AQUATIC CONTROL TECHNOLOGY, INC.
POND AND LAKE MANAGEMENT SPECIALISTS

December 8, 2005

Heart Pond Association
c/o Mr. David Lavoie, President
P.O. Box 4052
Chelmsford, MA 01824

Re: **Project Completion Report for the 2005 Non-Native Vegetation Control Program at Heart Pond – Chelmsford/Westford, MA**

Dear Mr. Lavoie:

The following report shall serve as a project completion report for the Aquatic Vegetation Management Program performed at Heart Pond and will summarize each phase of the project, from permitting, to the final treatment and inspection. Heart Pond is a relatively shallow impoundment of Pond Brook, with an average depth of approximately 7.0-8.0 ft. and a surface area of 91 acres. In recent years the waterbody has seen a significant increase in the density of the submersed plant community, specifically the non-native plant fanwort (*Cabomba caroliniana*). The recent increase in plant growth and the subsequent degradation of recreational actives prompted the Association to investigate the implementation of an Aquatic Vegetation Management Program.

It was determined following a Baseline investigation by a Biologist with Aquatic Control, that the most effective and feasible technique for the control of the increasing fanwort population was a whole pond Sonar AS™ (active ingredient fluridone) treatment program. The slow acting Sonar AS has proven to be the only aquatic herbicide effective at controlling fanwort.

Permitting

As the pond is located in two separate towns a Notice of Intent was filed with both the Chelmsford and Westford Conservation Commissions in May of 2005 in order to gain the necessary approval for the implementation of the proposed project. Public hearings were held and the project was approved in both Towns. A completed Order of Conditions was issued by the Westford Conservation Commission on 5/26/05 and by the Chelmsford Commission on 5/27/05. These approvals were received far enough in advance of the treatment season that no delays were experienced in the implementation of the program.

The second permit needed prior to the implementation of the chemical treatment project was a site-specific permit called a *License to Apply Chemicals* from MA DEP – Office of Watershed Management. This permit application was filed on 5/23/05 and was approved on 6/7/05.

Pre-Treatment Inspection

The pre-treatment inspection was performed on 6/7/05. The pre-treatment inspection is geared to confirm target plant distribution, gauge water flow and plant biomass/maturity. These data are crucial in the scheduling of the initial herbicide application.

The plant assemblage and distribution at the time of the inspection were similar to the conditions described in the 2004 Baseline Biological Survey Report dated January 5, 2005. In the areas of dense fanwort growth the plants were observed to be actively growing, but not yet at full maturity.

Based on the information collected during the pre-treatment inspection the initial herbicide treatment was scheduled. However, prior to the initial treatment the water level was lowered through cooperation with Chelmsford Town officials to create additional water storage and minimize the loss of herbicide downstream following the initial herbicide application. The pond level was lowered approximately 12-18 inches prior to treatment.

Chemical Treatment and Immunoassay FasTEST Analysis

The pond was briefly inspected again before the initial Sonar AS application. There was no appreciable change in plant maturity since the pre-treatment inspection approximately one week prior. Conditions were deemed optimal for the initial treatment; therefore, with no observable outflow, the initial treatment was performed (6/16/05). The Sonar AS was applied at a concentration of ~15-20 ppb. The chemical dose was divided among three predetermined treatment sectors based on area and average water depth. The chemical was evenly distributed throughout those areas using our Panther Airboat, which is specially equipped with subsurface chemical injection apparatus. Subsurface injection of Sonar AS is important because it eliminates the potential for damage to non-target terrestrial plants via chemical drift. It also reduces the rate of natural degradation by limiting its contact with the atmosphere and direct sunlight.

Due to the long contact time required in a successful Sonar treatment program (40-60 days) it was necessary to periodically monitor the herbicide concentration using FasTEST sample analysis. Samples were collected from three different sites designated as 1 (outlet end), 2 (mid-pond), and 3 (community beach basin). A fourth sample FasTEST sample collection site was established downstream of Heart Pond where the outlet waters, under high flow conditions, enter directly into the irrigation pond of the downstream cranberry grower. The results of the FasTEST monitoring throughout the treatment program are provided in the following table.

Date of Treatment	Concentration Applied	FasTEST Collection Date	Remaining Herbicide Concentration (ppb)			
			Site 1	Site 2	Site 3	Site 4
6/16/05	15-20 ppb	6/24/05	19.4	18.5	19.4	No outflow
----	----	7/11/05	12.8	13.5	13.7	<1.0
7/20/05	8-10 ppb	8/9/05	14.4	12.9	13.8	1.5
----	----	9/7/05	2.0	2.0	1.9	1.5

At the time of the FasTEST sample collection on 6/24/05, approximately one week after the initial treatment, the target plants showed the typical whitening or bleaching of the foliages green color (chlorosis) as the chlorophyll is degraded. In addition to the obvious signs of chlorosis it was observed that the plant growth had been arrested and therefore did not become matted to the surface, which was typical for that time of year.

The results of the first FasTEST sample indicated that an average of 19.1 ppb of active ingredient remained in the pond, which was within the targeted range 0f 15-20 ppb. While other exotic plant species like Eurasian Watermilfoil can be adequately controlled with doses as low as 5 ppb, we find that fanwort requires a somewhat greater dose, preferably greater than 10 ppb. Based on the slightly more advanced fanwort maturity, however, we opted to increase the initial treatment dose to effectively stop further plant maturation, which we have found to be critically important to the success of the treatment program. Following the initial treatment a multiple treatment approach was employed to maintain a target concentration of 10-15 ppb for the optimum contact time of approximately 40-60 days.

Based on plant conditions, outflow, weather, and most importantly FastTEST results we performed one additional "booster" treatment on 7/20/05 in order to maintain desirable fluridone concentrations. A dose in the range of 8-10 ppb was applied throughout the three treatment sectors in order to augment existing concentrations and return them to within the desired range. At the time of the second treatment the plants were extensively chlorotic, missing foliage, and beginning to decay. Chlorosis was observed extending 6-12

inches down the meristem of the fanwort plants. Even though the plants showed rather advanced symptoms of fluridone exposure, we felt it necessary to augment the remaining fluridone concentration to achieve the desired contact time, maximize immediate control, and potentially improve the duration of long-term control in subsequent growing seasons.

Post-Treatment Inspection

Two post-treatment inspections were performed. The first inspection on 9/7/05 indicated that the fanwort had dropped out of the water column to the pond bottom and had already moderately decomposed.

During the second post treatment inspection, performed in late September, Aquatic Control Biologists were accompanied by David Lavoie, Heart Pond Association President, to confirm that satisfactory results ($\geq$ 90% control of fanwort) were achieved. The documented areas of dense fanwort growth were surveyed through visual observation and using a "throw-rake". The rake was randomly dragged along the pond bottom to collect representative plant samples in order to ascertain the presence or absence of viable fanwort as well as record any impacts to non-target plant species. At no time during the survey was any viable fanwort observed or collected. The only evidence of fanwort that was found were black, leafless stems that were undergoing decomposition.

Although no viable fanwort growth was observed post-treatment, healthy native plant populations were observed. Some impact to the native plants, particularly within the waterlily community was observed and is not uncommon during the year of treatment. It has been our experience that the Sonar dose applied and maintained for fanwort control are insufficient to have any long-term impacts to the native plant species, which are typically more tolerant to Sonar exposure. We therefore expect the waterlily population will largely rebound within the next 1-2 years.

Healthy growth of Robbins pondweed and coontail were observed throughout the shoreline areas. These vegetated areas serve an important role in the ecology of the pond. They serve as valuable fish cover and spawning habitat, as well as a natural bio-filter and sediment trap for inflow waters. Other beneficial submersed plants were observed growing at varying densities throughout the pond. It was also observed that much of the waterlily cover along the shoreline of the pond was impacted; however, it has been our consistent experience that the herbicide concentrations targeted for fanwort control are insufficient to cause significant long-term damage.

The treatment program as a whole was very successful and likely attained greater than 99% control of the targeted plant species, including the inlet areas, which are difficult to achieve control due to the continuous inflow of untreated water. The carryover control in years two and three is uncertain; however, it is not uncommon to experience three years of fanwort control following a successful treatment program. Non-target impacts appear to be minimal and at no time during the course of the treatment program were there any reports or observations of fish mortality and or injury to other wildlife.

Water Quality Sampling

In order to satisfy Special Condition #24 of the Westford Order of Conditions (OOC) and Special Condition #2 of the Chelmsford OOC a water quality sample was collected from the "deep hole" portion of the pond. The sample was analyzed for the suite of baseline water quality parameters set forth in the Westford OOC. The results of the surface grab sample along with our interpretations are provided in the following section.

Parameters	Results	Units
pH	6.58	S.U.
Alkalinity as $CaCO_3$	63	mg $CaCO_3$/l
Turbidity	1.4	NTU
Kjeldahl Nitrogen	4.0	mg/l
Ammonia Nitrogen	0.07	mg/l
Nitrate Nitrogen	0.38	mg/l
Total Phosphorus	0.025	mg/l
True Color	50	Pt-Co
Apparent Color	90	Pt-Co
Total Coliform	<50	Organisms/100 ml
Fecal Coliform	<10	Organisms/100 ml

Sample collected 11/4/05

pH – pH is a measurement scale used to designate the degree of the acid or alkaline condition of a solution. The scale ranges from 0, being the most acidic, to 14, being the most basic or alkaline. The pH value of 7 is considered to be neutral. A pH range of 5.5-8.5 is necessary to maintain a healthy fishery. The pH values obtained at Heart Pond (6.58) were well within the acceptable range and should be quite favorable to fish populations.

Nitrogen – Nitrogen exists in ponds and lakes in several forms. Kjeldahl nitrogen testing results are representative of the amounts of organic or biomass nitrogen and ammonium. Inorganic forms of nitrogen, which are those most readily available for plant and algae use, are Ammonia Nitrogen and Nitrate Nitrogen. Nitrate nitrogen, in the presence of oxygen, is the breakdown product of ammonia, which is released during the decomposition of organic material. The level of organic nitrogen (Kjeldahl Nitrogen – Ammonia Nitrogen) is elevated in this sample. Values in excess of 1.0 mg/l are generally described as above average and illustrative of a potentially productive water column. These elevated organic nitrogen values are likely in-part due to decomposing fanwort biomass resulting from the treatment program. Therefore this value may be representative of an isolated spike in an otherwise typical organic nitrogen profile. Additional sampling will be required to establish long-term trends and baseline values.

The inorganic forms, most importantly Nitrate Nitrogen, are of greatest concern with regard to the immediate consumption by plants and algae species. The Nitrate Nitrogen results from the sampling round also indicates slightly elevated levels of nitrogen, as it is generally thought that inorganic nitrogen levels in excess of 0.30 mg/l are sufficient to support nuisance algae blooms.

Equally important as the shear amount of available nitrogen is the ratio of total nitrogen to total phosphorus (N:P). The ratio of nitrogen to phosphorus is important for determining how algae growth will be limited. Systems that have N:P ratios less than 10:1 are typically nitrogen limited and those that have ratios in excess of 15:1 are considered phosphorus limited. Like most freshwater systems Heart Pond is phosphorus limited.

Total Phosphorus – Phosphorus is often considered the limiting nutrient essential to plant and algae growth in freshwater systems, which is the case at Heart Pond. Typically a value of 0.03 mg/l or greater is sufficient to stimulate excessive plant and algae growth. The level obtained from Heart Pond was below the 0.03 mg/l threshold and therefore no reason for immediate concern. It is important to understand, however, this sample represents a limited view of the ever-fluctuating phosphorus levels. In order to establish more meaningful baseline values, additional and more frequent sampling would be required.

True and Apparent Color – True and apparent color illustrate how the water is colored. For example, apparent color is the measure of the color that is caused by substances that are in solution and by substances that are suspended in the water. Whereas, true color is the measure of the color that is produced by substances that are in solution only. Therefore, the apparent color value is determined directly from the raw sample and true color is obtained from filtered (in order to remove any particles in suspension) sample water. The results from Heart

Pond show that the color of the water is almost equally the result of both materials in solution and in suspension.

Total and Fecal Coliform Bacteria – Coliform bacteria are microscopic organisms which gain access to water from many sources, but primarily from excretions from humans, animals, surface run-off, and the multiplication of non-fecal forms on fibrous materials in the water. All coliforms do not originate from fecal sources; however, all fecal sources exhibit coliform organisms. Like E. coli the MA DPH has established thresholds for "swimmable waters". The current standards are <1000 orgs/100 ml for total coliform and <100 orgs/100ml for fecal coliform. The values for total and fecal coliform for this sample were below detectable limits.

Management Recommendations

Although we expect good control of the fanwort growth through 2006, we do recommend that the Association perform, at a minimum, early and late season qualitative vegetation surveys. An early season survey is important to document any fanwort regrowth as well as the recolonization of the pond bottom by more desirable native plant species. The late season survey will further document possible fanwort regrowth and native plant recolonization, but will also serve as the basis for management recommendations in future years. To further establish baseline water quality values at Heart Pond it may also be advisable to collect additional water quality samples at the time of the early and late season vegetation surveys. Based on the recent changes in the ecology of the pond we recommend that the Association budget for a whole pond algaecide treatment in 2006 as a contingency.

The associated cost of the recommended 2006 management tasks are outlined in the cost schedule on the following page.

As this report serves to satisfy the requirements of the Orders of Conditions issued by the Towns of Westford and Chelmsford, we feel it necessary to remind you that a copy of the report should be forwarded to each Town's Conservation Commission upon receipt.

We appreciate your business and cooperation throughout this year's project. We look forward to working with you in the future to preserve the ecological, aesthetic, and recreational value of Heart Pond. If you have any questions or require additional information, please do not hesitate to contact our office.

Sincerely,

Aquatic Control Technology, Inc.

Keith Gazaille
Senior Biologist

Gerald N. Smith
President/Aquatic Biologist

2006 MANAGEMENT COST SCHEDULE

Management Task	Cost
▪ Early and late season vegetation surveys, inclusive of a general plant assemblage map and written narrative.	$1,500
▪ Collection of two water quality samples at each of the vegetations surveys (total of 4 samples and our written interpretations of the results	$475
▪ Whole pond copper-based algaecide treatment, inclusive of MA DEP permitting, chemical, and applications services	$1,750/treatment[1]

[1] – *We are recommending this algaecide treatment as a contingency and therefore treatment will only be performed if necessary. In the event that no treatment is required the Association would only be responsible for a $200 permitting fee.*