AQUATIC PLANT SURVEY AND
DEVELOPMENT OF A NUISANCE AQUATIC PLANT MANAGEMENT PLAN

FOSTER'S POND
ANDOVER, MASSACHUSETTS

2004

Prepared for:

Foster's Pond Corporation
c/o Stephen E. Cotton
19 Pomeroy Road
Andover, MA 01810

Submitted by:

Aquatic Control Technology, Inc.
11 John Road
Sutton, MA 01590-2509

AQUATIC CONTROL TECHNOLOGY, INC.
POND AND LAKE MANAGEMENT SPECIALISTS

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INTRODUCTION

In 2004, the Foster's Pond Corporation hired Aquatic Control Technology, Inc. a lake management company based in Sutton, Massachusetts to conduct an aquatic plant survey and develop a nuisance aquatic vegetation management plan for Foster's Pond. This effort was prompted by concerns over the increasing density and distribution of non-native aquatic weed species in the lake.

Aquatic Control has good familiarity with Foster's Pond, having been contracted for hydro-raking the shorefronts of individual property owners on a semi-annual basis since 1992. Foster's Pond is infested with fanwort (*Cabomba caroliniana*), which is only temporarily controlled by hydro-raking. The Corporation also commented that the fanwort infestation has worsened in the past couple of years, prompting this evaluation of management alternatives. The following report summarizes findings from our comprehensive field survey, evaluates applicable aquatic plant management strategies and culminates in a recommended nuisance aquatic plant management plan for Foster's Pond.

METHODS

Aquatic Control Biologists surveyed Foster's Pond on August 16, 2004. Weather conditions consisted of overcast skies and no wind, providing good visibility. The entire pond was systematically toured by boat. A comprehensive transect/data point sampling methodology was used to gather qualitative and quantitative information on existing conditions in the lake. Data points were evenly distributed throughout the open-water portions of the pond. The location of each data point was geo-referenced using a Differential GPS system equipped with sub-meter accuracy. This information was transferred into a GIS software application providing for accurate mapping. Data point locations are depicted in Figure 1. A total 39 data points were sampled.

At each data point the following information was recorded: water depth, sediment type, aquatic plants present in decreasing order of abundance, total plant cover, total fanwort cover, and plant biomass. Water depth and sediment probing was conducted with a calibrated sounding rod.

The plant community was assessed through visual inspection, use of a long-handled rake and throw-rake. Plants were identified to genus and species where possible. Plant cover was given a percentage rank based on the areal coverage of plants within an approximate 400 square foot area assessed at each data point. Generally, in areas with 100% cover, bottom sediments could not be seen through the vegetation. Percentages less than 100% indicated the amount of bottom area covered by plant growth. The presence and dominance of fanwort, the non-native plant, was also recorded at each location. In addition to cover percentage, a plant biomass index was assigned at each data point to document the amount of plant growth vertically through the water column. Plant biomass was estimated on a scale of 0-4, as follows:

0	No biomass; plants generally absent
1	Low biomass; plants growing only as a low layer on the sediment
2	Moderate biomass; plants protruding well into the water column but generally not reaching the water surface
3	High biomass; plants filling enough of the water column and/or covering enough of the water surface to be considered a possible recreational nuisance or habitat impairment
4	Extremely high biomass; water column filled and/or surface completely covered, obvious nuisance conditions and habitat impairment severe

Information recorded at each data point is provided in the Field Survey Data Table found in the Appendix. In addition to the plant survey, some limited water quality analysis was performed. Field testing of a temperature/dissolved oxygen profile and Secchi disk water clarity was performed at the

deep-hole location at the southern end of the pond. In addition, a surface grab water sample was collected for analysis of a suite of water quality parameters by an independent, MA Certified Laboratory.

SURVEY FINDINGS

Pond and Watershed Description

Orthophotos and hydrology coverage available from the MassGIS website and from the study conducted by Wright and Adilman in 2001 were used as base maps for the figures provided in this report. Using this information we calculated the surface area of Foster's Pond to be approximately 120 acres. Previous reports list the surface area at 135 acres, but floating islands that have transitioned into scrub-shrub wetlands probably account for some of the lost open-water.

For descriptive purposes the pond is broken into separate geographic areas throughout the balance of this report. The areas are defined below and can be specifically located using the numbered data points shown in Figure 1.

Main Pond – open water southerly cove comprising data points 6-21
Outlet Cove – near the dam comprising data points 38 & 39
Channel – connecting the main pond to the outlet cove comprising data points 24-37
Mill Reservoir – dredged northeast coves off Azalea Drive comprising data points 1-5

These four areas describe the majority of open water that is navigable by boat. In addition to these areas, there are three large emergent wetlands – areas where no data points are shown on Figure 1. The largest is the shrub-scrub wetland located between mill reservoir and the channel. The other two are coves dominated by abundant waterlily growth at the east and west ends of the main pong.

One primary inlet tributary named Frye's Brook flows into the northeast cove (off of Azalea Drive). There are also a number of adjacent wetland areas that drain into the lake. Based on the contour lines on the USGS topographical map, the watershed appears to be fairly small. It is difficult to accurately delineate the watershed, but it appears as if the drainage basin area to lake basin area ratio (db:lb) is less than 10:1. The majority of the pond's immediate watershed appears to support light residential development.

Water depths found in the lake appeared to be consistent with the detailed bathymetry (water depth) contour maps that were previously prepared by Wright and Adilman, 2001. The deepest water depth encountered in the main pond was 13 feet. A 15 foot measurement was recorded in the mill reservoir section. The wetland between mill reservoir and channel supported abundant plant growth and water depths less than 3 feet. The channel extending from the main pond to the outlet cove had an average water depth of just 4 feet. The average water depth from all of the data points was calculated to be just under 7 feet.

The dam and spillway are located in the outlet cove at the northernmost point of the pond. There is a 12 foot wide concrete spillway and an inoperable low-level gate valve. There was 1-2 inches of water flowing over the top of the spillway at the time of our inspection.

Water Quality

Water quality monitoring was not the primary focus of this survey, but some limited sampling was conducted to establish baseline values. The surface grab water sample collected from the main pond in proximity to data point number 14 yielded the following results.

Parameter	Units	Results (8/16/04 sampling)
pH	S.U.	6.6
Alkalinity	mg/L CaC03	24
Phosphorus	mg/L	0.022
Turbidity	NTU	0.65
True Color	Pt-Co	20
Apparent Color	Pt-Co	25
Total Coliform Bacteria	org/100 ml	<50
Fecal Coliform Bacteria	org/100 ml	<10
Secchi Disk	Feet	10.3

The pH and alkalinity values are fairly typical of waterbodies in eastern Massachusetts. The water is slightly acidic and has a low buffering capacity. Field sampling performed by the Corporation on July 24, 2004 showed lower pH values (4.85-5.32). The phosphorus concentration of 22 µg/l is favorably low for a mesotrophic waterbody like Foster's Pond. Phosphorus concentrations above 30 µg/l are often sufficient to stimulate planktonic (free-floating) algal blooms. Phosphorus generally ranges between 10-50 µg/l in ponds and lakes in this region. Results for Total Phosphate ($P0_4$) from the Corporation's July 24, 2004 sampling ranged between 20-50 µg/l. Phosphate values multiplied by 0.326 yields phosphorus values. Therefore the range of phosphorus reported by the Corporation were between 6.5 and 16.3 µg/l, somewhat lower than the laboratory test of the 8/16/04 sample collected by Aquatic Control. Water clarity was quite good as measured by four different tests. Turbidity was very low. True and apparent color readings were low and showed that most of the color is attributable to dissolved substances such as tannic or humic acids that leach out of wetlands. Even the field test with a Secchi Disk yielded 10.3 feet of clarity on an overcast day. The final parameters tested were total and fecal coliform bacteria, both of which were at or below the lab's detection limit.

The only other field measurement of water clarity that we collected was a temperature/dissolved oxygen profile using a YSI meter. The following values were recorded:

Depth (meters)	Temperature (°C)	Dissolved Oxygen (mg/l)
Surface	23.5	5.22
1.0	23.5	5.12
2.0	23.5	5.09
3.0	23.0	3.83

Foster's Pond is too shallow to thermally stratify. Deeper lakes (>25 feet) usually thermally stratify into three distinct layers during the summer months; 1) the epilimnion or the warmer surface waters, 2) the metalimnion or thermocline where there is a transition in temperature and 3) the hypolimnion or the cooler bottom waters. Usually there is no mixing or water exchange between the epilimnion and the hypolimnion when the lake is stratified. There was ample oxygen in the lake to support warmwater fish, but the concentrations seemed somewhat lower than expected. This may be partially attributable to the overcast skies that may slow photosynthesis in plants and algae and the associated oxygen release.

Aquatic Vegetation

The primary focus of the survey was to document the aquatic plant community, particularly the non-native and invasive species. The dominant plants encountered during the survey are listed below in decreasing order of abundance:

Macrophyte Species	Common Name	Abbreviation	Type	Distribution
Cabomba caroliniana	Fanwort	Cc	submersed **EXOTIC**	Common to abundant growth throughout pond
Nymphaea odorata	White waterlily	Ny	Floating-leaf	Abundant growth throughout pond
Utricularia spp.	Bladderwort	U	Submersed	Common growth throughout pond
Ceratophyllum demersum	Coontail	Cd	Submersed	Scattered in several locations
Brasenia schreberi	Watershield	B	Floating-leaf	Common growth through waterlily beds
Potamogeton ephihyrus	Ribbon-leaf pondweed	Pe	Submersed	Scattered in a few locations
Valisneria americana	Wild celery	V	Submersed	Scattered in a few locations
Potamogeton amplifolius	Large-leaf pondweed	Pa	Submersed	Scattered in a few locations
Megalodonta beckii	Water marigold	Mb	Submersed	Mill reservoir area
Potamogeton gramineus	Variable-leaf pondweed	Pg	Submersed	One occurrence in mill reservoir area
Potamogeton perfoliatus	Clasping-leaf pondweed	Pp	Submersed	One occurrence
Chlorophyta spp.	Filamentous green algae	Fa	Submersed	Few locations
Sparganium sp.	Burreed	Sp	Emergent	Few occurrences
Scirpus sp.	Rushes	Sc	Emergent	Mill reservoir shoreline
Eriocaulon sp.	Spikrush	Eo	Emergent	Mill reservoir shoreline
Pontederia cordata	Pickerelweed	Po	Emergent	Shoreline locations
Typha sp.	Cattail	T	Emergent	Shoreline locations
Decodon verticillatus	Water willow	Dv	Emergent	Shoreline locations
Lythrum salicaria	Purple loosestrife	Ls	Emergent	Shoreline locations

Eleven different submersed and floating-leafed vascular plants were encountered in Foster's Pond, as well as filamentous green algae. There were also seven different emergent aquatic species documented along the shoreline.

The most common plant in Foster's Pond based on its coverage and biomass is fanwort. It was the most prevalent species found in 34 out of the 39 data point locations. Average values from the data point sampling suggest that on 8/16/04 Foster's Pond supported 79% total plant cover. Fanwort cover was found to cover 53% of the open-water areas that were surveyed. The average biomass index was 2.9 on a scale that runs from 0 to 4. This suggests that plant growth had reached moderate to high biomass throughout most of the open water areas. Common to abundant plant growth approached the surface was generally encountered to water depths of 10 feet. Even scattered plants were found in depths between 10 and 13 feet.

Four distinct vegetation assemblages were encountered during the survey and are depicted in Figure 2. The most noticeable were the dense beds of floating leafed waterlilies. White waterlily was predominant, but the smaller leaved watershield was also regularly encountered. Waterlily growth dominated the shallow mill reservoir area and the backwater areas at the east and west ends of the main pond. In the main pond, there was a distinct assemblage made up of waterlilies and fanwort at nearly equal densities. This assemblage was found along most shoreline areas and scattered through the channel. Bladderwort, coontail and other submersed species did account for some lower density understory growth in this waterlily and fanwort assemblage. Deeper water areas of the main pond were dominated by fanwort, which was nearly forming a monoculture. Bladderwort and coontail were present, but fanwort generally accounted for 80% of the plant growth. The final

assemblage was found in the channel and outlet cove. Fanwort continued to dominate the plant growth in these areas, but higher densities of coontail, pondweeds, bladderwort and water marigold were encountered.

MANAGEMENT ALTERNATIVES

Fanwort has been established in Foster's Pond for years, but its distribution was primarily limited to the channel and outlet cove. Over the past few years it has reportedly spread throughout the open-water portions of the main pond. This rapid growth highlights the invasive potential of this non-native species in Massachusetts ponds and lakes.

Because fanwort is one of the more problematic aquatic plants in the northeast, there is considerable experience to draw from when evaluating management options. The most notable aspect of the life cycle of fanwort is that its primary mode of propagation is through vegetative means. Floating plant fragments can develop adventitious roots, sink to the bottom and establish new colonies. This must be taken into consideration when evaluating optional management strategies. The following review of management alternatives is based on Aquatic Control's direct experience with these techniques for fanwort control. The findings and recommendations are also consistent with the recently completed Final Generic Impact Report – *Eutrophication and Aquatic Plant Management in Massachusetts* and the accompanying *Practical Guide to Lake and Pond Management in Massachusetts*.

Mechanical Harvesting and Hydro-Raking (*Not Recommended for Long-Term Control*)

For this reason, mechanical approaches including harvesting and hydro-raking are generally not recommended to control large scale fanwort infestations. Harvesting and hydroraking operations inevitably create plant fragments that cannot be effectively contained and collected. Furthermore, these mechanical controls usually can only provide weeks of effective control before the plants regrow. Mechanical harvesting and hydro-raking are suitable, temporary management strategies when a lake is already completely infested with the nuisance plants and other strategies cannot be used. Hydro-raking has been utilized to maintain individual shorefronts in Foster's Pond for years. However, it is now apparent that fanwort has reached more problematic densities and it is doubtful that hydro-raking can provide sufficient seasonal control.

Dredging (*Not Recommended at this Time*)

The only other mechanical strategy sometimes used for aquatic plant control is dredging. The two objectives of dredging are usually to remove the nutrient-rich sediments and deepen a waterbody beyond the photic zone or the depth to which light penetrates and supports rooted plant growth. We found fanwort already growing in 9-10 foot water depths in Foster's Pond. The majority of the pond would probably need to be deepened to 10 feet or more to prevent nuisance weed growth. This would be prohibitively expensive on a waterbody the size of Foster's Pond. Assuming an average water depth of 6 feet, deepening by an average of 4 feet throughout the 120-acre waterbody would require the removal of nearly 775,000 cubic yards of material. Using standard dredging unit costs of $5-$10 per cubic yard, a dredging project at Foster's Pond may cost between $3.8-$7.8 million. This does not take into account permitting requirements or design constraints given the pond's suburban setting. Actual dredging costs may be significantly higher. Smaller scale, partial dredging in the pond may be more feasible, but the unit costs for removal will likely be higher.

Biological Controls (*None Known for Fanwort*)

There are no known biological controls that specifically target fanwort growth. For Eurasian watermilfoil (*Myriophyllum spicatum*) there is a native aquatic weevil (*E. lecontei*) that is being commercially reared and sold as a bio-control agent. However, it only feeds on Eurasian watermilfoil and its closest native relative northern watermilfoil (*M. sibiricum*). There are no similar herbaceous insects for fanwort control.

The only bio-control known to work on these plants are triploid (sterile) grass carp. These herbaceous fish eat submersed aquatic plants. Presently, they are illegal in every New England State except for Connecticut, where they can be introduced to ponds and small lakes with a special permit. The principal reason they are banned is that many state regulators do not want another non-native species introduced to the region. Even though the fish are sterilized, there is a slim chance that fertile fish would be stocked. Grass carp would probably eat fanwort, but they do have feeding preferences and may favor some of the desired native plants over the target species. Accurately calculating fish stocking rates is also difficult. Too few fish will not be effective. Too many fish may eliminate the rooted plant problem, but promote algae bloom conditions. Even if they were legal, triploid grass carp would probably not be recommended for a large multiple-use lake like Foster's Pond.

Eliminating the mechanical and biological options leaves physical and chemical control strategies. Physical or manual controls such as handpulling, suction harvesting and bottom weed barriers are effective strategies for widely scattered growth and new or "pioneer" infestations. They are not effective for large-scale plant removal and are not appropriate for the current level of fanwort growth in Foster's Pond. They might be appropriate as a follow-up management strategy once the plants are initially controlled with a chemical treatment. Aeration is sometimes effective at controlling algae growth, but it offers no control over vascular plants. The only physical control that could be considered for fanwort control at Foster's Pond is water level lowering or drawdown. Chemical treatment with registered aquatic herbicides is the other proven strategy for control of fanwort. The merits and limitations of both approaches are discussed below.

Drawdown (*Recommended*)

Drawdown or lowering the water level during the winter months to expose aquatic plants to freezing and drying conditions can be an effective strategy to control nuisance species. Fanwort is susceptible to winter drawdowns. Limiting factors of drawdowns include the ability to effectively lower and refill the waterbody, the remaining water volume during drawdown, and sediment characteristics. Drawdowns can have negative impacts to fish and other aquatic organisms if there is not sufficient water volume remaining after the lake is lowered. Impacts to adjacent wetlands and impacts to wells located near the water's edge also need to be considered. Drawdown is often considered on lakes with dams and suitable outlet structures, because it offers a potentially low or no cost weed control strategy that is perceived favorably by the public.

Presently, both the low-level gate valve and the removable stop logs at the dam are inoperable. We understand that the Corporation is pursuing repair of the stop logs to allow for a 12-18 inch drawdown during the winter months. This will not provide wide-scale control of fanwort, which was found growing to water depths of 10 feet. The principal benefits of a 12-18 inch drawdown would be to provide for flood storage and to prevent ice damage during the winter months. It would enable homeowners to remove leaf litter and other debris from their immediate shorelines, as well as providing access for dock or wall maintenance. Limited drawdowns should provide an added benefit of flushing suspended debris, sediments and nutrients out of the pond and help to preserve water quality.

It may also be worthwhile to investigate the potential for somewhat deeper drawdowns in the future. The relatively shallow water depths of Foster's Pond prohibit drawdown from being a primary weed control strategy, but a limited 3-4 foot drawdown could become a component of an integrated management program. A drawdown of this magnitude could help extend the duration of nuisance plant control that is achieved following an herbicide application. However, more evaluation will be needed. Lowering the pond by 12-18 inches is probably within the range of normal water level fluctuations when the stop logs were removable and it is not expected to significantly impact adjacent wetlands or shallow wells located near the shoreline. Dropping the water level by as much as 3 feet would probably be consistent with recommendations of the recently released Massachusetts GEIR for Lake Management, but it should be more closely evaluated before being attempted.

Chemical Treatment

Probably the most effective and commonly employed means of controlling nuisance fanwort growth is with the application of EPA and State registered aquatic herbicides. Considerable advancements in aquatic herbicide applications have occurred in recent years. Treatments are usually targeting species-selective control of non-native or invasive species, while preserving the desirable native species to provide fish and wildlife habitat. Herbicides and algaecides that are currently registered for aquatic applications have been extensively tested and provide a wide margin of safety for humans and non-target organisms when they are professionally applied in accordance with label directions.

Sonar (fluridone) is the only herbicide that is currently registered for use in Massachusetts that effectively controls fanwort. The systemic action of Sonar kills the entire plant including the root structures and successful Sonar treatments usually provide 2-3 years of effective fanwort control before retreatment is necessary. Non-chemical strategies (i.e. drawdown, handpulling and bottom barriers) can often be used in the years following treatment to extend the duration of control. We have performed a number of successful, low-dose Sonar treatments for fanwort and milfoil control in the northeast in recent years. A list of some of our representative Sonar treatment projects is provided in the Appendix.

Sonar's mode of action is that it prevents carotenoid synthesis in plants. Carotenoids are the yellow pigments that protect chlorophyll. Without carotenoids the chlorophyll is broken down by sunlight and the plants essentially starve to death. Susceptible plants show chlorotic effects (whitening or bleaching) after sufficient exposure to Sonar. Chlorosis is very evident in fanwort, but it is a slow process. Plants must be exposed to sufficient concentrations Sonar for 45-60 days or longer to be completely controlled. Fortunately, fanwort is controlled by very low concentrations of Sonar. In most cases, fanwort will be effectively controlled with concentrations between 10 and 20 parts per billion (ppb) of Sonar. The Sonar label allows for applications up to 150 ppb. Using these lower application rates allows for susceptible species like fanwort to be controlled, while many of the heartier native species are preserved. Still, impacts to non-target, native plants are the most significant negative impact of using Sonar at Foster's Pond. Dominant plants in Foster's Pond that would not be significantly impacted by a low-dose Sonar treatment include the pondweeds, stonewort, bladderwort, and all of the emergent species. Coontail may be more noticeably impacted. The waterlilies and watershield would show impact in the year of treatment, but should rebound the year after treatment. The other potential negative impact following treatment is the formation of additional floating islands that consist of decomposing waterlily root structures and attached hydrosoils. The non-dredged portions of the mill reservoir areas and the shallow coves off of the main pond pose the greatest threat for additional floating island formation. There are already numerous floating islands in these locations. We do not expect to see an excessive amount of floating island formation since it would be a low-dose treatment targeting fanwort control and impacts to waterlilies will probably only be noticeable during the year of treatment.

The slow mode of action and high solubility of Sonar limits its effectiveness for spot or partial-lake treatments. It cannot be used effectively to treat shorelines or small sections of a waterbody. Whole lake treatments are usually performed with the liquid formulation of Sonar (Sonar AS). This allows for precise application of the target concentration. In most cases, a series of 2-3 low dose applications are required to keep Sonar concentrations within the target range for the required 45-60 day period. Following the initial application, Sonar residues are monitored using an immunoassay developed by the manufacturer called FasTEST. Water samples are collected 10-21 days following treatment and shipped out via overnight delivery for FasTEST analysis. Results that show the in-lake Sonar concentration are usually provided within 24-48 hours. Follow-up booster applications are then scheduled once Sonar drops below the target concentration. It often takes 6-8 weeks for plants to be completely controlled after a Sonar treatment. This slow die-off avoids dissolved oxygen depletions that could stress fish and prevents sudden nutrient release from the decomposing plants that could stimulate an algal bloom.

There are two pellet formulations of Sonar (Q-Quick Release; and PR-Precision Release) that are designed to release the active ingredient over a period of several weeks. The pellet formulations are intended for partial-lake applications, but treatment results are much less predictable. Sediment type influences the rate of herbicide release and once released, the herbicide is immediately diluted with untreated water. This necessitates applying 4-5 times the target concentration of Sonar, which greatly increases the treatment cost. Most of the partial lake Sonar pellet applications that we have performed in recent years have only been marginally successful, while results of whole-lake applications with Sonar liquid have been excellent.

The last herbicide worth mentioning for Foster's Pond is Renovate (triclopyr). This product just received its full aquatic registration with the EPA in 2003, however, its registration in Massachusetts is still pending. It offers a systemic mode of action, but only requires 48-72 hours of contact time, which makes it more attractive for partial lake applications. It reportedly can be used to control fanwort, but we are not aware of any field trials that have been performed in the northeast. We are working with CT DEP to try Renovate for fanwort control is 2005. It is expected to receive its Massachusetts registration in 2005. The current pricing makes it considerably more expensive than the other herbicides and more information is needed before this product should be considered at Foster's Pond, but it may prove to be another herbicide option in the near future.

SUMMARY AND RECOMMENDED PROGRAM

The expanding infestation of fanwort appears to be the most immediate problem facing Foster's Pond. Where more than 50% of the lake is already infested with fanwort, an active management program is recommended to prevent further loss of open-water conditions or displacement of diverse assemblage of native plants. The recommended management plan should integrate species-selective herbicide treatments and limited winter drawdown.

We are presently recommending that a whole lake Sonar herbicide treatment be performed at Foster's Pond. Using the detailed bathymetry provided by Wright and Adilman (2001), we were able to calculate water volume estimates for various portions Foster's Pond. The main pond, the channel and outlet cove account for the majority of the water volume. Treating these areas only and leaving the heavily vegetated mill reservoir and adjacent wetland areas untreated would only result in a 25% reduction in herbicide costs (approximately $3,000), while the application, monitoring and other costs associated with the treatment would remain unchanged. Furthermore, the potential for dilution into untreated areas may reduce the effectiveness of treatment. There is also a possibility that fanwort in the untreated portions of the pond could reinfest the treated sections more rapidly.

A whole-lake treatment program with Sonar herbicide would allow for species-selective control of the nuisance fanwort and would provide at least 2-3 years of effective control. The estimated cost for whole-lake Sonar treatment program would be $37,250-$42,500 for the initial year. These costs are inclusive of filing the required License to Apply Chemicals application with DEP, conducting Sonar FasTEST monitoring during the treatment program, performing pre and post-treatment aquatic plant inspections, and preparing year end report.

A Sonar treatment program would probably need to be initiated in May or early June, depending on the stage of plant growth and ability to control outflow. The treatment is most effective when the plants are actively growing, but before they have matured and reached the surface. Ideally, the pond will be lowered by 12-18 inches in advance of the first Sonar application to help minimize downstream loss of the herbicide. Monitoring and follow-up Sonar herbicide treatments would then occur over the next 4-6 weeks. Plants should be effectively controlled within about 8 weeks of the initial treatment.

Sonar has a favorable toxicology profile. It is even approved for application to potable (drinking) water reservoirs at low concentrations (<20 ppb) with no restrictions on using treated lake water for drinking or domestic purposes. The chemical label does not restrict swimming following treatment, but we believe it is prudent practice to close the lake to swimming on the day of each application. The only restriction is not to use treated lake water for irrigation purposes (i.e. watering lawns or gardens) for 30 days following the last Sonar application. For a split-treatment program similar to what is being proposed at Foster's Pond, the irrigation restriction period may extend over a 60-90 day period. Sonar does not migrate through hydrosoils so there are no restrictions on using well water, including shallows wells located in close proximity to the water's edge.

Public notices could be drafted and provided to the Corporation for dissemination. Prior to treatment, the entire pond shoreline would need to be posted with signs that warn of the treatment date and the temporary water use restrictions to be imposed following treatment. A fact sheet on Sonar herbicide prepared by the Department of Health from the State of Washington is attached. There is also good summary data on Sonar herbicide in Final GEIR (2004).

A second recommendation is repair of stop logs on the dam to facilitate a 12-18 inch drawdown. A drawdown of this magnitude will be most effective for flood storage and to prevent ice damage during the winter months. Lowering the water level and retarding outflow prior to a Sonar treatment program will help to improve the efficacy of the treatment and may help reduce treatment costs. Finally, the effects of a 12-18 inch drawdown should be closely monitored to evaluate whether deeper (3-4 feet) may be a possibility in the future.

Foster's Pond supports an expanding infestation of exotic and invasive fanwort growth. On-going management will be required for the foreseeable future to maintain adequate fanwort control to preserve suitable fish and wildlife habitat as well as recreational uses of the pond. Leaving the fanwort growth unmanaged will result in increased fanwort densities and additional displacement of native species. Being an enhanced (dammed) waterbody, Foster's Pond has relatively shallow water depths and fertile bottom sediments that can support abundant aquatic plant growth. While trying to control non-point source nutrient inputs from the watershed is important and will help in the long-term to preserve water quality, it will do nothing to control the nuisance fanwort growth. Rooted plants derive the majority of their nutrients from the bottom sediments, which watershed management cannot address. In-pond management will be required to control the fanwort growth and prevent further loss of open-water habitat. Presently, treatment with Sonar herbicide is the most selective and least disruptive means of controlling the fanwort growth. Limited winter drawdowns should be integrated in future years to help extend the duration of fanwort control that is achieved following treatment. However, based recent fanwort treatment experiences in Massachusetts, some level of re-treatment will likely be required within a 2-5 year period following a whole-pond Sonar treatment.

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APPENDIX

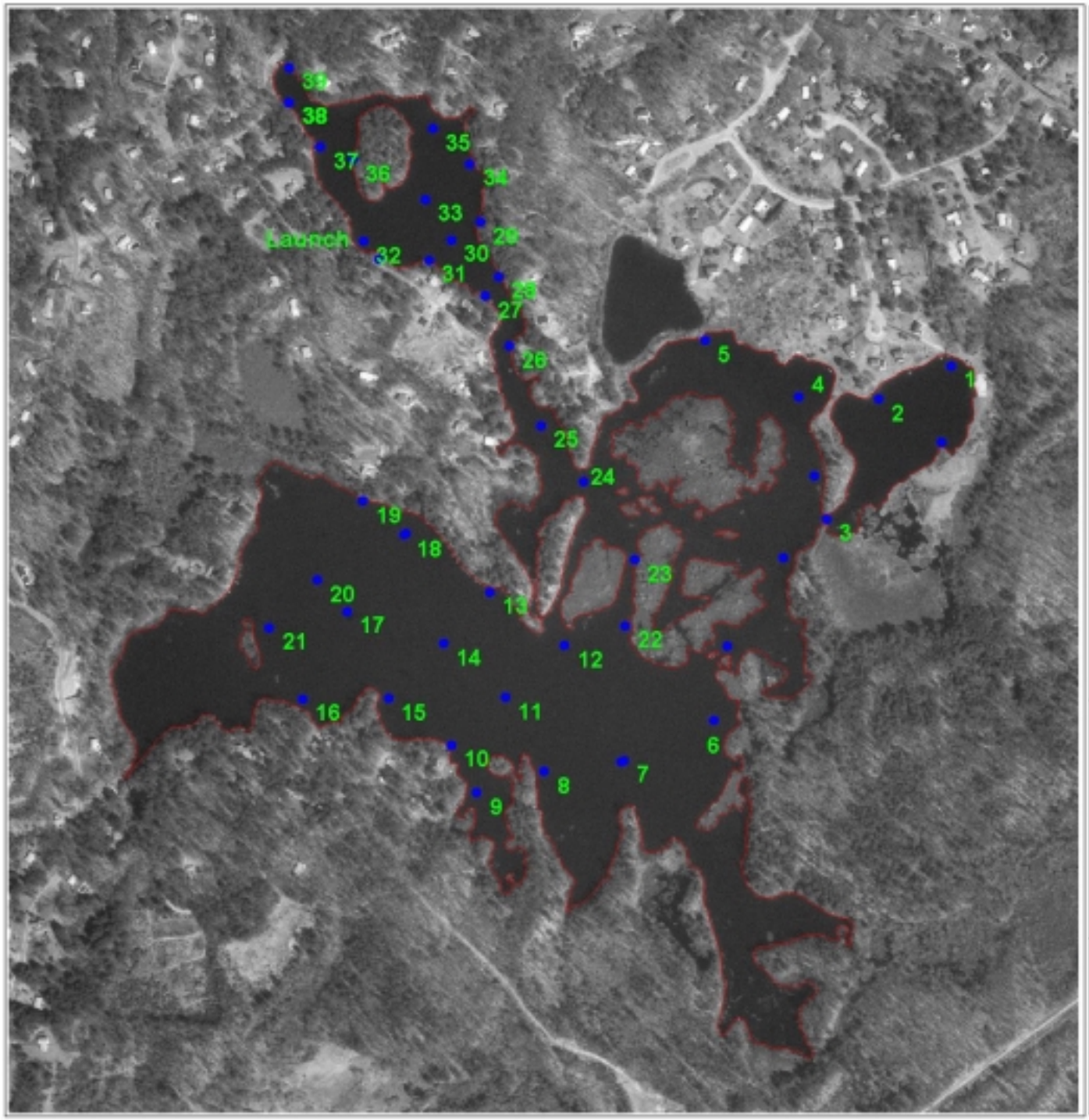
- Field Survey Data Table
- Figure 1 – Data Point Locations
- Figure 2 – Dominant Aquatic Plant Assemblages
- Photographic Documentation
- Information on Sonar Herbicide

FOSTER'S POND – FIELD SURVEY DATA TABLE (survey date 8/16/04)

Transect Data Point	Water Depth (feet)	Sediment Type	Dominant Vegetation*	% Total Plant Cover	% Fanwort Cover	Biomass Index
1	15			0	0	0
2	10		(Ny, Cc, U, Sc, Eo, Po)	0	0	0
3	3	G	Cc, Ny, Dv (T, Ls)	100	40	4
4	13		Cc (Ny)	60	45	3
5	8	M/G	Cc, Ny, Cd, Pg	80	55	3
6	5.5	M	Cc, U, Cd, Ny, Fa	100	80	4
7	9	M	Cc, U	80	70	2.5
8	7	M	Cc, U, Ny, Cd	100	80	3
9	3	M	Cc, Ny, B, U, Fa, Cd	60	30	3
10	7	G	Cc, Ny, B, U	60	30	3
11	9.5	M	Cc	60	60	2
12	7	M	Cc, U, Ny, Cd	100	70	4
13	9	M	Cc, U, Ny	100	90	3.5
14	11			0	0	0
15	6.5	M/G	Cc, Cd, U, Ny	100	70	3
16	5	M	Cc, Ny, U, Cd	100	70	3.5
17	11		Cd	10	0	1
18	9	M	Cc, U, Pe, Cd	100	80	3
19	5	M/G	Cc, Ny, U	80	55	3
20	9.5	M	Cc, U	100	95	3
21	7	M	Cc, Ny, U, Cd	100	85	4
22	4.5	M	Cc, Cd, Ny, U	100	60	4
23	6	M	Cc, Ny, Cd, U	70	40	3.5
24	4	G/M	Cc, Cd, Ny, B, U	70	40	3
25	4	M	Cc, B, U, Cd, Ny	100	80	3.5
26	4	M	Cc, U, Pe, Ny	100	80	3.5
27	3	S/G	Cc, Pe, U, Ny, B, Sp	80	40	3
28	7	M	Cc, U, Pa, Ny	90	60	3
29	4.5	M/S	Cc, Ny, U	80	50	3
30	5	M	Cc, Mb, Ny, U, Cd	100	50	3.5
31	3	G/M	Cc, Mb, U, Pe, Ny, Cd, V	90	45	3.5
32	6	S/M	Cc, Pe, U, V, Ny	100	70	3
33	7.5	M	Cc, Cd, Pp, Ny, U	90	60	3
34	7	M	Cc, Cd, Ny, U	90	60	3
35	5.5	M	Cc, Ny, U, Cd	100	60	3.5
36	6	M	Cc, Ny, B, Cd	100	70	3
37	8.5	S/M	Cd, Cc, Ny, U	60	20	2
38	6	S/M	Cc, U, Cd, Ny	90	55	3
39	3.5	S/M	Cc, Ny, U, Cd	75	40	3
Averages	*6.79*			*78.85*	*53.46*	*2.88*

*Note: Dominant Vegetation descriptions provided on following page.

Macrophyte Species	Common Name	Abbreviation
Cabomba caroliniana	Fanwort	Cc
Nymphaea odorata	White waterlily	Ny
Utricularia spp.	Bladderwort	U
Ceratophyllum demersum	Coontail	Cd
Brasenia schreberi	Watershield	B
Potamogeton ephihyrus	Ribbon-leaf pondweed	Pe
Valisneria americana	Wild celery	V
Potamogeton amplifolius	Large-leaf pondweed	Pa
Megalodonta beckii	Water marigold	Mb
Potamogeton gramineus	Variable-leaf pondweed	Pg
Potamogeton perfoliatus	Clasping-leaf pondweed	Pp
Chlorophyta spp.	Filamentous green algae	Fa
Sparganium sp.	Burreed	Sp
Scirpus sp.	Rushes	Sc
Eriocaulon sp.	Spikrush	Eo
Pontederia cordata	Pickerelweed	Po
Typha sp.	Cattail	T
Decodon verticillatus	Water willow	Dv
Lythrum salicaria	Purple loosestrife	Ls



FOSTER'S POND
Andover, MA

FIGURE 1

Data Point Survey Locations

Survey Date: 8/16/04
Map Date: 9/20/04

LEGEND:

- Data Point Locations - geospatially referenced using DGPS
- Pond shoreline drawn from Orthophoto available from MassGIS

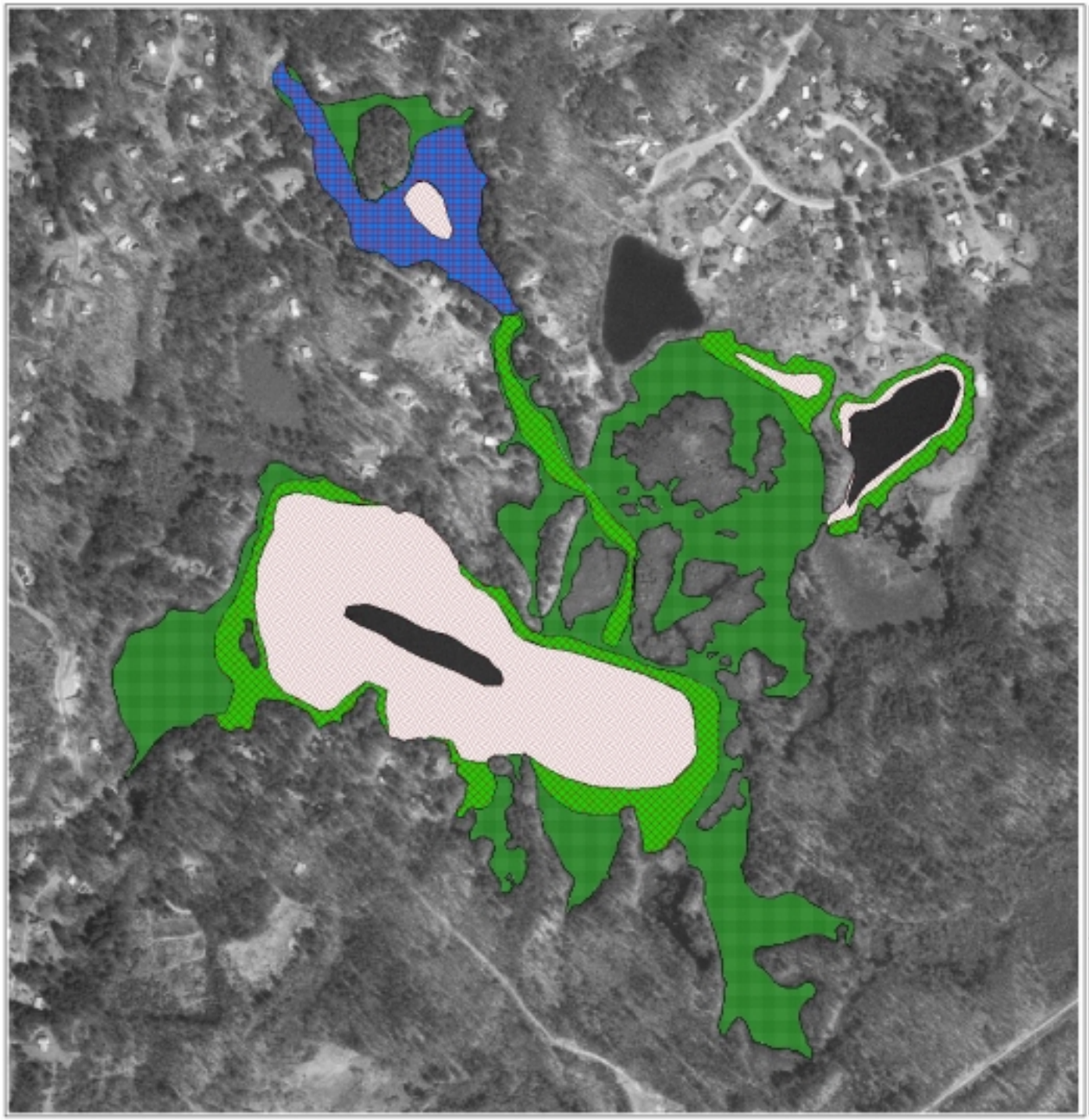
Pond Surface Area
approximately 120 acres

N
W E
S

300 0 300 600 Feet

AQUATIC CONTROL TECHNOLOGY, INC.

11 John Road
Sutton, MA 01590
508-865-1000 Tel.
508-865-1220 Fax
www.aquaticcontroltech.com



FOSTER'S POND
Andover, MA

FIGURE 2
Dominant Vegetation Assemblages

Survey Date: 8/16/04
Map Date: 9/20/04

LEGEND:

- Common to abundant fanwort lesser amounts of bladderwort and coontail
- Common to abundant fanwort lesser amounts of pondweeds, bladderwort and water marigold
- Common to abundant fanwort and waterlilies lesser amounts of bladderwort and coontail
- Abundant waterlilies
- No significant vegetation cover

N
W E
S

300 0 300 600 Feet

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Flowering fanwort growth in northern outlet cove

Dense, flowering fanwort growth in northern outlet cove

Beginning of channel through dense waterlilies to northeast coves

Dense waterlily growth in northeast coves

Scrub-shrub vegetated floating islands in northeast cove

Close-up of fanwort (*Cabomba caroliniana*)

Microbac Laboratories, Inc.

MASSACHUSETTS DIVISION
148 Bartlett Street
Marlborough, MA 01752
(508) 460-7600 Fax (508) 460-7777
Daniel J. Ste.Marie, Lab Director
www.microbac.com E-Mail: massachusetts@microbac.com

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CERTIFICATE OF ANALYSIS

AQUATIC CONTROL TECHNOLOGY
11 JOHN ROAD
SUTTON,MA 01590-2509

Date Reported	9/3/2004
Date Received	8/19/2004
Sample ID	0408-01029
Invoice No.	83705
Cust #	A031
Cust P.O. #	

Subject **FOSTERS POND SAMPLE 8/19/04**

Sampled By: CLIENT Date 8/16/2004 Time

Test	Result	Date	Time	Tech	Method
001 FOSTERS POND 8/16/04					
pH	6.6 S.U.	8/19/2004	15:00	RLC	SM-4500-H-B
Alkalinity as CaCO3	24 mg CaCO3/L	8/20/2004		RLC	SM 2320B
Turbidity	0.65 NTU	8/19/2004	15:30	RLC	SM 2130B
Nitrate Nitrogen as N	0.33 mg/L	8/20/2004	16:30	KJR	4500-NO3-D
True Color	20 Pt-Co	8/19/2004	16:45	RLC	SM 2120B
Apparent Color	25 Pt-Co	8/19/2004	16:45	RLC	SM 2120B
Total Coliform	<50 per 100ml	8/19/2004	17:05	LBC	SM 9222
Fecal Coliform	<10 per 100ml	8/19/2004	17:05	LBC	SM 9222D
Phosphorous as P	0.022 mg/L	8/31/2004		DLK	EPA 200.7
Temperature at Lab	12.0 Degrees C	8/19/2004		LMS	

This report has been reviewed and is electronically signed by:

Daniel J. Ste.Marie
Laboratory Director

Fluridone (Sonar®)

March 2000

Fact Sheet

Environmental Health Programs
Office of Environmental Health & Safety

Washington State Department of Health

Fluridone is an aquatic herbicide used to control common nuisance plants like pondweed and watermilfoil. It is not equally effective at killing all water plants and has been used in Washington to selectively remove certain nuisance weeds. It is absorbed by the leaves, shoots and roots of vascular plants and kills susceptible plants by inhibiting their ability to form carotene, a substance which plants need to maintain essential levels of chlorophyll. Damage in susceptible plants usually appears in 7-10 days after water treatment.

Fluridone is the active ingredient in Sonar® and comes in two formulations: pellets (Sonar SRP) and liquid concentrate (Sonar A.S.)

The initial rate of application recommended by Sonar labels is quite dilute and varies depending on the size of pond or lake, density of weeds, and susceptibility of targeted weeds. Control of watermilfoil in Washington is often accomplished with rates as low as 10-20 parts per billion (ppb).

Environmental Persistence

Fluridone is moderately persistent in water and sediments following treatment of a pond or lake. Field tests have shown that the average half-life in pond water is 21 days and longer in sediments (90 days in hydrosoil). Residues may persist longer depending on the amount of sunlight and the water temperature. Fluridone is primarily degraded by sunlight and microorganisms.

Health Impacts

Laboratory animals (mice, rats, dogs) fed fluridone in their diets showed little signs of toxicity even when fed levels which far exceed potential human exposure from use of Sonar. Fluridone is not considered to be a carcinogen or mutagen and is not associated with reproductive or developmental effects in test animals.

There is no EPA standard for maximum allowable concentration (MCL) of fluridone in public water supplies. For the purpose of Sonar product registration, EPA determined that 150 ppb is an acceptable level for potable water following Sonar use. This level provides a 1000-fold safety factor between the no effect level in experimental animals and the estimated human exposure via drinking water.

Common Questions

Can I use treated lake water for drinking? The Sonar label prohibits application to water within 1/4 mile of functioning potable water intakes unless the treatment rate is 20 ppb or less. Estimated human exposure from daily consumption of water with 20 ppb of fluridone is 10,000-fold less than the no effect level in test animals. People who wish to avoid even minimal residues can do so by filtering their drinking water with a charcoal-based filter.

Can I swim and fish in treated water? There are no swimming or fishing restrictions associated with fluridone treatment. Fluridone does not significantly bioaccumulate or biomagnify in fish. Consumption of fish from treated water does not pose a threat to human health.

Can fluridone leach into groundwater wells, which are shallow and close to a treated water body? Fluridone tends to bind to organic matter and should not leach into groundwater from aquatic sediments. Fluridone shows a limited ability to leach if applied to soil.

What about the other ingredients in Sonar? "Inert" ingredients included in formulations of fluridone are confidential. DOH was permitted to review the list of inerts in Sonar and concluded that these chemicals are not of human concern at applied concentrations.

Can I use treated water for watering domestic plants? For information about susceptibility of specific plants, consult the product label or contact the manufacturer. According to the manufacturer, Sonar used at the maximum-labeled rate (150 ppb) may affect domestic plants, especially plants in the *Solanaceae* family (tomato, potato, eggplant, peppers etc.). More dilute concentrations are unlikely to affect domestic plants. Again, a charcoal-based filter will remove fluridone residues from water.

Need More Information?

Please Contact:

- Your county health agency
- Washington State Department of Health Pesticide Program (360)236-3360
- Washington State Department of Ecology Water Quality Program (360)407-6563
- Sepro is the company which manufactures Sonar products. Material Safety Data Sheets and current copies of Sonar labels are available by calling 1-800-419-7779 or at the Sepro website www.sepro.com/aquatics/sonar/index.html
- Additional copies of this fact sheet can be obtained from:
  Office of Environmental Health & Safety
  P.O. Box 47825
  Olympia, Washington 98504-7825
  Tollfree: (888) 586-9427

Sonar*
Aquatic Herbicide

FA&B
Features, Advantages & Benefits

Sonar* Aquatic Herbicide

Sonar aquatic herbicide provides an answer to these problems. Sonar selectively manages undesirable aquatic vegetation for a year or longer with minimal risk to the environment. That makes water usable for recreation, brings the fish population back into balance and restores property values. Sonar won't restrict swimming, fishing or drinking and is effective in freshwater ponds, lakes, reservoirs, rivers, and canals. Sonar is available in two formulations—Aqueous Suspension (liquid in gallon, quart and pint containers) and SRP (slow release pellets in 40 lb. pails). Sonar AS is available for immediate uptake into the target plants while Sonar SRP slowly dissipates to provide an extended period of contact.

Feature	Advantage
Sonar has been thoroughly tested and has a very minimal effect on the aquatic environment.	Sonar has no use restrictions.

Benefit: As effective as Sonar is on target aquatic weeds, it won't restrict swimming, fishing, drinking or livestock consumption, even immediately after application.

Feature	Advantage
Selectivity.	Sonar treatments can remove targeted nuisance plant populations while allowing beneficial native vegetation to flourish and grow in a less competitive environment.

Benefit: Native vegetation can re-establish itself, usually within one year.

Feature	Advantage
Long-term control—target weeds are often eliminated for a year or more.	Fewer treatments mean a reduction in chemical use.

Benefit: Sonar provides a cost-effective, long-term solution.

Feature	Advantage
Flexibility.	Given the right combination of dosage, timing of application and susceptible plants, Sonar can be used for anything from very specific species control to a broad spectrum of difficult-to-control vegetation management.

Benefit: Sonar works in large and small waterbodies and in situations with moving water. Whether the intended use of your waterbody is fishing, swimming, irrigation or simply aesthetic beauty, Sonar can provide an effective plant management solution through a wide variety of treatment strategies.

SePRO Corporation 11550 North Meridian Street, Suite 600, Carmel, IN 46032
Visit our web site at **www.sepro.com**

SePRO Corporation

SePRO Corporation is a national organization with a full line of products devoted to aquatic ecosystem restoration.
A carefully-prescribed aquatic plant management plan featuring the use of SePRO herbicides—backed by a thorough research and development department and a hands-on team of knowledgeable Aquatic Specialists—makes water usable for recreation, brings the fish population back into balance and restores property values.

Feature	**Advantage**
SePRO has more Aquatic Specialists throughout the U.S. than any other aquatic product company.	SePRO products are supported by sound technical advice from field experts familiar with native and exotic vegetation.

Benefit: SePRO Aquatic Specialists work with applicators in your area to prescribe a treatment plan unique to your aquatic weed or algae problem. The treatment strategy is backed by years of thorough research, field-trial studies, a high degree of product knowledge and a proven track record.

Feature	**Advantage**
Research and Development.	Ongoing research and development efforts work to advance the science of aquatic weed control with the latest product technologies.

Benefit: Comprehensive research in the laboratory and field allows SePRO to demonstrate results and maximize each product to its potential. Dedication to actively seeking new products makes SePRO a world leader in advancing the science of aquatic plant management.

Feature	**Advantage**
Cooperative research and regulatory efforts and consistent interaction with state regulatory agencies.	SePRO is recognized by state agencies as a committed, reliable partner.

Benefit: SePRO brings a track-record of long-term aquatic habitat restoration in accordance with local guidelines. SePRO specialists are available to assist with regulations and permitting to expedite the rehabilitation of your waterbody.

Feature	**Advantage**
Preferred Applicator Program. 	SePRO has partnered with a nation-wide team of elite aquatic applicators to build an alliance of dedicated professionals well-trained in the effective use of SePRO aquatic plant management products.

Benefit: SePRO Preferred Applicators throughout the U.S. possess insider knowledge of SePRO's products and services. The partnership between SePRO and its Preferred Applicators ensures that the right tool will be used to its potential for the right job.

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REPRESENTATIVE FANWORT AND WATERMILFOIL TREATMENT PROJECTS WITH SONAR (FLURIDONE) HERBICIDE

Aquatic Control Technology, Inc.

WATERBODY NAME	CLIENT/ CONTACT	YEAR	WATERBODY SIZE	DESCRIPTION & RESULTS	CONTRACT AMOUNT
Bartlett Pond Northborough, MA	Engineering Department • Contact: Sue Brackett 508-393-5015 (days)	1996 & 1999	45 Acres	Sonar treatment program to selectively control non-native and invasive Eurasian watermilfoil and fanwort growth in this 45-acre pond, while maintaining a diverse assemblage of native plants. Pond has a rapid flushing rate, so a split-treatment program was performed in May and June of 1996. Comprehensive pre and post-treatment aquatic plant monitoring and reporting accompanied this treatment program. Excellent milfoil and fanwort control (>95%) achieved for three years following treatment. The pond was treated again in 1999 resulting in excellent control of the milfoil and fanwort, with <10% re-growth as of 2001.	$18,000
Congamond Lakes Southwick, MA / Suffield, CT	Citizens to Restore Congamond • Contact: Gerald Crane 860-668-5783 (days) Lake Management Committee • Contact: Dick Grannells 413-569-0515 (days)	2001	465 acres	Whole lake Sonar AS treatment to control Eurasian watermilfoil. Milfoil biomass and cover were reduced by >95% within 60 days of treatment. Excellent milfoil control has been maintained in the lake to date. Approximately 35 acres have been spot-treated for curlyleaf pondweed and widely scattered milfoil growth over the past three years. Detailed plant surveys and wetlands assessments have accompanied this high profile project. Native plant recolonization has continued to increase each year following treatment. This is a high-profile fishing lake with a prized bass fishery. The lake hosts more than 80 organized fishing tournaments per year and reports suggest that the fishing has never been better.	$180,000
Copake Lake Copake, NY	Copake Lake Association • Contact: Barbara Bunger 413-528-3145 518-325-5632 (day/evening)	2002	420 Acres	Whole lake Sonar treatment program performed in 2002, to selectively control non-native and invasive Eurasian watermilfoil growth in this 420-acre lake. The treatment program was desired to replace harvesting that was no longer providing sufficient control. The treatment has provided two seasons of excellent milfoil control (>95 %). Only widely scattered milfoil has returned and it is being aggressively handpulled.	$80,000
Jacobs Pond Norwell, MA	Conservation Commission • Contact: Judy Salter 781-659-8022 (days)	1997& 2001	59 Acres	Sonar treatment program to selectively control non-native and invasive fanwort growth in this 59-acre pond, while maintaining a diverse assemblage of native plants. Treatment performed under scrutiny of the South Shore Natural Science Center, which is located adjacent to the pond and uses the pond as a field laboratory. Pond has a rapid flushing rate, so a split-treatment program was performed in June and July of 1997. Comprehensive pre and post-treatment aquatic plant monitoring and reporting accompanied this treatment program. Excellent fanwort control (>95%) was maintained for nearly four years until the pond was again successfully treated in 2001	$22,500

Lower Chandler Mill Pond Duxbury, MA	Conservation Commission • Contact: Joseph Grady Conservation Administrator 781-934-1104 (days)	2000	40	A series of sequential treatments were performed with Sonar herbicide commencing in late spring. Excellent control of the targeted fanwort has been obtained throughout the summer of 2003. We're projecting 4-5 years of nuisance level fanwort control. Treatment at the pond in 1999 by another lake management company reportedly provided one year of plant control. We encourage you to call this client.	$23,000
Pine Pond Kent, NY	Gypsy Trail Club • Contact: Mark Walsh 518-432-7511 (days)	1997 & 2004	75-Acres	Whole lake treatment with Sonar AS herbicide was conducted in 1997. Re-growth of milfoil finally reached densities worthy of another whole lake Sonar treatment in 2004, but milfoil densities were still lower than what was documented prior to the 1997 treatment.	$24,000
Pratt Pond Upton, MA	Conservation Commission & Lake Study Committee • Contact: Charles Pedersen 508-529-3370 (days)	1994	38 Acres	Sonar SRP treatment program to selectively control non-native and invasive fanwort growth in the littoral zone of this 38-acre pond, while maintaining a diverse assemblage of native plants. Pond has been annually monitored since the Sonar treatment in 1994 and no fanwort regrowth has been found.	$12,000
Reservoir Pond Canton, MA	Reservoir Pond Association • Contact: Sandy Denehey 508-529-3370 (days)	2001	240 Acres	Sonar AS treatment of this 240 acre impounded waterbody for control of variable watermilfoil and fanwort. Multiple applications yielded excellent control of all targeted plants. No significant fanwort regrowth was observed through the 2003 season.	$54,500
Spy Pond Arlington, MA	Spy Pond Association • Contact: Bill Eykamp 781-646-3320 (days)	2001	103 Acres	Treatment of Eurasian watermilfoil and coontail during the late spring of 2001 with Sonar AS herbicide. Greater than 99% control of the milfoil biomass & cover was achieved. In addition to the effective Sonar treatment, ACT successfully, permitted the project in accordance with the Massachusetts Wetland Protection Act.	$35,000
Sunset Lake Braintree, MA	Planning and Conservation Department • Contact: Allen Weinberg 781-794-8233 (days)	1994	57 Acres	Sonar treatment program to selectively control non-native and invasive Eurasian watermilfoil growth in this 57-acre lake. Treatment performed as part of a long-term management program being developed for the lake. Comprehensive pre and post-treatment aquatic plant monitoring and reporting accompanied this treatment program. Excellent milfoil control (>95%) was achieved for three complete years following treatment. Town retained ACT to continue an annual aquatic plant monitoring program. Approximately 15-acres of milfoil was spot-treated with Reward® (Diquat) herbicide in 1997 and every 1-2 years since, which has successfully prevented a widespread infestation of milfoil from becoming established.	$25,000

West Twin Lake Salisbury, CT	Town of Salisbury • Contact: Val Bernardoni, 1st Selectman 860-435-5170 (days)	2001	105 Acres	Multiple application Sonar AS treatment to control Eurasian watermilfoil in the "third lake" basin of the Twin Lakes system located in Salisbury, CT. A barrier was used to segregate the treated areas from sensitive upstream habitat containing an endangered submersed plant species. Limited drawdown was used prior to application in order to manage retention times during the treatment. Excellent control of target plants was achieved post-treatment. Approximately 15-20 acres of milfoil regrowth, attributed to reinfestation from the untreated "first" and "second" lakes, has been successfully spot-treated with Reward herbicide in 2003 and 2004. Native plants have continued to aggressively recolonize the lake following the 2001 Sonar treatment.	$28,000

♦ Note: For all Massachusetts projects listed above, ACT prepared and filed Notice of Intent applications with the Conservation Commission and was successful in obtaining a valid Order of Conditions. In addition, ACT prepared and filed the License to Apply Chemicals with MA DEP, Office of Watershed Management.