1.0 Introduction

The "Applicant", the City of Peabody Department of Community Development and Planning, is seeking approval to initiate Aquatic Management Programs at various city-owned waterbodies: Bartholomew Pond, Crystal Lake, Devils Dishful Pond, Elginwood Pond, and Sidneys Pond. The objective of the management program is to control growth of nuisance and non-native aquatic plant species, Eurasian watermilfoil (*Myriophyllum spicatum*), spiny naiad (*Najas minor*), common reed (*Phragmites australis*), and nuisance algae, to improve and maintain open water habitat, maintain water quality, promote growth of less pervasive native plant species, and provide safe recreational access to the waterbodies. Based on the type, distribution, and density of vegetation within the waterbodies, it has been concluded the restoration goals of the Applicant can best be achieved through regular monitoring and the prudent use of USEPA/MA DAR registered herbicides and algaecides.

The proposed project has been filed as an Ecological Restoration Limited Project under 310 CMR 10.53(4) and will protect the interest of the Wetland Protection Act by controlling a nuisance species, improving fish habitat, improving water quality, and slowing lake eutrophication.[1]

2.0 Problem Statement:

All of the waterbodies surveyed are shallow and impounded located within urban area of Peabody. The entirety of each pond would be considered littoral area, where sunlight penetrates through the water column to the sediment and support dense aquatic macrophyte growth. Four of the five pond's (Sidneys Pond excluded) conditions were not biologically desirable at the time of survey; extensive non-native and nuisance submersed vegetation and nuisance algae growth impaired the waterbodies. As seen by the current conditions, unmanaged, dense growth of vegetation and algae can degrade water quality, fish/wildlife habitat, and reduce recreational access to the waterbodies. Based on the goals of the Applicant, a management program focusing on regular monitoring and chemical treatment with USEPA/MA DAR approved herbicides and algaecides is proposed to control the non-native and nuisance plant and algae species to maintain open water conditions and maintain desirable water quality.

3.0 Site Descriptions:

Table 1: Waterbody Data Matrix

		Waterbody[2]				
		Bartholomew Pond	*Crystal Lake*	*Devils Dishful Pond*	*Elginwood Pond*	*Sidneys Pond*
Location		42.50839, -70.96605	42.54926, -70.99974	42.54083, -71.00693	42.54872, -71.00304	42.51434, -70.94198
Inlet from:		Surface area	Surface area	Winona Pond	Crystal Lake/ Devils Dishful Pond	Lower Spring Pond
Outlets to:		Lower Spring Pond	Elginwood Pond	Elginwood Pond	Norris Brook	Goldthwait Brook
Surface Area	(acres)	9.38	8.63	26.51	8.67	6.91
Est. Mean Depth	(feet)	7	5	4	4	4
Maximum Reported Depth	(feet)	15	12	10	8	10

[1] Department of Environmental Protection. Guidance for Aquatic Plant Management in Lake and Ponds as it Relates to the Wetlands Protection Act: April 2004, 1p.

[2] Estimates based on observed and reported conditions

Estimated Volume	(acre-feet) ((gallons))	65.6 (21.3 million)	43.1 (14.0 million)	106 (34.5 million)	34.7 (11.3 million)	27.6 (9.0 million)
Watershed	(acres)	153	348	1012	1968	1381
Dominant Plant Species		Spiny naiad, microscopic algae	Spiny naiad, yellow waterlily, cattails, common reed	Eurasian watermilfoil, white waterlily, yellow waterlily, lotus	Common waterweed, spiny naiad, coontail, yellow waterlily, Sago pondweed, common reed, cattails	Bladderwort

4.0 Existing Conditions:

Brief surveys of the waterbodies were conducted in August 2018 by a SŌLitude Environmental Scientist to document existing vegetation growth (Attachment C – Figures 2a-2e) and collect water samples for common water quality parameters. The results of these surveys with the results of the water quality and brief analysis follows.

Bartholomew Pond

At the time of the survey, Bartholomew Pond exhibited limited submersed vegetation growth, but was experiencing a moderate microscopic algae bloom impairing the water clarity. Fragments of spiny naiad were encountered throughout the pond; no rooted vegetation, spiny naiad or otherwise, was found, despite numerous throw-rake tosses.

Crystal Lake

After being dredged in 2017, the diverse vegetation assemblage found in Elginwood Pond downstream has yet to recolonize Crystal Lake. Moderate spiny naiad growth was documented throughout the littoral zone of the waterbody. Two patches of yellow waterlily (*Nuphar variagata*) was observed in the deeper, open water. An established stand of cattails (*Typha latifolia*) exists along the northeastern shoreline adjacent to Lowell Street. Scattered common reed regrowth was documented after being treated in 2017 with glyphosate. An aerating fountain was installed in September 2018 to assist in circulating water and improve dissolved oxygen concentrations.

Devils Dishful Pond

Devils Dishful Pond was completely infested with moderate density Eurasian watermilfoil growth. The western two-thirds of the pond's surface was covered with dense white waterlilies intermixed with yellow waterlilies. A small patch of American lotus (*Nelumbo lutea*) and watershield (*Brasenia schreberi*) was documented between the island and the shoreline. An established cattail stand was located at the southwestern corner of the pond adjacent to the inlet.

Elginwood Pond

Elginwood Pond supported the most diverse vegetation assemblage of the surveyed ponds. The dominant species was common waterweed (*Elodea canadensis*), found throughout the water column and underneath the yellow waterlily patches. Also documented was coontail (*Ceratophyllum demersum*), spiny naiad, and Sago pondweed (*Stuckenia pectinata*). Scattered wind-blown watermeal (*Wolffia sp.*) was collecting on the topped-out submersed vegetation and against the waterlily pads. Common reed dominates the southern shoreline, encroaching into shallow backwaters of the pond. Cattails were present in established patches in a western cove and near the inlet from Crystal Lake. Arrowroot (*Sagittaria latifolia*) was common along the shoreline adjacent to Lowell Street.

Sidneys Pond

Sidneys Pond exhibited the least vegetation growth of the surveyed ponds. Two patches of free-floating bladderwort (*Utricularia sp.*) were observed in the middle of the pond. An established wetland was located at the southern end of the pond near the Tapley Brook inlet.

Table 2: Water Quality Results

Parameter	pH	Alkalinity	Turbidity	Hardness	Conductivity	Total Phosphorus	Total Nitrogen	Total Kjeldahl Nitrogen	Nitrate/ Nitrite Nitrogen	e. coli
Unit of Measure	SU	mg CaCO3/L	NTU	mg/L	umhos/ cm	mg/L	mg/L	mg/L	mg/L	MPN/ 100ml
Desirable Range	5.5 - 8.0	>20	<5	>20	50 - 1500	<0.030	<1	<1	<1	<235
Bartholomew Pond	7.1	19.4	1.5	36.1	400	0.012	0.46	0.463	ND	140
Crystal Lake	7.6	47.2	3.2	116	1500	0.020	0.41	0.407	ND	15
Devils Dishful Pond	7.0	50.2	1.2	82.8	1200	0.022	0.54	0.545	ND	30
Elginwood Pond	6.8	48.7	1.9	102	1500	0.025	0.37	0.368	ND	39
Sidneys Pond	6.9	25.7	0.86	57.4	1200	0.018	0.55	0.372	0.18	96

All of the waterbodies exhibited desirable pH, turbidity, hardness, total phosphorus, total nitrogen, total Kjeldahl nitrogen, and nitrate/nitrite nitrogen levels; all indicative of healthy waterbodies. Both Bartholomew Pond and Sidneys Pond exhibited low alkalinity concentrations, but is common for this region, whereas most waterbody's alkalinity levels are naturally low, and reflect the character of the surrounding soils and geology. The e. coli results for Bartholomew Pond, while still below the threshold for swimmable waters, should continue with regular monitoring. These results provide a snap-shot of the water quality at the time of sampling and limit analysis of trends.

5.0 In-Lake Management Recommendations:

5.1 Program Overview:

Multiple-year approval is requested for the implementation of the Aquatic Management Programs at Bartholomew Pond, Crystal Lake, Devils Dishful Pond, Elginwood Pond, and Sidneys Pond. The goal of the management program is to control growth of invasive vegetation, in addition to other nuisance aquatic plant and algae species, to improve and maintain open water habitat, promote the growth of less pervasive plant species, and provide safe recreational access to the waterbodies through an integrated management program. This management program has been developed to be compatible with the goals of Applicant keeping in mind the regulatory responsibilities of the Peabody Conservation Commission and MA DEP.

As with any dynamic system, the ability to change and modify the management program is paramount to its success. The objectives of improving water quality and maintaining open water habitat can be achieved through regular monitoring supplemented by the prudent use of USEPA/MA DAR registered aquatic herbicides and algaecides. Specifically, we are requesting approval for use of fluridone (trade name: Sonar), diquat (Reward), flumioxazin (Clipper), imazamox (Clearcast), and glyphosate (AquaPro) herbicides,

and copper-based algaecides. The proposed herbicides and algaecides specifically affect the target species to be controlled and have a negligible effect on the non-target species and wildlife when applied in accordance with the label directions. All chemicals are applied at or below suggested does according to the product label. All doses are based on plant types and densities, so that a minimum amount of the chemicals is introduced into the waterbody.

No significant alteration to the wetland resource areas will occur as a result of the proposed pond management program; instead, the resource areas will be enhanced by controlling a non-native, invasive aquatic plant species, dense native vegetation, and improving water quality.

5.2 Proposed Products and Management Techniques

Fluridone (Sonar® – EPA # 67690-4 or equivalent)

Fluridone is a systemic herbicide that offers long-term control on invasive and nuisance aquatic vegetation. This herbicide hinders the ability of susceptible plants to produce carotene which protects chlorophyll from photodegradation, which results in mortality and subsequent long-term control of the targeted species (i.e., directly impacts the standing population and prevents future spread). This process is known as chlorosis and may be observed visually as the plant begins to lose its green color and take on a white or pink shade. Fluridone requires an extended contact time (45-60 days), so it has historically been used for low-dose, whole-pond treatments where dilution and contact time are more predictable, however, new granular formulations do allow for more effective spot-treatment.

Fluridone, when applied at recommended dosages is generally viewed as having one of the most environmentally friendly toxicology profiles of all products currently on the market. In fact, the US EPA has approved a limit of 150 ppb to be allowed in water used for drinking. Ideally, fluridone treatments are initiated early in the growing season when target vegetation is low or starting emergence. Presently, liquid and granular formations of this herbicide are available and included under this management plan. For aqueous applications, this chemical will be placed into an onboard mixing tank, mixed with pond water and evenly distributed throughout the surface of the treatment area via boat. This herbicide will be injected under the water surface through trailing hoses, minimizing the chance of chemical drift and assuring accurate placement of over the target species. For granular applications, the herbicide will be placed into a Heard spreader mounted to the bow of the treatment vessel and evenly distributed over the surface of the treatment area.

Fluridone water use restrictions, include no application within one-quarter mile of a potable water intake and no use of treated water for irrigation purposes within 30 days of application. Although there are no restrictions on swimming, boating or fishing, prudent use suggests that we close the pond on the day of treatment. The shoreline of the waterbody will be posted with signs warning of these temporary water uses restrictions, prior to treatment.

Impacts Specific to the Wetlands Protection Act using Fluridone[3]

- Protection of public and private water supply – Generally neutral, but may have detriment at high doses (prohibition within 0.25-mi. of drinking water intakes at doses >20 ppb)
- Protection of groundwater supply – Generally neutral (no significant interaction)
- Storm damage prevention – Neutral (no significant interaction)
- Prevention of pollution – Generally neutral (no significant interaction)
- Protection of land containing shellfish - Generally neutral (no significant interaction)
- Protection of fisheries - Possible benefit (habitat enhancement) and possible detriment (food source alteration, loss of cover)

[3] Commonwealth of Massachusetts Executive Office of Environmental Affairs. *Practical Guide to Lake Management*: 2004. 133 p.

- Protection of wildlife habitat – Possible benefit (habitat enhancement) and possible detriment (food source alteration, loss of cover)

Diquat (Reward® - EPA # 100-1091 or equivalent)

Reward (diquat) is an effective herbicide for partial-pond treatments due to its rapid mode of action and short herbicide concentration-exposure-time requirements. Even though diquat is considered to be a contact-herbicide, longer term control may be seen as plants' root crowns will not be allowed to develop.

The USEPA/MA registered herbicide diquat dibromide will be applied to the area at or below the permissible label dose. Reward is a widely used herbicide, applied to greater than 500 lakes and ponds annually, throughout the northeast, to control nuisance submersed aquatic plants. Diquat would be applied to control milfoil, spiny naiad, and other nuisance submersed plants at the application rate of 1.0-2.0 gal/acre, if necessary. Temporary water use restrictions for diquat are now: 1) No drinking or cooking for 3 days. 2) No irrigation of turf for 3 days and of food crops for 5 days, and 3) No livestock watering for 1 day. There are no restrictions on swimming, boating, or fishing, but prudent herbicide/algaecide management, suggest that we close the pond on the day of treatment. The shoreline of the pond will be posted with signs warning of these temporary water use restrictions, prior to treatment.

Diquat 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 adsorbed immediately and thereby biologically inactivated. Residual levels of diquat in treated water decline rapidly and their reduction is due to the uptake by the targeted vegetation and adsorption to suspended soil particles in the water or on the bottom mud. Photochemical degradation accounts for some loss under conditions of high sunlight and clear waters.

Impacts Specific to the Wetlands Protection Act using Diquat[4]

- Protection of public and private water supply – Benefit (water quality improvement)
- Protection of groundwater supply – Neutral no interaction as diquat is absorbed to soil particles
- Flood control - Neutral (no significant interaction)
- Storm damage prevention – Neutral (no significant interaction)
- Prevention of pollution – Generally neutral (no significant interaction), but could be a detriment if plant die-off causes low oxygen at the bottom of the lake
- Protection of land containing shellfish - Generally neutral (no significant interaction), but reduced algae might reduce food resources for shellfish, and direct toxicity is possible under unusual circumstances
- Protection of fisheries - Possible benefit (habitat enhancement) and possible detriment (food source alteration, loss of cover)
- Protection of wildlife habitat – Possible benefit (habitat enhancement) and possible detriment (food source alteration, loss of cover)

Flumioxazin (Clipper® - EPA # 59639-161 or equivalent)

The USEPA/MA registered herbicide flumioxazin (Clipper) is the only contact herbicide currently approved for use in Massachusetts that can provide effective control of duckweed and watermeal as well as filamentous algae. Flumioxazin was recently registered in Massachusetts and its use carries a number of restrictions which limit its use potential. Until flumioxazin is more widely used in the State and more data is collected it is unlikely that these restrictions will change, so its use would be reserved for small spot-treatments within the waterbodies.

[4] Commonwealth of Massachusetts Executive Office of Environmental Affairs. *Practical Guide to Lake Management*: 2004. 124 p.

Clipper herbicide is classified as a PPO (Protoporphyrinogen oxidase) inhibitor that initiates cell membrane disruption providing control of a broad range of susceptible plants. Clipper is a true contact herbicide that provides quick and effective control of target plant species. Although Clipper is not shown to have systemic activity, one or more years of reasonable control have been observed at other projects in New England where Clipper has been applied. Flumioxazin is extremely fast-acting and has a very short half-life so it is perfect for spot/site specific treatments.

Impacts Specific to the Wetlands Protection Act using Flumioxazin

- Protection of public and private water supply – Benefit (water quality improvement)
- Protection of groundwater supply – Neutral no interaction as flumioxazin has a low leaching potential
- Flood control - Neutral (no significant interaction)
- Storm damage prevention – Neutral (no significant interaction)
- Prevention of pollution – Generally neutral (no significant interaction), but could be a detriment if plant die-off causes low oxygen at the bottom of the lake
- Protection of land containing shellfish - Generally neutral (no significant interaction), but reduced algae might reduce food resources for shellfish, and direct toxicity is possible under unusual circumstances
- Protection of fisheries - Possible benefit (habitat enhancement) and possible detriment (food source alteration, loss of cover)
- Protection of wildlife habitat – Possible benefit (habitat enhancement) and possible detriment (food source alteration, loss of cover)

Imazamox (Clearcast – EPA #241-437-67690)

Recently registered by the MA Department of Agricultural Resources, the USEPA/MA registered herbicide Imazamox will be applied to the area at or below the permissible label dose. It has been registered for multiple years by the USEPA and utilized outside of the state to manage submersed, floating-leaf, and emergent vegetation. Imazamox would be applied as a foliar spray to control common reed, waterlily, and lotus growth at the application rate of 1.5 lbs ae/acre, if necessary. Temporary water use restrictions for Imazamox are now: 1) No drinking or cooking until residue testing results are below 50 ppb, 2) No irrigation until concentrations are below 50 ppb. There are no restrictions on swimming, boating, fishing, watering of livestock, or domestic use, but prudent herbicide management suggest that we close the area on the day of treatment. The surrounding area will be posted with signs warning of these temporary water use restrictions prior to treatment.

Imazamox is a systemic herbicide. When applied as a foliar spray, it is quickly absorbed by foliage and rapidly translocated to the growing points stopping growth. The concentrated herbicide is diluted with water in a low-volume backpack sprayer or low-volume boat-based pump system and applied to the targeted vegetation leaves via handheld wand or spray nozzle. A spray adjuvant will be mixed with the diluted herbicide to improve efficacy.

Impacts Specific to the Wetlands Protection Act using Imazamox

- Protection of public and private water supply – Generally neutral, but may have detriment at high doses (setback of treatment required, with distance based on dose and area treated)
- Protection of groundwater supply – Neutral (no interaction)
- Flood control - Neutral (no significant interaction)
- Storm damage prevention – Neutral (no significant interaction)
- Prevention of pollution – Generally neutral (no significant interaction), but could be a detriment if plant die-off causes low oxygen at the bottom of the lake

- Protection of land containing shellfish - Generally neutral (no significant interaction)
- Protection of fisheries - Possible benefit (habitat enhancement) and possible detriment (food source alteration, loss of cover)
- Protection of wildlife habitat – Possible benefit (habitat enhancement) and possible detriment (food source alteration, loss of cover)

Glyphosate (AquaPro® - EPA # 62719-324-67690, Rodeo – EPA # 62719-324 or equivalent)

Glyphosate is used to control waterlilies, watershield, and emergent plants such as purple loosestrife and common reed. It is typically applied in August/September for control of emergent species. Glyphosate would be applied at the recommended Federal/State concentration of 3 quarts/acre. There are no water-use restrictions associated with the use of glyphosate other than use in the vicinity of potable water intakes, but prudent practice calls for restriction of water usage on the day of treatment as an additional safeguard. These restrictions are consistent with good pesticide practice and Massachusetts guidelines for aquatic treatments.

Glyphosate is a systemic herbicide and is foliar active. This means the herbicide is active only on contact with the plant. It has no activity in surrounding soil or water. The chemical is applied to the leaves of the target plant and is translocated down into the rhizomes or roots of the plant. Glyphosate is absorbed by plant foliage and moves throughout plant tissues. Once inside the plant, the active ingredient in glyphosate interrupts the plant's ability to produce a protein it needs to live. The protein that glyphosate targets is found only in plants. It does not exist in humans, wildlife or fish. Glyphosate binds tightly to most types of soil particles and is unavailable for root uptake. There is low potential for leaching or contamination of groundwater with glyphosate herbicide. Microorganisms in the soil and water break down into its natural components.

Impacts Specific to the Wetlands Protection Act using Glyphosate[5]

- Protection of public and private water supply – Protection of public and private water supply – Detriment (prohibition within one quarter mile of surface drinking water supplies due to toxicity), but generally neutral where allowed
- Protection of groundwater supply – Neutral (no interaction)
- Flood control - Neutral (no significant interaction)
- Storm damage prevention – Neutral (no significant interaction)
- Prevention of pollution – Generally neutral (no significant interaction), but could be a detriment if plant die-off causes low oxygen at the bottom of the lake
- Protection of land containing shellfish - Neutral (no significant interaction)
- Protection of fisheries - Possible benefit (habitat enhancement) and possible detriment (food source alteration, loss of cover)
- Protection of wildlife habitat – Possible benefit (habitat enhancement) and possible detriment (food source alteration, loss of cover)

Algaecides (Captain – EPA # 67690-9, SeClear – EPA # 67690-55, GreenClean PRO – EPA #70299-15, or equivilant)

Approval for the use of a copper or peroxide based algaecide is requested in the event that nuisance algae conditions develop, warranting treatment.

Copper based algaecides (i.e. CuSO4, Captain, SeClear) are widely used and are applied to lakes and ponds throughout North America to control nuisance filamentous and microscopic algae. There are no water use restrictions associated with copper-based algaecides and SŌLitude treats several direct, potable

[5] Commonwealth of Massachusetts Executive Office of Environmental Affairs. *Practical Guide to Lake Management*: 2004. 128 p.

(drinking) water reservoirs and a number of recreation waterbodies in the Commonwealth with these algaecides, on a yearly basis. The concentrated liquid algaecides are first diluted with pond water and are then sprayed throughout the pond area. The application rate is generally 0.2 ppm or less for algae control. If applied, treatment will not exceed 50% of the pond volume.

Peroxide based algaecides (e.i. GreenClean PRO, GreenClean Liquid) are a recent addition to algae management. Similar to copper algaecides, there are no water use restrictions. The concentrated products are diluted with pond water and then sprayed evenly throughout the treatment area. The application rate is 0.5 – 1.5 gallons per acre-foot for algae control. If applied, treatment will not exceed 50% of the pond volume.

Impacts Specific to the Wetlands Protection Act using Copper[6] and Peroxide algaecides

- Protection of public and private water supply – Benefit (used to control algae)
- Protection of groundwater supply – Neutral (no significant interaction)
- Flood control - Neutral (no significant interaction)
- Storm damage prevention – Neutral (no significant interaction)
- Prevention of pollution - Generally neutral (no significant interaction), but could be a detriment if algae/plant die-off causes low oxygen at the bottom of the lake or causes release of taste and odor compounds or toxins
- Protection of land containing shellfish - Generally neutral (no significant interaction), but reduced algae might reduce food resources for shellfish, and direct toxicity is possible under unusual circumstances.
- Protection of fisheries - Possible benefit (habitat enhancement) and possible detriment (food source alteration, direct toxicity)
- Protection of wildlife habitat – Possible benefit (habitat enhancement) and possible detriment (food source alteration, direct toxicity)

Proper herbicide application allows for targeted plant control without posing an unreasonable adverse risk to non-target species and wildlife. Written approval from the Commission will be sought should alternate products be considered in future years. All products proposed for use will be registered for aquatic use in Massachusetts.

Management Technique Descriptions

Detailed information on all the approaches proposed in this NOI can be found at the **Massachusetts Department of Conservation and Recreation, Lakes and Ponds Program website**. There are links under the Publications tab to the "Generic Environmental Impact Report for Eutrophication and Lake Management in Massachusetts" and the "Practical Guide to Lake Management in Massachusetts."

<http://www.mass.gov/eea/agencies/dcr/water-res-protection/lakes-and-ponds/eutrophication-and-aquatic-plant-management.html>

Additional information on the herbicides and algaecides can be found at the **Massachusetts Department of Agricultural Resources website:** <http://www.mass.gov/eea/agencies/agr/pesticides/aquatic-vegetation-management.html>

[6] Commonwealth of Massachusetts Executive Office of Environmental Affairs. *Practical Guide to Lake Management*: 2004. 122 p.

5.3 Management Recommendations:

Waterbody	Target Species	Management Strategy	Application Methodology
Bartholomew Pond	Spiny naiad	Fluridone (whole-pond) Diquat (spot-treatment)	Sub-surface via pump system
	Filamentous/microscopic algae	Copper-based algaecides (if needed)	Surface via pump system
Crystal Lake	Spiny naiad	Fluridone (whole-pond) Diquat (spot-treatment)	Surface via pump system
	Common reed	Imazamox, glyphosate (spot-treatment)	Foliar via low volume backpack sprayer or pump system
	Yellow waterlily	Imazamox, glyphosate (spot-treatment, if needed)	Foliar via low volume or pump system
	Filamentous/microscopic algae	Copper-based algaecides (if needed)	Surface via pump system
Devils Dishful Pond	Eurasian watermilfoil	Fluridone (whole-pond) Diquat (spot-treatment)	Sub-surface via pump system
	White/Yellow waterlily	Imazamox, glyphosate (spot-treatment, if needed)	Foliar via low volume or pump system
	American lotus	Imazamox, glyphosate (spot-treatment)	Foliar via low volume or pump system
	Filamentous/microscopic algae	Copper-based algaecides (if needed)	Surface via pump system
Elginwood Pond	Spiny naiad	Fluridone (whole-pond) Diquat (spot-treatment)	Sub-surface via pump system
	Common reed	Imazamox, glyphosate (spot-treatment)	Foliar via low volume backpack sprayer or pump system
	White/Yellow waterlily	Imazamox, glyphosate (spot-treatment, if needed)	Foliar via low volume or pump system
	Watermeal	Flumioxazin (spot-treatment, if needed)	Surface via pump system
	Common waterweed, coontail, Sago Pondweed	Diquat (spot-treatment)	Sub-surface via pump system
Sidneys Pond	Bladderwort	Diquat (spot-treatment)	Sub-surface via pump system
	Filamentous/microscopic algae	Copper-based algaecides (if needed)	Surface via pump system

5.4 Monitoring:

Regular inspections will be conducted in order assess the growth phase of the target plant species and overall pond conditions. Post-management inspections will be conducted in order to assess the efficacy of the management efforts and any impacts on non-target species so future applications can be properly adjusted to minimize non-target impacts. Year-End Reports documenting our annual management efforts, observed conditions, management efficacy, and future recommendations can be provided to the Commission.

6.0 Alternatives Analysis:

Alternatives to the proposed Aquatic Plant Management Plan were considered. SŌLitude evaluated all available strategies for management of Southfield Court Pond. Findings and recommendations are based on direct experience and discussions found in the *Eutrophication and Aquatic Plant Management in Massachusetts Final Generic Environmental Impact Review* (FGEIR, EOEA 2004).

Bottom Weed Barriers: Not Recommended

Physical controls, such as the use of bottom weed barriers (i.e. Aquatic Weed Net or Palco) can be effective for small dense patches of nuisance vegetation, but are not cost effective or feasible for large areas. Weed barriers are expensive to install and maintain at ~$1.75/ft² (material & installation). Semi-annual maintenance to retrieve, clean and re-deploy the barriers would be expensive and time consuming. Additionally, covering expansive areas of the pond bottom may also have detrimental impacts on invertebrates or other types of wildlife.

Harvesting: Not Recommended

Harvesting of spiny naiad and Eurasian watermilfoil is not recommended because its ability to reproduce through vegetative fragmentation, leading to increased spread into previously un-infested areas or further intensifying growth rates. Additionally, harvesting would be costly and at best would only provide a season of relief from the native vegetation growth with no guarantee of success. The disruption and non-target impacts would be more significant than with spot-treatments using aquatic herbicides.

Biological: Not Recommended

There are no proven biological controls available or approved by the State for the control of the invasive aquatic plant species present.

Sediment Excavation/Dredging: Not Recommended

Dredging nutrient rich bottom sediment is sometimes used as a strategy to control excessive weed growth. Conventional (dry) or hydraulic dredging would require the expenditure of hundreds of thousands of dollars in design and permitting fees alone. Dredging may also have severe impacts to aquatic organisms (i.e. fish and macroinvertebrates) in the ponds with no guarantees of elimination of invasive vegetation.

Do Nothing: Not Recommended

If the invasive and nuisance plant and algae growth is allowed to continue unabated, eutrophication and filling-in at the waterbodies will continue to occur at an accelerated rate due to the annual decomposition of excessive plant material. Anoxic conditions would degrade water quality and potentially impact fish and other aquatic organisms. Stagnant conditions will also increase water temperatures promoting both algae and bacterial growth as well as providing extensive mosquito breeding habitat. The waterbodies' recreational and aesthetic value would be significantly degraded.

7.0 Compliance

Massachusetts Wetlands Protection Act:

The objective of this project is to controlling an invasive species. Managing densities of native species will typically not adversely affect wildlife habitat and will not negatively impact other interests of the Massachusetts Wetlands Protection Act. No significant alteration to wetland resources areas will occur as a result of the proposed management program; instead the resource areas will be enhanced by controlling the nuisance plant and algae growth. The proposed management activities are consistent with the guidelines in the following documents:

- Final Generic Environmental Impact Report: Eutrophication and Aquatic Plant Management in Massachusetts (June 2004)
- Guidance for Aquatic Plant Management in Lakes and Ponds: As it Relates to the Wetlands Protection Act (April 2004 – DEP Policy/SOP/Guideline # BRP/DWM/WW/G04-1)
- The Practical Guide to Lake Management in Massachusetts (2004)

DEP License To Apply Chemicals:

All chemical applications will be performed by Certified Applicators. The USEPA/MA registered aquatic herbicides will be applied at recommended label rates, in accordance with the "Order of Conditions" and DEP "License to Apply Chemicals" permits (BRP WM04). Prior to treatment, the shoreline will be posted with signs warning of all temporary water use restrictions. A site specific "License to Apply Chemicals" for the proposed treatment will be filed with Massachusetts DEP, Office of Watershed Management.

Massachusetts Environmental Policy Act:

The strategies proposed in this NOI are options approved under the Massachusetts Environmental Protection Act (MEPA) process that was approved in 2004 with the issuance of the FGEIR and the *Practical Guide to Lake and Pond Management in Massachusetts*. These approaches do not require individual MEPA review.

Massachusetts Endangered Species Act:

According to the most recent Natural Heritage maps provided by MA GIS (Attachment C - Figure 4), none of the waterbodies are located within area designated as Priority Habitats of Rare Species as determined by the Massachusetts Natural Heritage & Endangered Species Program (NHESP). A formal review by NHESP is not required.

8.0 Impacts of the Proposed Management Plan Specific to the Wetlands Protection Act:

Protection of public and private water supply – None of the waterbodies are used directly as a drinking water supply. Aquatic herbicide treatment at the waterbodies will not have any adverse impacts on the public or private water supply, when used in accordance with the project label and conditions of the MA DEP License to Apply Chemicals.

Protection of groundwater supply – According to available studies, there is no reason to believe that the groundwater supply will be adversely impacted by the proposed management strategies, specifically the application of the chemicals at the proposed rates to the waterbodies, when used in accordance with the product labels. Contamination of groundwater by aquatic herbicides is limited by their low rate of application, rapid rate of degradation, and uptake by target plants. SŌLitude's State licensed applicators take all necessary precautions when mixing and disposing of all chemical containers.

Flood control and storm damage prevention – No construction, dredging or alterations of the existing floodplain and storm damage prevention characteristics of the pond are proposed. However, in some instances, abundant and excessive aquatic plant growth can contribute to high water and flooding. Most commonly this occurs in the vicinity of waterbody outlets or water conveyance channels and structures. The unmanaged, annual growth and decomposition of abundant plant growth is also known to increase sediment deposition at an accelerated rate. Therefore, the proposed management approaches may increase the capacity of the resource areas over the long-term to provide flood protection.

Prevention of pollution – No degradation of water quality or increased pollution is expected by the proposed management approaches. The proposed herbicides are relatively slow acting in controlling the nuisance vegetation. This results in a slow release of nutrients from the decaying plants, reducing the potential for increases in nutrients that can cause algae blooms. Removal of the excessive growth of aquatic vegetation will contribute to improved water circulation and a reduction in the potential for anoxic conditions. The post-treatment decrease in plant biomass will help to decrease the rate of eutrophication currently caused by the decomposing of excessive plant material.

Protection of fisheries and shellfisheries – Contiguous, dense beds of aquatic vegetation provide poor habitat for most species of fish. Dense plant cover frequently results in significant diurnal fluctuations in dissolved oxygen as well as oxygen depletion during certain times of the year. While temporary effects on some desirable submersed and floating-leafed species may occur following the application of an aquatic herbicide, non-target plants typically rebound quickly. Shoreline emergent plants will not be impacted following the use of aquatic herbicides.

Protection of wildlife and wildlife habitat – In general, excessive and abundant plant growth, especially non-native plants, provides poor wildlife habitat for fish and other wildlife. The proposed management plan is expected to help prevent further degradation of the waterbodies through excessive weed growth and improve the wildlife habitat value of the pond in the long-term. Maintaining a balance of open water and vegetated areas (20-40%) of native species is intended.