as they will be used again the following year.

Table 1. Recommended number of points to sample in proposed treatment polygons, based on total acreage of treatments to be evaluated.

		4 pts/acre (minimum)	10 pts/acre (maximum)	
Area to be treated (acres)	Minimum points/lake	Points/lake	Points/lake	Recommended # of Points to sample
10	100	40	100	100
20	100	80	200	100
30	100	120	300	120
40	100	160	400	160
50	100	200	500	200

b. If the proposed treatment area consists of more than 50% of the lake littoral area, or whole-lake scale treatment methods are being used (i.e. liquid applications), then this step is omitted.
   i. Instead, whole-lake P/I surveys should be conducted each year following treatment for the purposes of post-treatment evaluation.
   ii. More intensive monitoring in some polygons may be warranted for evaluating treatment effectiveness or fine-tuning treatment regimes.

5. *Evaluate the treatment plan*.
   a. Once the acreage for treatment is established, be sure everyone involved agrees that a chemical treatment is the best method for solving the lake's EWM problems.
   b. Evaluate the cost of treatment to be sure everyone involved understands the cost of chemical treatment.

<u>Year 2 First treatment</u>

1. *Pre-treatment Survey - Spring just before treatment*
   a. Using the established proposed treatment polygons from YR 1, repeat the methods in the proposed treatment survey area sampling **only for EWM.** Adjust the delineation of the treatment area, if necessary. Plants may be small, and may be sparse this time of year. Underwater visual/video of the middle and edges of the proposed polygon is highly recommended.
   b. This step may be omitted for whole-lake scale treatments (i.e. where it is not necessary to define individual treatment polygons, e.g. when liquid herbicide is applied over large areas).

2. *Conduct Treatment.*

a. It is best to conduct the treatment as close to ice-out as possible for several reasons.
    i. Many studies have shown that the chemical herbicides are effective at temperatures normally found in lakes just after ice-off.
        1. One exception is endothall products, which are not as effective at temperatures below 50° F.
    ii. The best results are obtained when the biomass of the invasive is still low, so that there is less decomposing plant material and consequently less demand for oxygen that could rob other living organisms of oxygen.
    iii. Also, it is best to treat before the natives are growing fast, so that they are minimally affected by the chemical.
b. Therefore, treatment should occur in early spring (after ice-out), when EWM is actively growing throughout the proposed treatment areas (optimally around 6 inches tall).
c. If optimal conditions for treatment have not occurred prior to May 31, consult with the DNR to confirm if treatments may go forward. It is possible that treatments are unnecessary or would be detrimental to the native plant community if conducted too late in the season. .

3. *Post-treatment Survey*
    a. A post-treatment survey should be scheduled when native plants are well established, generally mid-July through mid-August.
    b. If treating curly-leaf pondweed (CLP), a post treatment survey needs to be completed before CLP seasonal growth ends, possibly before many natives are easily visible (i.e. mid-June). Consult with the DNR to determine the optimal time to do a post-treatment survey for CLP.
    c. For the post-treatment survey, repeat the P/I for all species in the treatment polygons, as was done the previous summer
        i. Use the results from this survey to compare with the results from the pre-treatment survey to
            1. evaluate the effectiveness on target plants,
            2. evaluate any harm or benefit to native plants
            3. identify next year's potential treatment areas for target plants.
        ii. For whole-lake scale treatments, a full lake-wide P/I survey should be conducted.
    d. To compute the significance of results from the pre- and post-treatment surveys (pre-treatment survey in summer of Year 1 and post-treatment survey in summer of Year 2) see *Appendix I. ComputePre&PostData.xls* on the UW Extension Lakes *APM in Wisconsin* website (http://www.uwsp.edu/cnr/uwexlakes/ecology/APMguide.asp) or the DNR website (http://dnr.wi.gov/org/water/fhp/lakes/ComputePrePostData.xls).

4. *Redefine proposed treatment polygons (if further treatments are planned)***.**
    a. If the polygon boundaries have shifted or new colonies have emerged, new treatment polygons must be mapped and surveyed before the end of Year 2 in preparation for treatment in Year 3.

        i. Follow all instructions for Year 1 steps 2-5 above.
        ii. If only targeted polygons are to be treated in years following a whole-lake scale treatment, then sub-sampling should occur in these polygons as described in Year 1 steps 2-5.
    b. If the exact same polygons treated in Year 2 will be treated again in Year 3 the post-treatment survey in Year 2 can serve as the proposed treatment survey for the treatment to be done in Year 3.
        i. If a whole-lake P/I survey is conducted as part of a whole-lake scale treatment, this serves as the pre-treatment survey for Year 3.
    c. Mapping of the new areas could be done immediately after the post-treatment survey or in late summer or fall, but would be separate from the post-treatment survey.
    d. If, after completing the first treatment, more treatments are needed, all areas that have ever been treated must be included in subsequent pre- and post-treatment surveys. By doing this, we can assess longer-term impacts of treatments on the plant community.

5. *Measuring success or the need to change course.*
    a. Choose a percent decrease in the target plant area coverage or frequency of occurrence for an annual goal of at least 50% for restoration projects.
        i. If you have sampled 100 points for the pre- and post-treatment survey, you will be able to detect a 20% or larger change in species frequency (of both natives and the target species).
        ii. You must sample many more points (approximately 350 points) to see a 10% change in a species frequency.
    b. For an overall long term goal, a reduction to less than large scale treatment (less than 10 acres or 10% of lake littoral area) where annual spot treatments can sustain low level occurrences is reasonable. Alternatively, a goal of reducing dense beds to scattered plants using a density measurement might be appropriate.
    c. An acceptable native response is no net loss and ideally some gain. However, some loss may be purely sampling variance or inter-annual variation.

<u>Year 3 and Year 4 (if additional treatments are planned)</u>

1. *Repeat Year 2 procedure.*
    a. Be sure to resample all areas treated in all years even if treatment area declines in size over time so that an accurate record of control can be established.

<u>Year 5</u>

1. *Repeat Year 2 procedure if necessary.*

2. *Conduct a lake wide P/I survey (repeat base year) to gauge overall lake community response.*
    a. Use the P/I results to update the management plan.
    b. Consult with a DNR lake coordinator to adjust your APM plan goals.

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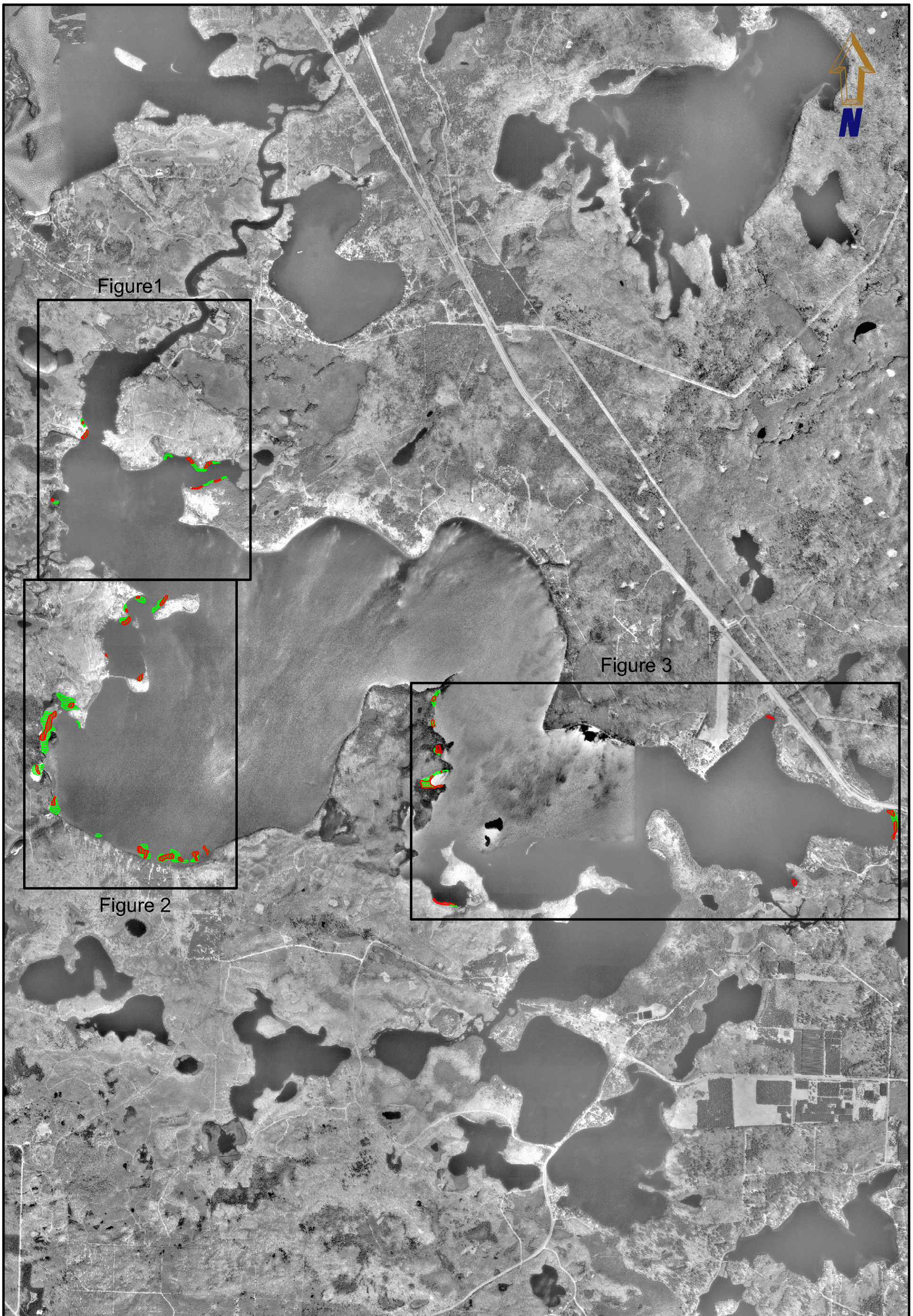
APPENDIX B

MAP, 2007 VS 2008 EURASIAN WATERMILFOIL, TOMAHAWK LAKE



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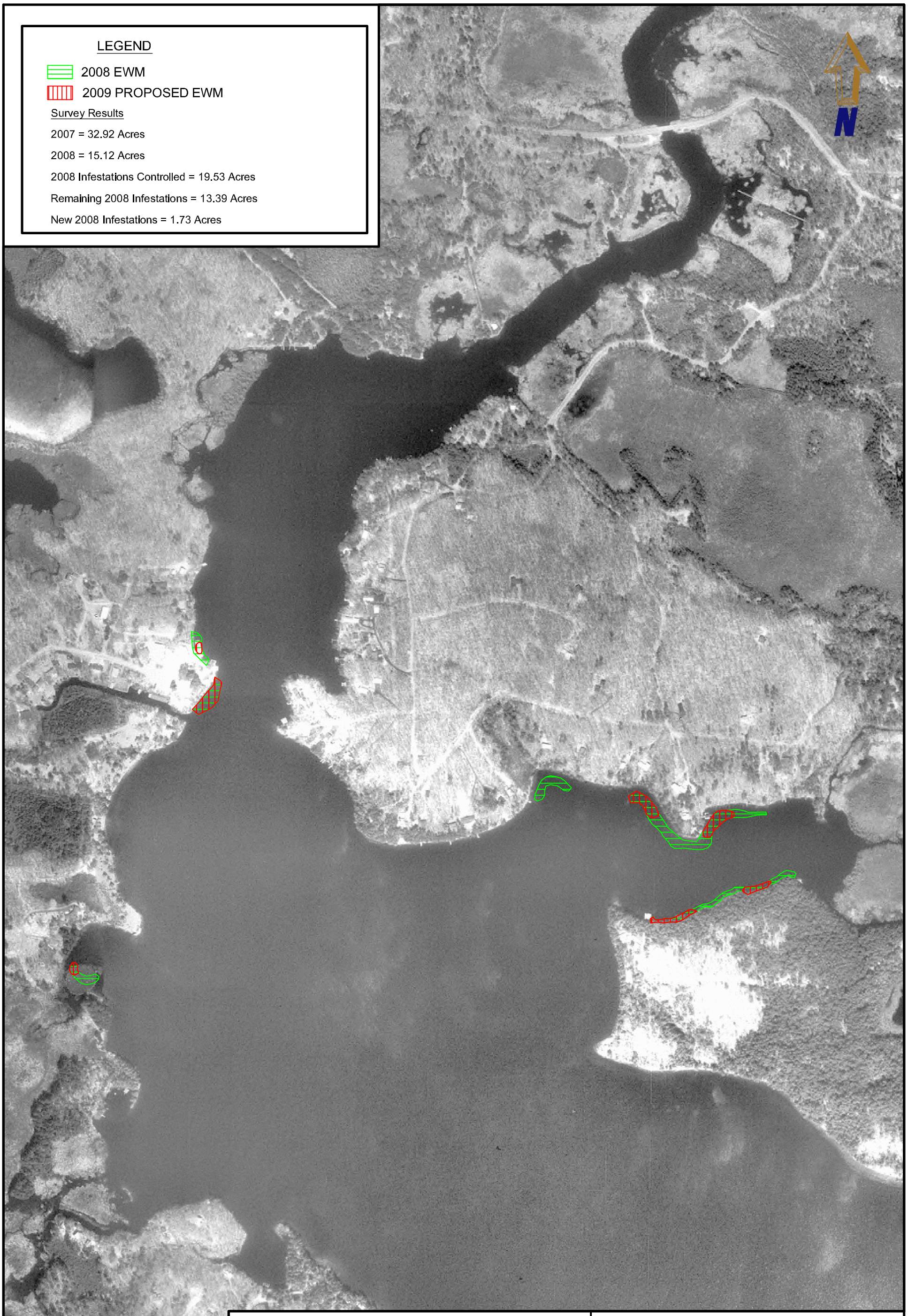
Fall 2008 EWM Suvey

TOMAHAWK LAKE PROPERTY OWNERS ASSOCIATION
TOMAHAWK LAKE
ONEIDA COUNTY, WISCONSIN

DATE: 10/23/08	DRAWN BY: NLB	TASK NUMBER: 100	PROJECT NUMBER: LTH08-5500-0905	FIGURE 1



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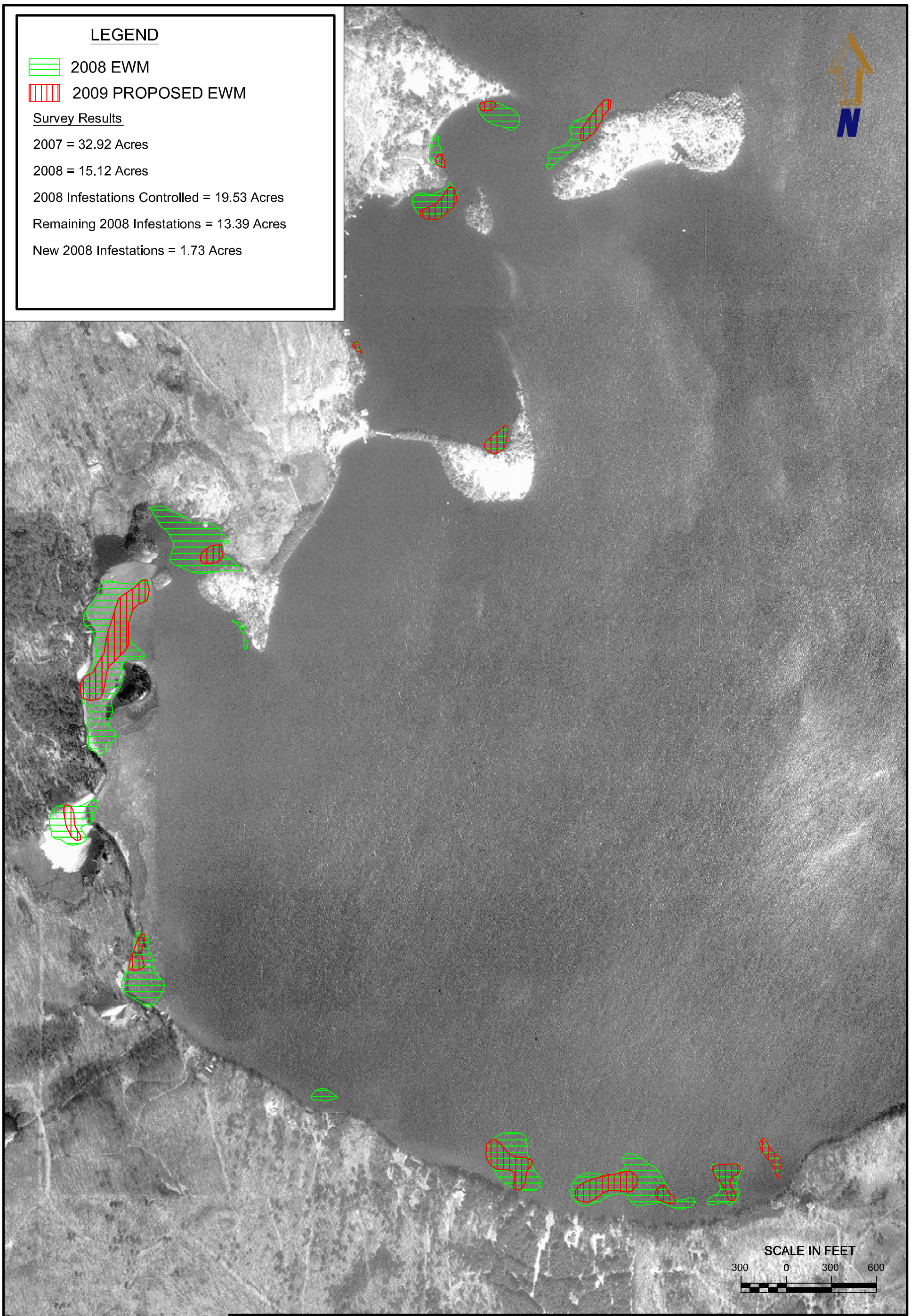
2008 and 2009 EWM Survey Maps

TOMAHAWK LAKE PROPERTY OWNERS ASSOCIATION
TOMAHAWK LAKE
ONEIDA COUNTY, WISCONSIN

DATE: 10/23/08	DRAWN BY: NLB	TASK NUMBER: 100	PROJECT NUMBER: LTH08-5500-0905	FIGURE 2



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2008 and 2009 EWM Survey Maps

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ONEIDA COUNTY, WISCONSIN

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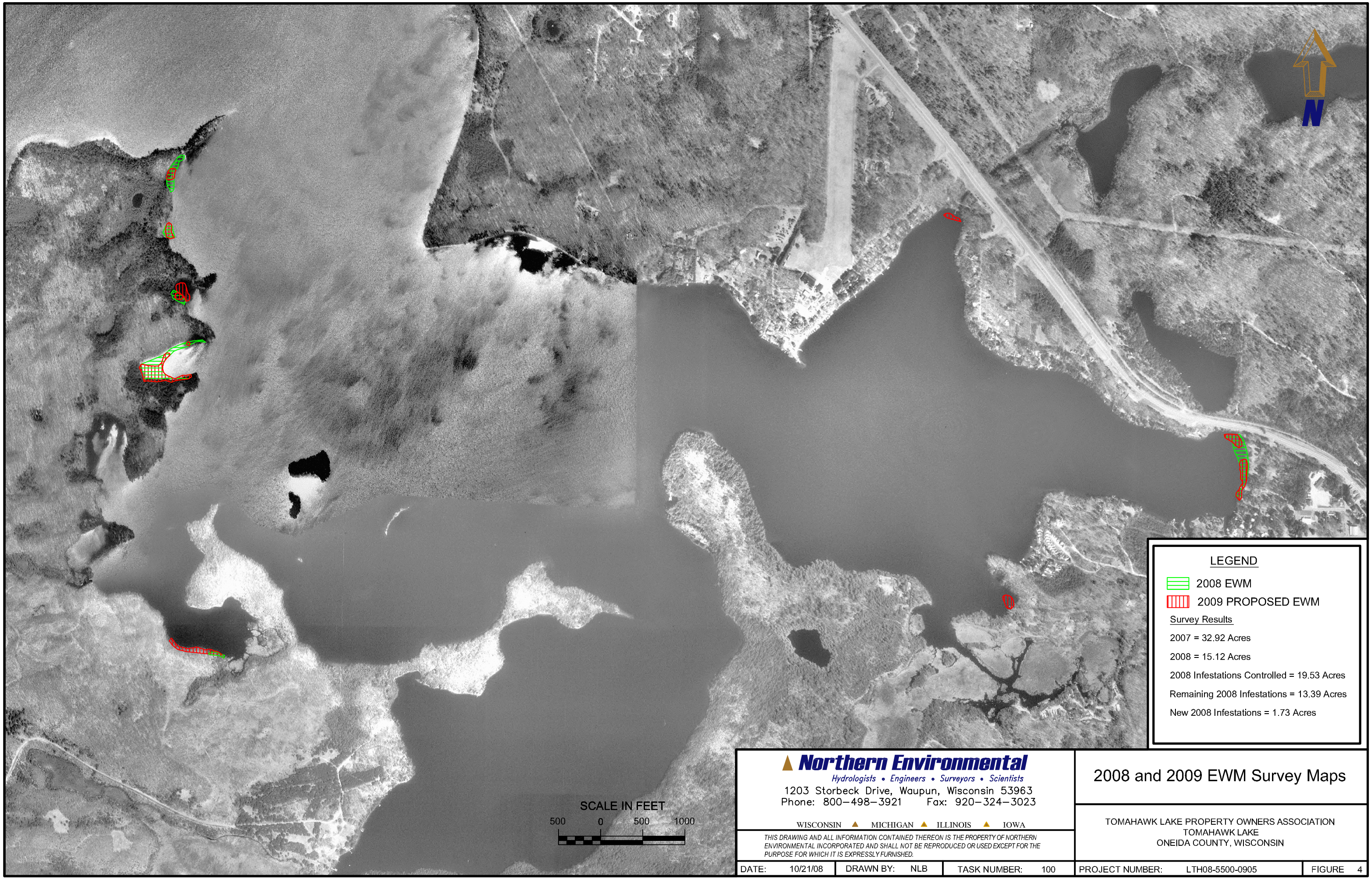

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2008 and 2009 EWM Survey Maps

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ONEIDA COUNTY, WISCONSIN

DATE: 10/21/08	DRAWN BY: NLB	TASK NUMBER: 100	PROJECT NUMBER: LTH08-5500-0905	FIGURE 4

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APPENDIX C

AQUATIC PLANT MANAGEMENT HERBICIDE TREATMENT RECORD, 2008 TOMAHAWK LAKE

State of Wisconsin
Department of Natural Resources

Aquatic Plant Management Herbicide Treatment Record

Form 3200-111 (5/01)

Notice: Completion of this form is a condition of the permit and provides records required by WDNR (NR 107) and DATCP (ATCP 29.21 and 29.22). The Department may not issue you future permits unless you complete and submit this form. Personally identifiable information required on this form is not likely to be used for purposes other than that for which it is originally being collected. It may also be made available to requesters under Wisconsin's Open Records law [ss. 19.31 – 19.39, Wis. Stats.]

Submit this form:
(1) immediately if any unusual circumstances occurred during treatment
(2) as soon after treatment as possible, no later than 30 days
(3) by October 1 if no treatment occurred

Completion of this form along with the permit satisfies the requirements of WDNR (NR 107) and DATCP (ATCP 29.21 and 29.22).

General Permit Information

Permit Number	Waterbody Name (including ponds, e.g., Smith Pond)
	Tomahawk Lake
County	Permit Holder Name
Oneida	Tomahawk Lake Property Owners Association, Inc./Todd Kavemeier, President

Treatment Information

Treatment Date	Starting Time (24 hr)	Ending Time (24 hr)	Water Temp (°C)	Ambient Air Temp (°C)	Wind Speed (mph)	Wind Direction
5/27/2008	**05:30**	20:00	11	10	5	NNE

Other Conditions Noted (i.e., dead fish, spawning fish, algae bloom, etc.)

Onsite Supervision Present? ☐ Yes ☒ No

If Yes, Supervisor Name

Mixing and Loading Site Location (if other than business site or from prepackaged retail container or applied with equipment with a total capacity of not more than 5 gallons liquid or 50 pounds dry)

Herbicide Treatment and Water Use Restrictions Signs Posted In Accordance With NR 107? ☒ Yes ☐ No

Applicator shall provide each customer with a free copy of each pesticide label used (if requested)

Applicator Information

Individual or Business Name	Telephone Number
Schmidt's Lndsg. & Nursery Inc./Schmidt's Aquatic Plant Control	715-445-3962

Street Address
320 GOLF Drive

City	State	ZIP Code
Iola	WI	54945

Individuals Making Pesticide Application:	Last Name	First	Certification #
	Schmidt	Clifford	029377
	Last Name	First	Certification #
	Last Name	First	Certification #

Name of Person Completing Form	Signature	Date Signed
Clifford Schmidt		**6/3/2008**

 Date: 6/3/2008

Aquatic Plant Management Herbicide Treatment Record

Form 3200-111 (5/01)

Treatment Site and Chmical Information (use attached additional site / herbicide sheet if necessary)

Site No, Property Name, Address / Fire No	Treated Shoreline Length (ft)	Treated Distance Off Shore	Treated Acreage	Permitted Acreage (per property)	Sensitive Area?	Herbicide(s) Used / EPA Reg. Number(s)	Amount Applied (e.g., gals, lbs)	GPS Location Latitude / Longitude
See permit map			38.1	38.1	☐ Y	Navigate 2,4-D,	5,900lbs.	° 45 ‘50 N ° 89 ‘41 W
					☐ Y			° ‘ N ° ‘ W
					☐ Y			° ‘ N ° ‘ W
					☐ Y			° ‘ N ° ‘ W
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					☐ Y			° ‘ N ° ‘ W

Aquatics at Treatment Site: TS = Target Species SP = Species Present

TS SP	Sites	TS SP	Sites	TS SP	Sites	TS SP Other Aquatics	Sites
☐ ☐ cattail		☐ ☐ white-stem pondwd		☐ ☐ coontail		☐ ☐	
☐ ☐ yellow pond lily		☐ ☐ flat-stem pondwd		☐ ☐ elodea		☐ ☐	
☐ ☐ white pond lily		☐ ☐ floating-leaf pondwd		☐ ☐ filamentous algae		☐ ☐	
☐ ☐ watershield		☐ ☐ sago pondwd		☐ ☐ richardson pondwd		☐ ☐	
☐ ☐ large-leaf pondwd		☒ ☒ e. milfoil		☐ ☐ illinois pondwd		☐ ☐	
☐ ☐ curly-leaf pondwd		☐ ☐ n. milfoil		☐ ☐ planktonic algae		☐ ☐	
☐ ☐ robbins pondwd		☐ ☐ wild celery		☐ ☐		☐ ☐	

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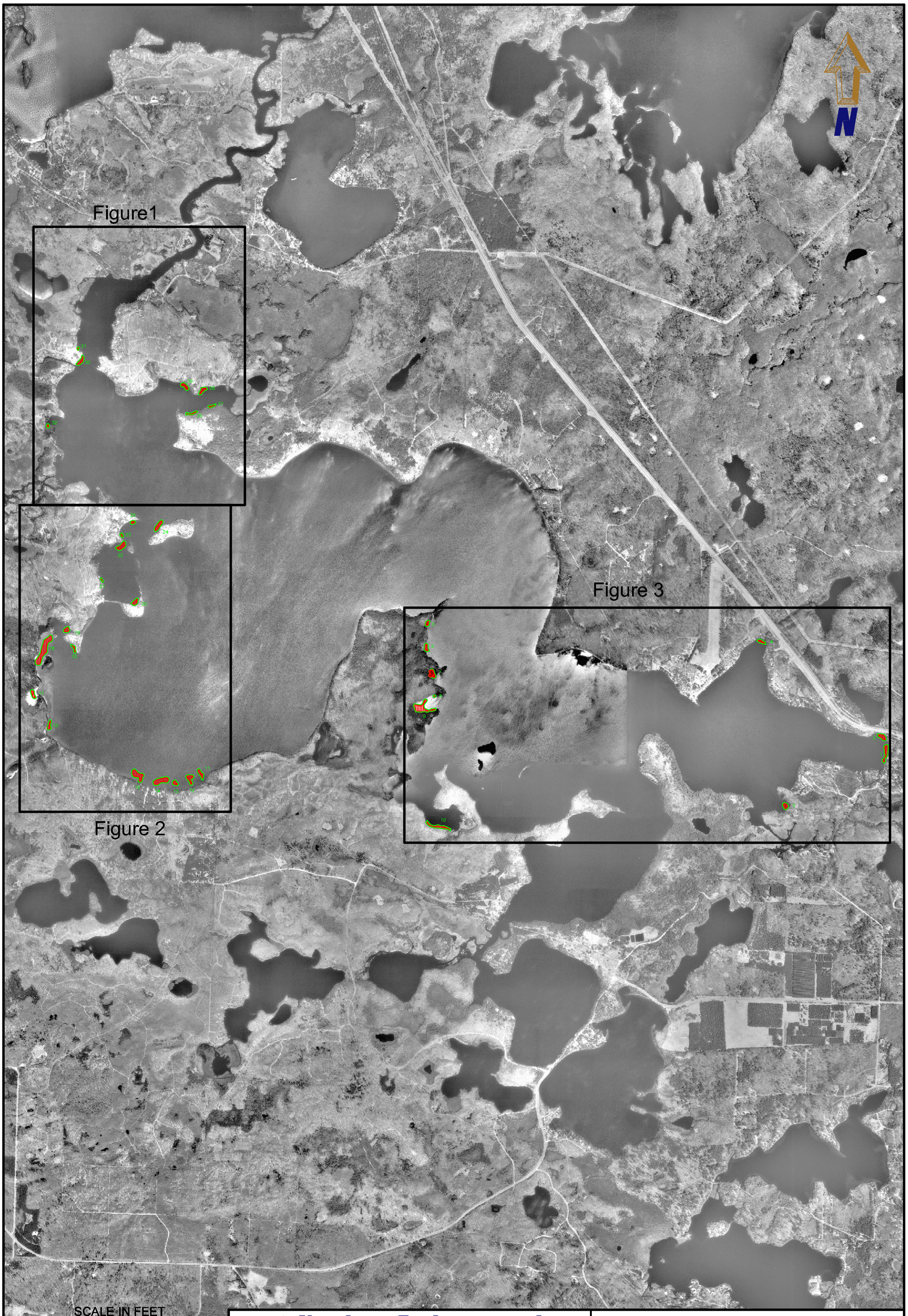
APPENDIX D

MAP, PROPOSED 2009 EWM TREATMENT AREAS, TOMAHAWK LAKE



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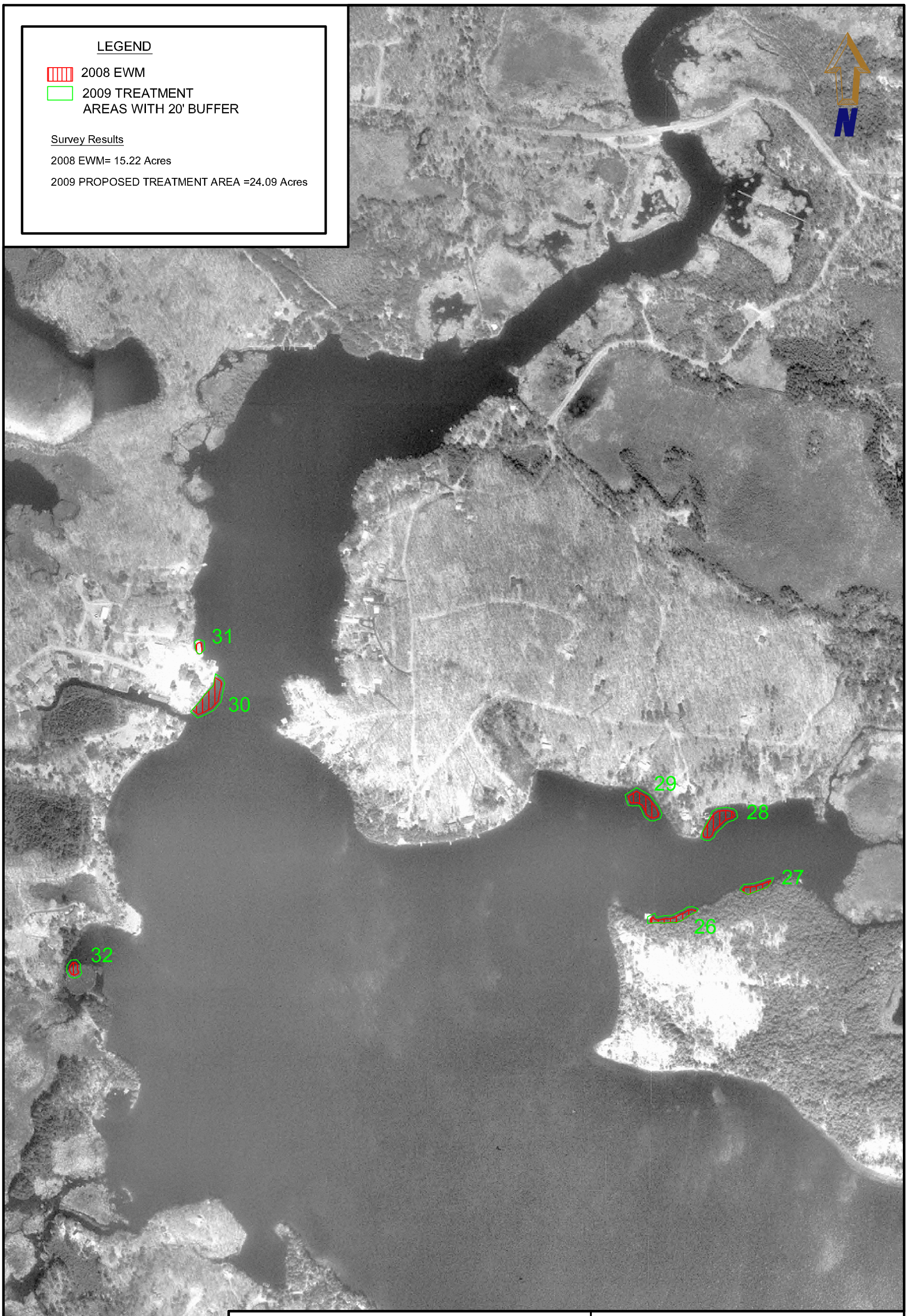
Fall 2008 EWM Treatment Areas

TOMAHAWK LAKE PROPERTY OWNERS ASSOCIATION
TOMAHAWK LAKE
ONEIDA COUNTY, WISCONSIN

DATE: 12/08/08	DRAWN BY: NLB	TASK NUMBER: 100	PROJECT NUMBER: LTH08-5500-0905	FIGURE 1



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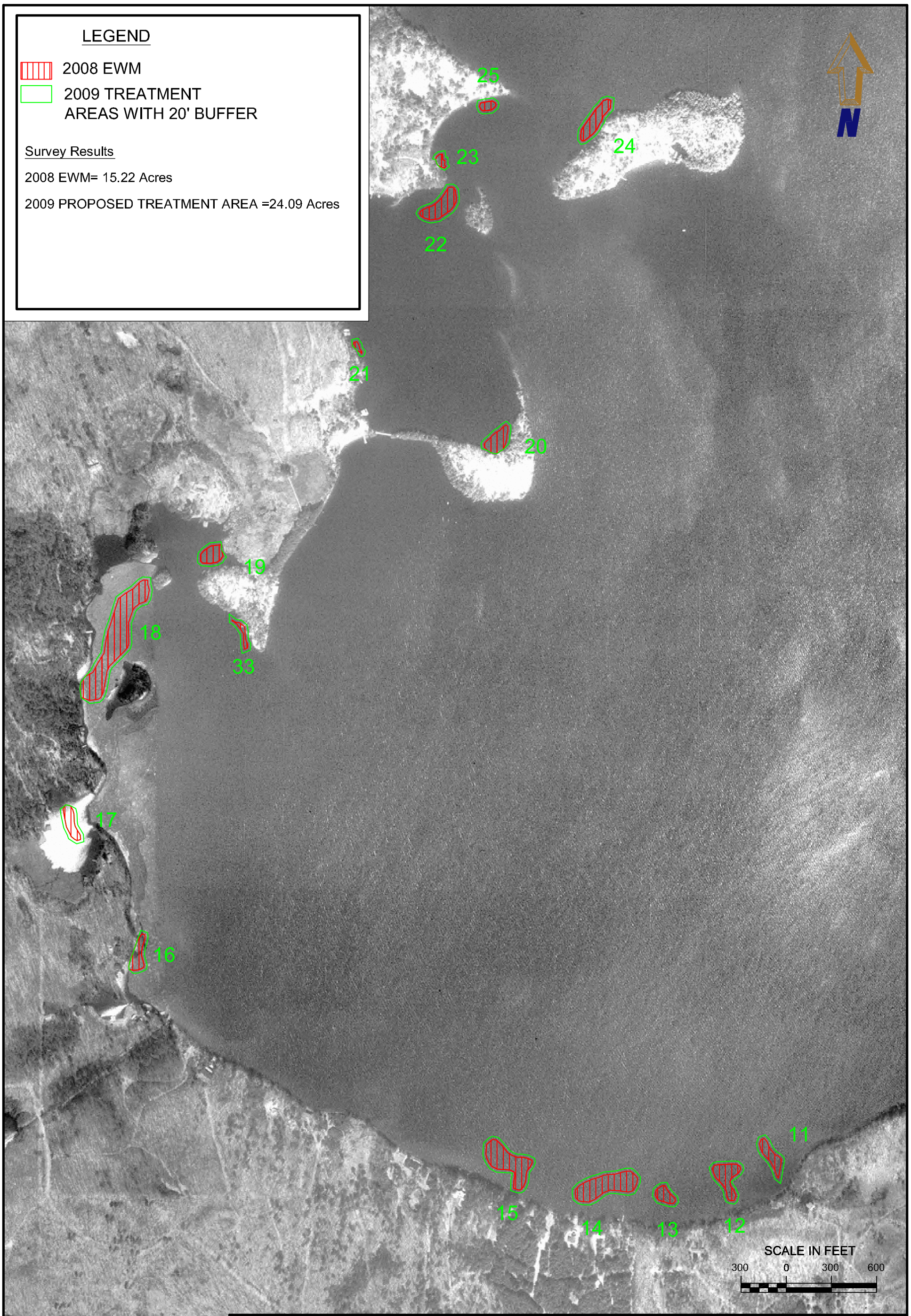
2008 EWM TREATMENT AREAS

TOMAHAWK LAKE PROPERTY OWNERS ASSOCIATION
TOMAHAWK LAKE
ONEIDA COUNTY, WISCONSIN

DATE: 12/08/08	DRAWN BY: NLB	TASK NUMBER: 100	PROJECT NUMBER: LTH08-5500-0905	FIGURE 2



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2008 EWM TREATMENT AREAS

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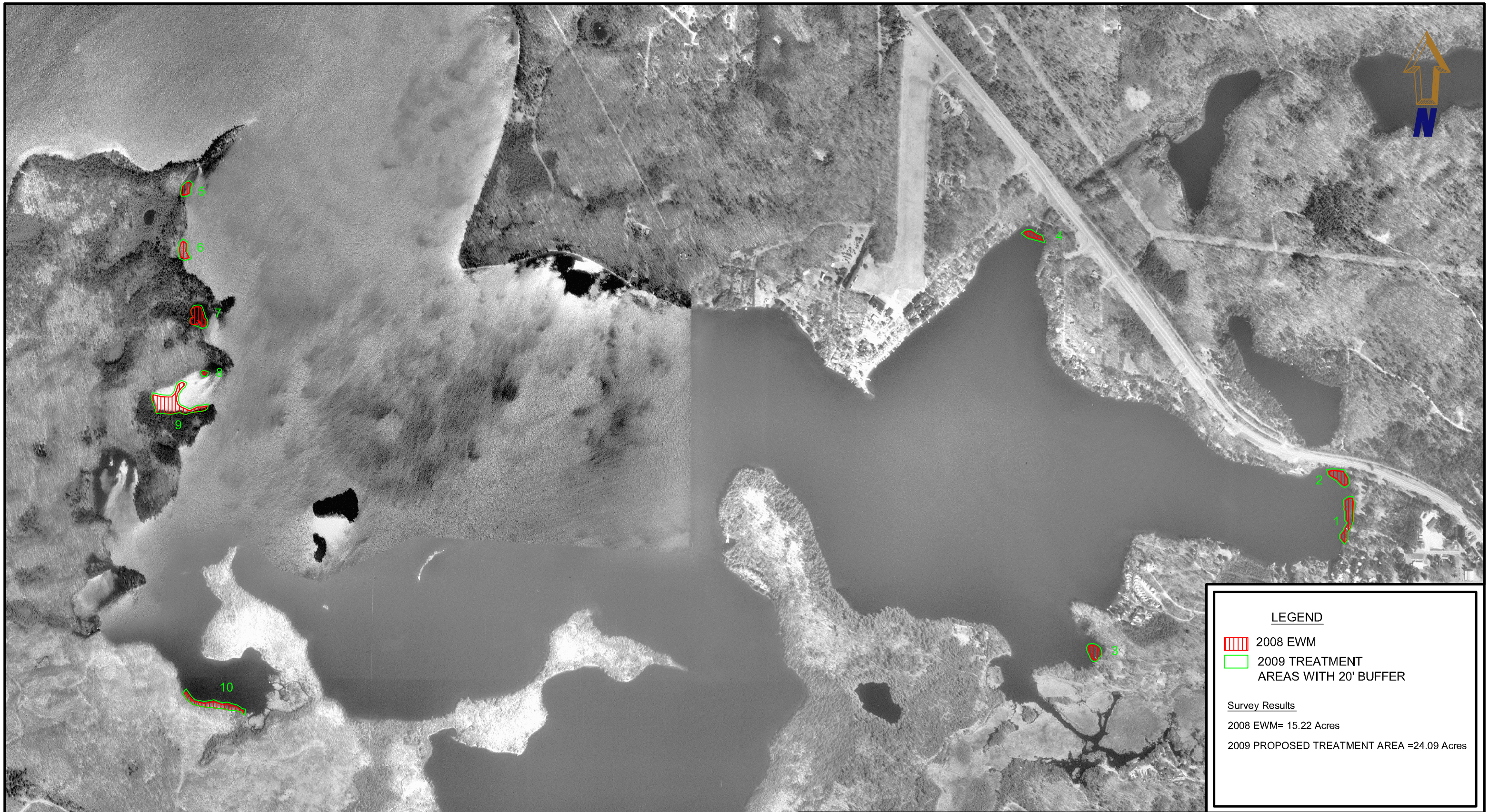
ONEIDA COUNTY, WISCONSIN

DATE: 12/08/08	DRAWN BY: NLB	TASK NUMBER: 100	PROJECT NUMBER: LTH08-5500-0905	FIGURE 3



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2008 EWM TREATMENT AREAS

TOMAHAWK LAKE PROPERTY OWNERS ASSOCIATION
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ONEIDA COUNTY, WISCONSIN

DATE: 12/08/08	DRAWN BY: NLB	TASK NUMBER: 100	PROJECT NUMBER: LTH08-5500-0905	FIGURE 4

APPENDIX E

DATA IN A MICROSOFT EXCEL SPREADSHEET

Polygon	Figure	Depth Range (ft)	EWM Acreage	Treatment Acreage*
1	4	0-5	0.69	1.05
		6-10	0	0
		10+	0	0
		Total	0.69	1.05
2	4	0-5	0.43	0.73
		6-10	0	0
		10+	0	0
		Total	0.43	0.73
3	4	0-5	0	0
		6-10	0.35	0.55
		10+	0	0
		Total	0.35	0.55
4	4	0-5	0	0
		6-10	0.2	0.44
		10+	0	0
		Total	0.2	0.44
5	4	0-5	0.18	0.29
		6-10	0.07	0.1
		10+	0	0
		Total	0.25	0.39
6	4	0-5	0.1	0.19
		6-10	0.18	0.35
		10+	0	0
		Total	0.28	0.54
7	4	0-5	0.52	0.74
		6-10	0.06	0.09
		10+	0	0
		Total	0.58	0.83
8	4	0-5	0	0
		6-10	0.03	0.09
		10+	0	0
		Total	0.03	0.09
9	4	0-5	1.21	1.59
		6-10	0.41	0.54
		10+	0	0
		Total	1.62	2.13
10	4	0-5	0.74	1.13
		6-10	0	0
		10+	0	0
		Total	0.74	1.13
11	3	0-5	0	0
		6-10	0.32	0.64
		10+	0	0
		Total	0.32	0.64
12	3	0-5	0	0
		6-10	0.47	0.8
		10+	0.05	0.09
		Total	0.52	0.89
13	3	0-5	0	0
		6-10	0.23	0.44
		10+	0	0
		Total	0.23	0.44

Polygon	Figure	Depth Range (ft)	EWM Acreage	Treatment Acreage*
14	3	0-5	0	0
		6-10	1.07	1.55
		10+	0.04	0.06
		Total	1.11	1.61
15	3	0-5	0.05	0.08
		6-10	0.89	1.32
		10+	0.1	0.15
		Total	1.04	1.55
16	3	0-5	0	0
		6-10	0.34	0.52
		10+	0	0
		Total	0.34	0.52
17	3	0-5	0.05	0.09
		6-10	0.27	0.47
		10+	0	0
		Total	0.32	0.56
18	3	0-5	0.3	0.29
		6-10	1.84	2.5
		10+	0.21	0.41
		Total	2.35	3.2
19	3	0-5	0.06	0.09
		6-10	0.25	0.4
		10+	0.02	0.04
		Total	0.33	0.53
20	3	0-5	0.4	0.59
		6-10	0	0
		10+	0	0
		Total	0.4	0.59
21	3	0-5	0.05	0.14
		6-10	0	0
		10+	0	0
		Total	0.05	0.14
22	3	0-5	0.04	0.07
		6-10	0.5	0.8
		10+	0.04	0.06
		Total	0.58	0.93
23	3	0-5	0.07	0.16
		6-10	0.02	0.04
		10+	0	0
		Total	0.09	0.2
24	3	0-5	0.08	0.14
		6-10	0.3	0.54
		10+	0.1	0.18
		Total	0.48	0.86
25	3	0-5	0.04	0.09
		6-10	0.08	0.19
		10+	0	0
		Total	0.12	0.28
26	2	0-5	0	0
		6-10	0.21	0.39
		10+	0	0
		Total	0.21	0.39

Polygon	Figure	Depth Range (ft)	EWM Acreage	Treatment Acreage*
27	2	0-5	0	0
		6-10	0.15	0.26
		10+	0	0
		Total	0.15	0.26
28	2	0-5	0.02	0.03
		6-10	0.34	0.58
		10+	0.01	0.02
		Total	0.37	0.63
29	2	0-5	0	0
		6-10	0.31	0.57
		10+	0.04	0.08
		Total	0.35	0.65
30	2	0-5	0.09	0.13
		6-10	0.36	0.53
		10+	0	0
		Total	0.45	0.66
31	2	0-5	0.06	0.11
		6-10	0	0
		10+	0	0
		Total	0.06	0.11
32	2	0-5	0.08	0.22
		6-10	0	0
		10+	0	0
		Total	0.08	0.22
33	3	0-5	0.05	0.17
		6-10	0.05	0.18
		10+	0	0
		Total	0.1	0.35
Entire Lake	**1**	**0-5**	**5.31**	**7.39**
		6-10	**9.3**	**14.88**
		10+	**0.61**	**1.09**
		Total	**15.22**	**24.09**

* - includes a 20' protective buffer around EWM originally mapped.