

LONG-RANGE AQUATIC
VEGETATION MANAGEMENT PLAN
ONOTA LAKE
PITTSFIELD, MASSACHUSETTS

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Prepared for:

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INTRODUCTION

Onota Lake is an important freshwater resource to the City of Pittsfield (City) and the entire Berkshire County area. A City Beach and Swim area, public boat launch, fishing pier and boat livery located in Burbank Park along the lake's eastern shoreline are extensively used throughout the summer months. The lake is also stocked and managed with a variety of gamefish including trout and northern pike. Summer camps are owned and operated on lakefront property, and the lake is especially important to the resident shoreline property owners.

Working with the Lake Onota Preservation Association (LOPA), the City embarked on a comprehensive two-year nuisance aquatic vegetation management effort in 1999. The primary objective of the program was to achieve immediate control over the non-native and highly invasive Eurasian watermilfoil (milfoil) plant that had infested the lake. Mechanical harvesting, which was the primary weed control strategy employed in previous years, was no longer providing adequate control of the milfoil growth. This rendered portions of the lake unusable for the majority of the summer season. After considerable research, the City and LOPA decided that whole-lake treatment with SONAR™ (fluridone) herbicide was the most suitable means of controlling the milfoil infestation at Onota Lake.

Aquatic Control Technology, Inc. of Sutton, Massachusetts was selected through a competitive procurement process to complete this three-phase, two-year program to control Eurasian watermilfoil and other nuisance aquatic plants at Onota Lake. The first phase of the program was the development of a "draft" *Comprehensive Aquatic Vegetation Management Plan*. This was completed in April 1999 and submitted as the project description portion of the Notice of Intent application that was filed with the Pittsfield Conservation Commission. Phase two was the SONAR herbicide treatment program completed during the 1999 season. Excellent control of milfoil was achieved throughout the lake by the end of the summer of 1999. There were widely scattered milfoil plants that persisted in the lake at the end of the year, however, which necessitated gaining approval to perform phase three; follow-up treatments during the 2000 season in order to insure that the guaranteed level of milfoil control stated in the contract could be achieved. Permitting proceeded over the winter months. The Conservation Commission granted conditional approval to spot-treat remaining milfoil growth with Navigate® (2,4-D) herbicide during the 2000 season. A single 2,4-D application performed in early July - once the curlyleaf pondweed growth had senesced - provided excellent control of the remaining milfoil. The guaranteed level of milfoil control was exceeded, while a diverse assemblage of desirable, native plants was preserved for fish and wildlife habitat.

The final phase of this milfoil management program called for development of a vegetation management plan. The intention was to incorporate other non-chemical milfoil management strategies into a long-range aquatic vegetation management plan for Onota Lake. Most of the available techniques were already discussed in the "draft" *Comprehensive Aquatic Vegetation Management Plan* prepared in April 1999 and in the "draft" *Year 2000 and Long-Range Aquatic Vegetation Management Plan* prepared in January 2000. Now, after gaining the experience of the 1999 and 2000 chemical treatment programs, recommendations for a long-range aquatic vegetation management plan at Onota Lake can be revisited and adjusted accordingly.

There will also be a need to integrate future vegetation management techniques with other lake and watershed management efforts. The City and LOPA are already initiating watershed management activities to improve water quality and control the causes of accelerated eutrophication. The City successfully received a Section 319 Grant to install a culvert under Thomas Island Road and widen an existing channel. A 1991 Diagnostic/Feasibility Study of the lake suggested that these modifications would reduce the impact of sediment and nutrient laden storm water entering Onota Lake. This project is currently in the design and permitting phases. More recently, the City was also the recipient of a Small

Lake and Pond Grant from the Massachusetts Department of Environmental Management to perform bank and trail stabilization within Burbank Park. In addition, LOPA continues to conduct annual volunteer monitoring of the lake and is currently investigating in-lake and watershed nutrient reduction strategies. All of the on-going and future management efforts planned for the Onota Lake system must be carefully integrated to maximize the overall benefit to the lake.

VEGETATION MANAGEMENT OBJECTIVES

Obtaining immediate milfoil control was the City's stated objective and reason for pursuing a chemical treatment program during the 1999 and 2000 seasons. The non-native and highly invasive Eurasian watermilfoil growth was the most visible "threat" to open-water conditions in the lake. The treatments achieved dramatic milfoil reductions during both seasons. Carryover benefits of the 1999-2000 treatment program may keep milfoil below nuisance densities throughout 2001 and possibly longer, but milfoil will immediately begin to recolonize Onota Lake and other problems with nuisance vegetation may develop.

Identifying clear objectives is the first and most important step towards developing a long-range vegetation management plan. A reasonable objective for Onota Lake is to control non-native and invasive vegetation in order to preserve a diverse native plant assemblage for fish and wildlife habitat and open-water conditions for recreational activities. Objectives must be routinely updated and adjusted accordingly as conditions change at the lake.

Onota Lake is currently facing two nuisance vegetation issues: infestations of non-native Eurasian watermilfoil and non-native curlyleaf pondweed. In recent years, milfoil has been the focus of vegetation management efforts, since the plant persisted for the entire summer season. The chemical treatment programs controlled milfoil in 1999 and 2000, but it will begin to regrow immediately. This will not be the result of reintroduction, so much as it will occur from surviving plant parts such as root structures or possibly some seed propagation. Typically, the milfoil regrowth does not all occur in the same year and it is difficult to predict where and how much will regrow. Based on the milfoil distribution observed at Onota Lake in October 2000, an estimated 50 or more acres in the lake may support milfoil in 2001. The milfoil density/biomass will likely be lower than what existed prior to the 1999 treatment program, but if no management is performed the milfoil densities will quickly rebound. Again, it is impossible to make accurate predictions, but if milfoil is left unmanaged at Onota Lake in 2001 the infestation may approach 100 acres by 2002 and could return to pre-treatment densities within a two or three year period.

Curlyleaf pondweed is probably equally as invasive as milfoil, but its peculiar life cycle makes it less problematic. Curlyleaf pondweed typically matures by mid to late June. Once mature, the plants form turions or seed-like structures that settle to the lake bottom. The plants then quickly die-off, usually by early to mid July. The turions germinate over the summer and "dwarf" plants are usually visible by the fall. These "dwarf" plants then over winter and are poised to grow aggressively shortly after ice-out in the spring. Since the curlyleaf plants die-back in by early to mid July, they generally do not impair access to the lake during peak summer usage.

APPLICABLE AQUATIC VEGETATION MANAGEMENT TECHNIQUES

With the two-year (1999-2000) chemical treatment program to control milfoil now concluded, the City will need to develop and follow a long-term management plan that focuses on preventing milfoil from returning to its pre-SONAR treatment densities and preventing the establishment of other non-native or invasive aquatic plants. The large size of Onota Lake and the diversity of potentially problematic aquatic species will require several in-lake plant control techniques to be incorporated into the management plan.

Matching the proper technique to individual sites and infestations will be the greatest challenge. The techniques cannot simply be employed based on their effectiveness and suitability for a particular site. Other intangibles such as public acceptance, ability to be permitted and cost will undoubtedly be considered.

Since milfoil is likely to be the primary target of vegetation management efforts at Onota Lake for the foreseeable future, milfoil management will be the focus of the following discussion of management alternatives. The applicability of the various techniques to control curlyleaf pondweed and other potentially problematic species will be mentioned where appropriate. The plant species identified to have nuisance potential in Onota Lake by Fugro (1996) are listed in Table 1 below, along with their response to large scale management alternatives.

Table 1 - Response of Potentially Nuisance Plants in Onota Lake to Large Scale Management Alternatives

Species	Common Name ¹	Drawdown	Harvesting	Chemical/ Herbicide Treatment	Weevil
<i>Ceratophyllum demersum</i>	Coontail	2	1	3	0
<i>Elodea canadensis</i>	Waterweed	1	1	3	0
<i>Chlorophyta</i>	Green Algae	0	0	1	0
<i>Myriophyllum spicatum</i>	Eurasian Watermilfoil	2	1	3	0-3
<i>Najas flexilis</i>	Bushy Pondweed	2	2	2	0
<i>Nuphar variegata</i>	Yellow Waterlily	2	1	3	0
<i>Nymphaea odorata</i>	White Waterlily	2	1	3	0
<i>Potamogeton crispus</i>	Curlyleaf Pondweed	1	2	2	0
<i>Potamogeton richardsonii</i>	Claspingleaf Pondweed	2	2	2	0
<i>Spirodela polyrhiza</i>	Big Duckweed	0	0	2	0

Response to various management alternatives compiled by Aquatic Control Technology, Inc.

KEY: 0 – Typically No Control

1 – Temporary Control, Generally Less Than 1 Year

2 – Potential for Annual Control

3 – Potential for Multiple Seasons of Control

¹ Species list and nuisance potential reported by Fugro (1996)

Other factors that should be considered when selecting a vegetation management approach include the size and distribution of the plant infestation, lake usage in the immediate vicinity of the infestation, presence of non-target plants and/or wildlife and plans for upcoming management alternatives. For instance, a problematic late summer infestation of milfoil may not warrant a chemical treatment if a deep drawdown is scheduled for the upcoming winter. The primary vegetation management strategies that should be considered at Onota Lake are presented in Table 2. A brief discussion of how each approach can be utilized at Onota Lake is provided, however, this is only the first step towards development of a working management plan that will require continual refinement and redirection of efforts and funding as conditions change in the lake.

TABLE 2 - ALTERNATIVE MILFOIL CONTROL STRATEGIES FOR ONOTA LAKE

Technique	Applicable Milfoil Infestation Size	Advantages	Disadvantages	Unit Cost	Anticipated Duration of Control
Bottom Weed Barriers	Small dense infestations 5,000-10,000 ft ²	<ul style="list-style-type: none"> Area selective control Effective for several years with proper upkeep 	<ul style="list-style-type: none"> Cost-prohibitive for large infestations (>1/4 acre) Requires SCUBA Diver installation in waters >4 ft. deep Must be removed, cleaned, repaired and reinstalled every 2-3 years Not specific for milfoil, controls all plants Swimming and boating hazard in shallow water areas 	<ul style="list-style-type: none"> \$0.75-\$0.85 ft² for material alone \$1.25-\$1.35 ft² installed with anchoring devices >\$50,000 per acre installed Maintenance \$0.25-\$0.50 ft² every 2-3 years 	5 - 10 years with proper upkeep
Chemical Treatment	> 1 acre	<ul style="list-style-type: none"> Can provide area and/or species selective control Systemic products control milfoil for 2-3 years Plants are typically controlled within a matter of weeks Low unit cost 	<ul style="list-style-type: none"> Temporary restrictions on using treated water for drinking or irrigation purposes Must be repeated every 1-3 years Desirable, native plants are occasionally impacted Negative public perception towards chemicals 	<ul style="list-style-type: none"> \$300-\$500/acre 	2-3 years using systemic-acting herbicides like fluridone and 2,4-D
Drawdown	Only controls plants to the depth that water is lowered	<ul style="list-style-type: none"> Relatively low cost approach, since outlet structure is already in-place Milfoil is controlled by winter drawdowns Facilitates shoreline clean-up and maintenance for lake abutters 	<ul style="list-style-type: none"> Will not control milfoil in deeper water portions of the lake Impacts the entire lake shoreline May have negative impacts on adjacent wetlands May affect wells near the water's edge Potential increase in drawdown resistant plants 	<ul style="list-style-type: none"> Nominal - perhaps up to \$5,000 annually for more extensive monitoring 	1-2 years in the zone of drawdown
Hand-Pulling	widely scattered <400 plants per acre	<ul style="list-style-type: none"> Good selectivity Plant biomass removed from lake Causes little disruption Good public perception 	<ul style="list-style-type: none"> Requires SCUBA Divers in waters greater than 2-3 feet deep Not effective on large or dense infestations Very labor intensive and time consuming 	<ul style="list-style-type: none"> Varies \$200-\$1,000 or more per acre 	1-2 years
Harvesting	>10 acres	<ul style="list-style-type: none"> Immediate removal of nuisance plants Plant biomass removed from lake City already owns and operates harvesters 	<ul style="list-style-type: none"> Not Recommended - Escaping fragments can spread the infestation and aggravate the problem Short-term control - multiple cutting required per summer Not selective - removes all plants and juvenile fish 	<ul style="list-style-type: none"> \$450-\$650 per acre per cutting \$900-\$1,300 per acre annually 	2-3 months - multiple cuttings required each summer
Suction Harvesting	<1 acre	<ul style="list-style-type: none"> Good selectivity Plant biomass removed from lake Good public perception 	<ul style="list-style-type: none"> Very inefficient Limited equipment availability Requires SCUBA Divers to operate lake to lake 	<ul style="list-style-type: none"> \$4,000-\$6,000 per acre 	1-2 years
Weevils (<i>E. lecontei</i>)	>1 acre	<ul style="list-style-type: none"> Biological control with good public perception Only graze on Eurasian watermilfoil If population becomes established it can be self-sustaining 	<ul style="list-style-type: none"> Effectiveness cannot be guaranteed from lake to lake Does not completely kill the milfoil, causes plants to collapse and lie along bottom so they are no longer a nuisance Control may be cyclical with some good years and other bad years Will take several years for weevil population to become established - no other management can be performed during that time in those areas 	<ul style="list-style-type: none"> ~\$20,000 for a 10-acre introduction program performed over three years 	Unknown

Bottom Weed Barriers

Benthic or bottom weed barriers are most effective for small dense plant infestations. They are usually used in the deeper portions (>5 feet) of swim areas or around boat docks and piers. Some lakes, like Lake Wonoscopomuc in Lakeville, CT, have even been able to effectively use these barriers to control milfoil infestations in larger areas by regularly repositioning the barriers. Barriers are most effective at controlling small dense plant infestations that do not exceed 5,000-10,000 square feet in size.

A few different materials have been commercially manufactured as bottom weed barriers. Probably the most effective currently available is called Aquatic Weed Net™. It is a PVC coated fiberglass screening that was originally developed by researchers at Cornell University. The aperture size of the screen is small enough to block enough sunlight to prevent weed growth, while still allowing gas transpiration so there is less "billowing" or lifting off of the bottom. The barriers can be anchored to the bottom a number of different ways. ACT's preferred method is to use lengths of steel re-bar that are encased in capped PVC pipes. This provides a long, even weight that is free of sharp edges that could be hazardous to swimmers or may damage the barriers. These anchors can also be easily collected and removed when the barriers are taken out for cleaning and repair. This must be done every 1-3 years (depending on the siltation rate) otherwise plants will begin to root on top and through the barriers.

Most installations in water depths greater than four feet must be completed by SCUBA Divers. The barriers are available in panels that are either 7 or 14 feet wide and 100 feet long. They can be cut to fit any configuration. Material costs typically run around \$0.75-\$0.85 per square foot. Estimated costs to purchase and have the material initially installed with the anchoring devices is probably closer to \$1.25-\$1.35 per square foot. Maintenance costs for removal, cleaning/repair and redeployment probably run in the range of \$0.25-\$0.50 per square foot. Properly maintained barriers have a useful lifespan of 5-10 years.

Chemical/Herbicide Treatment

The chemical treatment programs performed at Onota Lake during the 1999 and 2000 seasons provided species selective control of milfoil. The whole-lake SONAR (fluridone) treatment performed in 1999 controlled the majority of milfoil growth throughout the lake. Navigate (2,4-D) was then effectively used to spot-treat remaining milfoil growth in 2000. Both herbicides were also fairly selective for milfoil, leaving a diverse assemblage of desirable native plants in the lake.

Although the City has concerns with utilizing chemical treatment as a regular management activity, it does provide for species and area selective plant control. Chemical treatments are often more cost effective than other approaches, if they can provide one or more years of effective plant control. Just as the decision was reached to resort to a whole lake treatment with SONAR herbicide to get the milfoil population under control, chemical usage should be carefully evaluated in the future to prevent milfoil or other nuisance species from returning to pre-treatment densities.

Aquatic herbicides are either systemic or contact acting. Systemic products, like SONAR and Navigate, are usually preferred because they generally provide multiple years of effective control. Contact products generally only provide annual control, but can be effective for shoreline spot-treatments or where water flow is an issue. Contact herbicides, such as Reward® (diquat) can also provide rapid and effective control of curlyleaf pondweed. Currently registered products that should be considered for future milfoil control at Onota Lake are listed in the following table.

Table 3 - Aquatic Herbicides for Milfoil Control at Onota Lake

Trade Name	Active Ingredient	Formulation/ Type	Advantages	Disadvantages
SONAR™	Fluridone	Liquid & Granular Systemic	<ul style="list-style-type: none"> Multiple years of control Can be selective at low concentrations Excellent toxicology profile 	<ul style="list-style-type: none"> Not effective for spot or shoreline treatments Control takes 6-8 weeks or longer Considerably higher cost for partial lake treatments
Navigate®	2,4-D	Granular Systemic	<ul style="list-style-type: none"> Multiple years of control Is selective for dicot plants (milfoil) Effective for spot or shoreline treatments Plants controlled in 2-3 weeks 	<ul style="list-style-type: none"> Restrictions on using treated water for drinking or irrigation Improperly associated with other banned chemicals
Reward®	Diquat	Liquid Contact	<ul style="list-style-type: none"> Fast acting, controls plants in 1-2 weeks Can be used for spot or shoreline treatments Only requires 1-2 days of contact time Water use restrictions only 3 days for drinking, 5 days for irrigation Provides rapid control of curly-leaf pondweed 	<ul style="list-style-type: none"> Only provides seasonal control May impact non-targeted native species

In order to provide a fair cost comparison for the three herbicides proposed for milfoil control at Onota Lake, the unit costs listed below assume a partial lake/shoreline treatment with a minimum treatment area of 25 acres.

Herbicide	Unit Cost	10-Year Projections, # of Applications / Cost
SONAR™ (Fluridone)	\$750-\$850 per acre	4 applications / ~\$80,000
- SRP Granular		
- Systemic action		
Navigate ® (2,4-D)	\$350-\$450 per acre	4 applications / ~\$40,000
- Granular		
- Systemic action		
Reward® (Diquat)	\$275-\$375 per acre	10 applications / ~\$80,000
- Concentrated Liquid		
- Contact action		

The unit cost for a whole lake treatment with SONAR AS (liquid) is considerably lower, but the entire 620-acre lake must be treated. It should be expected that whole lake SONAR AS treatment cost will be \$125,000 or more.

A brief summary of the primary properties of the herbicides that may be considered for use at Onota Lake is provided below.

SONAR™ Herbicide - SONAR (fluridone) is generally viewed as having one of the most “environmentally friendly” toxicology profiles of all products currently on the market. In fact SONAR is the only herbicide approved by the EPA for use in drinking water reservoirs at a dose of 20 ppb (parts per billion) or less. SONAR has no temporary water use restrictions other than 1.) No application within one-quarter mile of a potable water intake and 2.) No use of treated water for irrigation purposes within 30 days of treatment. When using SONAR, it is not so much the dose that matters as the amount of time the vegetation is in contact with the herbicide, which is why series of low-dose applications are generally performed. The USEPA label for SONAR allows a maximum application rate of 150 ppb to be used in lakes. The 1999 SONAR treatment program targeted maintaining a concentration of averaging 5 ppb in the water column for a 45-day plus period. Lake-wide the total amount of SONAR applied was less than one-quarter the maximum permissible label rate.

Fluridone is a carotenoid synthesis inhibitor. Carotenoid or yellow plant pigment works to protect the photosynthesizing chlorophyll pigment. Once the chlorophyll is unprotected it is broken down by the sun, which renders the plant incapable of producing food and as a result starves to death. This slow action of SONAR reduces the possibility of oxygen depletion due to decaying plant material and the potential for ensuing algae blooms.

Navigate® Herbicide - Navigate (2,4-D granular) could be applied for control of Eurasian watermilfoil, or yellow and white waterlilies. Like SONAR, Navigate is a systemic-acting chemical that is likely to provide two or more years of control of Eurasian watermilfoil, while Reward will not. It can also be very specific to Eurasian watermilfoil at low dose application rates, and it can be effectively used for spot-treatments. The 2000 Navigate treatment at Onota Lake achieved excellent control of the targeted milfoil, while preserving a diverse assemblage of native plants. The granular herbicide is evenly applied throughout the treatment area with a cyclone spreader/seeders. Control of targeted plants in the treated areas is expected to last for 1-2 seasons or longer. Treatments generally occur at approximately 100 lbs./acre, instead of the maximum label rate of 200 lbs./acre. Navigate has no water use restriction for swimming, fishing or boating, however, prudent practice calls for closure of the treated area on the day of treatment. Use of water for irrigation, watering livestock (i.e. cattle or horses, etc.) and drinking or domestic purposes is generally restricted for 30 days following treatment.

Navigate is a systemic herbicide that is absorbed through the foliage and root systems. Following root absorption, the herbicide moves upward into the shoots of the plant affecting its enzymes, respiration and cell division. After treatment with the granular Navigate, plants begin to die within a week to ten days, and would be expected to fully disappear within two to three weeks following application. The vegetation actively absorbs the chemical. Navigate not taken up by plants becomes bound to the bottom sediments, where it is degraded or broken down by microbial (bacteria) and photolytic (light) processes. Navigate is generally below drinking water thresholds 14-21 days following treatment.

Reward® Herbicide - Reward (diquat dibromide) is a widely used herbicide, applied to lakes and ponds throughout North America to control nuisance submersed aquatic plants. Reward would be applied to control nuisance growth of Eurasian watermilfoil, curlyleaf pondweed, waterweed or naiad at the application rate of 1.0-2.0 gal/acre, which is less than the USEPA label's recommended maximum application rate. Temporary water use restrictions for Reward are 1) no drinking or cooking for 3 days, 2) no irrigation of turf/nonfood crops for 3 days, and 3) no watering livestock for 1 day. There are no restrictions on swimming, boating or fishing, but prudent pesticide management, suggest that treated portions of the lake be posted and closed on the day of treatment.

Reward is translocated to some extent within the plant. Its rapid action tends to disrupt the leaf cuticle of plants and acts by interfering with photosynthesis. Upon contact with the soil, it is absorbed immediately and thereby biologically inactivated. The concentration of Reward in treated water after application at the 1-2 gallon per surface acre (1-2 lbs. diquat cation per acre) use rate is approximately 0.37 ppm (mg cation/L) immediately after application. Instantaneous concentrations of 0.37 ppm fall to about 0.1 ppm after 24 hours and 0.01 ppm by 4 days. Reward not adsorbed by the plants is tightly bound to soil, and rendered biologically unavailable.

This list will need to be amended as new products become available or label directions are changed due to the re-registration process with the USEPA. A pending label change for Navigate will hopefully lessen the water use restriction periods that must be imposed following treatment. A new product that should be available within the next year or two is called Renovate™ (triclopyr). It has been used and evaluated for several years under an Experimental Use Permit issued by the USEPA. It has systemic-acting properties and has proven to be effective at controlling milfoil. Whether or not Renovate will be a more suitable herbicide than SONAR or Navigate for Onota Lake cannot be determined until Renovate receives its full aquatic registration and label directions.

Drawdown

The EIR prepared by Fugro East, Inc. in 1996 appears to provide a thorough examination of the potential impacts and advantages of implementing a drawdown program at Onota Lake. The recommended target drawdown of 4-5 feet has not yet been performed, due to the 3-foot (± 0.5 ft.) drawdown limit imposed by the Conservation Commission and DEP in the current Order of Conditions. Drawdown can be an effective follow-up management approach to prevent rapid re-infestation of Eurasian watermilfoil, curlyleaf pondweed and other potentially nuisance species. It is unlikely that the current drawdown limit of ~3-feet exposes enough of the lake bottom to freezing and drying conditions to offer much in the way

of weed control. Increasing the drawdown depth would increase this benefit. The Fugro (1996) study estimated that a 2-foot drawdown would expose 73 acres, a 4-foot drawdown would expose 257 acres and a 6-foot drawdown would expose 290 acres. Even just increasing the depth of drawdown to the recommended 4-6 feet would expose considerably more of the lake bottom and should help to reduce the amount of vegetation that approaches the surface and may become problematic in the most heavily used portion of the littoral zone. Drawdown could be particularly effective in the shallower north basin.

The benefits of drawdown would be limited beyond the depth that the lake is lowered. Some ice scouring may occur to a slightly deeper depth, but for the most part, milfoil would not be controlled where the bottom was not exposed to freezing and drying conditions. Milfoil was found growing in water depths of 15 feet at Onota Lake and was growing to the surface in areas that were 12-feet deep. Drawdown would not control all of the milfoil at Onota Lake and would need to be integrated with other management strategies. Another benefit of drawdown is that it allows shoreline residents access to clean their swim areas and repair walls and docks in the lake.

Consideration should be given to incrementally increasing the current 3-foot drawdown to the practical maximum of 6 feet over a several year period. The 1996 EIR will likely need to be updated by evaluating the monitoring that has been performed in the years that a 3-foot drawdown was performed. When even temporary lowering of the lake's water level was discussed at the public hearings held by the Conservation Commission for the chemical treatment program, strong concerns were voiced from members of the audience. Monitoring will also need to be continued to insure that all necessary steps are taken to minimize the possible adverse impacts described in the EIR. A more comprehensive annual monitoring program performed by a lake management firm may cost \$5,000. Deep (6 foot) drawdowns should probably be limited to every second or third year to prevent a switch in the plant assemblage to a drawdown tolerant, nuisance species. Drawdown's potential as a low-cost weed control alternative for Onota Lake merits attempting to permit for increased drawdown depth.

Hand-Pulling

Hand-pulling milfoil and other nuisance plants can be an effective strategy for widely scattered plant growth. Volunteers could be trained to carefully hand-pull milfoil from immediate shoreline areas. However, most hand-pulling efforts performed in waters greater than 2-3 feet deep will require SCUBA Divers. Diver hand-pulling has been effectively employed at Lake George, NY. It has reportedly been most effective where plant densities do not exceed 1-2 plants in every 10 square meters or less than 400 plants per acre. Hand-pulling efforts on more extensive milfoil infestations are usually ineffective. One example is Dudley Pond in Wayland, MA where a crew of SCUBA Divers was hired to hand-pull milfoil for an entire summer from this 90-acre pond. Milfoil continued to regrow as soon as an area was cleared, even after several truck loads of milfoil had been removed. After an expenditure of more than \$20,000, there was no noticeable reduction in the milfoil density on the pond.

Hand-pulling will be most effective to control widely scattered milfoil plants at Onota Lake. Perhaps SCUBA Divers could be placed on call, so they could quickly remove scattered plant growth that was identified by lake residents, LOPA members or City officials. Hand-pulling costs can vary greatly depending on the infestation and number of SCUBA Divers being used. Costs ranging from \$200-\$1,000 per acre should be anticipated.

Harvesting

Even though previous harvesting efforts did not provide acceptable levels of control over the milfoil, harvesting may still be utilized for control of other potentially nuisance, native species. Harvesting may even be desired to remove all vegetation from high-use beach and swim locations. Some harvesting might be required in future years for control of curlyleaf pondweed (which is generally only controlled for one season following a chemical treatment) and other nuisance plants, albeit at a substantially reduced

level than what is currently required. Curlyleaf pondweed's rapid growth rate (inches per day) will hinder the effectiveness and efficiency of harvesting. Where curlyleaf pondweed is usually only problematic during the six-week period from mid May to early July, the expense and effort of a harvesting program may not be justified. Harvesting might be an effective means of removing native plant growth from high-use swim areas, such as the broad-leafed pondweed growth that swimmers reportedly complained about towards the end of the summer in 2000 near the City Beach in Burbank Park.

It will be important for future harvesting efforts at Onota Lake to avoid stands of milfoil. Otherwise, it may accelerate the widespread recolonization of milfoil. Future harvesting programs should be guided by a comprehensive early season plant inspection performed prior to the start of work to identify "no harvest" areas of milfoil growth. Routine monitoring should also be performed during the harvesting effort.

The City of Pittsfield now owns and operates the harvesting equipment that was previously owned and operated by Berkshire County. However, harvesting is still the strategy being used to control nuisance weed growth at nearby Pontoosuc Lake, so conflicts over equipment availability may arise. Unit costs for contract-harvesting of milfoil by a company like ACT usually run between \$450-\$650 per acre. It is difficult to assign a unit cost for harvesting work in Pittsfield, since the City already owns the equipment. Costs that must be factored into the ultimate per acre unit cost include operator wages, fuel and routine maintenance, repair and parts, insurance and storage/launching fees.

Suction Harvesting

Suction harvesting is essentially a more effective method of diver hand-pulling. SCUBA Divers dislodge individual milfoil plants, then powered suction lines to carry milfoil plants to a collection basket on the surface. Usually a fragment barrier must be installed around the area where the suction harvesting barge is operating to prevent escaping plant fragments. This greatly limits the mobility of the this technique and makes it better suited to controlling small, dense patches of milfoil; similar to what is recommended for bottom barriers. Limitations of this approach include equipment availability - only a few suction harvesting barges are known to be operating in the northeast - and the high unit cost. The need for SCUBA Divers, surface staff and all the equipment brings the estimated unit cost to \$4,000-\$6,000 per acre. Hopefully, there will be some improvements in this technique to make it a more cost-effective alternative in the future.

Weevils

The aquatic weevil (*Euhrychiopsis lecontei*) is known to feed specifically on Eurasian watermilfoil. First recognized by researchers at Middlebury College in VT as a potential biological control agent for milfoil, naturally occurring weevil populations have been studied in some detail and weevil stocking programs initiated in a number of states - most notably; VT, MA, MN and WI. There is even a company now operating out of the Midwest (Enviro-Science Inc.) that is both raising weevils and offering the services of setting up weevil stocking and management programs. BSC Group of Worcester has a cooperative agreement with Enviro-Science to handle the stocking and follow-up monitoring programs in MA.

There is tremendous interest in weevils. ACT invited Bob Hartzel of the BSC Group to survey Onota Lake to evaluate sites for a weevil stocking program. The effectiveness of the 1999 and 2000 chemical treatment programs left the lake in no condition to support a weevil stocking program. An area of dense milfoil growth is needed to support a weevil population. A summer 2001 survey is planned to evaluate potential weevil stocking sites on Onota Lake. Weevils have yet to be used to control milfoil regrowth following a whole-lake SONAR application.

Based on a review of existing literature and discussions with the top researchers, state personnel and industry representatives involved with weevil introductions, a summary of the most accurate and current information is provided below:

- Weevils (either naturally occurring or stocked) have resulted in milfoil crashes in a number of waterbodies including a few ponds/lakes in MA.
- Considering that *E. lecontei* is a native species, why it has not had a greater impact on controlling milfoil and the factors effecting its population size and distribution are still poorly understood.
- Weevil stocking programs performed in WI in 1997 and monitored in 1998/1999 showed some milfoil reduction in 3 of 12 lakes. They stocked 15,000 weevils in a 100-acre lake. Weevil purchase costs alone were \$1.00/weevil. Source: Dan Helsel; WI DNR (pers. Comm.).
- Where weevils do work to reduce milfoil populations, often times the level/degree of control may not be acceptable for swimming or other water uses. The stems are slow to collapse and then may do so only 1-2 feet beneath the water surface.
- Even where weevils have worked well to control milfoil, the duration of control is "cyclical", generally on the order of 2-3 years before the milfoil rebounds. At Brownington Pond in VT, (the first site where weevil impacts on milfoil were documented) there have been 3 separate and distinct milfoil declines followed by resurgent plant growth over a 10 year period. As of last summer, milfoil cover was greater than at any time in the past decade. Source: Holly Crosson; VT DEC (pers. Comm.).

The introduction of weevils is still very much experimental, yet the attraction and benefit of an effective biological control on combating milfoil is easily understood. A "pilot or demonstration" stocking program of weevils at Onota Lake has merit and should be pursued. It will require identifying one cove or area of the lake for such a project to occur over a 2-3 year period. During this time, no other milfoil control technique (i.e. harvesting or chemical treatment) should be undertaken in these area(s). The fall/winter drawdown of 3 feet reportedly will not significantly impact the weevil population as the adult weevils over-winter on shore. One possible site is the small, relatively undeveloped cove towards the middle of the southern shoreline. Another potential site might be the cove in the southwest corner of the lake. Milfoil growth was found in this cove during the October 2000 inspection. A third possible site would be along the northwestern shoreline of the north basin. This shoreline is undeveloped and bordered by a scrub-shrub wetland. Estimated costs for a 2-3 year program inclusive of weevils, stocking and pre and post-introduction inspections and reporting is in the range of \$20,000 for a ~10-15 acre cove. If weevils are found to be a viable milfoil control strategy for Onota Lake, further introductions may be warranted to other portions of the lake.

RECOMMENDED MONITORING PROGRAM

Maintaining a comprehensive monitoring program will be as equally important in the upcoming years as it was during the 1999-2000 chemical treatment programs. Vegetation management strategies will also need to be incorporated into other lake and watershed management efforts such as storm water diversion, bank stabilization, phosphorus reduction and fisheries management.

Monitoring will play an integral role in determining the most appropriate vegetation management techniques to maintain desired conditions in the lake, as well as helping to most effectively allocate budget resources. Both professional (paid) and volunteer monitoring efforts should be utilized at Onota Lake.

Professional Aquatic Vegetation Surveys - A survey protocol should be established that will allow for a trained aquatic biologist to be hired to conduct professional aquatic plant surveys of the lake. The survey

should at least incorporate a visual inspection of the entire littoral zone of the lake, with specific transects and sampling stations for more detailed plant assessment. The surveys should result in a letter/report that describes the aquatic plant community and a generalized distribution map that shows coverage of the dominant plant assemblages. Plant density and biomass indices should be established to allow for direct annual comparisons. The maps should also be produced in at least a CAD and preferably a GIS format.

An early season aquatic plant survey should be conducted each spring to finalize in-lake management needs for the upcoming summer season. A late season survey may also be appropriate to evaluate the effectiveness of management activities that were employed over the previous summer, and to help project management and budgetary requirements for the following year. The tasks of professional survey could also be expanded to include the required monitoring and reporting that may be required in the Order of Conditions for a drawdown program, harvesting or chemical treatment. Costs for a professional aquatic vegetation survey program as described above are likely to be in the \$3,000-\$4,000 range.

Volunteer Monitoring Efforts – LOPA is already performing detailed annual macrophyte surveys and routine water quality monitoring at Onota Lake. These efforts should be continued and expanded upon, if possible. This information is often invaluable, as residents are more apt to notice new milfoil infestations or other subtle changes in the plant community than a consultant that only visits the lake on one or two occasions each year. LOPA's volunteer monitors should maintain logs of the aquatic plant community that could be easily incorporated into a professional survey report that is produced annually. Volunteer monitoring could also be instrumental in guiding annual harvesting efforts at the lake. Volunteers could inspect potential harvest areas prior to any work being performed, in order to buoy off milfoil infestations or other "no harvest" areas.

Water quality monitoring could be expanded from the Secchi Disk and temperature/dissolved oxygen profiles currently being performed to include several other parameters that directly influence weed and algae growth and the lake's overall water quality. Sampling stations established at the major tributaries, mid-lake and outlet would provide better evidence of how nutrients are reaching and being processed in the lake. Collected data could be used to update nutrient and hydrologic budgets for the lake, and monitor the effectiveness of proposed nutrient abatement strategies, such as the Thomas Island box culvert that is designed to divert nutrient-laden stormwater flow from the main body of the lake. Ideally, sampling should occur monthly and even more frequently from May through September, but any regular sampling program continued from year to year will provide meaningful data. Sample analysis should be conducted by a Massachusetts Certified Laboratory that has experience with lake water sampling techniques. LOPA may also consider seeking expanded participation in the Mass Water Watch Partnership program.

The following parameters should be considered for inclusion in a routine sampling program at Onota Lake:

- Phosphorus - is usually the nutrient that limits algae and some aquatic plant growth in freshwater systems. Total phosphorus concentrations of just 0.03 mg/l are sufficient to stimulate algal bloom conditions. Phosphorus should be the primary target of nutrient abatement efforts, which makes it the most important water quality parameter to test. The laboratory conducting the sampling must have minimum sensitivity of 0.01 mg/l (10 µg/l), but preferably it should be lower (0.001 mg/l or 1 µg/l) to allow for comparison with results from previous sampling efforts.
- Nitrogen - is second to phosphorus in its importance to algae and aquatic plant growth. The three primary forms of nitrogen include nitrate, ammonia and kjeldahl. Nitrate is the end product that is readily available for plant and algae uptake. Laboratory sensitivity should be to 0.1 mg/l.
- pH - is a measure of the hydrogen ion concentration and can be an indicator of pollution.
- Alkalinity - measures the water's buffering capacity against acid additions (i.e. acid rain or pollution)
- Turbidity - measures suspended and colloidal matter in water.
- Color - allows for differential between suspended and dissolved materials.
- Chlorophyll A - provides a quantitative measure of algal content in the water.
- Coliform Bacteria - total and fecal coliform bacteria are direct indicators of water quality and pollution.

SUMMARY OF AQUATIC VEGETATION MANAGEMENT RECOMMENDATIONS

The reduction of nuisance milfoil at Onota Lake obtained through the 1999 and 2000 chemical treatment programs cannot be taken for granted. Now more than ever, the City and LOPA must make a commitment towards controlling non-native and invasive vegetation at Onota Lake. Chemical treatments have proven to be effective at Onota, but other non-chemical approaches must be integrated into a multi-faceted aquatic vegetation management program.

Milfoil is expected to continue to be the most significant threat to desired open-water conditions in Onota Lake for the foreseeable future. An estimated 50 acres of the lake may support milfoil growth in 2001. If no management is performed, the milfoil infestation is expected to more than double in 2002 and will likely return to pre-treatment densities within just a few short years. The various milfoil management strategies employed at Onota Lake must be specifically tailored to match the size and location of the milfoil infestation being targeted. The City and LOPA should also continue to experiment with several of the strategies outlined in the preceding pages. Future chemical treatments at Onota Lake should be limited to larger milfoil infestations that cannot be cost-effectively controlled with other techniques, or if other techniques prove to be ineffective. Specific vegetation management recommendations for Onota Lake for the 2001 and beyond are listed below:

- ◆ Annual Monitoring - Initiate a comprehensive vegetation monitoring program that utilizes volunteer efforts from LOPA and professional inspections by lake managers. These survey efforts will serve to document conditions in the lake and plan management efforts. Estimated annual cost \$3,000-\$4,000.
- ◆ Weevils - Contact BSC Group in the spring of 2001 relative to a weevil stocking program. A site inspection will likely be required to identify suitable stocking sites. The City and LOPA will also need to educate nearby property owners about the 2-3 year commitment that must be given to a weevil stocking program. Estimated three year program cost for a 10-15 acre stocking site inclusive of monitoring is in the range of \$20,000.
- ◆ Drawdown - Monitoring data that has been collected since 3 foot drawdowns were permitted at the lake should be reviewed to reevaluate the likelihood of performing deeper drawdowns at the lake. Deeper drawdowns may provide a relatively low-cost means of controlling shoreline milfoil growth. Initiating a deeper drawdown program will likely need to proceed incrementally and should probably be alternated with less extensive 3-foot drawdowns. Estimated review and permitting costs \$10,000. Estimated annual monitoring costs \$5,000.
- ◆ Diver Hand-Pulling - Local SCUBA Divers should be contacted regarding availability and cost for diver hand-pulling of widely scattered milfoil growth that is identified by vegetation surveys of the lake.
- ◆ Chemical Treatment - Until weevils, deeper drawdown or other non-chemical techniques are identified that can provide effective milfoil control at Onota Lake, chemical treatments should continue to be used when appropriate. Infestations larger than one acre can be effectively spot-treated with 2,4-D herbicide. Unit costs will likely range between \$300-\$500 per acre, depending on the total area being treated. Unless other management strategies are planned for the areas where milfoil was identified in October 2000, the City should consider budgeting \$20,000 for spot-treatment of up to 50 acres of milfoil in 2001.
- ◆ Watershed Management Efforts - Watershed management efforts will play an equal if not more important role at preserving conditions at Onota Lake as vegetation management. All efforts at the lake need to be carefully coordinated. The City and LOPA should continue to educate watershed residents and lake users about proper lake stewardship. Best management practices (BMP's) should be stressed to reduce nutrient and sediment loading to the lake. People should be educated on how to identify non-native species (i.e. milfoil, water chestnut, fanwort, zebra mussels, etc.) and who to notify if they are found in the lake. Installation of a boat washing station should be considered for the Burbank Park boat ramp.

APPENDIX A

Onota Lake Nuisance Aquatic Vegetation Management Program - Year One Update (1999)



October 25, 1999

City of Pittsfield
c/o Mr. Robert S. Mellace, Director
Department of Parks and Recreation
874 North Street
Pittsfield, MA 01201

Re: Onota Lake Nuisance Aquatic Vegetation Management Program – Year One Update (1999)

Dear Bob:

The following report has been prepared to update the City on the status of the nuisance aquatic vegetation management program that is currently underway at Onota Lake. The two primary phases of the program were the development of a Comprehensive Aquatic Vegetation Management Plan to evaluate both immediate and long-term management needs, and completion of a whole-lake Sonar™ (Fluridone) herbicide treatment program to provide an immediate reduction of milfoil biomass.

The program was initiated in April 1999 with the preparation of the Comprehensive Aquatic Vegetation Management Plan and submission of the Notice of Intent application to the Pittsfield Conservation Commission and MA DEP. Review and discussion of the proposed management plan was extended over two public hearings on April 22nd and April 29th. The Order of Conditions that was issued at the end of April permitted the whole-lake Sonar herbicide treatment program described in the Comprehensive Aquatic Vegetation Management Plan. A few modifications to the Comprehensive Aquatic Vegetation Management Plan were required. One was that pre-treatment lowering of the lake's water level to prevent downstream loss of Sonar was not permitted due to concerns raised by MA DFW over impacts to spawning fish. Pre-dawn dissolved oxygen monitoring was required weekly at several locations. The use of the alternate herbicides listed in the plan was also not permitted, and their future use will require the filing of a formal amendment.

Once the Conservation Commission issued the Order of Conditions and MA DEP, Office of Watershed Management issued the License to Apply Chemicals tasks associated with the whole-lake Sonar treatment began. This report provides a summary of the treatment program, along with a discussion of results and recommendations for the 2000 season.

SONAR TREATMENT PROGRAM

The treatment program designed for Onota Lake focused on maintaining a minimum concentration of Sonar (~ 4 ppb) for a 30-40 day period. It was expected that this low concentration would effectively control the targeted milfoil, while preserving desired, native vegetation in the lake. An initial Sonar AS (aqueous solution) application of 8-12 ppb was proposed. The Sonar concentrations would then be monitored at multiple locations using FastEST assays, and the concentration would be augmented accordingly with 1-2 additional low-dose applications. Since lowering the lake level to retard outflow was not approved, a decision was made to further augment the Sonar concentration by using the SRP (slow release pellet) formulation in selected locations.

Initiating the treatment program in mid-late May was anticipated, but the actual treatment timing was dependent upon the following three factors:

Aquatic Control Technology, Inc.

- Stage of Milfoil Growth – plants must in their most active phase of growth, but have reduced biomass.
- Reduced Outflow – without approval to lower the lake prior to treatment, water levels were monitored and long-range forecasts consulted to avoid excessive outflow considerably greater than the required minimum of 5 cfs.
- Thermal Stratification – Since Sonar has been proven not to mix below the thermocline, the lake needed to thermally stratify so that the Sonar would remain in contact with the plants in the upper 12-15 feet.

This resulted in a small treatment “window” when there was desirable conditions for all three factors. A cursory inspection performed on May 11th revealed little milfoil growth, considerable outflow and no thermal stratification. This delayed the formal pre-treatment inspection until May 25th. By that time, milfoil was actively growing and outflow from the lake had subsided. Still there was little thermal stratification, but the initial treatment date was scheduled for June 1st. Fortunately, weather conditions during the week between the survey and treatment were calm and unseasonably warm, enabling the desired thermal stratification to occur.

Treatments

The initial Sonar application was performed on June 1st. The shallower, northern basin (~200 acres) was treated with 10 ppb of Sonar AS and 20 ppb of Sonar SRP around the two primary inlets on the western shoreline and near the outlet. The deeper southern basin was treated with 6 ppb of Sonar AS. The inability to lower the lake prior to treatment necessitated that the initial dose be lowered slightly, in the event that substantial outflow occurred following treatment. Lowering the dose preserved more Sonar for the second and third applications, in order to maintain adequate Sonar concentrations (4 ppb) for a 30-40 day period.

Results of the FasTEST analyses guided the timing and dose of the two additional Sonar applications. On June 17th 7 ppb of Sonar AS was added to the northern basin and 3 ppb Sonar AS was added to the southern basin. On July 9th 5 ppb Sonar AS was added to the northern basin and 10 ppb Sonar SRP was added to the shoreline areas that contained the milfoil growth in the southern basin.

Each treatment was performed by dividing the lake into several sections using buoys and physical landmarks. The surface area and average depth of each section was then used to calculate chemical quantities. Sonar AS is a concentrated liquid that was first diluted at least 50:1 with lake water and was then injected subsurface using weighted hoses through each section of the lake. Sonar SRP was evenly distributed throughout treatment sections using a cyclone seeder/spreader. Two boats were used for each treatment, a 16-foot Grumman Spray Boat and 16-foot Panther Airboat. Treatments were conducted by ACT's Commercially Certified Applicators. Access points along the shoreline were posted with signs warning of the temporary water use restrictions prior to the first application. Notice of each treatment date was also published in the Berkshire Eagle and was broadcast on local radio stations.

FasTEST Analyses

Water samples were collected from 8 different locations shown on Figure 5 (copy attached) in the Comprehensive Aquatic Vegetation Management Plan. These sites are described below:

Location #	Description	Sample Depth
1	Northern end of northern basin	0.5 meters
2	Deep hole location in northern basin, off of Thomas Island	0.5 meters
3	Outlet on lake side	0.5 meters
4	Southwestern cove in southern basin	0.5 meters
5	Southeastern cove in southern basin	0.5 meters
6	Deep hole location in southern basin	0.5 meters
7	Deep hole location in southern basin	3.0 meters
8	Deep hole location in southern basin	9.0 meters

Five complete sampling rounds were performed, which documented the in-lake Sonar concentrations one-week beyond the final treatment. Follow-up samples were collected at 4 surface locations about 10 days later. Actual FasTEST results are listed in Table 1.

The FasTEST results show that Sonar concentrations averaged above 5 ppb at each station above the thermocline for more than 54 days. Sonar was only recorded at the 9-meter depth (station #8) on July 7th, which was most likely a sampling anomaly. Results of the June 8th and June 14th sampling rounds helped determine timing and dosage for the June 17th treatment; while the June 22nd and July 7th sampling rounds helped decide the July 9th treatment. Detecting less Sonar in the water than was actually applied is anticipated, and can be attributed to plant uptake, sediment adsorption and loss of Sonar to photodegradation. Fortunately, due to the drought like conditions in June and July there was no additional outflow, other than the required minimum 5 cfs, during the entire treatment program. Downstream loss was not nearly as much of a negative factor as it had the potential to be. Conditions overall were optimal for the treatment program. Sonar stayed within the zone of plant growth above the thermocline, excessive outflow was not an issue and Sonar concentrations remained above 4 ppb longer than the 30-40 day target.

Water Quality

As stated previously, one of the specific conditions in the Order of Conditions issued by the Pittsfield Conservation Commission was to monitor temperature and dissolved oxygen profiles at multiple locations in the lake weekly during the treatment program. This sampling was to be performed at or around sunrise, which should represent the lowest daily oxygen concentrations as the oxygen demand is greatest when plants and algae are not actively photosynthesizing. Bob Race from LOPA graciously agreed to volunteer for this demanding task. The six stations selected in the lake included both shallow water and deep hole locations in the northern and southern basins. The complete data from the temperature and dissolved oxygen sampling is available in the LOPA 1999 Summary Report of the Volunteer Monitoring Program.

Dissolved oxygen readings at the shallow water sampling stations generally ranged between 6.5 and 9.5 mg/l. Oxygen was well mixed through the water column at these locations and was often near saturation levels considering the warm water temperatures. Oxygen readings did drop below 6 mg/l at a few of the shallow water stations during July and early August, but they never dropped below 5 mg/l.

Surface oxygen concentrations at the two deep hole stations were often the same or slightly higher than the readings at the shallow water stations. Thermal stratification was noticeable at both of these locations. Throughout June in the shallower northern basin, oxygen concentrations started to steadily drop-off between 9 and 12 feet and were generally less than 1 mg/l in depths greater than 18 feet. In July and August there was a sharp oxygen drop-off after 12 feet. In the deeper southern basin, oxygen concentrations were more consistent throughout the summer, with the oxygen concentration beginning to drop after 30 feet and sharply dropping off after 36-39 feet.

These results were fairly comparable with dissolved oxygen profiles that were reported by IT Corp. in their 1991 D/F Study of Onota Lake. The oxygen profiles were nearly identical in the deeper southern basin. There was a sharper drop-off evident in the shallow northern basin in 1999. It should be noted, however, that the 1999 readings were taken when oxygen concentrations were probably at their lowest point during the day. It is highly unlikely that there were any oxygen profiles recorded at the same time in previous years.

There was some concern over reduced water clarity in the lake this summer, especially in the northern basin. Secchi disk readings in the southern basin hovered around 4 meters for much of the summer, which was slightly lower than the summer readings reported in the D/F Study (IT 1991). Readings in the

northern basin were usually around 2 meters, and clarity did drop below 2 meters in August. Water samples were collected from each basin on July 29th. Laboratory testing revealed higher turbidity, color and phosphorus concentrations in the northern basin. Algal counts were also slightly higher in the northern basin, with nearly 13,000 cells/ml, compared with 8,000 cells/ml in the southern basin. Reduced clarity and water quality in the shallower northern basin, compared with the deeper southern basin, should not be unexpected considering the increased interaction with the bottom sediments through wind and wave action. It was also theorized in LOPA's 1999 Summary Report that the thawing which occurred during last winter's drawdown and caused substantial uplifting of frozen bottom sediments may have been a contributing factor. Decomposing vegetation also may have partially attributed to the clarity loss in the northern basin, but the conditions were inevitably aggravated by the minimal inflow into this end of the lake during the summer that reduced any flushing effects. Clarity was reportedly increasing by the end of the summer.

RESULTS

The objective of this treatment program was to completely control the nuisance Eurasian watermilfoil growth in Onota Lake. The City established a contractual obligation for an "aggressive" 90 percent milfoil reduction. Pre and post-treatment inspections attended by the City, LOPA and ACT were conducted to document treatment effectiveness.

A long-handled rake and/or small Danforth anchor was dragged along the lake bottom to collect submersed plants; while floating, floating-leafed and emergent plants were visually inspected. Plants were identified to genus and species where possible. Milfoil coverage was estimated with two separate indices. Plant cover was given a percentage rank based on the areal coverage of plants. 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.

Plant biomass (weight of plants per unit area) was also 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.

Pre-Treatment Milfoil Distribution

Milfoil was just beginning to actively grow in late May 1999, which made it difficult to determine the full extent of the infestation. This task was further complicated by the reduced visibility during the May 25th inspection due to poor weather conditions. Visual observations made during that survey, along with LOPA maps from previous years and the 1996 Fugro plant assemblage map were used to estimate the pre-treatment milfoil distribution that is depicted in Figure 1.

Milfoil coverage was fairly extensive and contiguous in the northern basin. There was also a considerable amount of curly-leaf pondweed (*Potamogeton crispus*), which is another non-native, nuisance plant in Massachusetts. Both of these plants were either at or within 1-2 feet of the surface in the northern basin. The only areas without much plant growth in the northern basin were in the deep hole location where water depths exceeded 15 feet and along the immediate shoreline until water depths of 3 feet were

reached. The lack of plant growth observed around the immediate shoreline can likely be attributed to the winter drawdown program that has been performed in recent years.

In the deeper southern basin, milfoil was generally confined to the immediate shoreline, except for areas just south of the sandbar/old roadway (from the City Beach to the sandbar on both the east and west shorelines) where water depth drops-off less sharply enabling milfoil to extend farther from shore. In the remainder of the southern basin, milfoil typically started growing 50-75 feet from shore and extended out towards the middle in 100-200 foot wide bands. This pattern was fairly contiguous along the western shoreline. Milfoil growth was patchy along the eastern shoreline, south of the public boat ramp.

Looking at the entire lake, an estimated 45 percent of the lake supported common to abundant growth of milfoil. Milfoil coverage ranged from 50-100 percent and the biomass indices assigned ranged from 2-4. Translating this into acreage, an estimated 275 acres of the 617-acre lake were infested with milfoil.

Native plants were present during the pre-treatment inspection, but it was early in their growing cycle and estimating their total coverage was difficult. Locations where native plants appeared to be fairly well established are shown by letter abbreviations on Figure 1. The dominant plants encountered included several species of pondweed (*Potamogeton*), wild celery (*Vallisneria americana*), coontail (*Ceratophyllum demersum*) and stonewort/muskgrass (*Nitella/Chara*). Floating leafed waterlilies (*Nymphaea* and *Nuphar*) were confined to a few areas in the northern basin.

Post-Treatment Milfoil Distribution

The effectiveness of the Sonar treatment program was closely monitored during and after the treatment. Post-treatment inspections were conducted on August 4th, August 18th, September 2nd and September 29th. Either Gerry Smith or Marc Bellaud of ACT usually attended these surveys, along with Bob Race the President of LOPA, Bob Mellace the Director of Parks and Recreation and City Councilor Joe Guzzo. Bob Burns of SePRO Corp. attended the August 4th survey. The post-treatment plant mapping was performed during the September 2nd and 29th surveys, since visual observation was required to find the remaining milfoil. The post-treatment milfoil distribution is depicted in Figure 2.

Despite taking an extraordinarily long time for the milfoil to die back, the treatment program appears to have been very successful at controlling milfoil. In the shallow, northern 200 plus acres of the lake (north of the City Beach), excellent milfoil control was achieved. Reductions of more than 95 percent of the milfoil coverage and more than 99 percent of the milfoil biomass were observed.

Results were not as easily definable in the deeper, southern basin. Despite considerable reductions in the milfoil biomass, remnants of milfoil plants remained fairly widespread along the shorelines. The plants were generally 2-4 feet below the surface and were not problematic for boating or fishing, but they were still visible. The remaining milfoil could be characterized by having stalks that were nearly completely stripped of leaves, except for a small green tip. The stalks themselves were in poor condition, as they broke easily and were difficult to retrieve with a rake or anchor. Milfoil stalks that were usually completely brown and appeared to be dead could also be retrieved off of the bottom, but a small percentage still had one tiny green leaf. The viability of these remaining plants is unknown.

Descriptions of the remaining milfoil plants are provided on Figure 2. The majority of the remaining milfoil in the southern basin could be characterized by single stem milfoil plants with stripped stems and 2-4 inch green tips. Coverage ranged from 1-10 percent and the biomass index was less than 1. This condition milfoil plant was also more abundant in a few locations where the coverage ranged between 10-25 percent and the biomass index was 1-2. There were only two locations where milfoil appeared to be more prominent and healthy. These areas were found off of the point just north of the boat ramp on the eastern shoreline and directly across the lake on the western shoreline. Combined, these two areas

probably total 4-5 acres. Milfoil plants at these locations had multiple stems and the green tips were 6-10 inches long, before a stripped stalk was reached. Plant coverage in these areas was estimated at 25-50 percent and the biomass index was 2.

The remaining milfoil distribution shown on Figure 2 was a compilation of the September 2nd and September 29th post-treatment survey efforts. We recorded much less remaining milfoil coverage on September 29th, but realize that bright sunny conditions with no wind is probably needed to see all of the remaining plants. We attempted to duplicate the sampling transects that were established during the 1996 Fugro study and are still being used by LOPA for their annual plant mapping efforts. It was difficult to retrieve much milfoil from any of the transects that we checked (T1, T2, T3, T5, T6, T9). Only the T1 transect, which is in the cove on the western shoreline immediately south of the sand bar, produced even notable native plant growth.

Based on the results of the two surveys performed in September, we estimate that greater than 95 percent of the pre-treatment milfoil biomass was controlled throughout the lake. The remaining milfoil plant coverage in the southern basin, however, was estimated at 75-100 acres. This suggests only a 70-80 percent reduction in the pre-treatment milfoil coverage for the lake. However, the remaining milfoil was generally 2-4 feet beneath the water's surface and not terribly problematic for recreational uses. The overall milfoil control achieved, based on a function of both biomass and percent cover, arguably exceeded the City's greater than or equal to 90 percent control criteria.

The viability of the milfoil plants that remained at Onota Lake is questionable. Bo Burns indicated that SePRO has never seen a lake that averaged 5 ppb of Sonar for more than 40 days, where nearly 100 percent milfoil control has not been achieved.

The treatment program apparently helped control curly-leaf pondweed immediately, as it was not too evident by mid-June when it should have been at its peak biomass. There also appeared to be some impact to many of the native species. Clasp-leaf pondweed (*P. richardsonii*), which is susceptible to Sonar, had noticeably reduced coverage following the treatment. There were also less floating-leaf waterlilies in the northern basin. Yet there still was some healthy native plant growth observed during the post-treatment inspections. Certainly the most abundant growth was found immediately north and south of the sand bar that divides the northern and southern basins. Robbins' pondweed (*P. robbinsii*) was fairly abundant in this area. There was also scattered growth of other broad and thin-leafed pondweeds. There was no observable impact of treatment on emergent or wetland plants along the shoreline. It is difficult to accurately assess the impact to native species, since the plants were not well developed during our May 25th pre-treatment inspection. Again, locations where native plants were encountered during the post-treatment surveys are depicted on Figure 2.

RECOMMENDATIONS

The 1999 Sonar treatment program was unquestionably successful at controlling nuisance milfoil at Onota Lake. Comments from lake residents and the public received by Bob Mellace, Bob Race and Joe Guzzo, suggested that the lake was far more usable this year than at any time in recent memory. With regard to the remaining milfoil in the southern basin, its viability is still in question. Based on the condition of the plants this past August, we decided to hold-off on additional treatment work until the spring of 2000. We and SePRO felt that the heavily "damaged" milfoil remaining in the lake would not effectively translocate additional Sonar. As was mentioned earlier, SePRO has never seen milfoil not be controlled with these Sonar concentrations for more than 40 days. We have had numerous conversations with SePRO since Bo Burns inspected the lake on August 4th and they remain somewhat confident that milfoil will continue to die over the winter and will not be problematic next year.

Our recommended course of action is to inspect the lake in May 2000 to try and quantify how much milfoil is left or if regrowth is occurring. If the milfoil persists in the narrow bands along the shoreline in the southern basin, it would be our strong recommendation to treat with 2,4-D granular herbicide. Like Sonar, 2,4-D is a systemic-acting herbicide that has the potential to provide multiple seasons of milfoil control. It is more effective and preferred over Sonar for "spot" or partial lake treatments, because it does not dilute as readily and controls targeted plants within ~3 weeks, versus 6 weeks or longer with Sonar SRP. If the September 1999 milfoil distribution is observed in May 2000, we would anticipate a 75-100 acre total treatment area at approximately 100 pounds of 2,4-D per acre.

Use of 2,4-D granular or another alternate herbicide listed in the Comprehensive Aquatic Vegetation Management Plan, will require filing for an amendment to the Order of Conditions issued by the Pittsfield Conservation Commission. These permitting tasks should be handled during the winter months, to avoid any untimely delays in treatment scheduling next spring.

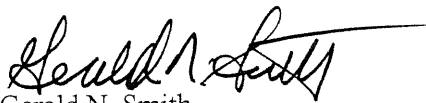
The alternate treatment approach, which we do not favor, is to spot-treat remaining milfoil growth with Sonar SRP (slow release pellets). Due to the potential for water movement and dilution in these shoreline treatment areas, we have severe reservations whether Sonar SRP would be effective. This same shoreline was treated with Sonar SRP on July 9th as part of the 1999 treatment program and the milfoil persisted into late September.

We will be addressing further revisions to the Comprehensive Aquatic Vegetation Management Plan, including long-term recommendations, as modifications are made following treatment requirements and results observed during the 2000 season.

We look forward to continue attempting to make this management program a success next year. Please feel free to contact our office with any questions.

Sincerely,

AQUATIC CONTROL TECHNOLOGY, INC.

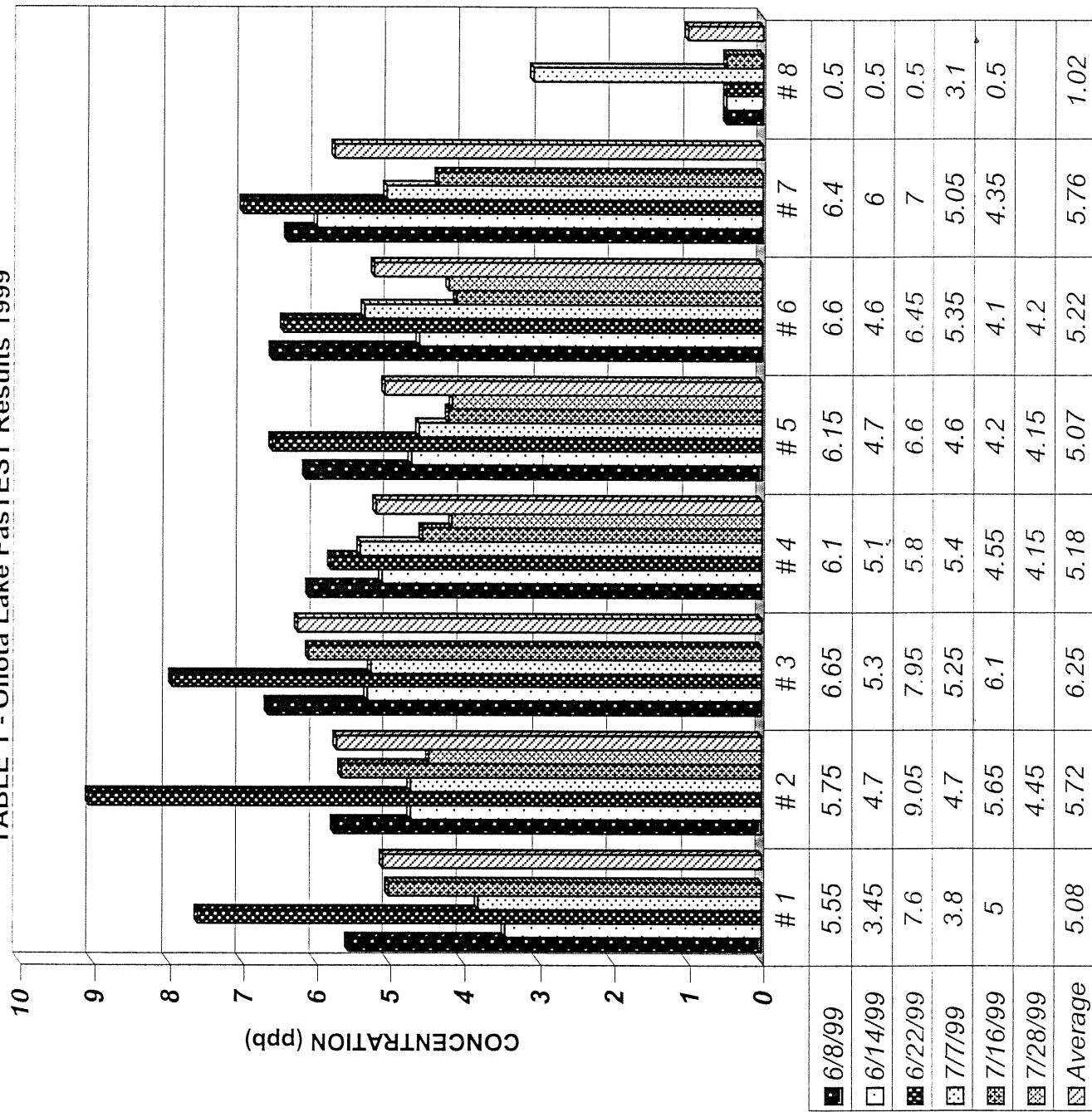


Gerald N. Smith
President/Aquatic Biologist



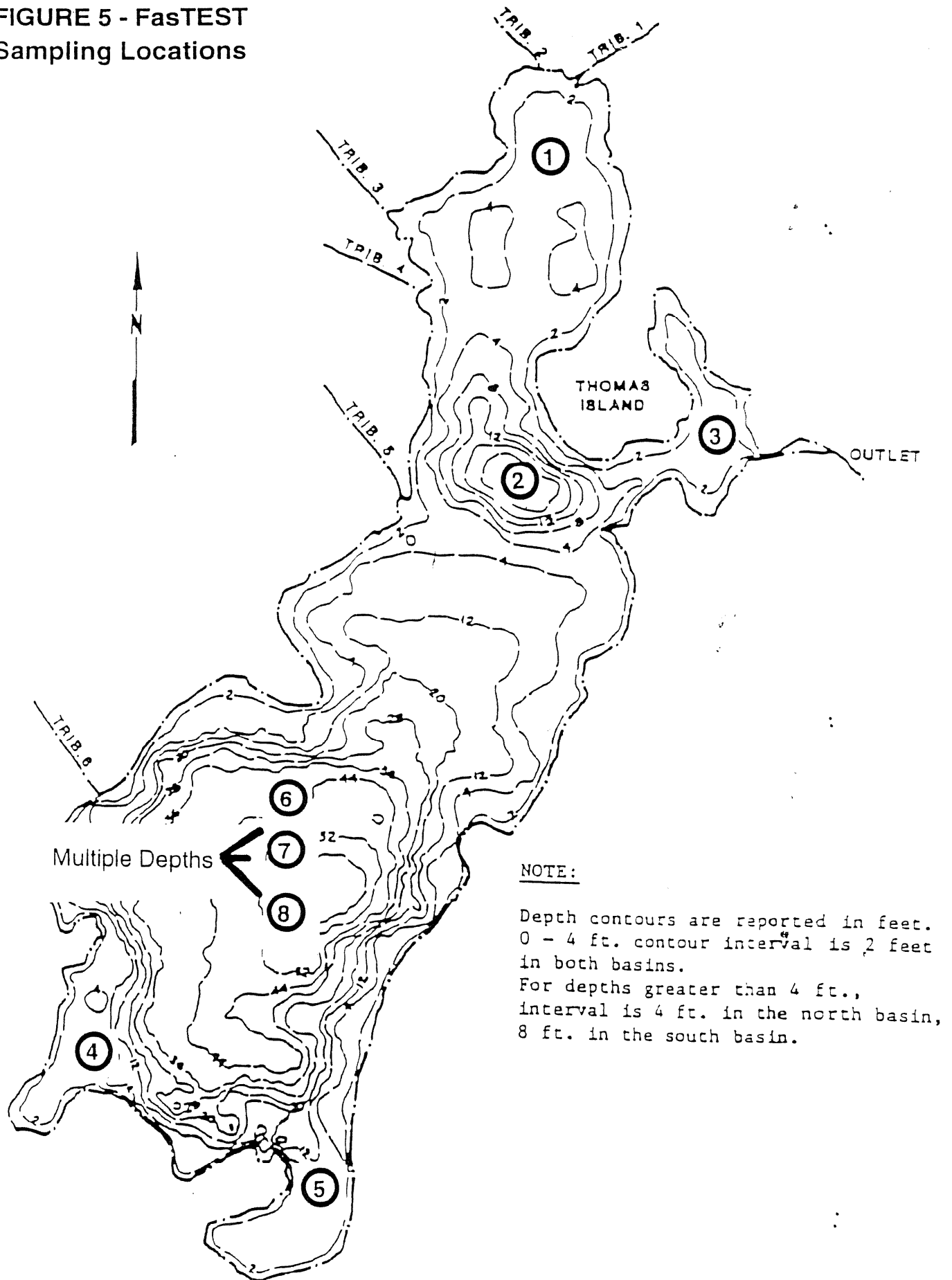
Marc Bellaud
Senior Biologist

TABLE 1 - Onota Lake FastEST Results 1999








STATIONS

**FIGURE 5 - FastEST
Sampling Locations**



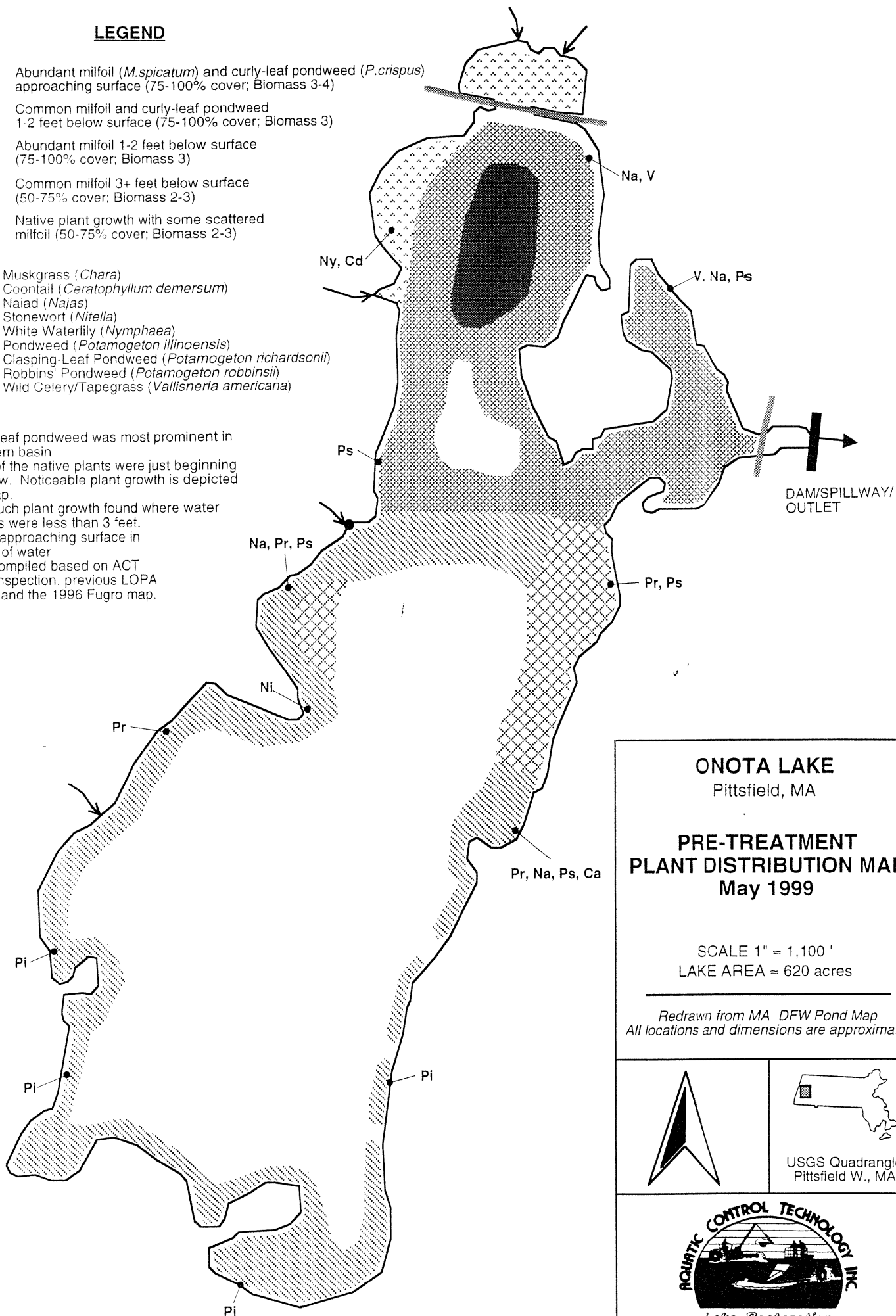
LEGEND

-  Abundant milfoil (*M. spicatum*) and curly-leaf pondweed (*P. crispus*) approaching surface (75-100% cover; Biomass 3-4)
-  Common milfoil and curly-leaf pondweed 1-2 feet below surface (75-100% cover; Biomass 3)
-  Abundant milfoil 1-2 feet below surface (75-100% cover; Biomass 3)
-  Common milfoil 3+ feet below surface (50-75% cover; Biomass 2-3)
-  Native plant growth with some scattered milfoil (50-75% cover; Biomass 2-3)

- Ca - Muskgrass (*Chara*)
- Cd - Coontail (*Ceratophyllum demersum*)
- Na - Naiad (*Najas*)
- Ni - Stonewort (*Nitella*)
- Ny - White Waterlily (*Nymphaea*)
- Pi - Pondweed (*Potamogeton illinoensis*)
- Pr - Claspingleaf Pondweed (*Potamogeton richardsonii*)
- Ps - Robbins' Pondweed (*Potamogeton robbinsii*)
- V - Wild Celery/Tapegrass (*Vallisneria americana*)

Notes:

- Curly-leaf pondweed was most prominent in northern basin
- Most of the native plants were just beginning to grow. Noticeable plant growth is depicted on map.
- Not much plant growth found where water depths were less than 3 feet.
- Milfoil approaching surface in 4 feet of water
- Map compiled based on ACT 5/99 inspection, previous LOPA maps and the 1996 Fugro map.



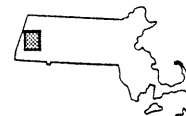
ONOTA LAKE

Pittsfield, MA

PRE-TREATMENT PLANT DISTRIBUTION MAP May 1999

SCALE 1" = 1,100 '
LAKE AREA ≈ 620 acres





Redrawn from MA DFW Pond Map
All locations and dimensions are approximate



USGS Quadrangle
Pittsfield W., MA



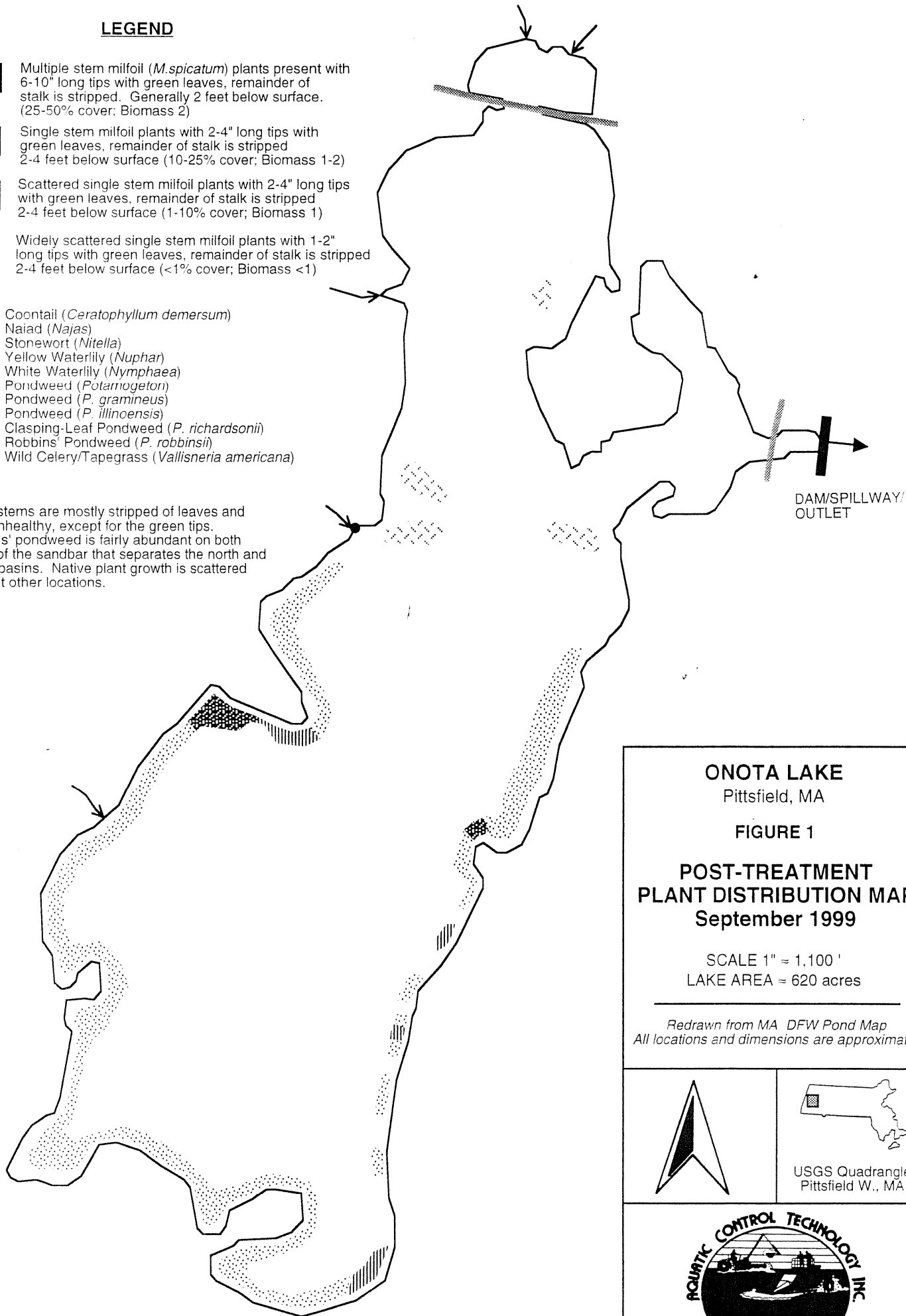
LEGEND

-  Multiple stem milfoil (*M. spicatum*) plants present with 6-10" long tips with green leaves, remainder of stalk is stripped. Generally 2 feet below surface. (25-50% cover; Biomass 2)
-  Single stem milfoil plants with 2-4" long tips with green leaves, remainder of stalk is stripped 2-4 feet below surface (10-25% cover; Biomass 1-2)
-  Scattered single stem milfoil plants with 2-4" long tips with green leaves, remainder of stalk is stripped 2-4 feet below surface (1-10% cover; Biomass 1)
-  Widely scattered single stem milfoil plants with 1-2" long tips with green leaves, remainder of stalk is stripped 2-4 feet below surface (<1% cover; Biomass <1)

- Cd - Coontail (*Ceratophyllum demersum*)
- Na - Naiad (*Najas*)
- Ni - Stonewort (*Nitella*)
- Nu - Yellow Waterlily (*Nuphar*)
- Ny - White Waterlily (*Nymphaea*)
- P - Pondweed (*Potamogeton*)
- Pg - Pondweed (*P. gramineus*)
- Pl - Pondweed (*P. illinoensis*)
- Pr - Clasp-Leaf Pondweed (*P. richardsonii*)
- Ps - Robbins' Pondweed (*P. robbinsii*)
- V - Wild Celery/Tapegrass (*Vallisneria spiralis*)

Notes:

- Milfoil stems are mostly stripped of leaves and look unhealthy, except for the green tips.
- Robbins' pondweed is fairly abundant on both sides of the sandbar that separates the north and south basins. Native plant growth is scattered in most other locations.



ONOTA LAKE

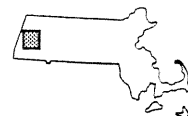
Pittsfield, MA

FIGURE 1

POST-TREATMENT PLANT DISTRIBUTION MAP September 1999

SCALE 1" = 1,100 '
LAKE AREA = 620 acres

Redrawn from MA DFW Pond Map
All locations and dimensions are approximate



USGS Quadrangle
Pittsfield W., MA



APPENDIX B

Onota Lake Nuisance Aquatic Vegetation Management Program - Project Completion Report (2000)



November 29, 2000

City of Pittsfield
c/o Mr. Robert S. Mellace, Director
Department of Parks and Recreation
874 North Street
Pittsfield, MA 01201

Re: Project Completion Report - Onota Lake Nuisance Aquatic Vegetation Management Program

Dear Bob:

This report summarizes the milfoil management strategies undertaken at Onota Lake during the 2000 season and serves as our project completion report for this two-year contract. The contract consisted of two distinct phases; development of a Comprehensive Aquatic Vegetation Management Plan to evaluate both immediate and long-term management needs, and whole-lake Sonar™ herbicide treatment, that was desired to provide immediate control of the non-native and highly invasive Eurasian watermilfoil (*Myriophyllum spicatum*) growth in Onota Lake.

The first phase was initially addressed by preparation of the "draft" *Comprehensive Aquatic Vegetation Management Plan* that was submitted as the project description portion of the Notice of Intent application in April 1999. That document summarized the existing conditions at Onota Lake, described previous investigations and management efforts, detailed the proposed Sonar™ herbicide treatment program and provided a brief description of alternative management strategies. Upon completion of the whole lake Sonar treatment in 1999, the plan was updated to submit as part of the request for an amendment to the Order of Conditions in order for spot-treatment work to be performed during the 2000 season. That document was titled "draft" *Year 2000 and Long-Range Aquatic Vegetation Management Plan*. A final update of the *Long-Range Aquatic Vegetation Management Plan* was prepared and submitted under a separate cover.

The second phase of the contract was initiated by the whole-lake Sonar herbicide treatment program performed during the 1999 season. A complete and detailed description of work completed during 1999 was provided in our Year One Update report submitted on October 25, 1999. Summarizing that report, the three "low dose" applications of Sonar herbicide that were performed in June and July 1999 provided excellent milfoil control, but some scattered and "unhealthy" milfoil persisted through the end of the year. Since the contract stated a two-year guarantee of milfoil control, it was anticipated that spot-treatments would be required during the 2000 season to achieve the desired level of control. The following report summarizes the milfoil treatment activities performed at Onota Lake during the 2000 season.

CONDITIONS FOLLOWING THE 1999 SONAR HERBICIDE TREATMENT

The milfoil growth in Onota Lake was evaluated using two separate indices. Plant cover was a percentage estimate of the amount of lake bottom covered by milfoil growth. Plant biomass was described as the weight of plants per unit area or the height and density of plants in the water column. Based solely on biomass, we estimated that more than 95 percent of the pre-treatment milfoil growth had been controlled lake-wide. The shallower, 200-acre north basin was nearly free of milfoil plants. Reductions in the overall milfoil coverage were reduced due to the "unhealthy" milfoil plants that

Aquatic Control Technology, Inc.

persisted along the shoreline margins of the deeper, 400-acre south basin. The milfoil plants are described and depicted in Figure 1. We estimated that this low density and damaged milfoil was scattered throughout 75-100 acres in the south basin. Some of the plants appeared to be healthy enough to over-winter and start actively growing in the spring, which necessitated obtaining permit approval in order to be prepared to perform spot-treatment work during the 2000 season.

Aside from the amount of milfoil controlled, Onota Lake responded fairly well to the whole lake Sonar treatment program. Weekly monitoring of temperature and dissolved oxygen performed at numerous stations showed no discernible drop in oxygen concentrations. While many of the native plants in the lake were initially impacted by the Sonar treatment, a fairly diverse native plant assemblage was observed during the post-treatment inspections. Some concern was raised over the reduced water clarity (lower Secchi Disk readings) that were observed throughout the summer, but this did not appear to be directly attributed to the chemical treatment program. No other adverse impacts of the treatment program were observed or reported.

YEAR 2000 TREATMENT PROGRAM

The presence of scattered milfoil plants in Onota Lake at the conclusion of the 1999 Sonar treatment program increased the likelihood that spot-treatments would be required during the 2000 season. Scattered milfoil growth along the shorelines of the south basin was anticipated. Sonar AS (liquid) herbicide is much too soluble to use for spot or shoreline treatments. The limited effectiveness of the Sonar SRP (slow release pellets) used during the 1999 treatment program did not make SRP an attractive alternate formulation. Since Sonar™ (fluridone) was the only chemical approved for use at Onota Lake in the Order of Conditions issued by the Pittsfield Conservation Commission, gaining approval to use Reward® (diquat) or Navigate® (2,4-D) for spot-treatment work during the 2000 season was paramount to success of the program.

Permitting

The *Year 2000 and Long-Range Aquatic Vegetation Management Plan* was prepared and submitted with a request to amend the Order of Conditions. This document detailed the need to spot-treat remaining milfoil growth in the year 2000 and outlined other non-chemical management strategies that are being considered for future milfoil management efforts. The herbicide of choice for the milfoil spot-treatment work at Onota Lake is 2,4-D. Like fluridone, 2,4-D has a systemic-action that kills the entire milfoil plant, including the root structures. This usually provides prolonged milfoil control (2-3 years), compared with the seasonal control that is usually achieved with contact-acting herbicides like diquat. Diquat was included as an alternate product in the amendment request, in case there was any conflicting usage of lake water discovered (i.e. drinking water intakes) that would have prohibited the use of 2,4-D. The Conservation Commission granted conditional approval for the use of 2,4-D herbicide in the year 2000.

Pre-Treatment Milfoil Distribution

Considering the condition of the milfoil plants at the end of 1999, we expected milfoil growth to be delayed until the late spring or early summer of 2000. Milfoil was difficult to find during the initial inspection of the lake performed by Bob Race, LOPA President, and Marc Bellaud, ACT Biologist, on May 30, 2000. The curly-leaf pondweed (*Potamogeton crispus*) coverage was so extensive at that time, that other plants could not be found through the dense canopy that the curlyleaf pondweed was creating. Abundant curlyleaf pondweed growth persisted through the month of June. A decision was reached to delay the spot-treatment until an accurate assessment of milfoil growth in the lake could be obtained, even though the treatment would likely occur during the period of peak summer usage at the lake. On July 6, 2000, another pre-treatment survey was conducted by Bob Race, Marc Bellaud, Bob Mellace the Director of the Pittsfield Parks and Recreation Department and Bo Burns the Northeast Aquatic Specialist for

SePRO (manufacturer of Sonar). By that time the curlyleaf pondweed had died-back enough to get a clear assessment of the amount of milfoil growth at the lake. Bo Burns also confirmed that 2,4-D was the best herbicide choice for spot-treatment of the remaining milfoil growth at Onota Lake. Surprisingly, more milfoil regrowth had occurred in the north basin than anticipated. Figure 2 depicts the milfoil distribution and areas spot-treated with 2,4-D herbicide.

Navigate® (2,4-D) Treatment

Following the July 6, 2000 inspection, a map (Figure 2) was submitted to the Conservation Commission for their final evaluation and approval prior to treatment. A mid-week treatment date of July 12, 2000 was then selected to avoid any closures of the lake over a weekend. The general public then received notice of the treatment date in a newspaper ad, over the local electronic media and from the warning signs that were posted around the entire shoreline of the lake. The lake was closed to all uses on the day of treatment.

The granular 2,4-D herbicide was applied using cyclone seeder/spreaders that were mounted on the bow of 16-foot jon boats equipped with outboard motors. The seeder/spreaders were calibrated to evenly distribute the herbicide throughout the treatment areas. Two boats were used for the treatment so that it could be completed in one-day. Approximately 100 acres were treated with 2,4-D herbicide on July 12, 2000. The treatment proceeded smoothly and without incident. 2,4-D typically achieves effective control of milfoil within three weeks from the date of treatment.

Post-Treatment Milfoil Distribution

Bob Race, Bob Mellace and Marc Bellaud performed the first post-treatment inspection of the lake on August 29, 2000. Excellent control of the milfoil was achieved throughout the 100 acres that were treated. In fact, the only viable milfoil plants found within a treated area, was along the sandbar that separates the lake into its north and south basins. The milfoil plants were found at the outside edge of that treatment area. The only other viable milfoil plants found were in isolated coves at the southern end of the lake. None of these areas fell within a treatment area. The native plant growth appeared to be diverse and even fairly robust in some areas during that inspection. Several species of pondweeds and other submersed plants were noted.

A second cursory, post-treatment inspection was performed on September 6, 2000. Bob Race, Bob Mellace, Marc Bellaud and Gerry Smith the President of ACT were present for that inspection. Similar observations were made at that time.

On October 12, 2000, Marc Bellaud conducted a final post-treatment inspection of Onota Lake. The entire perimeter of the lake was toured by boat and the submersed plant community was inspected using an Aqua-Vu Underwater Camera system. Essentially the same milfoil distribution was encountered, but the native plant community was even more significant than thought following earlier inspections. Fifteen different species of aquatic plants were encountered, including five species of broad-leafed pondweeds (*Potamogeton spp.*) that have high fish and wildlife habitat value. Extensive beds of submersed plants were found along the shorelines of the south basin. Native plants were even becoming reestablished in the north basin, which supported extensive milfoil coverage before this treatment program was initiated. The final post-treatment plant distribution is shown in Figure 3.

SUMMARY AND RECOMMENDATIONS

Spot-treating the milfoil growth at Onota Lake this past summer enabled us to meet and exceed the desired level of milfoil control stipulated in the contract. For two consecutive years, the milfoil at Onota Lake was kept below nuisance levels. This left the lake far more usable for recreational pursuits and the

reduced milfoil coverage provided for the resurgence of a more diverse and robust native plant community. Chemical treatments were proven to be an effective strategy to selectively control nuisance and non-native plants like Eurasian watermilfoil.

Prior to 1999, the milfoil infestation at Onota Lake was so extensive that whole-lake treatment with Sonar™ (fluridone) herbicide was the most attractive treatment alternative. Low concentrations of fluridone were able to provide effective control of the milfoil, while lessening impacts to non-target plants. Two or more years of effective milfoil control were also anticipated due to fluridone's systemic-acting properties that kill the entire milfoil plant, including the root structures. Fluridone also has an extremely favorable toxicology profile, with precautions against using treated water for irrigation purposes being the only water use restriction associated with its use. The 1999 treatment program at Onota Lake achieved a dramatic reduction in the overall milfoil biomass.

Some of fluridone's limitations were revealed at Onota, when scattered milfoil plants were not controlled along the shoreline in the southern basin. Even applying the slow release pellet formulation of Sonar did not control milfoil plants in 1999. Navigate® (2,4-D), another systemic-acting herbicide, was effectively used for spot-treatment work during this past summer. The 2,4-D may have even shown greater selectivity for milfoil, considering the health of the native plant community at the end of the season.

Both fluridone and 2,4-D are effective alternatives for future milfoil management efforts at Onota Lake. Fluridone should be considered if milfoil returns to nuisance densities in large contiguous blocks, such as the entire north basin. 2,4-D is better suited to target smaller or shoreline infestations of milfoil.

Of course, future milfoil management efforts should attempt to incorporate non-chemical strategies where and when applicable. Some strategies that will be discussed in greater detail in our *Long-Range Aquatic Vegetation Management Plan* include stocking of aquatic weevils, diver handpulling, use of bottom weed barriers, suction harvesting and deeper winter drawdowns. Undoubtedly, integrating several of these techniques will provide the most effective results and will be the most acceptable to regulators and the general public. This will require a concerted effort from the City of Pittsfield and the Lake Onota Preservation Association.

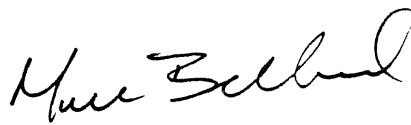
We hope that the City of Pittsfield was pleased with the results of the 1999-2000 treatment program at Onota Lake. We will also look forward to assisting the City with their lake management efforts in the future.

Sincerely,

AQUATIC CONTROL TECHNOLOGY, INC.







Gerald N. Smith
President/Aquatic Biologist



Marc Bellaud
Senior Biologist

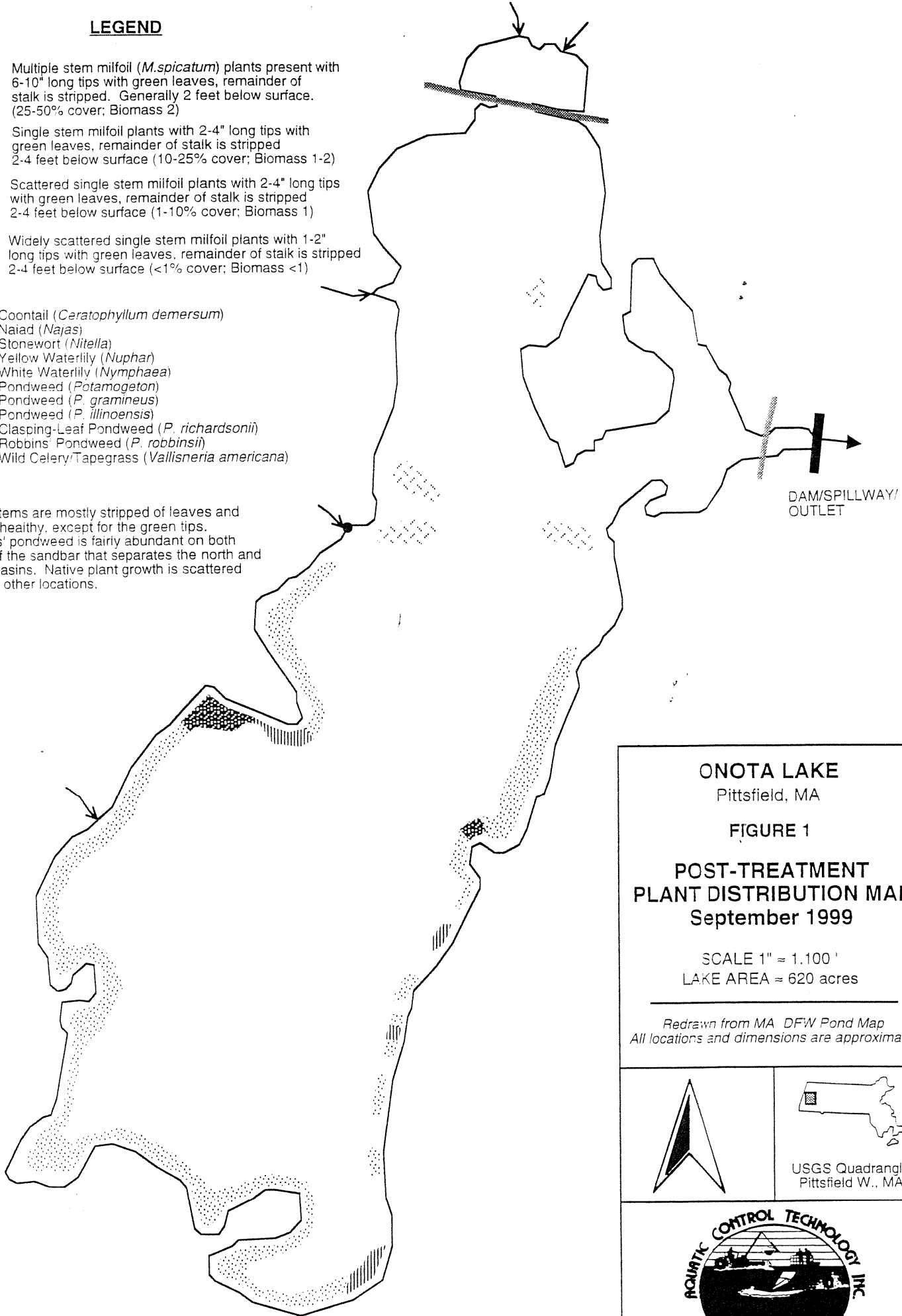
LEGEND

-  Multiple stem milfoil (*M. spicatum*) plants present with 6-10" long tips with green leaves, remainder of stalk is stripped. Generally 2 feet below surface. (25-50% cover; Biomass 2)
-  Single stem milfoil plants with 2-4" long tips with green leaves, remainder of stalk is stripped 2-4 feet below surface (10-25% cover; Biomass 1-2)
-  Scattered single stem milfoil plants with 2-4" long tips with green leaves, remainder of stalk is stripped 2-4 feet below surface (1-10% cover; Biomass 1)
-  Widely scattered single stem milfoil plants with 1-2" long tips with green leaves, remainder of stalk is stripped 2-4 feet below surface (<1% cover; Biomass <1)

- Cd - Coontail (*Ceratophyllum demersum*)
- Na - Naiad (*Najas*)
- Ni - Stonewort (*Nitella*)
- Nu - Yellow Waterlily (*Nuphar*)
- Ny - White Waterlily (*Nymphaea*)
- P - Pondweed (*Potamogeton*)
- Pg - Pondweed (*P. gramineus*)
- Pi - Pondweed (*P. illinoensis*)
- Pr - Claspingleaf Pondweed (*P. richardsonii*)
- Ps - Robbins' Pondweed (*P. robbinsii*)
- V - Wild Celery/Tapegrass (*Vallisneria americana*)

Notes:

- Milfoil stems are mostly stripped of leaves and look unhealthy, except for the green tips.
- Robbins' pondweed is fairly abundant on both sides of the sandbar that separates the north and south basins. Native plant growth is scattered in most other locations.



ONOTA LAKE

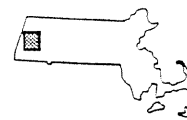
Pittsfield, MA

FIGURE 1

POST-TREATMENT PLANT DISTRIBUTION MAP September 1999

SCALE 1" \approx 1,100 '
LAKE AREA \approx 620 acres

Redrawn from MA DFW Pond Map
All locations and dimensions are approximate



USGS Quadrangle
Pittsfield W., MA



LEGEND

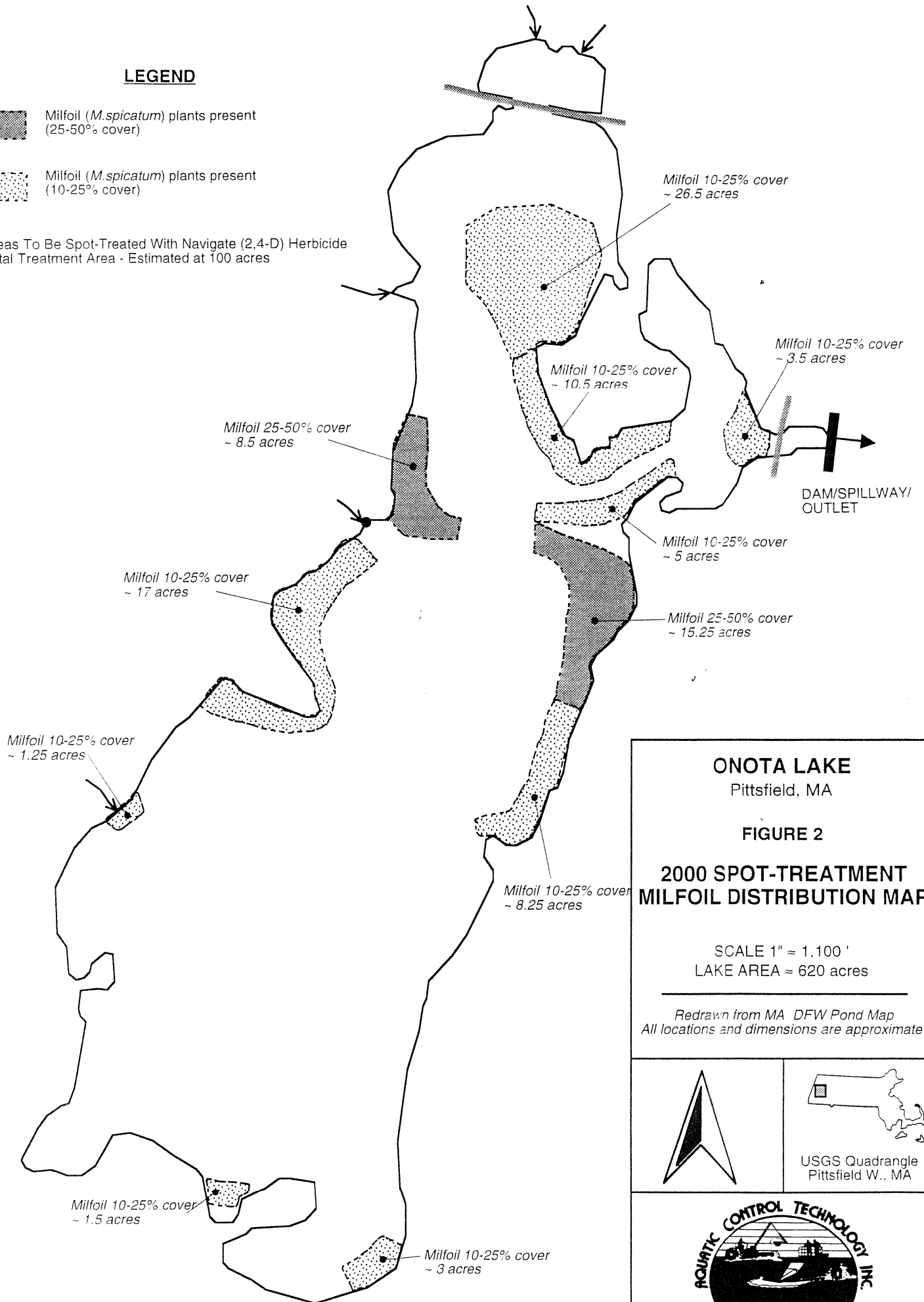


Milfoil (*M. spicatum*) plants present
(25-50% cover)



Milfoil (*M. spicatum*) plants present
(10-25% cover)

Areas To Be Spot-Treated With Navigate (2,4-D) Herbicide
Total Treatment Area - Estimated at 100 acres



ONOTA LAKE

Pittsfield, MA

FIGURE 2

2000 SPOT-TREATMENT MILFOIL DISTRIBUTION MAP

SCALE 1" \approx 1,100 '
LAKE AREA \approx 620 acres





Redrawn from MA DFW Pond Map
All locations and dimensions are approximate



USGS Quadrangle
Pittsfield W., MA



LEGEND

-  Mixed Plant Assemblage - 25-75% cover
(Ps, C, Na, Pc, Cd, Pi, Pz, Pa, etc.)
-  Mixed Plant Assemblage - 0-25% cover
(Ps, C, Na, Pc, Cd, Pi, Pa, etc.)
-  Mostly Low-Growing Naiad (Na, Nf)
-  Mostly Non-Native Curly-Leaf
Pondweed (Pc)

- C - Muskgrass (*Chara*)
- Cd - Coontail (*Ceratophyllum demersum*)
- Na - Naiad (*Najas guadalupensis/flexilis*)
- Nm - European Naiad (*Najas minor*)
- Ni - Stonewort (*Nitella*)
- Nu - Yellow Waterlily (*Nuphar*)
- Ny - White Waterlily (*Nymphaea*)
- Pa - Large-leaf Pondweed (*Potamogeton amplifolius*)
- Pc - Curlyleaf Pondweed (*P. crispus*)
- Pi - Pondweed (*P. illinoensis*)
- Pr - Clasp-Leaf Pondweed (*P. richardsonii*)
- Ps - Robbins' Pondweed (*P. robbinsii*)
- Pz - Flat-Stem Pondweed (*P. zosteriformis*)
- V - Wild Celery/Tapegrass (*Vallisneria americana*)
- M - Eurasian watermilfoil (*M. spicatum*)

