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Environmental Services
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Long-Term Variable Milfoil Management Plan

Ossipee Lake System
Ossipee/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 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 and/or recreational use. 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 Infestation in the Ossipee Lake System

Variable milfoil (*Myriophyllum heterophyllum*) was documented in the Ossipee Lake System in the mid to late 1990s. Variable milfoil was first documented in Broad Bay in 1995, and then in Leavitt Bay (Phillips Brook area) in 2003. Milfoil has also been documented in Portsmouth Cove (between Broad and Leavitt Bays), in the outlet channel just above the dam, in Causeway Cove (a.k.a. Pickerel Cove), and near (west of) the island in Leavitt Bay. In 2012, variable milfoil was documented in the mouth of the Pine River in Ossipee Lake.

Figure 1 illustrates the historic variable milfoil infestations on the waterbody. The following table provides a summary of each area indicated in Figure 1 (areas are based on the grid overlay shown in Figure 1).

Area	Location/Area Description	Year	Description of Growth	% Milfoil Cover in Area
A3	Southwestern shoreline of Lake Ossipee at marina	2016	Newly documented population of variable milfoil within this marina complex	75%
		2017	Dense growth of variable milfoil through the growing season. Fall treatment, will evaluate in spring to determine management success.	75%
		2018	Scattered single stems	<5%
A4	Southern end of Lake Ossipee, mouth of Pine	2009	No milfoil growth	0%
		2010	No milfoil growth	0%
		2011	No milfoil growth	0%

Area	Location/Area Description	Year	Description of Growth	% Milfoil Cover in Area
	River (tributary)	2012	Scattered stems and a couple of small clumps of growth	<5%
		2013	Single scattered stems	<1%
		2014	No milfoil growth observed	0%
		2015	No milfoil growth observed	0%
		2016	A couple of single stems of milfoil observed	<1%
		2017	Expanding growth in the mouth of the river, out into Ossipee Lake with patchy growth. Patchy growth found in Pine River downstream of Route 25 crossing.	25% in mouth of river, isolated growths upstream.
		2018	Very dense milfoil growth in portions of the mouth of the Pine River	50% overall, more in some portions
B3	River channel connecting Lake Ossipee to Broad Bay	2016	Single stems and small clusters of milfoil found around docking system of campground	<1%
		2017	A few stems near the campground docks in the river.	<1%
		2018	Scattered stems, some patches near docks at campground	<1%
C1	North end of Broad Bay	2009	Scattered stems and small patches	5%
		2010	Scattered stems and small patches	5%
		2011	Scattered stems and small patches	5%
		2012	Scattered stems and small patches	5%
		2013	Scattered stems and small patches	5%
		2014	Scattered stems and small patches	5%
		2015	One or two stems observed in May, a few more patches present in August	5%
		2016	No milfoil documented in this area this growing season	0%
		2017	Scattered stems/clusters,	<1%

Area	Location/Area Description	Year	Description of Growth	% Milfoil Cover in Area
			low density	
		2018	Patchy growth in Ossipee Lake Marina, new are of growth documented in a western cove	<5%
C2	Main basin portions of Broad Bay and Leavitt Bay	2009	Dense growth in Phillips Brook and mouth of Phillips Brook	Phillips- 90%
		2010	Patchy growth in Portsmouth Cove and dense growth in Phillips Brook and mouth of Phillips Brook	Portsmouth- 25% Phillips- 90%
		2011	New growth in a southeast cove of Broad Bay, scattered growth in Portsmouth Cove, new growth west of island in Leavitt Bay, and scattered growth in Phillips Brook	Broad Bay Southeast Cove- 10% Portsmouth- 25% West of island- 40% Phillips- 90%
		2012	New growth in a southeast cove of Broad Bay, scattered growth in Portsmouth Cove, new growth west of island in Leavitt Bay, and scattered growth in Phillips Brook	Broad Bay Southeast Cove-10% Portsmouth- 20% West of island- 30% Phillips- 30%
		2013	Southeastern cove and Portsmouth Cove growth reduced by diving. Growth west of island reduced by herbicides and diving. Phillips Brook growth small scale, managed by diving.	Broad Bay Southeast Cove- <5% West of island- 25% Portsmouth- 15% Phillips- 10%
		2014	Southeastern cove and Portsmouth Cove growth reduced by management but some growth still present. Growth west of island not present. Phillips Brook growth absent.	Broad Bay Southeast Cove- 5% West of island- 0% Portsmouth- 15% Phillips- 0%
		2015	Southern cove of Broad Bay had scattered stems of growth, less than previous years. No other milfoil observed through this section.	Broad Bay Southeast Cove- <5% West of island- 0% Portsmouth- 0% Phillips- 0%
		2016	Scattered patches of milfoil in typical places	Broad Bay Southeast Cove- <5%

Area	Location/Area Description	Year	Description of Growth	% Milfoil Cover in Area
			this year, as well as in a few newly documented locations as show on the attached map. Milfoil has expanded in this zone.	West of island- 15% Portsmouth- 0% Phillips- 5% River Channel- <5%
		2017	Scattered patches of milfoil in typical places this year, as well as in a few newly documented locations as show on the attached map. Milfoil has expanded in this zone.	Broad Bay Southeast Cove- <5% West of island- 15% Portsmouth- 0% Phillips- 5% River Channel- <5%
		2018	Scattered patches of milfoil in typical places this year, as well as in a few newly documented locations as show on the attached map. Milfoil has expanded in this zone.	Broad Bay Southeast Cove- <5% West of island- 15% Portsmouth- 0% Phillips- 5% River Channel- <5%
C3	Southern end of Broad Bay/Causeway Cove	2008	New patchy milfoil growth in CausewayCove, diving	20%
		2009	Increased cover of milfoil in Causeway Cove	40%
		2010	Increased cover of milfoil in Causeway Cove	60%
		2011	Patchy growth in Causeway Cove following treatment	15%
		2012	Patchy growth in Causeway Cove, increasing despite diving efforts	30%
		2013	Patchy growth in Causeway Cove following herbicide treatment	<5%
		2014	Patchy growth in Causeway Cove	25%
		2015	Scattered stems early season, small clumps late season.	<10%
		2016	Scattered stems in Causeway Cove, though less than in past years. New patch of milfoil off the point as shown in Figure 1.	<5%

Area	Location/Area Description	Year	Description of Growth	% Milfoil Cover in Area
		2017	Scattered stems in Causeway Cove, though less than in past years.	<5%
		2018	Scattered patchy of growth in Causeway Cove, similar growth patterns compared to historic growth, lower density.	<5%
D1, D2	Berry Bay, outlet	2009	No milfoil observed	0%
		2010	One patch of milfoil observed in outlet channel, removed by divers	0%
		2011	No milfoil observed	0%
		2012	One patch of milfoil observed in outlet channel, removed by divers	0%
		2013	No milfoil observed	0%
		2014	One patch of milfoil observed in outlet channel, removed by divers	0%
		2015	None in D1. New area of growth identified in western cove of outlet channel in D2, and patchy milfoil is historic locations above dam and near condo complex.	Western Cove = 80% Other areas = <5%
		2016	None in D1 observed during DES survey, though volunteers reported a few stems late season. Scattered patches of growth observed in Marist Cove early season, and in cove off channel connecting to Leavitt Bay. Single stems and scattered patches observed in outlet steam above dam.	<10% by end of season
		2017	None observed in outlet or Berry Bay, though a large patch is present in Ligouri (sp?) Cove.	0% in historic areas, 30% in Ligouri Cove
		2018	No milfoil observed in outlet channel of lake, large patch of fairly dense	<5%

Area	Location/Area Description	Year	Description of Growth	% Milfoil Cover in Area
			growth observed in Ligouri Cove	

In terms of the impacts of the variable milfoil in the system, there are several houses around the shoreline of the Ossipee Lake system, with mostly seasonal cottages, though there are many year-round dwellings. There are also commercial business, including marinas, campgrounds, children's camps and other facilities around the lake which are impacted by variable milfoil growth.

The Ossipee Lake system is large, made up of a number of basins. Though the infestation of variable milfoil is small relative to the size of the lake system, allowing the infestation to continue unmanaged only serves to put other parts of the Ossipee Lake system and downstream waterbodies at higher risk of infestation due to generation of fragments from infested areas.

Milfoil Management Goals and Objectives

The goal for Lake Ossipee 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 towns of Ossipee and Freedom appreciate the importance of keeping the Lake Ossipee system usable and controlling the variable milfoil. The Town of Ossipee has allocated money for diver pulling in Phillips Brook, Leavitt Bay, and Portsmouth Cove. In addition, the Town of Ossipee Conservation Commission has funded Lake Host Program workers at the Pequawket Trail boat launch every year since 2006.

Lake Resident Support

The Ossipee Lake Alliance (OLA) is a well-established lake association for the Lake Ossipee system. In addition to being active in outreach and educational activities for the lake and watershed they have taken an active role in coordinating milfoil-related activities. The OLA has done much education and outreach about invasives, has posted signage and educational materials that pertain to invasives, and has offered financial support for the Lake Host Program. The lake association also promotes participation in the statewide Weed Watcher Program to enhance early detection activities throughout the Lake Ossipee system.

Waterbody Characteristics

The following table summarizes basic physical and biological characteristics of Lake Ossipee, including the milfoil infestation. Note that a current review of the Natural Heritage Bureau (NHB) database was requested and the results are shown in the table below, as well as in other relevant sections of this plan. Historic species that showed up in past reports are retained here, even if they were not included in the current review.

OSSIPEE LAKE:

Parameter/Measure	**Value/Description**
Lake area (acres)	3,090
Watershed area (acres)	209,510.6
Shoreline Uses	Residential, forested, commercial
Max Depth (ft)	61.05
Mean Depth (ft)	28.05
Trophic Status	Oligotrophic
Color (CPU) in Epilimnion	27.5
Clarity (ft)	11.2
Flushing Rate (yr-1)	4.6
Waterbody Type	Natural w/dam
Invasive Plants	Variable milfoil *(Myriophyllum heterophyllum)*
Infested Area (acres)	See Figures for historic and current distributions
Distribution	See Figures for historic and current distributions
Sediment type in infested area	Varies but mostly sandy
Rare, Threatened, or Endangered Species in Waterbody (according to NH Natural Heritage Bureau (NHB) Inventory review)	2019 Review Several species and habitats of concern (see Figure 6 and refer to the most recent NHB review the full list)

BROAD BAY:

Parameter/Measure	Value/Description
Lake area (acres)	463.6
Watershed area (acres)	224,340.9
Shoreline Uses (residential, forested, agriculture)	Residential, forested, commercial
Max Depth (ft)	73.6
Mean Depth (ft)	27.4
Trophic Status	Oligotrophic
Color (CPU) in Epilimnion	26
Clarity (ft)	19.8
Flushing Rate (yr-1)	34.1
Natural waterbody/Raised by Damming/Other	Natural w/dam
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)	Silty/Sandy with areas of more organic substrate
Rare, Threatened, or Endangered Species in Waterbody (according to NH Natural Heritage Bureau (NHB) Inventory review)	2019 Review Several species and habitats of concern (see Figure 6 and refer to the most recent NHB review the full list)

LEAVITT BAY:

Parameter/Measure	Value/Description
Lake area (acres)	176.1
Watershed area (acres)	227,267.7
Shoreline Uses (residential, forested, agriculture)	Residential, forested, commercial
Max Depth (ft)	42.2
Mean Depth (ft)	11.2
Trophic Status	Oligotrophic
Color (CPU) in Epilimnion	20.5
Clarity (ft)	13.2
Flushing Rate (yr-1)	221.3
Natural waterbody/Raised by Damming/Other	Natural w/dam
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)	Silty/Sandy
Rare, Threatened, or Endangered Species in Waterbody (according to NH Natural Heritage Bureau (NHB) Inventory review)	2019 Review Several species and habitats of concern (see Figure 6 and refer to the most recent NHB review the full list)

BERRY BAY:

Parameter/Measure	**Value/Description**
Lake area (acres)	145.4
Watershed area (acres)	230,233.1
Shoreline Uses (residential, forested, agriculture)	Residential, forested, commercial
Max Depth (ft)	38.3
Mean Depth (ft)	12.2
Trophic Status	Mesotrophic
Color (CPU) in Epilimnion	21
Clarity (ft)	14.9
Flushing Rate (yr-1)	254
Natural waterbody/Raised by Damming/Other	Natural w/dam
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)	Rocky/cobbly
Rare, Threatened, or Endangered Species in Waterbody (according to NH Natural Heritage Bureau (NHB) Inventory review)	2019 Review Several species and habitats of concern (see Figure 6 and refer to the most recent NHB review the full list)

A native aquatic vegetation map and key is shown in Figure 3. This is compared annually to growth observed in the field. Substantive changes will warrant a map update. 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 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

Fisheries Information

Ossipee Lake is managed for landlocked salmon and rainbow trout (both stocked species) and secondarily for lake trout. Ossipee Lake also contains Brook trout, chain pickerel, large and smallmouth bass, yellow and white perch, common white suckers, brown bullheads, cusk, sunfish spp., common and golden shiners, and rainbow smelt. Successful landlocked salmon reproduction occurs in the Bearcamp River, a large tributary to Ossipee Lake.

Lake whitefish (*Coregonus clupeaformis*) were reported in an historic NHB review from a historic documentation of the species in 1946. The lake whitefish is a reclusive fish that tends to spend most of its time in the deeper and colder waters of lakes. The whitefish does come into shallower waters to spawn in early winter. Spawning habitat is generally shallow rocky or sandy areas in waters that are less than 25 feet in depth. The young of the year fish spend time in shallow waters early on, then migrate deeper as they mature. Lake whitefish feed on small organisms due to a small mouth size. Prey includes small fish in the water column, and benthic organisms such as

insects. Based on the habitat types and habits of this fish, there are no anticipated impacts as a result of the proposed herbicide treatment. Small fish species and benthic organisms are not expected to be impacted by the treatment.

The most recently available Natural Heritage Bureau review of this system identified a number of rare species and exemplary natural communities in the lake system. Refer to the most recent NHB review the full list of wildlife species of concerns in this system. Most of the species are located within the Ossipee Lake basin where no variable milfoil is present. Other species that fall within proximity to the treatment areas in Causeway Cove and Phillips Brook include the common loon which should not be impacted by these small-scale and isolated control efforts, as well as the brook snaketail and the purple martin, which are much removed from the actual treatment locations.

Wildlife Information

Blanding's turtle: This turtle is listed as endangered in New Hampshire, with no federal listing, and it is apparently secure globally. The Fish and Game department ask that contractors avoid direct herbicide application in scrub shrub dominated wetland coves, in order to minimize impacts to habitat for this species.

Brook snaketail: This dragonfly species was document in the outflow of the Ossipee Lake system, in and near the Ossipee River. The record dates to 2008. This dragonfly is not listed in NH, or federally, and it is apparently secure but with cause for concern globally. It is not expected that control activities in the Ossipee system will affect this species.

Common loon: It is expected that loons could be found in most locations throughout the Ossipee Lake system. The Fish and Game Department requests that herbicide treatments not be permitted within 100 meters of any active nest. They cite that the method of application, by motorboat and/or airboat, may result in nest abandonment and loss of eggs and/or loon chicks, as well as herbicide damage to the floating aquatic plants. Further, Fish and Game requests that no chemical or non-chemical treatments, such as hand pulling should occur between May 15 and July 15th within 100 meters of any known or suspected loon nests. Care will be taken with control practices so as to minimize any impacts to loon populations.

A historical review (but not this recent one) notes the presence of purple martin (*Progne subis*) on the northwest shore of Ossipee Lake, which is much removed from the actual treatment locations; therefore, no impacts to this species are expected from control actions for variable milfoil.

There are no NH F&G Wildlife Management Areas within a mile of this waterbody. The Ossipee Pine Barrens, Bearcamp Memorial Forest, Ossipee Lake Natural Area, Long Sands Constitution Park, and Broad Bay Road Parcel lots encompass more than 1,000 acres of conservation land abutting this waterbody. No terrestrial species are being managed in this area currently.

Recreational Uses and Access Points

As one of the state's largest lakes, Ossipee Lake is used for numerous recreational activities including boating, fishing, swimming, and water skiing by both pond residents and transient boaters.

There are two public access sites on Lake Ossipee, the lake can also be accessed by one of the three commercial marina launches around the lake.

There are an estimated 125-160 motorboats on the lake each day (swelling to close to 500 on the weekends), and roughly 60-100 non-motorized craft.

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

In addition to the designated beaches, there are many properties around the lake with private beaches, docks, and swim platforms. These have not been quantified for the purposes of this plan. Figure 5 shows the locations of commonly used swimming areas, access sites, designated beaches, and marinas on Ossipee Lake.

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.

Lake Ossipee

The littoral zone of Ossipee Lake is characterized by a mix of native and non-native (variable milfoil) plant growth (Figure 3). Native species include a mix of floating plants (floating heart, yellow water-lily, white water-lily, watershield), emergent plants (rush, bur-reed, pickerelweed, sedge, bulrush, three-way sedge, arrowhead, and smartweed), and submergent plants (pondweed). Native plant communities are mixed around the entire lake, and are characterized as 'scattered' by the DES.

There is a Hudsonia inland beach strand system listed in a review by the NHB, this system includes the following rare species also listed by NHB: blunt-leaved milkweed (*Asclepius amplexicaulius),* hairy hudsonia (*Hudsonia tomentosa)*, and wild lupine (*Lupinus perennis).* This inland habitat is not expected to be negatively impacted by the treatment as it will not be directly in contact with the treated lake water.

Blunt-leaved milkweed (*Asclepius amplexicaulius)*, was documented in 1988 as present in the hudsonia inland beach strand system on Ossipee Lake. This species grows in sandplains and is not expected to be negatively impacted by the treatment because of it should not be in direct contact with treated lake water.

From 1964 to 2000, hairy hudsonia (*Hudsonia tomentosa)* was documented in the hudsonia inland beach strand habitat of Lake Ossipee. This species is not expected to be negatively affected by treatment because it grows in sand, and is not generally in direct contact with lake water.

Wild lupine (*Lupinus perennis*) grows in dry, sandy areas and at Lake Ossipee is found in the hudsonia inland beach strand area, because of this, it is not expected to be negatively impacted by treatment of lake water.

Golden heather (*Hudsonia ericoides*) was documented in 1988 at the Lake Ossipee Hellquist Site. This species is not expected to be negatively impacted by treatment because it grows in sandy, pinebarren habitats, areas generally set back from the water.

Narrow-leaved cotton-grass (*Eriophorum angustifolium)*, was documented by the NHB in 1991 when it was located in the Pequawket Bog. This species

lives in peatland and is sensitive to changes in its habitat, the hydrology of the area, increased nutrient input and sedimentation. Treatment proximity?

Pease's blunt spike-rush (*Eleocharis obtusa var. peasei)*, was documented by the NHB in 1923 as present in Lake Ossipee near Bearcamp Memorial Forest, it has not been documented since. This species is sensitive to herbiciding, however its documented location is far from any treatment areas and as such is not expected to be negatively impacted by water treatment.

There are several natural communities, rare, threatened or endangered plants in this area (a full map and list is shown in Figure 6).

Because of the sensitivity of the plant community where the Pine River enters Lake Ossipee, and per NHB's request, diving will be used as a primary control technique at that site. Should herbicide treatment be needed DES will work with NHB and other interests to determine BMPs for those sites.

Broad Bay

The littoral zone of Broad Bay is characterized by a mix of native and non-native (variable milfoil) plant growth (Figure 3). Native species include a mix of floating plants (yellow and white water-lily, watershield), emergent plants (spike rush, arrowhead, bur-reed, pickerelweed, sedge, cattail), and submergent plants (pondweed, grassy spike rush, bladderwort). Native plant communities are mixed around the entire lake, and are characterized as 'scattered/common' by the DES. The invasive plant, variable milfoil, has been present in Broad Bay since 1995.

There has been a kettle hole bog system listed in historical NHB reviews which is within a setback distance from the treatment area in Causeway Cove, but it does not appear to be hydrologically connected (surficially) to Causeway Cove and thus should not be impacted as a result of this treatment. This site was not included in the recent NHB review, but this information is maintained for posterity in this plan.

An historical record of mermaid-weed (*Proserpinaca pectinata*) is shown on the NHB map originating from 1975. In a plant survey by DES and NHB during summer 2011, no mermaidweed was found in the area that was previously documented to support populations of this plant. 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.

Leavitt Bay

The littoral zone of Leavitt Bay is characterized by a mix of native and non-native (variable milfoil) plant growth (Figure 3). Native species include a mix of floating plants (yellow and white water-lily, floating heart), emergent plants (spike rush, three-way sedge, buttonbush, swamp candle, sedge, bur-reed), and submergent plants (quillwort, bladderwort, tape grass, various pondweed species). Filamentous algae was documented in patches on the bottom in various parts of the bay. Native plant communities are mixed around the entire lake, and are characterized as 'scattered' by the DES. The invasive plant, variable milfoil, has been present in Leavitt Bay since roughly 2003, and is present primarily in Phillips Brook which enters the bay at the southern end of the basin.

An NHB review yielded a 1979 historical record for budding pondweed (*Potamogeton gemmiparus*) in Leavitt Bay stream (Phillips Brook) where management actions are needed. A summer 2011 survey by NHB and DES showed the plant was not present within the treatment zone.

Long-leaved redtop-panic grass (*Coleataenia longifolia ssp. longifolia*) is listed by the NHB as historically present (1966 and earlier) in the channel connecting Leavitt Bay and Berry Bay. This is a monocot species and not susceptible to the herbicide of choice for this project, and it is some distance downstream of the Phillips Brook treatment area.

Berry Bay

The littoral zone of Berry Bay is characterized by a mix of native and non-native (variable milfoil) plant growth (Figure 3). Native species include a mix of floating plants (yellow and white water-lily), emergent plants (sedge, swamp candle, three-way sedge, grass sp., arrowhead, bur-reed), and submergent plants (tape grass, pondweed). Filamentous algae was documented in patches on the bottom in various parts of the bay. Native plant communities are mixed around the entire lake, and are characterized as 'scattered' by the DES. NHB has listed the presence of needle beak sedge (a monocot not susceptible to the herbicide of choice and well downstream of any treatment areas).

Wells and Water Supplies

Figure 7 shows the location of wells, water supplies, well-head protection areas, and drinking water protection areas around the subject waterbody, based on information in the DES geographic information system records.

Note that it is likely that Figure 7 does not show the location of all private wells.

Note that the map in Figure 7 cannot be provided on a finer scale than 1:48,000. Due to public water system security concerns, a large-scale map may be made available upon agreement with DES' 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 Actions

BASIN	SITE	DATE	METHOD	AREA (ac)	CONTRACTOR
BROAD BAY		6/5/1996	DIQUAT	6	ACT
LEAVITT BAY	PHILLIPS BROOK	2004	HAND PULL	VARIED	CLIFF CABRAL
BROAD/LEAVITT	PORTSMOUTH COVE	2004	HAND PULL	VARIED	CLIFF CABRAL
LEAVITT BAY	PHILLIPS BROOK	6/16/2004	HERBICIDE - DIQUAT	4.5	LYCOTT
LEAVITT BAY	PHILLIPS BROOK	2005	HAND PULL	VARIED	CLIFF CABRAL
BROAD/LEAVITT	PORTSMOUTH COVE	2005	HAND PULL	VARIED	CLIFF CABRAL
LEAVITT BAY	PHILLIPS BROOK	2006	HAND PULL	VARIED	CLIFF CABRAL
BROAD/LEAVITT	PORTSMOUTH COVE	2006	HAND PULL	VARIED	CLIFF CABRAL
LEAVITT BAY	PHILLIPS BROOK	2007	HAND PULL	VARIED	CLIFF CABRAL
BROAD/LEAVITT	PORTSMOUTH COVE	2007	HAND PULL	VARIED	CLIFF CABRAL
LEAVITT BAY	PHILLIPS BROOK	2008	HAND PULL	VARIED	CLIFF CABRAL
BROAD/LEAVITT	PORTSMOUTH COVE	2008	HAND PULL	VARIED	CLIFF CABRAL
LEAVITT BAY	PHILLIPS BROOK	2009	HAND PULL	VARIED	CLIFF CABRAL

BASIN	SITE	DATE	METHOD	AREA (ac)	CONTRACTOR
BROAD/LEAVITT	PORTSMOUTH COVE	2009	HAND PULL	VARIED	CLIFF CABRAL
BROAD/LEAVITT/ BERRY	PORTSMOUTH COVE/CAUSEWAY COVE/OUTLET CHANNEL	2010	HAND PULL AND DASH	VARIED	CLIFF CABRAL
OSSIPEE SYSTEM	PICKEREL COVE, PHILLIPS BROOK, OSSIPEE LAKE MARINA	6/7/2011	2,4-D	12	ACT
BROAD BAY	VARIOUS COVES	8/1/2011	HAND PULL	2.5 HOURS, 80 GALLONS	DES
BROAD BAY	VARIOUS COVES	8/18/2011	HAND PULL	3.5 HOURS 90 GALLONS	DES
BROAD BAY/LEAVITT BAY	VARIOUS COVES	8/29/2011	HAND PULL	3 HOURS 60 GALLONS	DES
LEAVITT BAY	NORTHWEST COVE	9/19/2011	DASH	3 HOURS 180 GALLONS	DES
BROAD BAY/LEAVITT BAY	PINE RIVER, BROAD BAY COVES, LEAVITT BAY, PHILLIPS BROOK	8/17/2012	DIVER/DASH	3 HOURS, 150 GALLONS	DES
BROAD BAY/LEAVITT BAY	CAUSEWAY COVE, LEAVITT BAY, PHILLIPS BROOK	9/14/2012	2,4-D (G)	15 ACRES AT 100 LBS/ACRE	ACT
BROAD BAY/LEAVITT BAY	PINE RIVER, BROAD BAY COVES, LEAVITT BAY, PHILLIPS BROOK	9/20/2012	DIVER/DASH	2 HOURS, 150 GALLONS	DES
BROAD BAY/LEAVITT BAY	BROAD BAY COVES, LEAVITT BAY, PHILLIPS BROOK	9/25/2012	DIVER/DASH	2.5 HOURS, 140 GALLONS	DES
BROAD BAY/LEAVITT BAY	BROAD BAY COVES, LEAVITT BAY	9/16/2013	2,4-D & TRICLOPYR (G)	21.8 ACRES	ACT
BROAD BAY	BROAD BAY COVES	10/12/2013	DIVER/DASH	40 GALLONS	AB AQUATICS
OSSIPEE SYSTEM	OSSIPEE LAKE FREEDOM	6/17/2014	2,4-D BEE (G)	799 LBS FOR 7.2 ACRES	ACT

BASIN	SITE	DATE	METHOD	AREA (ac)	CONTRACTOR
OSSIPEE SYSTEM	OSSIPEE LAKE FREEDOM	7/22/2014	DASH	360 GALLONS	NEW ENGLAND MILFOIL
OSSIPEE SYSTEM	OSSIPEE LAKE FREEDOM	7/23/2014	DASH	40 GALLONS	NEW ENGLAND MILFOIL
OSSIPEE SYSTEM	OSSIPEE RIVER	7/23/2014	DASH	160 GALLONS	NEW ENGLAND MILFOIL
OSSIPEE SYSTEM	OSSIPEE RIVER	7/22/2015	DASH	120 GAL	NEW ENGLAND MILFOIL
OSSIPEE SYSTEM	OSSIPEE RIVER	7/23/2015	DASH	100 GAL	NEW ENGLAND MILFOIL
OSSIPEE SYSTEM	OSSIPEE RIVER	8/19/2015	DASH	80 GAL	NEW ENGLAND MILFOIL
OSSIPEE SYSTEM	OSSIPEE LAKE FREEDOM	8/20/2015	DASH	140 GAL	NEW ENGLAND MILFOIL
OSSIPEE SYSTEM	OSSIPEE LAKE FREEDOM	8/26/2015	DASH	300 GAL	NEW ENGLAND MILFOIL
OSSIPEE SYSTEM	OSSIPEE LAKE FREEDOM	8/27/2015	DASH	620 GAL	NEW ENGLAND MILFOIL
OSSIPEE SYSTEM	OSSIPEE LAKE FREEDOM	9/2/2015	DASH	220 GAL	NEW ENGLAND MILFOIL
OSSIPEE SYSTEM	OSSPIEE LAKE FREEDOM	6/22/2016	2,4-D BEE (G)	1818 LBS FOR 12.8 ACRES	SOLitude
OSSIPEE SYSTEM	OSSIPEE LAKE, NEAR PINE RIVER OUTLET	10/20/2016	DASH	160 GALLONS	AB AQUATICS
OSSIPEE SYSTEM	OSSIPEE LAKE, NEAR PINE RIVER OUTLET	10/21/2016	DASH	240 GALLONS	AB AQUATICS
OSSIPEE SYSTEM	OSSIPEE RIVER NEAR BROAD BAY BY SAND BAR	10/24/2016	DASH	180 GALLONS	AB AQUATICS
OSSIPEE SYSTEM	OSSIPEE RIVER NEAR DAM BY END	10/25/2016	DASH	100 GALLONS	AB AQUATICS
OSSIPEE SYSTEM	OSSIPEE RIVER AT COVE NEAR RIDGE ROAD	10/26/2016	DASH	140 GALLONS	AB AQUATICS
OSSIPEE SYSTEM	OSSIPEE RIVER AT COVE NEAR BAY ROAD	10/27/2016	DASH	160 GALLONS	AB AQUATICS
OSSIPEE SYSTEM	OSSIPEE RIVER, BROAD BAY, BAY RD, SAND BAR	10/28/2016	DASH	320 GALLONS	AB AQUATICS
LEAVITT BAY	RIVER	11/9/2016	DASH	190 GALLONS	AB AQUATICS

BASIN	SITE	DATE	METHOD	AREA (ac)	CONTRACTOR
OSSIPEE SYSTEM	SOUTHERN SHORE MAIN LAKE BODY	11/10/2016	DASH	260 GALLONS	AB AQUATICS
OSSIPEE SYSTEM	SOUTHERN SHORE MAIN LAKE BODY	11/11/2016	DASH	300 GALLONS	AB AQUATICS
OSSIPEE LAKE	FAR SW POINTS AND TIP OF PENINSULA	8/14/2017	DASH	45 GALLONS	AB AQUATICS
OSSIPEE LAKE	SW POINTS IN COVE EAST OF PENINSULA	8/14/2017	DASH	80 GALLONS	AB AQUATICS
OSSIPEE LAKE	SW POINTS EAST TIP OF PENINSULA	8/14/2017	DASH	10 GALLONS	AB AQUATICS
OSSIPEE LAKE	FAR SOUTH POINTS TO THE WEST	8/15/2017	DASH	25 GALLONS	AB AQUATICS
OSSIPEE LAKE	SOLO POINT IN SOUTHWEST	8/15/2017	DASH	10 GALLONS	AB AQUATICS
OSSIPEE LAKE	COVE NW OF SOLO POINT	8/15/2017	DASH	10 GALLONS	AB AQUATICS
OSSIPEE LAKE	FURTHEST SOUTH COVE TO THE WEST	8/16/2017	DASH	2 GALLONS	AB AQUATICS
OSSIPEE LAKE	COVE MIDWAY UP WESTERN QUADRANT ON EAST SHORE	8/16/2017	DASH	20 GALLONS	AB AQUATICS
OSSIPEE LAKE	COVE ON NORTH END OF LARGE PENINSULA	8/16/2017	DASH	0 GALLONS	AB AQUATICS
OSSIPEE LAKE	WEST SHORE OF CENTRAL BAY NEXT TO ISLAND	8/16/2017	DASH	118 GALLONS	AB AQUATICS
OSSIPEE LAKE	LAKEFRONT LANDING MARINA	8/17/2017	DASH	5 GALLONS	AB AQUATICS
OSSIPEE LAKE	MOUTH OF PINE RIVER	8/17/2017	DASH	220 GALLONS	AB AQUATICS
OSSIPEE LAKE	MOUTH OF PINE RIVER	8/18/2017	DASH	260 GALLONS	AB AQUATICS
OSSIPEE LAKE	VARIOUS	9/14/2017	2,4-D (G)	2.67 ACRES	SOLitude
OSSIPEE LAKE	DANFORTH RIVER BETWEEN UPPER AND LOWER LAKE	9/21/2017	DASH	60 GALLONS	AB AQUATICS
OSSIPEE LAKE	DANFORTH CAMPGROUND, SHORE AND COVE	9/22/2017	DASH	180 GALLONS	AB AQUATICS

BASIN	SITE	DATE	METHOD	AREA (ac)	CONTRACTOR
OSSIPEE LAKE	CAMPGROUND AND COVE TO THE WEST	9/25/2017	DASH	60 GALLONS	AB AQUATICS
OSSIPEE LAKE	MARINA AND RIVER	9/25/2017	DASH	6 GALLONS	AB AQUATICS
OSSIPEE LAKE	COVE WEST OF CAMPGROUND MARINA	9/26/2017	DASH	12 GALLONS	AB AQUATICS
OSSIPEE LAKE	WEST COVE, NORTH OF T.Z.C.	9/26/2017	DASH	24 GALLONS	AB AQUATICS
OSSIPEE LAKE	NARROWS (SOUTHERN TAPERED ZONE)	9/26/2017	DASH	30 GALLONS	AB AQUATICS
OSSIPEE LAKE	SOUTHERN MIDDLE DANFORTH (NARROWS)	9/27/2017	DASH	20 GALLONS	AB AQUATICS
OSSIPEE LAKE	SOUTHERN MARINA (DANFORTH)/OSSIPEE LAKE MIDDLE	9/27/2017	DASH	30 GALLONS	AB AQUATICS
OSSIPEE LAKE	OSSIPEE LAKE MARINA	9/28/2017	DASH	80 GALLONS	AB AQUATICS
OSSIPEE LAKE	Lakefront Landing	8/22/2018	DASH	20 GALLONS	AB AQUATICS
OSSIPEE LAKE	Lakefront Landing	8/22/2018	DASH	20 GALLONS	AQUALOGIC
OSSIPEE LAKE	Coves	8/23/2018	DASH	100 GALLONS	AB AQUATICS
OSSIPEE LAKE	Coves	8/23/2018	DASH	100 GALLONS	AQUALOGIC
OSSIPEE LAKE	Rocky Ridge Marker/Leavitt Bay	8/24/2018	DASH	100 GALLONS	AB AQUATICS
OSSIPEE LAKE	Rocky Ridge/Leavitt Bay	8/24/2018	DASH	100 GALLONS	AQUALOGIC
OSSIPEE LAKE	Leavitt Bay	8/28/2018	DASH	40 GALLONS	AB AQUATICS
OSSIPEE LAKE	Leavitt Bay	8/28/2018	DASH	40 GALLONS	AQUALOGIC
OSSIPEE LAKE	Ligouri Cove	8/29/2018	DASH	60 GALLONS	AB AQUATICS
OSSIPEE LAKE	Ligouri Cove	8/29/2018	DASH	60 GALLONS	AQUALOGIC
OSSIPEE LAKE	N coves	8/30/2018	DASH	20 GALLONS	AB AQUATICS
OSSIPEE LAKE	Northern coves	8/30/2018	DASH	20 GALLONS	AQUALOGIC
OSSIPEE LAKE	Pine River	8/31/2018	DASH	40 GALLONS	AB AQUATICS
OSSIPEE LAKE	Pine River	8/31/2018	DASH	40	AQUALOGIC

				GALLONS	
BASIN	**SITE**	**DATE**	**METHOD**	**AREA (ac)**	**CONTRACTOR**
OSSIPEE LAKE	River 2	9/4/2018	DASH	20 GALLONS	AB AQUATICS
OSSIPEE LAKE	River	9/4/2018	DASH	20 GALLONS	AQUALOGIC
OSSIPEE LAKE	Downside of dam	9/5/2018	DASH	10 GALLONS	AB AQUATICS
OSSIPEE LAKE	Ossipee Lake dam	9/5/2018	DASH	20 GALLONS	AQUALOGIC
OSSIPEE LAKE	Pine River	9/12/2018	DASH	100 GALLONS	AQUALOGIC
OSSIPEE LAKE	Pine River	9/13/2018	DASH	225 GALLONS	AQUALOGIC
OSSIPEE LAKE	Pine River	9/19/2018	DASH	75 GALLONS	AQUALOGIC
OSSIPEE LAKE		9/20/2018	2,4-D GRAN	13.1 ACRES	SOLitude
OSSIPEE LAKE	Ossipee Lake Marina	9/25/2018	DASH	100 GALLONS	AQUALOGIC
OSSIPEE LAKE	Ossipee Lake Marina	9/26/2018	DASH	75 GALLONS	AQUALOGIC
OSSIPEE LAKE	Ossipee Lake Marina	9/27/2018	DASH	75 GALLONS	AQUALOGIC
OSSIPEE LAKE	Danforth Pond	9/28/2018	DASH	100 GALLONS	AQUALOGIC
OSSIPEE LAKE	Ossipee Lake Marina	10/1/2018	DASH	25 GALLONS	AQUALOGIC

Aquatic Invasive Plant Management Options

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

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

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

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

Feasibility Evaluation of Control Options

DES has evaluated the feasibility of potential control practices on the subject waterbody. The following table summarizes DES' control strategy recommendations for the subject waterbody:

Control Method	Use in Ossipee Lake System
Restricted Use Areas (RUAs) and/or Fragment Barriers	The purpose of RUAs and fragment barriers is to contain small areas of exotic aquatic plant growth to 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	Hand pulling and Diver-Assisted Suction Harvesting (DASH) are recommend as annual activities during the growing season, as long as milfoil (or other invasive species) are a problem in this system. Most areas of growth are small and reasonably managed by this approach. A few days a month should be earmarked for such work, to be aided by efforts of local Weed Watchers who survey and mark areas of milfoil growth, to be supplemented by DES survey data.
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.

Control Method	Use in Ossipee Lake System
Extended Drawdown	Not feasible or practical due to the size of the waterbody, and limited areas of invasive plant growth.
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	A no control option would only allow for further spread of this plant within this system.

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 (see attached figures for findings). Based on this survey the following recommendations are made for variable milfoil control in the system:

Year	Action	Responsible Party	Schedule
2017	Weed Watcher Training/Refresher and Weed Watching Activities	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 (areas to be determined based on updated spring survey)	Contract Diver	May-September as needed
	Herbicide treatment, if needed, based on diver progress as monitored by DES (areas to be determined based on updated spring survey)	SOLitude Lake Management, LLC.	June or September
	Survey waterbody and planning for next season's control actions	DES	September

Year	Action	Responsible Party	Schedule
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 (areas to be determined based on updated spring survey)	Contract Diver	May-September as needed
	Herbicide treatment, if needed, based on diver progress as monitored by DES (areas to be determined based on updated spring survey)	SOLitude Lake Management, LLC.	June or September
	Survey waterbody 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 (areas to be determined based on updated spring survey)	Contract Diver	May-September as needed
	Herbicide treatment, if needed, based on diver progress as monitored by DES (areas to be determined based on updated spring survey)	SOLitude Lake Management, LLC.	June or September
	Survey waterbody and planning for next season's control actions	DES	September

Year	Action	Responsible Party	Schedule
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 (areas to be determined based on updated spring survey)	Contract Diver	May-September as needed
	Herbicide treatment, if needed, based on diver progress as monitored by DES (areas to be determined based on updated spring survey)	SOLitude 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
	Diver/DASH work as needed and recommended (areas to be determined based on updated spring survey)	Contract Diver	May-September as needed
	Herbicide treatment, if needed, based on diver progress as monitored by DES (areas to be determined based on updated spring survey)	SOLitude Lake Management, LLC.	June or September
	Survey waterbody 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 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 management in the subject waterbody.

Figure 1: Map of Variable Milfoil Infestations Over Time

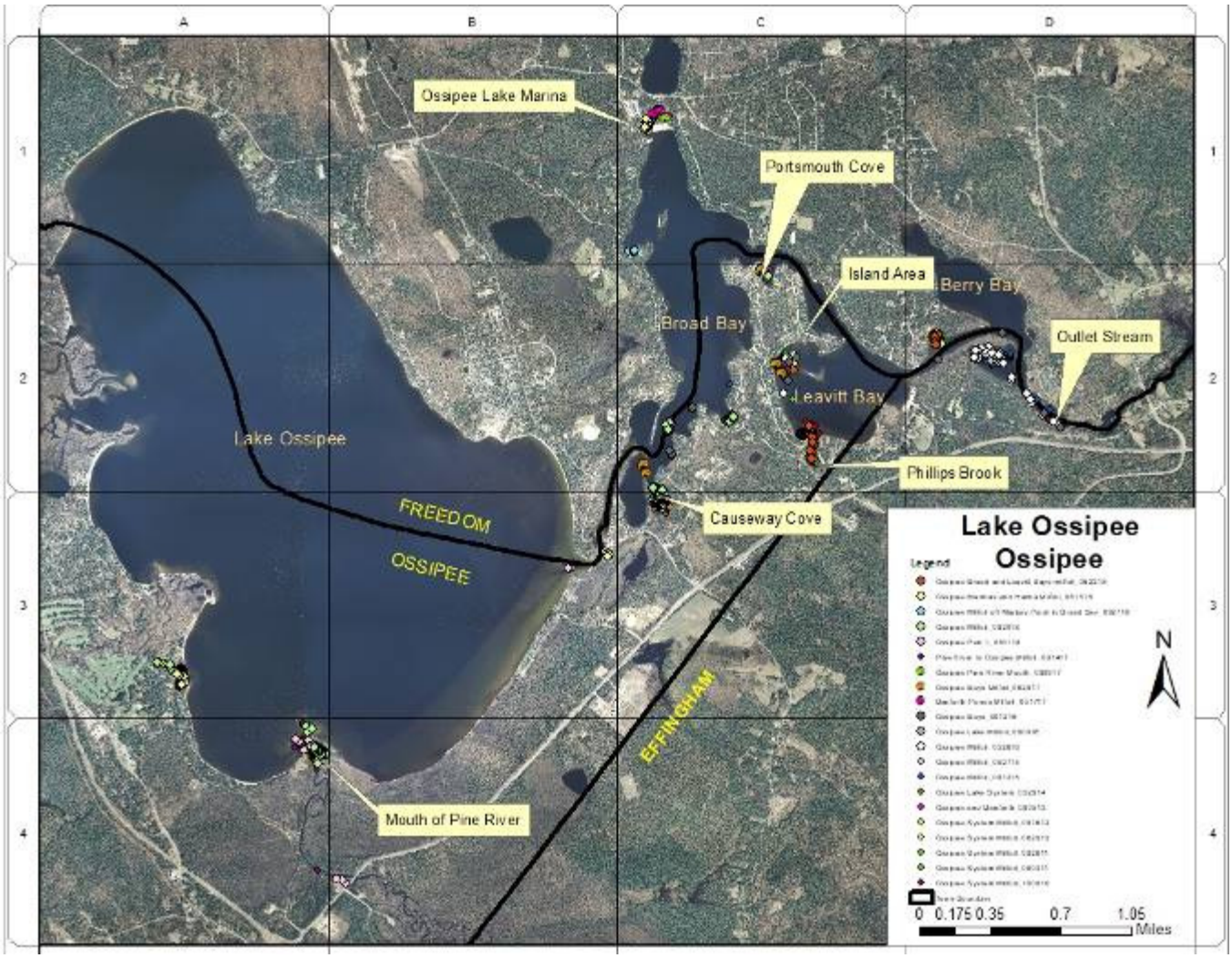
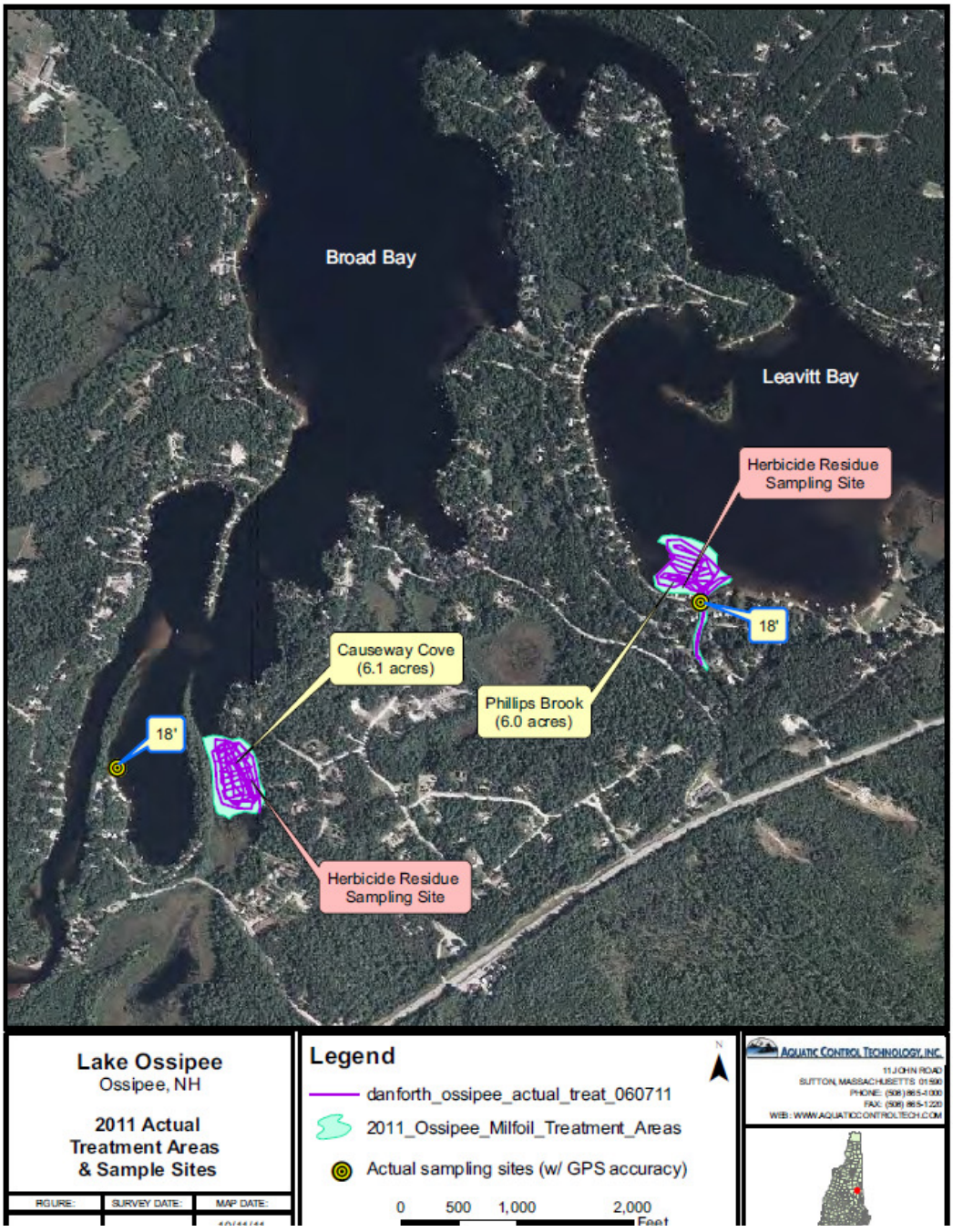
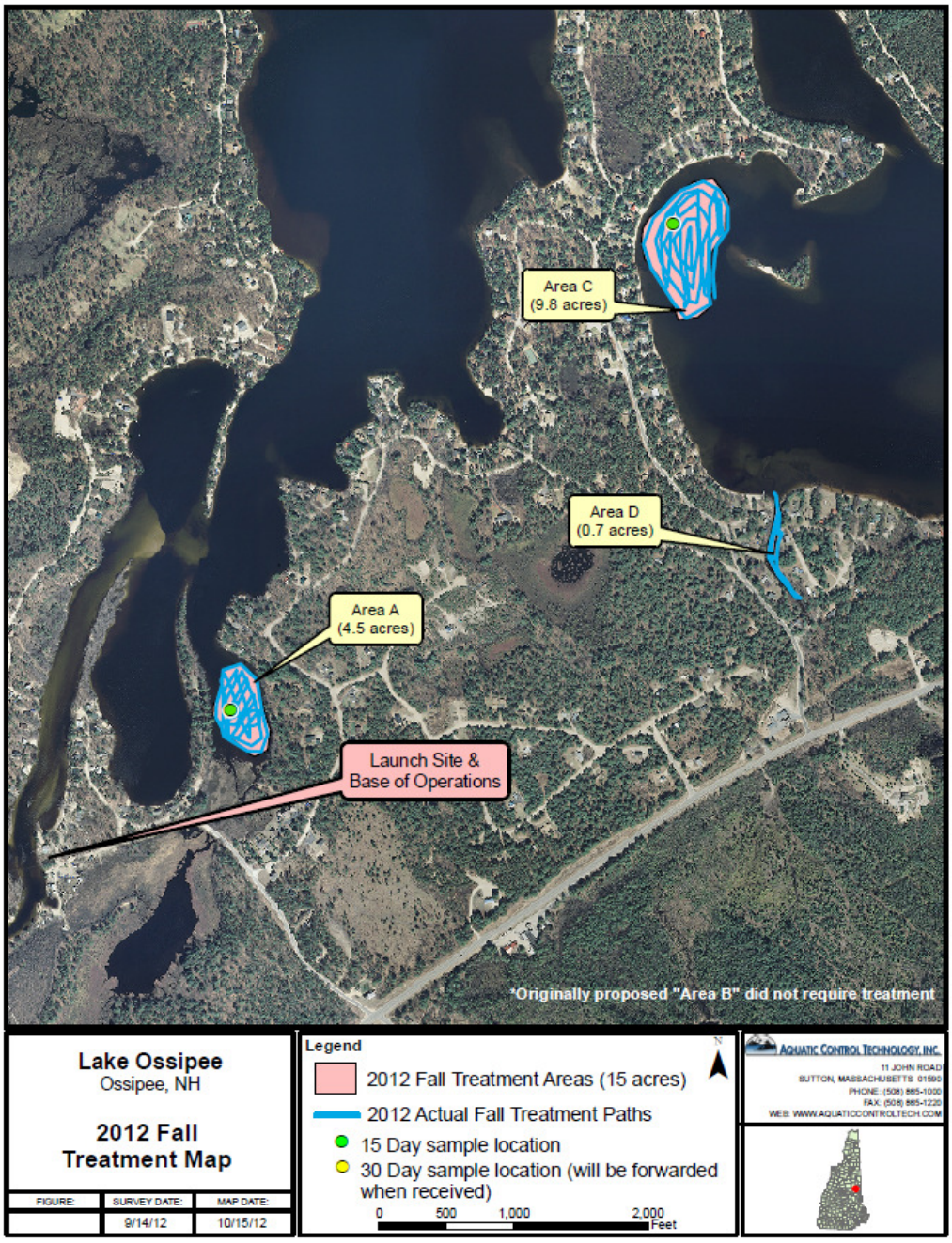


Figure 2: Map of Control Actions Over Time

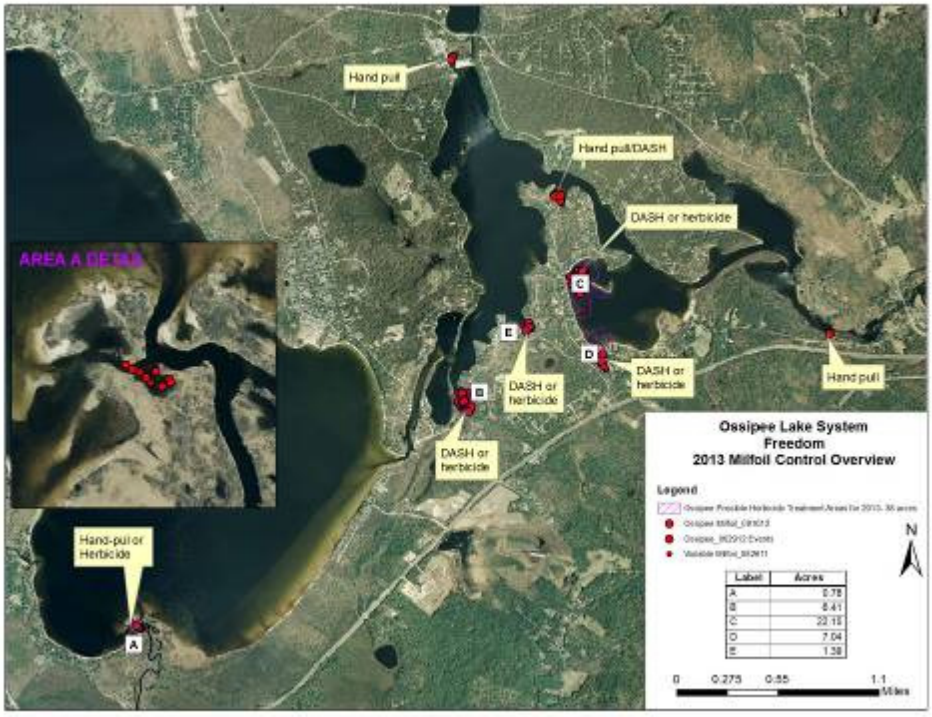
2011 (map provided by Aquatic Control Technology)



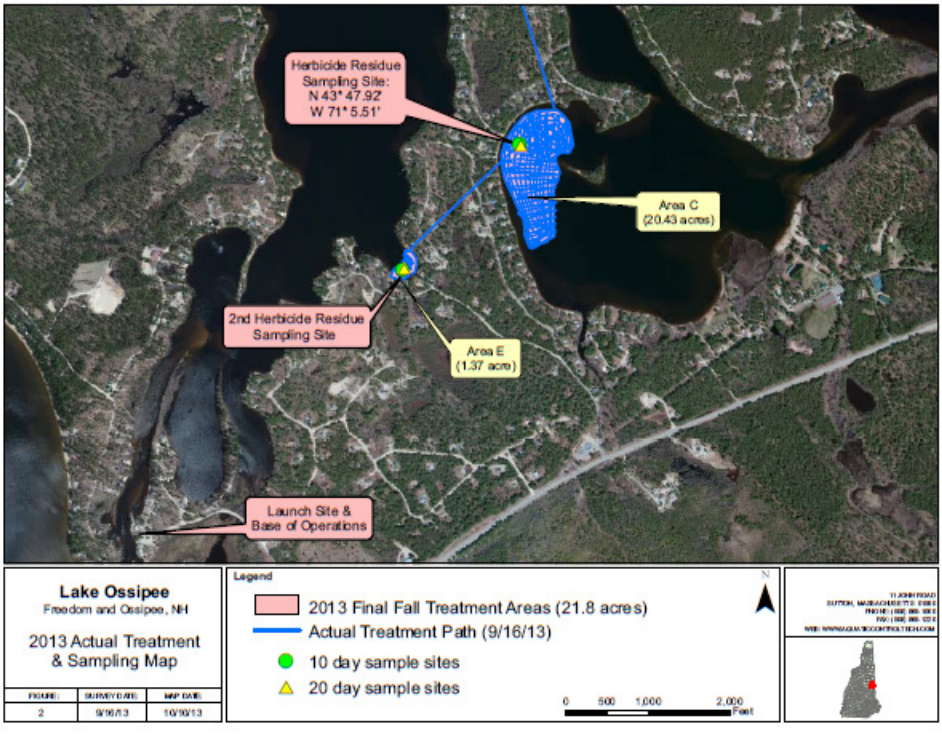
2012 (map provided by Aquatic Control Technology)



2013 (proposed)



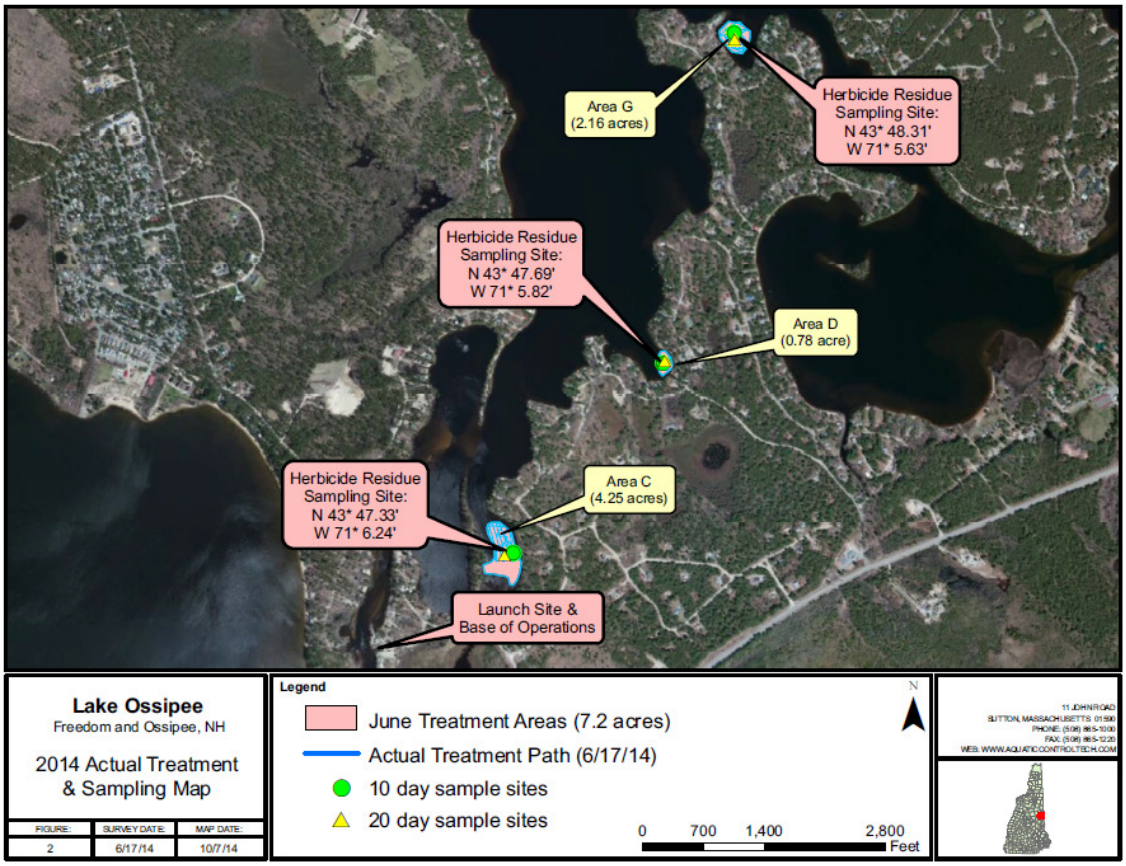
2013 (actual)



2014 (proposed diver/DASH areas)

2014 (proposed/potential herbicide treatment)

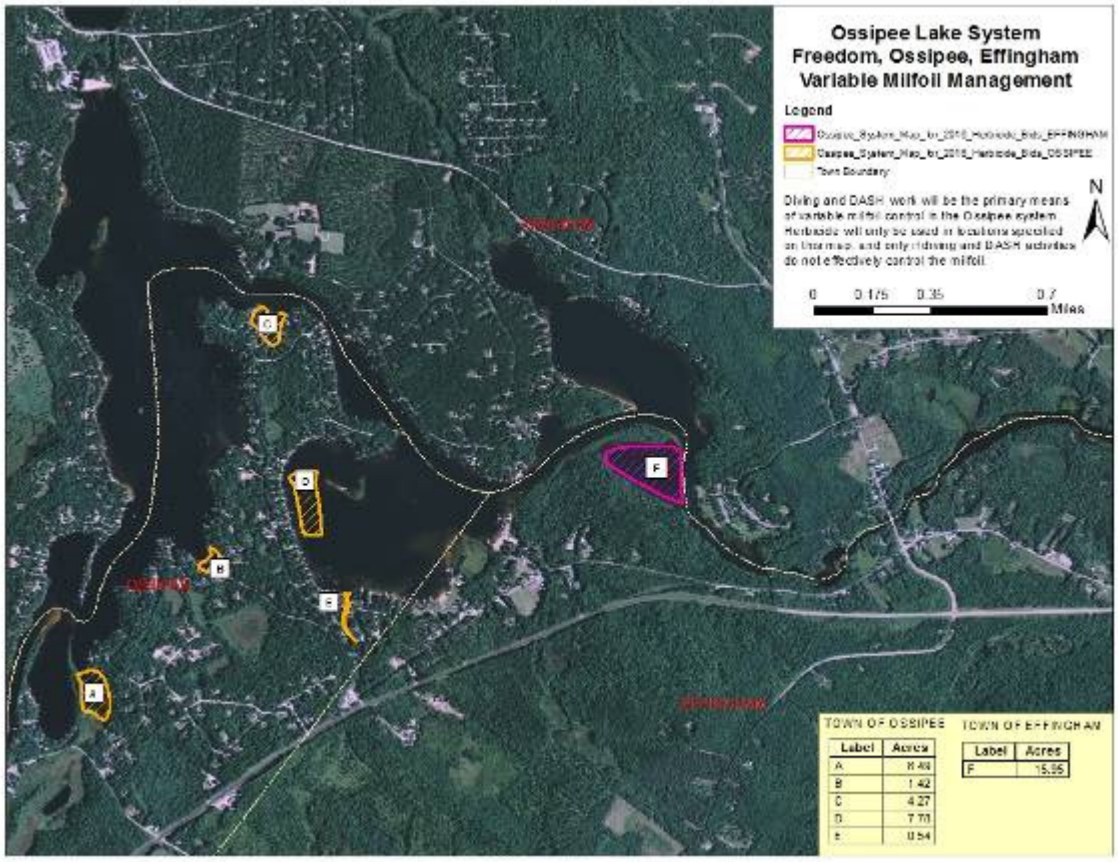
2014 (actual)


Area G
(2.16 acres)
Herbicide Residue
Sampling Site:
N 43° 48.31'
W 71° 5.63'
Herbicide Residue
Sampling Site:
N 43° 47.69'
W 71° 5.82'
Area D
(0.78 acre)
Herbicide Residue
Sampling Site:
N 43° 47.33'
W 71° 6.24'
Area C
(4.25 acres)
Launch Site &
Base of Operations
Lake Ossipee
Freedom and Ossipee, NH
2014 Actual Treatment
& Sampling Map
FIGURE: 2
SURVEY DATE: 6/17/14
MAP DATE: 10/7/14
Legend
June Treatment Areas (7.2 acres)
Actual Treatment Path (6/17/14)
10 day sample sites
20 day sample sites
N
0 700 1,400 2,800
Feet

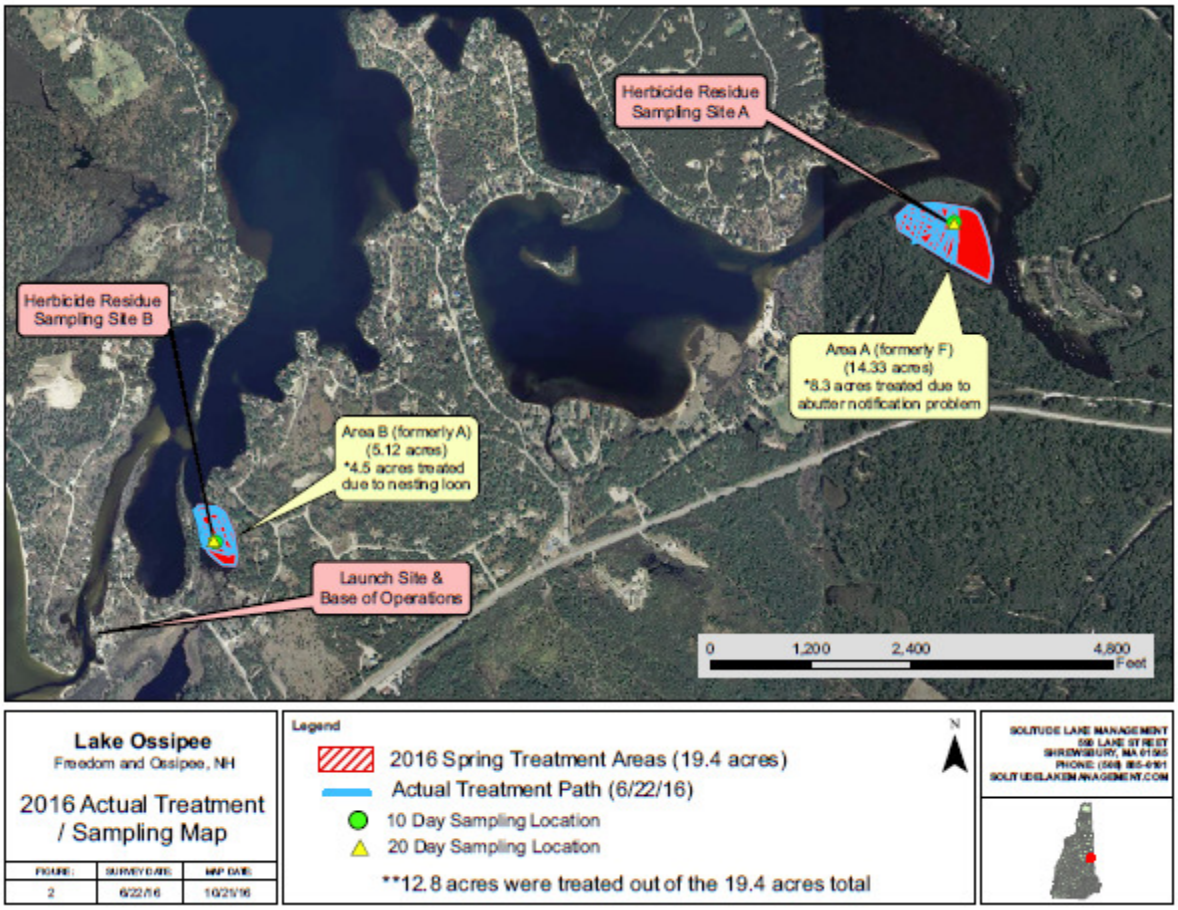
2015 (proposed/potential diving areas)

2015 (proposed/potential herbicide treatment areas)

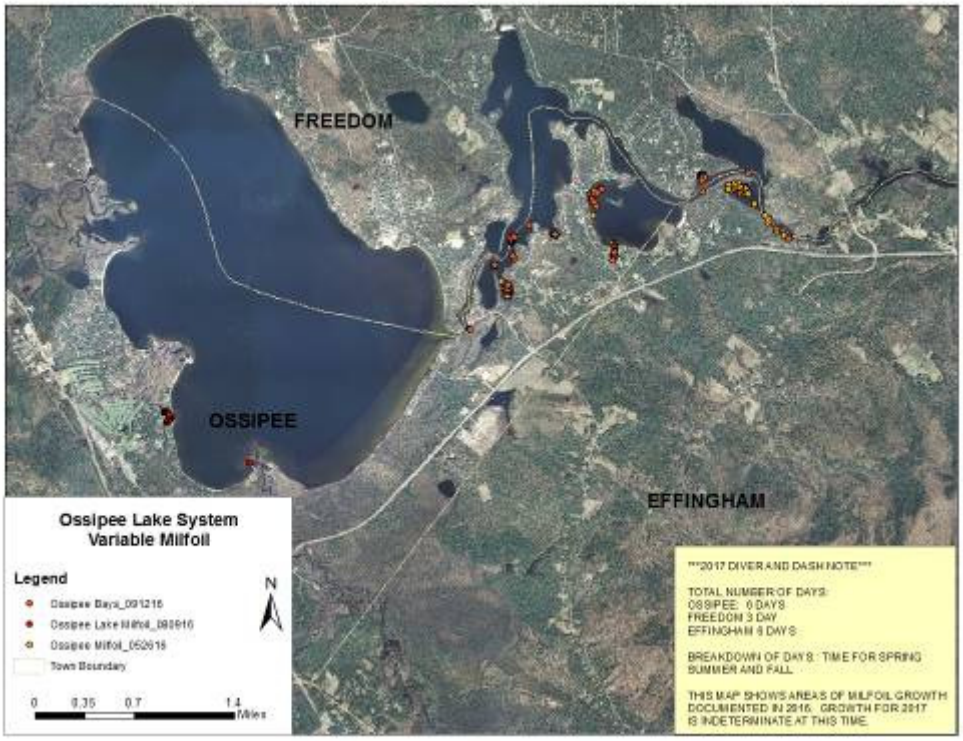
2016 (proposed)

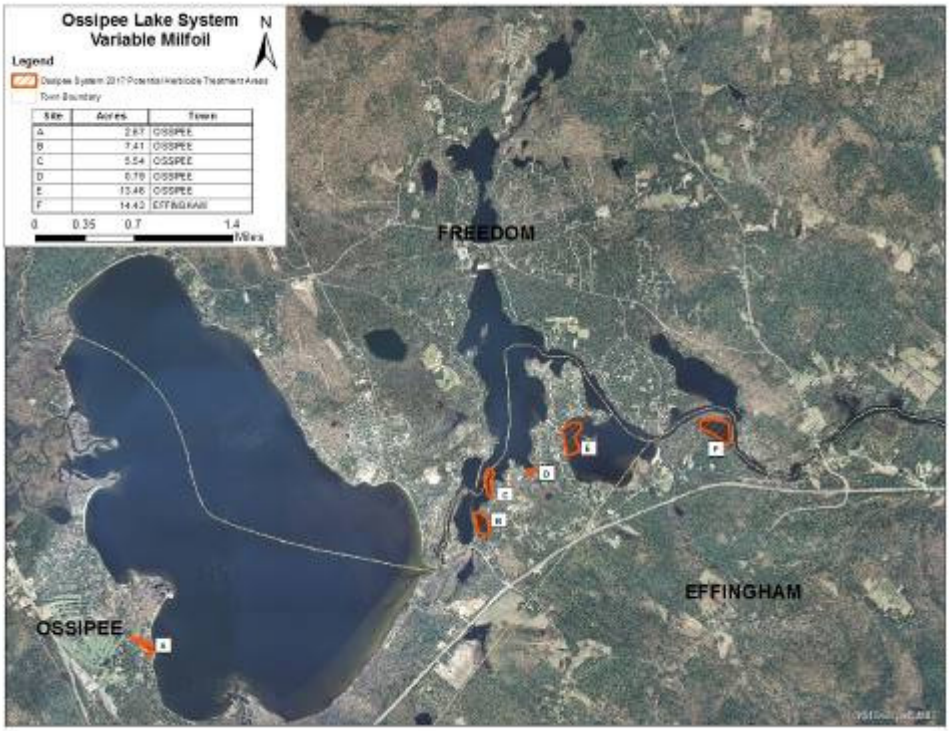


2016 (actual)

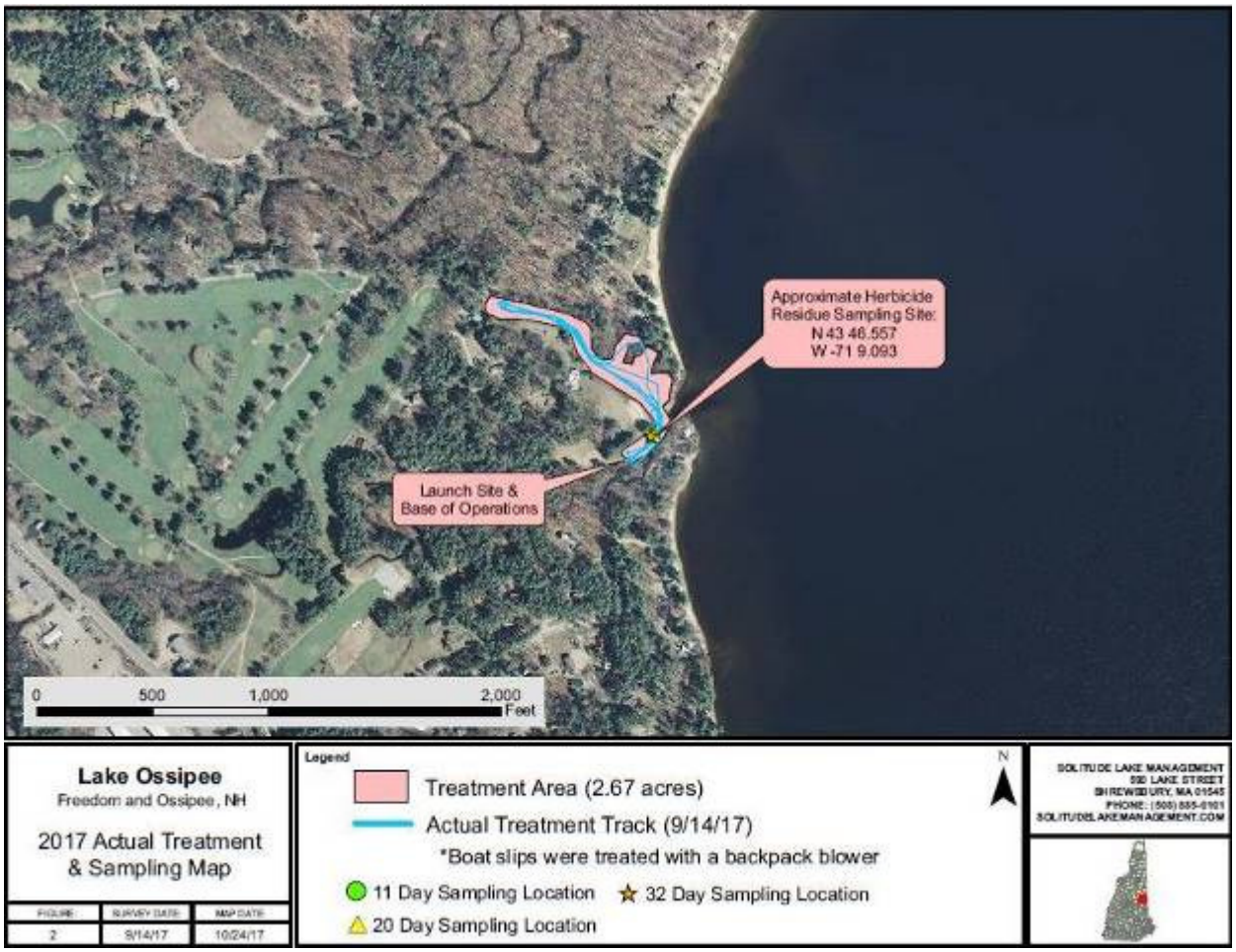

Herbicide Residue Sampling Site A
Herbicide Residue Sampling Site B
Area A (formerly F) (14.33 acres) *8.3 acres treated due to abutter notification problem
Area B (formerly A) (5.12 acres) *4.5 acres treated due to nesting loon
Launch Site & Base of Operations
0
1,200
2,400
4,800
Feet
Lake Ossipee
Freedom and Ossipee, NH
2016 Actual Treatment / Sampling Map
FIGURE: 2
SURVEY DATE: 6/22/16
MAP DATE: 10/21/16
Legend
2016 Spring Treatment Areas (19.4 acres)
Actual Treatment Path (6/22/16)
10 Day Sampling Location
20 Day Sampling Location
**12.8 acres were treated out of the 19.4 acres total
N
SOLITUDE LAKE MANAGEMENT
PHONE: (508) 865-0191
SOLITUDELAKEMANAGEMENT.COM

2017 (proposed)

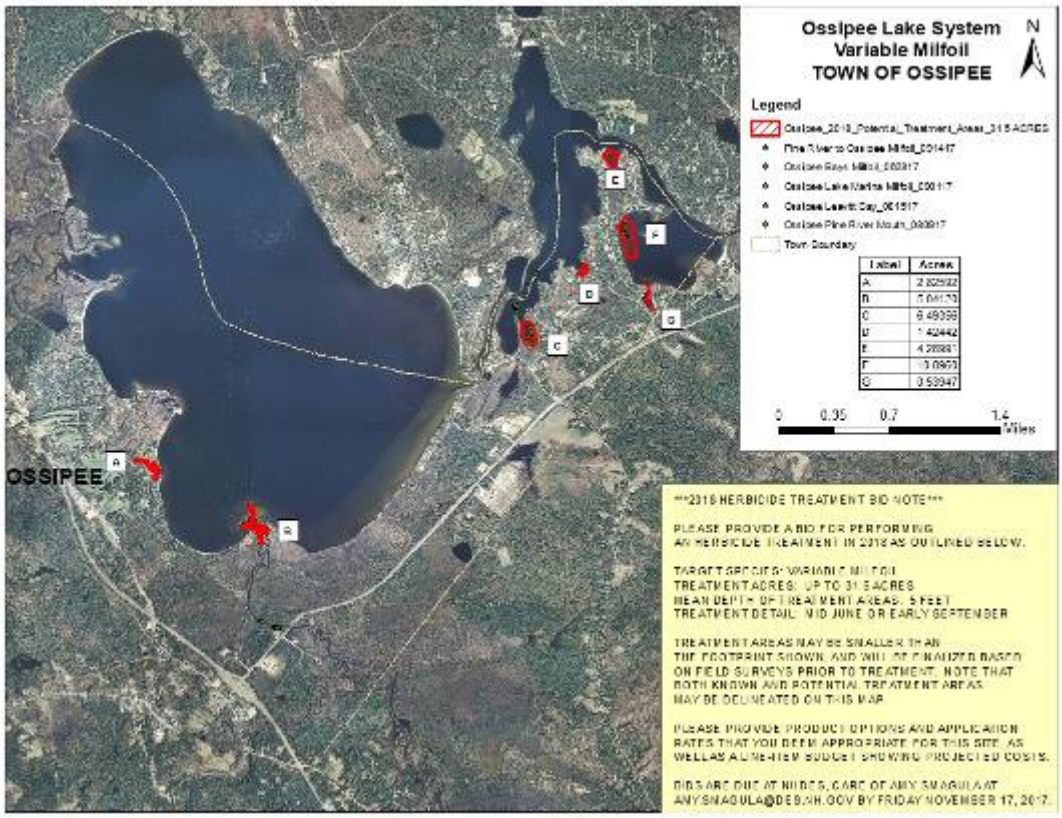




2017 (Actual)


Approximate Herbicide Residue Sampling Site:
N 43 46.557
W -71 9.093
Launch Site & Base of Operations
0
500
1,000
2,000
Feet
Lake Ossipee
Freedom and Ossipee, NH
2017 Actual Treatment & Sampling Map
FIGURE
SURVEY DATE
MAP DATE
2
9/14/17
10/24/17
Legend
Treatment Area (2.67 acres)
Actual Treatment Track (9/14/17)
*Boat slips were treated with a backpack blower
11 Day Sampling Location
32 Day Sampling Location
20 Day Sampling Location
N
SOLITUDE LAKE MANAGEMENT
SHREWSBURY, MA 01545
SOLITUDELAKEMANAGEMENT.COM

2018 (Proposed)



2018 Actual

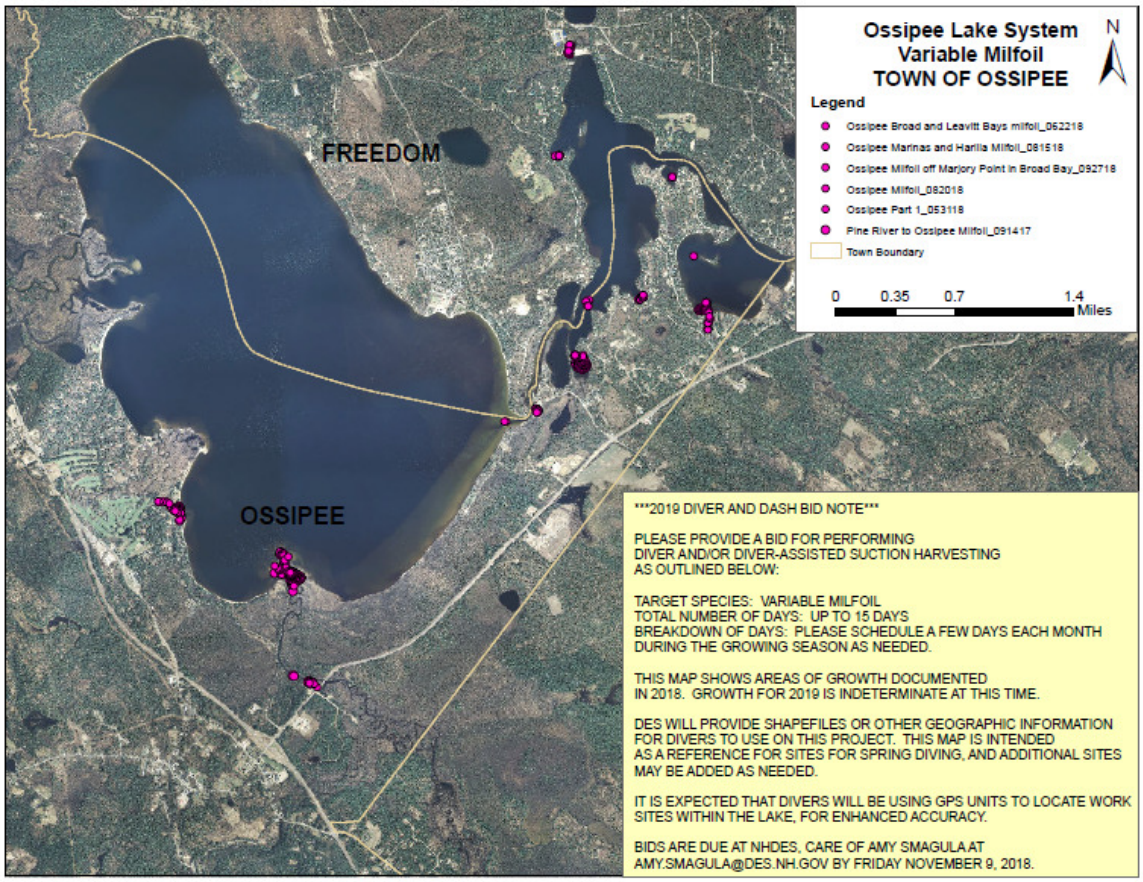

Area A
(1.3 acres)
GSA Herbicide Residue
Sampling Site A:
N 43° 46.556'
W 71° 09.093'
GSA Herbicide Residue
Sampling Site B:
N 43° 46.336'
W 71° 08.365'
Area B
(4.4 acres)
0
500
1,000
2,000
Feet


Lake Ossipee
Freedom and Ossipee, NH
2018 Actual Fall
(A & B) Treatment
& Sampling Map
Legend
2018 Fall Treatment Areas (13.1 acres total)
Actual Treatment Track (9/20/18)
11 Day Sampling Location
20 Day Sampling Location
N


Area D
(2.5 acres)
GSA Herbicide Residue
Sampling Site D:
N 43° 47.593'
W 71° 05.345'
GSA Herbicide Residue
Sampling Site C:
N 43° 47.388'
W 71° 06.252'
Area C
(1.9 acres)
0
500
1,000
2,000
Feet


Lake Ossipee
Freedom and Ossipee, NH
2018 Actual Fall
(C & D) Treatment
& Sampling Map
Legend
2018 Fall Treatment Areas (13.1 acres total)
Actual Treatment Track (9/20/18)
11 Day Sampling Location
20 Day Sampling Location
N

2019 Proposed



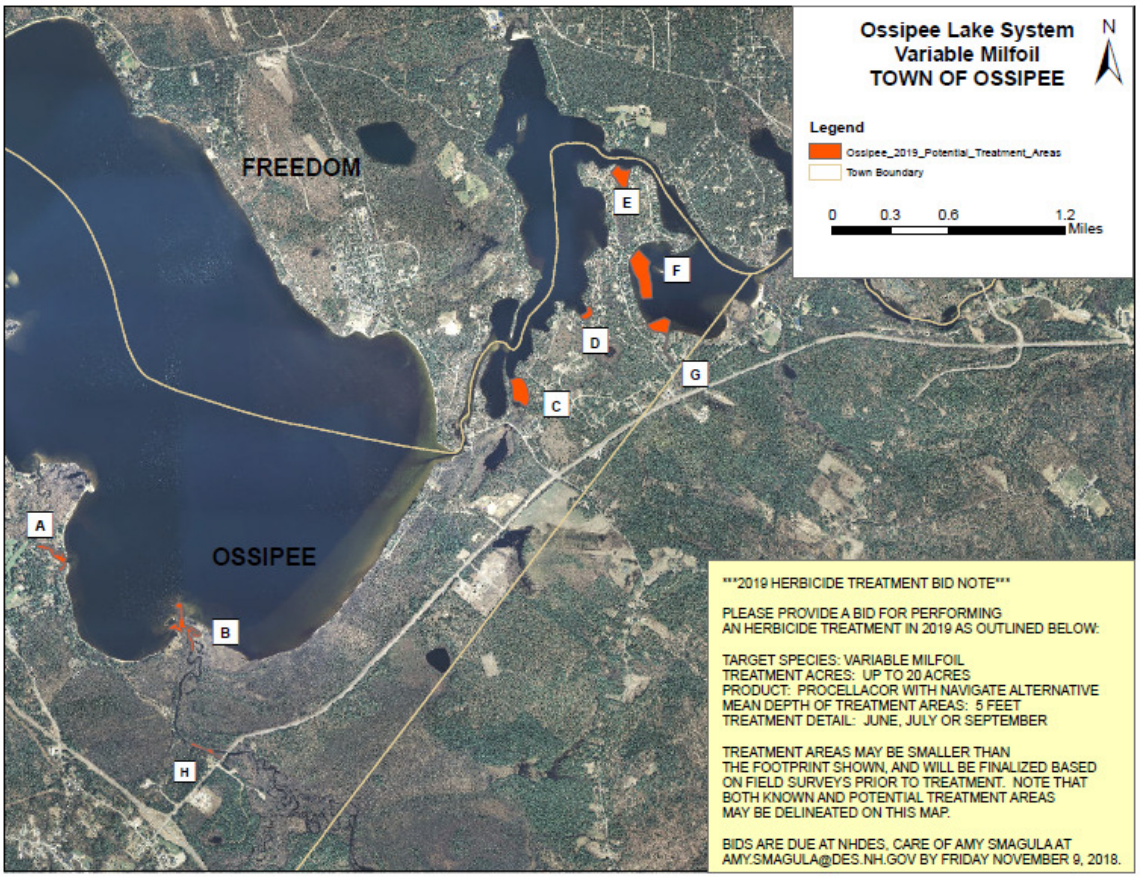
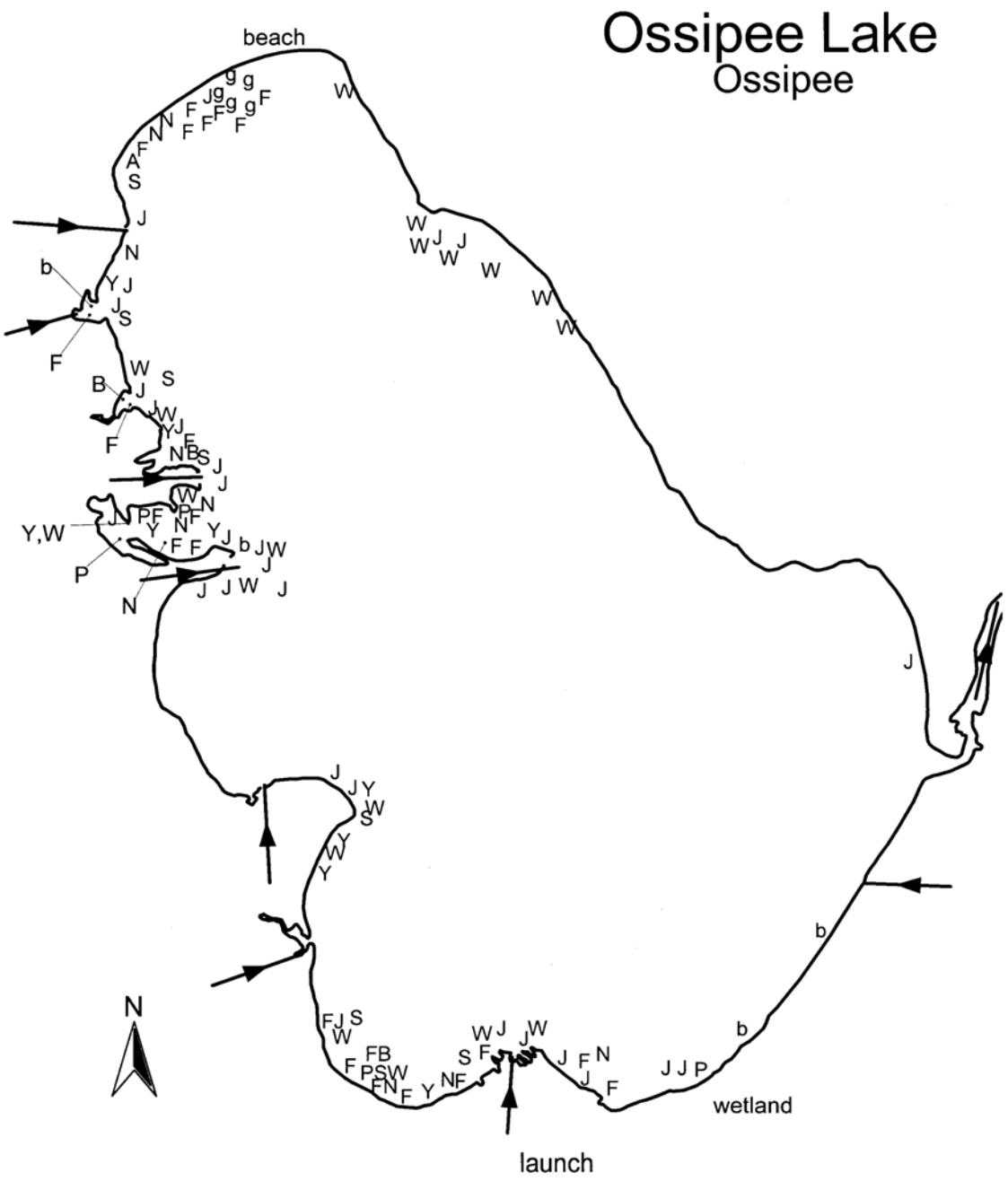

Ossipee Lake System
Variable Milfoil
TOWN OF OSSIPEE
N
Legend
Ossipee_2019_Potential_Treatment_Areas
Town Boundary
0 0.3 0.6 1.2
Miles
FREEDOM
OSSIPEE
A
B
C
D
E
F
G
H
2019 HERBICIDE TREATMENT BID NOTE
PLEASE PROVIDE A BID FOR PERFORMING
AN HERBICIDE TREATMENT IN 2019 AS OUTLINED BELOW:
TARGET SPECIES: VARIABLE MILFOIL
TREATMENT ACRES: UP TO 20 ACRES
PRODUCT: PROCELLACOR WITH NAVIGATE ALTERNATIVE
MEAN DEPTH OF TREATMENT AREAS: 5 FEET
TREATMENT DETAIL: JUNE, JULY OR SEPTEMBER
TREATMENT AREAS MAY BE SMALLER THAN
THE FOOTPRINT SHOWN, AND WILL BE FINALIZED BASED
ON FIELD SURVEYS PRIOR TO TREATMENT. NOTE THAT
BOTH KNOWN AND POTENTIAL TREATMENT AREAS
MAY BE DELINEATED ON THIS MAP.
BIDS ARE DUE AT NHDES, CARE OF AMY SMAGULA AT
AMY.SMAGULA@DES.NH.GOV BY FRIDAY NOVEMBER 9, 2018.

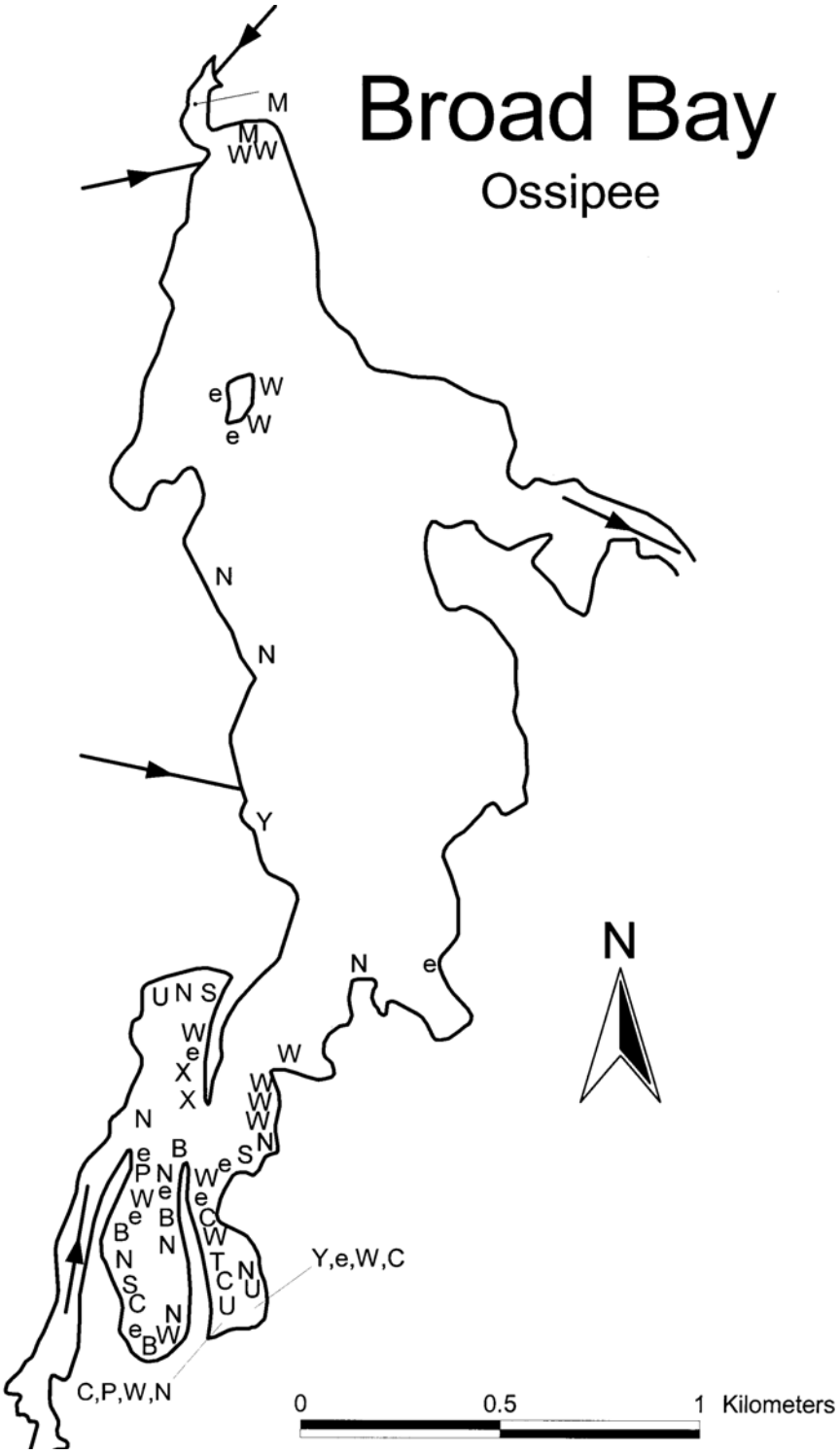
Figure 3: Map of Native Aquatic Macrophytes



LAKE: OSSIPEE LAKE **TOWN:** OSSIPEE **DATE:** 8/13/03

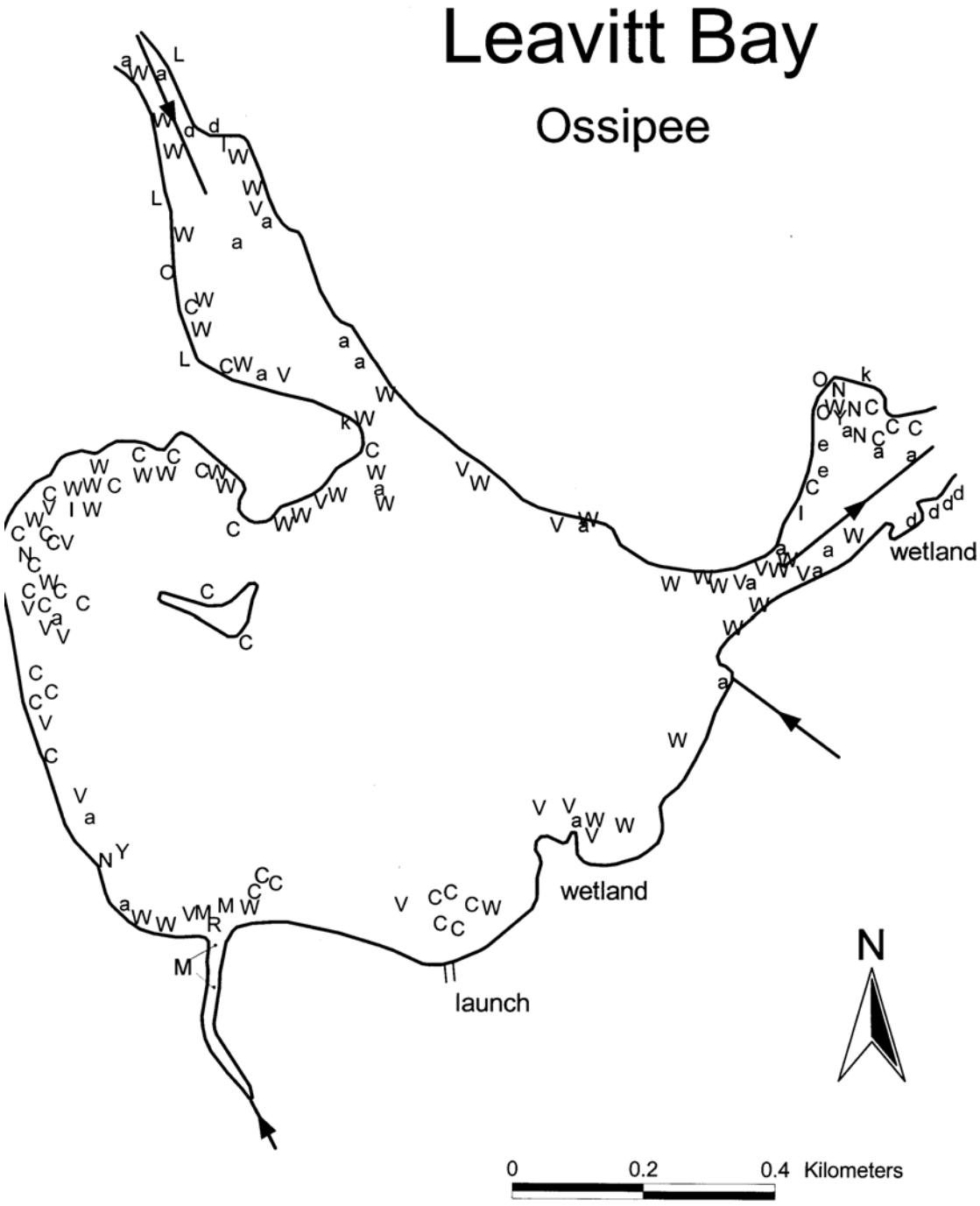
KEY	PLANT NAME		ABUNDANCE
	GENERIC	COMMON	
J	Juncus	Rush	Scattered
F	Nymphoides cordatum	Floating heart	Scattered
Y	Nuphar	Yellow water lily	Sparse
W	Potamogeton	Pondweed	Scattered
S	Sparganium	Bur reed	Sparse
N	Nymphaea	White water lily	Sparse
B	Brasenia schreberi	Water shield	Sparse
P	Pontederia cordata	Pickerelweed	Sparse
C	Cyperaceae	Non-flowering sedge	Sparse
b	Scirpus	Bulrush	Sparse
d	Dulichium arundinaceum	Three-way sedge	Sparse
A	Sagittaria	Arrowhead	Sparse
g	Polygonum	Smartweed	Sparse

Broad Bay



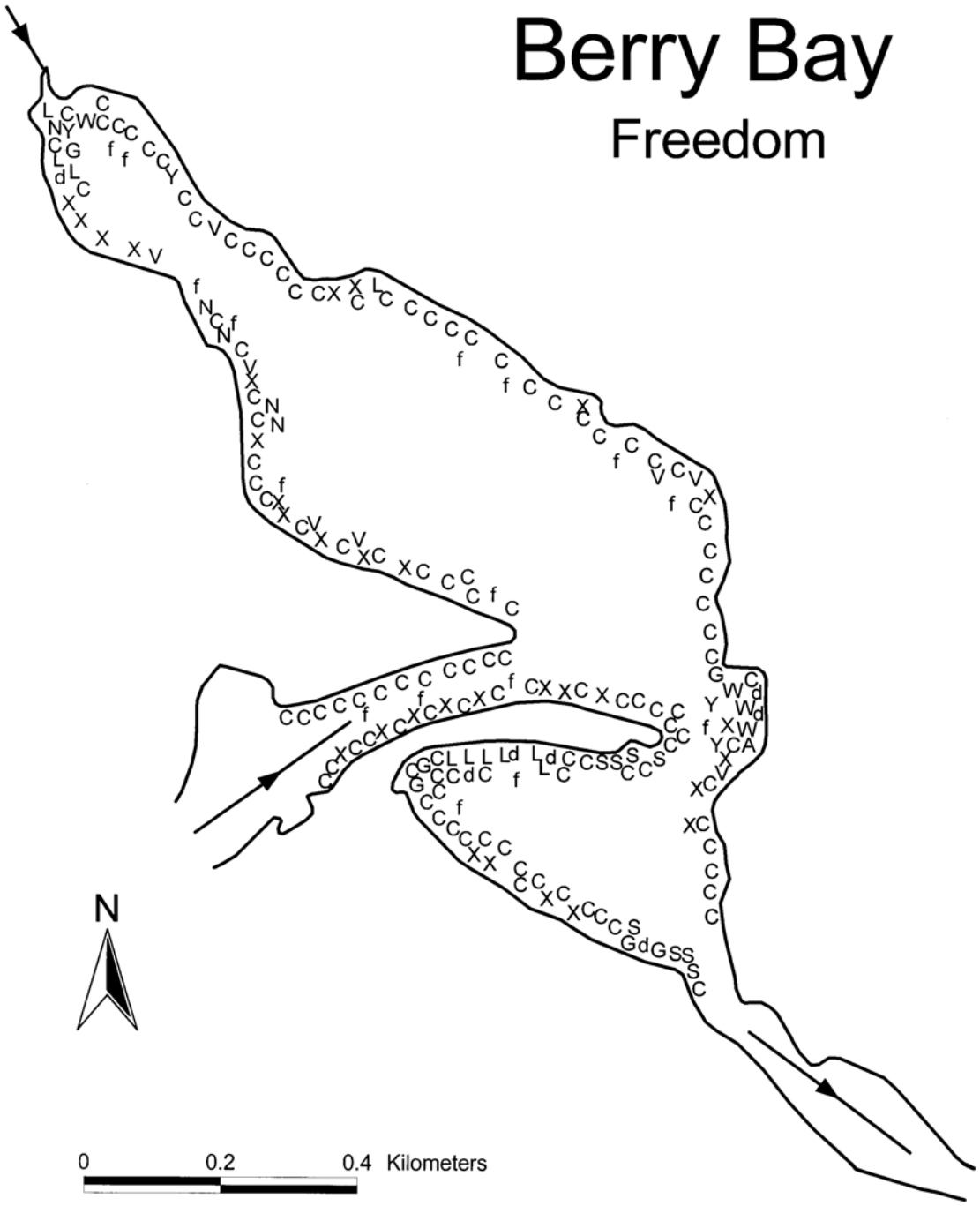
LAKE: BROAD BAY	TOWN: OSSIPEE	DATE: 8/11/03

KEY	PLANT NAME		ABUNDANCE
	GENERIC	COMMON	
e	Eleocharis	Spike rush	Scattered
W	Potamogeton	Pondweed	Scattered
A	Sagittaria	Arrowhead	Sparse
N	Nymphaea	White water lily	Scattered
Y	Nuphar	Yellow water lily	Sparse
X		Bottom growth	Scattered
S	Sparganium	Bur reed	Scattered
U	Utricularia	Bladderwort	Sparse
P	Pontederia cordata	Pickerelweed	Sparse
C	Cyperaceae	Non-flowering sedge	Scattered
B	Brasenia schreberi	Water shield	Sparse
T	Typha	Cattail	Sparse
M	Myriophyllum heterophyllum	Water milfoil	Scattered


Leavitt Bay
Ossipee
wetland
wetland
launch
N
0
0.2
0.4 Kilometers

LAKE: LEAVITT BAY	TOWN: OSSIPEE	DATE: 7/30/03

KEY	PLANT NAME		ABUNDANCE
	GENERIC	COMMON	
e	Eleocharis	Spike rush	Sparse
I	Isoetes	Quillwort	Sparse
d	Dulichium arundinaceum	Three-way sedge	Sparse
O	Cephalanthus occidentalis	Buttonbush	Sparse
L	Lysimachia terrestris	Swampcandle	Sparse
k	Carex	Sedge	Sparse
C	Cyperaceae	Non-flowering sedge	Scattered
U	Utricularia	Bladderwort	Scattered
Y	Nuphar	Yellow water lily	Sparse
N	Nymphaea	White water lily	Sparse
M	Myriophyllum heterophyllum	Water milfoil	Sparse
V	Vallisneria americana	Tape grass	Scattered
R	Potamogeton robbinsii	Robbins pondweed	Sparse
W	Potamogeton spp.	submerged pondweed	Scattered
a	Potamogeton amplifolius	Bass weed	Scattered
F	Nymphoides cordatum	Floating heart	Sparse
f	Potamogeton spp.	pondweed w/ floating leaf	Sparse
S	Sparganium	Bur reed	Sparse
		Filamentous algae	Scattered


Berry Bay
Freedom
N
0
0.2
0.4 Kilometers

LAKE: BERRY BAY	TOWN: FREEDOM	DATE: 8/6/03

KEY	PLANT NAME		ABUNDANCE
	GENERIC	COMMON	
C	Cyperus	Sedge	Scattered
X		Sterile thread-like leaf	Scattered
V	Vallisneria americana	Tape grass	Scattered
N	Nymphaea	White water lily	Sparse
L	Lysimachia terrestris	Swampcandle	Sparse
d	Dulichium arundinaceum	Three-way sedge	Sparse
G	Gramineae	Grass family	Sparse
Y	Nuphar	Yellow water lily	Sparse
W	Potamogeton	Pondweed	Sparse
A	Sagittaria	Arrowhead	Sparse
S	Sparganium	Bur reed	Sparse
f		Filamentous algae	Scattered

Figure 4: Bathymetric Map

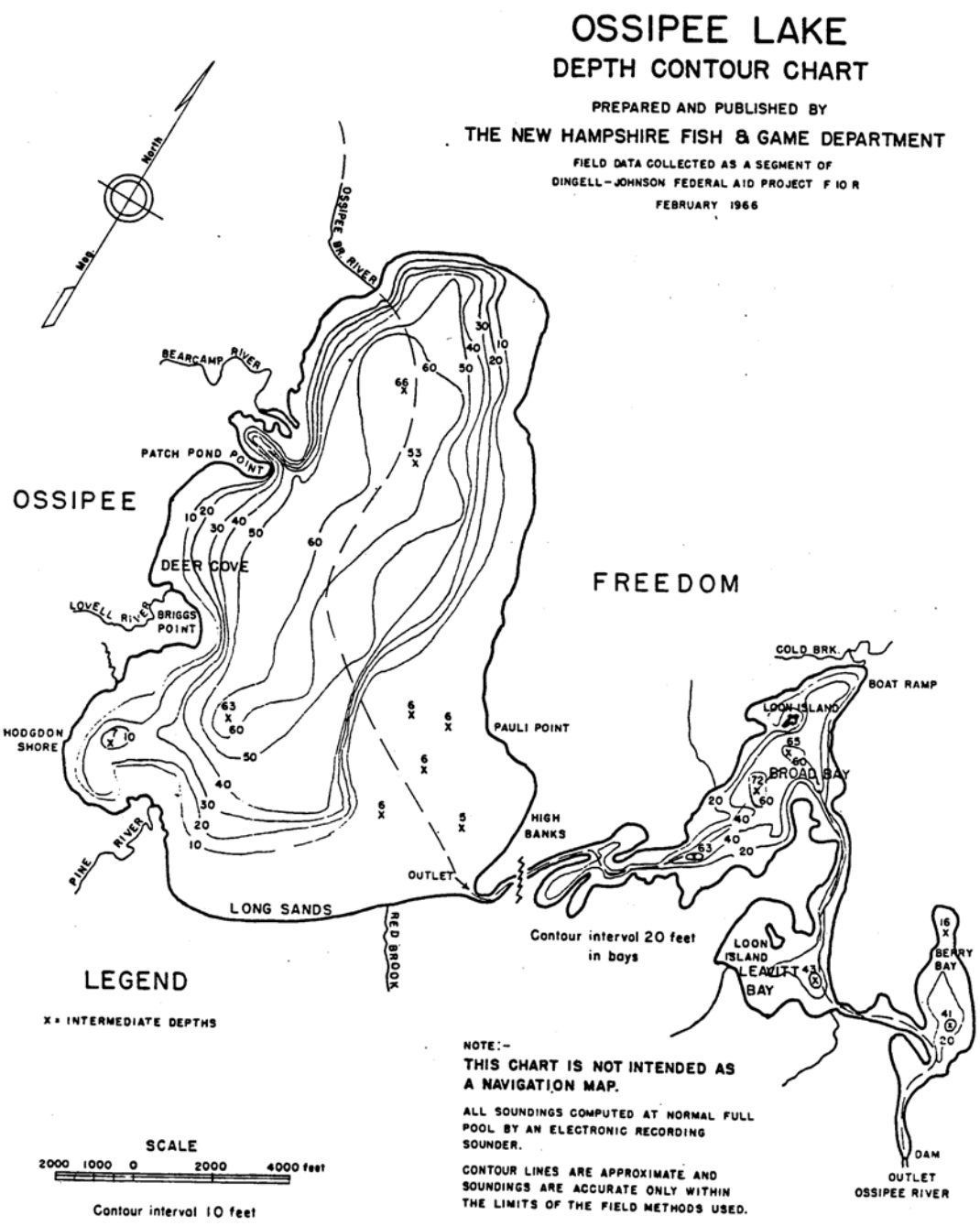


Figure 5: Public Access Sites, Swim Areas, Docks and Swim Platforms

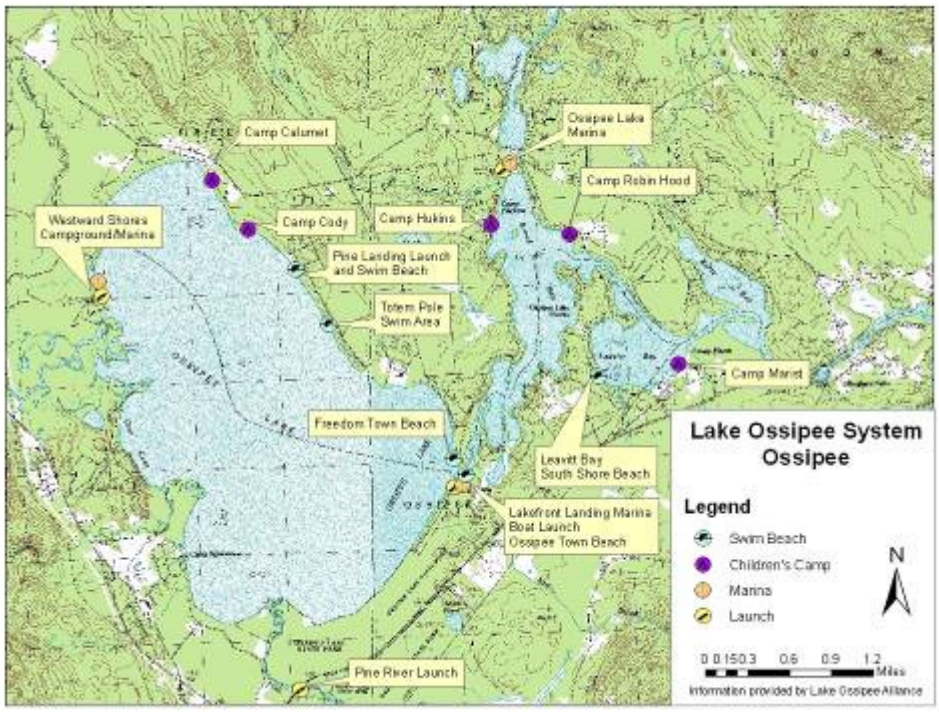


Figure 6: Critical Habitats or Conservation Areas

CONFIDENTIAL – NH Dept. of Environmental Services review

Memo

NH NATURAL HERITAGE BUREAU
NHB DATACHECK RESULTS LETTER

To: Amy Smagula, DES-Biology Section
29 Hazen Drive
Concord, NH 03301

From: Amy Lamb, NH Natural Heritage Bureau
Date: 2/13/2019 (valid for one year from this date)
Re: Review by NH Natural Heritage Bureau
NHB File ID: NHB19-0459 Town: Ossipee Location: Ossipee Lake
Description: 15 days of DASH, 20 acres of herbicide
cc: Kim Tuttle

As requested, I have searched our database for records of rare species and exemplary natural communities, with the following results.

Comments: Since additional work is proposed in the Pine River this year, NHB recommends pre-treatment surveys for long-leaved pondweed (historically observed at this location) as well as Vasey's pondweed. Although neither Beck's water-marigold (not in NHB database but reported anecdotally) nor Vasey's pondweed were observed in 2018, it is recommended that these species continue to be included in pre-treatment surveys at the mouth of the Pine River. NHB supports the 100-foot setback that was employed around the small-flowered dwarf-bulrush in 2018. Contact the NH Fish & Game Department to address wildlife concerns.

Natural Community	State[1]	Federal	Notes
Bulblet umbrella sedge open sandy pond shore	--	--	Threats to this community are trampling through recreation, water level changes, storm related wave damage.
Hudsonia inland beach strand	--	--	Threats are primarily recreational use that disturbs the vascular plants.
Low-gradient silty-sandy riverbank system	--	--	Threats to this natural community are changes in the river's hydrology, human disturbance of the riverbank (such as bulldozer activity), and increased nutrient levels from upland runoff.
Medium level fen system	--	--	Level fens are stagnant, and as such are characterized by low nutrient levels, relatively high acidity levels, and accumulations of peat. The primary threats to this community are changes to its hydrology (especially that which causes pooling), increased nutrient input from stormwater runoff, and sedimentation from nearby disturbance.
Sandy pond shore system	--	--	These natural communities are extremely vulnerable to trampling, and tend to disappear from areas that experience even moderate recreational use. They are vulnerable to changes to the hydrology of the pond or lake.
Short graminoid - forb meadow marsh/mudflat	--	--	Threats to these communities are primarily alterations to the hydrology of the wetland

Department of Natural and Cultural Resources
Division of Forests and Lands
(603) 271-2214 fax: 271-6488

DNCR/NHB
172 Pembroke Rd.
Concord, NH 03301

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Memo

NH Natural Heritage Bureau
NHB Datacheck Results Letter

			and increased input of nutrients and pollutants in storm runoff.
Temperate minor river floodplain system	--	--	Threats are primarily changes to the hydrology of the river, land conversion and fragmentation, introduction of invasive species, and increased input of nutrients and pollutants.
Twig-rush sandy turf pond shore	--	--	These natural communities are extremely vulnerable to trampling, and tend to disappear from areas that experience even moderate recreational use. They are vulnerable to changes to the hydrology of the lake or nearby streams, especially changes that would cause erosion.

Plant species	**State[1]**	**Federal**	**Notes**
Acadian quillwort (*Isoetes acadiensis*)*	E	--	Threats to this species include changes in water level, aquatic herbides, habiat change.
coastal plain grass-leaved-goldenrod (*Euthamia caroliniana*)	T	--	Threats include water level manipulations of ponds, pond shore development, heavy recreational use, and herbiciding. Increased nutrient levels, e.g., from septic runoff, is also a threat.
comb-leaved mermaid-weed (*Proserpinaca pectinata*)*	E	--	The pond or lake shore natural communities where this species occurs are extremely vulnerable to trampling, and tend to disappear from areas that experience even moderate recreational use. They are also vulnerable to changes to the lake's hydrology.
hairy hudsonia (*Hudsonia tomentosa*)	T	--	This species requires periodic disturbance to its habitat (disturbed openings, river and streambanks). However, existing plants are very sensitive to trampling when growing on open sand.
long-leaved pondweed (*Potamogeton nodosus*)*	T	--	Threats to aquatic species include changes in water quality, e.g., due to pollution and stormwater runoff, and significant changes in water level.
Pease's blunt spikesedge (*Eleocharis obtusa var. peasei*)*	E	--	Threats include water level manipulations of ponds, pond shore development, heavy recreational use, and herbiciding. Increased nutrient levels, e.g., from septic runoff, is also a threat.
small-flowered dwarf-bulrush (*Cyperus subsquarrosus*)	E	--	
tall cottonsedge (*Eriophorum angustifolium ssp. angustifolium*)*	E	--	The primary threats are changes to this species' peatland habitat, including changes to local hydrology, increased nutrient input from stormwater runoff, and sedimentation from nearby disturbance.
Vasey's pondweed (*Potamogeton vaseyi*)	E	--	Threats to aquatic species include changes in water quality, e.g., due to pollution and

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NH NATURAL HERITAGE BUREAU
NHB DATACHECK RESULTS LETTER

stormwater runoff, and significant changes in water level.

Vertebrate species	State[1]	Federal	Notes
Common Loon (*Gavia immer*)	T	--	Contact the NH Fish & Game Dept (see below).
Purple Martin (*Progne subis*)	T	--	Contact the NH Fish & Game Dept (see below).

[1]Codes: "E" = Endangered, "T" = Threatened, "SC" = Special Concern, "--" = an exemplary natural community, or a rare species tracked by NH Natural Heritage that has not yet been added to the official state list. An asterisk (*) indicates that the most recent report for that occurrence was more than 20 years ago.

Contact for all animal reviews: Kim Tuttle, NH F&G, (603) 271-6544.

A negative result (no record in our database) does not mean that a sensitive species is not present. Our data can only tell you of known occurrences, based on information gathered by qualified biologists and reported to our office. However, many areas have never been surveyed, or have only been surveyed for certain species. An on-site survey would provide better information on what species and communities are indeed present.

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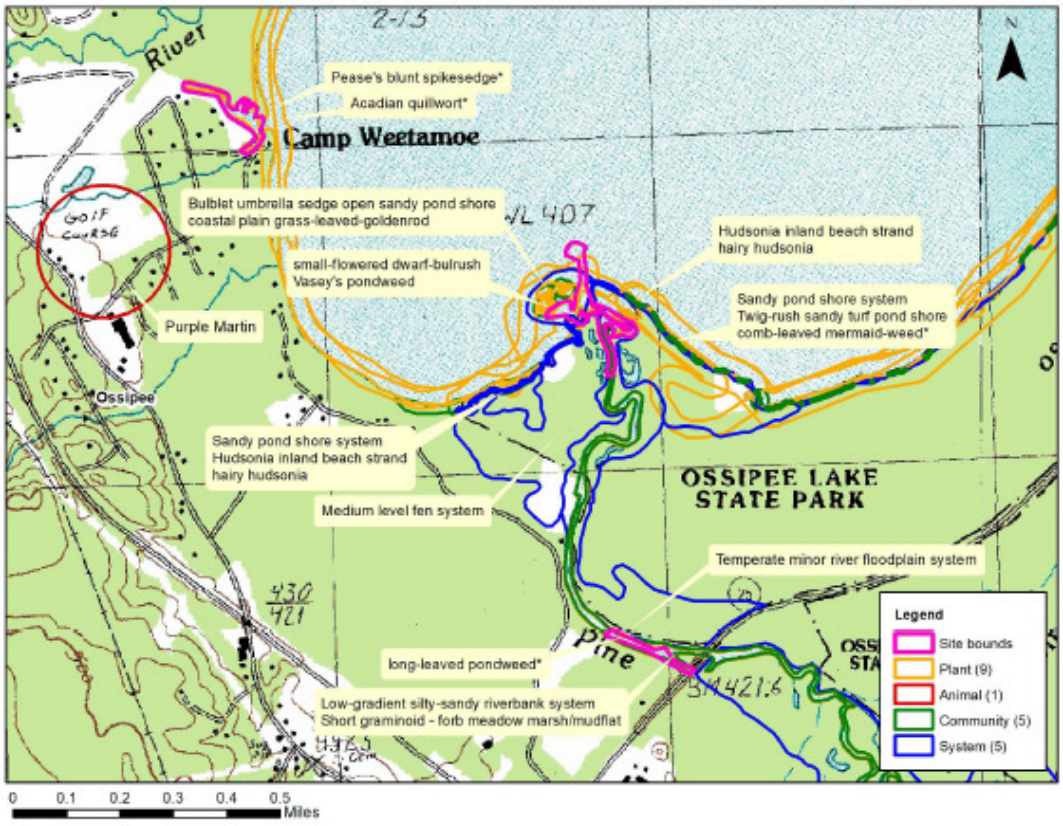
NHB19-0459


Pease's blunt spikesedge*
Acadian quillwort*
Camp Weetamoe
Bulblet umbrella sedge open sandy pond shore
coastal plain grass-leaved-goldenrod
small-flowered dwarf-bulrush
Vasey's pondweed
Purple Martin
Ossipee
Hudsonia inland beach strand
hairy hudsonia
Sandy pond shore system
Twig-rush sandy turf pond shore
comb-leaved mermaid-weed*
Sandy pond shore system
Hudsonia inland beach strand
hairy hudsonia
Medium level fen system
OSSIPEE LAKE
STATE PARK
Temperate minor river floodplain system
long-leaved pondweed*
Low-gradient silty-sandy riverbank system
Short graminoid - forb meadow marsh/mudflat
Legend
Site bounds
Plant (9)
Animal (1)
Community (5)
System (5)
0 0.1 0.2 0.3 0.4 0.5
Miles

NHB19-0459

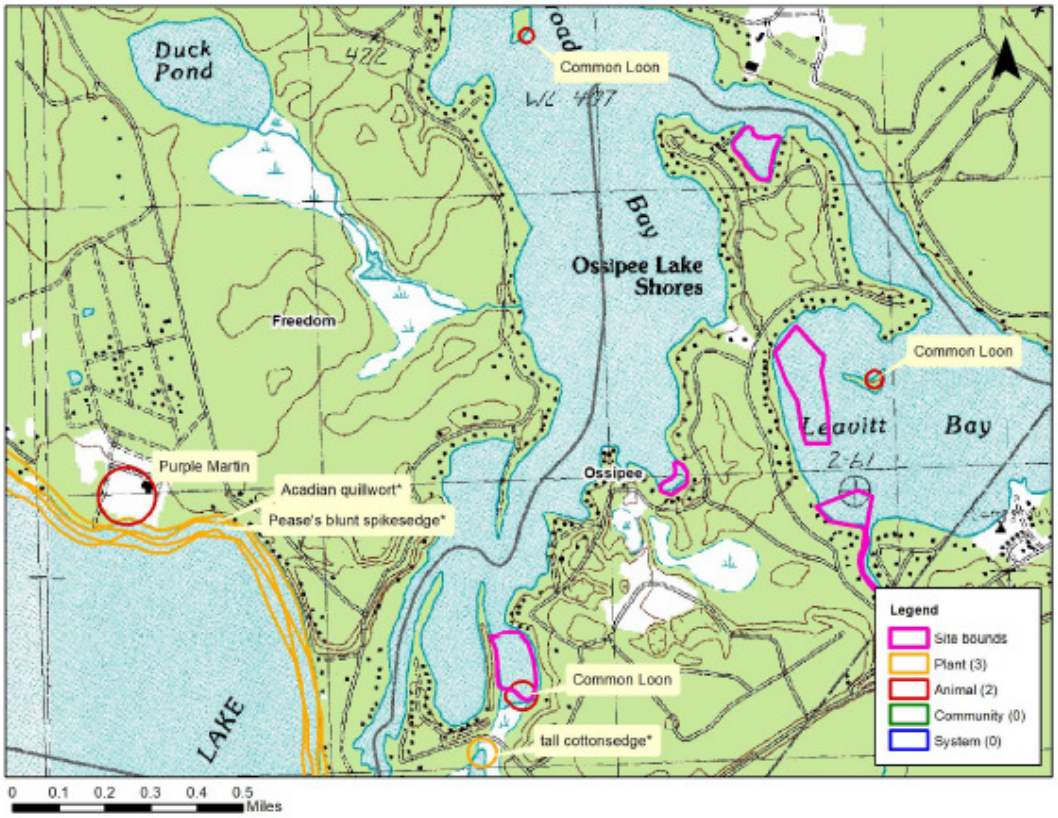
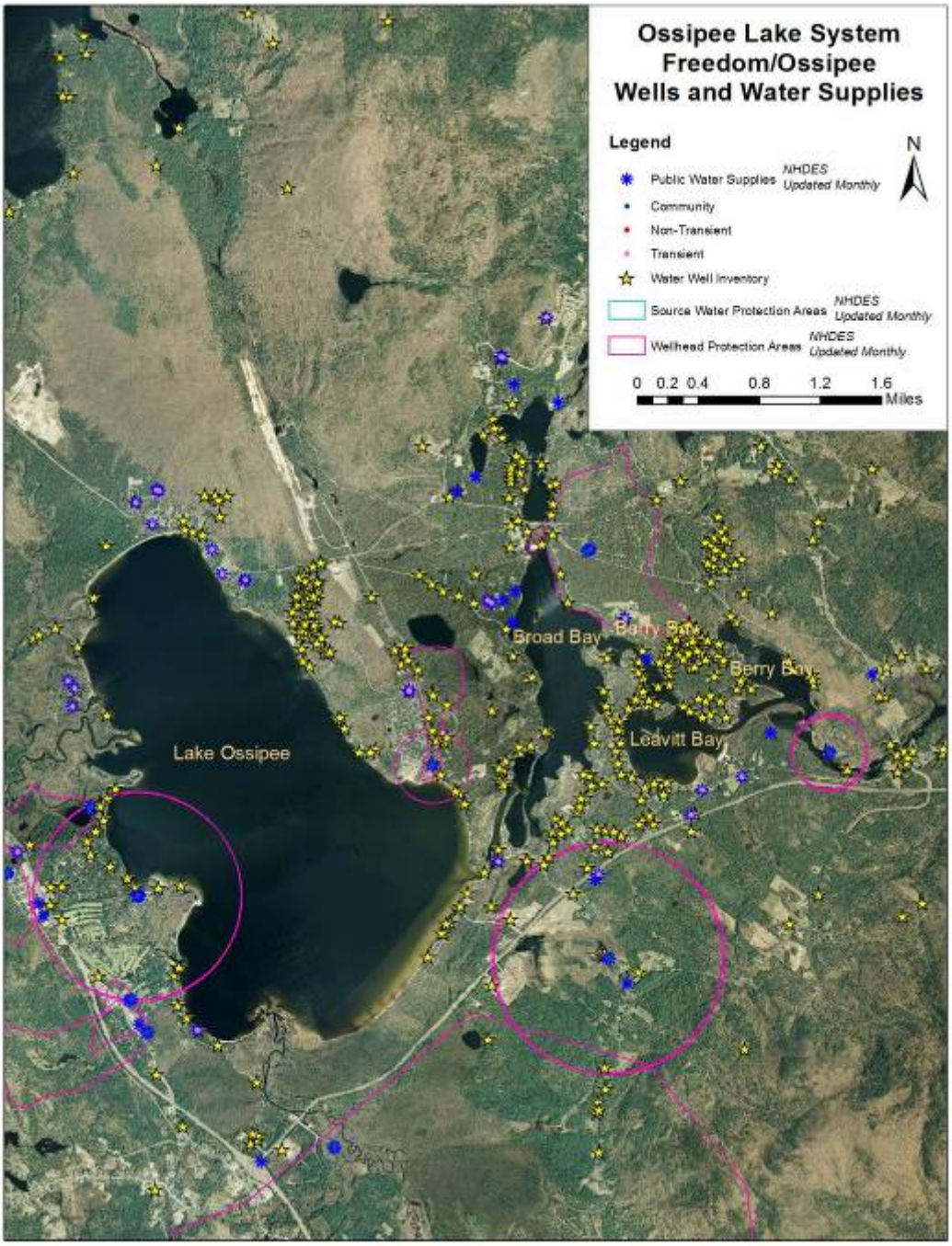

Duck Pond
Common Loon
Bay
Ossipee Lake Shores
Freedom
Common Loon
Leavitt Bay
Purple Martin
Acadian quillwort*
Pease's blunt spikesedge*
Ossipee
Common Loon
tall cottonsedge*
LAKE
Legend
Site bounds
Plant (3)
Animal (2)
Community (0)
System (0)
0 0.1 0.2 0.3 0.4 0.5
Miles

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



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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