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

Danforth Pond System
Freedom, 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 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 Danforth Pond System

Variable milfoil (*Myriophyllum heterophyllum*) became established in Danforth Ponds in Freedom, New Hampshire around 2000, though some records date the introduction to the late 1980s or early 1990s (personal communication with Dr. C. Barre Hellquist, botanist). The plant quickly colonized several areas of the different basins that make up the chain of Danforth Ponds, specifically Middle and Lower Danforth Ponds. In 2010, DES documented a new infestation of variable milfoil in Upper Danforth Pond (also known as Huckins Pond), in one small cove area.

Figure 1 illustrates the distribution of variable milfoil infestations in this waterbody over time, with general area labels shown on the map for ease of reference. Figure 2 illustrates, over several maps, the sequence of exotic plant control actions over time, including one for the upcoming growing season.

Variable milfoil plants became well-established over the years, with dense mature plant growth in the middle basin of the chain of lakes in particular. The root crowns are likely mature and management efforts, particularly herbicide treatment, may need to be repeated in consecutive years to fully target the root crowns. Additionally, variable milfoil has flowered annually in the middle basin and it is expected that there is an established seed bank in the lake sediments that could germinate for years to come (data from recent studies between DES and the Army Corps of Engineers Environmental Research and Development Center shows that seeds are viable for several years), so if the standing stock of variable milfoil is successfully reduced through herbicide use and diving, efforts of volunteer monitors in routinely performing Weed Watching activities for early detection to guide diver work

will be critical for the long-term effectiveness of control efforts in this waterbody.

The following table provides a summary of each area indicated in Figure 1, based on updated data from each year (as available) at the end of the growing season. Note that infestations prior to 2009 did not involve detailed mapping or record keeping.

Area	Location/Area Description	Year	Description of Growth
C1, D1	Upper Danforth Pond	2008	No milfoil growth
		2009	No milfoil growth
		2010	New variable milfoil growth in northern-most cove of Upper Danforth, plus in narrows between Upper Danforth and northern part of lower basin of Upper Danforth Pond
		2011	Scattered stems and small patches of milfoil
		2012	Herbicide treatment controlled thicker growth, some stems remain, new growth in other areas of Upper Danforth
		2013	Expanding milfoil growth throughout Upper Danforth
		2014	Sparse growth in northern cove early season, late season milfoil patches in basin increased
		2015	Early season growth similar to year before, growing season management reduced some early season growth
		2016	Milfoil was more expansive early season in this basin, and it was reduced somewhat by late season, though growth was still scattered and fairly common.
		2017	Scattered stems early season in May, increasing over the summer despite dive efforts. Densities lower than in past years though, but milfoil still present.
		2018	Scattered stems early season in May, increasing over the summer despite dive efforts. Densities lower than in past years though, but milfoil still present.
		2019	Patchy growth around shore and in coves at the end of May. Without treatment this year, or early diving, milfoil expanded around the shoreline of the upper basin, increasing in density in some areas.
		2020	Patchy growth around shore and in coves
C2, C3	River connecting Upper and Middle Danforth Pond, including lower (southern) basin of	2008	No documented growth
		2009	No Documented growth
		2010	Small patches of growth documented in C2, several large patches of growth in C3
		2011	Patchy growth expanding some in C2, dense

Area	Location/Area Description	Year	Description of Growth
	Upper Danforth Pond		growths in C3
		2012	Increasing growth in river sections, expanded patches, more single stems
		2013	Scattered patchy growth in river
		2014	Minimal growth early season, patchy late season
		2015	Scattered patches of growth and single stems
		2016	Scattered single stems and small patches throughout the river channel, there does not appear to be much change from year to year despite diving efforts. Divers should focus more time in this area to clear patches that could become fragmented due to boating or fishing activities in the river.
		2017	Very sparse milfoil early season in May, increase to scattered patches by August, despite diving.
		2018	Scattered stems and small clumps, overall low abundance in river system.
		2019	Milfoil growth present as single stems in the river in May. Without treatment or early season diving, milfoil expanded through the river over the summer.
		2020	Scattered stems, a few patches
A3	Western coves of Middle Danforth	2008	Patchy growth in eastern coves, some large patches, growth extending down to 12+ water depths
		2009	Patchy growth in eastern coves, some large patches, growth extending down to 12+ water depths
		2010	Several thick patches of growth in eastern coves
		2011	Variable milfoil much reduced following management efforts, only single stems or small clumps
		2012	Single stems
		2013	Scattered stems
		2014	Scattered sparse stems in May, patchy growth in cove in August
		2015	Scattered patchy growth along shore, reduced compared to past years
		2016	Reduced growth in 2016 in this area, limited small patches and scattered stems.
		2017	Increased growth this year compared to the last couple of years.
		2018	Lower density overall in this area in 2018. Milfoil present but only as scattered stems and small clusters.
		2019	Patchy growth in this area in late May, with expansion of milfoil footprint by mid-August

Area	Location/Area Description	Year	Description of Growth
			due to lack of herbicide treatment or timely diving.
		2020	Moderately sized patches of variable milfoil prior to treatment, much reduced after treatment in these areas
B3	Central and eastern portions of Middle Danforth Pond and lowest section of connecting river	2008	Patchy growth around the shoreline areas of Middle Danforth
		2009	Patchy growth around the shoreline areas of Middle Danforth
		2010	Northern cove of Middle Danforth supporting thick growth at mouth of stream, south eastern shoreline has patchy/moderate growth
		2011	Variable milfoil much reduced following management efforts, only single stems or small clumps remain in north cove of Middle Danforth
		2012	Patchy growth in northern cove at mouth of steam, and in stream itself
		2013	Increasing stems/patches in northern cove of Middle Danforth, moderate patches in mouth of stream
		2014	Scattered stems in May, increased patches in August
		2015	Increased patchy growth around campground beach and docking system
		2016	Some patchy growth though reduced compared to recent years.
		2017	Increased growth this year compared to the last couple of years.
		2018	Scattered patchy stems. Low density.
		2019	Patchy growth around campground docks and adjacent cove in late May. Without treatment or diving, milfoil persisted through the active growing season, and was present in a similar footprint in mid-August.
		2020	Patchy growth along shoreline area
B4	Narrows between Middle and Lower Danforth Ponds, and northern half of Lower Danforth Pond	2008	Large patches of growth scattered throughout narrows
		2009	Expanded thicker growth in narrows, some growth in northeastern corner of Lower Danforth
		2010	Thick and expansive patches of growth
		2011	Overall variable milfoil growth reduced, small patches persist
		2012	Scattered stems
		2013	Scattered stems
		2014	Scattered stems in narrows in May and August
		2015	Higher early season growth in narrows and eastern cove; reduced growth by August due to

Area	Location/Area Description	Year	Description of Growth
			control practices
		2016	Reduced growth though some milfoil plants are still scattered among the pondweeds up the middle of this narrow section.
		2017	Increased growth this year compared to the last couple of years.
		2018	Scattered and patchy stems. Low density.
		2019	A couple of milfoil plants noted mid-channel in late May, with a cluster of plants in small coves adjacent to the channel at that time. Expanded growth by August in channel.
		2020	Several large and expansive patches in narrows
B5	Southern half of Lower Danforth Pond and outflow stream to Broad Bay of Lake Ossipee downstream	2008	One small patch of growth on the eastern shoreline
		2009	Patchy growth expanding along eastern shoreline
		2010	No growth observed
		2011	No growth observed in Lower Danforth, single stems or patches observed in outflow stream
		2012	No growth observed (divers did some hand removal work in outflow river)
		2013	No growth in Lower Danforth, scattered stems in outflow river
		2014	No growth in Lower Danforth, scattered stems in outflow river
		2015	Scattered single stems in outlet channel; no growth observed in lower lake basin
		2016	No milfoil growth observed in the lower basin, a few scattered milfoil stems in the channel connecting to Broad Bay.
		2017	Scattered single stems, one small few-stemmed clump.
		2018	No growth observed.
		2019	One milfoil stem observed in late May along southern shoreline of Lower Danforth, not observed in August survey. Channel between the Danforths and Broad Bay had scattered but low density milfoil in May and August.
		2020	None observed
Ligouri Cove	Ligouri Cove on the north shore of the channel connecting Leavitt and Berry Bays, which falls within the town of Freedom	2018	Large area of dense variable milfoil growth in this cove during the summer growing season.
		2019	Ligouri Cove looked better this year, with lower density growth than recent years.
		2020	A couple of small stems only

In terms of the impacts of the variable milfoil in the system, there are several (64) houses around the shoreline of Middle and Lower Danforth Ponds, with

mostly seasonal cottages, though there are a few year-round dwellings. There are also 23 back lots with lake rights.

Lake residents have expressed frustration with the exotic plant growth, citing fouling of their swim beaches with numerous washed up fragments, swim impairments (particularly near the commercial campground and section between Middle and Lower Danforth Bays, and concerns about the whole pond being choked with the invasive plant.

Campground owners on Middle Danforth Pond have concerns about the safety of their campers in their swim beach area, and the recreational values of the pond. Additionally, the invasive plant infestation in this waterbody is a continuous threat to Lake Ossipee, which is immediately downstream of the Danforth Pond chain of lakes. There is much boat traffic migrating through the channel connecting Ossipee with the Danforth chain of lakes, not to mention continuous outflow of water and variable milfoil fragments through the river as well.

The periphery of the Danforth Ponds is relatively shallow but it drops off quickly with distance from shore, with suitable sediments for growth, not to mention excellent clarity so that plants could root deeper down in the water (to about 15 feet or more) and still gain adequate sunlight for growth.

Milfoil Management Goals and Objectives

The goal for Danforth Ponds is the reduction of overall biomass and distribution of variable milfoil in the system, with the eventual eradication (if feasible) using an Integrated Pest Management Approach.

Local Support

Town or Municipality Support

The town of Freedom appreciates the importance of keeping the Danforth Ponds system usable and controlling the variable milfoil. The town has allocated funds for milfoil hand-removal for the past several years. Both the town and several private entities have come forward over the years with donations for milfoil control.

Lake Association Support

While there is no formally established lake association on the Danforth Ponds system, a number of concerned lake residents are actively working to coordinate control activities and have become active in the Weed Watcher

Program. They are also working closely with town and other local entities to conduct outreach and education activities, monitoring activities and fundraising activities.

Since 2010, local efforts have been enhanced with the formation of the Freedom Aquatic Invasives Species Committee (FAISC), which guides activities related to milfoil mapping and control.

Waterbody Characteristics

The following table summarizes basic physical and biological characteristics of Danforth Ponds, 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).

Parameter/Measure	Value/Description
Lake area (acres for all three basins)	122.4
Watershed area (acres)	11,771.03
Shoreline Uses (residential, forested, agriculture)	Residential, forested, commercial (campground)
Max Depth (ft)- Lower/Middle/Upper	55.4 / 32.01 / 21.45
Mean Depth (ft)- Lower/Middle/Upper	23.4 / 15.51 / 8.9
Trophic Status- Lower/Middle/Upper	Mesotrophic
Color (CPU) in Epilimnion- Lower/Middle/Upper	19.5 / 20.5 / 23.5
Clarity (m)- Lower/Middle/Upper	15.51 / 16.17 / 12.87
Flushing Rate (yr-1)- Lower/Middle/Upper	31.6 / 29.7 / 56.7
Natural waterbody/Raised by Damming/Other	Natural
Invasive Plants (Latin name)	Variable milfoil *(Myriophyllum heterophyllum)*
Infested Area (acres)	See Figures for historic and current distributions
Distribution (ringing lake, patchy growth, etc)	See Figures for historic and current distributions
Sediment type in infested area (sand/silt/organic/rock)	Sandy/rocky/silty
Rare, Threatened, or Endangered Species in Waterbody (according to NH Natural Heritage Bureau (NHB) Inventory review)	2021 Review: Coastal plain grass-leaved-goldenrod (*Euthamia caroliniana*) Comb-leaved mermaidweed (*Proserpinaca pectinata*) Common loon (*Gavia immer*) Historical Listings: Lake quillwort (*Isoetes lacustris*)

A native aquatic vegetation map and key from an August 2009 survey (field checked annually, no updates needed) by the DES Biology Section is shown in Figure 3. A bathymetric map is shown in Figure 4.

Beneficial (Designated) Uses of Waterbody

In New Hampshire, beneficial (designated) uses of our waterbodies are categorized into five general areas: 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

According to the NH Fish and Game Department, the primary fishery in Danforth Pond is largemouth bass, white perch, and black crappie. Other species present include yellow perch, chain pickerel, brown bullhead, smallmouth bass, rainbow trout, burbot, and American eel. A species of conservation concern, the bridled shiner, was recorded in 2005 at Trout Pond, which is directly upstream of the Danforth Ponds. Although the Danforth Ponds have not been surveyed, it is possible that bridled shiners are present in the Danforth system.

According to the New Hampshire Wildlife Action Plan, bridled 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, hedge hyssop, tape-like bur-reed, various pondweeds, bladderwort, tape-grass, waterweed, grassy spike rush).

Wildlife

An NHB review in 2019 showed the presence of the common loon (*Gavia immer*) on the lake. There is no expected impact to the loon as a result of control activities. The Fish and Game Department requests that a 100m setback be maintain from active loon nests until July 15th for any control practice (chemical or non-chemical). They also request that no airboats be used during the May through mid-July timeframe for treatments. The loons are more typically associated with the more open areas of the Ossipee Lake system, rather than the narrow basins of the Danforth system based on historic observations from field surveys.

Recreational Uses and Access Points

The Danforth Ponds are used for numerous recreational activities, including boating, fishing, swimming, and water skiing by both pond residents and transient boaters, including visitors to the commercial campground on Middle Danforth Pond. There is much transient boating between Ossipee Lake and the Danforth Ponds through the river channel that connects the ponds with the Ossipee Lake system.

There is a small town boat launch area in the cove opposite the campground beach, and a launch owned by the campground. Access to the Danforth Ponds can also be achieved via the river channel connecting to Broad Bay of Lake Ossipee.

There are generally less than five power boats from 'off the lake' that come in each day, though more come in on holiday weekends or during fishing tournaments. Canoeing and kayaking are more common on the ponds, as the campground owns 50+ non-motorized craft.

There is one designated beach on Middle Danforth which is owned by the campground. 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 beach, there are a few small private swim beaches located on private properties around the pond. There are 20 floating docks and swim platforms around the pond as well. Figure 6 shows the locations commonly used for swimming, and the locations of swim platforms and docks on Lower and Middle Danforth Ponds, as well as the location of the access site.

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 Danforth Ponds is characterized by a mix of native and non-native (variable milfoil, purple loosestrife) plant growth (Figure 3). Native species include a mix of floating plants (white and yellow water-lilies, floating heart, watershield), emergent plants (cattail, bur-reed, pipewort, water lobelia, grassy arrowhead, spike rush, pickerelweed, arrowhead, swamp loosestrife, and three-way sedge), and submergent plants (water naiad, alternate-leaf milfoil, water marigold, hedge hyssop, tape-like bur-reed, various pondweeds, bladderwort, tape-grass, waterweed, grassy spike rush). Native plant communities are mixed around the entire lake, and are characterized as 'scattered to common' by the DES.

Native plant populations have not appeared to change substantially in the lake over the years of milfoil management, and in fact appear to be recolonizing areas where variable milfoil growths have been reduced. The herbicide treatments that have been performed have been very target specific to the milfoils.

In addition to the variable milfoil in the pond, the only other invasive aquatic plant that was observed was purple loosestrife, which was scattered in small areas around the shoreline of the ponds (see Figure 3 for locations).

Historic NHB reviews of the system revealed the possible presence of three state-listed endangered plants in the Danforth Ponds: Lake quillwort (*Isoetes lacustris*), Comb-leaved mermaidweed (*Proserpinaca pectinata*), and Coastal plain grass-leaved-goldenrod (*Euthamia caroliniana*). Only the mermaidweed and goldenrod were listed in the 2019 review, but all species, current and historic, are included in the discussion below.

The *Isoetes lacustris* record is from 1940. No quillworts were observed in any surveys of the ponds on the September 2008 field date, nor have they been documented in more recent macrophyte surveys. If quillworts are present they are not expected to be affected by the 2,4-D treatment, as evidenced at other sites where treatments have been done.

The *Proserpinaca pectinata* record is from 1975, for an area of Hoyt Brook as it enters Broad Bay. The Danforth Ponds flow into the north end of Broad Bay. This plant was not observed during the plant survey in this area, though it is one that tends to grow prostrate on shallow mudflats, which were outside

of the survey area and proposed treatment areas, and could be missed. It is suspected that shifting sands and recreational uses of the waterbody over time may have resulted in reductions in this plant in the lake.

The goldenrod species is more on shore, and documented in a downstream site. Impact is unlikely, but in any event DES will work with the contractors to ensure that overspray on shore is avoided, so as not to impact this species, if it does occur higher up in the watershed than previously documented. Records are as recent as 2018.

Wells and Water Supplies

Figure 7 shows the location of wells, water supplies, well-head protection areas, and drinking water protection areas around the Danforth Ponds, 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

DATE	ACTION	AREA (ac)	ENTITY
10-Jun-02	DIQUAT TREATMENT (1.5 GALLONS/ACRE)	5	LYCOTT
SUMMER 2004	DIVING/HAND REMOVAL AROUND CAMPGROUND AREAS IN MIDDLE DANFORTH	<1	DES DIVERS
SUMMER 2005	DIVING/HAND REMOVAL AROUND CAMPGROUND AREAS IN MIDDLE DANFORTH	<1	CLIFF CABRAL
SUMMER 2006	DIVING/HAND REMOVAL AROUND CAMPGROUND AREAS IN MIDDLE DANFORTH	<1	CLIFF CABRAL

DATE	ACTION	AREA (ac)	ENTITY
SUMMER 2007	DIVING/HAND REMOVAL AROUND CAMPGROUND AREAS IN MIDDLE DANFORTH	<1	CLIFF CABRAL
SUMMER 2008	DIVING/HAND REMOVAL AROUND CAMPGROUND AREAS IN MIDDLE DANFORTH	<1	CLIFF CABRAL
SUMMER 2009	DIVING/HAND REMOVAL AROUND CAMPGROUND AREAS IN MIDDLE DANFORTH (2,760 GALLONS REMOVED, 10 DIVE DAYS)	Scattered areas	CLIFF CABRAL
SUMMER 2010	DIVING/HAND REMOVAL AROUND AREAS G-J AND RIVER SEGMENT BETWEEN UPPER AND MIDDLE DANFORTH (390 GALLONS REMOVED, 2 DIVE DAYS)	5	CLIFF CABRAL
02-Jun-10	2,4-D TREATMENT (100 LBS/ACRE GRANULAR)	21	ACT
07-Jun-11	2,4-D TREATMENT (100 LBS/ACRE GRANULAR)	16	ACT
SUMMER 2011	DASH/DIVING IN RIVER CHANNEL BETWEEN UPPER DANFORTH AND LOWER DANFORTH, AND IN SMALL PATCHES AROUND MIDDLE AND LOWER BASINS (210 GALLONS REMOVED, 4 DIVE DAYS)	5	CLIFF CABRAL
06/18/2012	DIVER/DASH WORK IN DANFORTH BAY, NEAR BACH AND MARINA	160	CLIFF CABRAL
06/19/2012	HUCKINS POND (UPPER DANFORTH) AND RIVER CHANNEL	240	CLIFF CABRAL
06/20/2012	DANFORTH BAY AREA	160	CLIFF CABRAL
25-Sep-12	2,4-D (G), 100 LBS/ACRE	10	ACT
END OF JUNE TO EARLY JULY 2013	HAND PULLING	1210	AB AQUATICS
09/16/2013	2,4-D & TRICLOPYR (G)	20 ACRES	ACT
06/04/2014	DIQUAT TREATMENT (10.9 GALLONS)	10.85 ACREAS	ACT
07/01/2014	HAND PULLING	30	NEW ENGLAND MILFOIL

DATE	ACTION	AREA (ac)	ENTITY
07/03/2014	HAND PULLING	240	NEW ENGLAND MILFOIL
09/11/2014	2,4-D (G) 300 LBS	2.7 ACRES	ACT
10/01/2014	DASH	180	NEW ENGLAND MILFOIL
06/18/2015	2,4-D BEE (G)	12.13 ACRES	ACT
06/29/2015	DASH	100	NEW ENGLAND MILFOIL
06/30/2015	DASH	200	NEW ENGLAND MILFOIL
07/02/2015	DASH	120	NEW ENGLAND MILFOIL
06/13/2016	DASH: Near marina and boat launch	60	AB AQUATICS
06/14/2016	DASH: Near boat dock and ramp	45	AB AQUATICS
06/14/2016	DASH: Cove on eastern shore	5	AB AQUATICS
06/14/2016	DASH: inlet on SW	20	AB AQUATICS
06/15/2016	DASH: South Channel	5	AB AQUATICS
06/15/2016	DASH: Northern Channel	20	AB AQUATICS
06/16/2016	DASH: Northern Channel	20	AB AQUATICS
06/17/2016	DASH: Northern Channel	40	AB AQUATICS
06/20/2016	DASH: Northern channel	30	AB AQUATICS
06/21/2016	DASH: Northern channel	20	AB AQUATICS
06/21/2016	DASH: mouth of N channel and swim area	30	AB AQUATICS
06/22/2016	DASH: N channel/North pond of Danforth	45	AB AQUATICS
06/27/2016	DASH: Northern Danforth Pond near inlet	60	AB AQUATICS

DATE	ACTION	AREA (ac)	ENTITY
06/28/2016	DASH: NW shore heading N in Northern Pond	80	AB AQUATICS
06/29/2016	DASH: N end around to E shoreline	140	AB AQUATICS
06/30/2016	DASH: Heading N along e shoreline	85	AB AQUATICS
07/01/2016	DASH: NE shore by first inlet heading SW	100	AB AQUATICS
09/15/2016	2,4-D BEE (G): Upper Danforth Pond	2142.3 lbs for 19.3 acres	AB AQUATICS
10/10/2016	DASH: Danforth, main pond, near boat ramp	100	AB AQUATICS
10/11/2016	DASH: Cove, near floating boat docks & N channel	40	AB AQUATICS
10/12/2016	DASH: Northern channel	40	AB AQUATICS
10/13/2016	DASH: Northern channel	100	AB AQUATICS
10/14/2016	DASH: Ossipee River Eaton bridge	100	AB AQUATICS
10/17/2016	DASH: Osspiee River, Lovering Brook	140	AB AQUATICS
10/18/2016	DASH: Ossipee River near Eaton bridge	100	AB AQUATICS
10/19/2016	DASH: Ossipee River north of beaver dam	60	AB AQUATICS
05/25/2017	DASH: Marina area	120	AB AQUATICS
05/26/2017	DASH: SE of Marina and SW cove	160	AB AQUATICS
05/30/2017	DASH: Southern Channel	70	AB AQUATICS
05/30/2017	DASH: NW Cove	60	AB AQUATICS
05/30/2017	DASH: Near Boat Launch	50	AB AQUATICS
05/31/2017	DASH: Southern Channel	5	AB AQUATICS
06/01/2017	DASH: Small Cove SE of Launch	60	AB AQUATICS
06/01/2017	DASH: Channel S of Launch	40	AB AQUATICS
06/02/2017	DASH: Channel S of Launch	140	AB AQUATICS
06/02/2017	DASH: Cove SW of Launch	10	AB AQUATICS
06/05/2017	DASH: Channel South of Boat launch	40	AB AQUATICS
06/05/2017	DASH: Cove SW of Launch	30	AB AQUATICS
06/05/2017	DASH: Channel South of Boat launch	10	AB AQUATICS
06/06/2017	DASH: Channel South of Boat launch	40	AB AQUATICS
06/06/2017	DASH: Cove SW of Launch	30	AB AQUATICS

DATE	ACTION	AREA (ac)	ENTITY
06/21/2017	DASH: Channel connecting pond to Broad Bay	60	AB AQUATICS
06/22/2017	DASH: Channel connecting pond to Broad Bay	50	AB AQUATICS
06/22/2017	DASH: Boat ramp and marina of camp ground	60	AB AQUATICS
06/26/2017	DASH: Narrow channel upper and lower ponds	5	AB AQUATICS
06/26/2017	DASH: Southern points upper pond	25	AB AQUATICS
06/27/2017	DASH: SE cove upper pond	5	AB AQUATICS
06/27/2017	DASH: NW Corridor, cove/marsh, upper pond	5	AB AQUATICS
06/27/2017	DASH: Western shore of upper pond	10	AB AQUATICS
09/14/2017	2,4-D (Gran)	10.2 acres	SOLitude
10/02/2017	DASH: Ossipee Lake Marina	30	AB AQUATICS
10/03/2017	DASH: Upper Danforth Pond	50	AB AQUATICS
07/11/2018	2,4-D gran	10.8 acres	SOLitude
08/29/2018	DASH LIGOURI COVE	60 GALLONS	AQUALOGIC
08/30/2018	DASH NORTHERN COVES BROAD BAY	20 GALLONS	AQUALOGIC
09/25/2018	DASH OSSIPEE LAKE MARINA	100 GALLONS	AQUALOGIC
09/26/2018	DASH OSSIPEE LAKE MARINA	75 GALLONS	AQUALOGIC
09/27/2018	DASH OSSIPEE LAKE MARINA	75 GALLONS	AQUALOGIC
09/28/2018	DASH DANFORTH POND	100 GALLONS	AQUALOGIC
10/01/2018	DASH OSSIPEE LAKE MARINA	25 GALLONS	AQUALOGIC
08/26/2019	DASH: Cove near boat ramp	110 GALLONS	AB AQUATICS
08/28/2019	DASH: Coves- boat ramp, near island E coast & marina	110 GALLONS	AB AQUATICS
08/29/2019	DASH: Das dock and S end of marina	100 GALLONS	AB AQUATICS
08/30/2019	DASH: Das dock and S end of marina	100 GALLONS	AB AQUATICS
09/10/2019	DASH: Marina next to beach inside campground	140 GALLONS	AB AQUATICS
09/11/2019	DASH: Dock area next to boat ramp	180 GALLONS	AB AQUATICS
09/12/2019	DASH: Dock area next to boat ramp	160	AB AQUATICS

DATE	ACTION	AREA (ac)	ENTITY
		GALLONS	
09/13/2019	DASH: Dock area above and cove NW side	120 GALLONS	AB AQUATICS
09/16/2019	DASH: Marshy area in NW quadrant	80 GALLONS	AB AQUATICS
09/17/2019	DASH: Docks at Ossipee Lake Marina and river leading	150 GALLONS	AB AQUATICS
09/18/2019	DASH: River to eastern side of beach and landing	60 GALLONS	AB AQUATICS
06/15/2020	HERBICIDE-PROCELLACOR	49 ACRES	SOLITUDE
07/02/2020	DASH	12 GALLONS	AB AQUATICS

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 Danforth Ponds. The following table summarizes DES' control strategy recommendations for Danforth Ponds

Control Method	Use on Danforth Ponds
Restricted Use Areas (RUAs)	The purpose of RUAs and fragment barriers is to contain small areas of exotic aquatic plant growth to

Control Method	Use on Danforth Ponds
and/or Fragment Barriers	prevent them from spreading further in a system. If variable milfoil is reduced by other integrated approaches outlined in this plan, then RUAs and fragment barriers may be a future consideration based on the size, configuration and location of remaining areas of growth.
Hand-pulling	Recommended as a primary means of control for milfoil growth in Lower Danforth and in river channel above Middle Danforth on a regular basis as needed. Other diving work is recommended as follow-up in larger infestation areas as those infestations are reduced by herbicide treatment.
Mechanical Harvesting/Removal	Not recommended due to the risk of fragmentation and drift, and subsequent further spread of the invasive plant.
Benthic Barriers	Recommended for small patches that are 20’ x 20’ in size or less, and where practical.
Herbicides	Herbicide treatment is recommended as a primary means of control only where infestations of the exotic plant are too widespread and/or dense for non-chemical means of control to be effective. There are several areas identified in the Figures attached to this plan that outline areas where herbicide use has been and may be needed to further reduce historic dense infestations of variable milfoil.
Extended Drawdown	Not feasible or practical for this waterbody due to lack of an impoundment structure.
Dredge	Cost prohibitive and not often effective for controlling invasive aquatic plants.
Biological Control	No biological controls are yet approved for use on variable milfoil.
No Control	The variable milfoil infestation in the Danforth Pond system has been expanding annually when control actions are not implemented. A no control option would only allow for further spread of this plant within this system and downstream to the Ossipee Lake system, as evidenced in the history of this infestation prior to coordinated management strategies being

Control Method	Use on Danforth Ponds
	implemented.

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
2017	Weed Watching and marking/reporting of milfoil growth	Local Weed Watchers	Once a month from May through September
	Survey and planning for summer/fall milfoil control actions	DES	May/June
	Diver/DASH work as needed and recommended	Contract Diver	June-September as needed
	Spot herbicide treatment, if needed, based on diver progress as monitored by DES	SŌLitude Lake Management, LLC	June or September
	Survey and planning for next season's control actions	DES	September
2018	Weed Watching and marking/reporting of milfoil growth	Local Weed Watchers	Once a month from May through September
	Survey and planning for summer/fall milfoil control actions	DES	May/June
	Diver/DASH work as needed and recommended	Contract Diver	June-September as needed
	Herbicide treatment, if needed, based on diver progress as monitored by DES	SŌLitude Lake Management, LLC	June or September

Year	Action	Responsible Party	Schedule
	Survey and planning for next season's control actions	DES	September
2019	Weed Watching and marking/reporting of milfoil growth	Local Weed Watchers	Once a month from May through September
	Survey and planning for summer/fall milfoil control actions	DES	May/June
	Diver/DASH work as needed and recommended	Contract Diver	June-September as needed
	Spot herbicide treatment, if needed, based on diver progress as monitored by DES	SŌLitude Lake Management, LLC	June or September
	Survey and planning for next season's control actions	DES	September
2020	Weed Watching and marking/reporting of milfoil growth	Local Weed Watchers	Once a month from May through September
	Survey and planning for summer/fall milfoil control actions	DES	May/June
	Diver/DASH work as needed and recommended	Contract Diver	June-September as needed
	Herbicide treatment, if needed, based on diver progress as monitored by DES	SŌLitude Lake Management, LLC	June or September
	Survey and planning for next season's control actions	DES	September
2021	Weed Watching and marking/reporting of milfoil growth	Local Weed Watchers	Once a month from May through September
	Survey and planning for summer/fall milfoil control actions	DES	May/June

Year	Action	Responsible Party	Schedule
	Diver/DASH work as needed and recommended	Contract Diver	June-September as needed
	Spot herbicide treatment, if needed, based on diver progress as monitored by DES	SŌLitude Lake Management, LLC	June or September
	Survey and planning for next season's control actions	DES	September
2022	Update and revise Long-Term Variable Milfoil Control Plan	DES and Interested Parties	Fall/ Winter

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 management in the subject waterbody.

Figure 1: Map of Variable Milfoil Infestations Over Time

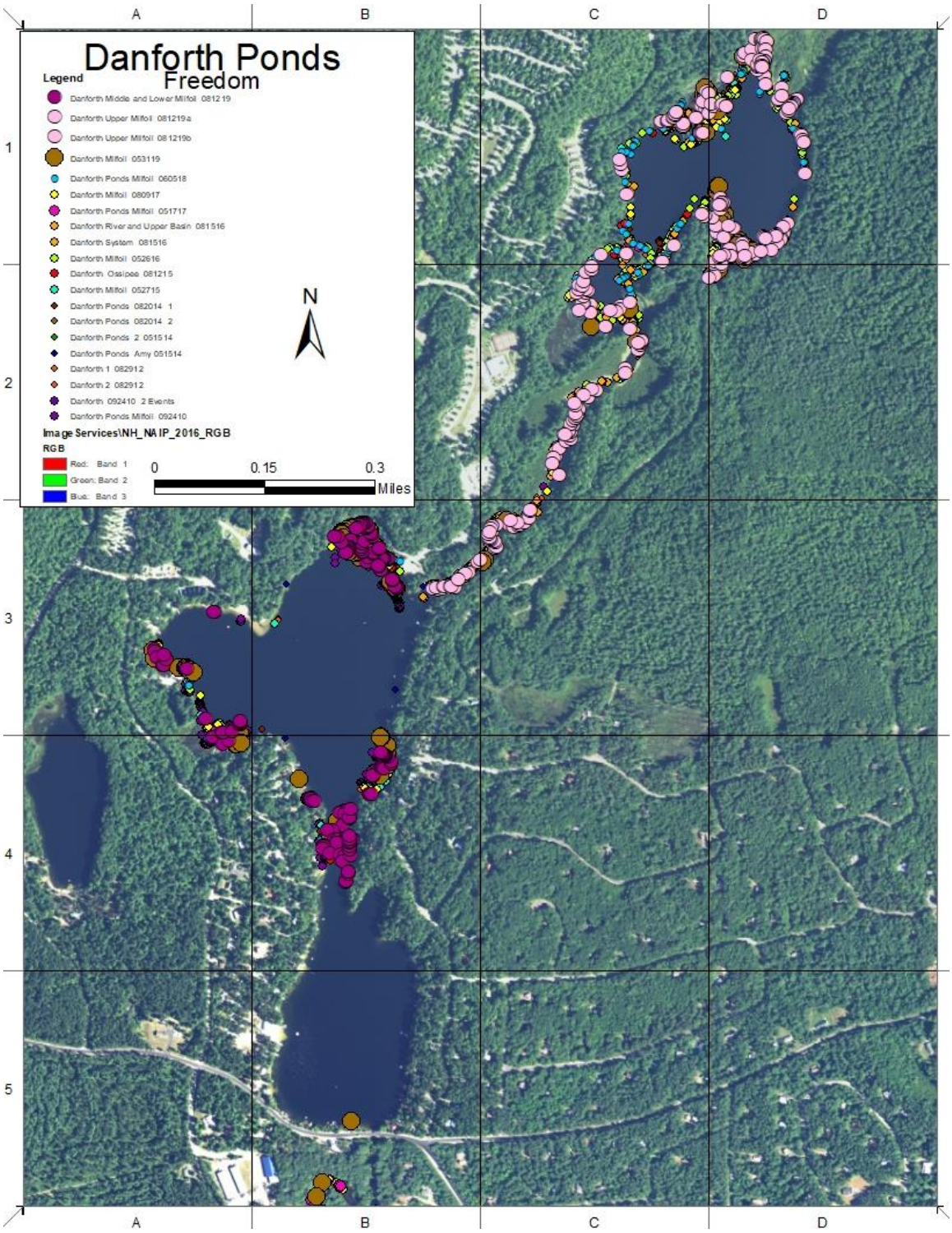
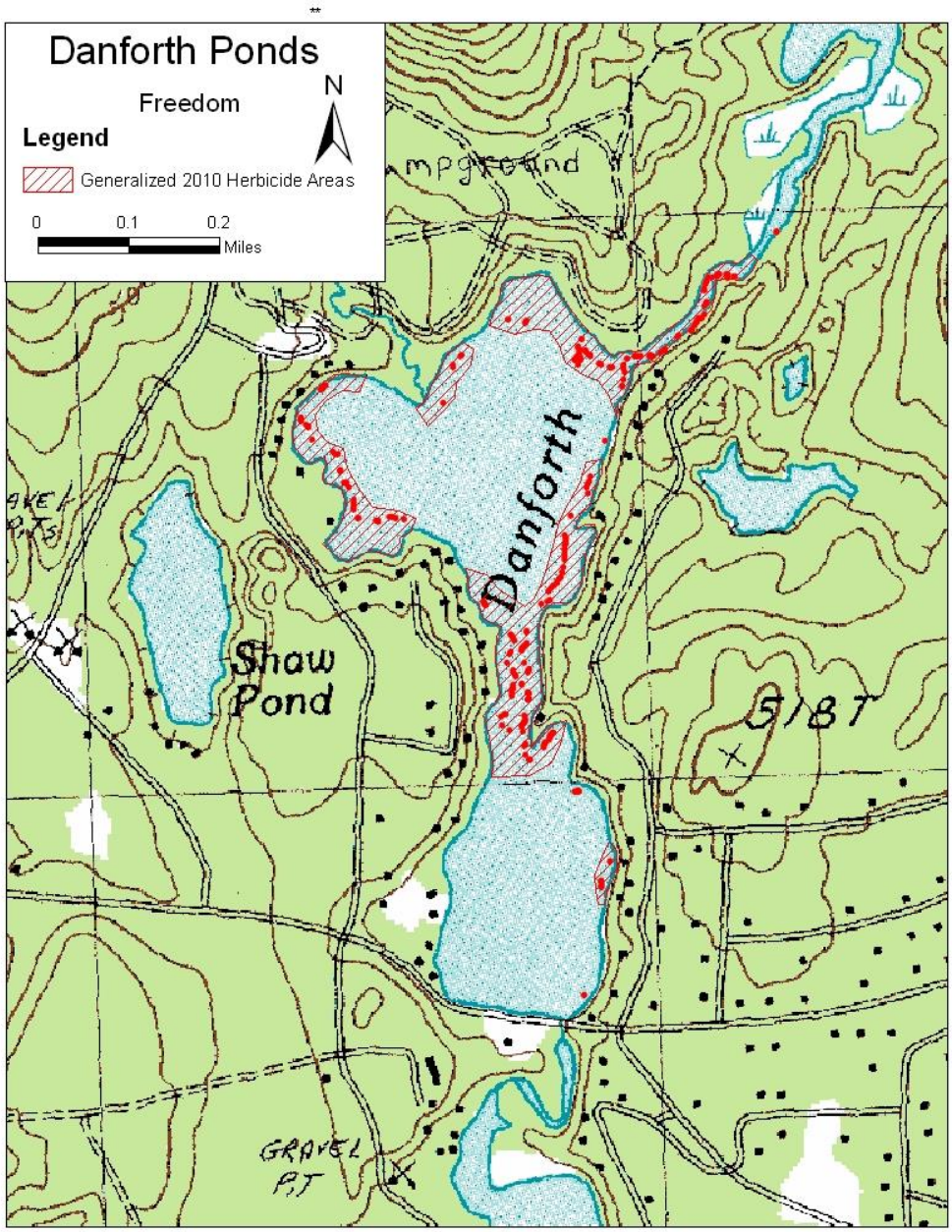
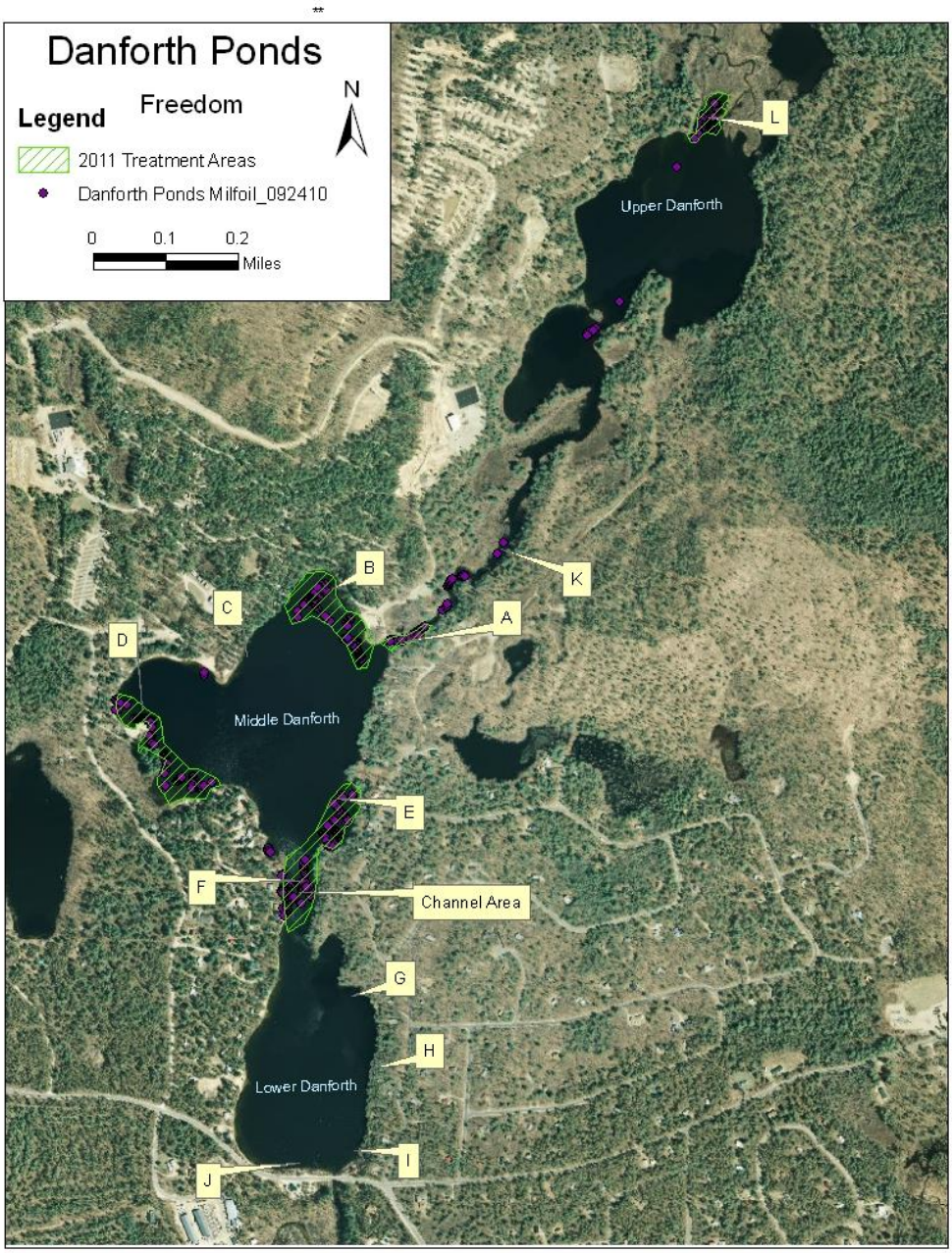


Figure 2: Map of Control Actions Over Time

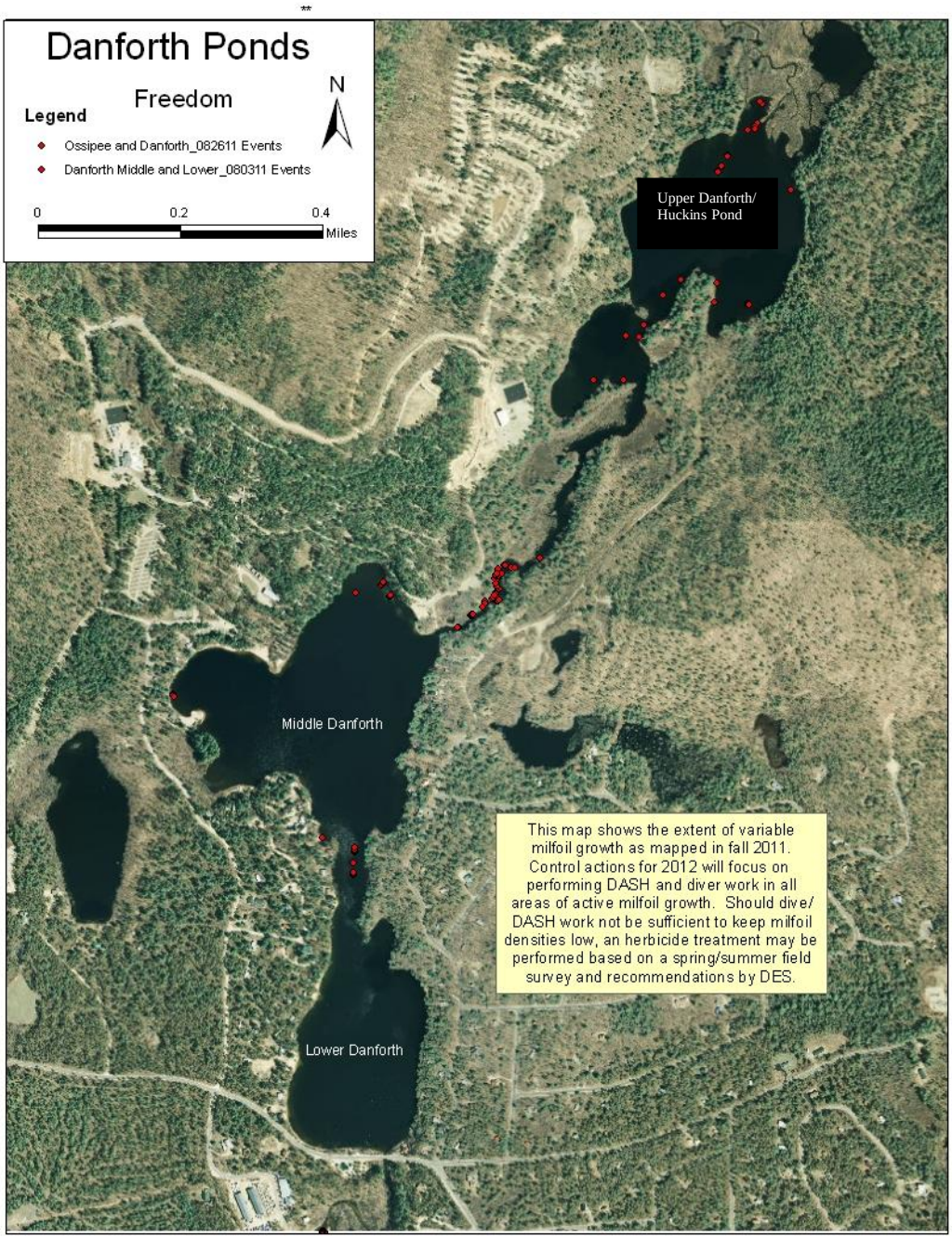
2010



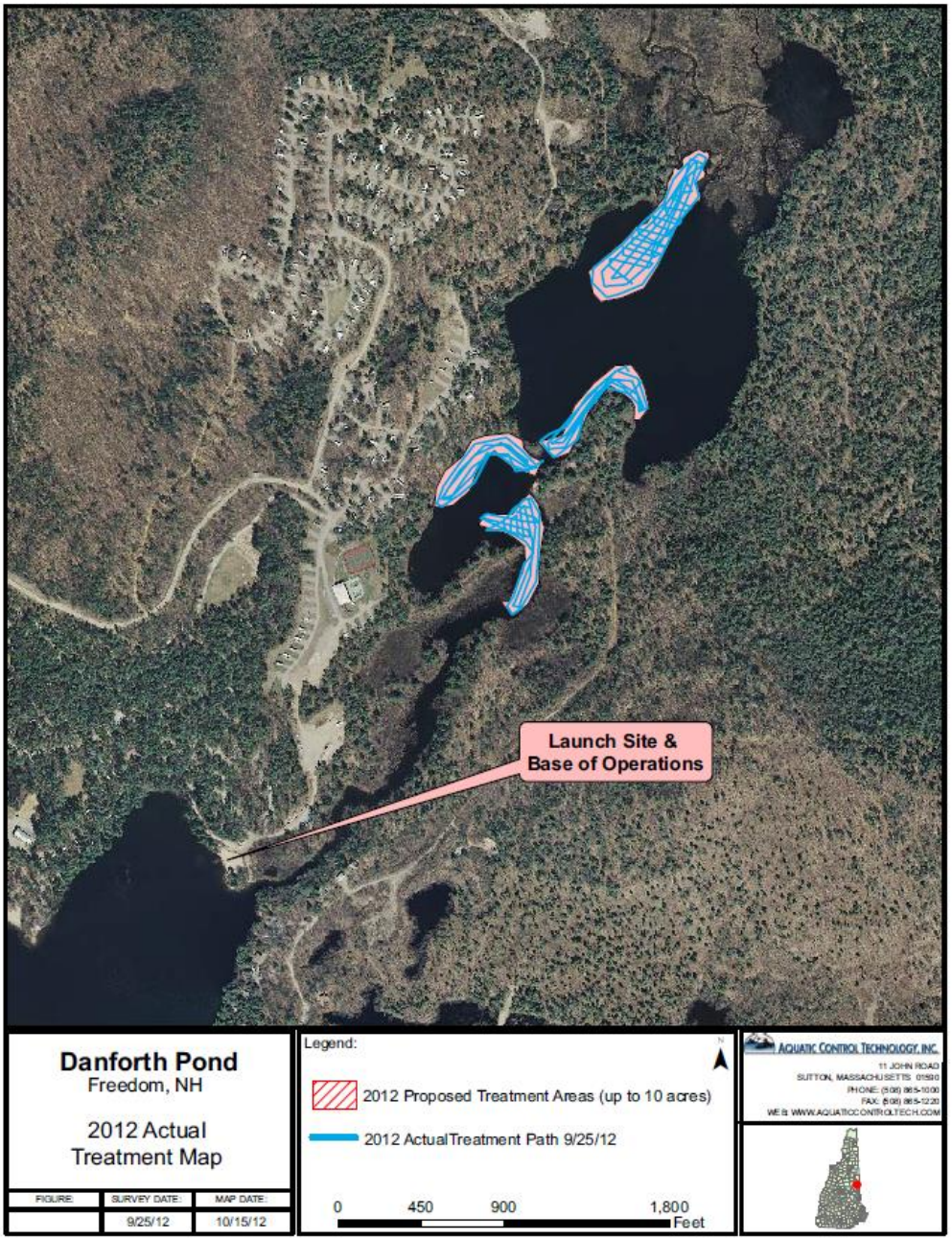
2011


Danforth Ponds
Freedom
Legend
2011 Treatment Areas
Danforth Ponds Milfoil_092410
0 0.1 0.2
Miles
N
Upper Danforth
Middle Danforth
Lower Danforth
Channel Area
A
B
C
D
E
F
G
H
I
J
K
L

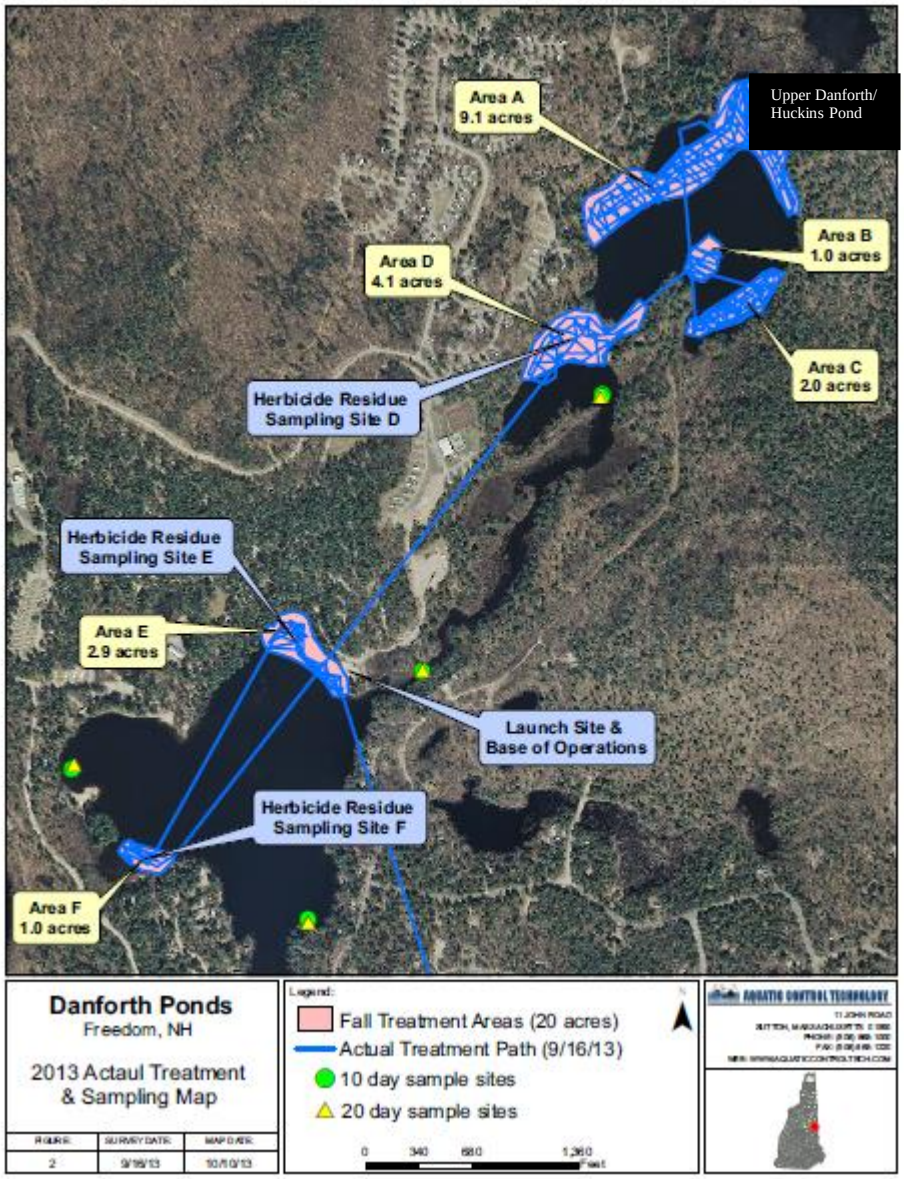
2012 (Spring/summer hand pull/DASH areas)



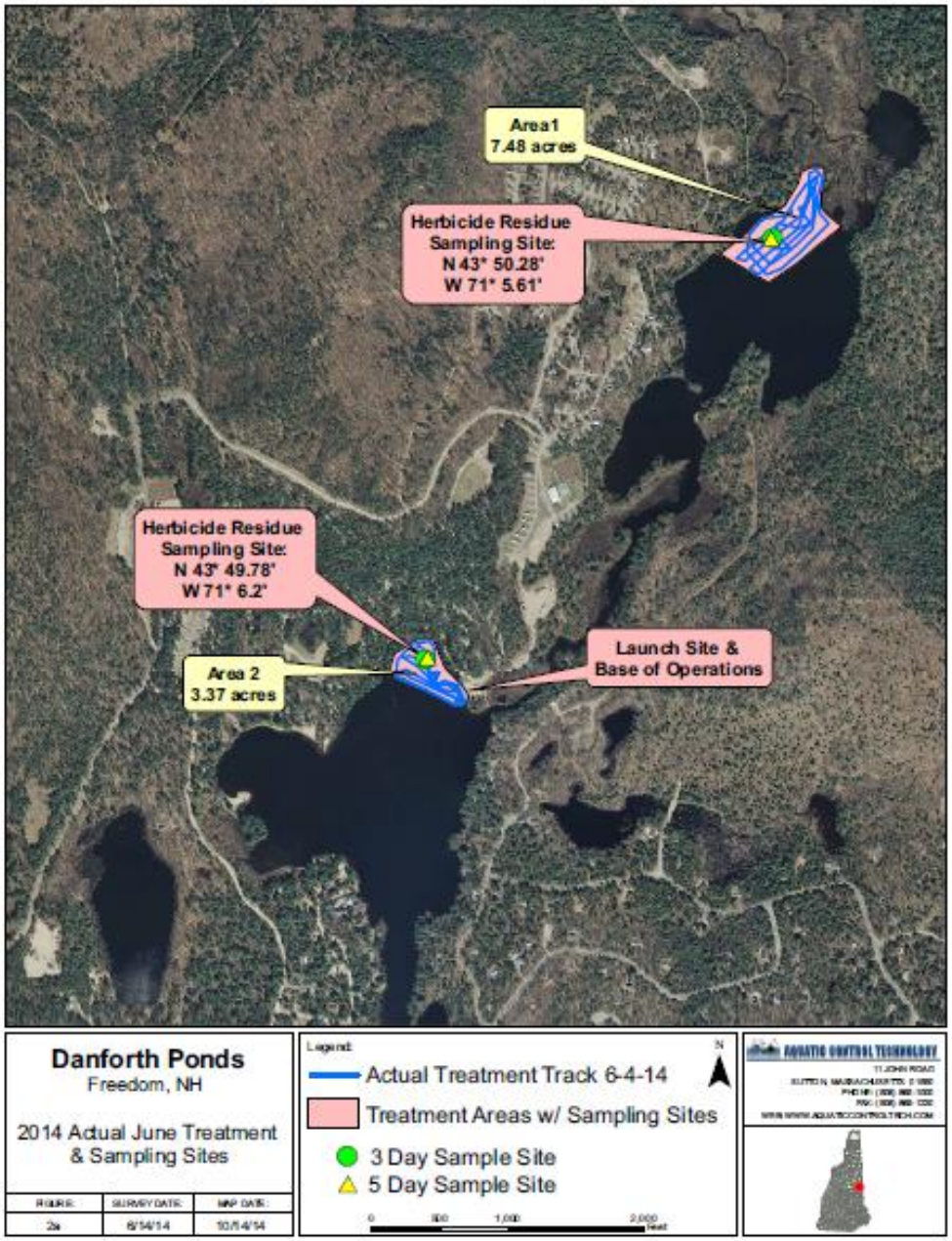
2012 (Herbicide Treatment Map provided by Aquatic Control Technology)

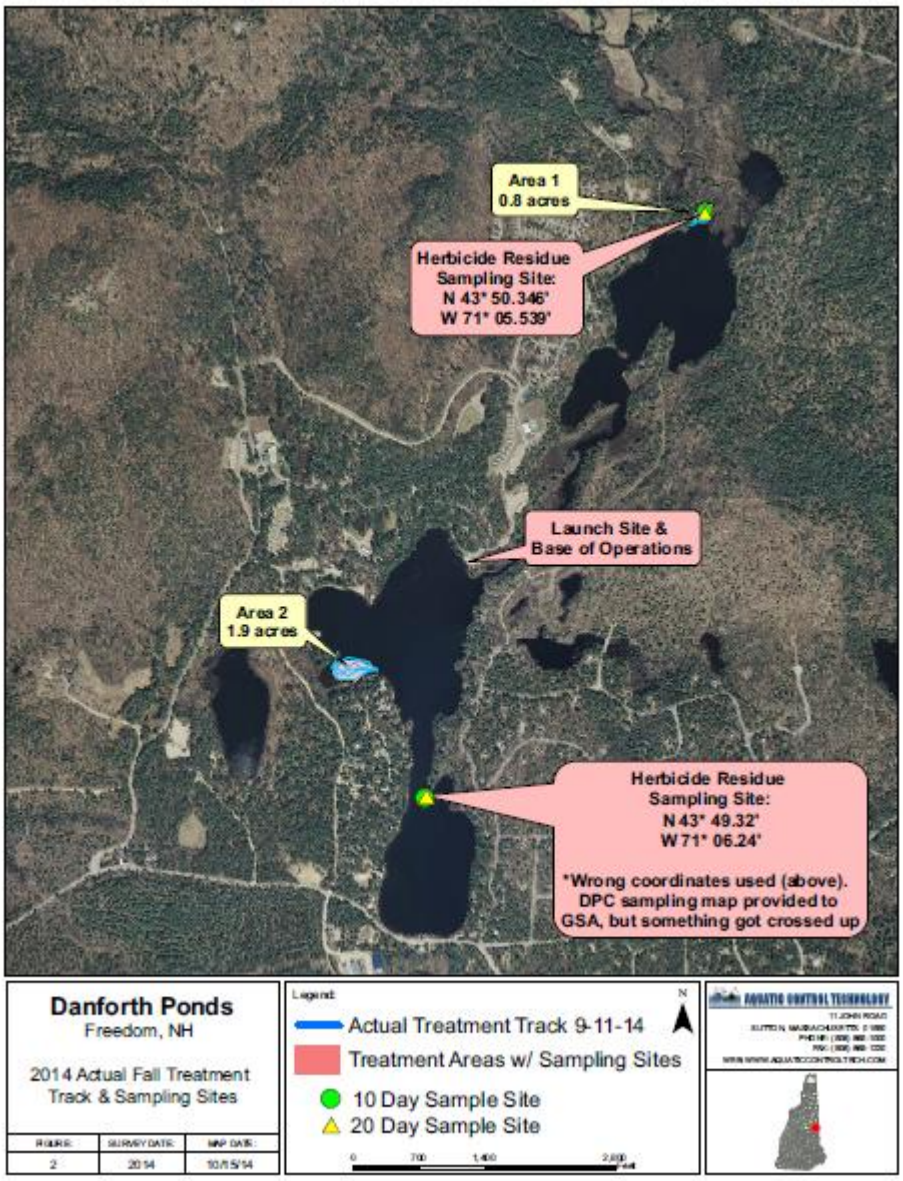


2013 (Actual)


Upper Danforth/
Huckins Pond
Area A
9.1 acres
Area B
1.0 acres
Area C
2.0 acres
Area D
4.1 acres
Herbicide Residue
Sampling Site D
Herbicide Residue
Sampling Site E
Area E
2.9 acres
Launch Site &
Base of Operations
Herbicide Residue
Sampling Site F
Area F
1.0 acres
Danforth Ponds
Freedom, NH
2013 Actaul Treatment
& Sampling Map
FIGURE
SURVEY DATE
MAP DATE
2
9/16/13
10/10/13
Legend:
Fall Treatment Areas (20 acres)
Actual Treatment Path (9/16/13)
10 day sample sites
20 day sample sites
0
340
680
1,360
Feet

2014 (Actual)


Area1
7.48 acres
Herbicide Residue
Sampling Site:
N 43° 50.28'
W 71° 5.61'
Herbicide Residue
Sampling Site:
N 43° 49.78'
W 71° 6.2'
Area 2
3.37 acres
Launch Site &
Base of Operations
Danforth Ponds
Freedom, NH
2014 Actual June Treatment
& Sampling Sites
FIGURE:
SURVEY DATE:
MAP DATE:
2a
6/14/14
10/14/14
Legend:
Actual Treatment Track 6-4-14
Treatment Areas w/ Sampling Sites
3 Day Sample Site
5 Day Sample Site
N
0
500
1,000
2,000
Feet



Danforth Ponds
Freedom, NH

2014 Actual Fall Treatment
Track & Sampling Sites

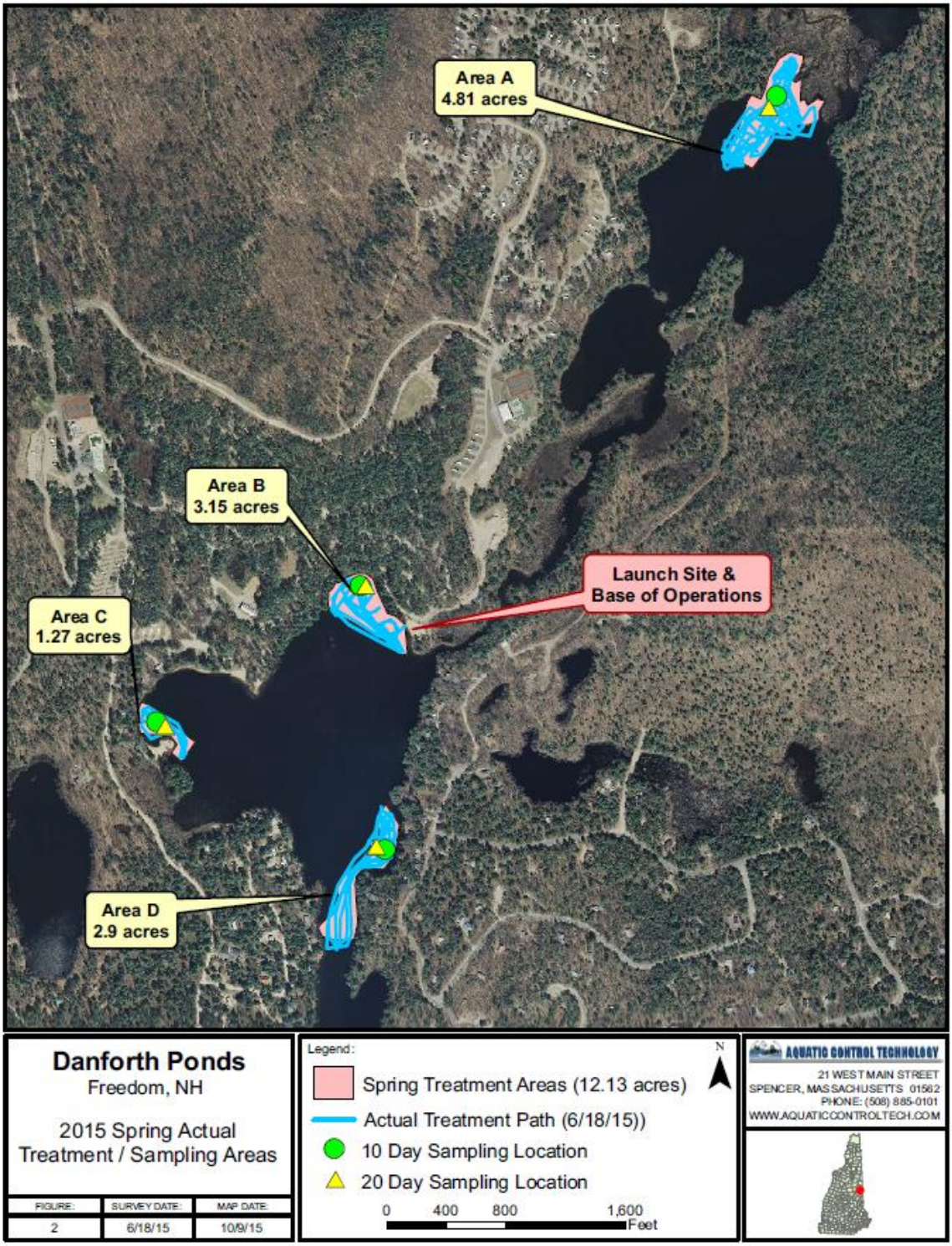
FIGURE:	SURVEY DATE:	MAP DATE:
2	2014	10/15/14

Legend:
Actual Treatment Track 9-11-14
Treatment Areas w/ Sampling Sites
10 Day Sample Site
20 Day Sample Site
0 700 1,400 2,800 Feet

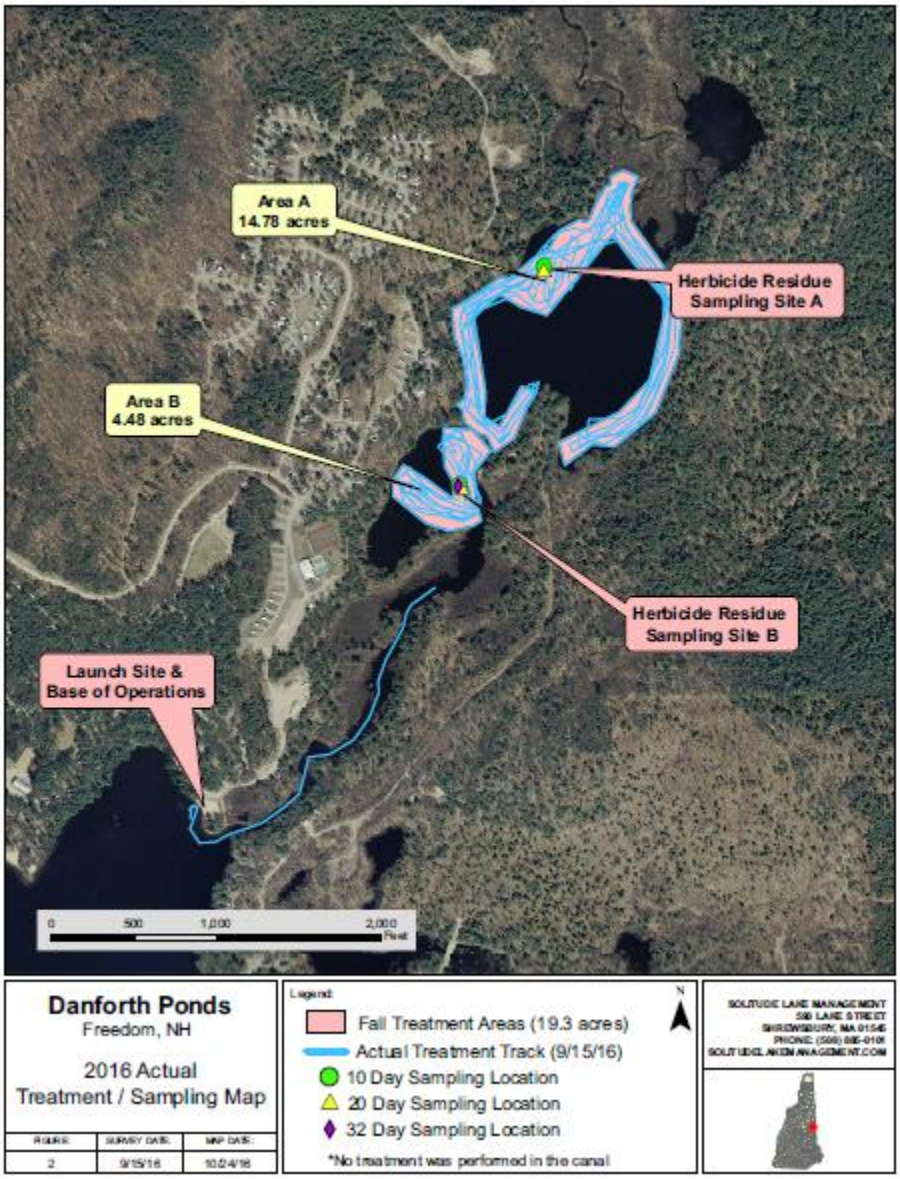
N

AQUATIC CONTROL TECHNOLOGY
11 JOHN ROAD
SUTTON, MASSACHUSETTS 01590
PHONE: (508) 865-1000
FAX: (508) 865-0200
WWW.WWW.AQUATICCONTROLTECH.COM

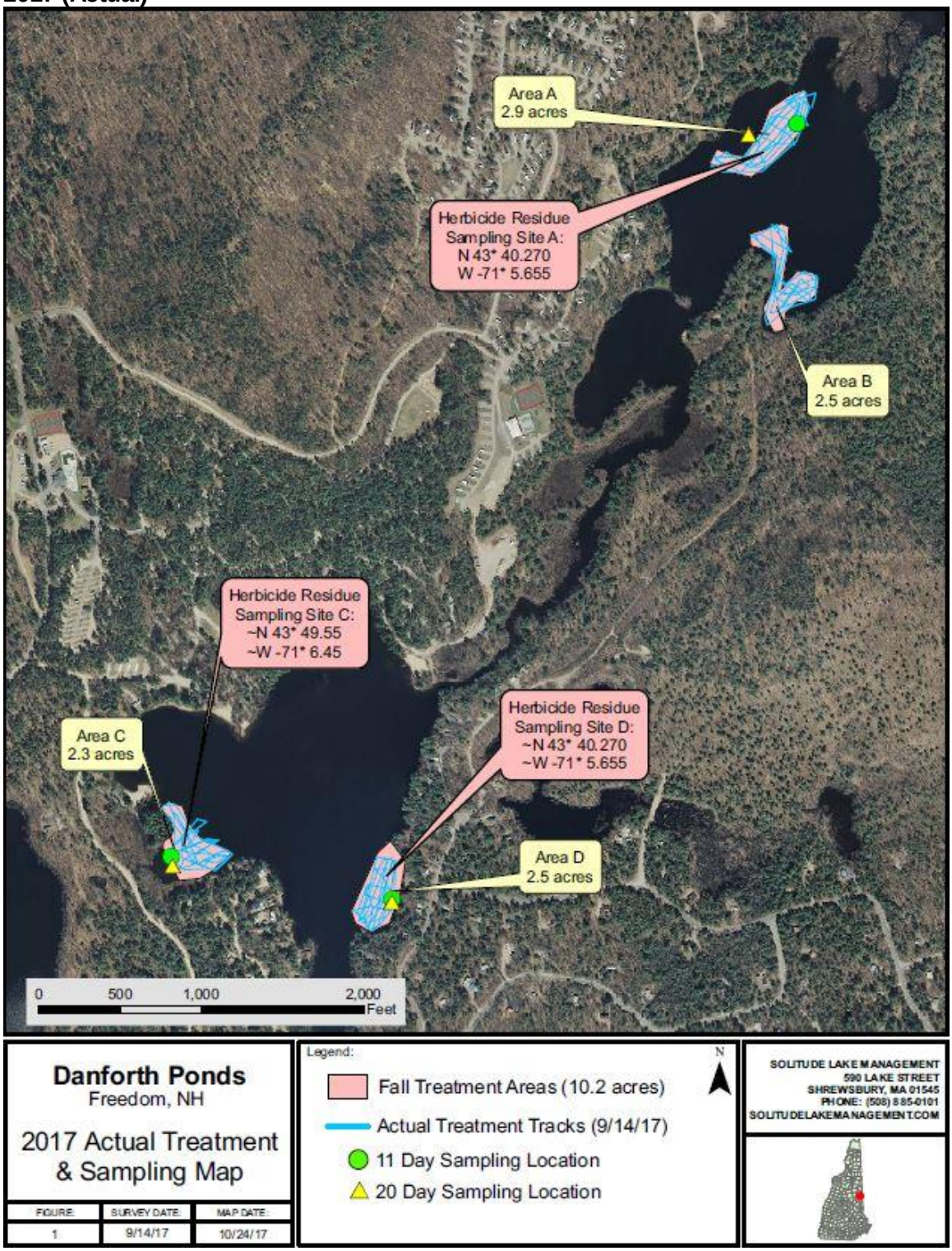
2015 (Actual)


Area A
4.81 acres
Area B
3.15 acres
Launch Site &
Base of Operations
Area C
1.27 acres
Area D
2.9 acres
Danforth Ponds
Freedom, NH
2015 Spring Actual
Treatment / Sampling Areas
FIGURE: 2
SURVEY DATE: 6/18/15
MAP DATE: 10/9/15
Legend:
Spring Treatment Areas (12.13 acres)
Actual Treatment Path (6/18/15))
10 Day Sampling Location
20 Day Sampling Location
0 400 800 1,600
Feet
N
AQUATIC CONTROL TECHNOLOGY
21 WEST MAIN STREET
SPENCER, MASSACHUSETTS 01562
PHONE: (508) 885-0101
WWW.AQUATICCONTROLTECH.COM

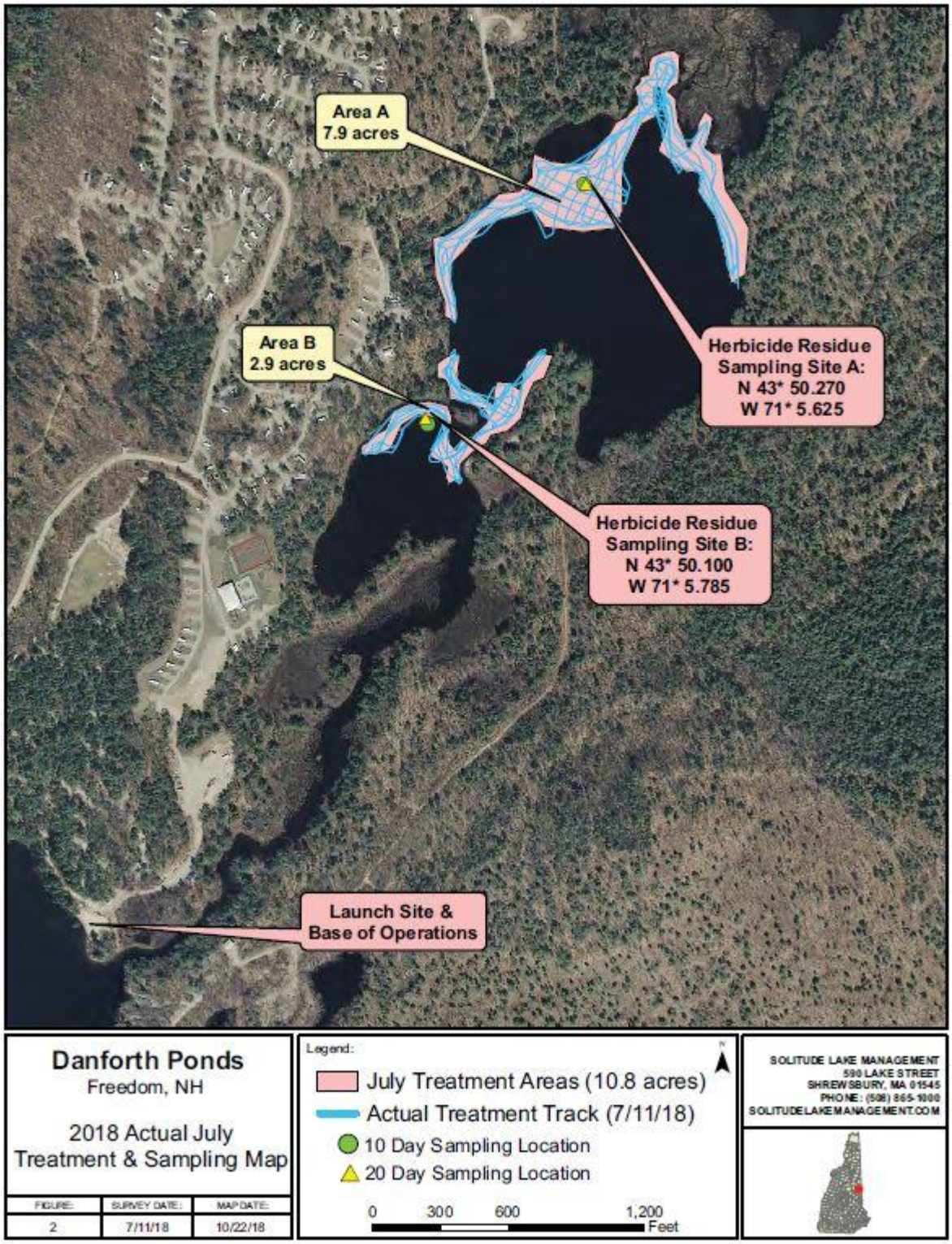
2016 (Actual)


Area A
14.78 acres
Herbicide Residue
Sampling Site A
Area B
4.48 acres
Herbicide Residue
Sampling Site B
Launch Site &
Base of Operations
0
500
1,000
2,000
Feet
Danforth Ponds
Freedom, NH
2016 Actual
Treatment / Sampling Map
FIGURE
SURVEY DATE
MAP DATE
2
9/15/16
10/24/16
Legend:
Fall Treatment Areas (19.3 acres)
Actual Treatment Track (9/15/16)
10 Day Sampling Location
20 Day Sampling Location
32 Day Sampling Location
*No treatment was performed in the canal
N
SOLITUDE LAKE MANAGEMENT
590 LAKE STREET
SHREWSBURY, MA 01545
PHONE: (508) 886-0101
SOLITUDELAKEMANAGEMENT.COM

2017 (Actual)


Area A
2.9 acres
Herbicide Residue
Sampling Site A:
N 43° 40.270
W -71° 5.655
Area B
2.5 acres
Herbicide Residue
Sampling Site C:
~N 43° 49.55
~W -71° 6.45
Area C
2.3 acres
Herbicide Residue
Sampling Site D:
~N 43° 40.270
~W -71° 5.655
Area D
2.5 acres
0
500
1,000
2,000
Feet
Danforth Ponds
Freedom, NH
2017 Actual Treatment
& Sampling Map
FIGURE:
SURVEY DATE:
MAP DATE:
1
9/14/17
10/24/17
Legend:
Fall Treatment Areas (10.2 acres)
Actual Treatment Tracks (9/14/17)
11 Day Sampling Location
20 Day Sampling Location
N
SOLITUDE LAKE MANAGEMENT
590 LAKE STREET
SHREWSBURY, MA 01545
PHONE: (508) 885-0101
SOLITUDELAKEMANAGEMENT.COM

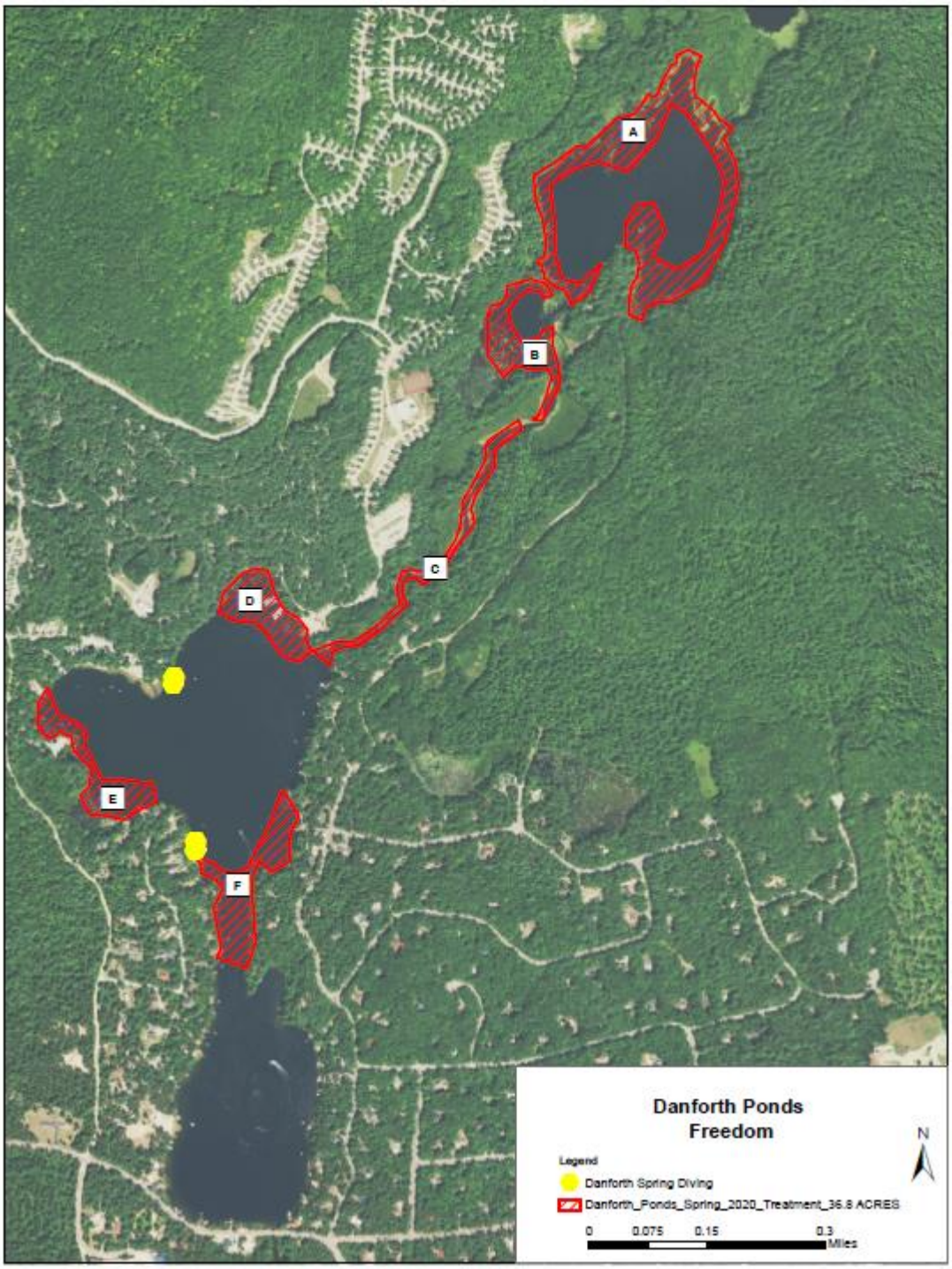
2018 (Actual)


Area A
7.9 acres
Area B
2.9 acres
Herbicide Residue
Sampling Site A:
N 43* 50.270
W 71* 5.625
Herbicide Residue
Sampling Site B:
N 43* 50.100
W 71* 5.785
Launch Site &
Base of Operations
Danforth Ponds
Freedom, NH
2018 Actual July
Treatment & Sampling Map
FIGURE: 2
SURVEY DATE: 7/11/18
MAP DATE: 10/22/18
Legend:
July Treatment Areas (10.8 acres)
Actual Treatment Track (7/11/18)
10 Day Sampling Location
20 Day Sampling Location
0 300 600 1,200
Feet
SOLITUDE LAKE MANAGEMENT
590 LAKE STREET
SHREWSBURY, MA 01545
PHONE: (508) 865-1000
SOLITUDELAKEMANAGEMENT.COM

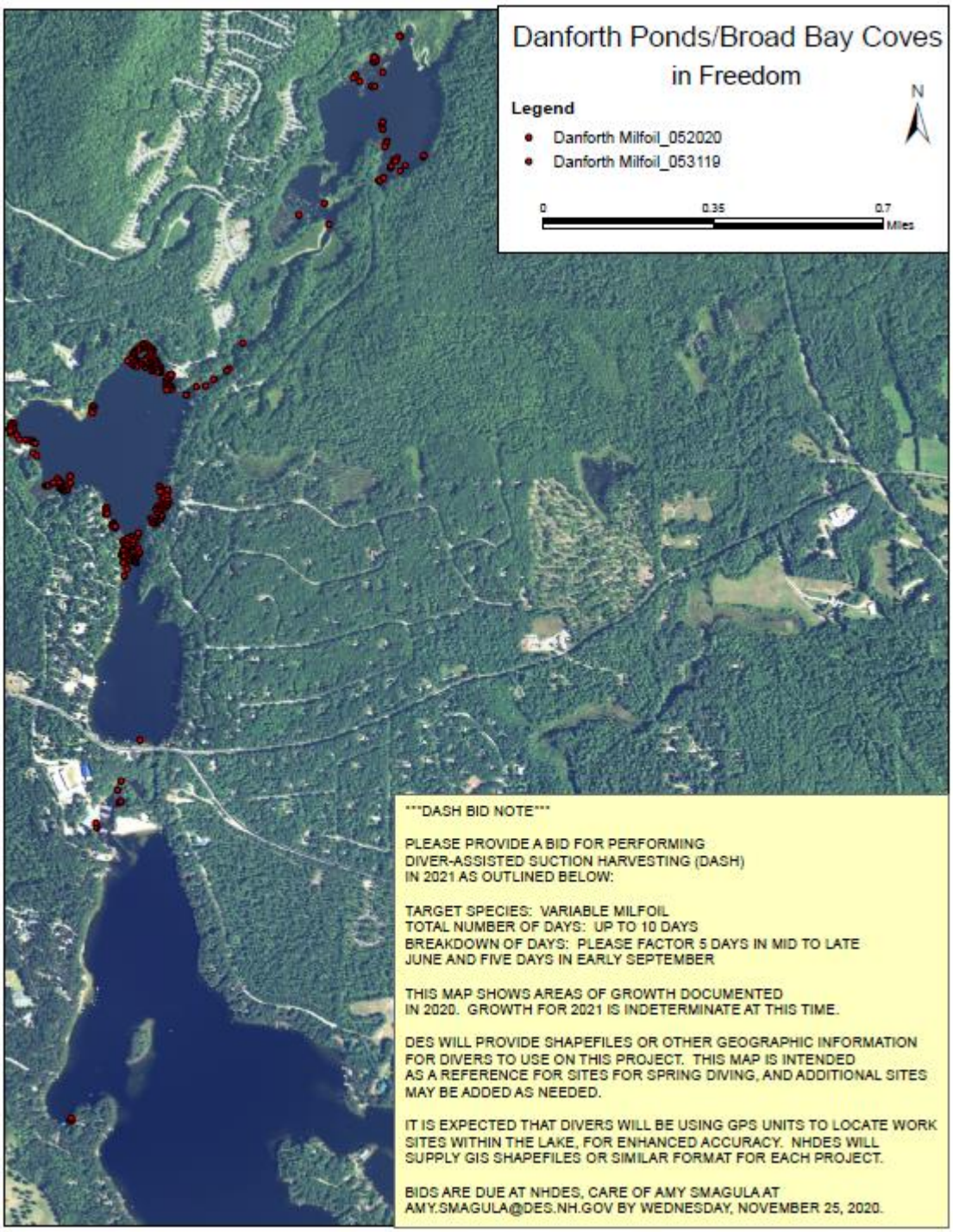
2019 Actual

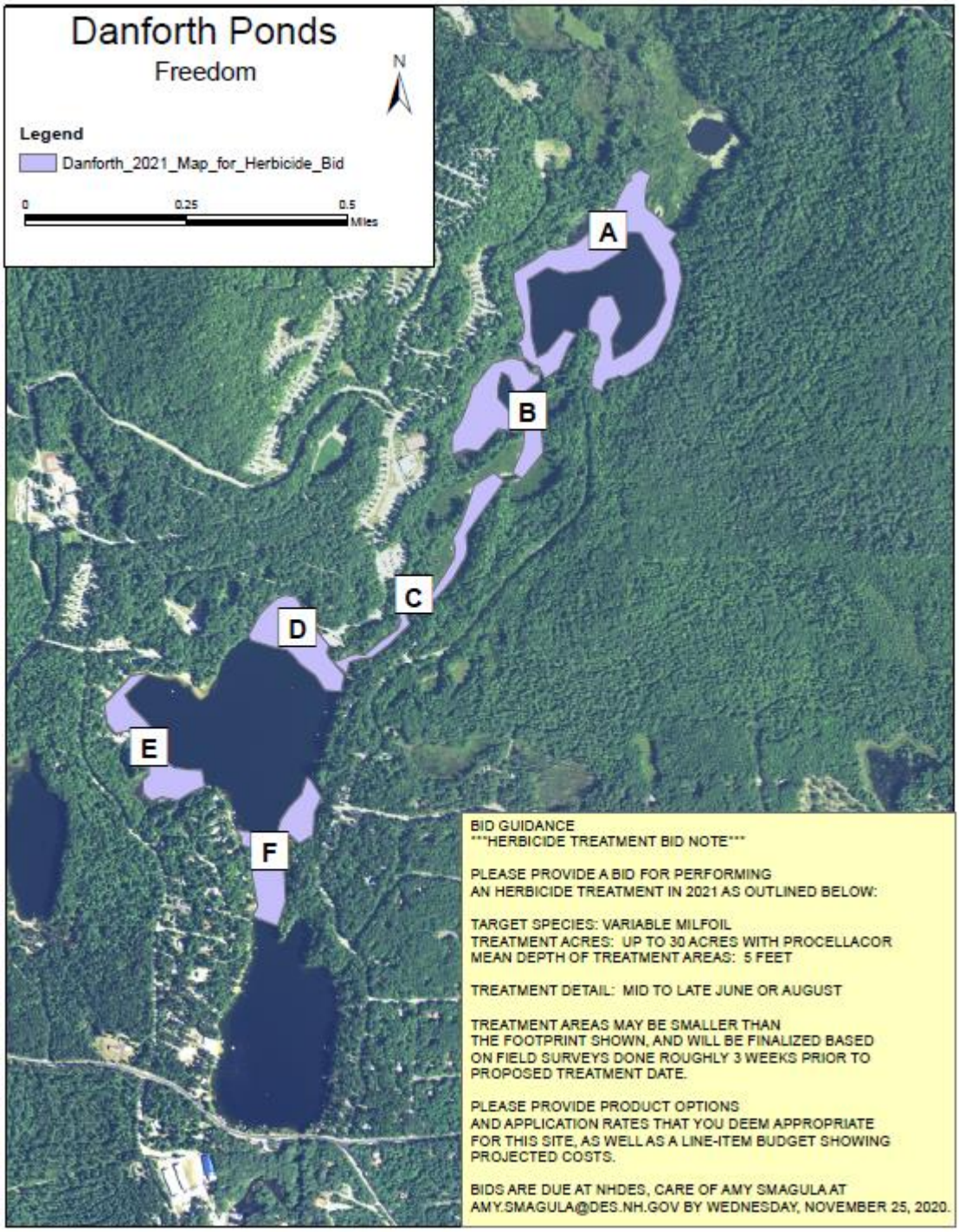
No herbicide treatment in 2019. See AB Aquatics dive reports and maps for details on locations/yield, in addition to the table earlier in this document.

2020 Actual


A
B
C
D
E
F
Danforth Ponds
Freedom
N
Legend
Danforth Spring Diving
Danforth_Ponds_Spring_2020_Treatment_36.8 ACRES
0
0.075
0.15
0.3
Miles

2021 Proposed





BID GUIDANCE
HERBICIDE TREATMENT BID NOTE

PLEASE PROVIDE A BID FOR PERFORMING
AN HERBICIDE TREATMENT IN 2021 AS OUTLINED BELOW:

TARGET SPECIES: VARIABLE MILFOIL
TREATMENT ACRES: UP TO 30 ACRES WITH PROCELLACOR
MEAN DEPTH OF TREATMENT AREAS: 5 FEET

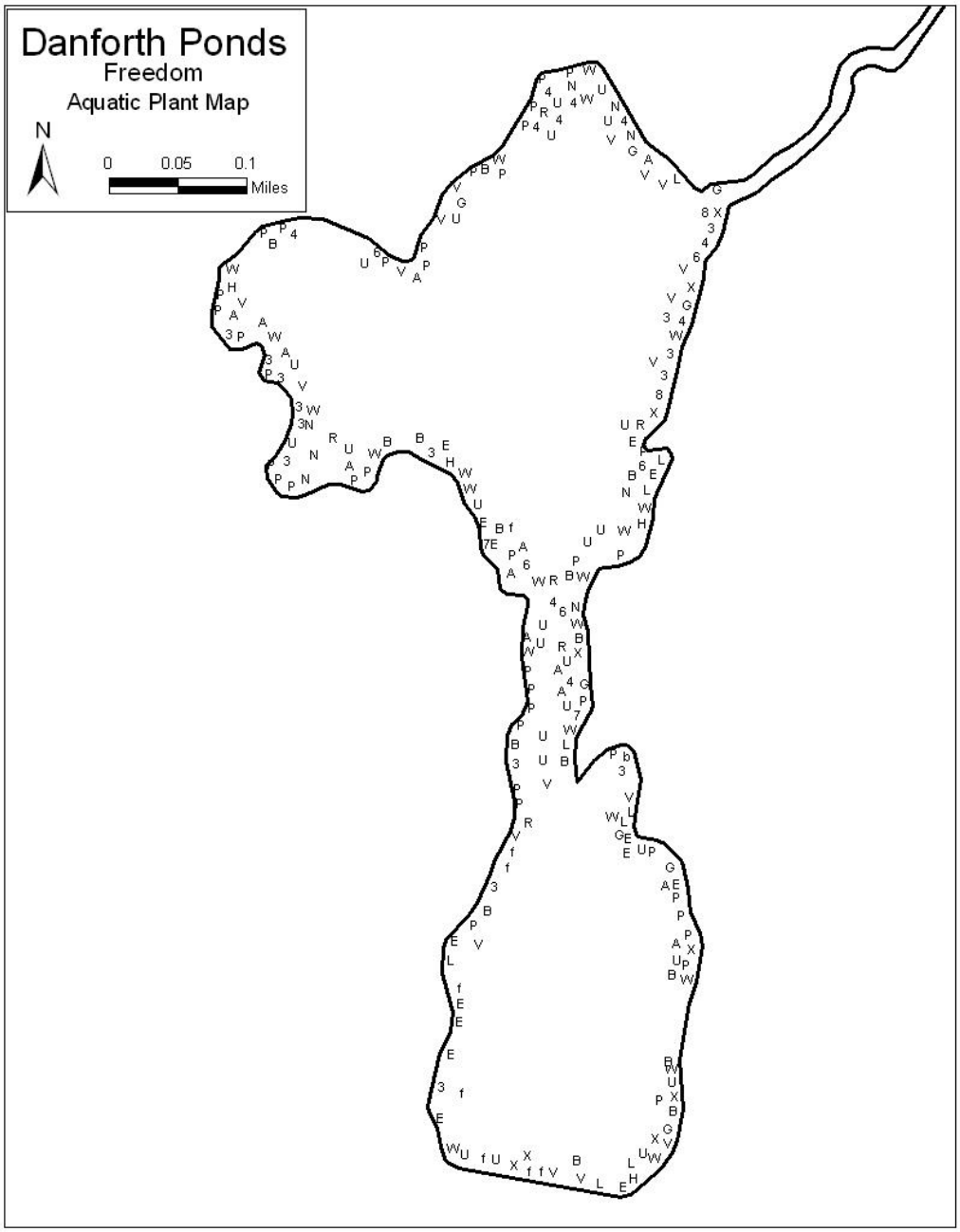
TREATMENT DETAIL: MID TO LATE JUNE OR AUGUST

TREATMENT AREAS MAY BE SMALLER THAN
THE FOOTPRINT SHOWN, AND WILL BE FINALIZED BASED
ON FIELD SURVEYS DONE ROUGHLY 3 WEEKS PRIOR TO
PROPOSED TREATMENT DATE.

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 WEDNESDAY, NOVEMBER 25, 2020.

Figure 3: Map of Native Aquatic Macrophytes



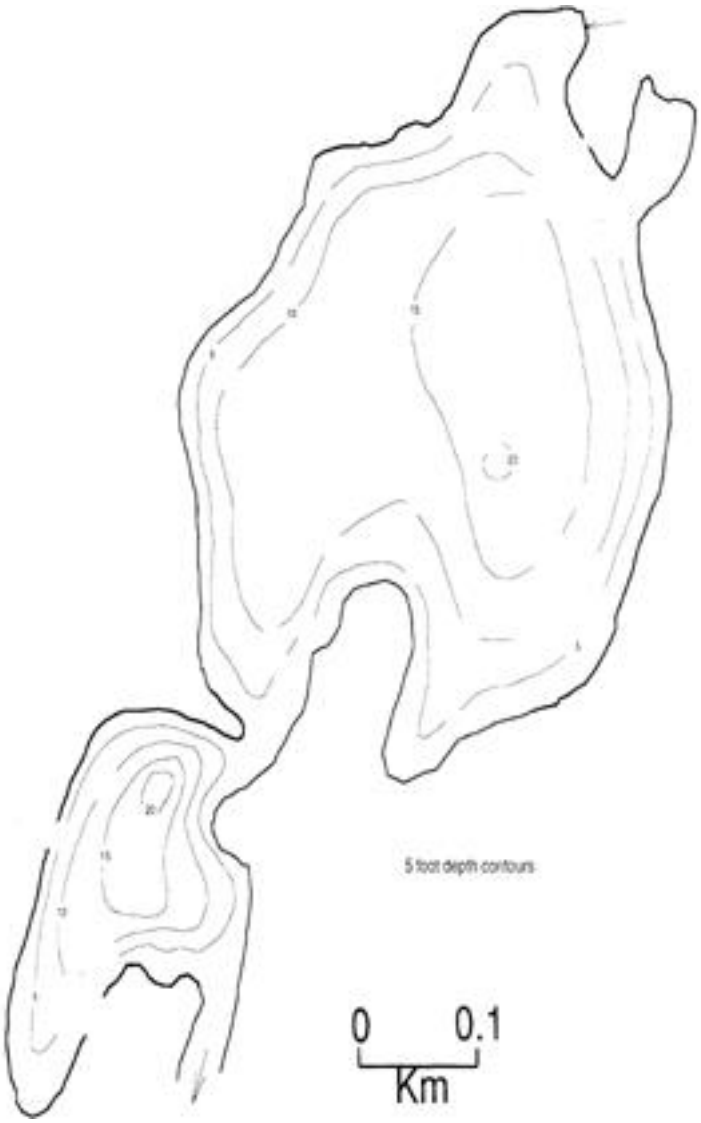
2019 (Actual)

Key to Macrophyte Map

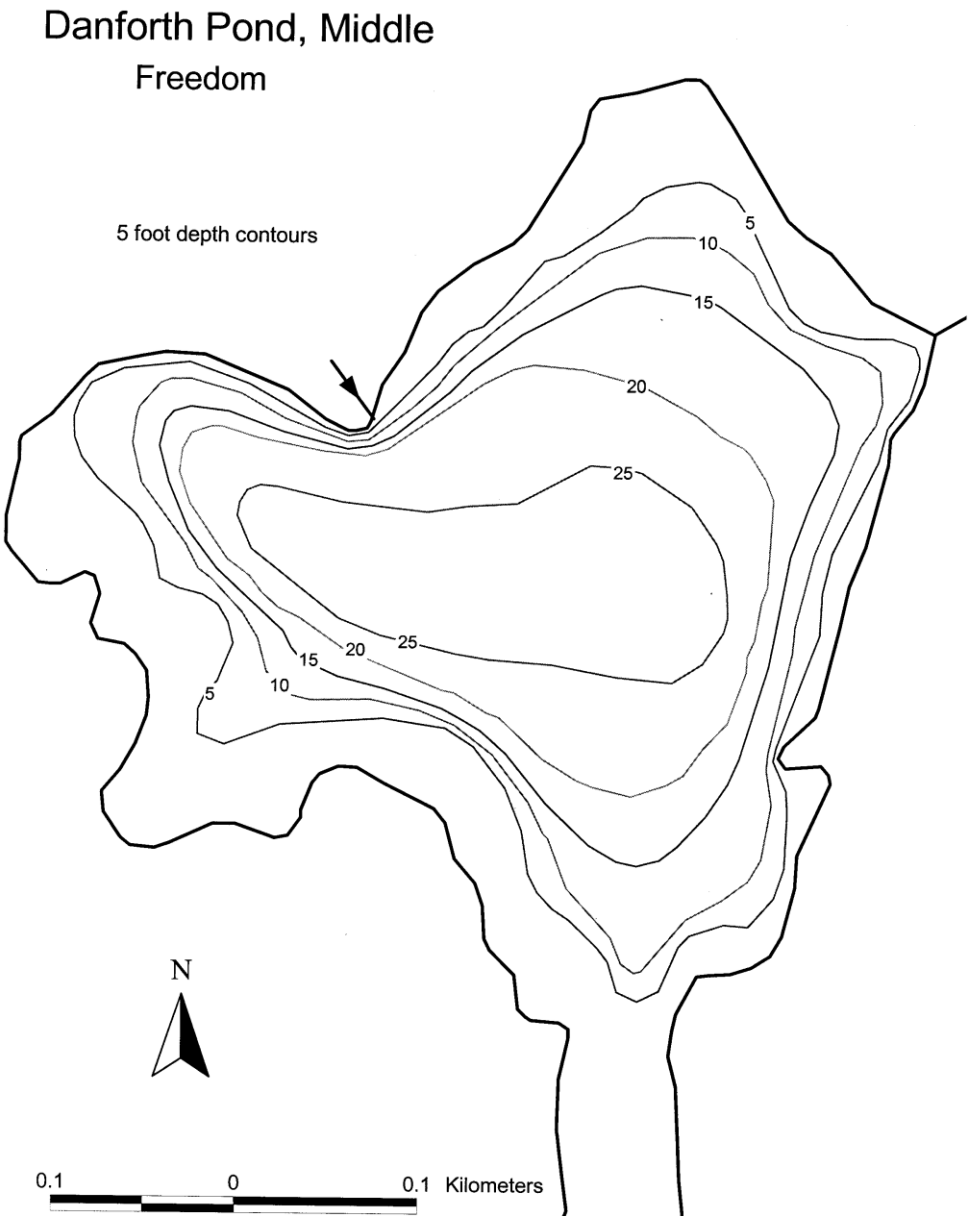
Symbol	Common Name	Latin Name
T	Cattail	*Typha*
b	Water naiad	*Najas*
a	Alternate-leaved milfoil	*Myriophyllum alterniflorum*
d	False loosestrife/water purslane	*Ludwigia*
9	Native milfoil	*Myriophyllum humile*
c	Water marigold	*Megalodonata beckii*
8	Hedge hyssop	*Gratiola*
7	Bur-reed	*Sparganium sp.*
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

Upper Danforth/Huckins Pond



Middle Danforth Pond



Lower Danforth Pond

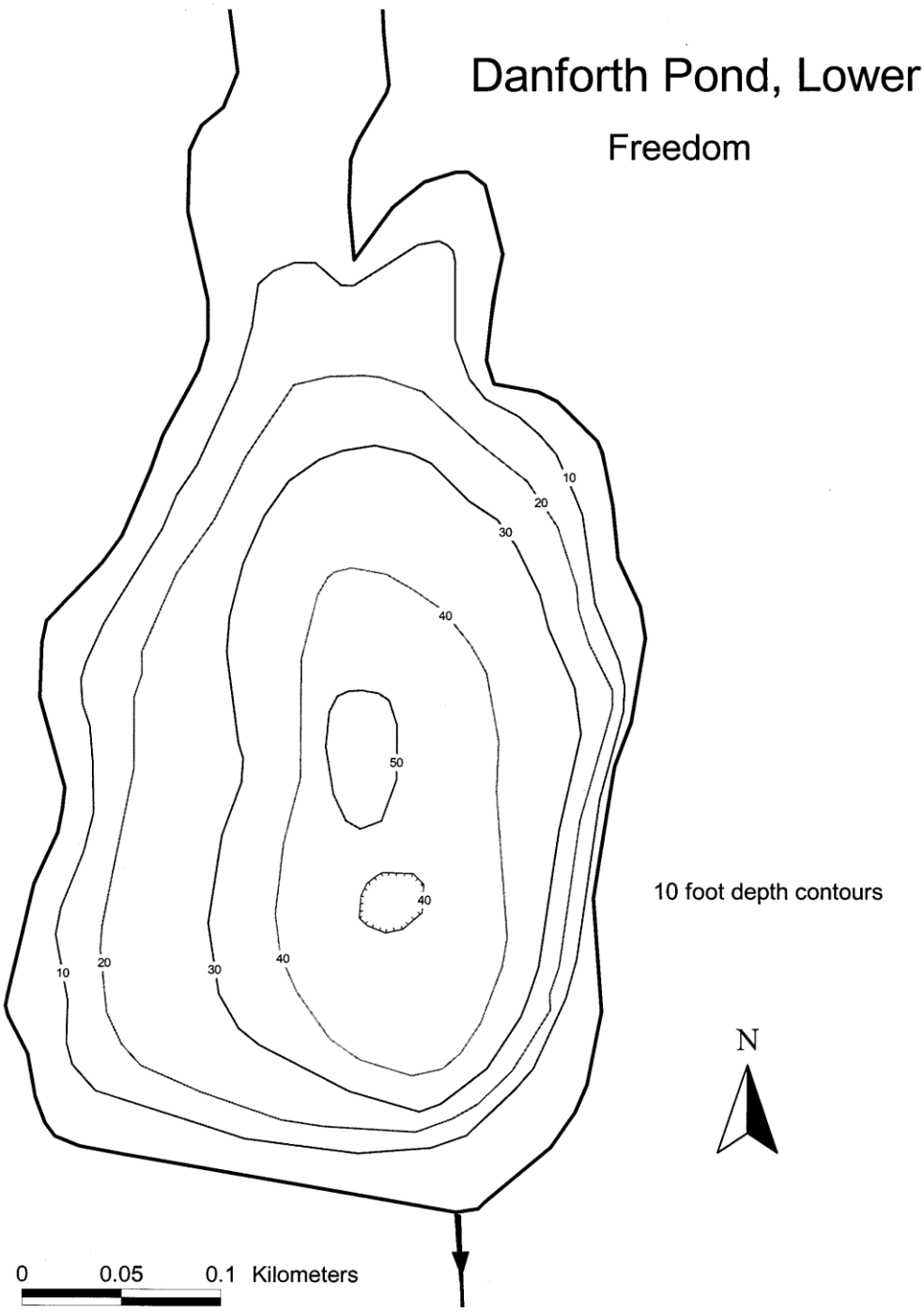


Figure 5: Critical Habitats or Conservation Areas

NHB21-0409

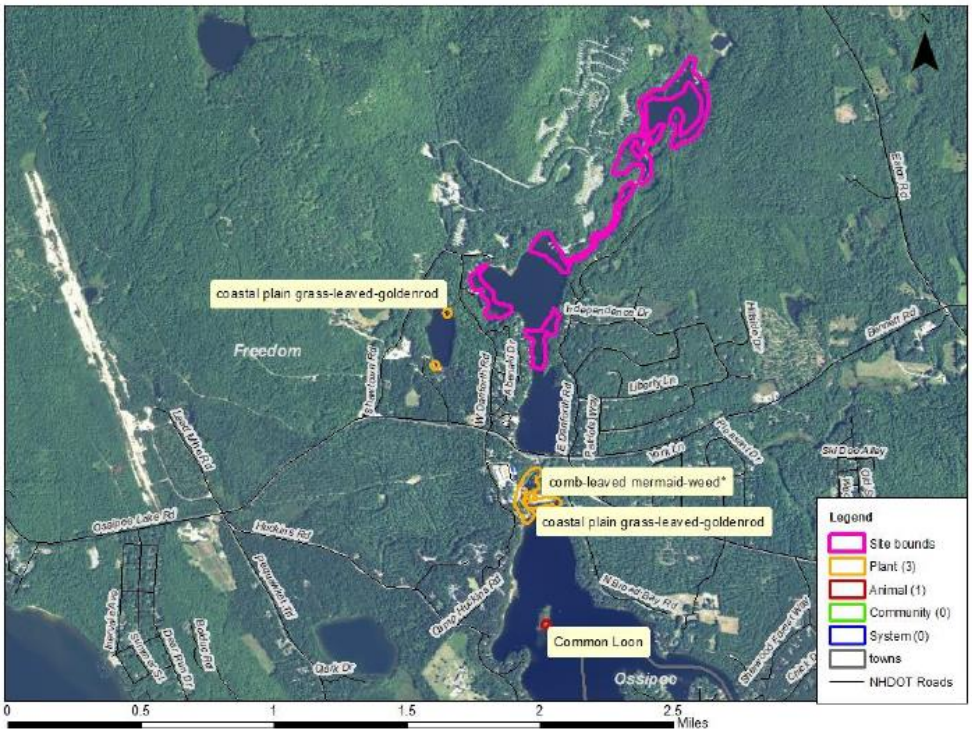


Figure 6: Public Access Sites, Swim Areas, Docks and Swim Platforms

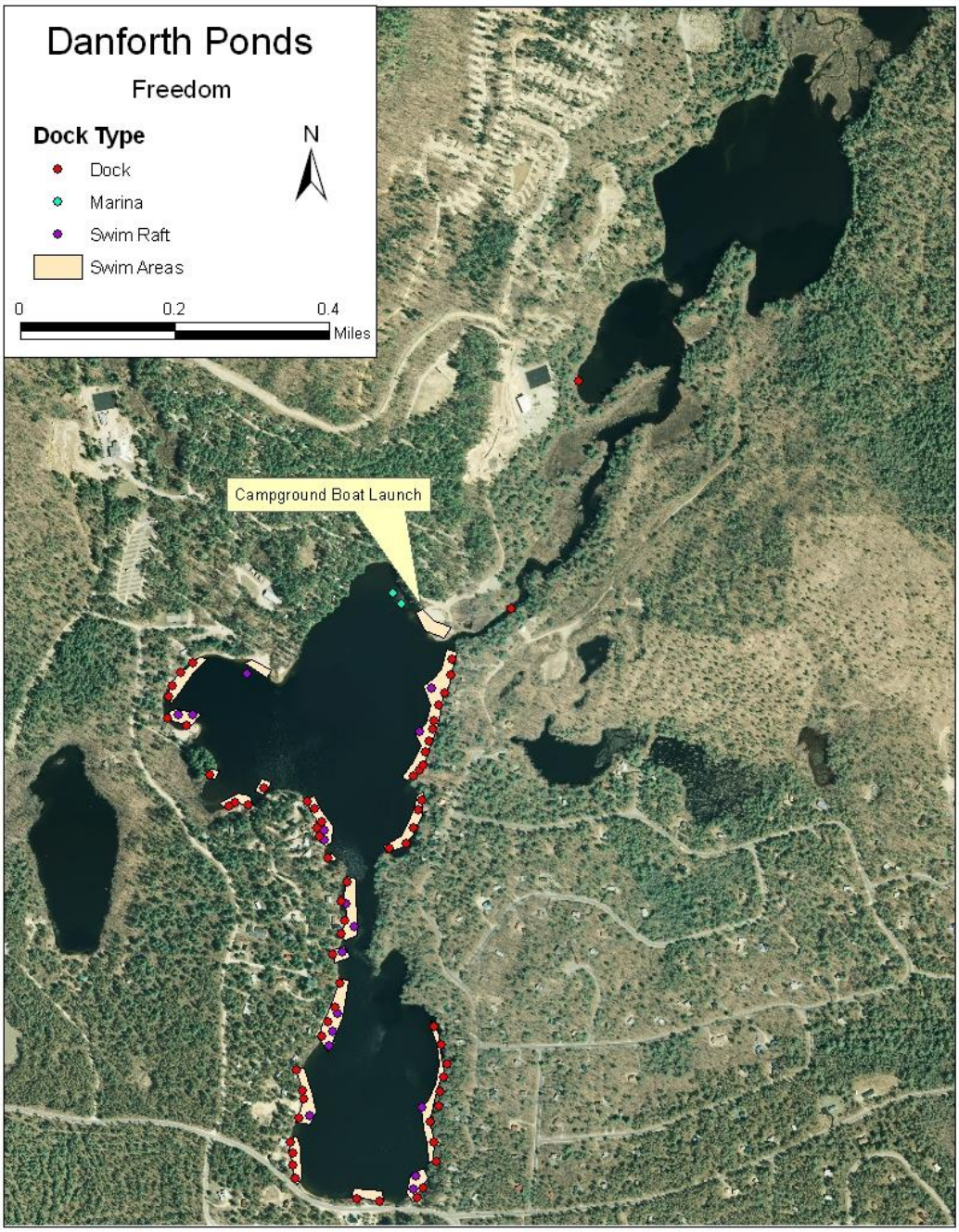
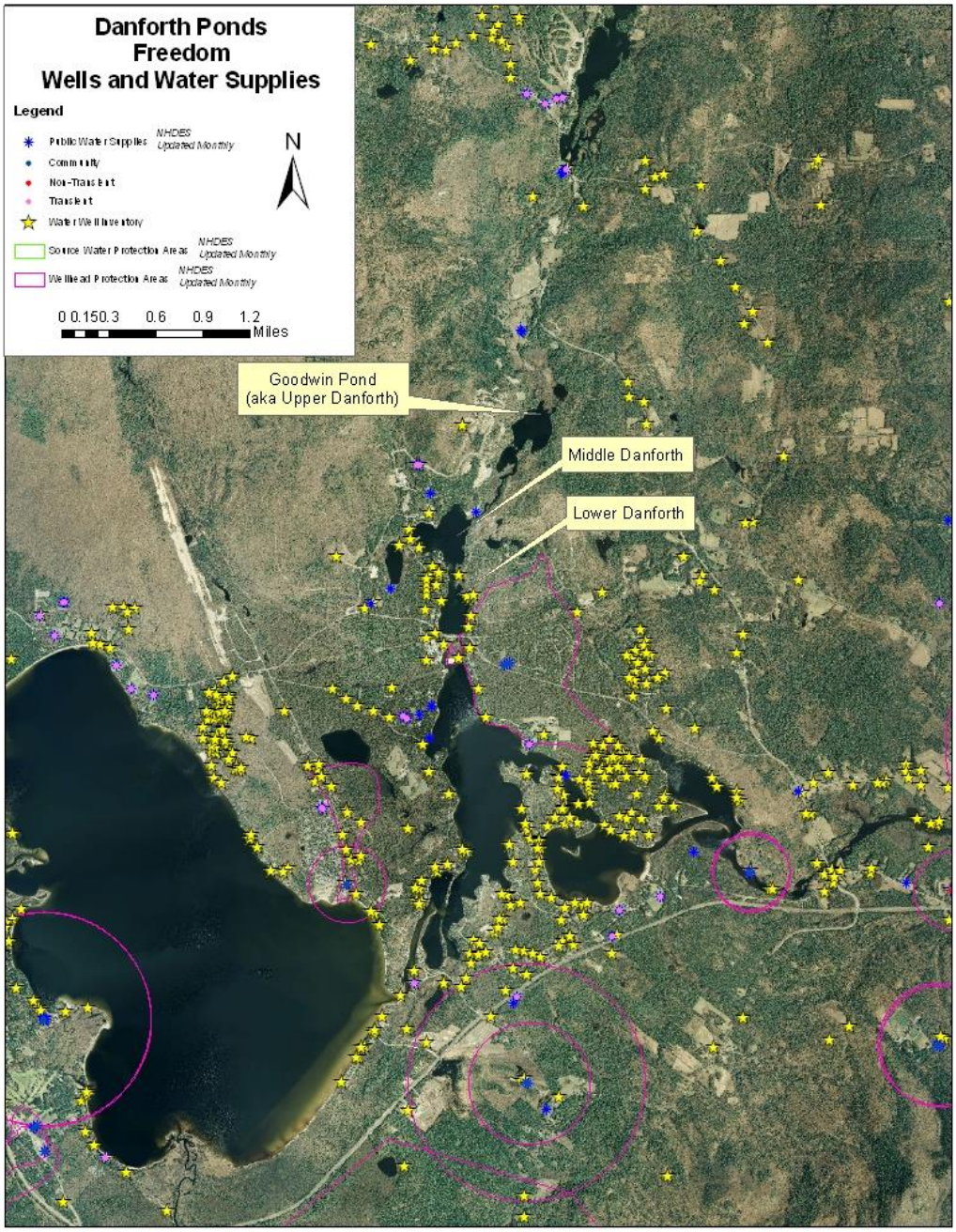


Figure 7: Wells and Water Supplies (1:48,000 scale)


Danforth Ponds
Freedom
Wells and Water Supplies
Legend
Public Water Supplies
NHDES
Updated Monthly
Community
Non-Transient
Transient
Water Well Inventory
Source Water Protection Areas
NHDES
Updated Monthly
Wellhead Protection Areas
NHDES
Updated Monthly
N
0 0.150.3 0.6 0.9 1.2
Miles
Goodwin Pond
(aka Upper Danforth)
Middle Danforth
Lower Danforth

Appendix A 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 exotic aquatic 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 (provide updated native plant map after review of milfoil in the Fall or after treatment)

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 threat to downstream waterbodies from the exotic aquatic plant based on limnological characteristics (water chemistry, quantity, quality as they relate to movement or support of exotic plant growth).

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 and other key resource managers who have conducted the field work and who are preparing or contributing to 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

- 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'). For larger areas Diver-Assisted Suction Harvesting (DASH) may be more appropriate.
- 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 or DASH
- 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 <u>not</u> 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). 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.

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.

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.

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