Evaluation of the June 2009 Aquatic Herbicide Treatments on Gray's Bay and Phelps Bay, Lake Minnetonka, Minnesota

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BACKGROUND

In Minnesota generally and on Lake Minnetonka in particular, there is interest in the potential for active aquatic plant management techniques to provide selective control of the invasive exotic species Eurasian watermilfoil (*Myriophyllum spicatum*, dicot) and curly-leaf pondweed (*Potamogeton crispus*, monocot). Selective control of dicotyledonous plants, which include Eurasian watermilfoil, may be achieved with the auxin-mimics 2,4-D (Green and Westerdahl 1990) and triclopyr (Netherland and Getsinger 1992), which are commonly used systemic herbicides (Getsinger et al. 1997, Poovey et al. 2004). Endothall is a contact herbicide (Netherland et al. 1991), which can be used to control a wide range of aquatic plants. Research has shown that endothall can be used to selectively control curly-leaf pondweed with careful selection of application rates (Skogerboe and Getsinger 2002) and seasonal timing (Poovey et al. 2002). Additional research has shown that low rates of endothall combined with 2,4-D or triclopyr can provide selective control of these two exotic species, if applied in early spring when most native species are dormant (Skogerboe and Getsinger 2006).

In 2007 a project was initiated on Lake Minnetonka to demonstrate the potential of aquatic plant management strategies to provide selective control of Eurasian watermilfoil (*Myriophyllum spicatum*) and curly-leaf pondweed (*Potamogeton crispus*). Three basins in Gray's, Phelp's, and Carmen's Bay were selected for pre treatment aquatic plant surveys conducted by personnel from the US Army Engineer Research and Development Center (ERDC). Eurasian watermilfoil and curlyleaf pondweed were present in all basins, and native plants were abundant in depths $\leq$ 15 ft.

In May 2008, large areas of Gray's, Phelps, and Carmen's bays were treated with a combination of liquid formulations of endothall and triclopyr. Results were presented in a summary report submitted to the Lake Minnetonka Conservation District (LMCD) (Skogerboe and Netherland 2008).

In June 2009, large areas of Phelps Bay, and Gray's Bay on Lake Minnetonka were treated with a granular formulation of the registered aquatic herbicide triclopyr. No treatments were conducted on Carman's Bay. Treatment plans called for triclopyr to be applied at target concentrations of 1 mg acid equivalent (ae.) /L. For perspective, the maximum label rate of triclopyr is 2.5 mg ae./acre. In conjunction with these treatments, ERDC personnel conducted plant surveys and collected water samples for triclopyr residue analysis. Sampling protocols were designed to determine initial dilution and dispersion patterns in order to link efficacy to herbicide residues.

Caution should be exercised in interpretation of these results for several reasons. First, this study lacks information gathered from a number of un-treated bays equal to the number of treated bays. Consequently, it is difficult or impossible to know what variation might have occurred in such bays in the absence of treatment with herbicides. During 2009, Carman's Bay was not treated, though it was monitored. Consequently, observations from Carman's Bay during 2009 may indicate variation in plants and perhaps water quality due to factors other than bay-wide treatment.

Second, it is important to note that the abundance of submersed plants may vary from year to year due to causes other than treatment; this is natural variation. For example, the abundance of curly-leaf pondweed can vary widely from year to year in the absence of lake-wide control. Woolf and Madsen (2003) reported that shoot biomass of curly-leaf increased by 100% from one year to the next in two of three lakes studied in southern Minnesota. This high level of variation in un-managed lakes suggests that caution should be exercised in interpreting observed changes in treated lakes.

Third, though results of a Chi-square test may indicate a statistically significant difference in the vegetation of a bay between two consecutive years, this does not necessarily mean that the difference resulted from treatment with herbicide.

METHODS

Aquatic Plant Evaluations:
At the request of the Minnesota Department of Natural Resources, ERDC initiated plant surveys on all three bays in June and September of 2007 to evaluate the plant communities and establish background data for potential future aquatic plant management demonstrations. The survey was conducted by John Skogerboe, ERDC Eau Galle Aquatic Ecology Laboratory, Spring Valley, WI using the point intercept method (Madsen 1999). Additional plant surveys were conducted in June, 2008 and 2009 and early September 2008 and 2009 to evaluate the effect of herbicide treatments on target and non target plant species.

Prior to conducting the first surveys, 50x50 m grids were established for Gray's Bay (Figure 1), Phelps Bay (Figure 2), and Carmen's Bay (Figure 3) using Garmin MapSource Topo mapping software. The grids were downloaded unto GPS (Global Positioning System) equipment accurate to 10 to 20 ft. Samples were collected using a 36-cm wide rake attached to a rope. At each sample point, the rake was thrown from the boat approximately 10 to 20 ft and then raised up to the water surface. Each species was then recorded for each sample point. Percent occurrence of plant species was calculated by dividing the number of points where a particular species was present by the total number of sample points in the littoral zone. June and September post treatment percent occurrence data were compared to the same pretreatment months using Chi Square analysis ($p \leq 0.05$). The average number of species per sample point, and the total the number of native plant species in each basin were calculated.

Water Sampling:
Water samples were collected by US Army ERDC personnel prior to the treatment and at 1 (15-18 hour), 2, 3, 4, 7, 14, 21, 28, and 35 days post-treatment on both bays. Sample sites for each

bay were selected both within and outside of the herbicide target areas to determine herbicide exposure within the target areas as well as dispersion of residues from the treated areas. Eight sample sites were located in Gray's Bay (Figure 4): 6 sites within treated target areas, one site (GR8) located in a non target water lily area, and one site located at a non target deep water site (GR5). Ten sample sites were located in Phelps Bay (Figure 5): 5 sites within treated target areas, three sites within non target water lily areas (PH8, PH9, and PH10) and two sites located in non target deep water sites (PH6 and PH7). Water samples collected within treated target areas were collected 1 ft from the bottom, and samples collected from non target areas were collected at mid depth.

Following collection, water samples were acidified and shipped to an ERDC facility located at the University of Florida Center for Aquatic and Invasive Plants. Triclopyr analyses were conducted via an enzyme-linked immunosorbant assay (ELISA) (Fischer and Michael 1997). Results are analyzed and reported as the triclopyr acid equivalent (ae). Triclopyr residue concentrations were log transformed and a linear regression was run to determine an equation to describe the loss rate of triclopyr from treated areas. The regression equation was then used to calculate the half life of triclopyr in treated areas.

Treatments:
Two bays, Gray's and Phelps were treated with 3,5,6-trichloro-2-pyridinyloxyacetic acid, triethylamine salt (triclopyr) applied as the granular formulation Renovate OTF. Residents on Carmen's Bay opted not treat.

Gray's Bay - Approximately 123 acres (average 5.7 feet) were treated on Jun 1, 2009 (Figure 6). Herbicides were applied by boat with battery powered granule spreaders. This treatment represented 70% of the 175-acre bay. Winds were between 4 to 6 mph on the treatment date and remained light and variable for several days following the application.

Phelps Bay - Approximately 122 acres (average 5.9 feet deep) were treated on June 2, 2009 (Figure 7). Herbicides were applied by boat with battery powered granule spreaders. This treatment represented 33% of the 373-acre bay. Winds were < 6 mph on the treatment date and remained light and variable for several days post-treatment.

Results

Water Residue Analysis:

<u>Gray's Bay</u>
Initial concentrations of triclopyr in treated target areas were less than the 1000 ug/L ae target application rate (Figure 8), and the mean initial concentration for all treated areas estimated by a linear regression was 490 ug/L ae (Table 1). Granular herbicide formulations can release herbicide over time, and water movement then disperses some of the herbicide into adjacent un-treated areas so that concentrations in the treated area may not actually reach the target application rate (Hoepple and Westerdahl 1983). The triclopyr half lives ranged from 7.0 to 12.8 days at sites located in the target areas and the mean was 9.6 days. Previously published concentration exposure time data showed that 250 ug/L ae triclopyr for 72 hrs provided control of Eurasian watermilfoil (Netherland and Getsinger 1992). The initial concentration at site

GR8 located in a non target water lily area was initially low, but was greater than100 ug/L ae and remained at that level through 21 DAT.

Phelps Bay

Initial concentrations in treated target areas were also less than the 1000 ug/L ae target application rate (Figure 9) and the mean initial concentration for all treated areas was 217 ug/L ae (Table 1). The triclopyr half lives ranged from 4.9 to 15.5 days at sites located in target areas and the mean was 6.6 days. Initial triclopyr concentrations at sites PH1 and PH3 were 499 and 474 ug/L ae similar to concentrations seen in Gray's Bay. Initial concentrations were 234 ug/L ae at site PH4 and less than 100 ug/L ae at sites PH2 and PH5. Initial concentrations in non target water lily areas were all greater than 100 ug/L ae and were 295 mg/L ae at site PH9 and 379 ug/L ae at site PH10 indicating triclopyr dispersion into these areas was rapid.

Aquatic Plant Evaluations:

Gray's Bay

Pre-treatment: The littoral zone (depth $\leq$ 15) contained 216 sample points which was 84% of all sample points (Table 2). Eurasian watermilfoil was found at 86% (Jun 07) and 86% (Sep 07) of littoral zone sample points, and curly-leaf pondweed was found at 20% (Jun 07) and 3% (Sep 07) of the littoral zone sample points. The decline in percent occurrence of curly-leaf pondweed was due to normal senescence in late spring and early summer. The native plant community was dominated by coontail (*Ceratophyllum demersum*, dicot), big-leaf pondweed (*Potamogeton amplifolius*, monocot), clasping-leaf pondweed (*Potamogeton richardsonii*, monocot), flat-stem pondweed (*Potamogeton zosteriformis*, monocot), and sago pondweed (*Stukenia pectinata*, monocot). Plant species were distinguished as monocots or dicots because some aquatic herbicides are selective for dicots while others are broad spectrum herbicides which can affect both monocots and dicots. The native plant community was composed of 18 different species including 6 dicots, 11 monocots, and 1 macro-alga.

Post treatment: June 2009 plant data was collected within 4 weeks of herbicide application, when the effects of the treatment were not complete. For example Eurasian watermilfoil in most cases was badly damaged and dying, but would still be counted as present. Sep 09 post treatment plant data showed a decline in the percent occurrence of Eurasian watermilfoil (Table 2) from 54 % in Sep 08 compared to 1 % in Sep 09. Residue data indicated that initial concentrations and half lives were sufficient to provide control of Eurasian watermilfoil in all treated areas, and the plant evaluations support this (Figure 10). The percent occurrence data also indicated an increase in curly-leaf pondweed in Jun 09 (23%) compared to Jun 08 (5%). Large changes in native plant species were not apparent; however spatterdock and fragrant water lily exhibited significant visual injury symptoms into Jul 09. Declines in percent occurrence of spatterdock and fragrant water lily were not statistically significant. Overall the number of native species per sample point declined in Sep 09 (2.3) compared to Sep 08 (2.7) and the percentage of sample points with native plants also declined.

Phelps Bay

Pre-treatment: The littoral zone (depth $\leq$ 15) contained 257 sample points which was 73% of all sample points (Table 3). Eurasian watermilfoil was found at 65% (Jun 07) and 67% (Sep 07) of littoral zone sample points, and curly-leaf pondweed was found at 36% (Jun 07) and 5% (Sep 07) of the littoral zone sample points. The native plant community was composed of 23 different species including 8 dicots, 14 monocots, and 1 macro-alga

2009 post treatment: Post treatment plant data showed a significant decline in the percent occurrence of Eurasian watermilfoil from Sep 08 (69%) to Sep 09 (20%). The data also indicated an increase in curly-leaf pondweed in Jun 09 (40%) compared to Jun 08 (1%). Much of the surviving or recovering Eurasian watermilfoil was located in areas where water residue data indicated that mean initial triclopyr concentrations were lowest (Figure 12). Observation also indicated that remaining Eurasian watermilfoil density was very low in areas where triclopyr concentrations were highest. Some Eurasian watermilfoil near sites PH2, PH5 and deeper areas near PH4 appeared denser than other treated areas indicating that some recovery occurred. Large changes in native plant species were not apparent; however spatterdock and fragrant water lily exhibited significant triclopyr symptoms into Jul 09 (Figure 12). Declines in percent occurrence were not statistically significant. Overall the number of native species per sample point declined in Sep 09 (2.2) compared to Sep 08 (2.7) and the percentage of sample points with native species also declined.

Carmen's Bay
Eurasian watermilfoil percent occurrence increased in Sep 09 (77%) compared to Sep 08 (72%) but was not statistically significant (Table 4). Infested areas were delineated (Figure 13). No significant changes occurred in the native plant community in Sep 09 compared to Sep 08. You may want to mention a lack of CLP recovery in Carmen's Bay compared to the 2 sites treated in 2009.

Discussion:

Percent occurrence of Eurasian watermilfoil declined significantly in both Gray's and Phelps bays following the 2009 triclopyr treatment. Some areas in Phelps Bay where residue data indicated low triclopyr concentrations showed recovery by September. Plant data and triclopyr residue data indicated that these areas and similar areas may need to be treated at higher rates. These areas include long narrow infested areas adjacent to deep water.

Percent occurrence of curlyleaf pondweed increased significantly in both Gray's and Phelps bays following the 2009 triclopyr treatment. Triclopyr is generally selective for dicots, and curlyleaf pondweed is a monocot which is generally not controlled by triclopyr. The ultimate level of curlyleaf pondweed infestation cannot be accurately predicted; however a previous study on Phelps Bay with triclopyr indicated that it increased significantly following successful control of Eurasian watermilfoil (Madsen and Getsinger 1995). Endothall applications in early spring could be used to control this species, and it was successfully used for curlyleaf pondweed control on all three bays in 2008.

Adverse visual impacts to native plants occurred primarily to white water lily and spatterdock in non target areas. Despite obvious injury symptoms, the percent occurrence data was not statistically significant. These species were exposed to low rates of triclopyr for 24 hrs in mesocosm trials, and despite early and often severe injury symptoms, good recovery was observed (Glomski and Nelson 2008). By comparison, the mean triclopyr half live was 9.6 days in Gray's Bay and 6.6 days in Phelps Bay. Visual observation and photos indicated significant triclopyr symptoms and a decrease in lily density. Visual observation of water lilies in September both white water lily and spatterdock indicated that remaining plants had recovered. Percent occurrence data also showed a significant increase in water marigold and white water crowfoot, both native dicots and potentially sensitive to triclopyr. Visual observation showed a significant increase in density of these species.

The increased success of the 2009 treatments in controlling EWM was likely related to an increased exposure of the plants to phytotoxic concentrations of triclopyr over several days. The increased plant density on the date of treatment, and generally calm conditions following the applications likely allowed the residues to remain in the treatment zones for a much longer period of time than was observed in 2008. The increased presence of curlyleaf pondweed in June 2009 suggests that it may need to be targeted in Phelp's and Gray's Bay in 2010.

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Table 1. Linear regression analysis of Triclopyr residue data and half lives calculated from regression equations.

Gray's Bay triclopyr residue analysis			
Sample Site	**Y intercept ug/L ae**	**R-square**	**Half Life Days**
GR1*	316	0.70	12.8
GR2*	593	0.96	8.7
GR3*	503	0.89	10.0
GR4*	349	0.84	11.1
GR5	118	0.00	
GR6*	516	0.88	10.0
GR7*	816	0.81	7.0
GR8	12	0.21	
All Treated Sites	490	0.76	9.6
Phelps Bay triclopyr residue analysis			
Sample Site	**Y intercept ug/L ae**	**R-square**	**Half Life Days**
PH1*	499	0.85	5.7
PH2*	95	0.89	10.5
PH3*	474	0.96	5.0
PH4*	234	0.99	5.5
PH5*	92	0.66	8.7
PH6	57	0.13	15.5
PH7	51	0.24	15.1
PH8	175	0.29	9.9
PH9	295	0.63	6.6
PH10	379	0.96	4.9
All Treated Sites	217	0.68	6.6

*Sample sites that were directly treated with triclopyr

Table 2. Summary of point intercept data collected for Gray's Bay (2007-2009)

Percent occurrence results: Gray's Bay						
	Jun 07	**Sep 07**	**Jun 08**	**Sep 08**	**Jun 09**	**Sep 09**
Exotic submersed macrophytes (%)*						
Eurasian watermilfoil (*Myriophyllum spicatum*)	86	86	50*	54*	37	1*
Curly-leaf pondweed (*Potamogeton crispus*)	20	3	5*	0	23*	1
Native submersed macrophytes (%)*						
water marigold (*Bidens beckii*)	1	1	1	2	6	6
coontail (*Ceratophyllum demersum*)	38	40	45	56	48	50
elodea (*Elodea canadensis*)	8	9	15	19	8	12
slender naiad (*Najas flexilis*)	5	2	21*	35*	33	31
big-leaf pondweed (*Potamogeton amplifolius*)	27	28	18	16	24	24
Illinois pondweed (*Potamogeton illinoensis*)	3	3	1	4	8*	8
white-stem pondweed (*Potamogeton praelongus*)	7	8	1*	0*	2	2
small pondweed (*Potamogeton pusillus*)	10	5	2*	2	0	0
clasping-leaf pondweed (*Potamogeton richardsonii*)	62	60	51	45	33*	29
fern pondweed (*Potamogeton robbinsii*)	24	23	16*	17	8	8
flat-stem pondweed (*Potamogeton zosteriformis*)	54	51	12	6*	2*	2
white water crowfoot (*Ranunculus longirostris*)	3	1	2	0	2	0
sago pondweed (*Stukenia pectinata*)	19	21	13	16	14	14
wild celery (*Vallisneria americana*)	5	5	6	17*	14	23
water star-grass (*Zosterella dubia*)	1	1	2	13*	2	3*
Native floating-leaf macrophytes (%)*						
spatterdock (*Nuphar advena*)	4	5	4	4	3	2
fragrant water-lily (*Nymphaea odorata*)	7	7	6	7	6	3
Submersed macro-algae (%)*						
chara	13	8	3*	11	14*	12
Number of sample sites	258	258	262	264	274	274
Number of sample sites in littoral zone (depth $\leq$ 15 ft)	216	216	218	238	233	233
Percent points in littoral zone	84	84	83	90	85	85
Mean number of species per point (littoral zone)	4.0	3.8	3.2	3.2	2.9	2.3
Mean number of native species per point (littoral zone)	2.9	2.9	2.4	2.7	2.3	2.3
Percentage of points with plants (littoral zone)	99	98	94	98	94	90
Percentage of points with native plants (littoral zone)	94	94	91	97	88	89
Number of plant species	20	20	20	18	20	20
Number of native plant species	18	18	18	17	18	18

All percent occurrence data are based on percentage of the littoral zone

*Indicates that the value was statistically significantly different compared to same sample interval from the previous year ($p < 0.05$)

Table 3. Summary of point intercept data collected for Phelps Bay (2007-2009)

Percent occurrence results: Phelps Bay						
	Jun 07	**Sep 07**	**Jun 08**	**Sep 08**	**Jun 09**	**Sep 09**
Exotic submersed macrophytes (%)						
Eurasian watermilfoil (*Myriophyllum spicatum*)	65	67	60	69	29*	20*
Curly-leaf pondweed (*Potamogeton crispus*)	36	5	1*	7	40*	3
Native submersed macrophytes (%)						
water marigold (*Bidens beckii*)	7	8	2	4	11*	13*
coontail (*Ceratophyllum demersum*)	52	55	56	69	46	53
elodea (*Elodea canadensis*)	1	2	3	5	9	6
northern milfoil (*Myriophyllum sibiricum*)	5	8	5	11	4	1*
slender naiad (*Najas flexilis*)	13	10	8	21*	23*	26
big-leaf pondweed (*Potamogeton amplifolius*)	18	23	15	6*	11	11
Illinois pondweed (*Potamogeton illinoensis*)	16	17	8	11	4	4
floating-leaf pondweed (*Potamogeton natans*)	1	1	1	1	2	3
white-stem pondweed (*Potamogeton praelongus*)	2	3	3	7	4	4
small pondweed (*Potamogeton pusillus*)	4	0	2	7*	0	0*
clasping-leaf pondweed (*Potamogeton richardsonii*)	27	29	23	24	23	23
fern pondweed (*Potamogeton robbinsii*)	3	3	3	1	2	2
flat-stem pondweed (*Potamogeton zosteriformis*)	37	40	10*	17*	3	4*
white water crowfoot (*Ranunculus longirostris*)	5	1	5	0	16*	5*
grassy arrowhead (*Sagittaria graminea*)	<1	1	0	1	0	0
softstem bulrush (*Scirpus validus*)	1	1	1	1	1	1
sago pondweed (*Stukenia pectinata*)	15	17	5*	10	15*	12
great bladderwort (*Utricularia vulgaris*)	2	2	2	2	6	7
wild celery (*Vallisneria americana*)	8	9	12	25*	9	19*
water star-grass (*Zosterella dubia*)	5	7	5	27*	8	8
Native floating-leaf macrophytes (%)						
spatterdock (*Nuphar advena*)	7	7	5	5	8	3
fragrant water-lily (*Nymphaea odorata*)	19	21	18	22	12	10
Submersed macro-algae (%)						
chara	3	2	1	2	11*	8*
Number of sample sites	365	365	363	360	355	336
Number of sample sites in littoral zone (depth $\leq$ 15 ft)	257	257	255	255	252	235
Percent points in littoral zone	70%	70%	70%	71%	71%	70
Mean number of species per point (littoral zone)	3.5	3.1	3.2	3.4	3.1	2.5
Mean number of native species per point (littoral zone)	2.5	2.7	2.2	2.7	2.3	2.2
Percentage of points with plants	97	96	91	92	91	88
Percentage of points with native plants	89	91	85	90	84	84
Number of plant species	25	24	24	24	24	25
Number of native plant species	23	22	22	22	22	23

All percent occurrence data is based on percentage of the littoral zone
*Indicates that the value was statistically significantly different compared to same sample interval from the previous year ($p < 0.05$)

Table 4. Summary of point intercept data collected for Carmen's Bay (2007-2009)

Percent occurrence results: Carmen's Bay					
	Jun 07	**Sep 07**	**Jun 08**	**Sep 08**	**Sep 09**
Exotic submersed macrophytes (%)					
Eurasian watermilfoil (*Myriophyllum spicatum*)	58	60	59	72	77
Curly-leaf pondweed (*Potamogeton crispus*)	28	4	4*	0	0
Native submersed macrophytes (%)					
water marigold (*Bidens beckii*)	4	4	1	10	8
coontail (*Ceratophyllum demersum*)	42	40	39	35	32
elodea (*Elodea canadensis*)	3	5	3	6	6
Northern milfoil (*Myriophyllum sibiricum*)	7	8	2	7	6
slender naiad (*Najas flexilis*)	12	10	3*	24*	18
big-leaf pondweed (*Potamogeton amplifolius*)	9	9	3	1*	1
Illinois pondweed (*Potamogeton illinoensis*)	3	4	3	15*	12
white-stem pondweed (*Potamogeton praelongus*)	2	2	1	4	3
small pondweed (*Potamogeton pusillus*)	2	1	1	1	1
clasping-leaf pondweed (*Potamogeton richardsonii*)	24	25	15	28	22
flat-stem pondweed (*Potamogeton zosteriformis*)	24	21	15	4*	3
white water crowfoot (*Ranunculus longirostris*)	2	0	2	0	0
sago pondweed (*Stukenia pectinata*)	17	20	10	16	13
great bladderwort (*Utricularia vulgaris*)	2	2	1	1	1
wild celery (*Vallisneria americana*)	4	6	5	23*	16
water star-grass (*Zosterella dubia*)	7	7	5	26*	20
Native floating-leaf macrophytes (%)					
fragrant water-lily (*Nymphaea odorata*)	10	10	13	14	11
Submersed macro-algae (%)					
chara	7	6	6	14*	11
Number of sample sites	305	305	304	301	315
Number of sample sites in littoral zone (depth $\leq$ 15 ft)	181	181	175	170	212
Percent points in littoral zone	59%	59%	58%	56%	67%
Mean number of species per point (littoral zone)	2.64	2.30	2.10	3.05	2.62
Mean number of native species per point (littoral zone)	1.78	1.68	1.25	2.32	1.85
Percentage of points with plants	85	83	85	95	87
Percentage of points with native plants	72	73	69	85	69
Number of plant species	20	19	21	20	18
Number of native plant species	18	17	19	19	17

All percent occurrence data is based on percentage of the littoral zone
*Indicates that the value was statistically significantly different compared to same sample interval from the previous year ($p < 0.05$)

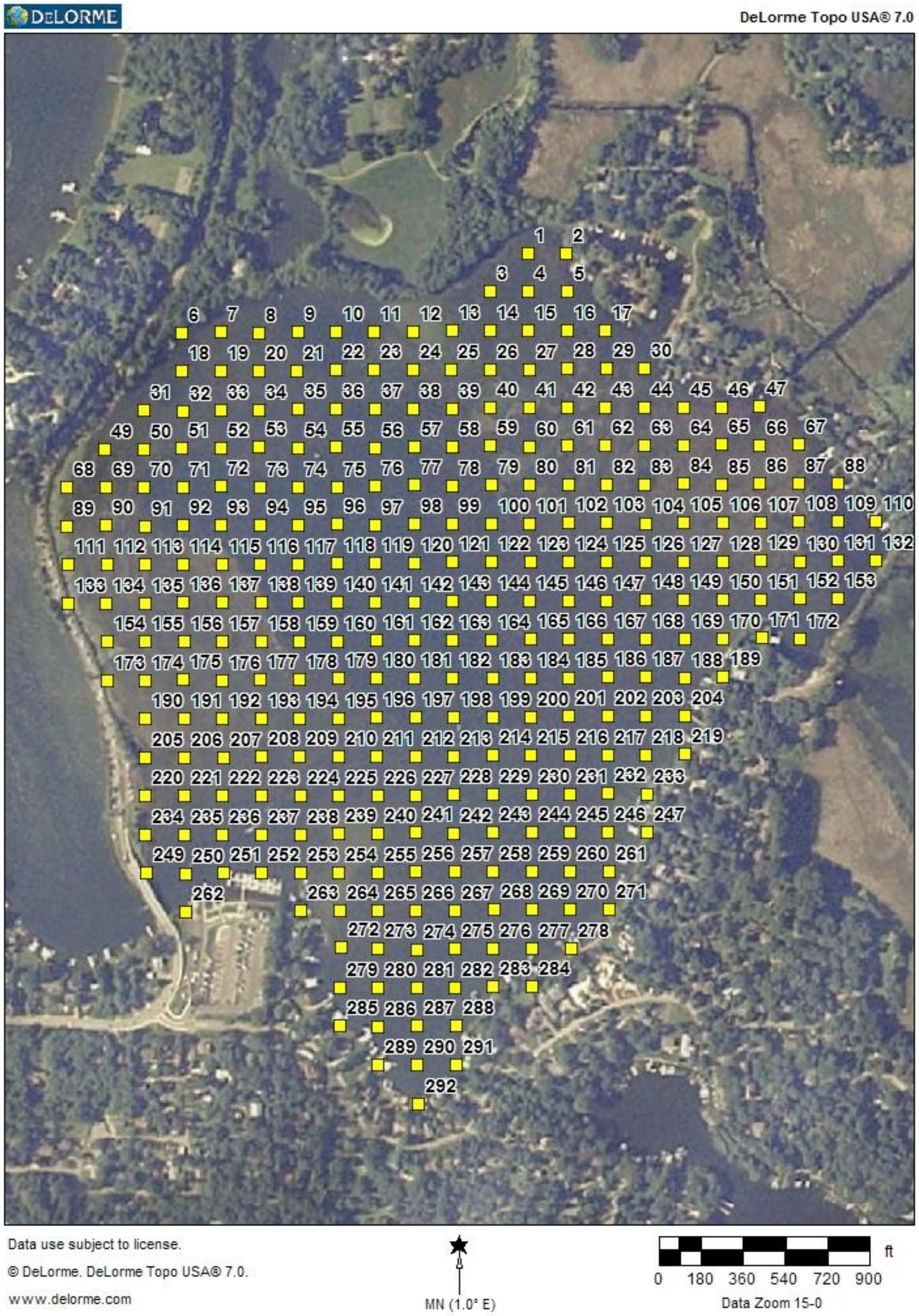

Figure 1. Gray’s Bay point intercept grid (50 m x 50 m)

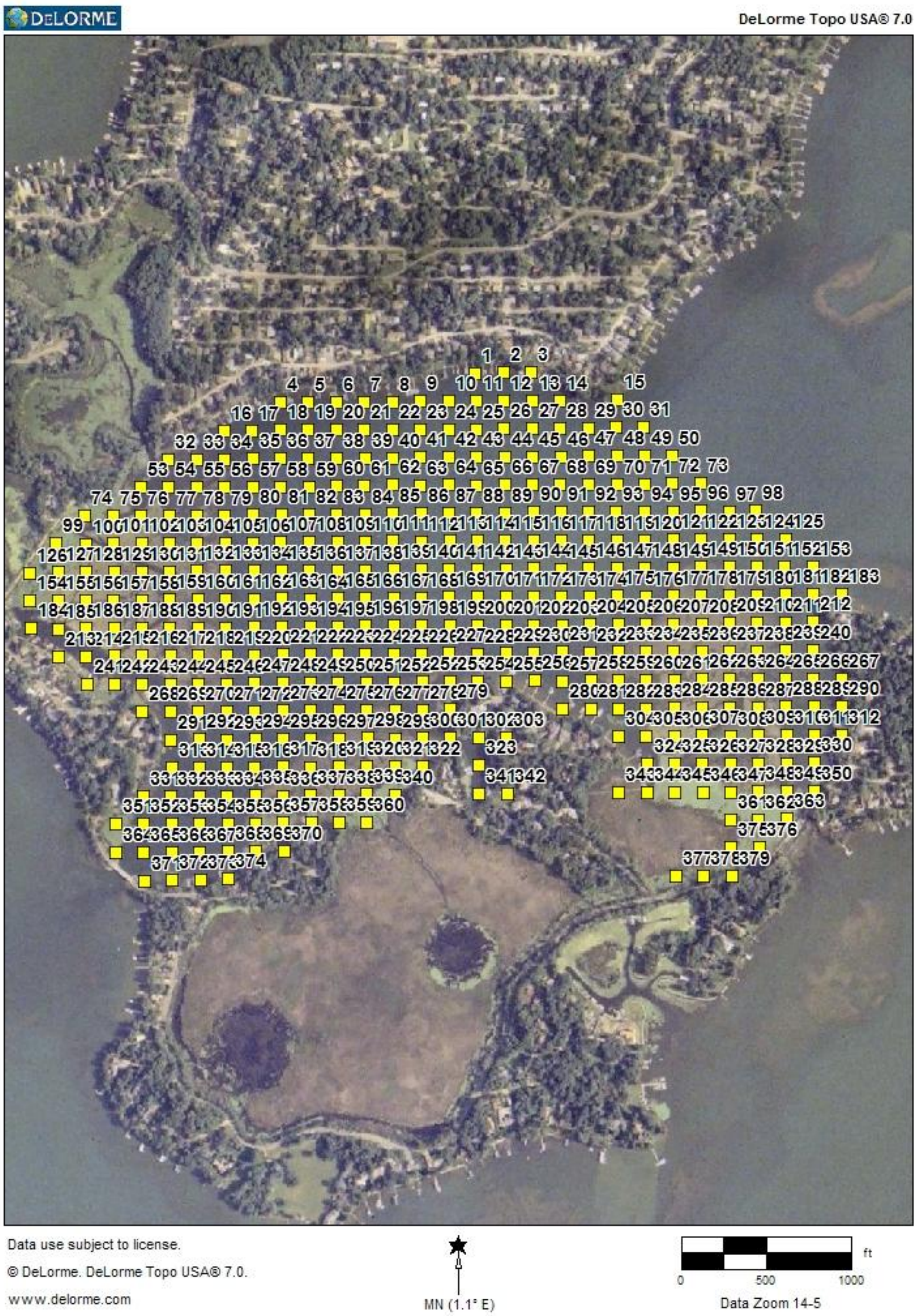

Figure 2. Phelps Bay Point Intercept Grid (50 m x 50 m)

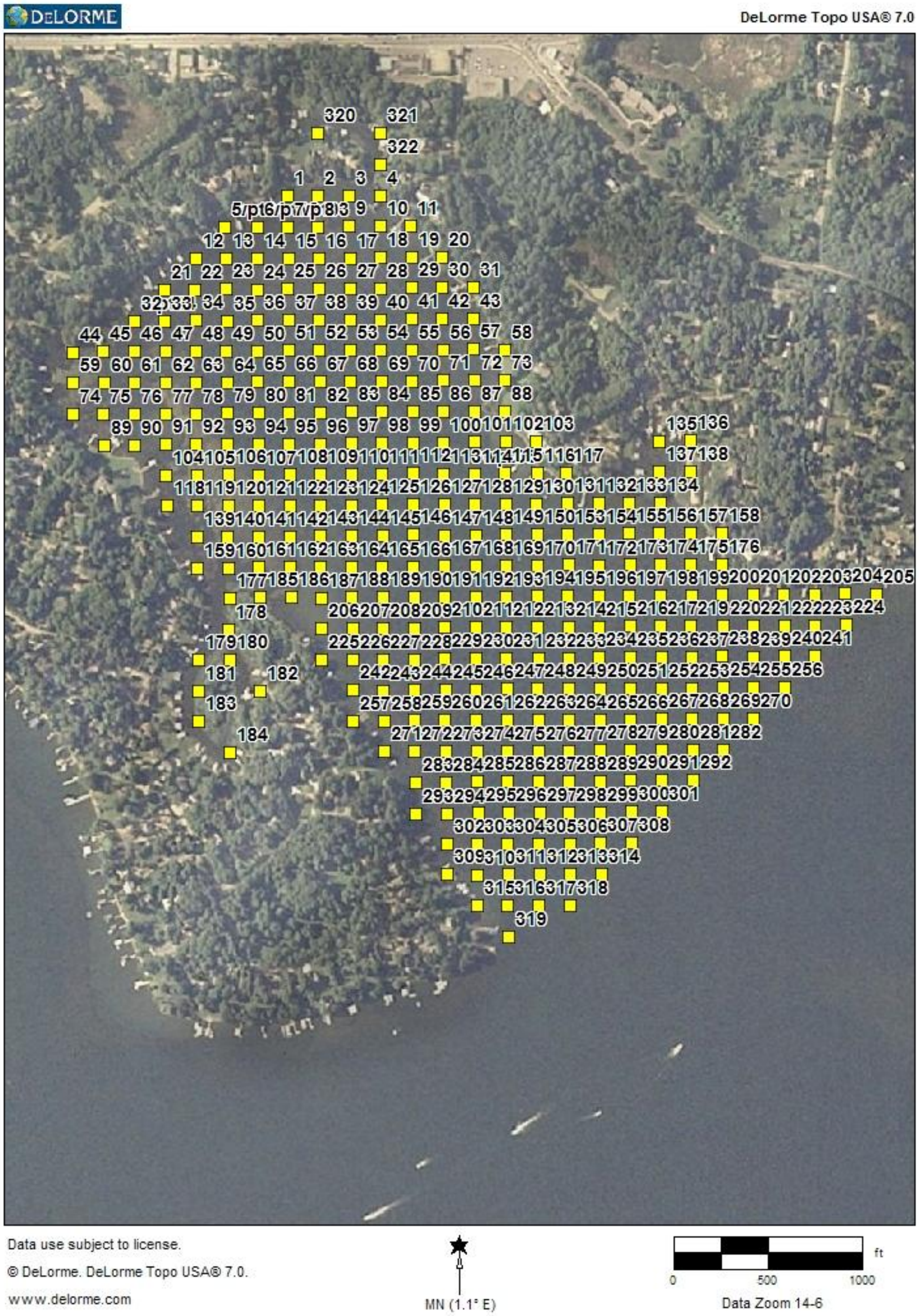

Figure 3. Carmen's Bay point intercept grid (50 m x 50 m)

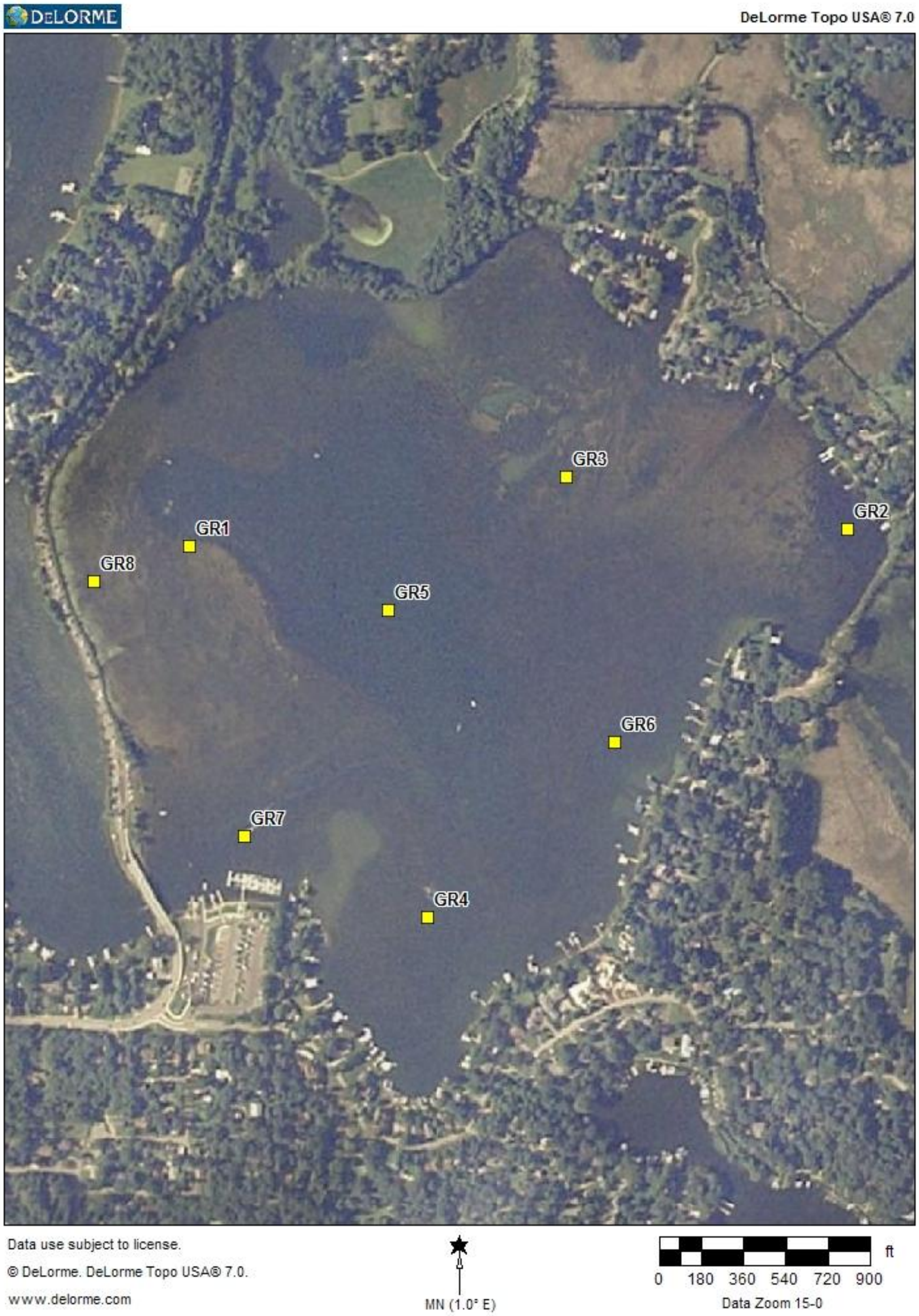

Figure 4. Gray's Bay water residue sample locations

Figure 5. Phelps Bay water residue sample locations

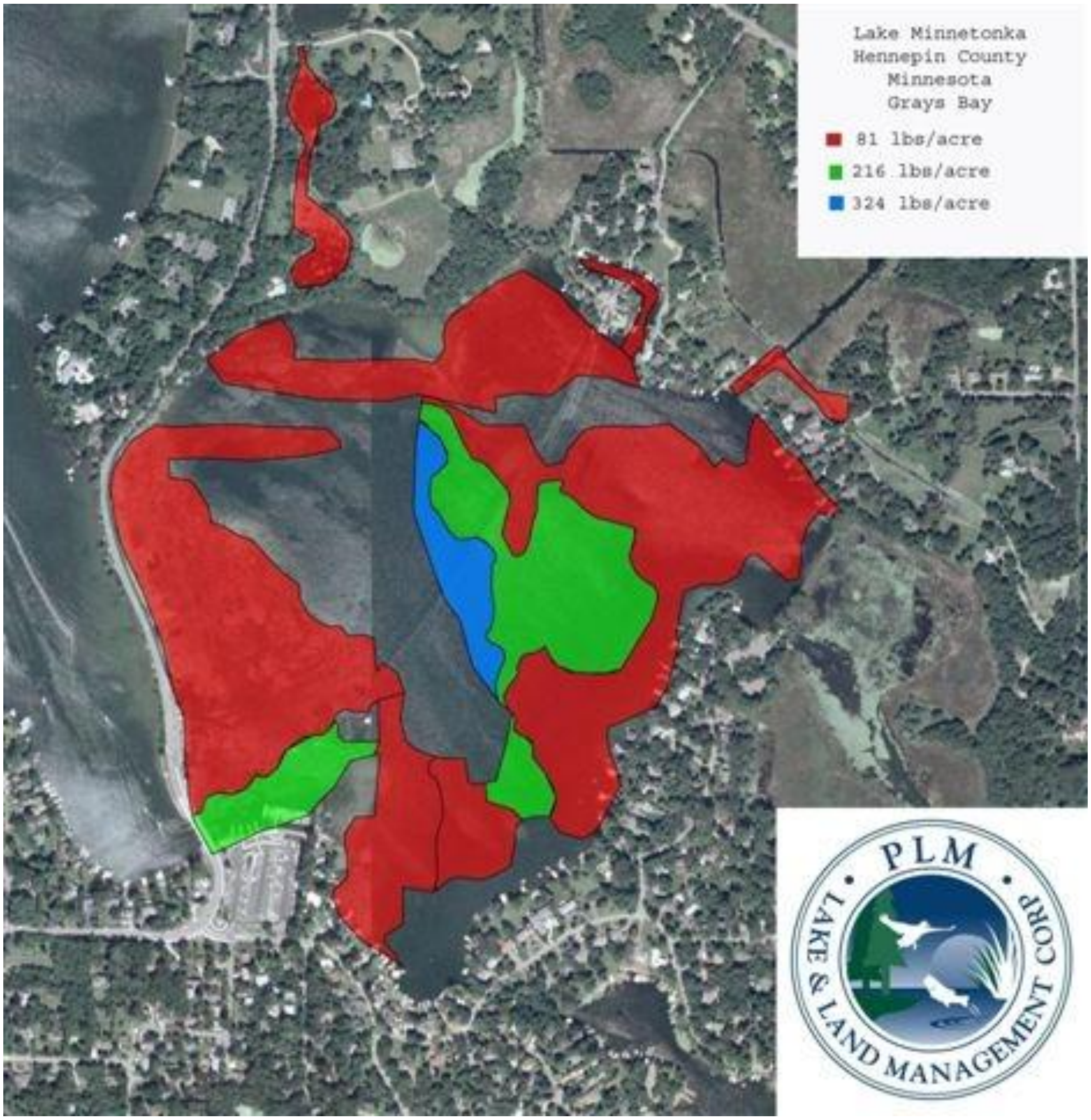

Figure 6. Gray's Bay areas treated with triclopyr in June 2009

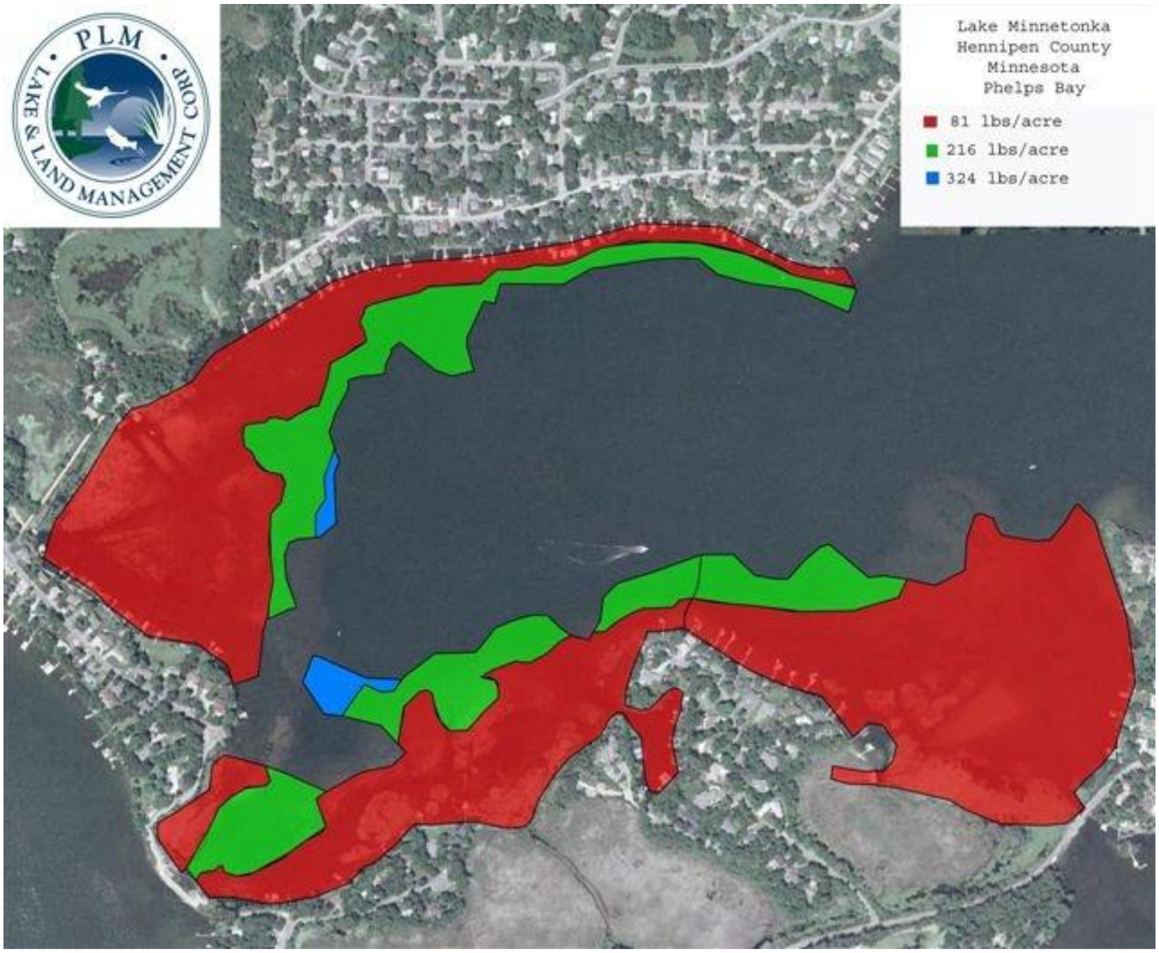

Figure 7. Phelps Bay areas treated with triclopyr in June 2009

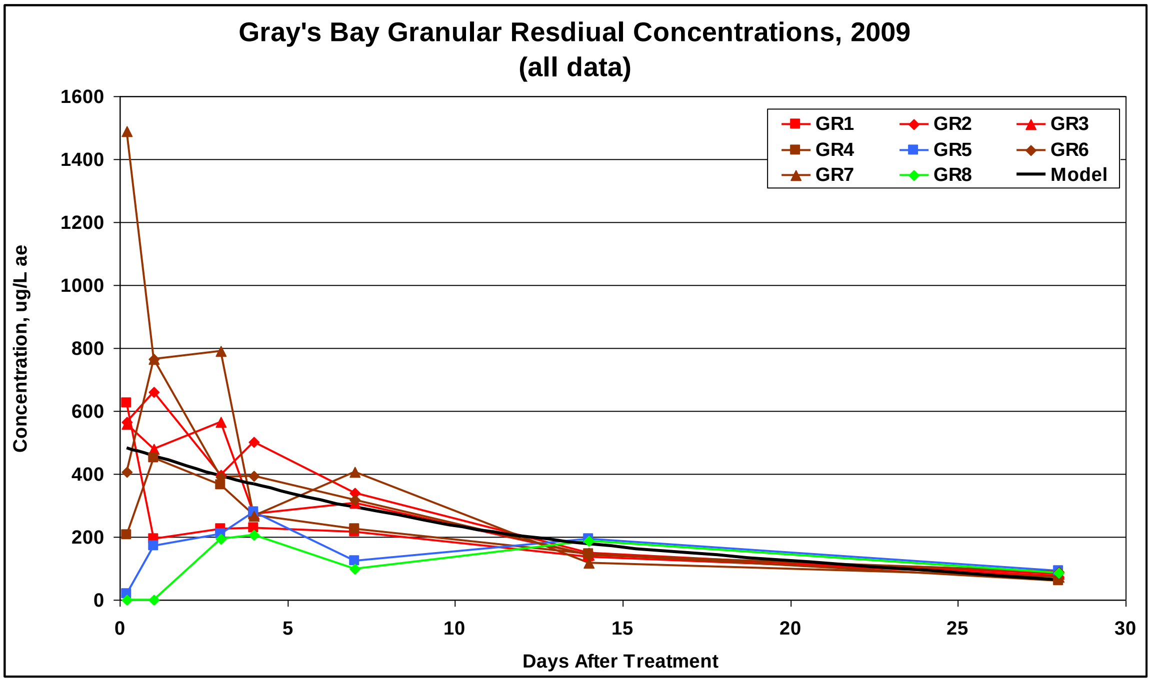

Figure 8. Gray's Bay 2009 triclopyr residue concentrations

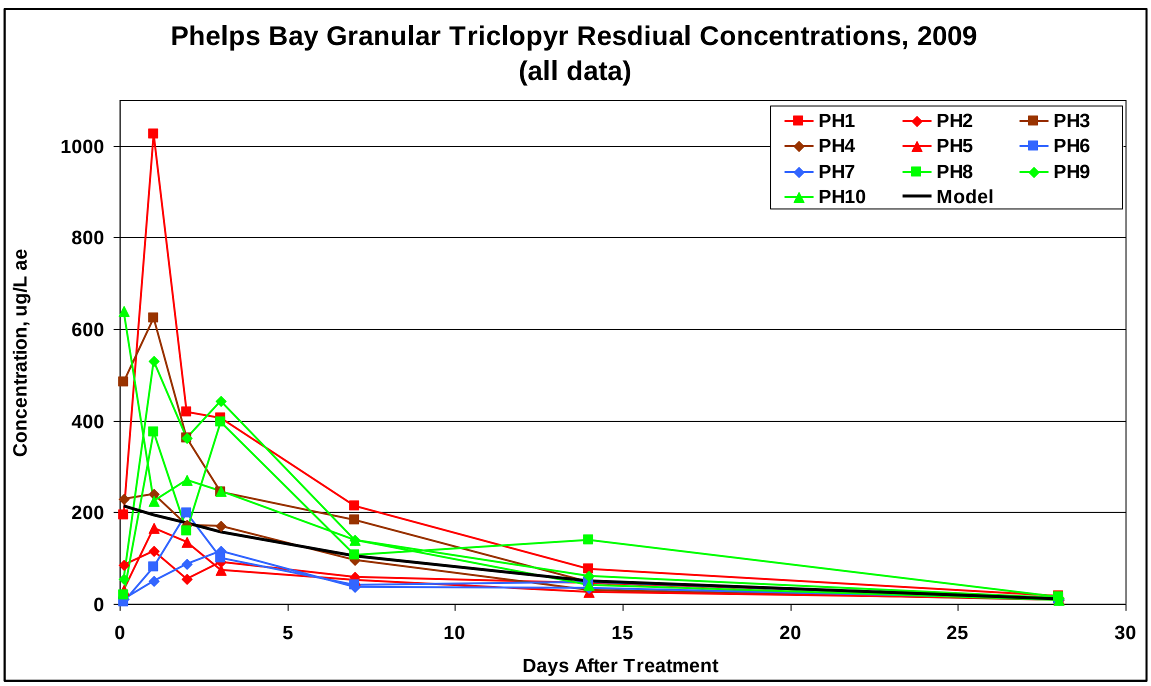

Figure 9. Phelps Bay 2009 triclopyr residue concentrations

Figure 10. Gray's Bay Eurasian watermilfoil locations, September 2009

Figure 11. Herbicide injury to fragrant water lily following application of triclopyr

Figure 12. Phelps Bay Eurasian watermilfoil locations, September 2009

Figure 13. Carmen's Bay Eurasian watermilfoil locations, September 2009