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NH Department of
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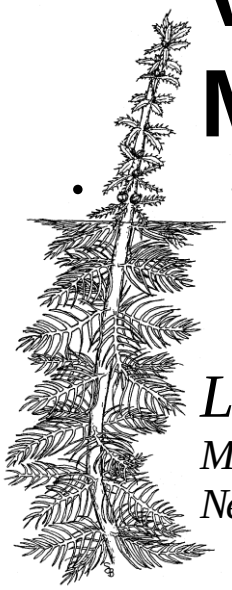
# Long-Term Variable Milfoil Management Plan



*Lake Winnisquam*

*Meredith, Sanbornton, Laconia, Belmont & Tilton, New Hampshire*

# Contents

## Purpose

The purposes of this exotic aquatic plant management and control plan are:

1. To identify and describe the historic and current exotic aquatic infestation(s) in the waterbody;
2. To identify short-term and long-term exotic aquatic plant control goals;
3. To recommend exotic plant control actions that meet the goals outlined in this plan; and
4. To recommend monitoring strategies to determine the success of the control practices over time in meeting the goals.

This plan also summarizes the current physical, biological, ecological, and chemical components of the subject waterbody as they may relate to both the exotic plant infestation and recommended control actions, and the potential social, recreational and ecological impacts of the exotic plant infestation.

The intent of this plan is to establish an adaptive management strategy for the long-term control of the target species (in this case variable milfoil) in the subject waterbody, using an integrated plant management approach.

Appendix A and Appendix B detail the general best management practices and strategies available for waterbodies with exotic species, and provides more information on each of the activities that are recommended within this plan.

## Invasive Aquatic Plant Overview

Exotic aquatic plants pose a threat to the ecological, aesthetic, recreational, and economic values of lakes and ponds (Luken & Thieret, 1997, Halstead, 2000), primarily by forming dense growths or monocultures in critical areas of waterbodies that are most used for aquatic habitat. These dense growths and near monotypic stands of invasive aquatic plants can result in reduced overall species diversity in both plant and animal species, and can alter water chemistry and aquatic habitat structure that is native to the system.

Since January 1, 1998, the sale, distribution, importation, propagation, transportation, and introduction of key exotic aquatic plants have been prohibited (RSA 487:16-a) in New Hampshire. This law was designed as a tool for lake managers to help prevent the spread of nuisance aquatic plants.

New Hampshire lists 28 exotic aquatic plant species as prohibited in the state (per Env-Wq 1303.02) due to their documented and potential threat to surface waters of the state.

According to the federal Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology (CALM), "exotic macrophytes are non-native, fast growing aquatic plants, which can quickly dominate and choke out native aquatic plant growth in the surface water. Such infestations are in violation of New Hampshire regulation Env-Wq 1703.19, which states that surface waters shall support and maintain a balanced, integrated and adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region" (DES, 2006). In fact, waterbodies that contain exotic aquatic plant infestations do not attain water quality standards and are listed as impaired.

## Variable Milfoil Infestation in Lake Winnisquam

Variable milfoil (*Myriophyllum heterophyllum*) became established in Lake Winnisquam in Meredith, New Hampshire around 1995. The most abundant variable milfoil growth is documented in the far northern and southern ends of the lake where larger contiguous stands of growth tend to persist. Some growth is located within the central portion of the lake, between Mosquito Bridge on Route 3 and Mohawk Island in Tilton. Milfoil stands have been primarily confined to Winnisquam Marine, Jays Marina, and Sunray Shores (a dredged channel to developed land in Belmont) and Mallards Landing. Figure 1 illustrates the distribution of variable milfoil infestations in this waterbody as a whole. Following is a summary of each site:

| Area | Location/Area Description | Year | Description of Growth |
|---|---|---|---|
| North End/North End Narrows | Northern tip of the lake, including Split Rock Sanctuary area, extending down the east and west shorelines through the narrows north of Three Sisters. Mostly in the town of Meredith. | 2009 | Patchy to expansive growth throughout north end and patchy growth along east and west shoreline |
| | | 2010 | Scattered milfoil stems |
| | | 2011 | Not surveyed |
| | | 2012 | Not surveyed |
| | | 2013 | Not surveyed |
| | | 2014 | Not surveyed |
| | | 2015 | Not surveyed |
| | | 2016 | Not surveyed |
| | | 2017 | Patchy to expansive growth throughout north end and patchy growth along east and west shoreline |
| | | 2018 | Late season treatment, no surveyed post treatment. Will survey in spring 2019. |
| | | 2019 | Variable milfoil present in early |

| Area | Location/Area Description | Year | Description of Growth |
|---|---|---|---|
| | | | July, some moderately sized patches and scattered single stems along norethern shoreline, with scattered stems and patches along western shoreline. |
| Black Brook | Located on the western shoreline in the central basin of the lake. Black Brook is a tributary to the lake, and milfoil has been present in a lagoon area along the brook. | 2009 | Not surveyed |
| | | 2010 | Not surveyed |
| | | 2011 | Not surveyed |
| | | 2012 | Not surveyed |
| | | 2013 | Not surveyed |
| | | 2014 | Not surveyed |
| | | 2015 | Not surveyed |
| | | 2016 | Not surveyed |
| | | 2017 | Not surveyed |
| | | 2018 | Need to survey in 2019 |
| | | 2019 | No milfoil found |
| Winnipesaukee River from Lake Opechee | Inflow from Lake Opechee, including areas along public access site and marina/docks | 2009 | Scattered stems |
| | | 2010 | Scattered stems |
| | | 2011 | Scattered stems |
| | | 2012 | Scattered stems |
| | | 2013 | Scattered stems |
| | | 2014 | Not surveyed |
| | | 2015 | Not surveyed |
| | | 2016 | Not surveyed |
| | | 2017 | None observed |
| | | 2018 | None observed |
| | | 2019 | None observed |
| South of Mosquito Bridge, north of Mohawk Island | South of Mosquito Bridge, north of Mohawk Island | 2009 | Growth observed to be dense in Jay's Marina area; all other areas were clear of milfoil |
| | | 2010 | Lower density of growth in Jay's Marina due to 2009 treatment, no growth observed elsewhere. |
| | | 2011 | Growth observed to be denser in Jay's Marina area; all other areas were clear of milfoil |
| | | 2012 | Not surveyed |
| | | 2013 | Not surveyed |
| | | 2014 | Not surveyed |
| | | 2015 | Not surveyed |
| | | 2016 | Not surveyed |
| | | 2017 | Growth observed to be dense in Jay's Marina area; all other areas were clear of milfoil |
| | | 2018 | Growth observed to be dense in Jay's Marina area; all other areas were clear of milfoil |
| | | 2019 | Growth observed to be dense prior to treatment in Jay's Marina area; single scattered plants around |

| Area | Location/Area Description | Year | Description of Growth |
|---|---|---|---|
| | | | Winnisquam Marine Docks, all other areas were clear of milfoil |
| Sunray Shores | Inlet channel and wetland complex with boat docks and shorefront homes on east shoreline of lake | 2009 | Dense widespread growth |
| | | 2010 | Dense widespread growth |
| | | 2011 | Dense widespread growth |
| | | 2012 | Dense widespread growth |
| | | 2013 | Dense widespread growth before treatment, reduced post treatment |
| | | 2014 | Spotty low density growth |
| | | 2015 | Scattered patches |
| | | 2016 | Higher density growth before treatment, reduced growth after treatment |
| | | 2017 | Scattered stems |
| | | 2018 | Scattered stems and patches, managed by diving in 2018. |
| | | 2019 | Increasing milfoil growth this season, with scattered single stems and small clusters of growth. |
| South of Mohawk Island South of Mosquito Bridge, north of Mohawk Island | Southern end of lakeSouth of Mosquito Bridge, north of Mohawk Island | 2009 | Patchy growth at south end of lake, dense growth in Ephraim's Cove |
| | | 2010 | Not surveyed |
| | | 2011 | Not surveyed |
| | | 2012 | Not surveyed |
| | | 2013 | Not surveyed |
| | | 2014 | Not surveyed |
| | | 2015 | Not surveyed |
| | | 2016 | Not surveyed |
| | | 2017 | None observed in southern basin, Ephraim Cove not surveyed. |
| | | 2018 | None observed in southern basin, Ephraim Cove and Mallards Landing to be surveyed in 2019 to determined management efforts. |
| | | 2019 | Scattered plants in Mallards Landing inlet, abundant shoreline growth in Ephraim's Cove, a couple of scattered plants at southern end of lake, and patchy growth around outflow basin prior to river channel, surrounding rock pile in the center of that outflow basin. |

Impacts of the infestation are felt by the commercial business along the shores of the lake, including restaurants, stores, marinas, and hotels, as well as a number of property owners of private seasonal and year round residences. By and large there are many areas of Lake Winnisquam that do not see any

problems from the milfoil. It is a large system given to sandy or rocky bottom substrate, which is not optimum for milfoil growth. Areas with history of dredge, silty bottomed areas, and coves are the likely areas for rapid and dense growth.

Though the infestation is small relative to overall lake size, allowing the infestation to continue unmanaged only serves to put downstream waterbodies at higher risk of infestation due to generation of fragments from infested areas.

## Milfoil Management Goals and Objectives

The management approach for Lake Winnisquam is to control and contain larger active infestations to prevent their further spread, while attempting to manage the infestation from the northern end of the lake to the southern end of the lake, along the flow gradient through the system.

The long-term goal for Lake Winnisquam is to reduce the overall acreage and percent cover of variable milfoil in the system using an Integrated Pest Management Approach.

## Local Support

### Town or Municipality Support

The various towns that have waterfront property along Lake Winnisquam have been supportive of milfoil control efforts in the past.

### Lake Association Support

Lake Winnisquam has an active large (umbrella) lake association known as the Winnisquam Watershed Network (WWN), as well as smaller community associations in various parts of the lake. These groups have provided financial support over the years for milfoil control, and some provided divers that have performed milfoil control activities in localized areas. They are supportive of milfoil control efforts with the ultimate goal of reducing milfoil in the lake as a whole, and preventing further infestations of exotic aquatic plants.

## Waterbody Characteristics

The following table summarizes basic physical and biological characteristics of Lake Winnisquam. Note that a current review of the Natural Heritage Bureau (NHB) database was requested and the results from that search are

included in the table below, as well as in other key sections of this report as they may pertain to the type of species (fish, wildlife, habitat, or macrophyte).

| **General Lake Information** | |
|---|---|
| Lake area (acres) | 4,262.5 |
| Watershed area (acres) | 291,530.9 |
| Shoreline Uses (residential, forested, agriculture) | Residential, forested, commercial |
| Max Depth (ft) | 174.9 |
| Mean Depth (ft) | 50.2 |
| Trophic Status | Oligotrophic |
| Color (CPU) in Epilimnion | 13 |
| Clarity (ft) | 31.4 |
| Flushing Rate ($yr^{-1}$) | 2.2 |
| Natural waterbody/Raised by Damming/Other | Natural / Dam |
| **Plant Community Information Relative to Management** | |
| Invasive Plants (Latin name) | *Myriophyllum heterophyllum* |
| Infested Area (acres) | See maps |
| Distribution (ringing lake, patchy growth, etc) | See maps |
| Sediment type in infested area (sand/silt/organic/rock) | Silty/sandy/rocky |
| Rare, Threatened, or Endangered Species in Waterbody (according to NH Natural Heritage Inventory) | 2020 Review:<br>Common Loon (*Gavia immer*)<br><br>Species Documented in Historic Reviews:<br>Water marigold (*Megalodonta beckii*)<br>Lake Whitefish (*Coregonus clupeaformis*)<br>Osprey (*Pandion haliaetus*) |

A native aquatic vegetation map and key from an August 22, 2007 survey by the DES Biology Section is shown in Figure 2 (this is field checked during each successive survey to evaluate any change). A bathymetric map is shown in Figure 3.

## Beneficial (Designated) Uses of Waterbody

In New Hampshire, beneficial (designated) uses of our waterbodies are categorized into five general categories: Aquatic Life, Fish Consumption, Recreation, Drinking Water Supply, and Wildlife (CALM).

Of these, Aquatic Life, Wildlife and Recreation are the ones most often affected by the presence of invasive plants, though drinking water supplies can also be affected as well in a number of ways.

Following is a general discussion of the most potentially impacted designated uses as they relate to this system and the actions proposed in this long-term plan.

The goal for aquatic life support is to provide suitable chemical and physical conditions for supporting a balanced, integrated and adaptive community of aquatic organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of the region.

### Aquatic Life

#### Fisheries Information

Lake Winnisquam is a popular fishing location for many anglers. The primary cold water fisheries in Lake Winnisquam include landlocked salmon, lake trout, and rainbow trout. The primary warm water fisheries are largemouth and smallmouth bass.

A recent seine survey by the New Hampshire Fish and Game Department along the shores of the Chemung State Forest recorded largemouth bass, common sunfish, bluegill, yellow perch, eastern chain pickerel, and musk turtles.

According to the New Hampshire Fish and Game Department, lake trout is a species of concern in Lake Winnisquam. Lake trout spend more time in the deeper waters of the lake, yet are indirectly influenced by the health and abundance of their prey populations. Also, there is an historic (1938) record of bridle shiners along the western shore of Lake Winnisquam.

#### Wildlife Information

The New Hampshire Natural Heritage Bureau lists three wildlife or fishery species of concern in the north end of Lake Winnisquam: the common loon, the lake whitefish, and the osprey.

There is a loon sanctuary in a small cove off from the northern end of Lake Winnisquam (shown in Figure 4). This area is cordoned off to prevent boat traffic from entering the area. Nesting loon boxes have been established within this area. Variable milfoil is dense within this area, and it is an area that is proposed for treatment. DES has encouraged the lake association to make contact with the Loon Preservation Society, so that they can be notified of the proposed treatment. In the past, a Loon Preservation Society representative has been on site to observe treatments in loon habitat on other waterbodies. These representatives carry handheld radio to communicate with the applicator during the treatment of the subject areas. The loon staff member monitors the behavior of the loons (if they are in the area), and directs the actions of the applicator so as to minimize any stress on the loons. The herbicides that are used are not toxic to the loons at the dose used to control milfoil, so toxicity effects are not an issue.

The lake whitefish is a reclusive fish that tends to spend most of its time in the deeper and colder waters of lakes. The whitefish does come into shallower waters to spawn in early winter. Spawning habitat is generally shallow rocky or sandy areas in waters that are less than 25 feet in depth. The young of the year fish spend time in shallow waters early on, then migrate deeper as they mature. Lake Whitefish feed on small organisms due to a small mouth size. Prey includes small fish in the water column, and benthic organisms such as insects. Based on the habitat types and habits of this fish, there are no anticipated impacts as a result of the proposed herbicide treatment. The treatment is set to take place in the shallow, silty north end of the lake. Small fish species and benthic organisms are not expected to be impacted by the treatment.

The osprey has a nesting area in one known location around the shoreline of Lake Winnisquam, particularly in the Ephraim's Cove area in the southern lake basin. The primary food for the osprey is fish. These birds are extremely territorial and do not stray too far from the nest. As the herbicides of choice do not bioaccumulate to toxic levels in the fish, or biomagnify along the food chain, impacts to the osprey as a result of the herbicide treatment are unlikely.

The lake association also mentioned that there are nesting bald eagles on the shoreline just west of Three Islands).

## Recreational Uses and Access Points

As one of the state's largest lakes, Lake Winnisquam is used for numerous recreational activities by lake residents and transient boaters and visitors. Access to the lake can be achieved at commercial or private launches around the lake, and with the opening of a new public boat launch in 2008, Lake

Winnisquam has become a destination for many transient boaters. There are an estimated 200-400 motorboats on the lake each day, and roughly 30-40 non-motorized craft.

There are four designated beach on the lake. A designated beach is described in the CALM as an area on a waterbody that is operated for bathing, swimming, or other primary water contact by any municipality, governmental subdivision, public or private corporation, partnership, association, or educational institution, open to the public, members, guests, or students whether on a fee or free basis. Env-Wq 1102.14 further defines a designated beach as *"a public bathing place that comprises an area on a water body and associated buildings and equipment, intended or used for bathing, swimming, or other primary water contact purposes. The term includes, but is not limited to, beaches or other swimming areas at hotels, motels, health facilities, water parks, condominium complexes, apartment complexes, youth recreation camps, public parks, and recreational campgrounds or camping parks as defined in RSA 216-I:1, VII. The term does not include any area on a water body which serves 3 or fewer living units and which is used only by the residents of the living units and their guests.*

In addition to the designated beaches, many properties have private beaches, docks, and swim platforms around the lake. These have not been quantified for the purposes of this plan.

Figure 4 shows the locations of access sites, designated beaches, and marinas on Lake Winnisquam.

## Macrophyte Community Evaluation

The littoral zone is defined as the nearshore areas of a waterbody where sunlight penetrates to the bottom sediments. The littoral zone is typically the zone of rooted macrophyte growth in a waterbody.

The Lake Winnisquam littoral zone is characterized by a mix of native and non-native (variable milfoil) plant growth (Figure 2). Native species include a mix of floating plants (yellow and white lilies, watershield), emergent plants (pickerelweed, cardinal flower, St. John's wort, arrow arum, spike rush, cattail, swamp loosestrife, grassy arrowhead, pipewort, water lobelia), and submergent plants (water naiad, waterweed, bladderwort, grassy spike rush, tape-like bur-reed, quillwort, tapegrass, and various pondweed species). Native plant communities are mixed around the entire lake.

The New Hampshire Natural Heritage Bureau lists one plant as endangered in New Hampshire. Water marigold (*Megalodonta* (or *Bidens*) *beckii*) has an

historic record at the north end of the lake. Based on field inspections by DES biologists across the state, water marigold is more common than previously documented around the state. During the August 2007 survey, water marigold was not observed in the north end of Lake Winnisquam; however, during a summer 2009 survey several small stands of this plant were documented along the eastern and northern end of this portion of the lake, where milfoil populations were once dominant.

## Wells and Water Supplies

Figure 7 shows the location of wells, water supplies, well-head protection areas, and drinking water protection areas around Lake Winnisquam, based on information in the DES geographic information system records. *Due to DES restrictions for providing water supply data under Homeland Security restrictions, note that the map in Figure 7 cannot be provided on a finer scale than 1:48,000.*

In the event that an herbicide treatment is needed for this waterbody, the applicator/contractor will provide more detailed information on the wells and water supplies within proximity to the treatment areas as required in the permit application process with the Division of Pesticide Control at the Department of Agriculture. It is beyond the scope of this plan to maintain updated well and water supply information other than that provided in Figure 7.

## Historical Control Activities and Progress Yield

| SITE | TOWN | DATE | TYPE | AREA (ac) | APPLICATOR |
|---|---|---|---|---|---|
| MALLARDS LANDING | BELMONT | 06-Jun-96 | 2,4-D (G) | 0.2 | ACT |
| SUNRAY SHORES | BELMONT | 06-Jun-96 | 2,4-D (G) | 7 | ACT |
| SPLIT ROCK SANCTUARY | MEREDITH | 10-Jun-98 | 2,4-D (G) | 4 | ACT |
| JAYS MARINA | TILTON | 12-Jun-01 | DIQUAT | 1.5 | ACT |
| SPLIT ROCK SANCTUARY | MEREDITH | 12-Jun-01 | DIQUAT | 15 | LYCOTT |
| SUNRAY SHORES | BELMONT | 12-Jun-01 | DIQUAT | 6 | LYCOTT |
| JAYS MARINA | TILTON | 10-Jun-02 | DIQUAT | 1.3 | LYCOTT |
| SPLIT ROCK SANCTUARY | MEREDITH | 10-Jun-02 | DIQUAT | 15 | LYCOTT |
| SUNRAY SHORES | BELMONT | 10-Jun-02 | DIQUAT | 10 | LYCOTT |

| SITE | TOWN | DATE | TYPE | AREA (ac) | APPLICATOR |
|---|---|---|---|---|---|
| SUNRAY SHORES | BELMONT | 06-Jun-06 | 2,4-D | 5 | LYCOTT |
| WINNISQUAM MARINE | BELMONT | 06-Jun-06 | 2,4-D | 2 | ACT |
| NORTHERN END AND WINNI RIVER | MEREDITH/ LACONIA | SUMMER 2007 | DIVER | VARIED | LAKE RESIDENTS |
| NORTHERN END | MEREDITH | 19-Jun-08 | 2,4-D | 38 | LYCOTT |
| NORTHERN END | MEREDITH | SUMMER 2008 | DIVER | VARIED | DIVEMASTER DIVE SERVICES |
| JAYS MARINA | TILTON | 08-Jun-09 | 2,4-D | 1.6 | ACT |
| NORTHERN END | MEREDITH | SUMMER 2009 | DIVER | VARIED | DES AND DIVEMASTER DIVE SERVICES |
| BLACK BROOK | SANBORNTON | SUMMER 2009 | BENTHIC BARRIER | 15' X 20' | DES |
| EPHRAIMS COVE | BELMONT | SUMMER 2010 | SCULPIN | 9.1 ACRES | AQUATIC CONTROL TECHNOLOGY |
| SPLIT ROCK SANCTUARY | MEREDITH | SUMMER 2010 | NAVIGATE | 9.2 ACRES | AQUATIC CONTROL TECHNOLOGY |
| SUNRAY SHORES | BELMONT | SUMMER 2010 | RENOVATE | 7.2 ACRES | AQUATIC CONTROL TECHNOLOGY |
| SUNRAY SHORES | BELMONT | 6/27/2013 | 2,4-D & TRICLOPYR (G) | 7.4 ACRES | ACT |
| SUNRAY SHORES | BELMONT | 8/4/2016 | 2,4-D BEE (G) | 951 LBS FOR 6.7 ACRES | SOLITUDE LAKE MANAGEMENT |
| SUNRAY SHORES | BELMONT | 9/21/2016 | DASH | 15 GALLONS | AQUALOGIC |
| SUNRAY SHORES | BELMONT | 9/22/2016 | DASH | 5 GALLONS | AQUALOGIC |
| SUNRAY SHORES | BELMONT | 9/27/2017 | DASH | 60 GALLONS | AQUALOGIC |
| SUNRAY SHORES | BELMONT | 9/6/2017 | DASH | 30 GALLONS | AQUALOGIC |
| SUNRAY SHORES | BELMONT | 9/5/2017 | DASH | 15 GALLONS | AQUALOGIC |
| SUNRAY SHORES | BELMONT | 6/20/2018 | HAND PULLING | 40 GALLONS | AQUALOGIC |

| SITE | TOWN | DATE | TYPE | AREA (ac) | APPLICATOR |
|---|---|---|---|---|---|
| SUNRAY SHORES | BELMONT | 6/20/2018 | DASH | 40 GALLONS | AQUALOGIC |
| NE SHORE | MEREDITH | 6/20/2018 | DASH | 125 GALLONS | AQUALOGIC |
| NE SHORE | MEREDITH | 6/23/2018 | DASH | 40 GALLONS | AQUALOGIC |
| NE SHORE | MEREDITH | 6/24/2018 | DASH | 40 GALLONS | AQUALOGIC |
| SUNRAY SHORES | BELMONT | 6/30/2018 | DASH | 80 GALLONS | AQUALOGIC |
| SUNRAY SHORES | BELMONT | 6/31/2018 | DASH | 120 GALLONS | AQUALOGIC |
| MALLARDS LANDING | BELMONT | 8/1/2018 | DASH | 150 GALLONS | AQUALOGIC |
| MALLARDS LANDING | BELMONT | 8/6/2018 | DASH | 20 GALLONS | AQUALOGIC |
| JAY'S / NE SHORE | TILTON/LACONIA | 8/7/2018 | DASH | 5 GALLONS | AQUALOGIC |
| W SHORE / E SHORE | SANBORTON/LACONIA | 8/8/2018 | DASH | 10 GALLONS | AQUALOGIC |
| E SHORE | MEREDITH | 8/9/2018 | DASH | 20 GALLONS | AQUALOGIC |
| CHAPMAN BROOK | MEREDITH | 8/10/2018 | DASH | 0 GALLONS | AQUALOGIC |
| VARIOUS | MEREDITH/TILTON | 9/26/2018 | 2,4-D (G) | 19.5 ACRES | SOLITUDE LAKE MANAGEMENT |
| JAYS MARINA, SOUTHERN END | MEREDITH & TILTON | 8/21/19 | Procellacor EC | 29.8 ACRES | SOLITUDE LAKE MANAGEMENT |
| NW SHORE | LACONIA/ MEREDITH | 8/28/2019 | DASH | 60 GALLONS | AQUALOGIC |
| N/A | N/A | 8/30/2019 | DASH | 30 GALLONS | AQUALOGIC |
| WINNISQUAM MARINE | BELMONT | 9/3/2019 | DASH | 20 GALLONS | AQUALOGIC |
| ANCHORAGE SWIM AREA AND MALLARDS LANDING | BELMONT | 9/4/2019 | DASH | 10 GALLONS | AQUALOGIC |
| FAR SOUTH | BELMONT | 9/5/2019 | DASH | 50 GALLONS | AQUALOGIC |

| SITE | TOWN | DATE | TYPE | AREA (ac) | APPLICATOR |
|---|---|---|---|---|---|
| SOUTHERNMOST COVE | BELMONT | 9/6/2019 | DASH | 25 GALLONS | AQUALOGIC |
| SOUTHERNMOST COVE | BELMONT | 9/9/2019 | DASH | 80 GALLONS | AQUALOGIC |
| SOUTHERNMOST COVE | BELMONT | 9/10/2019 | DASH | 40 GALLONS | AQUALOGIC |
| SUNRAY SHORES | BELMONT | 9/11/2019 | DASH | 40 GALLONS | AQUALOGIC |
| SUNRAY SHORES | BELMONT | 9/12/2019 | DASH | 160 GALLONS | AQUALOGIC |
| SUNRAY SHORES | BELMONT | 9/13/2019 | DASH | 50 GALLONS | AQUALOGIC |
| SUNRAY SHORES | BELMONT | 9/17/2019 | DASH | 100 GALLONS | AQUALOGIC |
| SUNRAY SHORES | BELMONT | 9/18/2019 | DASH | 120 GALLONS | AQUALOGIC |
| SUNRAY SHORES | BELMONT | 9/20/2019 | DASH | 100 GALLONS | AQUALOGIC |

## Aquatic Invasive Plant Management Options

The control practices used should be as specific to the target species as feasible. No control of native aquatic plants is intended.

Exotic aquatic plant management relies on a combination of proven methods that control exotic plant infestations, including physical control, chemical control, biological controls (where they exist), and habitat manipulation.

Integrated Pest Management Strategies (IPM) are typically implemented using Best Management Practices (BMPs) based on site-specific conditions so as to maximize the long-term effectiveness of control strategies. Descriptions for the control activities are closely modeled after those prescribed by the Aquatic Ecosystem Restoration Foundation (AERF) (2004). This publication can be found online at http://www.aquatics.org/bmp.html.

Criteria for the selection of control techniques are presented in Appendix A. Appendix B includes a summary of the exotic aquatic plant control practices currently used by the State of New Hampshire.

## Feasibility Evaluation of Control Options in this Waterbody

DES has evaluated the feasibility of potential control practices on Lake Winnisquam. The following table summarizes DES' control strategy recommendations for Danforth Ponds

| Control Method | Use on Lake Winnisquam |
|---|---|
| Restricted Use Areas | Recommended where feasible. Restricted Use Areas (RUAs) are best located where infestations are small and localized and can feasibly be contained. RUAs should be used along with fragment barriers to prevent spread of plants from the restricted area. |
| Hand-pulling | DES recommends hand-pulling for small patches of growth, as a follow up to larger scale control efforts, and wherever stems of milfoil are isolated enough to yield effective control. |
| Diver-Assisted Suction Harvesting | Following herbicide application, DES recommends that Diver-Assisted Suction Harvesting be the primary means of further reducing variable milfoil in the lake, where milfoil densities and areas are reduced enough to make this a reasonable and feasible option. |
| Mechanical Harvesting/Removal | Mechanical harvesting is not recommended due to the threat of spreading variable milfoil to uninfested areas of the lake through the generation of fragments. |
| Benthic Barriers | DES recommends installing small benthic barriers in areas of re-growth if small patches of variable milfoil re-grow and can adequately be contained by benthic barriers. |
| Herbicides | The use of a target specific systemic herbicide (like 2,4-D or similar) is recommended for control of variable milfoil where dense patches or areas persist. |
| Extended or Deep Drawdown | Drawdown is not an effective control method for variable milfoil, nor is it feasible in this waterbody. |
| Dredge | Not recommended due to nature of exotic plant distribution, the cost, or the ancillary ecological |

| Control Method | Use on Lake Winnisquam |
|---|---|
| | impacts that the dredge could have. |
| Biological Control | There are no approved biological controls for variable milfoil at this time in New Hampshire. |
| No Control | Variable milfoil is widespread and still expanding within Lake Winnisquam. A 'no control' option will foster the further encroachment of this exotic aquatic plant into currently uninfested areas. |

## Recommended Actions, Timeframes and Responsible Parties

An evaluation of the size, location, and type of variable milfoil infestation, as well as the waterbody uses was conducted at the end of the last growing season. Based on this survey the following recommendations are made for variable milfoil control in the system:

| Year | Action | Responsible Party | Schedule |
|---|---|---|---|
| 2018 | Weed Watcher Training | DES/Lake Winnisquam Watershed Network | Spring |
| | Weed Watching | Weed Watchers | May through September |
| | Diving/hand harvesting | Contract divers | As needed during growing season |
| | Herbicide treatment | SOLitude Lake Management | September |
| | Site assessment and remapping of variable milfoil infestation | DES | August/ September |
| 2019 | Weed Watching | Weed Watchers | May through September |
| | Diving/hand harvesting | Contract divers | As needed during growing season |

| Year | Action | Responsible Party | Schedule |
|---|---|---|---|
| | Herbicide treatment in Jay's Marina area with ProcellaCOR | SOLitude Lake Management | June |
| | Herbicide treatment in other designated areas, as needed, based on spring survey. ProcellaCOR recommended. | SOLitude Lake Management | Early September |
| | Site assessment and remapping of variable milfoil infestation | DES | August/ September |
| 2020 | Weed Watching | Weed Watchers | May through September |
| | Diving/hand harvesting | Contract divers | As needed during growing season |
| | Herbicide treatment if needed | SOLitude Lake Management | June or August |
| | Site assessment and remapping of variable milfoil infestation | DES | August/ September |
| 2021 | Weed Watching | Weed Watchers | May through September |
| | Diving/hand harvesting | Contract divers | As needed during growing season |
| | Herbicide treatment if needed | SOLitude Lake Management | September |
| | Site assessment and remapping of variable milfoil infestation | DES | August/ September |
| 2022 | Weed Watching | Weed Watchers | May through September |
| | Diving/hand harvesting | Contract divers | As needed during growing season |

| Year | Action | Responsible Party | Schedule |
|---|---|---|---|
| | Herbicide treatment if needed | SOLitude Lake Management | September |
| | Site assessment and remapping of variable milfoil infestation | DES | August/ September |
| 2023 | Update and revise Long-Term Variable Milfoil Control Plan | NH DES and interested parties | Fall/Winter |

Based on the types of native plants that are mixed in with the stands of variable milfoil (Figure 3) where herbicide application is recommended there are no significant impacts to native plant communities expected as a result of this treatment. For ProcellaCOR, white water lilies and watershield have been observed to show some epinasty during treatment; however, observations at other sites show that these species rebound between 4-8 weeks post treatment. Other mixed vegetation, like various pondweed species with floating leaves, will persist through treatment and provide mixed floating pad habitat that is not affected by the herbicide treatment.

## Notes

### Target Specificity

It is important to note that aquatic herbicide applications are conducted in a specific and scientific manner, and that the herbicides that are used can be target-specific when used at appropriate doses/concentrations: this means that the invasive plant can be removed and native plants favored in this type of control practice. *Not all aquatic plants will be impacted as a result of an herbicide treatment; therefore ecological functions of plants for habitat and lake ecology and chemistry/biology will be maintained.*

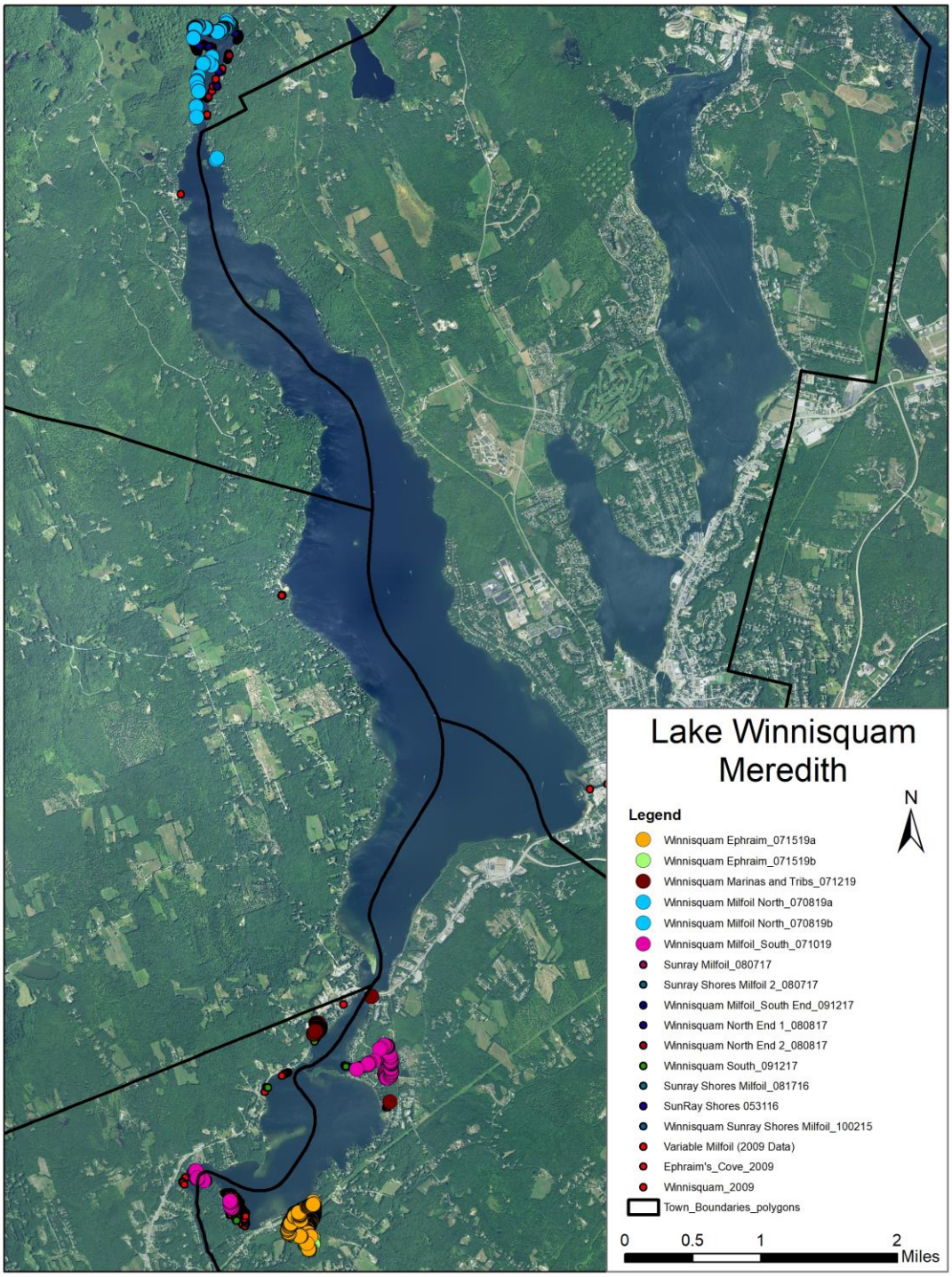
### Adaptive Management

Because this is a natural system that is being evaluated for management, it is impossible to accurately predict a management course over five years that could be heavily dependent on uncontrolled natural circumstances (weather patterns, temperature, adaptability of invasive species, etc).

This long-term plan is therefore based on the concept of adaptive management, where current field data drive decision making, which may result in modifications to the recommended control actions and timeframes for control. As such, this management plan should be considered a dynamic document that is geared to the actual field conditions that present themselves in this waterbody.

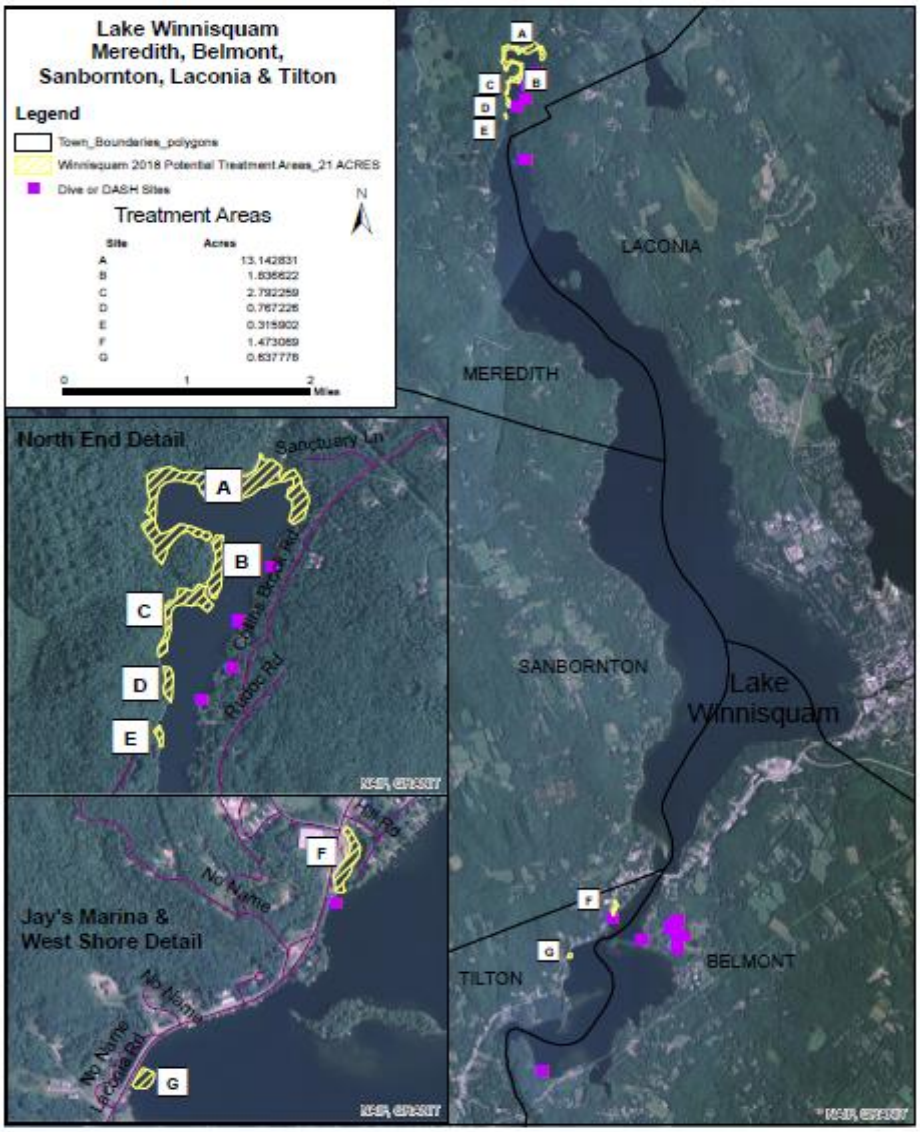
If circumstances arise that require the modification of part or all of the recommendations herein, interested parties will be consulted for their input on revisions that may be needed to further the goal of variable milfoil and fanwort management in the subject waterbody.

## Figure 1: Map of Variable Milfoil Infestations Over Time

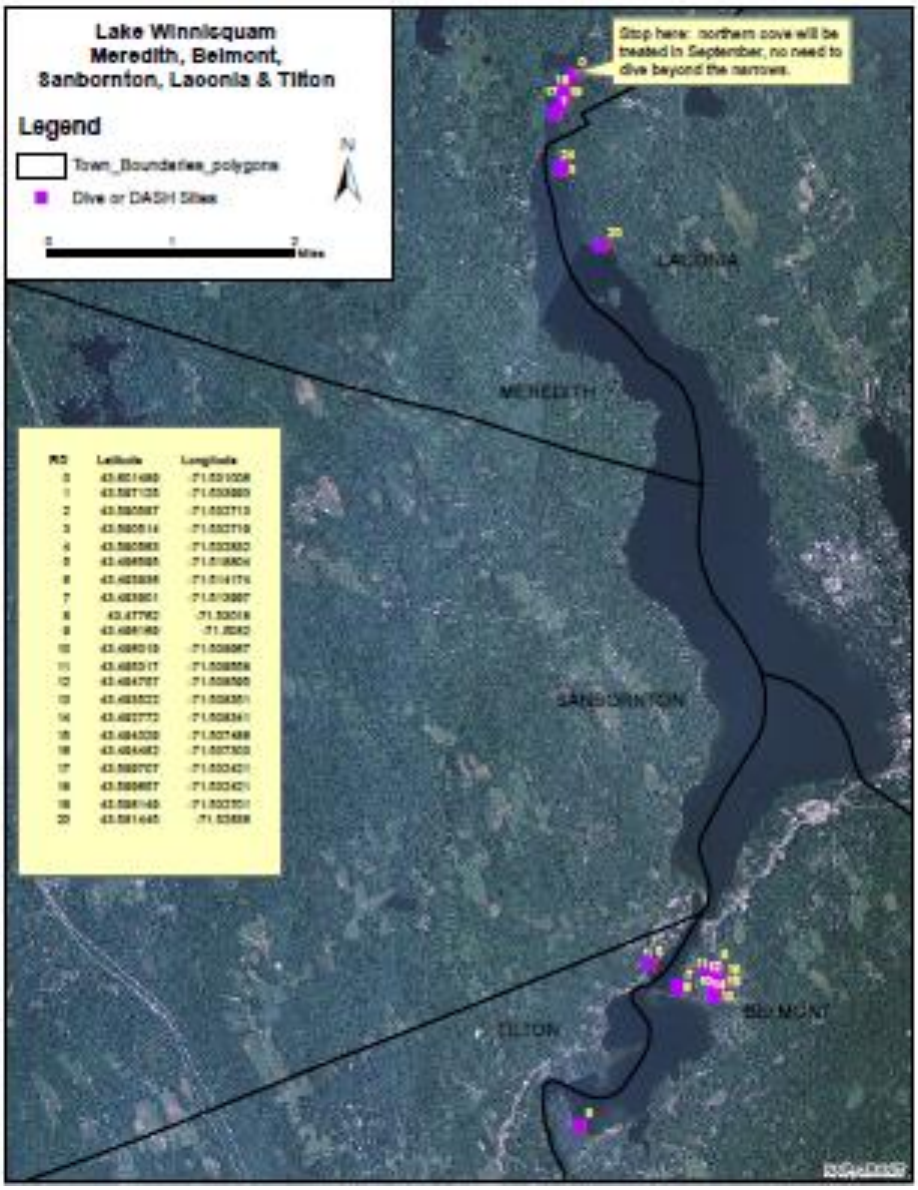


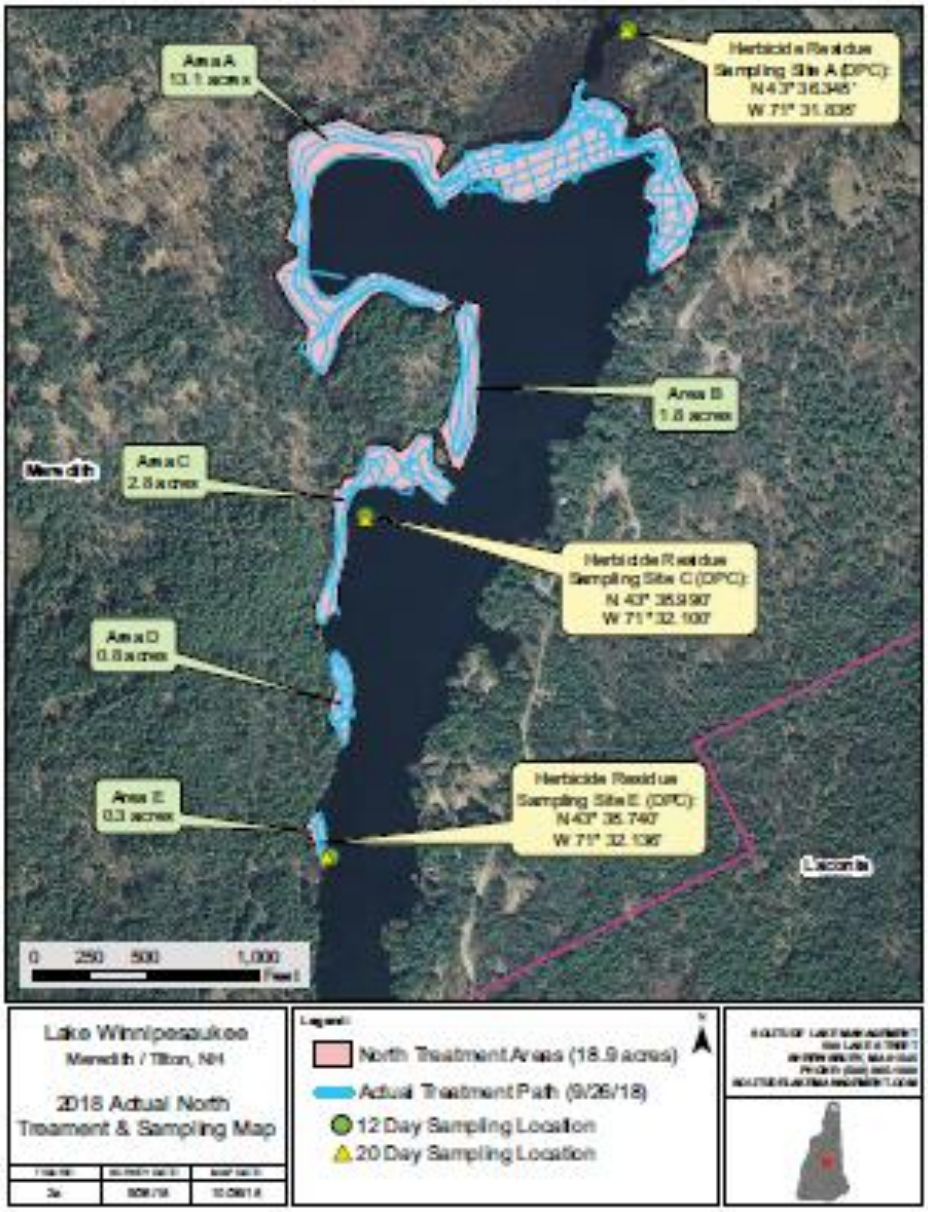
## Figure 2: Map of Control Actions Over Time

**2018 Proposed**



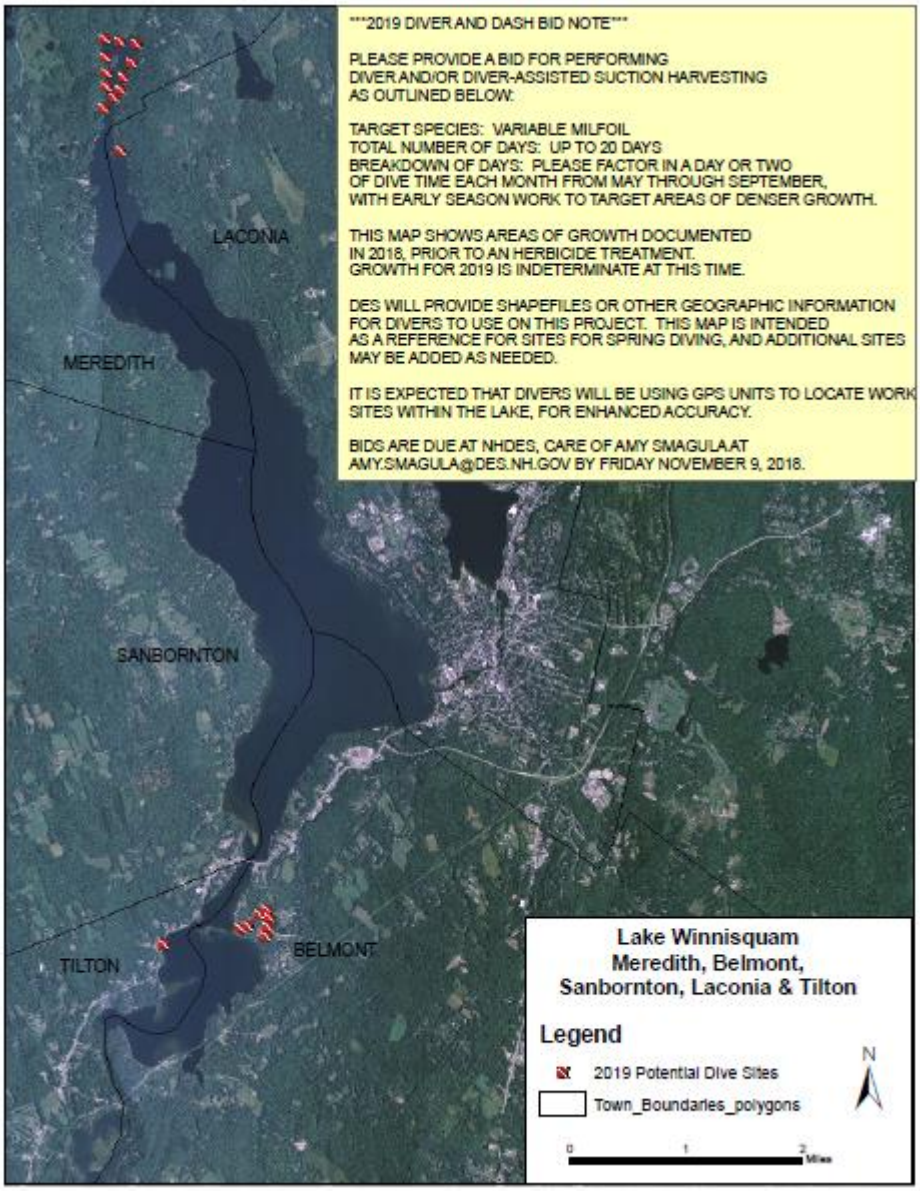
**2018 Actual**

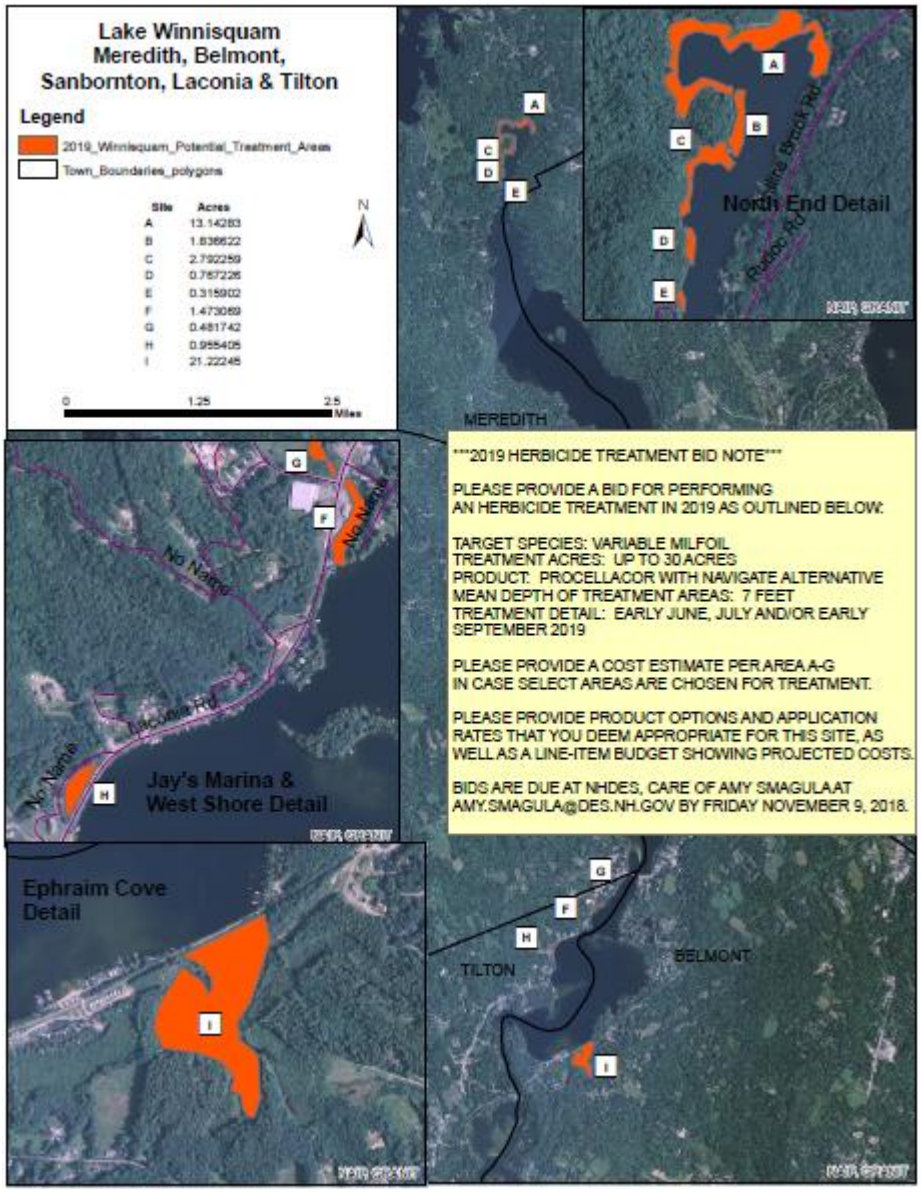

Lake Winnicquam
Meredith, Belmont,
Sanbornton, Laconia & Tilton
Legend
Town_Boundaries_polygons
Dive or DASH Sites
Stop here: northern cove will be treated in September, no need to dive beyond the narrows.
LACONIA
MEREDITH
SANBORNTON
TILTON
BELMONT


Area A
13.1 acres
Herbicide Residue
Sampling Site A (DPC):
N 43° 36.345'
W 71° 31.635'
Area B
1.8 acres
Meredith
Area C
2.8 acres
Herbicide Residue
Sampling Site C (DPC):
N 43° 35.997
W 71° 32.107
Area D
0.8 acres
Area E
0.3 acres
Herbicide Residue
Sampling Site E (DPC):
N 43° 35.740'
W 71° 32.136'
Laconia
0 250 500 1,000
Feet
Lake Winnipesaukee
Meredith / Tilton, NH
2018 Actual North
Treament & Sampling Map
Legend
North Treatment Areas (18.9 acres)
Actual Treatment Path (9/26/18)
12 Day Sampling Location
20 Day Sampling Location

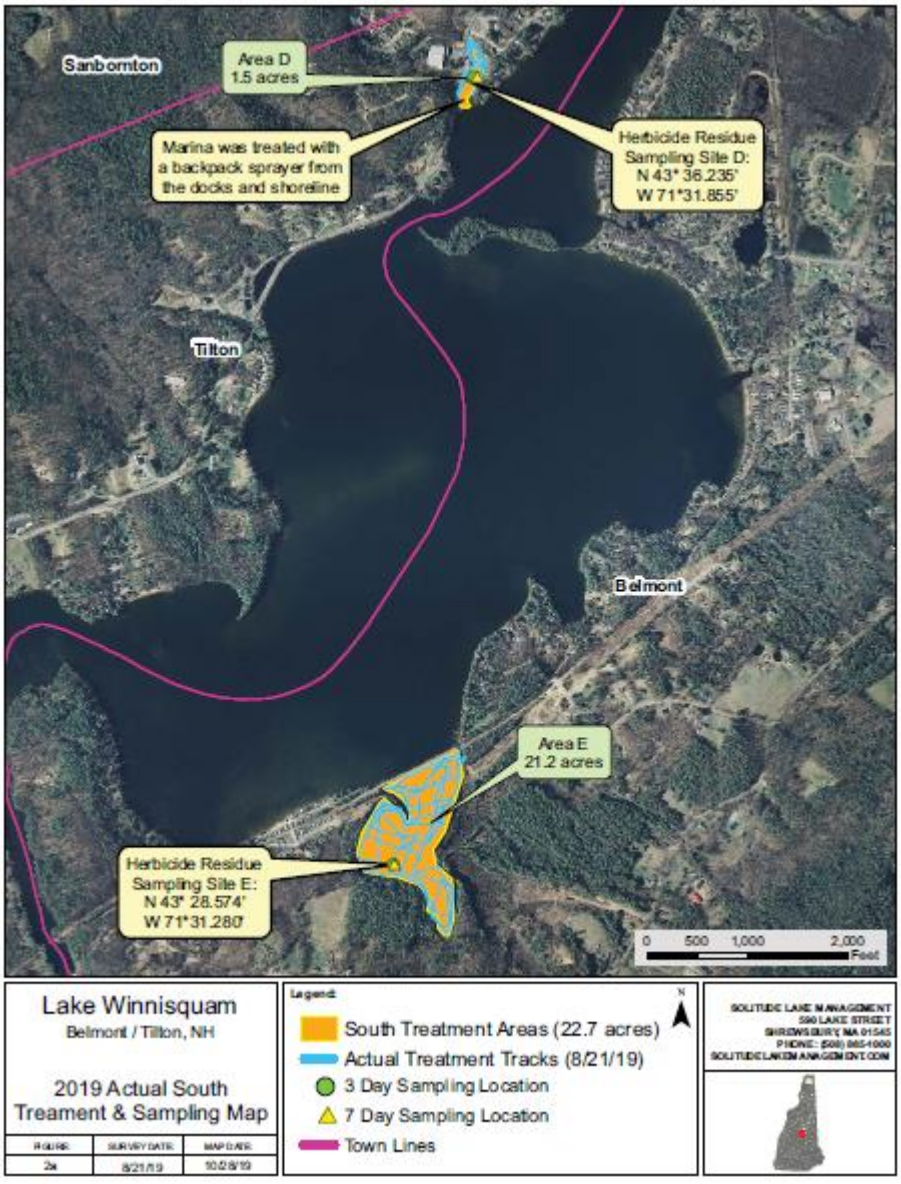

Area F
1.47 acres
(NOT TREATED DUE TO ACTIVE WELL)
Area G
0.64 acres
Herbicide Residues
Sampling Site G (DPC):
N 43° 29.495'
W71° 31.540'
0
300
600
1,200
Lake Winnipesaukee
Meredith / Tilton, NH
2018 Tilton Actual Treament & Sampling Map
Tilton Treatment Areas
Actual Treatment Track 9/25/18
12 Day Sampling Location
20 Day Sampling Location

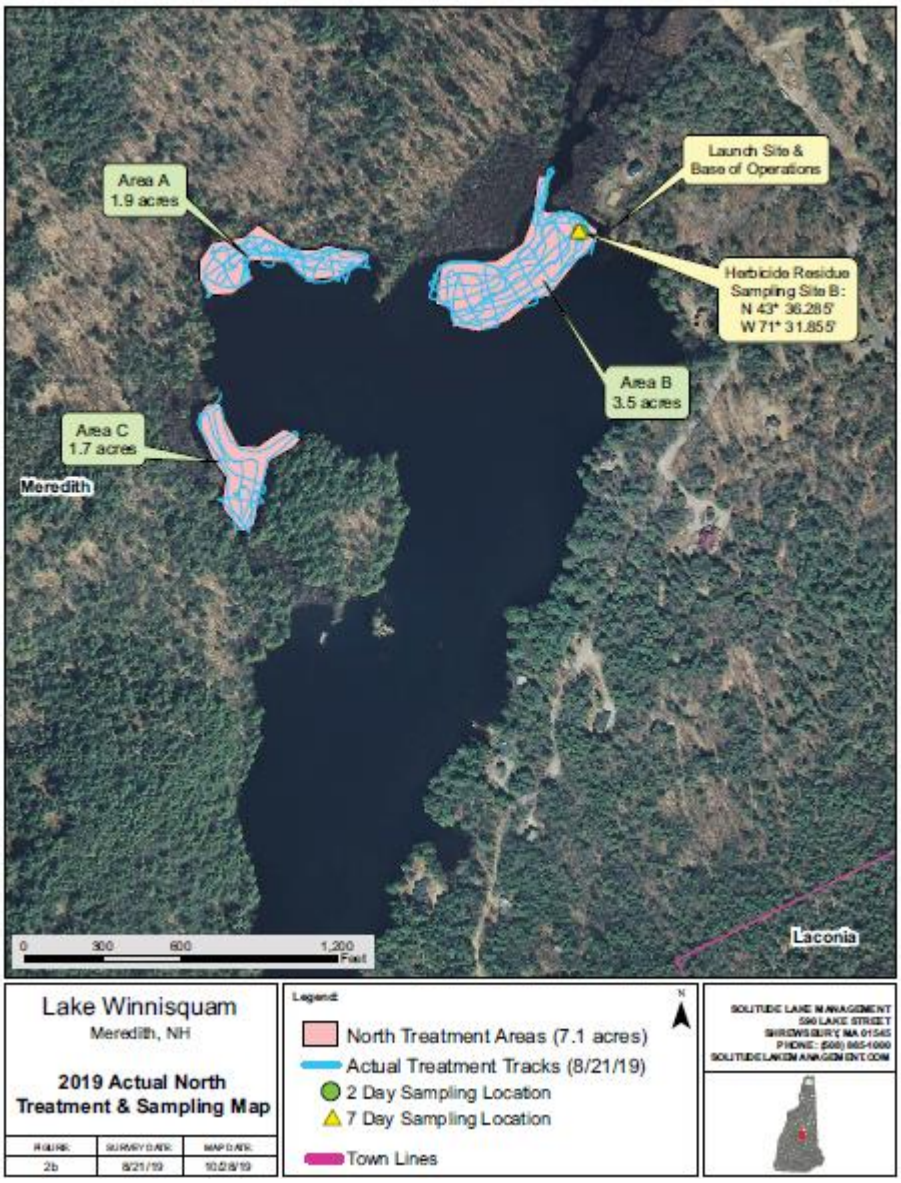
**2019 Proposed**




Lake Winnisquam
Meredith, Belmont,
Sanbornton, Laconia & Tilton
Legend
2019_Winnisquam_Potential_Treatment_Areas
Town_Boundaries_polygons
Site Acres
A 13.14283
B 1.836622
C 2.792259
D 0.787226
E 0.315902
F 1.473069
G 0.481742
H 0.955405
I 21.22248
N
0 1.25 2.5
Miles
North End Detail
Rocky Rd
Jay's Marina &
West Shore Detail
No Name
Lakeview Rd
Ephraim Cove
Detail
MEREDITH
TILTON
BELMONT
***2019 HERBICIDE TREATMENT BID NOTE***
PLEASE PROVIDE A BID FOR PERFORMING
AN HERBICIDE TREATMENT IN 2019 AS OUTLINED BELOW:
TARGET SPECIES: VARIABLE MILFOIL
TREATMENT ACRES: UP TO 30 ACRES
PRODUCT: PROCELLACOR WITH NAVIGATE ALTERNATIVE
MEAN DEPTH OF TREATMENT AREAS: 7 FEET
TREATMENT DETAIL: EARLY JUNE, JULY AND/OR EARLY
SEPTEMBER 2019
PLEASE PROVIDE A COST ESTIMATE PER AREA A-G
IN CASE SELECT AREAS ARE CHOSEN FOR TREATMENT.
PLEASE PROVIDE PRODUCT OPTIONS AND APPLICATION
RATES THAT YOU DEEM APPROPRIATE FOR THIS SITE, AS
WELL AS A LINE-ITEM BUDGET SHOWING PROJECTED COSTS.
BIDS ARE DUE AT NHDES, CARE OF AMY SMAGULA AT
AMY.SMAGULA@DES.NH.GOV BY FRIDAY NOVEMBER 9, 2018.

## 2019 Actual


Sanbornton
Area D
1.5 acres
Marina was treated with a backpack sprayer from the docks and shoreline
Herbicide Residue Sampling Site D:
N 43° 36.235'
W 71°31.855'
Tilton
Belmont
Area E
21.2 acres
Herbicide Residue Sampling Site E:
N 43° 28.574'
W 71°31.280'
0 500 1,000 2,000
Feet
Lake Winnisquam
Belmont / Tilton, NH
2019 Actual South Treament & Sampling Map
FIGURE
SURVEY DATE
MAP DATE
2a
8/21/19
10/28/19
Legend:
South Treatment Areas (22.7 acres)
Actual Treatment Tracks (8/21/19)
3 Day Sampling Location
7 Day Sampling Location
Town Lines
N
SOLITUDE LAKE MANAGEMENT
PHONE: (508) 865-1000




Lake Winnisquam
Meredith, NH

**2019 Actual North Treatment & Sampling Map**

| FIGURE: | SURVEY DATE: | MAP DATE: |
|---|---|---|
| 2b | 8/21/19 | 10/28/19 |

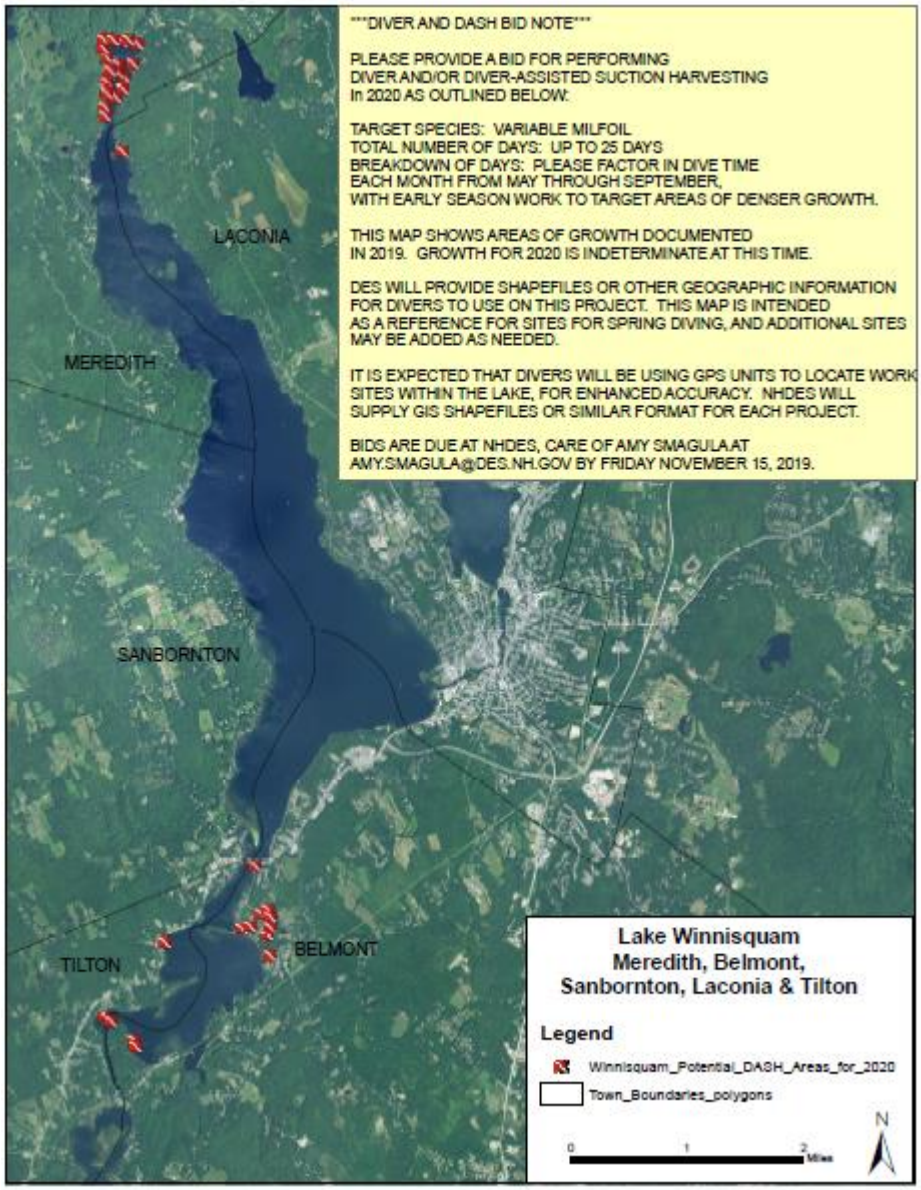
Legend:

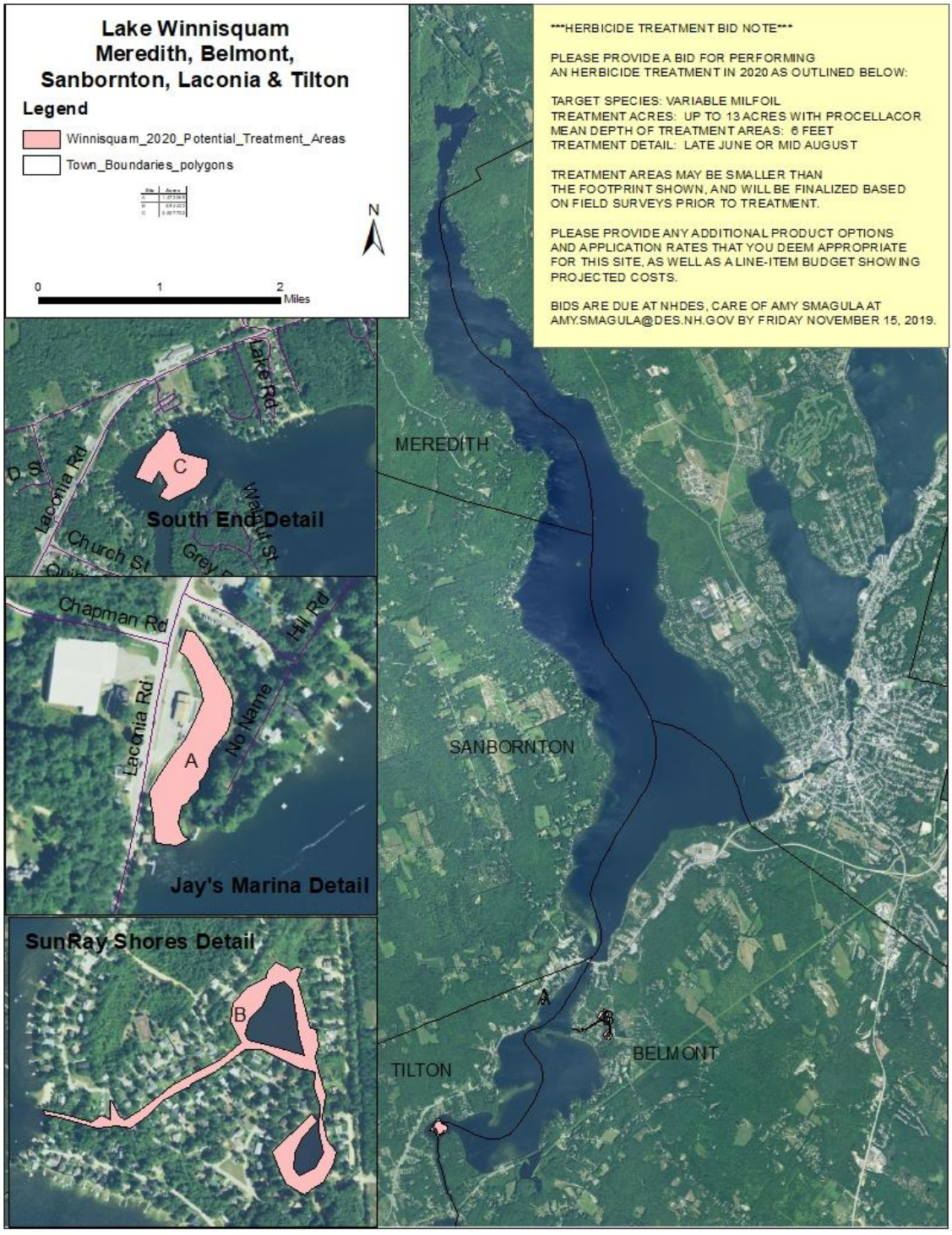
- North Treatment Areas (7.1 acres)
- Actual Treatment Tracks (8/21/19)
- 2 Day Sampling Location
- 7 Day Sampling Location
- Town Lines

N

SOLITUDE LAKE MANAGEMENT
590 LAKE STREET
SHREWSBURY, MA 01545
PHONE: (508) 865-1000
SOLITUDELAKEMANAGEMENT.COM

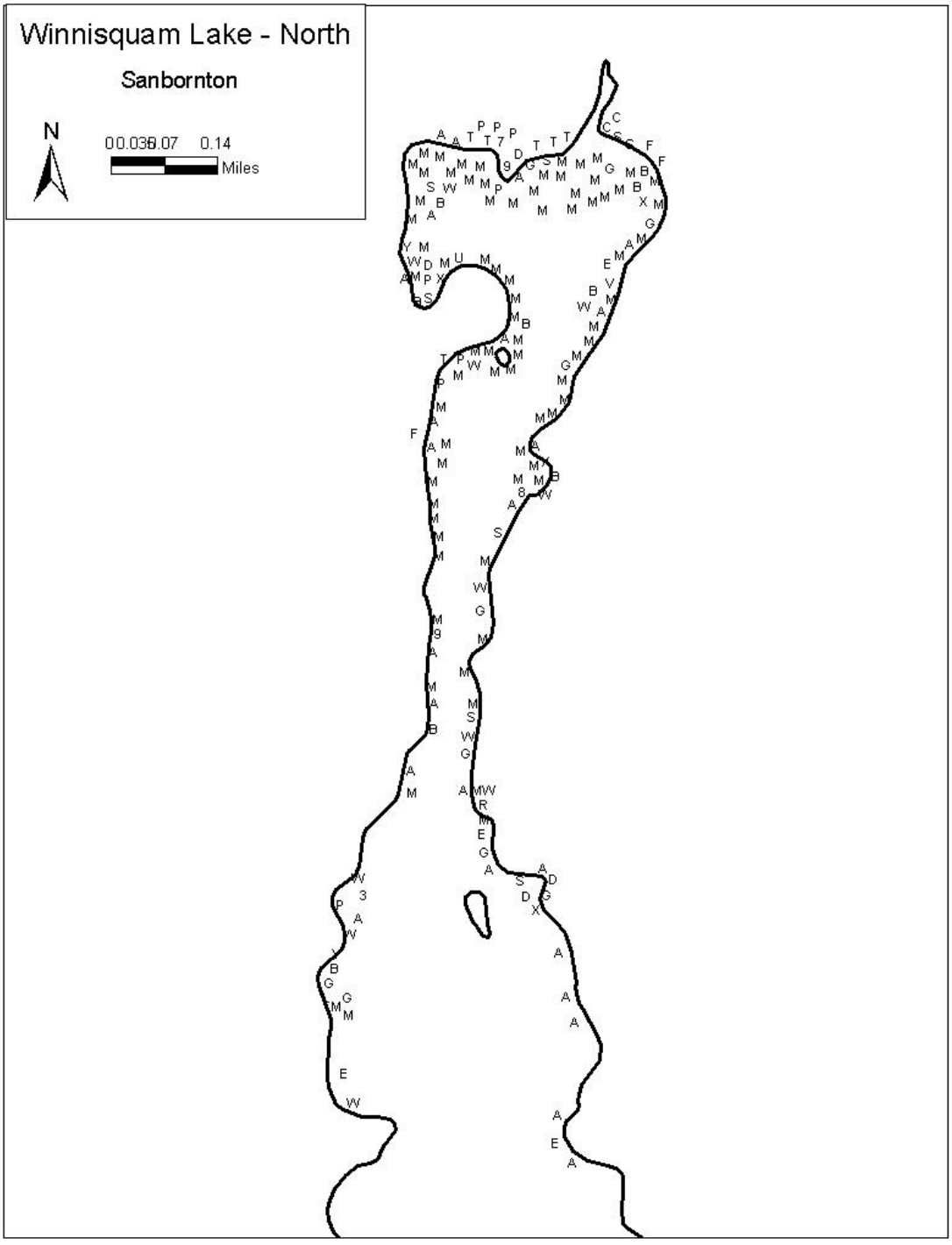
## 2020 Proposed



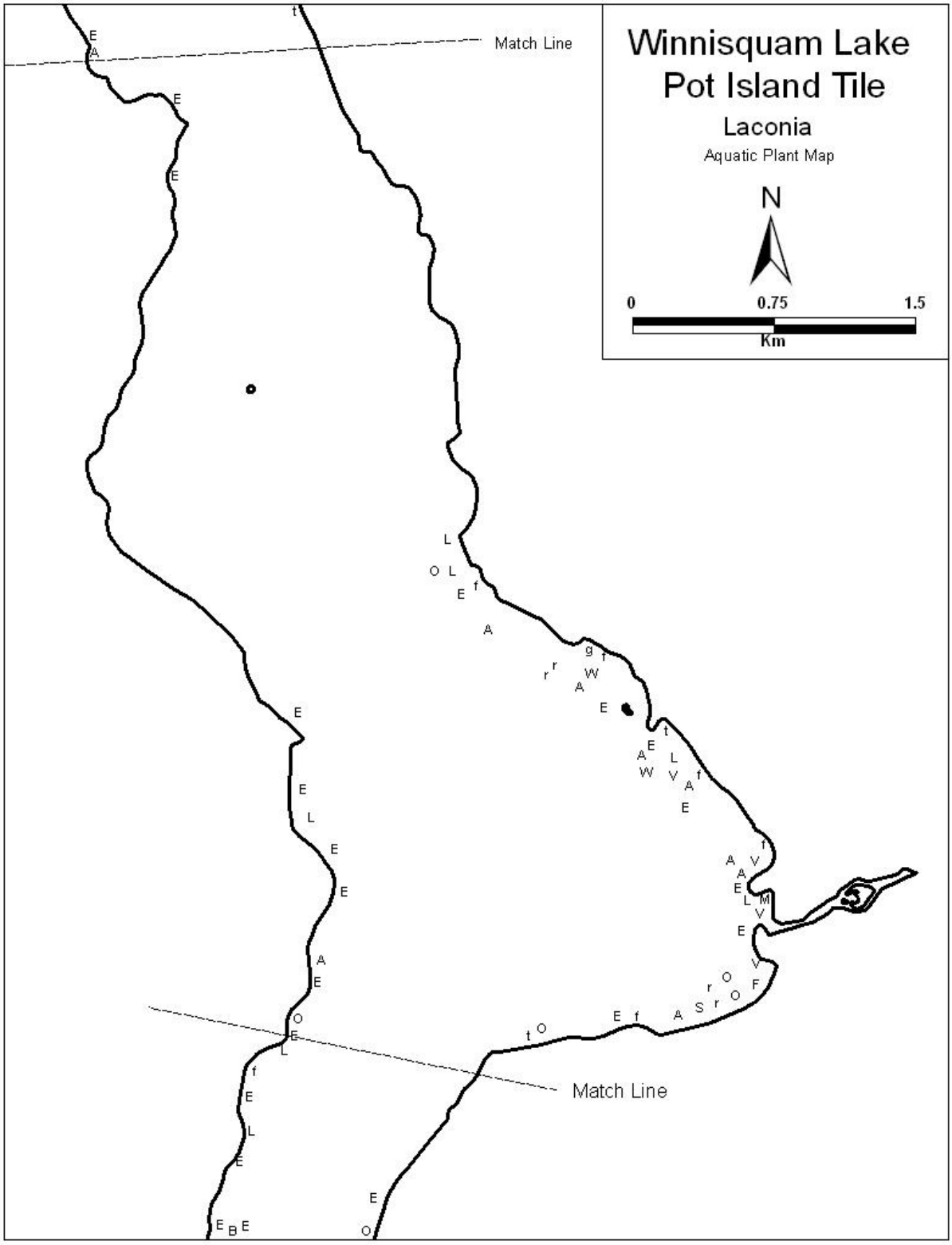

Lake Winnisquam
Meredith, Belmont,
Sanbornton, Laconia & Tilton
Legend
Winnisquam_2020_Potential_Treatment_Areas
Town_Boundaries_polygons
N
0
1
2
Miles
***HERBICIDE TREATMENT BID NOTE***
PLEASE PROVIDE A BID FOR PERFORMING
AN HERBICIDE TREATMENT IN 2020 AS OUTLINED BELOW:
TARGET SPECIES: VARIABLE MILFOIL
TREATMENT ACRES: UP TO 13 ACRES WITH PROCELLACOR
MEAN DEPTH OF TREATMENT AREAS: 6 FEET
TREATMENT DETAIL: LATE JUNE OR MID AUGUST
TREATMENT AREAS MAY BE SMALLER THAN
THE FOOTPRINT SHOWN, AND WILL BE FINALIZED BASED
ON FIELD SURVEYS PRIOR TO TREATMENT.
PLEASE PROVIDE ANY ADDITIONAL PRODUCT OPTIONS
AND APPLICATION RATES THAT YOU DEEM APPROPRIATE
FOR THIS SITE, AS WELL AS A LINE-ITEM BUDGET SHOWING
PROJECTED COSTS.
BIDS ARE DUE AT NHDES, CARE OF AMY SMAGULA AT
AMY.SMAGULA@DES.NH.GOV BY FRIDAY NOVEMBER 15, 2019.
Lake Rd
Laconia Rd
Church St
Walnut St
C
South End Detail
Chapman Rd
Hill Rd
Laconia Rd
No Name
A
Jay's Marina Detail
SunRay Shores Detail
B
MEREDITH
SANBORNTON
TILTON
BELMONT

## Figure 3: Map of Native Aquatic Macrophytes

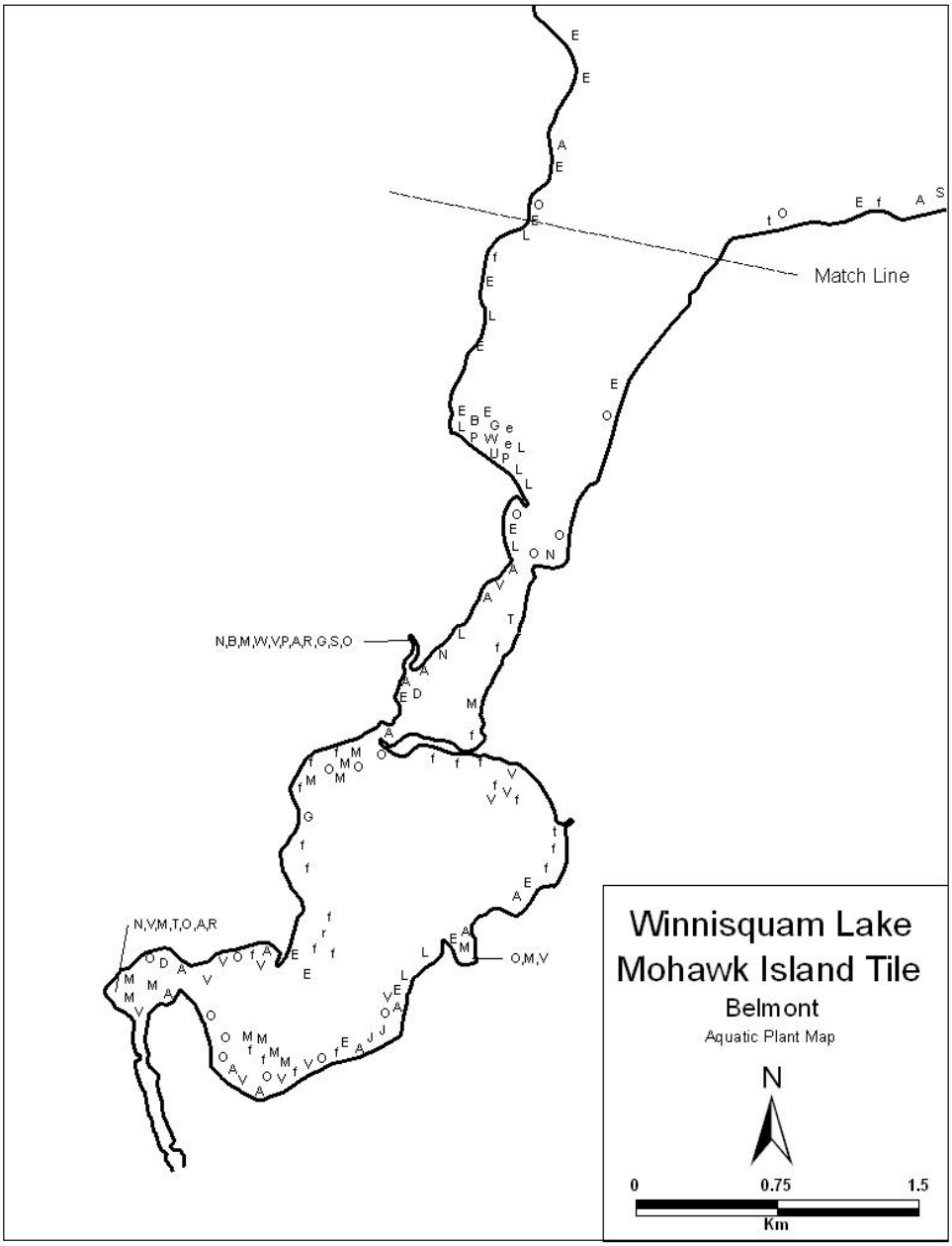
**Aquatic Vegetation Map and Key (North End)**



**Aquatic Vegetation Map and Key (Middle Section)**



## Aquatic Vegetation Map and Key (South Section)

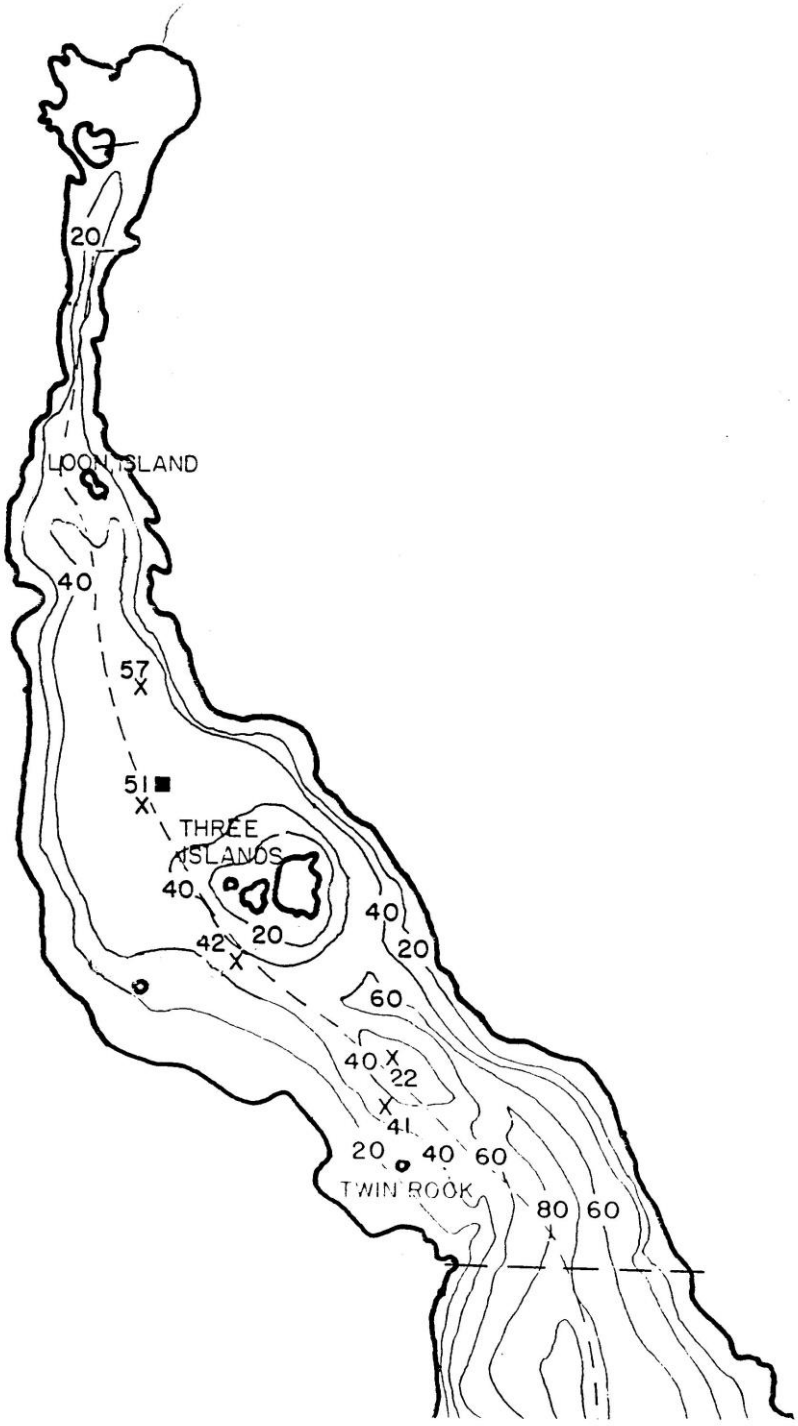


## Key to Macrophyte Map

| Symbol | Common Name | Latin Name |
|---|---|---|
| T | Cattail | *Typha* |
| b | Water naiad | *Najas* |
| a | Alternate-leaved milfoil | *Myriophyllum alterniflorum* |
| d | False loosestrife/water purslane | *Ludwigia* |
| 9 | Native milfoil | *Myriophyllum humile* |
| c | Water marigold | *Megalodonata beckii* |
| 8 | Hedge hyssop | *Gratiola* |
| 7 | Bur-reed | *Sparganium sp.* |
| 6 | Tape-like bur-reed | *Sparganium sp.* |
| W | White water-lily | *Nymphaea* |
| X | Big-leaved pondweed | *Potamogeton natans* |
| E | Pipewort | *Eriocaulon* |
| U | Bladderwort | *Utricularia* |
| L | Water lobelia | *Lobelia dortmanna* |
| H | Floating heart | *Nymphoides cordata* |
| G | Grassy arrowhead | *Sagittaria sp.* |
| V | Tapegrass | *Vallisneria americana* |
| 3 | Spike rush | *Eleocharis sp.* |
| f | Filamentous green algae | *n/a* |
| A | Bassweed | *Potamogeton amplifolius* |
| N | Waterweed | *Elodea sp.* |
| R | Robbins pondweed | *Potamogeton robbinsii* |
| 4 | Grassy spike rush | *Eleocharis sp.* |
| P | Pickerelweed | *Pontedaria cordata* |
| L | Purple loosestrife | *Lythrum salicaria* |
| J | Arrowhead | *Sagittaria sp.* |
| K | Swamp loosestrife | *Decodon verticillatus* |
| Y | Yellow water-lily | *Nuphar* |
| D | Three-way sedge | *Dulichium arundinaceum* |

**Figure 4: Bathymetric Map**

**Bathymetric Map (North Tile)**



**Bathymetric Map (South Tile)**

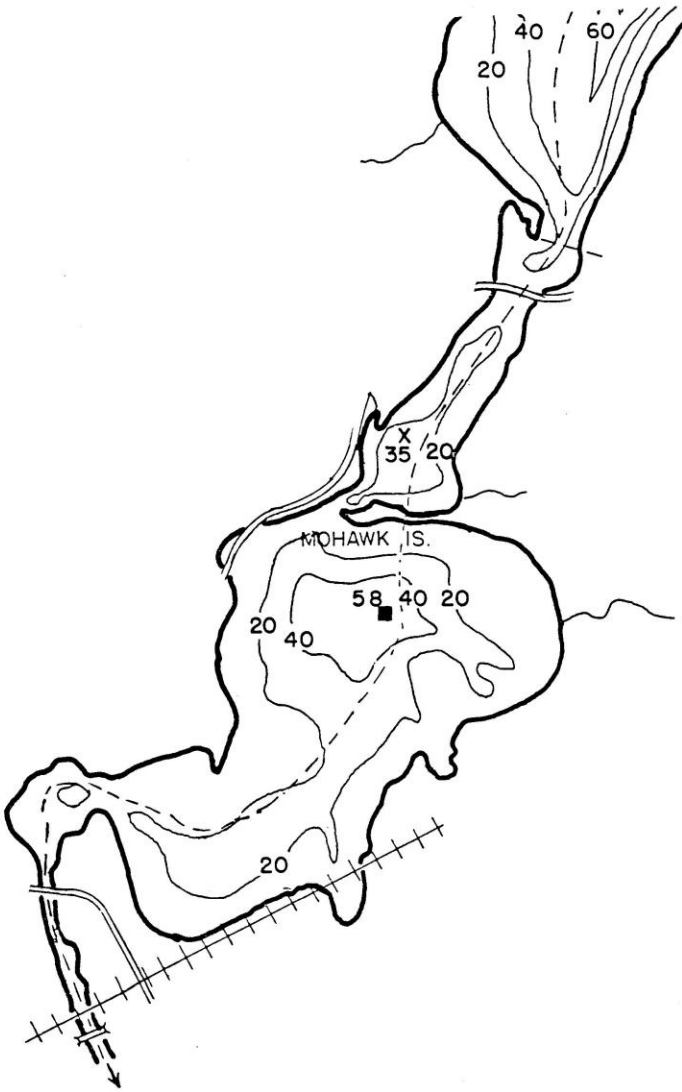
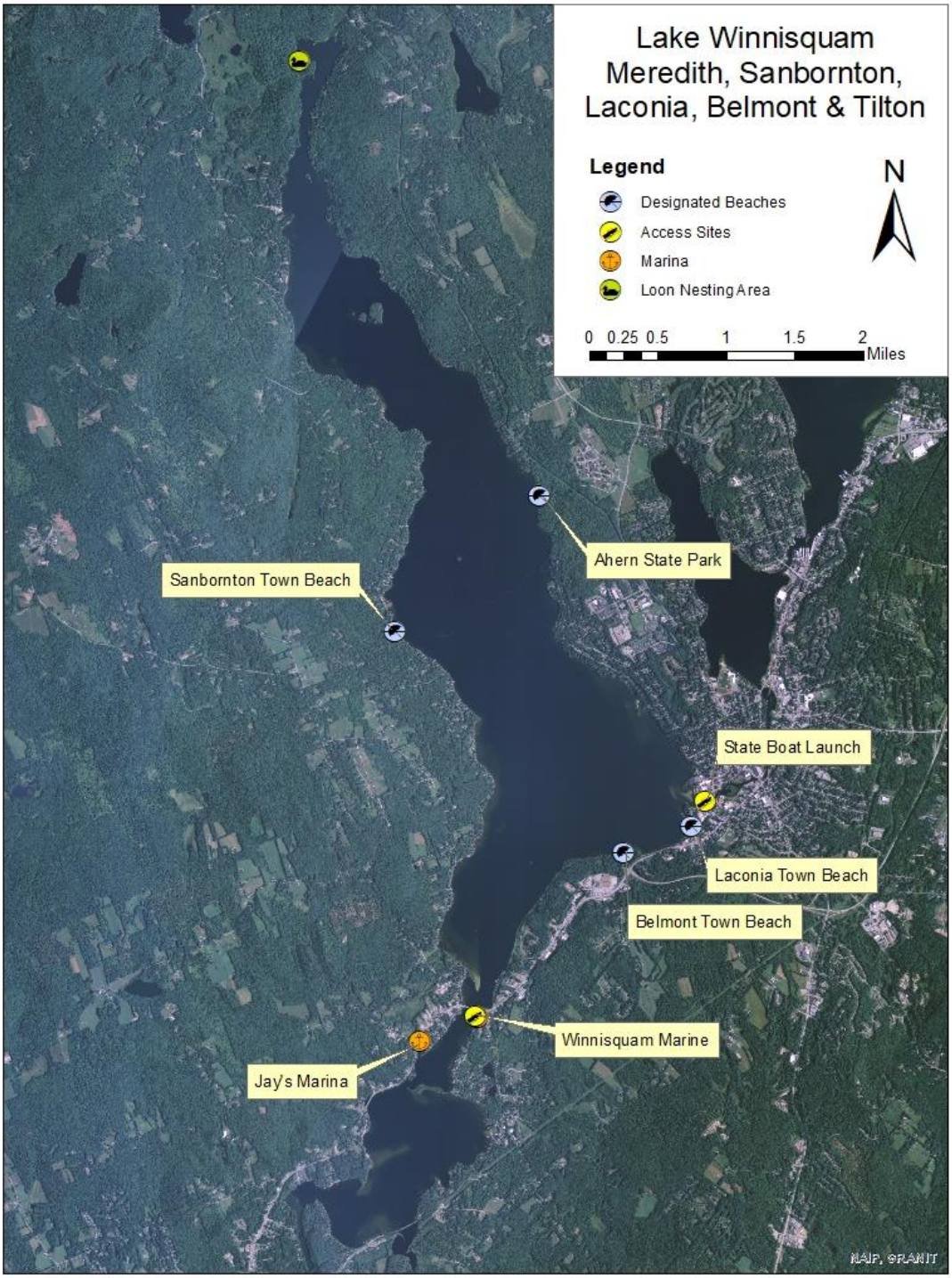
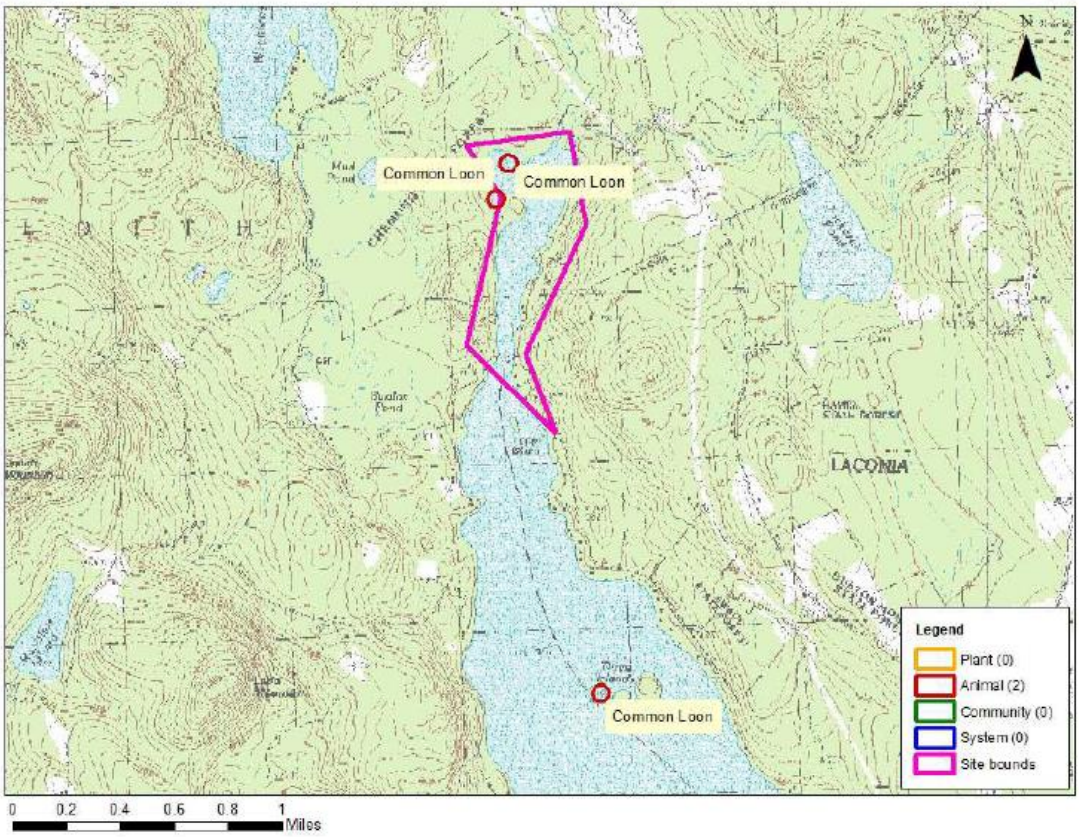


**Figure 4- Lake Winnisquam Designated Beaches and Access Sites**



## Figure 5: Critical Habitats or Conservation Areas

**NHB19-4144**



**NHB18-0403**

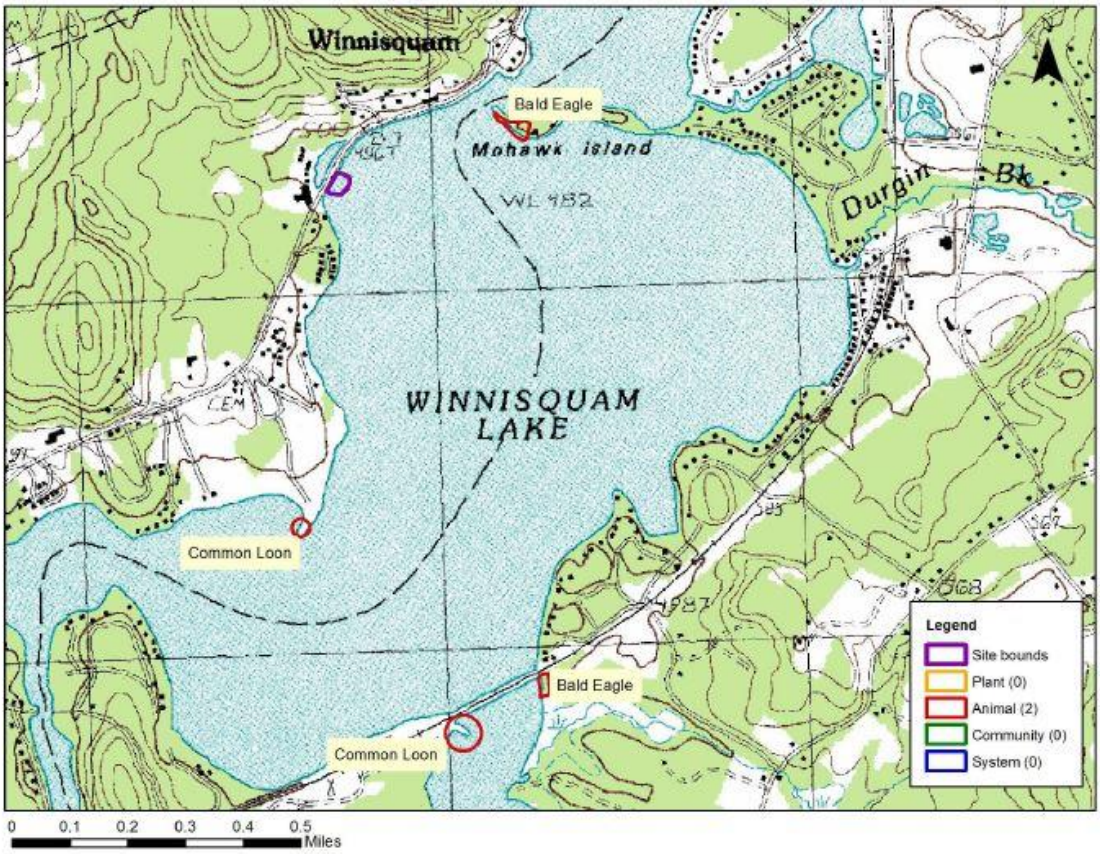
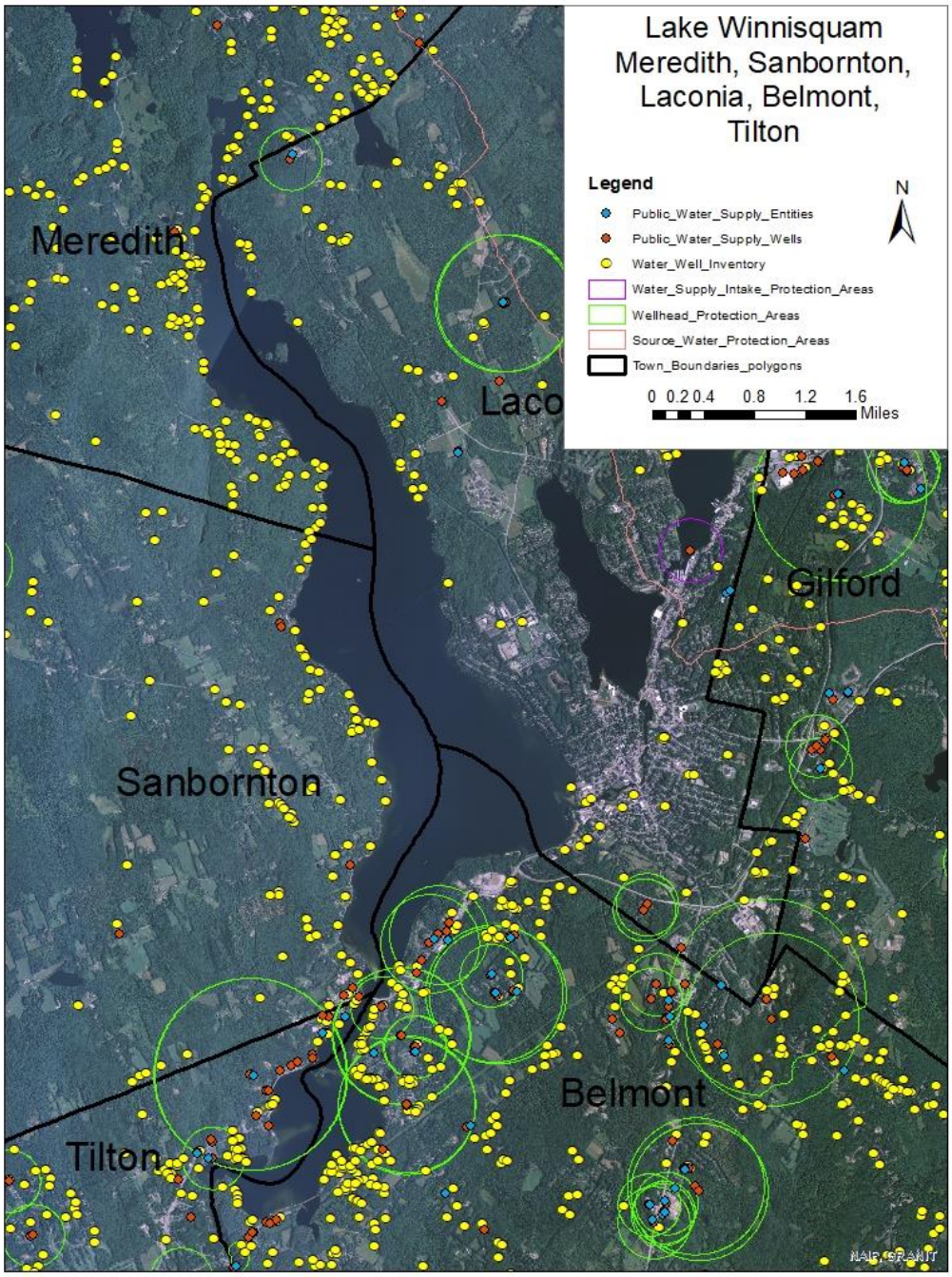

Winnisquam
Bald Eagle
Mohawk Island
WL 482
Durgin Bk
WINNISQUAM LAKE
Common Loon
Bald Eagle
Common Loon
Legend
Site bounds
Plant (0)
Animal (2)
Community (0)
System (0)
0 0.1 0.2 0.3 0.4 0.5
Miles

**Figure 6: Wells and Water Supplies (1:60,000 scale)**



## Appendix A Criteria to Evaluate Control Techniques

Preliminary Investigations

### I. Field Site Inspection

- Verify genus and species of the plant.
- Determine if the plant is a native or exotic species per RSA 487:16, II.
- Map extent of the plant infestation (area, water depth, height of the plant, density of the population).
- Document any native plant abundances and community structure around and dispersed within the exotic/nuisance plant population.

### II. Office/Laboratory Research of Waterbody Characteristics

- Contact the appropriate agencies to determine the presence of rare or endangered species in the waterbody or its prime wetlands.
- Determine the basic relevant limnological characteristics of the waterbody (size, bathymetry, flushing rate, nutrient levels, trophic status, and type and extent of adjacent wetlands).
- Determine the potential impacts to downstream waterbodies based on limnological characteristics (water chemistry, quantity, quality).

### Overall Control Options

For any given waterbody that has an infestation of exotic plants, one of four options will be selected, based on the status of the infestation, the available management options, and the technical knowledge of the DES Limnologists who have conducted the field work and who are preparing this plan. The options are as follows:

1) Eradication: The goal is to completely remove the exotic plant infestation over time. In some situations this may be a rapid response that results in an eradication event in a single season (such as for a new infestation), in other situations a longer-term approach may be warranted given the age and distribution of the infestation. Eradication is more feasible in smaller systems without extensive expanded growth (for example, Lake Winnipesaukee is unlikely to achieve eradication of its variable milfoil), or without upstream sources of infestation in other connected systems that continually feed the lake.

2) Maintenance: Waterbodies where maintenance is specified as a goal are generally those with expansive infestations, that are larger systems, that have complications of extensive wetland complexes on their periphery, or that have upstream sources of the invasive plant precluding the possibility for eradication. For waterbodies where maintenance is the goal, control activities will be performed on the waterbody to keep an infestation below a

desirable threshold. For maintenance projects, thresholds of percent cover or other measurable classification will be indicated, and action will occur when exotic plant growth exceeds the threshold.

3) Containment: The aim of this approach is to limit the size and extent of the existing infestation if it is localized in one portion of a waterbody, or containing infestations from downstream waterbodies if a headwater pond, lake or stream is infested. This could be achieved through the use of benthic barriers, fragment barriers, Restricted Use Areas or other such physical means of containment. In some cases an herbicide treatment may be used as a means of suppressing growth to prevent expansion of the infestation.

4) No action. If the infestation is too large, spreading too quickly, and past management strategies have proven ineffective at controlling the target exotic aquatic plant, DES, in consultation with others, may elect to recommend 'no action' at a particular site. All efforts will instead be made towards containment of the target species to that specific waterbody, so that downstream migration of the plant can be prevented.

If eradication, maintenance or containment is the recommended option to pursue, the following series of control techniques may be employed. The most appropriate technique(s) based on the determinations of the preliminary investigation will be selected.

Guidelines and requirements of each control practice are suggested and detailed below each alternative, but note that site specific conditions will be factored into the evaluation and recommendation of use on each individual waterbody with an infestation.

**A. Hand-Pulling**

- Can be used for exotic or native species.
- Can be used if infestation is in a small localized area (sparsely populated patch of up to 5' X 5', single stems, or dense small patch up to 2' X 2').
- Can be used if plant density is low, or if target plant is scattered and not dense.
- Can be used if the plant could effectively be managed or eradicated by hand-pulling a few scattered plants.
- Use must be in compliance with the Wetlands Bureau rules.

**B. Mechanically Harvest or Hydro-Rake**

- Can not be used on plants which reproduce vegetatively by fragmentation (e.g., milfoil, fanwort, etc.) unless containment can be ensured.
- Can be used only if the waterbody is accessible to machinery.
- Can be used if there is a disposal location available for harvested plant materials.
- Can be used if plant depth is conducive to harvesting capabilities (~ <7 ft. for mower, ~ <12 ft. for hydro-rake).
- Funds are available for repeated harvesting activities in that season.

- A navigation channel is required through dense plant growth.

**C. Herbicide Treatment**

- Can be used if application of herbicide is conducted in areas where alternative control techniques are not optimum due to depth, current, use, or density and type of plant.
- Can be used for treatment of exotic plants where fragmentation is a high concern.
- Can be used where species specific treatment is necessary due to the need to manage other plants
- Can be used if other methods used as first choices in the past have not been effective.
- A licensed applicator should be contacted to inspect the site and make recommendations about the effectiveness of herbicide treatment as compared with other treatments.

**D. Restricted Use Areas (per RSA 487:17, II (d))**

- Can be used for exotic species only.
- Can be established in an area that effectively restricts use to a small cove, bay, or other such area where navigation, fishing, and other transient activities may cause fragmentation to occur.
- Can not be used when there are several "patches" of an infestation of exotic aquatic plants throughout a waterbody.
- Can be used as a temporary means of control.

**E. Bottom Barrier**

- Can be used for exotic or native species.
- Can be used in small areas, preferably less than 10,000 sq. ft.
- Can be used in an area where the current is not likely to cause the displacement of the barrier.
- Can be used early in the season before the plant reaches the surface of the water.
- Can be used in an area to compress plants to allow for clear passage of boat traffic.
- Can be used in an area to compress plants to allow for a clear swimming area.
- Use must be in compliance with the Wetlands Bureau rules.

**F. Drawdown**

- Can be used if the target plant(s) are susceptible to drawdown control.
- Can be used in an area where bathymetry of the waterbody would be conducive to an adequate level of drawdown to control plant growth, but where extensive deep

habits exist for the maintenance of aquatic life such as fish and amphibians.

- Can be used where plants are growing exclusively in shallow waters where a drawdown would leave this area "in the dry" for a suitable period of time (over winter months) to control plant growth.
- Can be used in winter months to avoid encroachment of terrestrial plants into the aquatic system.
- Can be used if it will not significantly impact adjacent or downstream wetland habitats.
- Can be used if spring recharge is sufficient to refill the lake in the spring.
- Can be used in an area where shallow wells would not be significantly impacted.
- Reference RSA 211:11 with regards to drawdown statutes.

## G. Dredge

- Can be used in conjunction with a scheduled drawdown.
- Can be used if a drawdown is not scheduled, though a hydraulic pumping dredge should be used.
- Can only be used as a last alternative due to the detrimental impacts to environmental and aesthetic values of the waterbody.

## H. Biological Control

- Grass carp cannot be used as they are illegal in New Hampshire.
- Exotic controls, such as insects, cannot be introduced to control a nuisance plant.
- Research should be conducted on a potential biological control prior to use to determine the extent of target specificity.

## Appendix B Summary of Control Practices

### Restricted Use Areas and Fragment Barrier:

Restricted Use Areas (RUAs) are a tool that can be use to quarantine a portion of a waterbody if an infestation of exotic aquatic plants is isolated to a small cove, embayment, or section of a waterbody. RUAs generally consist of a series of buoys and ropes or nets connecting the buoys to establish an enclosure (or exclosure) to protect an infested area from disturbance. RUAs can be used to prevent access to these infested areas while control practices are being done, and provide the benefit of restricting boating, fishing, and other recreational activities within these areas, so as to prevent fragmentation and spread of the plants outside of the RUA.

### Hand-pulling:

Hand-pulling exotic aquatic plants is a technique used on both new and existing infestations, as circumstances allow. For this technique divers carefully hand-remove the shoots and roots of plants from infested areas and place the plant material in mesh dive bags for collect and disposal. This technique is suited to small patches or areas of low density exotic plant coverage.

For a new infestation, hand-pulling activities are typically conducted several times during the first season, with follow-up inspections for the next 1-2 years or until no re-growth is observed. For existing infestations, hand-pulling may be done to slow the expansion of plant establishment in a new area or where new stems are removed in a section that may have previously been uninfested. It is often a follow-up technique that is included in most management plans.

In 2007 a new program was created through a cooperative between a volunteer monitor that is a certified dive instructor, and the DES Exotic Species Program. A Weed Control Diver Course (WCD) was developed and approved through the Professional Association of Dive Instructors (PADI) to expand the number of certified divers available to assist with hand-pulling activities. DES has only four certified divers in the Limnology Center to handle problems with aquatic plants, and more help was needed. There is a unique skill involved with hand-removing plants from the lake bottom. If the process is not conducted correctly, fragments could spread to other waterbody locations. For this reason, training and certification are needed to help ensure success. Roughly 100 divers were certified through this program through the 2010 season. DES maintains a list of WCD divers and shares them with waterbody groups and municipalities that seek diver assistance for controlling exotic aquatic plants. Classes are offered two to three times per summer.

### Diver Assisted Suction Harvesting

Diver Assisted Suction Harvesting (DASH) is an emerging and evolving control technique in New Hampshire. The technique employs divers that perform hand removal actions as described above, however, instead of using a dive bag a mechanical suction device is used to entrain the plants and bring them topside where a tender accumulates and bags the material for disposal. Because of this variation divers are able to work in moderately dense stands of plants that cover more bottom area, with increased efficiency and accuracy.

### Mechanical Harvesting

The process of mechanical harvesting is conducted by using machines which cut and collect aquatic plants. These machines can cut the plants up to twelve feet below the water surface. The weeds are cut and then collected by the harvester or other separate conveyer-belt driven device where they are stored in the harvester or barge, and then transferred to an upland site.

The advantages of this type of weed control are that cutting and harvesting immediately opens an area such as boat lanes, and it removes the upper portion of the plants. Due to the size of the equipment, mechanical harvesting is limited to water areas of sufficient size and depth. It is important to remember that mechanical harvesting can leave plant fragments in the water, which if not collected, may spread the plant to new areas. Additionally harvesters may impact fish and insect populations in the area by removing them in harvested material. Cutting plant stems too close to the bottom can result in re-suspension of bottom sediments and nutrients. This management option is only recommended when nearly the entire waterbody is infested, and harvesting is needed to open navigation channels through the infested areas.

### Benthic Barriers:

Benthic barriers are fiberglass coated screening material that can be applied directly to the lake bottom to cover and compress aquatic plant growth. Screening is staked or weighted to the bottom to prevent it from becoming buoyant or drifting with current. The barriers also serve to block sunlight and prevent photosynthesis by the plants, thereby killing the plants with time. While a reliable method for small areas of plants (roughly 100 sq. ft. or less), larger areas are not reasonably controlled with this method due to a variety of factors (labor intensive installation, cost, and gas accumulation and bubbling beneath the barrier).

**Targeted Application of Herbicides:**

Application of aquatic herbicides is another tool employed for controlling exotic aquatic plants. Generally, herbicides are used when infestations are too large to be controlled using other alternative non-chemical controls, or if other techniques have been tried and have proven unsuccessful. Each aquatic plant responds differently to different herbicides and concentrations of herbicides, but research performed by the Army Corps of Engineers has isolated target specificity of a variety of aquatic herbicides for different species.

Generally, 2,4-D (Navigate formulation) is the herbicide that is recommended for control of variable milfoil. Based on laboratory data this is the most effective herbicide in selectively controlling variable milfoil in New Hampshire's waterbodies.

A field trial was performed during the 2008 summer using the herbicide Renovate to control variable milfoil. Renovate is a systemic aquatic herbicide that targets both the shoots and the roots of the target plant for complete control. In this application it was dispersed as a granular formulation that sank quickly to the bottom to areas of active uptake of the milfoil plants. A small (<5 acre) area of Captains Pond in Salem was treated with this systemic herbicide. The herbicide was applied in pellet form to the infested area in May 2008, and showed good control by the end of the growing season. Renovate works a little more slowly to control aquatic plants than 2,4-D and it is a little more expensive, but presents DES with another alternative that could be used in future treatments.

During the summer of 2010, DES worked with other researchers to perform field trials of three different formulations of 2,4-D in Lake Winnisquam, to determine which product was most target-specific to the variable milfoil. Navigate formulation was used, as were a 2,4-D amine formulation, and a 2,4-D amine and triclopyr formulation (MaxG). Although the final report has not been completed for this study, preliminary results suggest that all three products worked well, but that Navigate formation may be the most target specific of all three.

Another herbicide, Fluridone, is sometimes also used in New Hampshire, mainly to control growths of fanwort (*Cabomba caroliniana*). Fluridone is a systemic aquatic herbicide that inhibits the formation of carotenoids in plants. Reduced carotenoids pigment ultimately results in the breakdown of chlorophyll and subsequent loss of photosynthetic function of the plants.

In 2018, a new aquatic formulation of an herbicide was labeled and licensed for use. ProcellaCOR is a reduced-risk liquid formulation herbicide that is a systemic. Based on New Hampshire field data, it works well on variable milfoil, it is taken up very quickly following treatment (hours) and it degrades quickly in the water column, with typical non-detect readings within 24-48 hours post treatment.

### Extended Drawdown

Extended drawdown serves to expose submersed aquatic plants to dessication and scouring from ice (if in winter), physically breaking down plant tissue. Some species can respond well to drawdown and plant density can be reduced, but for invasive species drawdown tends to yield more disturbance to bottom sediments, something to which exotic plants are most adapted. In waterbodies where drawdown is conducted exotic plants can often outcompete native plants for habitat and come to dominate the system.

Some waterbodies that are heavily infested with exotic plants do conduct drawdowns to reduce some of the invasive aquatic plant density. During this reporting period both Northwood Lake (Northwood) and Jones Pond (New Durham) coordinated deep winter drawdowns to reduce growths of variable milfoil (the drawdown on Northwood Lake is primarily for flood control purposes, but they do see some ancillary benefits from the technique for variable milfoil control).

### Dredging

Dredging is a means of physical removal of aquatic plants from the bottom sediments using a floating or land-based dredge. Dredging can create a variety of depth gradients creating multiple plant environments allowing for greater diversity in lakes plant, fish, and wildlife communities. However due to the cost, potential environmental effects, and the problem of sediment disposal, dredging is rarely used for control of aquatic vegetation alone.

Dredging can take place in to fashion, including drawdown followed by mechanical dredging using an excavator, or using a diver-operated suction dredge while the water level remains up.

### Biological Control

There are no approved biological controls for submersed exotic aquatic plant at this time in New Hampshire.

## References

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