2011 Long Lake, Plainfield Township, MI
Milfoil Solution® Progress Report

Prepared for:

Plainfield Township

Prepared by:

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I. Introduction

Eurasian watermilfoil (*Myriophyllum spicatum*, hereafter referred to as milfoil) is an exotic aquatic species that tolerates a wide range of growing conditions and out-competes native vegetation. Monocultures of milfoil limit recreational use, reduce biodiversity, and can cause detrimental changes to water temperature and dissolved oxygen in severe infestations.

The native North American beetle, the milfoil weevil (*Euhrychiopsis lecontei)*, has been augmented in Long Lake, Iosco County, Michigan, since 2009 to suppress the growth of milfoil. This weevil is a specialist herbivore of milfoil and damages the plant in multiple ways. The most significant impact is caused by the weevil larva as it damages the meristem, or growing tip, and burrows through the stem. Nutrient flow in the plant is disrupted and the stem loses buoyancy and collapses in the water column. A cascading effect pulls neighboring plants lower into the water column and the rate of photosynthesis is significantly reduced in these stems.

The following is an outline of the Milfoil Solution® project at Long Lake:

Year	Survey Dates	Sites Established	Weevils Stocked
2009	Initial: 6/11, 6/18 Follow-up: 8/10	M1, S1, S2,	22,000
2010	Initial: 6/10, 6/17 Follow-up: 8/27	S3, S4, S5	95,000 (5 sites)
2011	Initial: 6/22, 6/30 Follow-up: 8/25	S6	92,000 (6 sites)
2012	--	--	*See* ***Section V.***
2013	*Final Survey*	--	--

II. Survey Methods

An initial survey is performed prior to weevil stocking and a follow-up survey is conducted six to eight weeks later. Qualitative observations include overall milfoil density and health, native plant species present, and the presence of weevils and weevil-induced damage. Quantitative measurements include milfoil density and weevil population density. Milfoil density is determined by randomly collecting stems throughout the milfoil bed using a quadrat. This sample is then converted to the number of stems per square meter (stems/m^2). Weevil population density (number of weevils per stem) is determined through lab analysis of 30 stems sampled from three transect lines at each site

III. Survey Results and Weevil Stocking

Seven sites were surveyed in 2011 (S1-S6, M1) and six sites were stocked this year (S1-S6) with a total of 92,000 weevils. Weevil densities (Table 1.) and milfoil densities (Table 2.) were recorded for each stocking and monitoring site.

- S1 - 23,000 weevils were stocked at this site. Laboratory analysis of milfoil samples from S1 revealed fifteen weevil life stages and weevil-induced damage to 33% of the stems.

- S2 and S3 - 20,000 weevils were stocked between these two connecting sites. Thirteen weevil life stages were found in S2 and damage was observed on 67% of these samples. S3 revealed four weevil life stages and damage to 22% of the samples.

- S4 - 12,000 weevils were stocked in S4. Laboratory analysis revealed four weevil life stages and damage to 33% of the samples.

- S5 - 32,000 weevils were stocked and thirteen weevil life stages were found on samples with 45% weevil-induced stem damage.

- S6 - 5,000 weevils were stocked at this newly-established site. Laboratory analysis revealed damage to 52% of samples and twenty-two weevil life stages were found throughout the initial and follow-up surveys.

- M1- Analysis of milfoil from the monitoring site revealed ten weevil life stages and damage to 56% of the samples.

Twelve native aquatic plant species were recorded in 2012: Clasping leaf pondweed (*Potamogeton perfoliatus*), Chara (*Chara* sp.), Coontail (*Ceratophyllum demersum*), Eelgrass/Water Celery (*Valisneria americana*), Elodea (*Elodea canadensis*), Flat-stem pondweed (*P. zosteriformis*), Large leaf pondweed (*P. amplifolius*), Northern watermilfoil (*Myriophyllum sibiricum*), Sago pondweed (*P. pectinatus*), Thin pondweed (*P. pusilus*), White water-buttercup (*Ranunculus aquatilus*), and White water lily (*Nymphaea* spp.).

IV. Discussion

The desired impacts of stocking the weevil include reductions in the overall extent and density of the milfoil and stems growing further below the surface of the water at non-nuisance levels. Survey results from 2009 to 2011show that Long Lake provides the necessary habitat for a milfoil weevil population to thrive and return after overwintering. The following points of discussion refer to survey activities and results from 2011:

- Weevil life stages and weevil-induced damage were observed in the field and during laboratory analysis at all sites during the initial and follow-up surveys in 2011.

- The weevil population at the monitoring site (M1) has increased from 2009 in which it was previously undetectable (Table 1.). Since that time, milfoil density has decreased by 54% (Table 2.). The natural weevil population at this site has not been directly augmented and it is likely that weevils are migrating to M1 from nearby sites.

- Of the stocking sites, S6 displayed the most improvement this year. At the time of the follow-up survey, milfoil was falling over and contained highly visible weevil-induced stem damage.

- Milfoil density at S1 decreased by 27% from 2010 to 2011. S2 and S4 have experienced increases and the observed weevil populations at these sites may require a season to rebound. These sites will continue to be stocked as outlined in **Section V.**

- An increase in native aquatic plant species and abundance has been observed in the lake since 2009. Previous surveys revealed seven to ten individual plant species, whereas twelve individual species were recorded in 2012. Native species are an important component because they out-compete milfoil and help to maintain it to low levels. Field observations reported that the milfoil is beginning to break up along the outer edges of the topped-out milfoil at S1-S5.

V. Future Recommendations

Long Lake exhibits high water clarity likely due to the zebra mussel populations found at each survey site. These invasive mussels provide excellent growing conditions for the aquatic plant species and milfoil has been found growing at depths from 10' to 20'. Additionally, 2011 has been an excellent year for milfoil growth state-wide and the progress of the weevil project in Long Lake has been slower than originally expected.

EnviroScience remains confident that weevils are able to provide long-term control in Long Lake and recommends a continued aggressive management approach. All sites (excluding S6) will be stocked in 2012 and areas of infestation on the western side of the lake will need to be addressed in the future. It is the recommendation of EnviroScience to stock 60k weevils in 2012 (rather than 40k) and has offered to match half of the contracted weevils.

If you have questions or comments regarding this report, please contact Sarah Lomske at (800) 940-4025, or e-mail at slomske@enviroscienceinc.com.

Sincerely,

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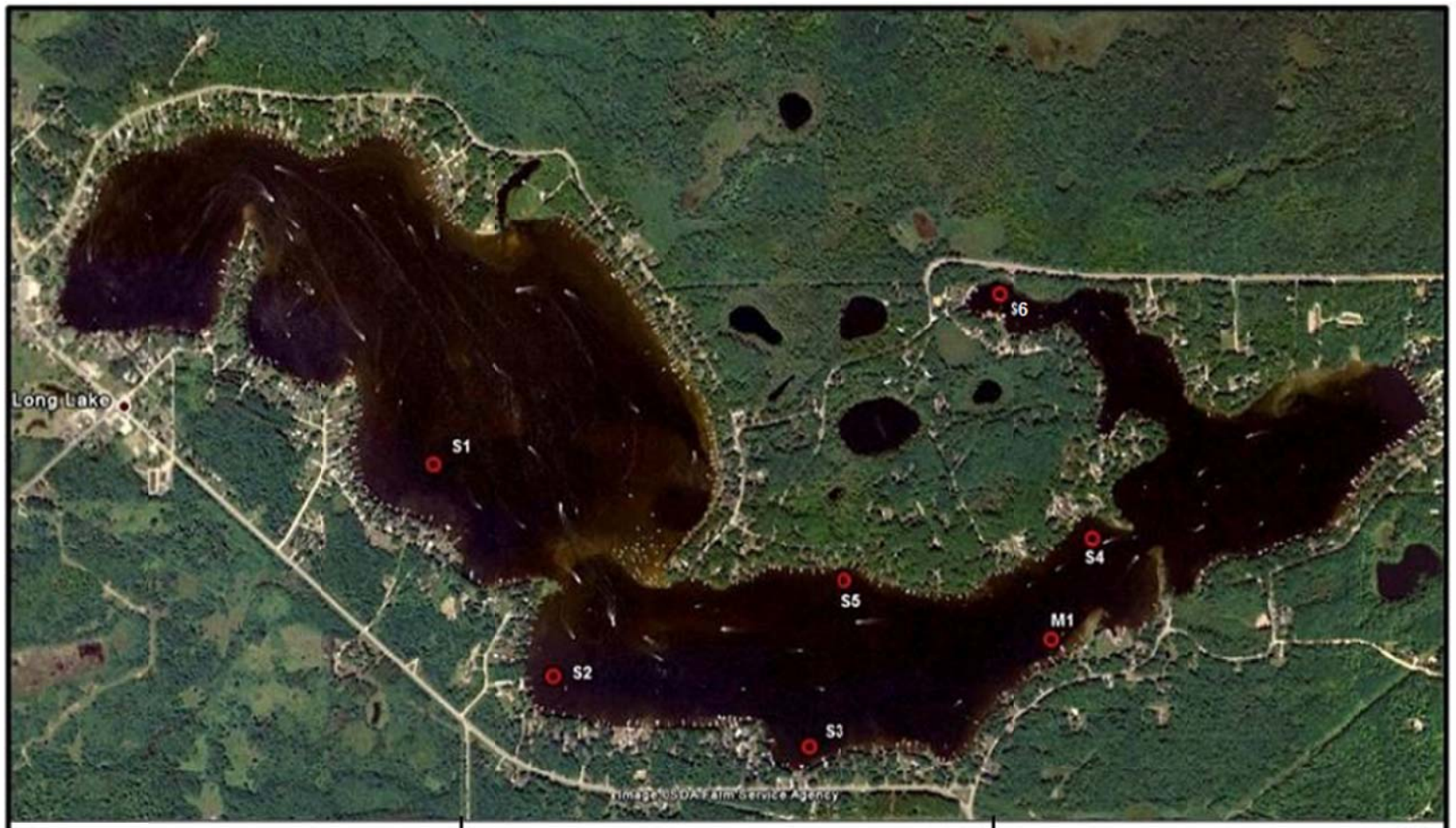

Figure 1. Long Lake Stocking & Monitoring Locations

Site Location

700 1,400 2,800 ft

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Table 1. Average Weevil Density (weevils/stem)

Site	2009	2010	2011
S1	0.27	0.32	0.25
S2	0.15	0.05	0.30
S3	-	0.31	0.07
S4	-	0.41	0.07
S5	-	0.31	0.22
S6	-	-	0.37
M1	0.00	0.07	0.17

Table 2. Average Milfoil Density (stems/m^2)

Site	2009	2010	2011
S1	100.00	205.11	150.20
S2	164.77	150.17	214.50
S3	**	176.83	152.02
S4	**	132.39	203.50
S5	**	126.86	154.45
S6	**	**	109.25
M1	240.72	205.56	112.95

***Site not established*

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