ATTACHMENT A:

Pillings Pond Aquatic Vegetation Management
Project Description

I. Introduction

Pillings Pond is an approximately 90-acre water body with a maximum depth of approximately 25 feet and an average depth of approximately 6 feet. The Town of Lynnfield has been involved in management of the Pond's algae and nuisance aquatic vegetation for a number of years, which in recent years has been through procuring the services of contractor to provide applications of herbicides, algaecides, and aluminum sulfate for phosphorus inactivation. The Town's most recent Order of Conditions (OOC) for aquatic vegetation and algae control was authorized in 2004 and recently expired in 2020. Rather than seek another extension of the 2004 OOC, the Town decided to reevaluate and update its approach to plant and algae management as presented in this Notice of Intent (NOI).

II. Pond Management Goals

When evaluating an aquatic vegetation and algae control strategy for Pillings Pond, it is important to consider past and current pond conditions, the lake's vegetation and algae management history, and long-term goals with regard to maintenance of the pond's ecological and recreational values. These goals include the following:

1. Prevent nuisance growth of non-native species, including spiny naiad (*Najas minor*), curlyleaf pondweed (*Potamogeton crispus*), water chestnut (*Trapa natans*), and common reed (*Phragmites australis*).
2. Pond management to maintain conditions that are suitable for recreational uses.
3. Preservation and improvement of the overall water quality and ecological values of Pillings Pond. A diverse native plant community plays an important role in maintaining a healthy lake ecosystem and its recreational values. For example, the role of rooted aquatic plants in maintaining lake water clarity is well documented, and native plant beds provide critical habitat as forage and protective cover for fish.
4. The Town acknowledges that pond management will require ongoing evaluation of conditions and a need to adapt the management approach as conditions change (e.g., introduction of a new non-native species to the pond).

III. Recent Aquatic Vegetation and Algae Management Activities

A summary of the four non-native aquatic plant species currently documented in Pillings Pond is provided in Table 1, followed by a summary of vegetation and algae control efforts conducted under the previous OOC from 2012-2019 in Table 2.

Table 1. Pillings Pond Non-Native Aquatic Plan Species

Species	Summary
Spiny naiad (*Najas minor)*	Spiny naiad is an annual submersed plant which propagates both by seed and from stem fragments. It tends to be found growing in shallow water ranging in depth from 2-15 feet.
curlyleaf pondweed (*Potamogeton crispus*)	Curlyleaf pondweed is a perennial submersed plant that typically grows at a depth of 2-12 feet. Growth of this plant tends to peak in June and die back starting in early July. This non-native plant does not grow to nuisance levels in all water bodies where it is found. Given its limited documented abundance in Pillings Pond and tendency to die back early in the summer recreation season, control of this plant is considered a lower priority than spiny naiad at this time. Any future control efforts targeting this plant will be based on supporting field data.
water chestnut (*Trapa natans*)	Water chestnut is an annual plant which flowers in mid to late July, with seed production continuing into the fall when frost kills the floating rosettes. The nuts of this plant can produce new plants for up to 12 years. A very limited number of plants have been documented in Pillings Pond recent years.
common reed (*Phragmites australis*)	Common reed is an invasive emergent wetland plant which has encroached along parts of the western shoreline of Pillings Pond. Common reed spreads primarily by rhizomes and can create very dense monoculture stands in bordering wetlands and shallow water.

spiny naiad

curlyleaf pondweed

water chestnut

common reed

Table 2. Pillings Pond Aquatic Vegetation and Algae Management Activities, 2012-2019

Year	Vegetation Control: Herbicide Treatments	Algae Control: Algaecide and Alum Treatments
2012	• Diquat treatment for spiny naiad: **11 acres**, 8/2/12, *area not reported*	• Split copper sulfate treatment[1]: late June/early July • Split copper sulfate treatment: 8/15/12 and 8/22/12
2013	*Record not available*	*Record not available*
2014	• Diquat treatment for spiny naiad: **12 acres**, 7/14/14 (*map provided*[2])	• Split copper sulfate treatment: 6/30/14 and 7/14/14
2015	• Diquat treatment for spiny naiad: **15 acres** 7/22/15, *area not reported*	• Alum treatment: 6/11/15 • Split copper sulfate treatment: 7/22/15 and 8/5/15
2016	• Diquat treatment for curlyleaf pondweed and spiny naiad: 5/25/16, *area and acreage not reported*[3] • Glyphosate treatment for water lilies in Lakeview Ave. cove, 8/4/16, *acreage not reported*	• Alum treatment: 6/8/16 • Half-pond copper sulfate treatment: 8/4/16, *area treated was not reported*
2017	• Diquat treatment for curlyleaf pondweed and sago pondweed: **20 acres,** 5/24/17 • Diquat treatment for spiny naiad: **20 acres,** 8/9/17 • Glyphosate treatment for common reed, 10/12/17, *area and acreage not reported*	• Alum treatment: 7/6/17 • Half-pond copper sulfate treatment: 8/31/17, *area treated was not reported*
2018	• Diquat treatment for curlyleaf pondweed: **20 acres** 5/23/18, *area not reported* • Diquat treatment for spiny naiad: **20 acres** 7/30/18, *area not reported* • Glyphosate treatment for common reed, 8/30/18, *area and acreage not reported*	• Alum treatment: 6/5/18 • Half-pond copper sulfate treatment: 8/13/18, *area treated was not reported*
2019	• Diquat treatment for curlyleaf pondweed: **20 acres** 5/29/19, *area not reported* • Diquat treatment for spiny naiad: **20 acres** 7/24/19, *area not reported* • Glyphosate treatment for common reed and water lilies, 9/24/19, *area and acreage not reported*	• Copper sulfate treatment: 5/29/19 • Copper sulfate treatment: 6/27/19 • Copper sulfate treatment: 7/24/19 • Copper sulfate treatment: 8/29/19 • Copper sulfate treatment: 9/24/19

Notes:

1. Split treatments apply copper sulfate to one half of the pond a time, typically with a period of 2 weeks between applications. This is done to limit the risk of oxygen depletion, which is more likely to occur following a whole-pond copper sulfate treatment. Where a half-pond treatment is noted (2016-2018), only the first half of the split treatment was determined to be needed based on the abundance of algae at the time of the application.
2. 2014 was the only year from 2012-2019 when a map of the treated area was provided in the end-of-year report.
3. Report states that a second diquat treatment was performed later in the season, but no date or details provided.

III. Proposed Aquatic Vegetation and Algae Management Program

A. Overview

As stated in Section II, aquatic vegetation control efforts will seek to balance the Town's goals of maintaining recreational use of the pond and maintaining a diverse and healthy pond ecosystem. Because of the frequency of herbicide applications in recent years, it is difficult to estimate what the condition of the Pillings Pond aquatic plant community would be if these treatments had been conducted on a less regular basis. However, it is reasonable to assume that the pond would have more abundant and diverse macrophyte growth in absence of these herbicide applications. Based on a vegetation survey a few years prior to the period of record presented in Table 1 (Geosyntec, 2009), only a small portion of sampling stations had moderate plant growth densities. Nuisance conditions were not observed in any part of the pond.

Although excessive plant growth (whether native or non-native) can clearly have a negative impact on pond recreational uses, The Town will also carefully consider the relationship between rooted aquatic plant abundance and algal abundance when making plant management decisions. Persistent nuisance algae blooms, including potentially toxigenic blue-green algae blooms, have been the primary lake management concern for Pillings Pond in recent years.

In general, lakes with limited macrophyte communities (such as Pillings Pond) tend to have higher algal abundance and more frequent occurrences of nuisance algal blooms. Many studies have shown that shallow lakes commonly exist in one of two alternative stable states: either a clear-water, macrophyte-dominated state or a turbid-water, algae-dominated state. Turbidity generally increases with increasing nutrient concentration, primarily due to increased algal abundance. However, biotic interactions related to the abundance of submersed macrophytes, fish and zooplankton have a very strong influence in determining overall algal abundance and availability of nutrients in the water column. As such, herbicide treatments in an algae-dominated lake such as Pillings Pond may exacerbate the in-lake conditions leading to continued high turbidity and nuisance algae blooms.

In lakes with dense growth of macrophyte species that top out at or near the water surface, herbicides and other plant management techniques can provide clear benefit with regard to maintaining recreational use and a diversity of open water habitat. However, the benefits of routine herbicide applications to control macrophytes are not as obvious in Pillings Pond. As a shallow lake with organic bottom sediments, a relatively large portion of Pillings Pond should be suitable for rooted aquatic plant growth unless (1) frequent plant control measures are used or (2) the pond persists in a turbid-water, algae-dominated state that limits rooted plant growth due to insufficient light penetration to the bottom sediments. Although the non-selective, broad-spectrum herbicides that have been used in Pillings Pond can provide short-term control of many submersed species, it is not clear that repeated use of such herbicides for this purpose is consistent with the Town's primary goals for Pillings Pond. As discussed above, the continued control of macrophytes with broad-spectrum herbicides may be a contributing factor to the lake's phytoplankton-dominated state. As such, control of rooted aquatic plants will generally be conducted only on an as-needed basis with a focus on control of non-native species and in areas where growth conditions result in documented impairment to recreational pond uses such as boating.

B. Aquatic Vegetation Management

Task A1: Herbicide Application

Diquat: Diquat dibromide is a quick-acting "contact" herbicide that has been used regularly in Pillings Pond in recent years. This herbicide is non-selective, providing temporary control for a broad range of native aquatic plants as well as invasive species such as spiny naiad and curlyleaf pondweed.

As stated in the diquat fact sheet prepared by the Massachusetts Department of Agricultural Resources (see Appendix A), "*Since diquat is effective in treating a large range of plants, it may have a widespread effect on nontarget plants. In addition to direct toxic effects of the herbicide, treatment of a pond with diquat may also cause indirect impacts including dissolved oxygen depletion and habitat loss. These impacts may cause general weakening and/or death of plants on a large scale (Aquatic Plants Management Program for Washington State, 1992)".*

The use of diquat in Pillings Pond has increased steadily since 2012, when a single treatment was conducted in an 11-acre area. Diquat has been applied to a 20-acre area of Pillings Pond twice per summer for the past three years (2017-2019), with the first treatment in May targeting curlyleaf pondweed and the second (July or August) targeting spiny naiad.

Based on the reporting associated with herbicide treatments from 2012-2019, there has been no clear documentation regarding the basis for the increased area or frequency of diquat application. For example, the 2019 report simply states "*Curlyleaf pondweed was found in sparse to moderate densities along the central/western portion of the pond*" and "*The initial treatment was completed on May 29th to target curlyleaf pondweed*". With the exception of a single map showing the 2014 treatment area for spiny naiad, no other maps or figures have indicated the documented areas of nuisance growth or the specific areas where herbicides have been applied.

It seems possible the Town's aquatic vegetation management goals could be achieved with less extensive and less frequent applications of this herbicide, as follows:

- Avoid herbicide applications in areas where growth of target non-native species is sparse or moderate, and where such growth is documented to be relatively stable (e.g., low-moderate density growth of curlyleaf pondweed that has not increased significantly over time).
- Avoid use of diquat (and other non-selective herbicides) in areas with a good diversity of native species and/or where protection of beneficial native species is a priority.
- As stated in Table 1, control of curlyleaf pondweed is considered a lower priority than spiny naiad at the time of this NOI submittal (July 2020). Any future control efforts targeting this plant will be based on supporting field data.
- Based on the goals stated above, diquat treatments will be conducted at the direction of the Commission on an as-needed basis for the control of non-native species. Such treatments will be based on submittal of information which describes vegetation conditions in the specific areas proposed for treatment, the proposed timing of the application, and the proposed dosage rate and method of application.

Glyphosate: Glyphosate is a systemic, broad-spectrum herbicide that can be effective for control of both floating leaf species (e.g., water lilies) and common reed for 1 to 2 years.

- Applications of glyphosate will be evaluated by the Commission as a second-tier alternative for control of common reed and floating leaf species to be used on an as-needed basis to

maintain recreational use of Pillings Pond if hydroraking cannot be conducted or is not feasible for a specific area requiring control. If glyphosate is used for control of common reed, control effectiveness can be greatly enhanced by conducting mechanical removal in the year following the treatment.

- Glyphosate treatments for water lilies may be conducted as a targeted “follow-up” treatment to prevent the re-emergence of nuisance levels of water lilies following initial control by hydroraking.
- Glyphosate applications will be conducted at the direction of the Commission, based on submittal of information which describes vegetation conditions in the specific areas proposed for treatment, the proposed timing of the application, and the proposed dosage rate and method of application.

The Town will publish a public notice prior to any herbicide treatment.

Task A2: Vegetation Cutting and Physical Removal Techniques

Mechanical Harvesting / Hydro-raking

- *Mechanical Harvesting:* Mechanical harvesting involves the use of barge-type boats that are designed to cut aquatic plants and remove them to a transport barge via a conveyor belt. When the barge is full, it is driven to a staging area where the cut vegetation is temporarily placed into a hopper before final removal by truck to a permanent upland disposal or composting site. The hopper will be located at the end of Highland Street. Little or no permanent disruption to the pond shoreline (bank) and/or buffer zone is anticipated as a result of the temporary use of this area.

  Mechanical harvesting would be scheduled for the peak aquatic plant growth period of the summer (late July through early August). By conducting harvesting at this time, relief could be provided in areas where dense growth impairs recreational boating. Removal of the harvested plant material from the pond will also remove nutrients contained in the plant that could otherwise decompose and fuel future plant and algae growth.

- *Hydro-raking:* The hydro-rake is a floating backhoe that uses a York rake attachment to remove vegetation and vegetative debris from the bottom and bank of the pond. Like the harvester, it is paddle wheel driven and can be used in shallow water. The hydro-rake is effective a removing plant debris and plants with large, well defined root systems such as water lilies and common reed. The machine "rakes" the upper sediment layer collecting plants and their root systems. Hydroraking is an effective means of selectively controlling water lilies, and by breaking up and removing the plant rhizomes can provide multiple years of control in target areas. This method is also effective for removal of rapidly accumulating pockets of vegetative debris that are wind blown into cove areas.

  Because the hydro-rake disturbs the sediment, past hydro-raking efforts have included a requirement for monitoring of turbidity and total suspended solids. The data indicate that the disturbed sediments settled out from the water column is a relatively short distance (< 250 feet). During future hydro-raking activities, turbidity will be monitored approximately 100' from the work area, in the center of the pond (or other appropriate in-lake location to represent background conditions) and at the dam. If turbidity at the dam rises above the background turbidity, a silt net will be deployed around the work area.

Hand Harvesting

Removal of plants by hand pulling does not require permit authorization, but is included in this project description for completeness. Water chestnut plants should be removed by hand pulling whenever

observed. Water chestnut hand removal efforts appear to have been successful to date, as new plants have not been reported in recent vegetation surveys. Continued vigilance in identifying and removing new plants every year prior to seed production will be crucial to the continued control of this plant.

When removing water chestnut plants by hand, it is very important to pull out the entire stem, root structure, and any attached nuts. The nuts range in color from green to black, and are easily identified by their sharply pointed spikes as shown in the photo below. Plants should be removed using a very slow and steady pulling motion, taking care not to snap the stem and leave behind the nut which can produce new plants for up to 12 years. Any plants that are harvested should be disposed of in an upland area as far from the pond as possible. It is important to recheck areas within a month after the initial handpulling to allow for removal of any regrowth or plants that were missed in the initial effort.

It should be noted that hand pulling can provide effective control when the number of water chestnut plants is low. If future conditions make hand pulling infeasible, larger scale removal efforts that require permitting under the Massachusetts Wetlands Protection Act (e.g. mechanical harvesting, diver assisted suction harvesting) will be considered, but are not included as part of this NOI.

C. Algae Management

Task B1: Algaecide Application

At the direction of the Commission, copper sulfate applications will be performed for the control of algae blooms. Severe blooms can be problematic for several reasons including reduced clarity, recreational safety, odor problems, fish kills, and the potential presence of toxins associated with some types of blue-green algae (cyanobacteria).

When authorized by the Commission, copper sulfate applications will be performed as follows:

- Copper sulfate applications will be split treatments, with application to one half of the pond a time and with a typical period of 2 weeks between applications. Split applications will reduce the risk of oxygen depletion, which is more likely to occur following a whole-pond copper sulfate treatment. Following the first half of a split application, the Commission will determine if the algal abundance conditions in the pond support the need for the second half of the split treatment.

- Copper sulfate applications will be based on submittal of information which describes the pond conditions which support the need for such application, the proposed timing of the application, the proposed dosage rate, and method of application.

- Although there are no water-use restrictions required for the use of copper sulfate, the Town will publish a public notice prior to any treatment.

Task B2: Phosphorus Inactivation with Alum

The application of aluminum salts (e.g., aluminum sulfate, referred to hereafter as alum) to Pillings Pond is proposed to help control algal abundance through phosphorus precipitation, which removes bio-available phosphorus from the water column.

Aluminum sulfate treatments will be performed to control algal abundance at the direction of the Commission, based on submittal of information which describes the proposed timing of the application, and which confirms the proposed dosage rate and method of application.

D. Lake Level Drawdown

Although not proposed as part of this Notice of Intent, lake-level drawdown should be considered for future permitting as part of long-term, sustainable plant management strategy for Pillings Pond. Drawdown is conducted during the winter months to control plant growth by exposing plant seeds and over-wintering structures to freezing conditions and desiccation. Based on information from the Lynnfield Department of Public Works, a vertical drawdown of approximately 2 feet can be achieved through operation of the pond outlet control structure. A few considerations regarding drawdown include:

- Although plant control achieved by a 2-foot drawdown would be limited to areas of sediment exposure at this depth, it would expose sediments at some near-shore areas where plant growth is most dense. A 2-foot drawdown would yield modest results at best, but would require very limited resources from the Town and would provide some co-benefits related to flood control.
- Drawdown is most effective for control of species that use vegetative propagules for overwintering and expansion such as curlyleaf pondweed, and can also provide effective control of water lilies and other floating-leaf species which grow densely and inhibit boat access in some cove and shoreline areas.
- Drawdown is not typically an effective control method for spiny naiad, which spreads predominantly by seed. Drawdown can actually promote increased growth of this plant. as has been documented for several New England lakes. The tradeoff between the benefits of drawdown for curlyleaf pondweed and water lily control should be carefully considered on an ongoing basis against the drawbacks associated with increased dominance of European naiad and alternate strategies needed for control of this plant.
- The degree of effectiveness for drawdown is expected to vary considerably from year to year based on weather conditions during the drawdown period (i.e., duration of continuous conditions below freezing, presence of insulating snow cover, quantity of rainfall/ability to maintain consistent sediment exposure to freezing conditions).

If the town decides to pursue authorization to conduct winter drawdown, future permitting will require documentation in conformance with Section V. of the MassDEP *Guidance for Aquatic Plant Management in Lakes and Ponds* (2004).

IV. Documentation and Reporting Requirements

In addition to any task-specific requirements specified above, the following are general documentation and reporting requirements that will apply to all proposed aquatic vegetation and algae management activities. Any specific plant and algae management actions that are implemented will be based on the Commissions prior receipt, review, and approval of the following information which will be updated, at a minimum, on an annual basis:

1. A pre-treatment vegetation survey map showing the distribution and density of target and non-target plants prior to control actions for each growing season. The map shall be of adequate scale, size and detail to accurately depict the specific proposed area(s) of plant or algae control and the proposed work to be performed.
2. A narrative site-specific work description and plan, including:
    - A description of the proposed control action(s), based on conditions observed during the pre-treatment survey. This shall include details of treatment methodologies and a full description of impacts to resources such as vegetation to be removed, non-target plant and fisheries

species, etc., that reflect the specific site conditions as observed during the pre-treatment survey (and previous years, where relevant).

- A discussion of any factors that may require modifications or adaptive management during the growing season in response to lake conditions.
- Details of erosion controls, site access, staging areas, timetables for work and/or application of chemicals, name of supervisor or person on call who takes responsibility for work, and any other important construction considerations that might result in a resource area impact.
- If vegetation harvesting or hydroraking is proposed, the ultimate disposal location of the vegetative spoils should be described and should be outside of wetland resource areas or buffer zones.

3. An end-of year report shall be provided to the Commission which describes all activities performed (including pre-treatment surveys), observations of treatment effectiveness based on a post-treatment survey, problems encountered, and activities anticipated for the next year.

V. Massachusetts Wetlands Protection Act Interests

The following is a discussion of the proposed aquatic vegetation and algae management program with regard to the specific interests of the Massachusetts Wetlands Protection Act.

Public and Private Water Supply

No impacts on public or private water supplies are anticipated as a result of this project. Pillings Pond is not a drinking water reservoir and there are no known public water supply wells in proximity to the pond. Post-treatment water use restrictions for each herbicide/algaecide include the following:

- **Diquat:** (1) No drinking or cooking for 3 days; (2) No irrigation of turf for 3 days or food crops for 5 days; (3) No livestock watering for 1 day. There are no restrictions on swimming, boating, or fishing, but to be prudent the pond will be posted as restricted to these activities on the day of treatment.
- **Glyphosate**: Glyphosate is prohibited within a quarter mile of surface water drinking supplies due to toxicity, but there are none within a quarter mile. There are no restrictions on swimming, boating, or fishing, but to be prudent the pond will be posted as restricted to these activities on the day of treatment.
- **Copper sulfate**: There are no water use restrictions for copper-based algaecides.
- **Alum**: There are no water use restrictions for alum.

Protection of Ground Water Supply

None of the proposed tasks are anticipated to have any effect on ground water supplies.

Flood Control and Storm Damage Prevention

The proposed activities do not include any construction, dredging, or alteration to the existing floodplain and stormwater characteristics of Pillings Pond. As such, the proposed work will not impact the pond's ability to provide flood control and protection from damage associated with storms.

Prevention of Pollution

No degradation of water quality or increased pollution are expected from the proposed work. Control of nuisance vegetation and algae is expected to decrease the total amount of organic matter that will

seasonally accumulate and then decompose in the pond, and will thereby help to limit anoxic conditions associated with such decomposition.

Protection of Fisheries and Shell Fisheries

The proposed management actions are intended to be protective of fisheries and shell fisheries. Excessive aquatic vegetation and algae blooms provide poor habitat for fish and increases biological oxygen demand plants decompose, which result in fish kills and impacts to fish health and development. Algae blooms left unabated have been known to increase pH level above 9 or 10, which can negatively impact fish and other aquatic wildlife. The proposed tasks should improve the fisheries habitat of the pond.

Protection of Wildlife and Wildlife Habitat

In general, very dense aquatic plant and algae growth provides poor wildlife habitat and food value. The annual decay of plants and algae contribute to the eutrophication of the water body, resulting in accelerated sediment deposition and potentially depressed oxygen levels. The propose management plan will focus on controlling invasive rooted plants and nuisance algae blooms.