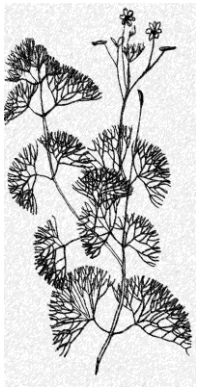
Prepared by:
NH Department of
Environmental Services
March 2021

Long-Term Variable Milfoil & Fanwort Management Plan



Phillips Pond
Sandown, 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 on non-target species;
4. To recommend exotic plant control actions that meet the goals outlined in this plan; and
5. To evaluate control practices used in this waterbody over time to determine if they are meeting the goals outlined in this plan.

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 important for aquatic habitat. Under some circumstances, dense growths and near monotypic stands of invasive aquatic plants can result, having the potential to reduce 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 even a single exotic aquatic plant do not attain water quality standards and are listed as impaired.

Variable Milfoil and Fanwort Infestation in Phillips Pond, Sandown

Phillips Pond has had a history of both variable milfoil and fanwort infestations. Fanwort entered the pond around 1983, and quickly ringed the entire shoreline area to depths of 10 feet. Variable milfoil entered the pond in the early 1990s. A whole-lake Fluridone treatment in 2006 eradicated the fanwort and greatly reduced the variable milfoil footprint in the pond; however in recent years the variable milfoil has rebounded, as evidenced in annual surveys conducted by DES. Fanwort has been making a rapid comeback since 2012.

Figure 1 illustrates the distribution of variable milfoil and fanwort infestations in Phillips Pond over time. The growth generally extends from shore to depths of 8-10 feet in this basin. Beyond about 10 feet the photic (light) zone diminishes rapidly with increased depth, and plant growth is limited.

In terms of the impacts of the variable milfoil and fanwort in the system, there are approximately 47 houses around the shoreline of Phillips Pond, with many more (58) back lots that have water access through a variety of rights-of-way around the pond. There is a swim beach at the northern end of the lake that is town owned and maintained. Invasive aquatic plant impacts can be widespread, due to the potential widespread growth around the pond. Lake residents have expressed concern that if the milfoil and fanwort are left to expand they will take over much of the pond habitat as it has in the past.

The following table provides a summary of variable milfoil and fanwort growth as shown in Figure 1 (area name reference in table below is relative to grid overlay of Figure 1).

Area	Location/Area Description	Year	Description of Growth	Year-End Percent Cover
1B, 1C	North end of lake	2005	Widespread milfoil and fanwort growth	>90%
		2006	Herbicide treatment greatly reduced growth of milfoil and fanwort	<5%
		2007	No growth observed	0%
		2008	Small patches of variable milfoil growth observed in northeastern cove	5%
		2009	Expanding patches of milfoil growth in eastern cove, despite diver work	15%
		2010	Expanding patches of milfoil growth in eastern cove, despite diver work	25%
		2011	Herbicide treatment reduced milfoil growth, but fanwort plants observed	Milfoil-<5% Fanwort- 5%
		2012	Increasing fanwort and milfoil populations, too much to pull, but no local resources for control	Milfoil-15% Fanwort- 10%
		2013	Increasing fanwort and milfoil populations, too much to pull, but no local resources for control	Milfoil- 15-20% Fanwort- 20%
		2014	Milfoil and fanwort scattered in patches along shore, expending.	Milfoil- 15-20% Fanwort- 20%
		2015	Milfoil and fanwort scattered in patches along shore, expending. Treatment recommended for 2016.	Milfoil- 15-20% Fanwort- 20%
		2016	Milfoil and fanwort scattered in patches along shore, expending. No treatment done, no local funds. Treatment recommended for 2018.	Milfoil- 25-30% Fanwort- 30%
		2017	Milfoil and fanwort scattered in patches along shore, expending. No local funds for treatment this year. Treatment recommended for next growing season.	Milfoil- 40% Fanwort- 40%
		2018	Scattered stems of milfoil and occasional fanwort	<1%

Area	Location/Area Description	Year	Description of Growth	Year-End Percent Cover
			stems	
		2019	Scattered plants	<5%
		2020	Scattered plants	<5%
2C	Eastern Cove/Shoreline	2005	Widespread milfoil and fanwort growth	90%
		2006	Herbicide treatment greatly reduced growth of milfoil and fanwort	<5%
		2007	No growth observed	0%
		2008	No growth observed	0%
		2009	No growth observed	0%
		2010	Patchy milfoil growth observed, plus scattered single stems	5%
		2011	Scattered fanwort stems appearing	10%
		2012	Scattered fanwort stems	10%
		2013	Scattered fanwort stems	20%
		2014	Increasing fanwort/milfoil growth	25% for both
		2015	Increasing fanwort/milfoil growth. No local funds for treatment this year. Treatment recommended for next growing season.	25% for both
		2016	Increasing fanwort/milfoil growth. No local funds for treatment this year. Treatment recommended for next growing season.	30% for both
		2017	Increasing fanwort/milfoil growth. No local funds for treatment this year. Treatment recommended for next growing season.	40% for both
		2018	Scattered variable milfoil and fanwort stems in July, gone by fall (either herbicide or diver removed)	<1%
		2019	Scattered patches	<5%
		2020	Patchy growth	<10%
3A, 3B, 3C, 4A, 4B	Southern end of lake	2005	Widespread milfoil and fanwort growth	>90%
		2006	Herbicide treatment greatly reduced growth of milfoil and fanwort	<5%

Area	Location/Area Description	Year	Description of Growth	Year-End Percent Cover
		2007	No growth observed	0%
		2008	No growth observed	0%
		2009	No growth observed	0%
		2010	No growth observed	0%
		2011	No growth observed	0%
		2012	Scattered fanwort stems	15%
		2013	Increase in fanwort and milfoil	Fanwort- 20% Milfoil- 5%
		2014	Increase in fanwort and milfoil	Both ~20%
		2015	Increase in fanwort and milfoil. No local funds for treatment this year. Treatment recommended for next growing season.	Both ~25%
		2016	Increase in fanwort and milfoil. No local funds for treatment this year. Treatment recommended for next growing season.	Both ~30%
		2017	Increase in fanwort and milfoil. No local funds for treatment this year. Treatment recommended for next growing season.	Both ~40%
		2018	Scattered milfoil and fanwort in July, reduced to single stems in the fall	<1%
		2019	Scattered stems	<5%
		2020	Scattered stems	<5%
B2	Western Cove/Shoreline (outlet area)	2005	Widespread milfoil and fanwort growth	90%
		2006	Herbicide treatment greatly reduced growth of milfoil and fanwort	<5%
		2007	No growth observed	0%
		2008	No growth observed	0%
		2009	No growth observed	0%
		2010	No growth observed	0%
		2011	No growth observed	0%
		2012	Sparse fanwort and milfoil	Milfoil- <5% Fanwort- <5%
		2013	Increased milfoil	Milfoil- 15%
		2014	Scattered patches and stems	15% for both
		2015	Scattered patches and stems. No local funds for treatment this year. Treatment recommended for next growing season.	15%

Area	Location/Area Description	Year	Description of Growth	Year-End Percent Cover
		2016	Increased density of patches/shoreline growth. No local funds for treatment this year. Treatment recommended for next growing season.	25%
		2017	Established stands of milfoil and fanwort. No local funds for treatment this year. Treatment recommended for next growing season.	35%
		2018	Scatttered milfoil and occasional fanwort by late season	<5%
		2019	Patchy growth	<5%
		2020	Scattered patches, expanding some compared to prior year	10%

Milfoil Management Goals and Objectives

The aquatic plant management plan for Phillips Pond in Sandown outlines actions to reduce growths (both density and distribution) of variable milfoil and fanwort, while maintaining native plant communities whenever control actions are being implemented.

This plan 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. It can be expected that herbicide use will be a needed tool to reduce larger and stubborn infestations due primarily to the nature of growth in the lake, though several areas will use primarily non-chemical means of control to reduce growth.

Local Support

Town or Municipality Support

The town of Sandown has been an advocate for invasive plant prevention and control for a number of years, dating back to the original fanwort and milfoil infestations in the pond. The town has put up substantial funds in the past for invasive plant control, and supports the efforts of the lake association to further reduce milfoil densities in order to achieve an eradication level of control.

Lake Resident Support

Phillips Pond has an active lake association that participates in Weed Watching and volunteer water quality monitoring, and has done so for a number of years. The lake association has individuals that are committed to performing follow-up monitoring for milfoil and fanwort re-growth and doing what is needed to control the milfoil in the system. They are also providing monetary match for this project.

Waterbody Characteristics

The following table summarizes basic physical and biological characteristics of Phillips Pond, including the milfoil and fanwort 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	
Lake area (acres)	85
Watershed area (acres)	2,005
Shoreline Uses (residential, forested, agriculture)	Mainly residential, some forested
Max Depth (ft)	19
Mean Depth (ft)	10
Trophic Status	Mesotrophic
Color (CPU) in Epilimnion	97
Clarity (ft)	5.6
Flushing Rate (yr^{-1})	3.7
Natural waterbody/Raised by Damming/Other	Natural
Plant Community Information Relative to Management	
Invasive Plants (Latin name)	*Myriophyllum heterophyllum and Cabomba caroliniana*
Infested Area (acres)	See maps
Distribution (ringing lake, patchy growth, etc)	See maps
Sediment type in infested area (sand/silt/organic/rock)	Sandy/silty/rocky
Rare, Threatened, or Endangered Species in or Near Waterbody (according to NH Natural Heritage Inventory)	2021 Review: Climbing hempvine (*Mikania scadens*) American featherfoil (*Hottonia inflata*) Blanding's Turtle (*Emydoidea blandingii*) Spotted Turtle (*Clemmys guttata*)

	Historic Reviews: Hessel's Hairstreak (*Callophrys hesseli*) Mocha Emerald (*Somatochlora linearis*)

An aquatic vegetation map and key from a summer 1990 survey (field checked in 2013 by DES for accuracy, no substantial change noted) by the DES Biology Section is shown in Figure 2. A bathymetric map from 1990 is provided 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.

Aquatic Life

Fishery

Phillips Pond is a warmwater fishery with smallmouth bass, largemouth bass, pickerel and horned pout.

According to the Natural Heritage Bureau, there are no records of state threatened or endangered fish or wildlife species in or adjacent to Phillips Pond.

Wildlife

A Natural Heritage Bureau 2018 review showed that there are two species of special concern in or near Phillips Pond, Blanding's Turtle (*Emydoidea blandingii*) and Spotted Turtle (*Clemmys guttata*). Hessel's Hairstreak (*Callophrys hesseli*), Mocha Emerald (*Somatochlora linearis*) have been recorded in previous reviews.

Hessel's Hairstreak: This butterfly is associated with Atlantic white cedar swamps. It is not specifically ranked in New Hampshire or federally, but it is a species of concern in the state due to rarity. The NHB review shows the presence of this species to the south of the pond, not actually associated with the pond, so there are no anticipated impacts to this butterfly from milfoil and fanwort control activities in Phillips Pond.

Mocha Emerald: This dragonfly species is associated with woodland stream habitats, and waterbodies with gravelly substrates. It is not specifically ranked in New Hampshire or federally, but it is a species of concern in the state due to rarity. The NHB review shows the presence of this species to the south of the pond, not actually associated with the pond, so there are no anticipated impacts to this dragonfly from milfoil and fanwort control activities in Phillips Pond.

Blandings Turtle: The Blanding's turtle (*Emydoidea blandingii***)** is listed as endangered in New Hampshire, where it is rare or uncommon. It has no federal listing, and it is listed as globally secure, but a cause for concern. It is not expected that habitat or food sources for the turtle will be affected by the recommended milfoil control practices. No significant impacts to native habitat or food sources for the turtle are expected to be impacted as a result of the proposed control actions. Fish and Game requests that herbicide applicators avoid direct herbicide application in scrub shrub dominated wetland coves, in order to minimize impacts.

Spotted Turtle: The spotted turtle is listed as threatened in New Hampshire, but has no federal ranking. It is globally secure, but rare and possibly vulnerable in New Hampshire. It is not expected that habitat or food sources for the turtle will be affected by the recommended control practices. No significant impacts to native habitat or food sources for the turtle are expected to be impacted as a result of the proposed control actions.

Recreational Uses and Access Points

Phillips Pond is used for numerous recreational activities, including boating, fishing, swimming, and water skiing by both mostly shorefront residents, and

less so by transient boaters (mainly due to lack of adequate public access and related parking for trailers).

In terms of boating activity, lake residents estimate that there are roughly 5-10 power boats using the waterbody on a regular basis, and about 10 or more non-motorized vessels such as canoes and kayaks (most of which are local).

There is one public beach on the shores of Phillips Pond (also called "designated beach") which is owned by the town of Sandown. 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.*

There are small private swim beaches located on private properties around the lake, and some floating docks and swim platforms around the waterbody as well. Figure 4 shows the location of the public access as well as those areas commonly used for swimming, and the locations of swim platforms and docks on Phillips Pond.

Macrophyte Community Evaluation

The littoral zone is defined as the nearshore area 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 Phillips Pond is characterized by a mix of native and non-native (variable milfoil and fanwort) plant growth (Figure 2). Native species include a mix of floating plants (floating heart, watershield, yellow and white water-lilies), emergent plants (pickerelweed, bur-reed, arrowhead, three-way sedge, cattail, swamp loosestrife, bulrush, pipewort), and submergent plants (pondweed, bladderwort). Native plant communities are mixed around the entire lake, and are characterized as 'common/abundant' by the DES.

The Natural Heritage Bureau lists climbing hempvine (*Mikania scadens*) and featherfoil (*Hottonia inflata*) as present in Phillips Pond. Both plants are listed as endangered plant species in New Hampshire. Both have a record from 1940 sightings in the outlet area of Phillips Pond in Sandown. A DES site visit with NHB in 2012 did not yield any findings/documentation of either species in areas where they were historically listed.

Wells and Water Supplies

Figure 7 shows the location of wells, water supplies, well-head protection areas, and drinking water protection areas around Phillips Pond. There are a few wells located near the shoreline of the lake that may be adjacent to the treatment area. The applicator will provide more detailed information on the wells and water supplies within proximity to the treatment areas as required in the permit application process by the Division of Pesticide Control at the Department of Agriculture.

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' data security policy. Visit DES' 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' 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.

Historical Control Activities

SITE	DATE	ACTION	AREA (ac)	APPLICATOR
WHOLE LAKE	FIRST TREATMENT 5/30/2006 BUMP TREATMENTS 6/14/06, 7/5/06, 7/26/06	FLURIDONE TREATMENT Q&AS	85	ACT

SITE	DATE	ACTION	AREA (ac)	APPLICATOR
NORTH END	10/05/2009	Pull	N/A- 50 GALLONS REMOVED	NH DES DIVERS
NORTH END	06/11/2010	PULL	N/A- 40 GALLONS REMOVED	NH DES DIVERS
NORTH END	09/02/2010	DASH AND PULL	N/A- 300 GALLONS REMOVED	NH DES DIVERS
NORTH END	09/27/2010	PULL	N/A- 60 GALLONS REMOVED	NH DES DIVERS
NORTH END	23-Jun-11	2,4D (G)	3.75	LYCOTT
VARIED	06/28/2011	HAND PULL	2 HOURS, 50 GALLONS FANWORT REMOVED	NH DES DIVERS
VARIED	08/26/2011	2 HOURS	2 HOURS, 70 GALLONS OF MILFOIL AND FANWORT REMOVED	NH DES DIVERS
	06/19/2014	DIQUAT AND FLUMINOXAZIN	25.3 ACRES	ACT
ALONG THE W SHORELINE, HEADING N	10/04/2014	DASH	N/A 70 GALLONS REMOVED	ROB FOUDRAIT
NE COVE	10/25/2014	ABA DASH	80 GALLONS	AB AQUATICS
NE COVE	11/05/2014	DASH	20 GALLONS	AB AQUATICS
NORTH END	06/15/2015	HAND PULL	N/A- 70 GAL REMOVED	AQUALOGIC
NE COVE	06/16/2015	HAND PULL	N/A- 60 GAL REMOVED	AQUALOGIC
NE COVE	06/17/2015	HAND PULL	N/A- 100 GAL REMOVED	AQUALOGIC
COVE N OF BOAT LAUNCH	06/19/2015	HAND PULL	N/A- 15 GAL REMOVED	AQUALOGIC
NW SHORE	06/22/2015	HAND PULL AND DASH	70 GAL	AQUALOGIC
COVE E OF BEACH	06/23/2015	HAND PULL	20 GAL	AQUALOGIC
COVE E OF BEACH	06/24/2015	HAND PULL	30 GAL	AQUALOGIC

SITE	DATE	ACTION	AREA (ac)	APPLICATOR
COVE E OF BEACH, AND COVES ALONG W SHORE	06/25/2015	HAND PULL	20 GAL	AQUALOGIC
RIVER INLET	08/19/2015	HAND PULL	90 GAL	AQUALOGIC
WEST SHORELINE	08/20/2015	HAND PULL	60 GAL	AQUALOGIC
WEST SHORELINE	08/24/2015	HAND PULL	40 GAL	AQUALOGIC
N/A	SUMMER 2016	NO FUNDS	NO FUNDS	N/A
N/A	SUMMER 2017	NO FUNDS	NO FUNDS	N/A
LAKEWIDE	06/18/2018	DEPTH CHARGE HERBICIDE (FLUMIOXAZIN & 2,4-D)	36.5 acres	SOLitude
AREAS MARKED BY NHDES	11/07/2018	DASH	30 GALLONS	AQUALOGIC
AREAS MARKED BY NHDES	11/08/2018	DASH	45 GALLONS	AQUALOGIC
AREAS MARKED BY NHDES	11/09/2018	DASH	30 GALLONS	AQUALOGIC
VARIED	08/28/2019	Depth Charge (flumioxazin & 2-4,D)	19.9 acres	SOLitude
Lower western peninsula, southern cove	08/17/2020	DASH	160 GALLONS	AB AQUATICS
Upper western coast	08/18/2020	DASH	90 GALLONS	AB AQUATICS
Upper eastern coast	08/19/2020	DASH	100 GALLONS	AB AQUATICS
Upper northeastern peninsula & cove	08/19/2020	DASH	80 GALLONS	AB AQUATICS
Southeastern third of pond to south	08/20/2020	DASH	40 GALLONS	AB AQUATICS

SITE	DATE	ACTION	AREA (ac)	APPLICATOR
Southern end of pond	08/20/2020	DASH	60 GALLONS	AB AQUATICS
Southwestern corner to southeastern end	08/21/2020	DASH	40 GALLONS	AB AQUATICS
S1 & S2 NW end	10/02/2020	DIVER/DASH	80 GALLONS	AB AQUATICS
S3, S4, S5 NE end	10/03/2020	DIVER/DASH	160 GALLONS	AB AQUATICS
S5 W side mid way	10/04/2020	DIVER/DASH	40 GALLONS	AB AQUATICS
S-6 W side mid way	10/04/2020	DIVER/DASH	80 GALLONS	AB AQUATICS
S6-10 W side	10/05/2020	DIVER/DASH	200 GALLONS	AB AQUATICS
S6 - 10 W side peninsula (2 dives)	10/06/2020	DIVER/DASH	100 GALLONS	AB AQUATICS
S1 - S5 North end	10/08/2020	DIVER/DASH	100 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 in Phillips Pond. The following table summarizes DES' control strategy recommendations for Sandown.

Control Method	Use on Phillips Pond
Restricted Use Areas	Restricted Use Areas may feasibly be used if the milfoil is (for some reason) not effectively controlled by a spring herbicide treatment. The RUA would be used to contain the milfoil infestation until divers, herbicides, or other methods could be scheduled.
Fragment Barrier	A fragment barrier may be a possibility to contain fragments if some areas of the infestation are not controlled by the herbicide treatment, but would be difficult to use due to the fact that the infestation currently forms a band of growth along the north end of the pond.
Hand-pulling	Hand-pulling and Diver-Assisted Suction Harvesting (DASH) have been used in Phillips Pond, but unfortunately due to lack of clarity (tannic water, elevated chlorophyll-a and occasional cyanobacteria blooms) divers have had difficulty seeing underwater to control milfoil and fanwort, and the plants have spread too quickly to control by diving alone. Follow-up diving is recommended as needed and as appropriate once the milfoil density and distribution are reduced.
Mechanical Harvesting/Removal	For Phillips Pond, mechanical harvesting is not recommended due to concerns about plant fragmentation and further spread. This technique also does not target root systems, so re-growth will likely be rapid.
Benthic Barriers	For Phillips Pond, DES recommends installing small benthic barriers in areas of re-growth if small patches of variable milfoil re-grow and can adequately be contained by benthic barriers.
Herbicides	Herbicide use is recommended for larger or denser areas of growth. The herbicide(s) of choice should be appropriately selected for control of the appropriate target species (fanwort and/or variable milfoil).
Extended Drawdown	Drawdown is not an effective control method for variable milfoil, nor is it feasible given the size and depth of the basin, and the depth to which milfoil is growing in this waterbody. There is also

Control Method	Use on Phillips Pond
	no impoundment structure/dam to regulate water levels on Phillips Pond.
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	Historic data show that Phillips Pond is prone to large scale infestations. Action is needed before the two invasive plants reach historic levels of growth.

Recommended Actions, Timeframes and Responsible Parties

Based on the growing season evaluation, the following control actions are recommended:

Year	Action	Responsible Party	Schedule
2018	Herbicide Treatment	SOLitude Lake Management, LLC	June or September
	Hand removal/diving if needed	DES	As needed
	Weed Watching and reporting of any new growth or re-growth	Phillips Pond Association Weed Watchers	May through September
	End of season survey	DES	September/October
2019	Weed Watching and reporting of any new growth or re-growth	Phillips Pond Association Weed Watchers	May through September
	Survey work to determine growing season control actions	DES	Spring/Summer

Year	Action	Responsible Party	Schedule
	Herbicide Treatment if needed	SOLitude Lake Management, LLC	June or September
	Hand removal/diving if needed	DES	As needed
	End of season survey	DES	September/October
2020	Weed Watching and reporting of any new growth or re-growth	Phillips Pond Association Weed Watchers	May through September
	Survey work to determine growing season control actions	DES	Spring/Summer
	Hand removal/diving if needed	DES	As needed
	End of season survey	DES	September/October
2021	Weed Watching and reporting of any new growth or re-growth	Phillips Pond Association Weed Watchers	May through September
	Survey work to determine growing season control actions	DES	Spring/Summer
	Hand removal/diving if needed	DES	As needed
	Herbicide treatment is needed	SOLitude Lake Management	TBD
	End of season survey	DES	September/October

Year	Action	Responsible Party	Schedule
2022	Weed Watching and reporting of any new growth or re-growth	Phillips Pond Association Weed Watchers	May through September
	Survey work to determine growing season control actions	DES	Spring/Summer
	Hand removal/diving if needed	DES	As needed
	End of season survey	DES	September/October
2023	Review and update Long-Term Management Plan as needed with extensions	DES	Winter

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.*

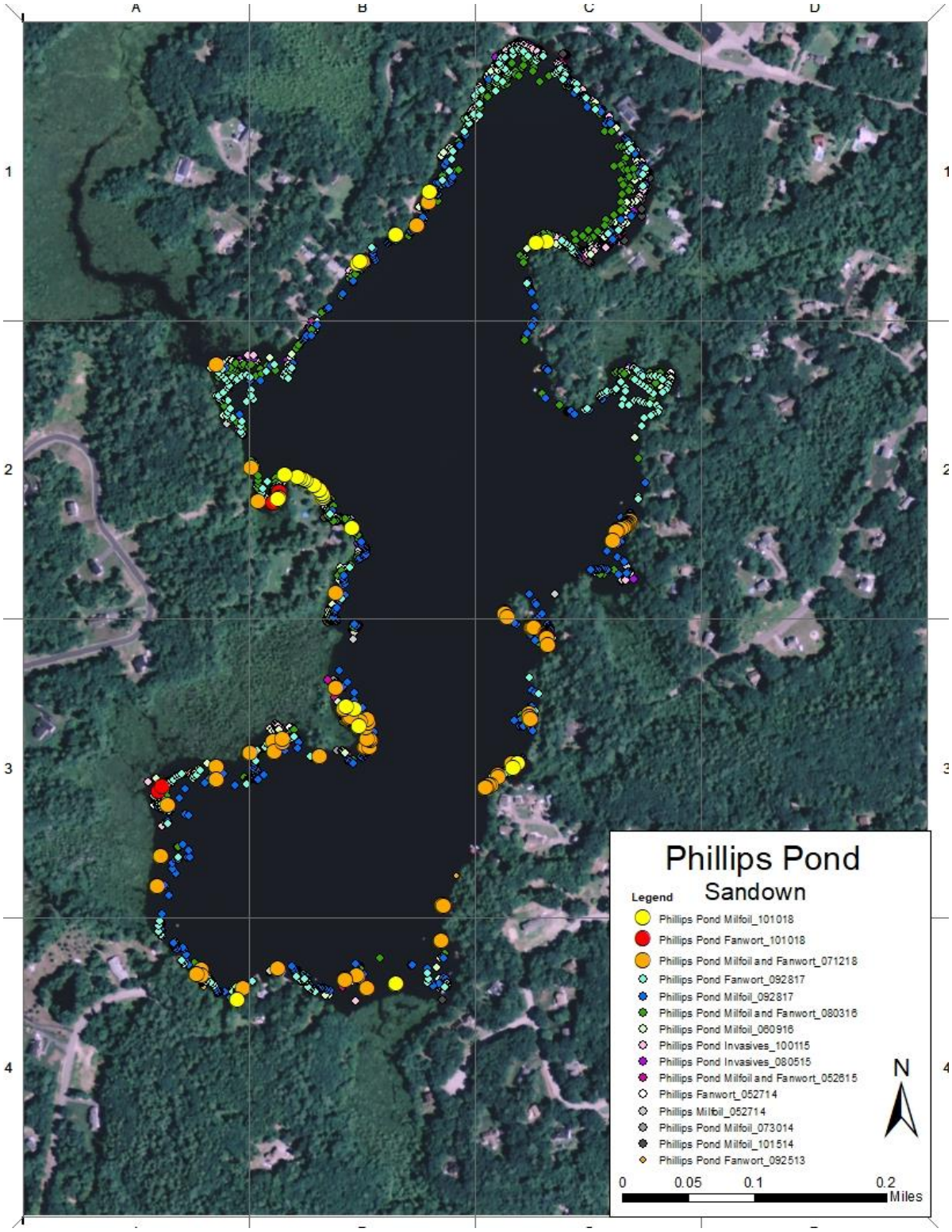
Adaptive Management

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 (from field survey work using DES established field survey standard operating procedures) drive decision making, which may result in modifications to the recommended control actions and timeframes for control. As such, this management plan should be considered a dynamic document that is geared to the actual field conditions that present themselves in this waterbody.

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

Figure 1: Map of Variable Milfoil Infestations Over Time



2020 Growth

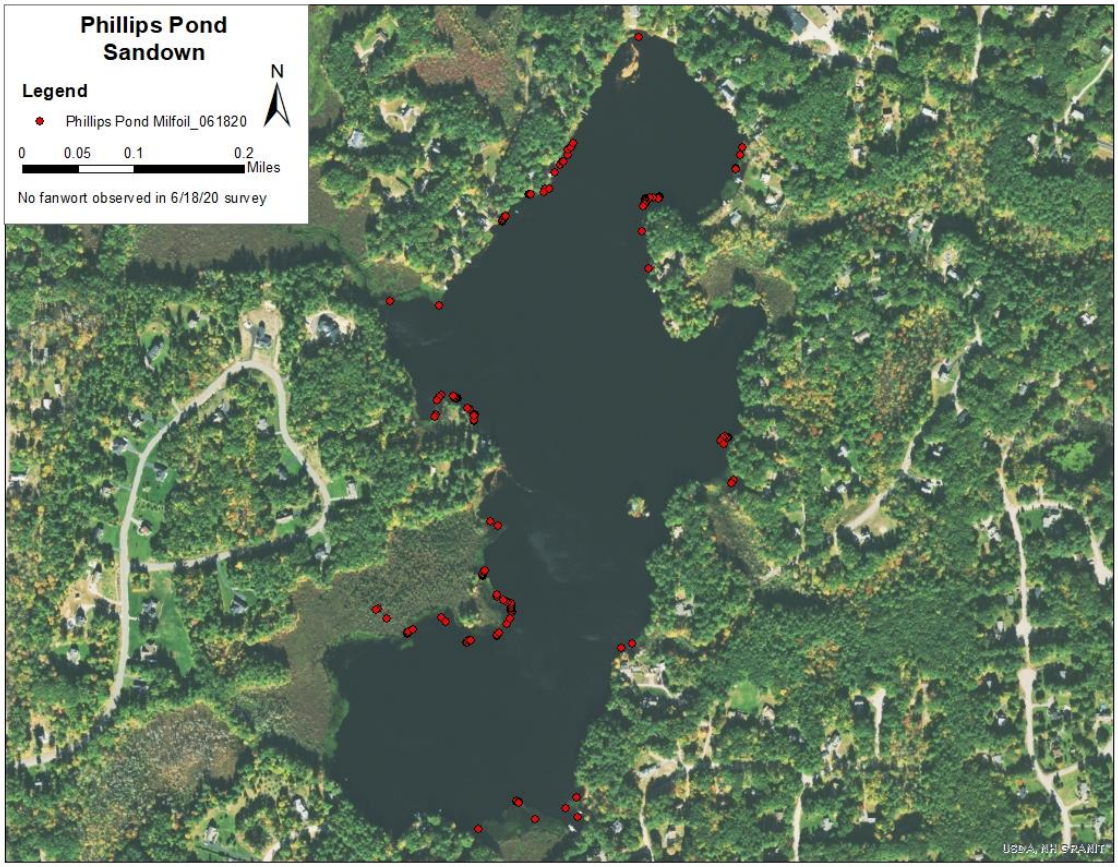
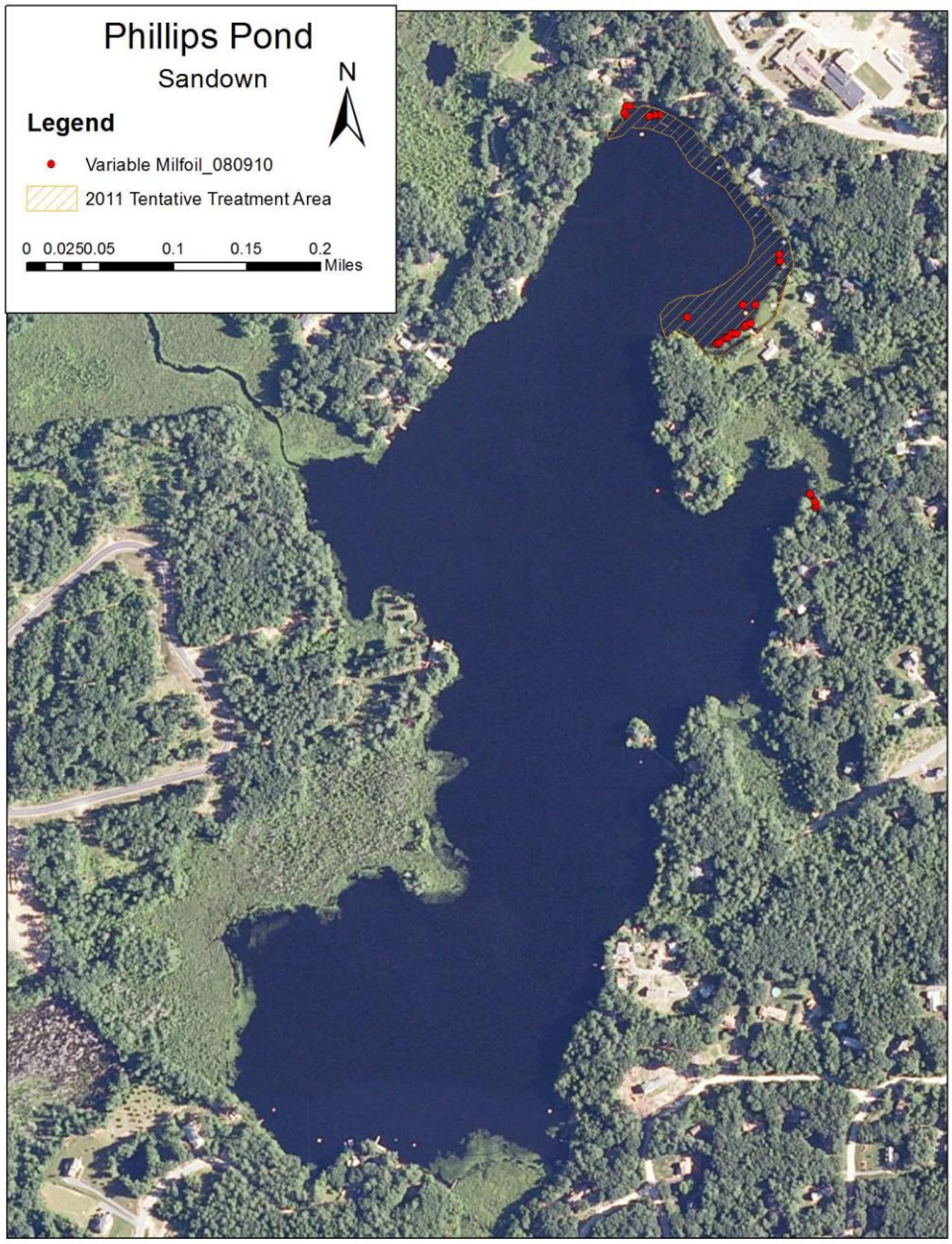
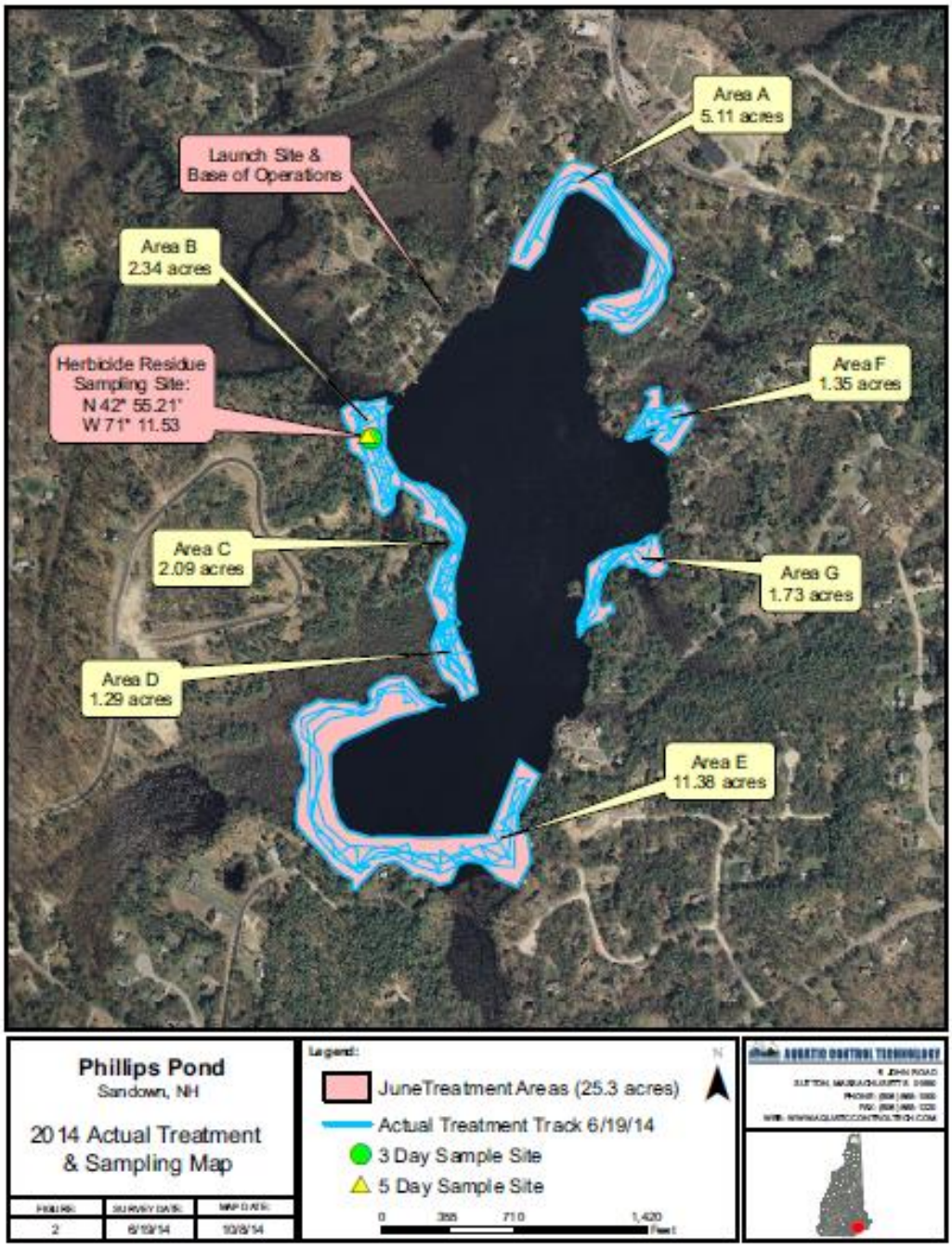

Phillips Pond
Sandown
Legend
Phillips Pond Milfoil_061820
N
0 0.05 0.1 0.2
Miles
No fanwort observed in 6/18/20 survey
USDA, NH GRANIT

Figure 2: Map of Control Actions Over Time

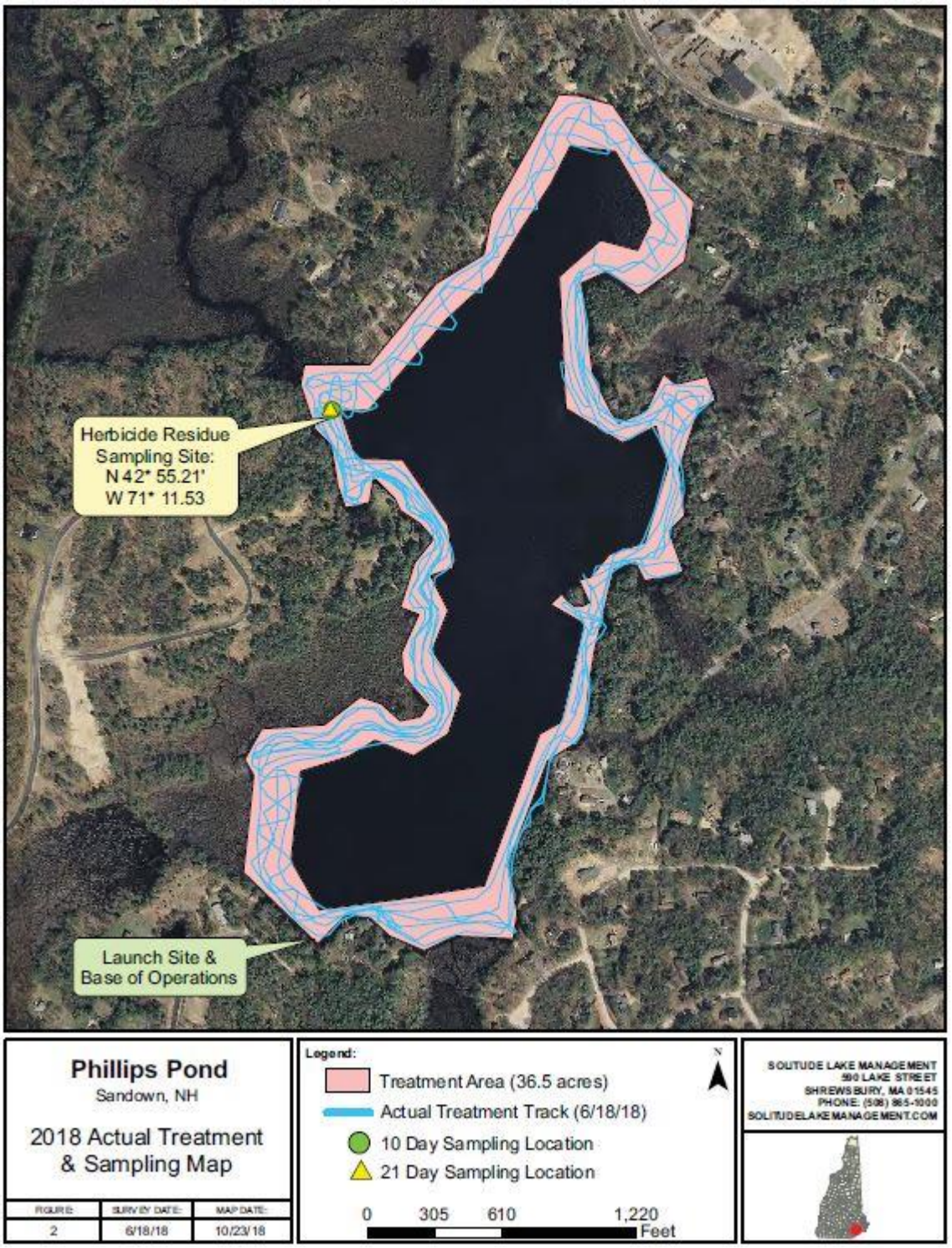
2011



2014 (actual)

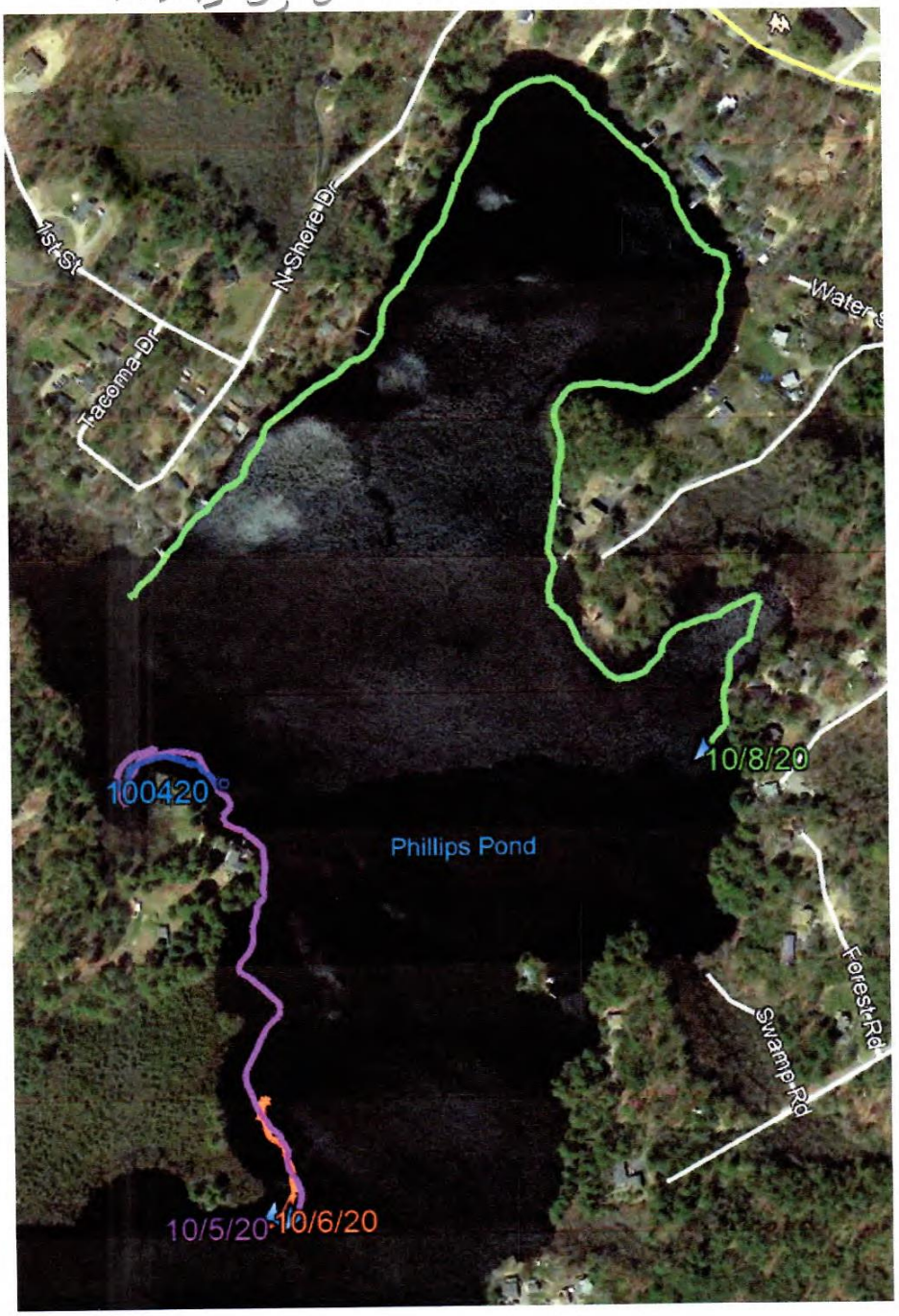

Launch Site &
Base of Operations
Area A
5.11 acres
Area B
2.34 acres
Herbicide Residue
Sampling Site:
N 42° 55.21'
W 71° 11.53
Area F
1.35 acres
Area C
2.09 acres
Area G
1.73 acres
Area D
1.29 acres
Area E
11.38 acres
Phillips Pond
Sandown, NH
2014 Actual Treatment
& Sampling Map
FIGURE:
SURVEY DATE:
MAP DATE:
2
6/19/14
10/8/14
Legend:
JuneTreatment Areas (25.3 acres)
Actual Treatment Track 6/19/14
3 Day Sample Site
5 Day Sample Site
0
355
710
1,420
Feet
N

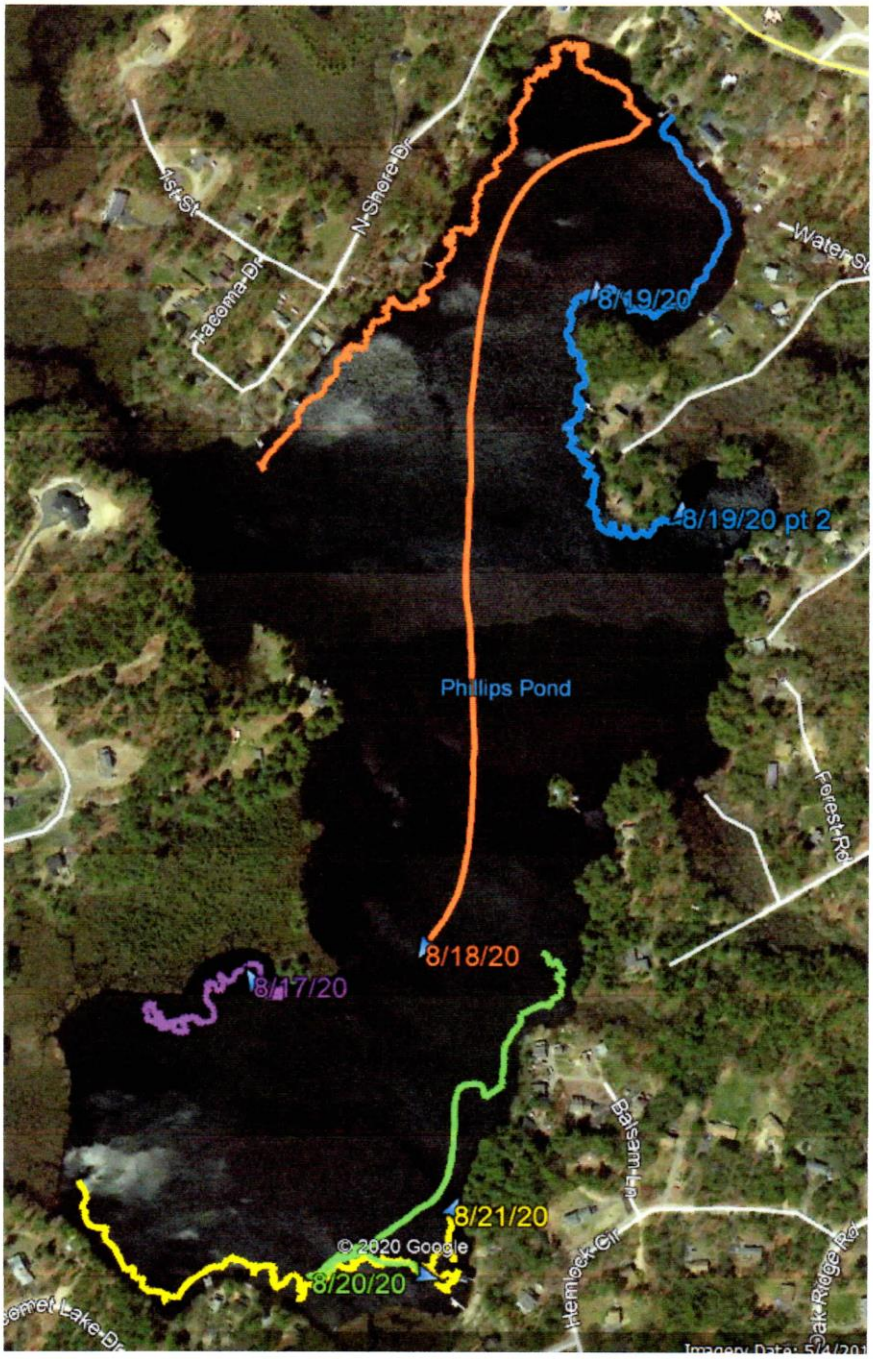
2018 Actual


Herbicide Residue Sampling Site: N 42° 55.21' W 71° 11.53
Launch Site & Base of Operations
Phillips Pond
Sandown, NH
2018 Actual Treatment & Sampling Map
FIGURE: 2
SURVEY DATE: 6/18/18
MAP DATE: 10/23/18
Legend:
Treatment Area (36.5 acres)
Actual Treatment Track (6/18/18)
10 Day Sampling Location
21 Day Sampling Location
N
0 305 610 1,220
Feet
SOLITUDE LAKE MANAGEMENT
900 LAKE STREET
SHREWSBURY, MA 01545
PHONE: (508) 865-1000
SOLITUDELAKEMANAGEMENT.COM

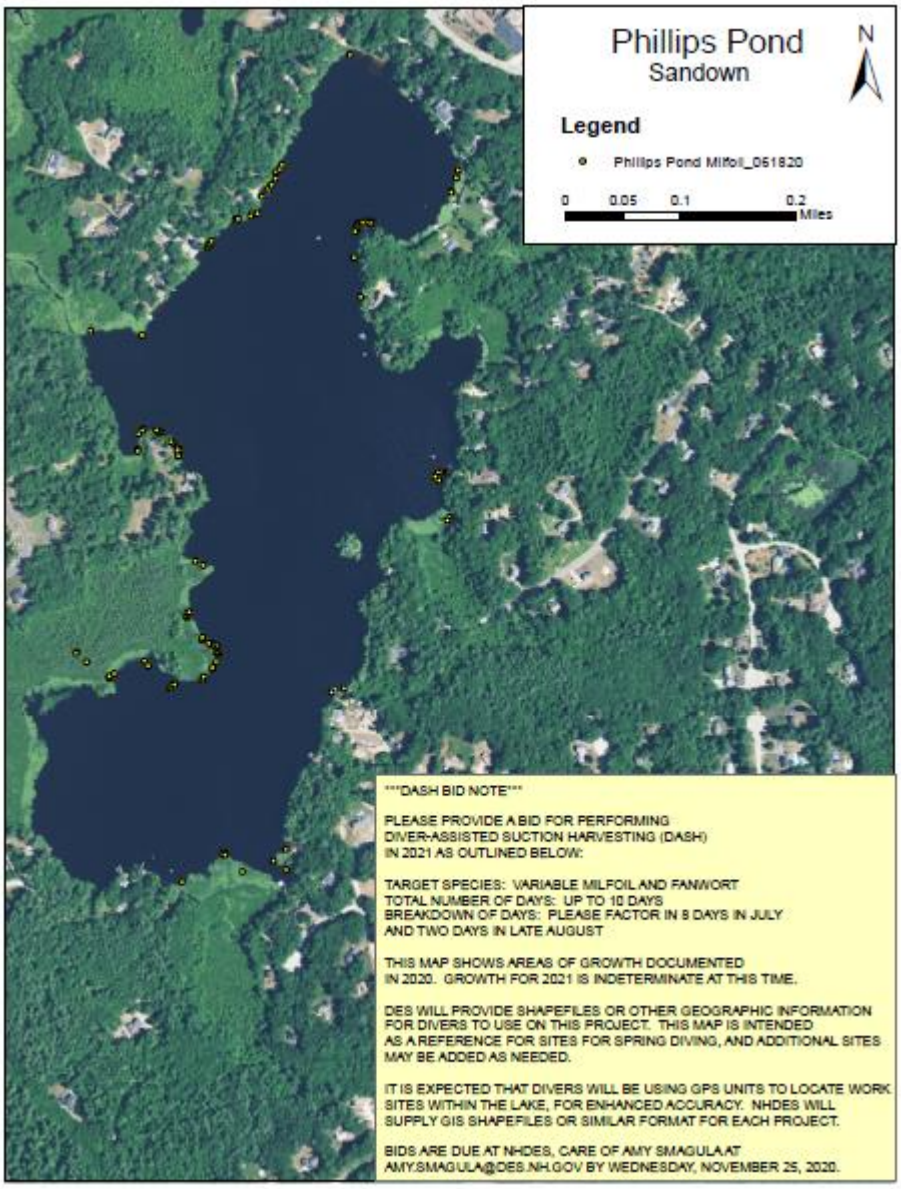
2020 Diving

10/4, 5, 6 + 8 2020


1st St
N Shore Dr
Tacoma Dr
Water
10/8/20
100420
Phillips Pond
Forest Rd
Swamp Rd
10/5/20
10/6/20


1st St
N Shore Dr
Tacoma Dr
Water St
8/19/20
8/19/20 pt 2
Phillips Pond
Forest Rd
8/18/20
8/17/20
Balsam Ln
8/21/20
© 2020 Google
8/20/20
Hemlock Cir
Oak Ridge Rd
Sennet Lake Dr

2021 Proposed



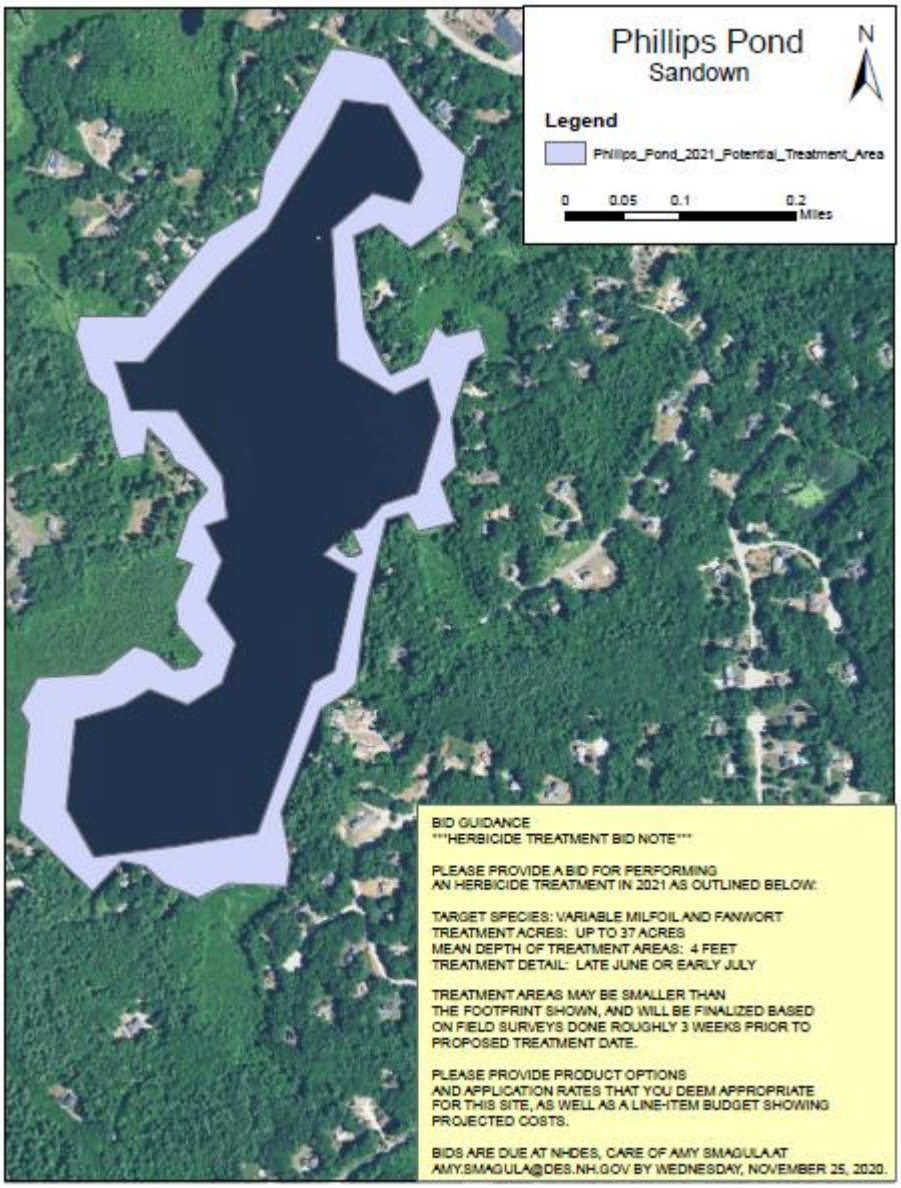
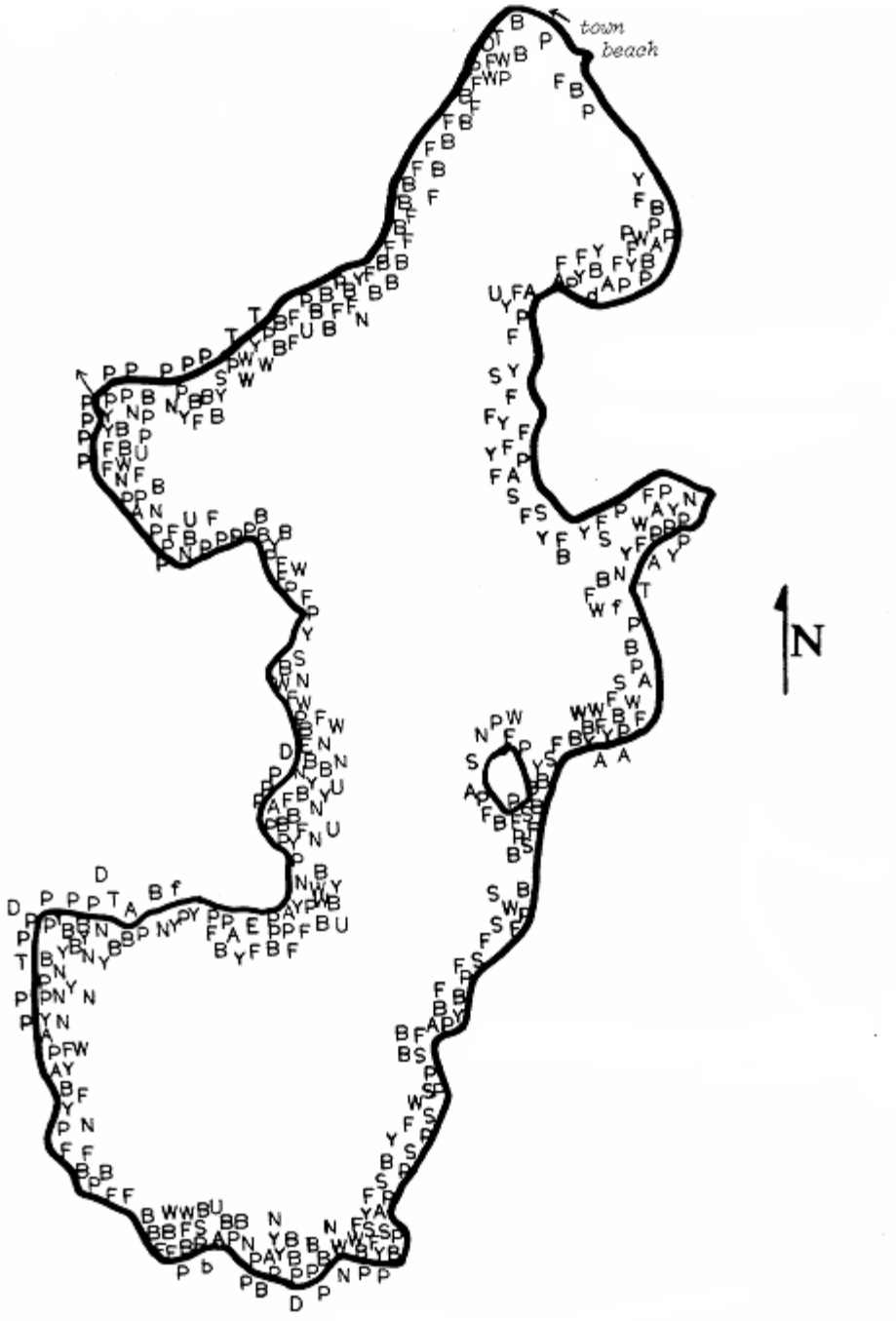

Phillips Pond
Sandown
N
Legend
Phillips_Pond_2021_Potential_Treatment_Area
0 0.05 0.1 0.2
Miles
BID GUIDANCE
HERBICIDE TREATMENT BID NOTE
PLEASE PROVIDE A BID FOR PERFORMING
AN HERBICIDE TREATMENT IN 2021 AS OUTLINED BELOW:
TARGET SPECIES: VARIABLE MILFOIL AND FANWORT
TREATMENT ACRES: UP TO 37 ACRES
MEAN DEPTH OF TREATMENT AREAS: 4 FEET
TREATMENT DETAIL: LATE JUNE OR EARLY JULY
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



Key to Macrophyte Map

Symbol	Common Name	Latin Name
P	Pickerelweed	*Pontedaria cordata*
F	Floating heart	*Nymphoides cordata*
S	Bur-reed	*Sparganium*
B	Watershield	*Brasenia schreberi*
Y	Yellow water-lily	*Nuphar*
W	Pondweed	*Potamogeton*
A	Arrow head	*Sagittaria*
d	Three-way sedge	*Dulichium arundinaceum*
U	Bladderwort	*Utricularia*
N	White water-lily	*Nymphaea*
F	Filamentous green algae	Chlorophyceae
T	Cattail	*Typha*
D	Swamp loosestrife	*Decodon verticillata*
b	Bulrush	*Scirpus*
E	Pipewort	*Eriocaulon*

Figure 4: Bathymetric Map

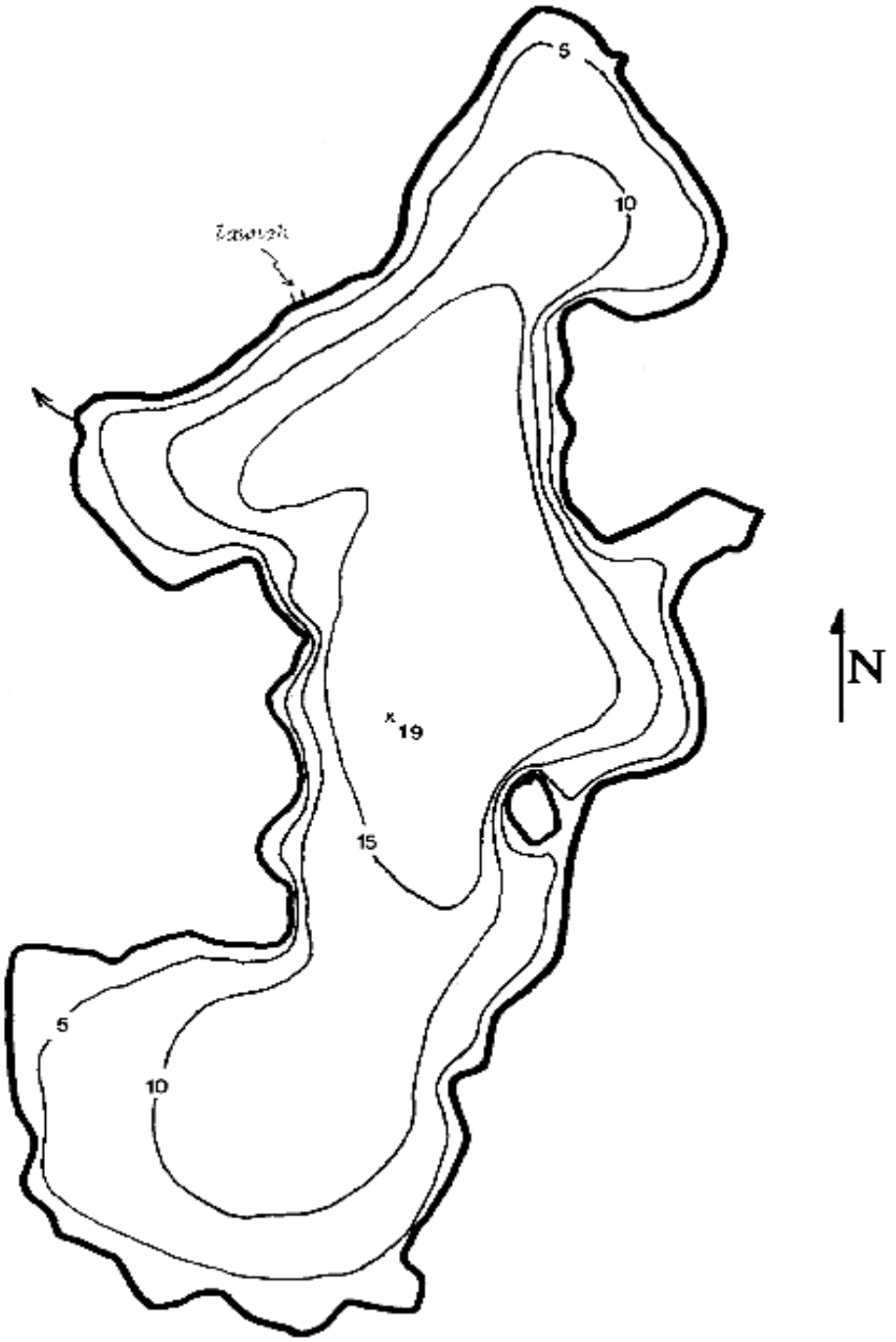


Figure 5: Critical Habitats or Conservation Areas

NHB21-0684

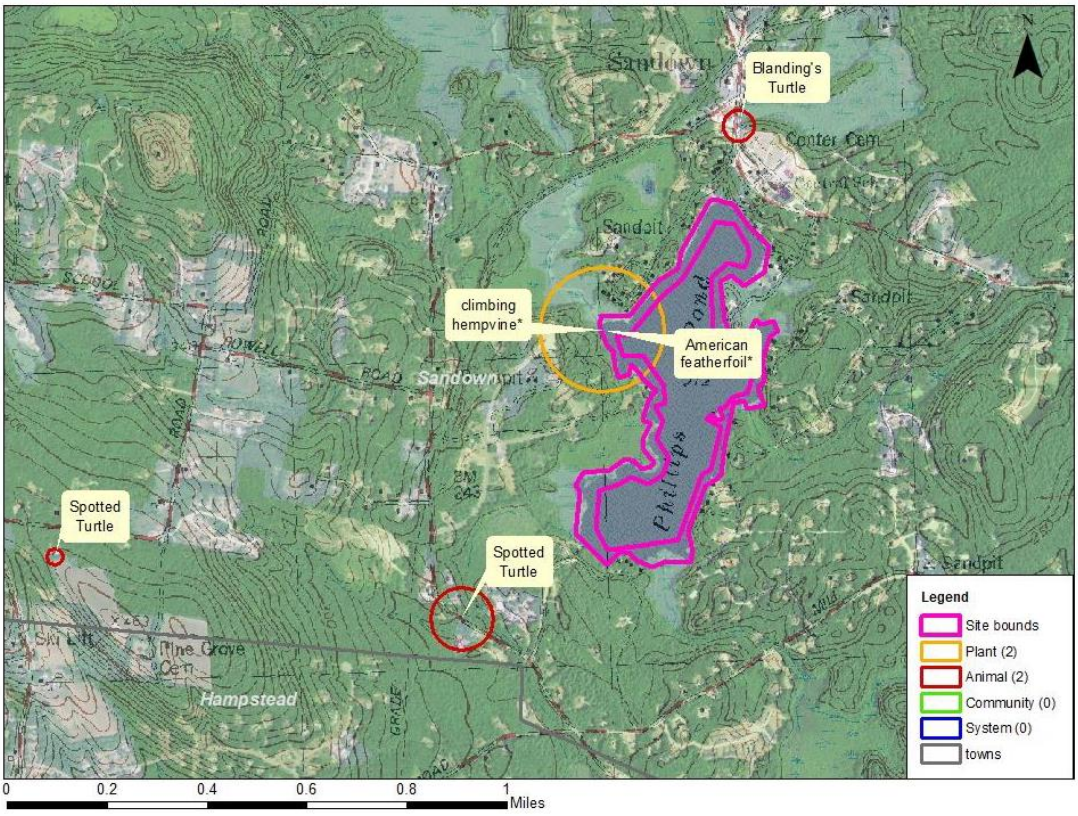


Figure 6: Public Access Sites, Swim Areas, Docks and Swim Platforms

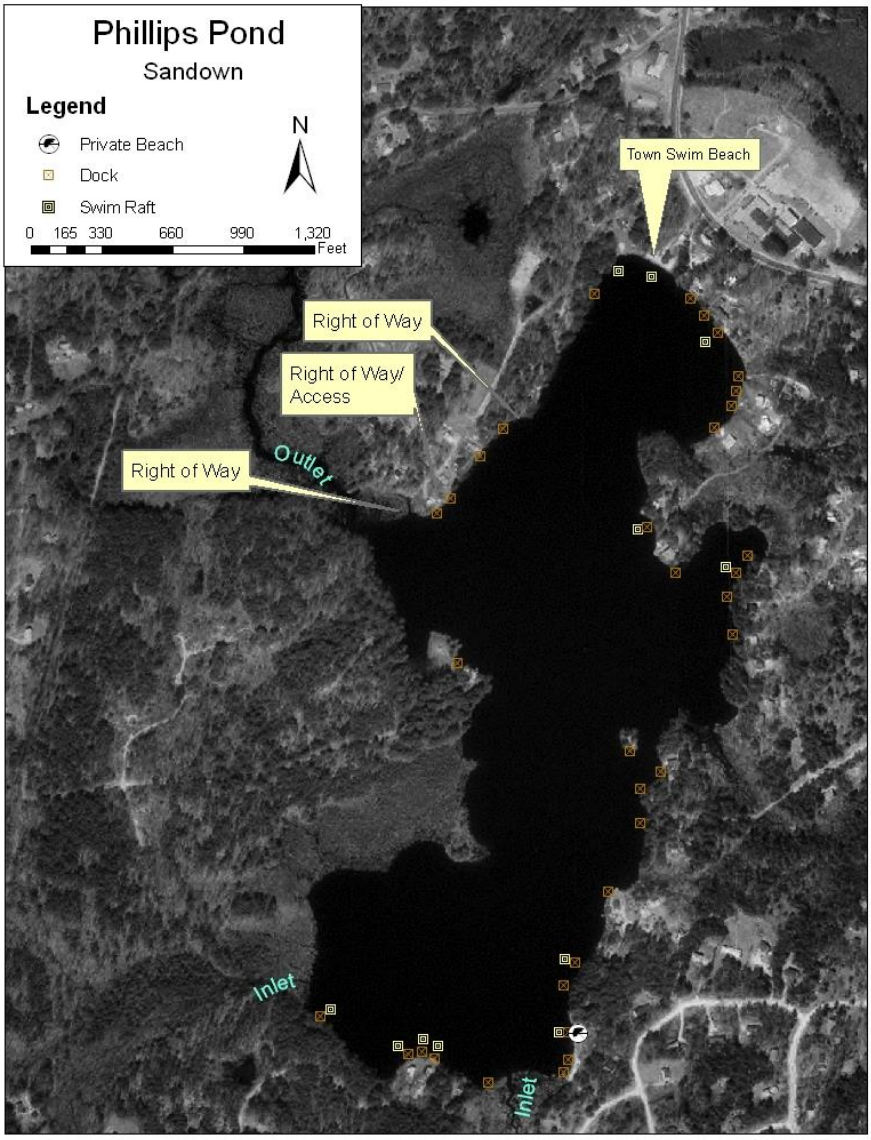
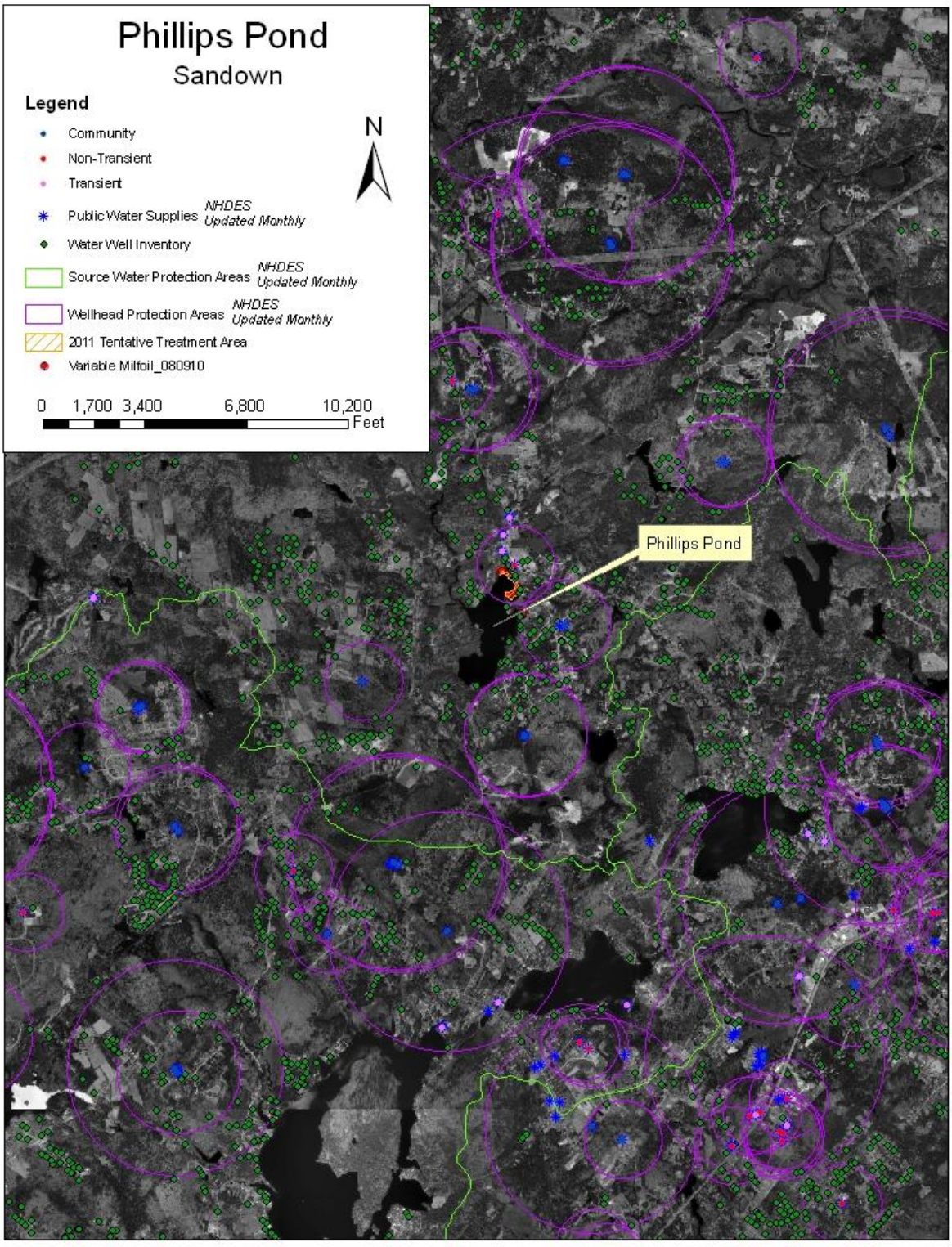


Figure 7: Wells and Water Supplies, 1:48,000 scale



Appendix A-Criteria to Evaluate 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.

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, Phillips Pond 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 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). 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.

References

Department of Environmental Services. 2006: 2006 Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology. November 2005. New Hampshire Department of Environmental Services. NHDES-R-WD-05-29. Available at http://des.nh.gov/WMB/swqa/calm.html

Halstead, J.M., J. Michaud, S. Hallas-Burt, and J.P. Gibbs. 2003. "An Hedonic Analysis of Effects of a Nonative Invader (*Myriophyllum heterophyllum)* on New Hampshire (USA) Lakefront Properties." Environmental Management. 32 (3): 391 – 398

Luken, J.O. and J.W. Thieret. 1997. Assessment and Management of Plant Invasions. Springer-Verlag, New York. 324 pages.