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NH Department of
Environmental Services
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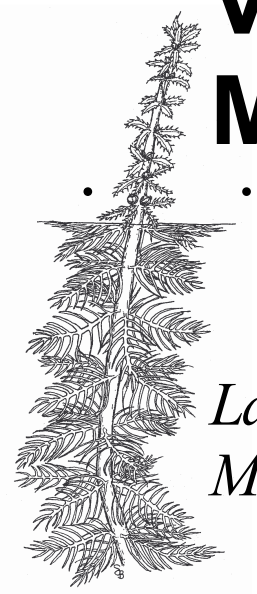
Long-Term Variable Milfoil Management Plan



Lake Winnipesaukee
Moultonborough, New Hampshire

Table of 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 minimize any adverse effects of exotic aquatic plant management strategies;
4. To recommend exotic plant control actions that meet the goals outlined in this plan; and
5. 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 provide 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 27 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 the Moultonborough Area of Lake Winnipesaukee

Variable milfoil (*Myriophyllum heterophyllum*) became established in Lake Winnipesaukee in 1965 in Moultonborough Bay, and the milfoil in this area is the longest standing infestation in New Hampshire. The plants throughout this area of the lake are mature and well-established, are known to form monocultures in many areas, and are generally widespread in others. In addition to well-established stands and mature root crowns, variable milfoil has flowered for a number of years in some areas of the lake, yielding a substantial seed stock in the lake substrate that could germinate and perpetuate growth for many years to come.

Figure 1 illustrates the extent of the variable milfoil infestation in Moultonborough over time since routine monitoring began (roughly 2010).

The following table provides a summary of each area indicated in Figure 1, where variable milfoil has been historically found (areas without variable milfoil growth have been excluded from this table).

Area	Location/Area Description	Year	Description of Growth	Variable Milfoil Percent Cover
B1, C1	Moultonborough Bay from Greens Basin through Deepwood Ledges/Hemlock Point near Marker Buoy 72	2010	Densest most widespread growth in Moultonborough.	>90% in most areas of growth
		2011	Densest and most widespread growth still, reduced by about	75% after 2010 control activities
		2012	Still most prevalent growth areas in Moultonborough, but coverage reduced	60% cover
D1, D2	Moultonborough Bay from Hemlock Point to Garnet Point	2010	Variable milfoil more prevalent around Hemlock Point area through Hemlock	60%

Area	Location/Area Description	Year	Description of Growth	Variable Milfoil Percent Cover
			and Ambrose Coves, less dense moving east along north and south shoreline areas. Langdon Cove had patchy milfoil in shallow wetland on southwestern end.	
		2011	Milfoil still present in same areas but much reduced, no longer present near Clark's Landing	40%
		2012	Milfoil continues to be reduced, with larger gaps of milfoil free areas between patches of growth	30%
E2, E3	Eastern side of Moultonborough area of Winnipesaukee Black Point around to Long Island	2010	Limited milfoil growth, mostly in cove behind (to west) of Nine Acre Island	<25%
		2011	Milfoil growth removed by diving.	0%
		2012	114 plants harvested from the cove behind (west of) Nine Acre Island.	<5%
D4	Long Island Harilla Landing Area	2010	The only area of milfoil growth is in Harilla Landing on the east side of Long Island	75%
		2011	Herbicide treatment reduced growth to small patchy areas, visited by divers	<20% post treatment, rebounding to 40% late season
		2012	Some regrowth around docks and launch	40% early season, reduced to <10% post treatment
A2	Blackey Cove	2010	Small dense patch along north western shoreline of cove and in northern shallow wetland cove where stream enters balance of cove milfoil free	15%
		2011	Reduced by herbicide treatment and diving, few stems remain in shallow wetland at north end	<5%
		2012	Some regrowth in north end wetland and along western shore. 18,672 plants harvested from the area, both in shallow and in deeper water.	10%
B2	Salmon Meadow, Ash Cove, Black Cat Island, Senter Cove	2010	Dense growth throughout most areas of Salmon Meadow and Ash Cove, patchy in Black	Salmon/Ash-75% Black Cat-

Area	Location/Area Description	Year	Description of Growth	Variable Milfoil Percent Cover
			Cat, scattered in Senter Cove	25% Senter-<10
		2011	Variable milfoil reduced in most areas through control activities	Salmon/Ash-30% Black Cat- 5% Senter-<5
		2012	Black Cat and Senter Cove milfoil densities further reduced by divers/benthic barrier. Black Cat 6,534 plants removed, along with benthic barrier. Local divers monitoring. Senter Cove 730 plants removed. Cove behind Hermit Island had 741 plants removed. Salmon/Ash milfoil increased rapidly despite regular dive activities.	Salmon/Ash-60% Black Cat-<5% Senter- 0%
All Others Not Listed	All other Lake Winnipesaukee areas within the Town of Moultonborough shown in Figure 1 but not included in descriptions above.	All	No growth. These areas are either exposed to winds (thus high water movement in form of waves) or substrates are not conducive to milfoil growth (bedrock, cobble, sandy with shallow depth to refusal)	0%

Throughout this portion of the lake there are many public access sites, marinas, a number of private residences and swim beaches. Residents, business owners and lake users have expressed concerns about milfoil and have illustrated a coordinated effort at reducing overall milfoil density and distribution.

Milfoil Management Goals and Objectives

The aquatic plant management plan for the portion of Lake Winnipesaukee that falls within Moultonborough outlines actions to reduce growths (both density and distribution) of variable milfoil (*Myriophyllum heterophyllum*) while maintaining native plant communities whenever variable milfoil control actions are being implemented. Because of the expansive size of the overall variable milfoil infestation within Lake Winnipesaukee, DES recognizes that eradication of variable milfoil in the lake system as a whole is unlikely, both due to the degree of fragmentation of the plants and subsequent spread, but also due to the overall cost of attempting a lake-wide eradication project on this lake.

The project will take place over many years, and focused efforts will be phased over time and will incorporate integrated plant management activities, as well as prevention, early detection, and containment elements, and routine monitoring to measure progress and direct control efforts.

While many towns around Lake Winnipesaukee are becoming more active in holistic lake management and milfoil reduction activities, including the Town of Moultonborough, this specific plan will focus on the goal of reducing the overall milfoil density and distribution in Moultonborough Bay and nearby coves and shoreline areas of the lake that fall within the Town of Moultonborough.

It should be clearly understood that milfoil control efforts in Lake Winnipesaukee will need to be well-coordinate (both in town and with other towns), long-term, multi-faceted, and done using integrated plant management techniques that also include a substantial monitoring and reporting effort by Weed Watchers and Lake Hosts.

Plans for the Moultonborough portion of the lake include performing spring survey work (May/early June) to plan for spring and early summer activities based on current data, and performing a July/August survey to plan for any follow-up activities that may be needed. Maps will be made available to interested parties as soon as they are developed.

Figure 2 (a series of maps) show historic and proposed control activities for this area.

Appendix A details the strategies available for waterbodies with exotic species, and provides more information on each of the activities that are recommended within this plan.

Local Support

Town or Municipality Support

The Town of Moultonborough is very supportive of the milfoil control effort in infested waterbodies in town, including portions of Lake Winnipesaukee that fall within the town boundaries. The town has formed a special Milfoil Committee that works under the Conservation Commission, and the group meets regularly to discuss and strategize for milfoil control activities. The town has been successful for the past several years in passing warrant articles to allocate funds for milfoil control efforts in waterbodies infested within Moultonborough town boundaries.

Lake Association Support

There is no formal singular lake association for Moultonborough Bay. As mentioned above, the Town of Moultonborough has developed a Milfoil Committee to coordinate activities relative to variable milfoil control within waterbodies in the town. The Milfoil Committee initiated and coordinates prevention (Lake Host) and early detection/continued monitoring (Weed Watcher) activities on a regular basis during the growing season, and also provides oversight for the diver/DASH work.

Members of the Milfoil Committee have also been keeping track of GIS data relative to milfoil infestations over time, and work actively to keep lines of communication open between DES, contractors, and town residents.

Waterbody Characteristics

The following table summarizes basic physical and biological characteristics of Moultonborough Bay area of Lake Winnipesaukee, including the milfoil infestation. 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	
Shoreline Uses (residential, forested, agriculture)	Commercial, residential, forested
Area of Lake Winnipesaukee in Moultonborough (acres)	~7,060
Max Depth (ft)	~81
Mean Depth (ft)	~35
Trophic Status	Oligotrophic
Color (CPU) in Epilimnion	10
Clarity (ft)	23
Natural waterbody/Raised by Damming/Other	Natural
Plant Community Information Relative to Management	
Invasive Plants (Latin name)	*Myriophyllum heterophyllum*
Infested Area (acres)	Originally 400+ acres but that coverage has been reduced each year with control actions. The maps included in this plan will show regular survey data that track the infestation.
Distribution (ringing lake, patchy growth, etc)	Figure 1 illustrates a general locations where variable milfoil has been a problem in this portion of the lake.
Sediment type in infested area (sand/silt/organic/rock)	Sandy/rocky/mucky (varies by area)
Rare, Threatened, or Endangered Species in Waterbody (according to NH Natural Heritage Inventory)	New England bluet (*Enallagma laterale*) Bridled shiner (*Notropis bifrenatus*) Common loon (*Gavia immer*) Purple martin (*Progne subis*)

An aquatic vegetation map (showing native vegetation) and key for Moultonborough Bay is shown in Figure 2 (data from summer/fall 2010, verified annually). 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, including water supplies and near shore wells, 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.

Fishery

The principal fisheries of Lake Winnipesaukee include both warm and coldwater species. Coldwater species of primary interest are; landlocked Atlantic salmon, lake trout, and rainbow trout; coldwater species of less interest are lake whitefish, round whitefish (species of concern in Wildlife Action Plan), burbot, brook trout, and rainbow smelt.

Warmwater species of primary interest are; largemouth bass, smallmouth bass, white perch, yellow perch, chain pickerel, black crappie, brown bullhead, and bluegill. The bass fishery is extremely popular with anglers as numerous fishing tournaments are held on the lake each year.

Numerous warmwater species are present in littoral areas of the lake and constitute the prey fish sought by larger gamefish (warmwater). These species include; banded killifish, common shiner, common white sucker, creek chubsucker, bridle shiner (species of concern in Wildlife Action Plan), fallfish, golden shiner, pumpkinseed, redbreast sunfish, rock bass, slimy sculpin, and yellow bullhead.

The American eel, a catadromous species, resides up to 4-9 years in our inland lakes, such as Lake Winnipesaukee, where they reach sexual maturity and migrate down the rivers and outlets of our large lakes to the Atlantic Ocean.

Listed Aquatic Species

A Natural Heritage Inventory review yielded several species of concern in Lake Winnipesaukee in this area, including New England bluet (*Enallagma laterale*), Bridled shiner (*Notropis bifrenatus*), common loon (*Gavia immer*), and purple martin

(*Progne subis*). Figure 5 shows a map of species distribution, as provided by the NHB.

The New England bluet was documented in the Lees Mills area of Lake Winnipesaukee. The record was from 2002. General comments about the bluet indicate that the population appears to be widespread in the vicinity, and secure. Lees Mills has done numerous historical herbicide treatments, apparently with no detriment to this damselfly population. By the time of the treatment, the bluets are already airborne, and out of the water. Egg laying is likely in July, and by that point the herbicide concentration will likely be below detection limits, particularly in this flow-through area. Other non-chemical approaches will not impact or target this species.

The bridled shiner was observed in several locations in cove/wetland areas on the periphery of Moultonborough Bay and Greens Basin areas (see Figure 5). Bridle shiners tend to inhabit areas of dense plant growth in the shallows of lakes and ponds. Native aquatic vegetation is not a target of the control actions recommended here, and many of the native submersed plant species will be present through and following treatment even within the treatment areas (water naiad, water marigold, various pondweeds, bladderwort, tape-grass, waterweed, grassy spike rush and macroalgae such as Chara and Nitella). In 2010 through 2012, Fish and Game biologists recommend against treating key habitat areas in June when the fish are spawning, and have been specifically requesting a condition that no control actions (chemical or non-chemical) take place until after July 15th , as that would allow for any fish eggs attached to plants to hatch and young of the year bridled shiners to find cover. DES biologists and contractors feel that in some cases spring treatment will help to maximize control of the variable milfoil, and because certain herbicides can be target specific with variable milfoil, much native vegetation will remain in these areas. If feasible, June treatment is preferred, but if it is deemed too much of a risk to the fish species then a treatment after July 15th is better than no control at all.

Common loons are found in many areas of Lake Winnipesaukee. DES has encouraged the town to make contact with the Loon Preservation Society, so that they can be notified of the proposed control activities. In the past, a Loon Preservation Society representative has been on site to observe herbicide 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 Fish and Game Department does request that herbicide treatments not be permitted within 100 meters of any nests. Their cited concern is that the method of application, by motorboat and/or airboat, may result in nest abandonment and loss of eggs and/or loon chicks, as well as herbicide damage to the floating aquatic plants. They further request that non-chemical means of control, such as hand pulling, be set

back 100 meters from any known or suspected loon nests during the period of May 15 and July 15th, to avoid "take" under RSA 212-Aof the Endangered Species Conservation Act.

The record for the state threatened purple martin was from within the Lees Mills area. We do not anticipate the herbicide treatment or non-chemical controls of variable milfoil will affect this avian species.
DES and the contractors are glad to work with the Fish and Game Department to identify strategies (timing, setback, etc) that are appropriate to protect the integrity of each of these species of concern while milfoil mitigation activities are conducted.

Recreational Uses and Access Points

Moultonborough Bay is used for numerous recreational activities, including boating, fishing, swimming, and water skiing by both lake residents and transient boaters. Additionally, there are places of business, including marinas and other shops.

There are various public ("designated") swim areas within Moultonborough, including town and association beaches. 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.*

Figure 6 shows the location of public access sites and swim beaches of particular interest/concern with regards to the milfoil infestation and control actions.

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 littoral zone of the bay 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 water-lilies, floating leaved pondweeds, and watershield,

floating heart), emergent plants (water lobelia, pipewort, bur-reed, pickerelweed, cattails, rush, arrowhead), and submergent plants (water naiad, pondweeds, tapegrass, waterweed, water marigold, bladderwort). Native plant communities are mixed around segments of the bay, and are characterized as 'sparse' for the bay.

There is a small amount of purple loosestrife (non-native) scattered around shoreline edges and in some marginal wetland areas around the lake as well.

Wells and Water Supplies

Figure 7 shows the location of wells, water supplies, well-head protection areas, and drinking water protection areas around the Moultonborough Bay Area, Lake Winnipesaukee, based on information in the DES geographic information system records. Note that it is likely that Figure 7 does not show the location of all private wells.

Note that the map in Figure 7 cannot be provided on a finer scale than 1:48,000. Due to public water system security concerns, a large-scale map may be made available upon agreement with DES's data security policy. Visit DES's OneStop Web GIS, http://www2.des.state.nh.us/gis/onestop/ and register to Access Public Water Supply Data Layers. Registration includes agreement with general security provisions associated with public water supply data. Paper maps that include public water supply data may be provided at a larger-scale by DES's Exotic Species Program after completing the registration process.

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.

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.htm. Additional information can be obtained from a document prepared for the State of Massachusetts called the Generic Environmental Impact Report for Lakes and Ponds, available at http://www.mass.gov/dcr/watersupply/lakepond/geir.htm.

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.

Historical Control Activities

SITE	DATE	ACTION	AREA (ac)	TARGET	CONTRACTOR
ASH & SALM MD-KRNWD	12-Jun-01	DIQUAT	17.2	MILFOIL	LYCOTT
ASH & SALM MD-KRNWD	11-Jun-03	DIQUAT	17	MILFOIL	LYCOTT
ASH & SALM MD-KRNWD	09-Jun-05	DIQUAT	17	MILFOIL	LYCOTT
ASH & SALM MD-KRNWD	05-Jun-07	2,4-D	19	MILFOIL	LYCOTT
BALD PEAK	12-Jun-01	DIQUAT	3.5	MILFOIL	LYCOTT
BALMORAL	12-Jun-01	DIQUAT	10	MILFOIL	ACT
BALMORAL	04-Jun-02	2,4-D(G)	20	MILFOIL	ACT
BALMORAL	07-Jun-06	2,4-D	11	MILFOIL	ACT
BALMORAL/SUISSEVALE	16-Jun-05	2,4-D	13.5	MILFOIL	LYCOTT
BLACK CAT ISLAND	11-Jun-02	DIQUAT	0.5	MILFOIL	ACT
BLACK CAT ISLAND	09-Jun-04	DIQUAT	0.5	MILFOIL	ACT
BLACK CAT ISLAND	05-Jun-08	2,4-D	0.65	MILFOIL	LYCOTT
BLACK CAT ISLAND	01-Jul-05	BENTHIC BARRIER	<1 ACRE	MILFOIL	LYCOTT
CASTLE SHORE ROAD COVE	15-Sep-09	2,4-D	2	MILFOIL	ACT
CASTLE SHORE ROAD COVE	01-Jul-10	DASH	<1ACRE	MILFOIL	CONTRACT DIVER
GILMAN POINT	20-Jun-07	2,4-D	5.5	MILFOIL	ACT
GILMAN PT, GREENS BA	04-Jun-03	2,4-D	6	MILFOIL	ACT
GILMAN PT, GREENS BA	06-Jun-05	2,4-D	6	MILFOIL	ACT
GREENS BASIN	12-Jun-01	DIQUAT	60	MILFOIL	ACT
GREENS BASIN	20-Jun-07	2,4-D	4.9	MILFOIL	ACT
GREENS BSN/HANSON CV	01-Jun-79	ENDOTHALL	12	MILFOIL	ABC CORP.
GREENS BSN/HANSON CV	22-Jun-10	2,4-D	9.8	MILFOIL	LYCOTT
GREENS BSN/HANSON CV	15-Sep-10	2,4-D	15.5	MILFOIL	LYCOTT
HANSON COVE	12-Jun-00	DIQUAT	14	MILFOIL	LYCOTT
HEMLOCK COVE	12-Jun-02	DIQUAT	5.5	MILFOIL	ACT
HEMLOCK COVE	22-Jun-10	2,4-d	4.1	MILFOIL	ACT
HEMLOCK HARBOR	06-Jun-00	DIQUAT	3	MILFOIL	ACT
HEMLOCK HARBOR	12-Jun-01	DIQUAT	5	MILFOIL	LYCOTT
HEMLOCK HARBOR	12-Jun-02	DIQUAT	12	MILFOIL	ACT
HEMLOCK HARBOR	23-Jun-03	2,4-D	12	MILFOIL	ACT
HEMLOCK HARBOR	07-Jun-05	2,4-D	12	MILFOIL	ACT

SITE	DATE	ACTION	AREA (ac)	TARGET	CONTRACTOR
HEMLOCK HARBOR	21-Sep-10	2,4-d	19	MILFOIL	LYCOTT
KRAINEWOOD SHORES	01-Jun-79	ENDOTHALL	8	MILFOIL	ABC CORP.
KRAINEWOOD SHORES	10-Jun-97	DIQUAT	19.8	MILFOIL	ACT
KRAINEWOOD SHORES	09-Jun-99	DIQUAT	17.2	MILFOIL	ACT
LANGDON COVE	SUMMER 2010	DASH/DIVERS	<2 ACRES	MILFOIL	PRIVATE CONTRATORS
MOULTONBORO BAY	10-Jun-98	2,4-D (G)	20	MILFOIL	ACT
MOULTONBORO BAY	9/21/10-9/22/10	2,4-D	239	MILFOIL	ACT
RICHARDSON SHORES	01-Jun-79	DIQUAT	5	MILFOIL	ABC CORP.
SALMON MEADOW COVE	01-Jun-79	ENDOTHALL	40	MILFOIL	ABC CORP.
SALMON MEADOW COVE	01-Jun-81	2,4-D (G)	2.2	MILFOIL	N.E. WEEDS
SALMON MEADOW COVE	01-Jun-82	2,4-D (G)	2.2	MILFOIL	N.E. WEED
SUISSEVALE	19-Jun-07	2,4-D	7	MILFOIL	ACT
SUISSEVALE MARINA	29-Jun-10	2,4-D	1	MILFOIL	ACT
UPPER MOULT. BAY	01-Jun-78	SILVEX	50	MILFOIL	ABC CORP.
WAYMAY POINT	SUMMER 2010	DIVERS/DASH	<1 ACRE	MILFOIL	PRIVATE CONTRATORS
SEVERAL AREAS	6/8/2011	2,4-D	43	MILFOIL	ACT
SEVERAL AREAS	SUMMER 2011	DIVERS/DASH	20-30	MILFOIL	PRIVATE CONTRATORS
SEVERAL AREAS	9/7/2011	2,4-D	130	MILFOIL	ACT
SEVERAL AREAS, SEE FIGURES FOR DETAILS	26-Jun-12	2,4-D (G)	28.2	MILFOIL	ACT
LEES MILL RIVER, LEES MILL LAUNCH, NE GANZY, SUISSEVALE LAGOON AND BEACH, BIRCH HILL ISLAND AND SHOAL, LINCOLN ISLAND, HEMLOCK AND AMBROSE COVES, SALMON MEADOW AND ASH COVES AND NORTH COVE OF BLACK CAT ISLAND	JUNE THROUGH EARLY JULY 2012	DIVER/DASH WORK TOTALING 347 HOURS, WITH 7,215 GALLONS OF MILFOIL REMOVED	VARIED	MILFOIL	AB AQUATICS

SITE	DATE	ACTION	AREA (ac)	TARGET	CONTRACTOR
LEES MILLS, BANZY NE, BIRCH HILL ISLAND AND SHOAL, LINCOLN ISLAND, HEMLOCK AND AMBROSE COVES, GREENS BASIN AND BADGER ISLAND AREAS, ASH COVE, BLACK COVE NORTH, BLACKEY COVE, WYMAN COVE	MID JULY THROUGH EARLY AUGUST 2012	DIVER/DASH WORK TOTALING 255 HOURS, WITH 3,931 GALLONS OF MILFOIL REMOVED	VARIED	MILFOIL	AB AQUATICS
AMBROSE COVE MARINA, SUISSEVALE MARINA, HEMLOCK COVE, NORTH COVE NEAR SUISSEVALE, LINCOLN ISLAND, BIRCH ISLAND, CASTLE SHORES, BIRCH HILL ISLAND, GANSY ISLAND, SALMON MEADOW COVE, BALMORAL BASIN, HARILLA LANDING, BALMORAL CANAL	MID AUGUST THROUGH EARLY SEPTEMBER 2012	DIVER/DASH WORK TOTALING 220 HOURS, WITH 1,828 GALLONS OF MILFOIL REMOVED	VARIED	MILFOIL	AB AQUATICS
SEVERAL AREAS, SEE FIGURES FOR DETAILS	06-Sep-12	2,4-D (G)	58.7	MILFOIL	ACT

Feasibility Evaluation of Control Options in this Waterbody

DES has evaluated the feasibility of potential control practices on Moultonborough Bay Area, Lake Winnipesaukee. The following table summarizes DES' control strategy recommendations for Moultonborough Bay Area, Lake Winnipesaukee

Control Method	**Use on Moultonborough Bay and Lake Winnipesaukee Areas in Moultonborough**
Restricted Use Areas	Restricted Use Areas (RUAs) may be used in areas identified as appropriate by DES based on field data. When infestations are small and localized and restriction of those areas could reduce spread of milfoil, an RUA may be considered.
Hand-pulling/Diver-Assisted Suction Harvesting (DASH)	DES will make recommendations about hand removal or DASH following a thorough mapping of the milfoil in this portion of the lake. It is expected that diver work and DASH will be a widely used technique in many areas as either a primary control effort for small infestations, as a follow up to other control efforts, or in combination with other techniques to reduce overall milfoil density. The town will have one or two DASH units available for use in this area.

Control Method	Use on Moultonborough Bay and Lake Winnipesaukee Areas in Moultonborough
Mechanical Harvesting/Removal	Mechanical harvesting is not recommended in any area of Lake Winnipesaukee due to the threat of spreading variable milfoil to uninfested areas of the lake through the generation of fragments. While variable milfoil is widespread in Moultonborough Bay there is still some uninfested habitat, and the generation of fragments that may not be well-contained in a harvesting project could drift. Also, this is not a permanent solution and harvesting would become a routine activity due to re-growth.
Benthic Barriers	Benthic barriers are recommended for areas where small growths are persistent, and where the barriers could feasibly be used (much of the lake bed in this area is rocky and not conducive to benthic barrier placement, but DES will recommend this technique as/if appropriate).
Herbicides	A target specific, systemic herbicide (like 2,4-D or similar) is recommended as needed to control larger and denser areas of growth and to reduce density/distribution of variable milfoil so that other non-chemical controls can be more feasibly used.
Extended Drawdown	Drawdown is not an effective control method for variable milfoil and is not feasible in this location of the lake.
Dredge	Not recommended due to nature of exotic plant distribution, the cost, or the ancillary ecological 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	We have seen over the years that a no control option only allows for the further distribution of this non-native exotic plant in NH. Fragments generated by variable milfoil perpetuate the problem in the lake as a whole, and many towns are rallying to reduce the overall presence of variable milfoil in Lake Winnipesaukee.

Recommended Actions, Timeframes and Responsible Parties

Year	Action	Responsible Party	Recommended Schedule
2010	Field mapping of all areas of Lake Winnipesaukee within town of Moultonborough	DES	June/July

Year	Action	Responsible Party	Recommended Schedule
	Recommendations made regarding location-specific activities for control and finalization of long-term management plan	DES	June/July/early August
	Weed Watching and marking of areas of growth and Lake Hosting	Local Weed Watchers and Lake Hosts	Monthly from May through September
	Diving and DASH in areas recommended by DES based on field survey data	Town of Moultonborough and Contract Divers	June - October
	Herbicide treatment (see figures for 2010 areas)	Aquatic Control Technology, Inc. with town of Moultonborough and DES	September
2011	Herbicide treatment (see figures for 2011 areas)	Aquatic Control Technology, Inc.	Spring and/or Fall
	Weed Watching and marking of areas of growth for divers and Lake Hosting	Local Weed Watchers and Lake Hosts	Monthly from May through September
	Diving and DASH in areas recommended by DES based on field survey data	Town of Moultonborough and Contract Divers	June - October
	Field mapping of all areas of Lake Winnipesaukee within town of Moultonborough	DES	Spring (pre-treatment) and fall (post-treatment)
2012	Field survey to identify areas of milfoil growth for treatment, divers and DASH for spring/early summer control	DES	May
	Herbicide treatment (see figures for 2012)	Aquatic Control Technology, Inc.	June and/or September

Year	Action	Responsible Party	Recommended Schedule
	Weed Watching and marking of areas of growth for divers and Lake Hosting	Local Weed Watchers and Lake Hosts	Monthly from May through September
	Diving and DASH in areas recommended by DES based on field survey data	Town of Moultonborough and Contract Divers	June - October
	Field survey to identify areas of milfoil growth for treatment, divers and DASH for spring/early summer control	DES	July/August
2013	Field survey to identify areas of milfoil growth for treatment, divers and DASH for spring/early summer control	DES	May/June
	Herbicide treatment (see figures for 2013 proposed areas)	Aquatic Control Technology	June- Areas TBD, minus bridled shiner habitats Mid-July- Lees Mill area Early September- Any area needing treatment, not including Lees Mill area Mid Sepetember- Lees Mills area (if not treated in July)
	Weed Watching and marking of areas of growth for divers and Lake Hosting	Local Weed Watchers and Lake Hosts	Monthly from May through September
	Diving and DASH in areas recommended by DES based on field survey data	Town of Moultonborough and Contract Divers	June - October
	Field survey to identify areas of milfoil growth for treatment, divers and DASH for spring/early summer control	DES	August

Year	Action	Responsible Party	Recommended Schedule
2014	Field survey to identify areas of milfoil growth for treatment, divers and DASH for spring/early summer control	DES	May
	Herbicide treatment (areas TBD)	TBD	Spring and/or Fall
	Weed Watching and marking of areas of growth for divers and Lake Hosting	Local Weed Watchers and Lake Hosts	Monthly from May through September
	Diving and DASH in areas recommended by DES based on field survey data	Town of Moultonborough and Contract Divers	June - October
	Field survey to identify areas of milfoil growth for treatment, divers and DASH for spring/early summer control	DES	July/August
2015	Assessment of milfoil situation and long-term management plan update	DES and Town of Moultonborough	Fall

Notes

Target Specificity

It is important to realize that aquatic herbicide applications are conducted in a specific and scientific manner. To the extent feasible, the permitting authority favors the use of selective herbicides that, where used appropriately, will control the target plant with little or no impact to non-target species, such that the ecological functions of native plants for habitat, lake ecology, and chemistry/biology will be maintained. *Not all aquatic plants will be impacted as a result of an herbicide treatment.*

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 management in the subject waterbody.

Therefore, the approach for Moultonborough is to perform regular surveys to track the variable milfoil growth and to guide management activities based on real-time condition in the system. Diving will be done when feasible, and herbicides will only be used if densities or distribution of milfoil preclude successful dive activity.

2013 Detail

Variable milfoil control in Lake Winnipesaukee (Moultonborough) during 2013 will be aimed at further building off from progress made during 2011 through 2012 control efforts. Specifically, integrated plant management strategies will be used to continue to reduce the variable milfoil population throughout infested areas in Moultonborough.

A field survey will be performed in late May or early June to map the milfoil growth in all areas of Moultonborough. These data will be used to determine the type and scope of field management activities during the early to mid growing season period. Another field survey will be performed in August to plan for late summer/early fall activities. Historic data from previous control efforts, as well as substrate/depth considerations and milfoil coverages will be evaluated and factored into final control option selection in each area. We anticipate the following:

Timeframe	Action	Notes
May	• Field survey/mapping • Diver/DASH work in areas TBD	Carryover areas known from Fall 2012
June	• Field survey/mapping • Herbicide treatment of up to 80 acres with *Sculpin*, in areas TBD • Diver and DASH work, areas TBD from May/June survey	Potential areas for herbicide treatment shown in proposed map for 2013, but note that areas will exclude those documented as bridled shiner habitat.
July	• Herbicide treatment in Lees Mill Area with *Sculpin or Renovate MaxG*, of up to 39 acres, after July 15 • Diver and DASH work, areas TBD	If there are no objections with regards to irrigation restrictions. Lees Mills is indicated as bridled shiner habitat, and as such, it precludes control actions in the area until after July 15th.
August	• Field survey/mapping • Diver and DASH work, areas	Assessment of progress, fine tuning of late season

Timeframe	Action	Notes
	TBD from August survey	plans/strategy
Early September	• Herbicide treatment of up to 120 acres with *Renovate MaxG*, in areas TBD • Diver and DASH work, areas TBD from August survey	Potential areas for herbicide treatment shown in proposed map for 2013.
Mid September (after 9/15)	• Herbicide treatment in Lees Mill Area with *Renovate MaxG*, of up to 39 acres • Diver and DASH work, areas TBD from August survey	This treatment will take place only if July treatment indicated above does not take place due to irrigation concerns.

Figure 1: Variable Milfoil Infestation Over Time

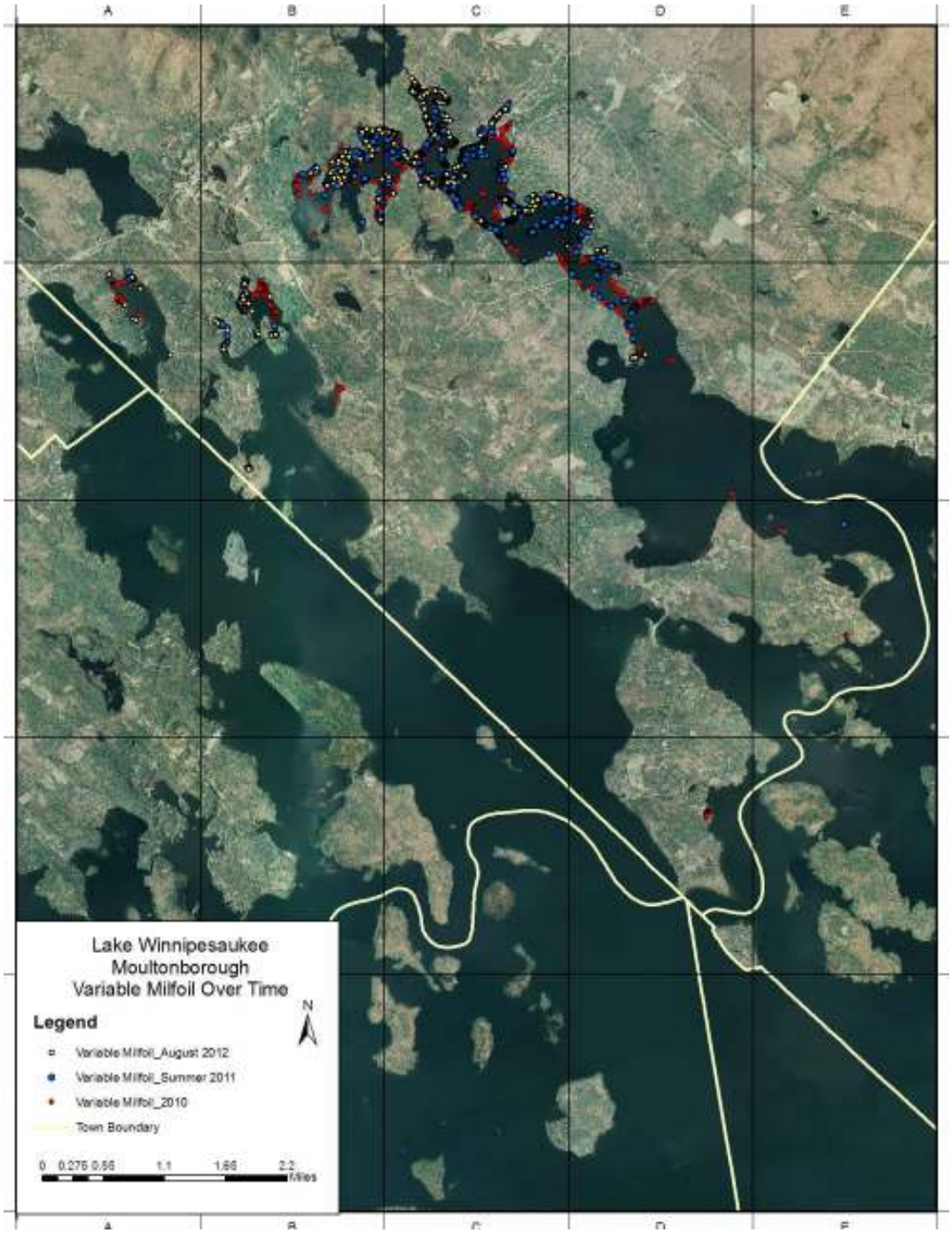
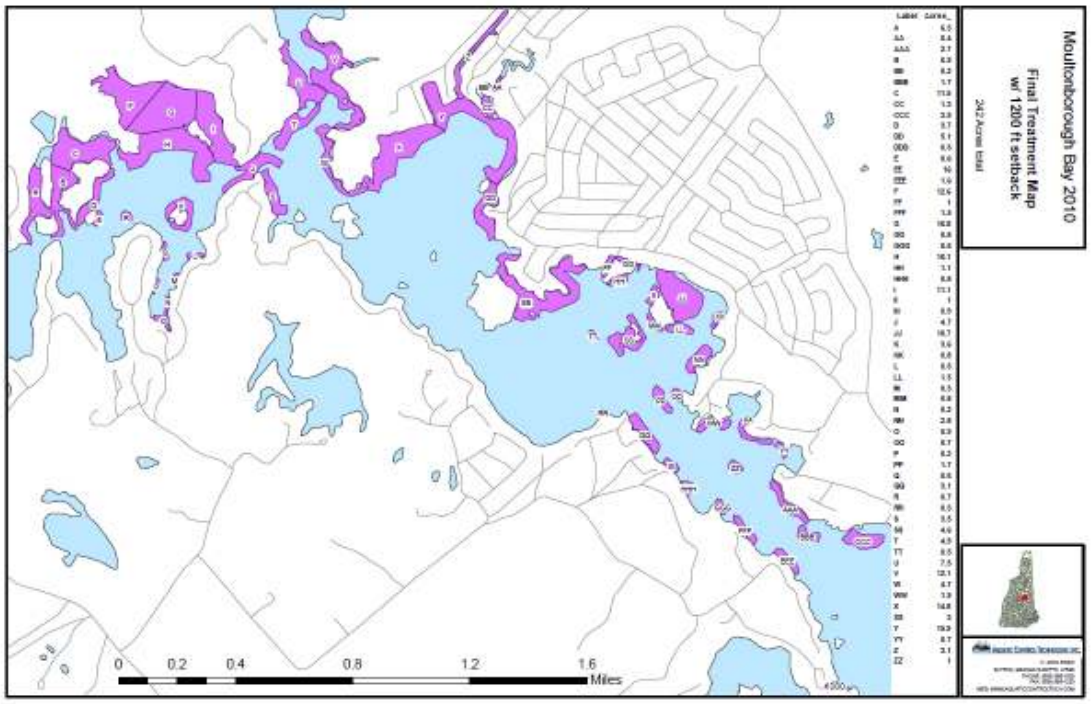
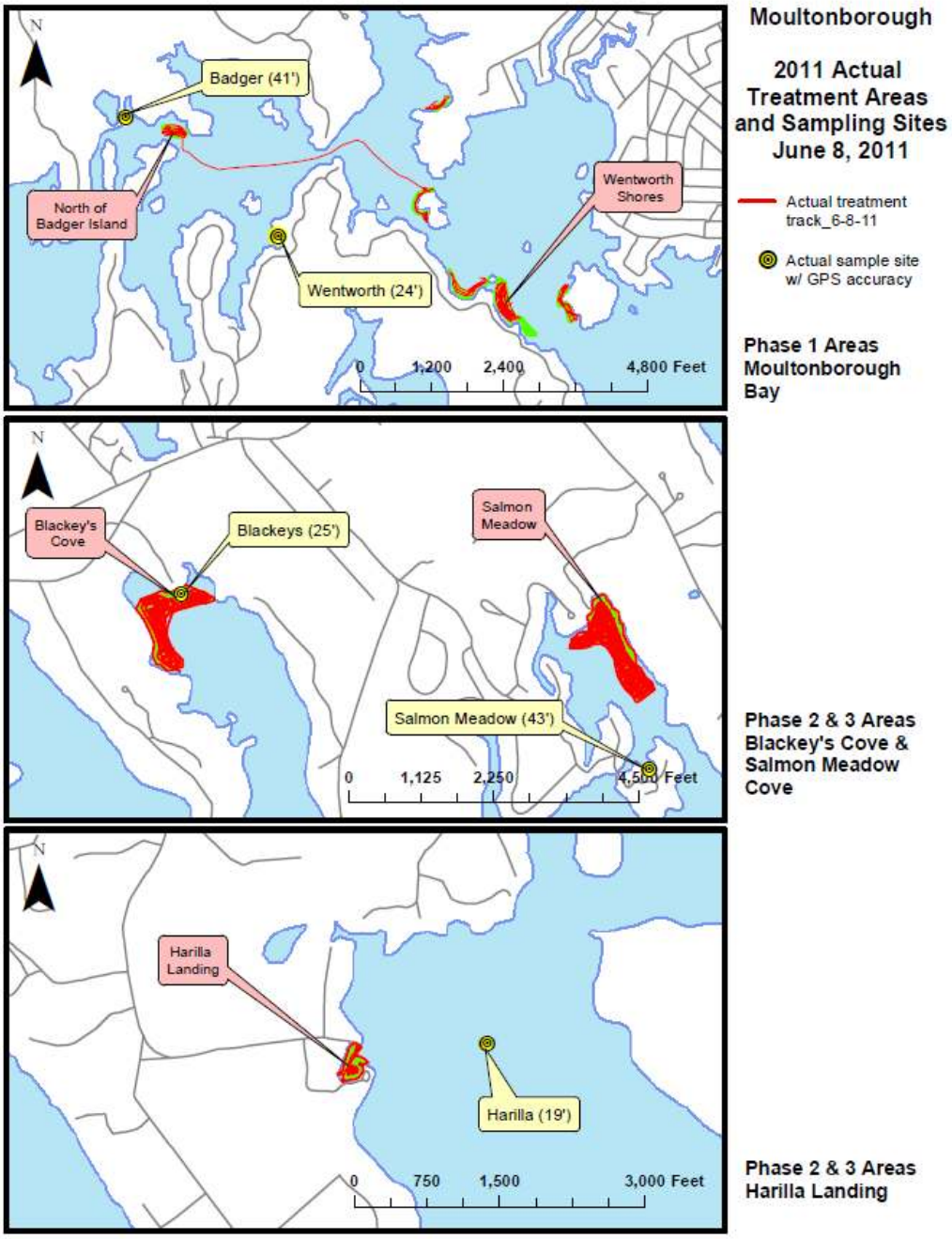


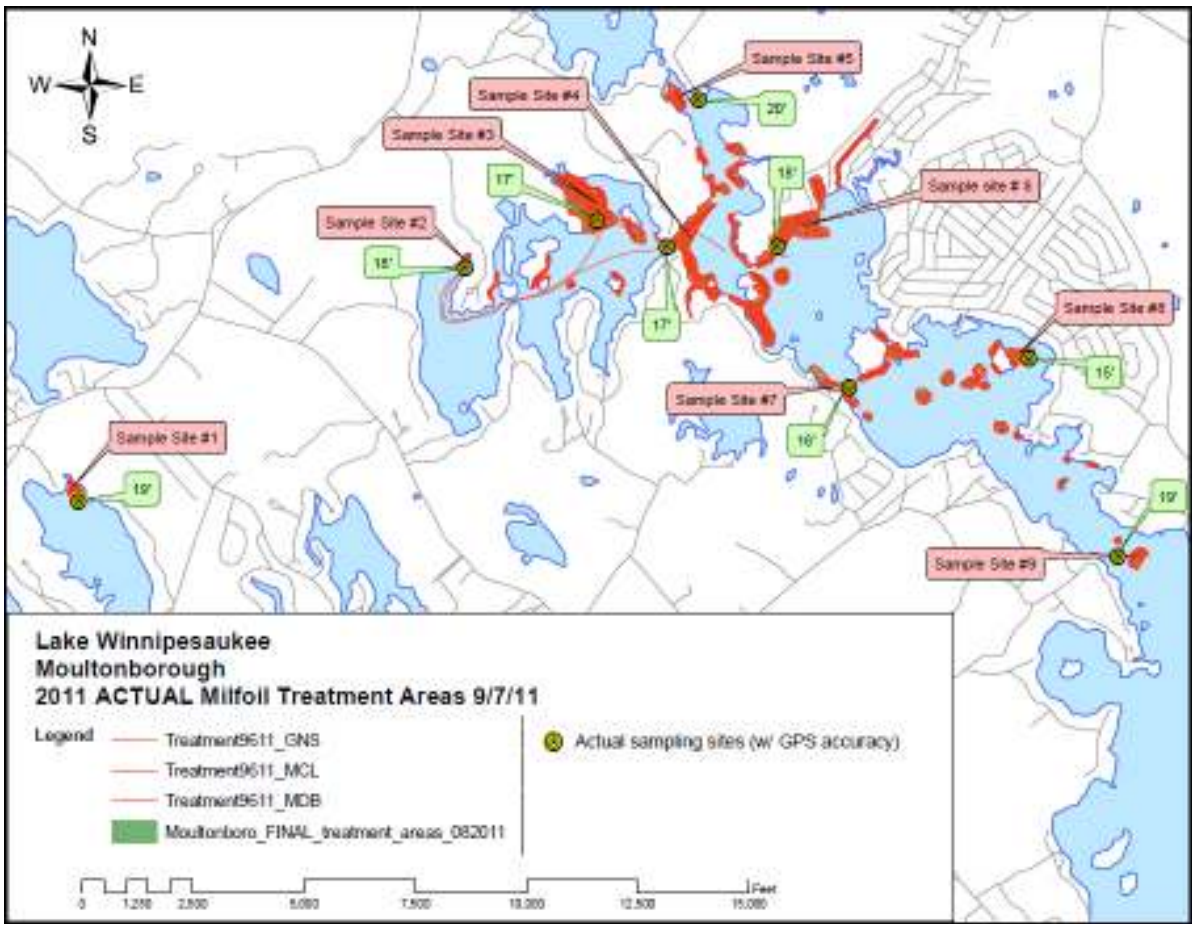
Figure 2: Variable Milfoil Control Actions

2010 (map produced by Aquatic Control Technology)

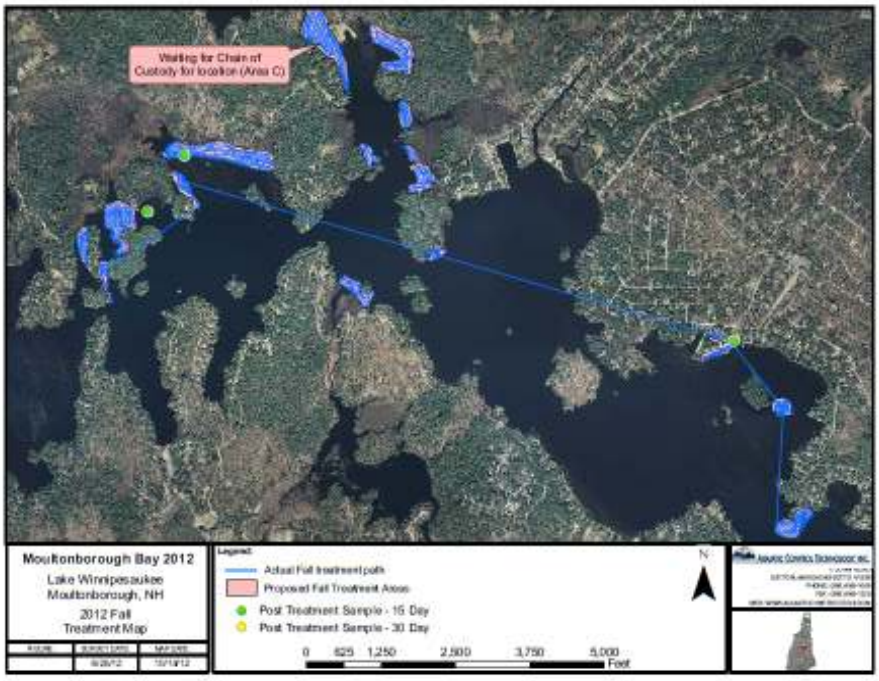


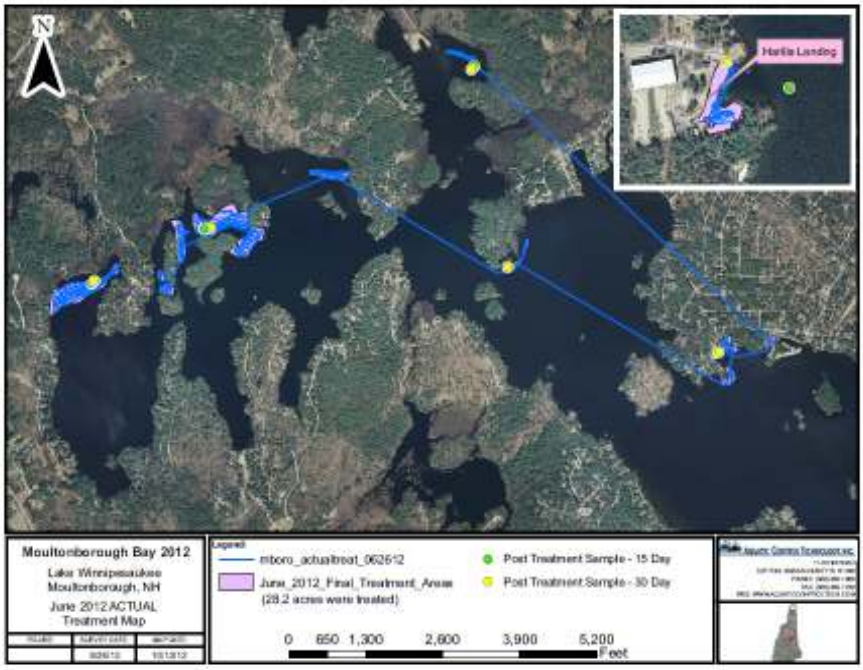
2011 (maps produced by Aquatic Control Technology)




N
W
E
S
Sample Site #5
Sample Site #4
Sample Site #3
Sample Site #2
Sample site # 6
Sample Site #8
Sample Site #7
Sample Site #1
Sample Site #9
20'
17'
18'
17'
15'
16'
19'
19'
Lake Winnipesaukee
Moultonborough
2011 ACTUAL Milfoil Treatment Areas 9/7/11
Legend
Treatment9611_GNS
Treatment9611_MCL
Treatment9611_MDB
Moultonboro_FINAL_treatment_areas_082011
Actual sampling sites (w/ GPS accuracy)
0
1,250
2,500
5,000
7,500
10,000
12,500
15,000
Feet

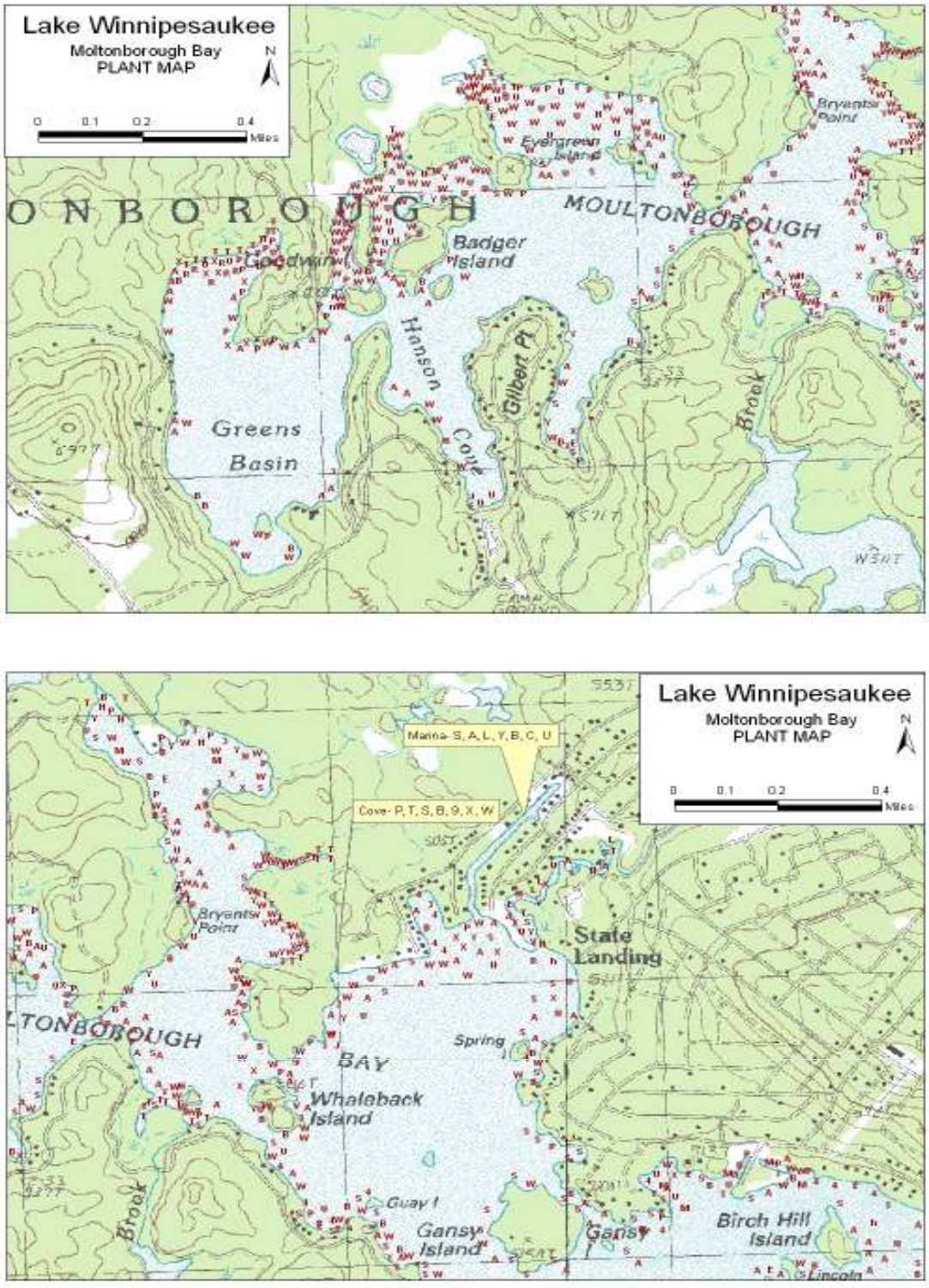
2012 (maps produced by Aquatic Control Technology)

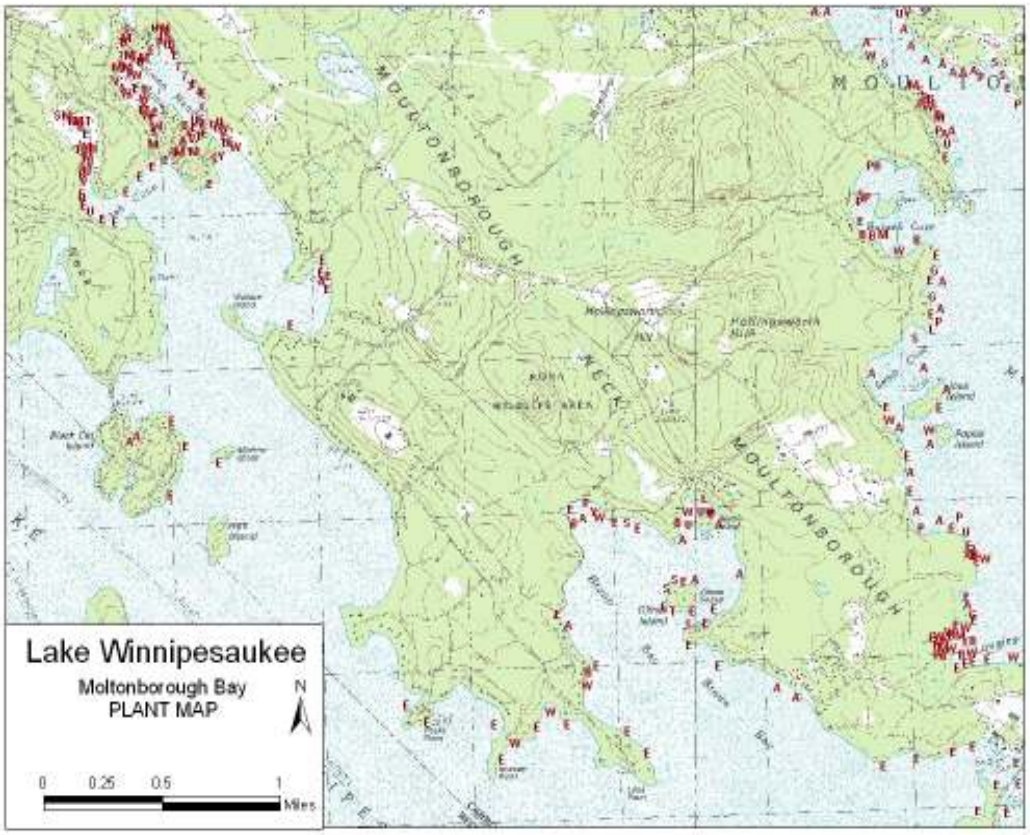


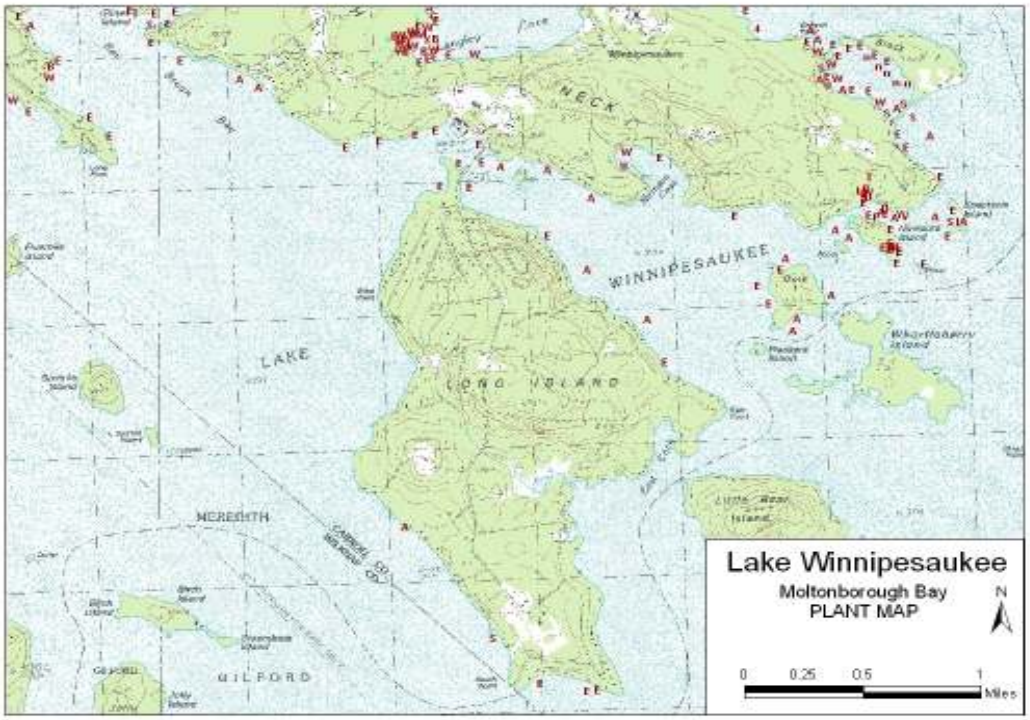


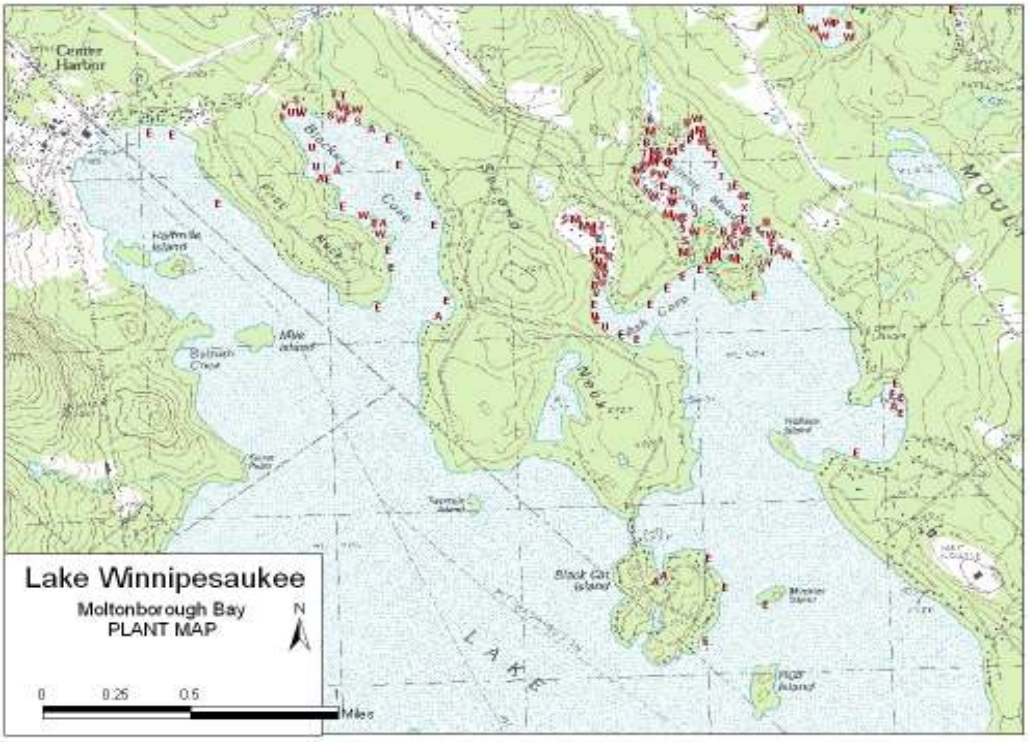
2013 (proposed)

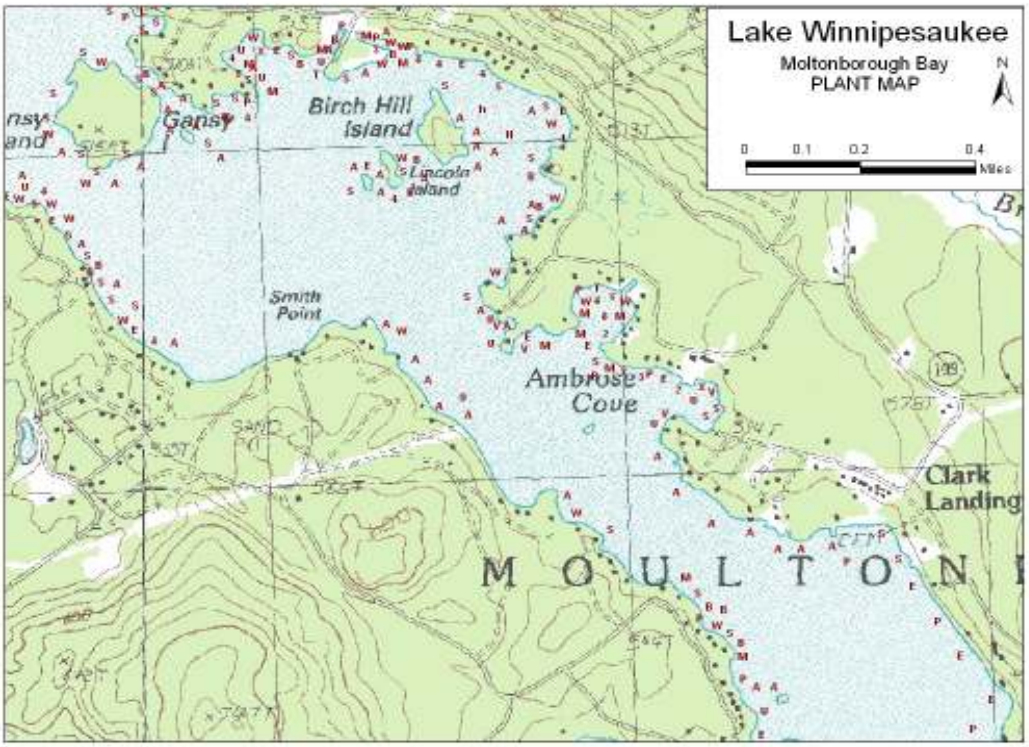
Figure 3: Map of Native Aquatic Macrophytes




MOULTONBOROUGH
NECK
MOULTONBOROUGH
Lake Winnipesaukee
Moltonborough Bay
PLANT MAP
N
0 0.25 0.5 1
Miles


NECK
WINNIPESAUKEE
LAKE
LONG ISLAND
MEREDITH
GILFORD
Lake Winnipesaukee
Moltonborough Bay
PLANT MAP
N
0 0.25 0.5 1
Miles


Center Harbor
Lake Winnipesaukee
Moltonborough Bay
PLANT MAP
N
0
0.25
0.5
Miles


Lake Winnipesaukee
Moltonborough Bay
PLANT MAP
N
0
0.1
0.2
0.4
Miles
Gansy
Birch Hill Island
Lincoln Island
Smith Point
Ambrose Cove
Clark Landing
MOULTON

Plant Key

Symbol*	Common Name	Latin Name
n	Naiad	*Najas sp.*
l	Water lobelia	*Lobelia dortmanna*
E	Pipewort	*Eriocaulon septangulare*
S	Bur-reed	*Sparganium*
B	Watershield	*Brasenia schreberi*
W	White water-lily	*Nymphaea*
Y	Yellow water-lily	*Nuphar*
A	Bassweed	*Potamogeton amplifolius*
P	Pickerelweed	*Pontedaria cordata*
U	Bladderwort	*Utricularia*
X/4	Pondweed species	*Potamogeton*
T	Cattail	*Typha*
J	Rush	*Juncus*
G	Grassy pondweed	*Potamogeton gramineus*
p/2	Clasping-leaf pondweed	*Potamogeton perfoliatus*
8/g	Grassy arrowhead	*Sagittaria sp.*
V	Tapegrass	*Vallisneria americana*
e	Waterweed	*Elodea*
H	Floating heart	*Nymphoides cordata*
7	Nitella	*Nitella*
C	Coontail	*Ceratophyllum*
9	Water marigold	*Megalodonta bechii*
L	Purple loosestrife	*Lythrum salicaria*

*Note that some plants may be depicted by two symbols as mapping was done over time and alternate symbols may have been used to depict the same plant.

Figure 4: Bathymetric Map

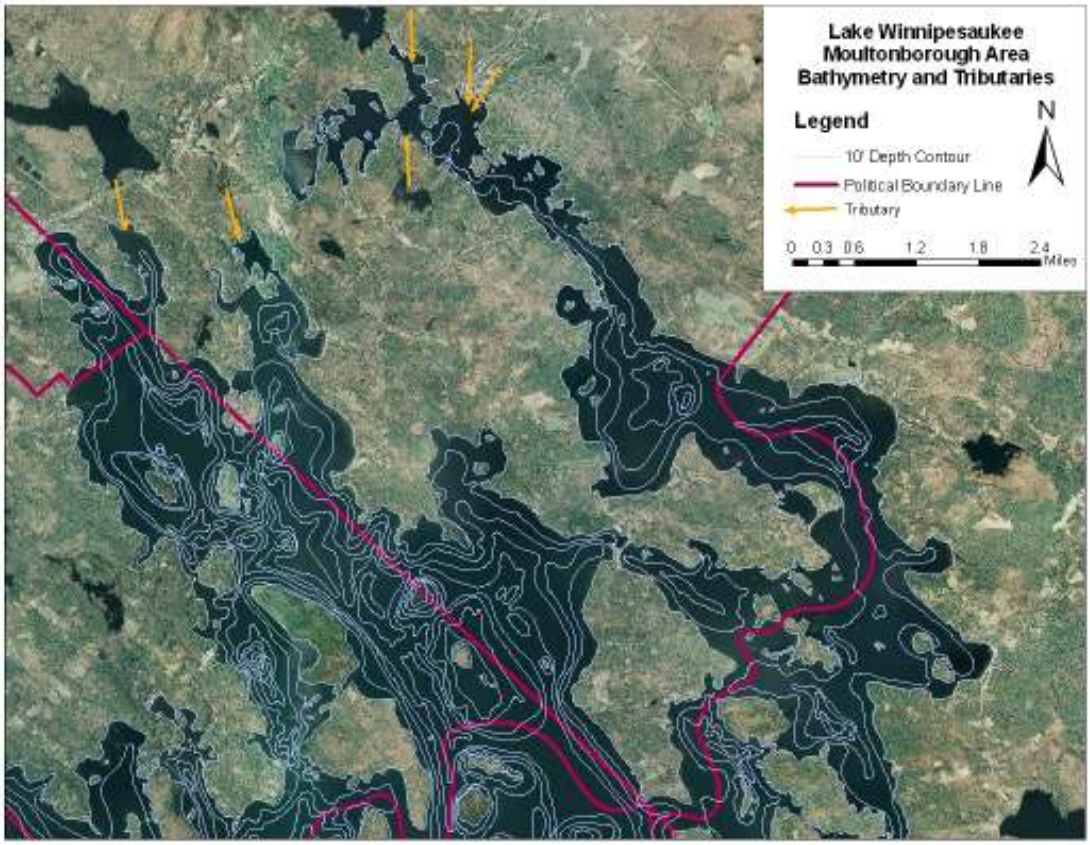
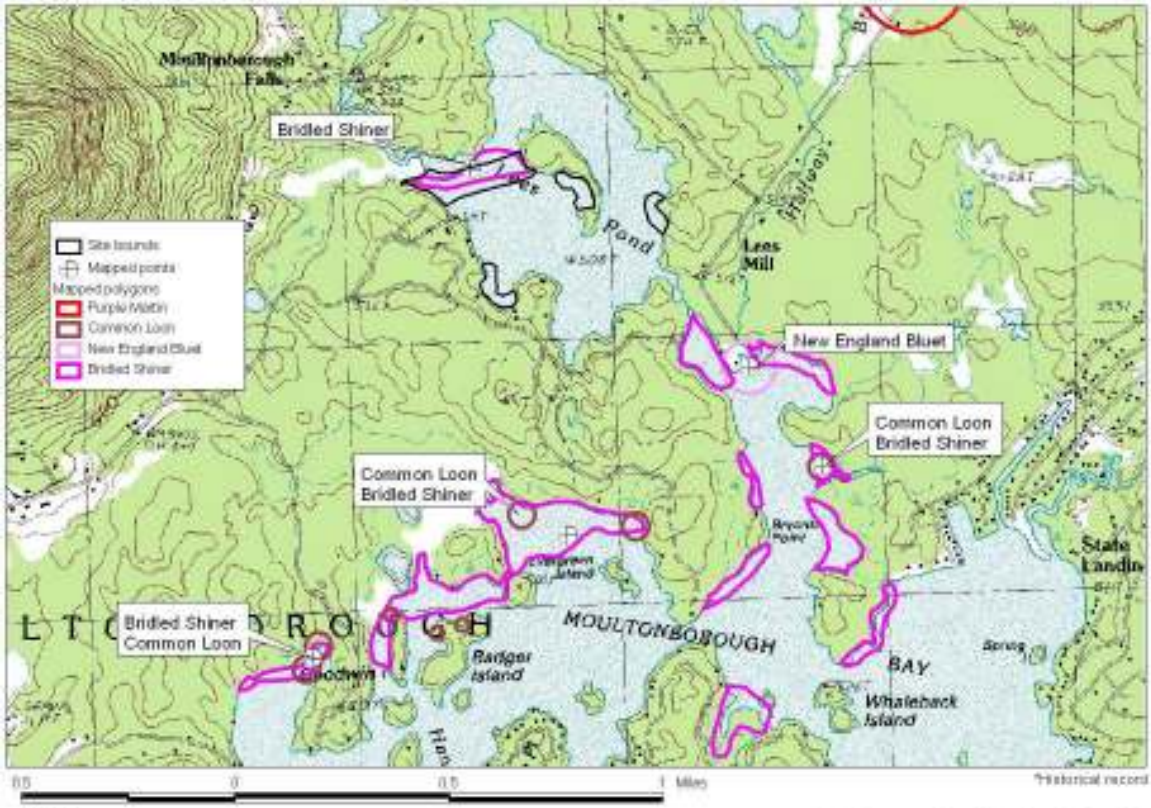


Figure 5: Critical Habitats or Conservation Areas

NH Natural Heritage Bureau

Known locations of rare species and exemplary natural communities

Note: Mapped locations are not always exact. Occurrences that are not in the vicinity of the project are not shown.



1:15000

*Historical record

Valid for one year from this date. 17 Dec 2012

Figure 6: Public Access Sites, Swim Areas

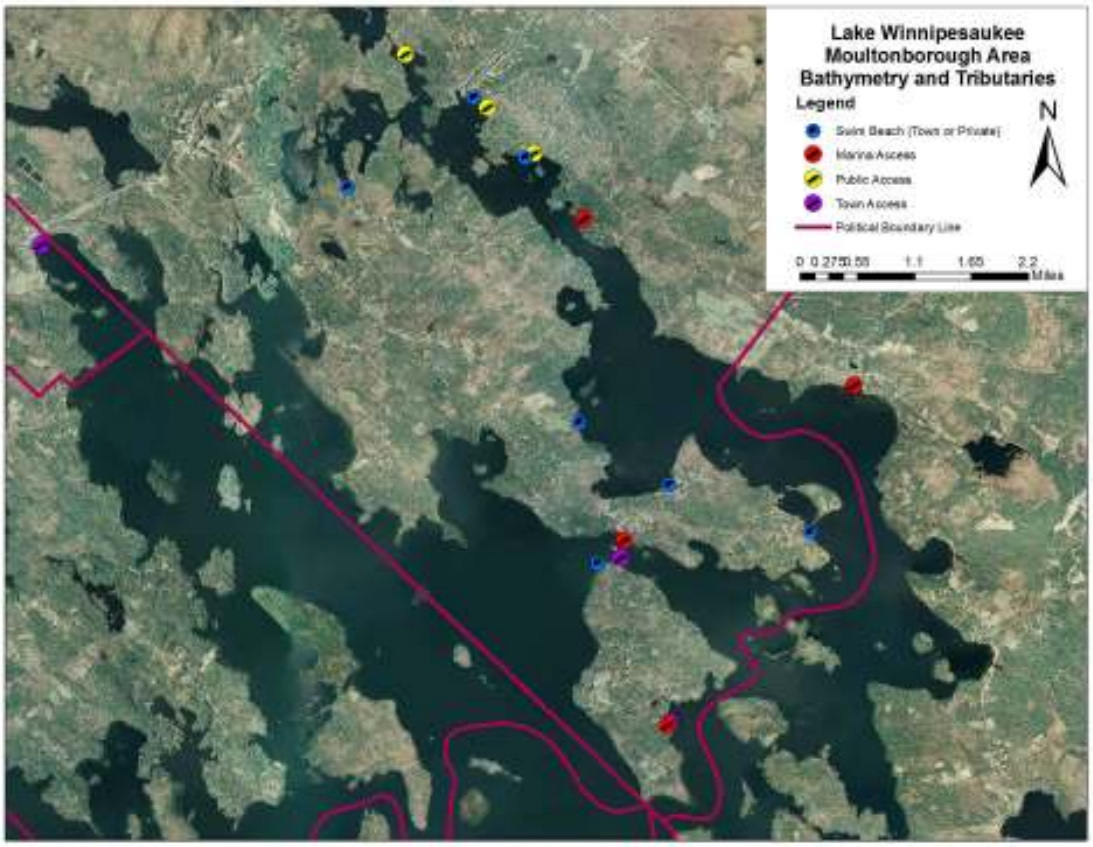


Figure 7: Wells and Water Supplies

Appendix A Selection of Aquatic Plant 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 within an infested waterbody if it is localized in one portion of that waterbody (such as in a cove or embayment), or if a whole lake is infested action may be taken to prevent the downstream migration of fragments or propagules. This could be achieved through the use of fragment barriers and/or Restricted Use Areas or other such physical means of containment. Other control activities may also be used to reduce the infestation within the containment area.

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. Feasibility of control or control options may be revisited if new information, technologies, etc., develop.

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 and Diver Assisted Suction Harvesting(DASH)

- Hand-pulling 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').
- DASH should be used for more expansive growth of greater densities
- Can be used if plant density is low, or if target plant is scattered and not dense.
- 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).
- If a waterbody is fully infested and no other control options are effective, mechanical harvesting can be used to open navigation channel(s) 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 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 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 unless approved by Department of Agriculture.
- 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). All three products successfully reduced variable milfoil growth, and the study shows that the two newer formulations of 2,4-D (Sculpin and Renovate MaxG) could be added to the available options for herbicide selection.

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.

Other aquatic herbicides are also used in New Hampshire when appropriate (glyphosate, copper compounds, etc). The product of choice will be recommended based on what the target species is, and other waterbody-specific characteristics that are important to consider when selecting a product.

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.

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