

**Long-Term Variable Milfoil Management and Control Plan for
COBBETTS POND
Windham, New Hampshire
Rockingham County**

Prepared by: New Hampshire Department of Environmental Services (DES),
in consultation with the
New Hampshire Fish and Game Department (F&G)
January 2008

PROBLEM STATEMENT

Exotic aquatic plants pose a threat to the ecological, aesthetic, recreational, and economic values of lakes and ponds (Luken & Thieret, 1997, Halstead, 2000). According to the 2006 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 Env-Ws 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).

Though exotic aquatic plants can negatively impact an aquatic system, native aquatic plants are beneficial to the aquatic ecology of waterbodies. Diverse assemblages of native aquatic plants are a source of oxygen to the system, they provide stabilizing root systems to minimize erosion and turbidity, and they provide food and habitat for aquatic life.

Variable milfoil (*Myriophyllum heterophyllum*) became established in Cobbetts Pond in Windham, New Hampshire in the mid 1990s. Over time the plant has colonized extensive sections of shoreline in the northern basin on the pond. Figure 1 illustrates the distribution of variable milfoil infestations in this waterbody.

Following is a summary of each area indicated in Figure 1:

Area A- Located along the northern shoreline of the pond. This area is nearly 17 acres in size, and the variable milfoil is scattered in small to large patches throughout the indicated area. Many of the distinct patches are difficult to see as they tend to follow a transitional steep section of lake bottom that is just visible during a boat survey. The water is roughly 4-8 feet in depth, and the milfoil is generally in line with a steep depth gradient in this area. Variable milfoil is present at only 35% of the overall area, but the nature and distribution of the patches warrants a full herbicide application throughout this area.

Area B- Area B is located along the southeastern shoreline of the pond, and comprises an area of 15.5 acres. Milfoil growth is locally dense throughout this area, and ranges from 50% to 75% cover along this stretch of shoreline.

Area C- Area C is the northeastern tip of the lake, and comprises 11.6 acres. Variable milfoil is very dense, and ranges from 75%-85% cover in this area. Milfoil growth ranges from a depth of about 1 foot, to a depth of about 10-12 feet.

Area D- Area D is a small patch of milfoil growth that covers less than 3 acres. The patch is just south of the constriction between the north and south basins of Cobbetts Pond. Variable milfoil here is present in small patches that range between 50-85% cover.

Individual Points- The individual points around the pond indicate areas where small patches or groupings of a few stems of milfoil are present. One point is located along the southeastern shoreline nearly opposite the outlet cove of the pond. The other point is located on the southernmost point in the pond, near the town beach.

In terms of the impacts of the variable milfoil in the system, there are several (261) houses around the shoreline of Cobbetts Pond, with a mix of seasonal cottages and year-round homes (though most are converting to year-round homes at this point in time). There are also 423 back lots with water access. Many of these, and in particular in the northern basin, abut areas of dense variable milfoil growth.

Lake residents have expressed frustration with the exotic plant growth, citing fouling of their swim beaches, swim impairments, and concerns about the whole pond being choked with the invasive plant. Some shorefront properties, particularly in Area B, have shallow water depths along their shorefronts, which make the milfoil problem more pronounced in terms of recreational use of the waterbody. In Area C, a large function hall facility has a large portion of frontage on the pond, and recognizes reductions in the aesthetic value of the shorefront and shallows due to the dense variable milfoil growth.

The invasive plant infestation in this pond has increased gradually over time, and though management has occurred every few years with the use of aquatic herbicides, the milfoil has gained a foothold and has expanded to cover larger areas. Additionally, historic mapping techniques may have allowed for small patches of milfoil to be missed, which could have resulted in sources of fragments and expansion of the milfoil infestation to these larger areas.

At this time, there are no data and no observed problems with the biological integrity of the aquatic community as a result of the variable milfoil infestation; however, the variable milfoil infestation is still somewhat localized in the shallow areas of one part of the lake. No biological integrity surveys have been conducted, however, as part of this plan preparation.

PURPOSE

In June 2007, the Cobbetts Pond Association requested matching funds from the Department of Environmental Services to conduct an aquatic plant control project during the spring of 2008 to control areas infested with variable milfoil.

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

1. To identify the waterbody's beneficial use areas, including essential aquatic habitat, designated conservation zones, swimming areas, boat access sites, and boating use areas;
2. To present the aquatic macrophyte distribution map, including both native and exotic species;
3. To identify short-term and long-term exotic aquatic plant control goals that protect and conserve the lake's beneficial uses;
4. To recommend exotic plant control actions that meet the goals outlined in this plan; and
5. To recommend monitoring strategies to determine the success of the control practices over time in meeting the goals.

This plan also summarizes the current physical, biological, ecological, and chemical components of Cobbetts Pond and the social and ecological impacts of the variable milfoil infestation. The intent of this strategic plan is to greatly reduce variable milfoil coverage in Cobbetts Pond, with the potential to eradicate variable milfoil from Cobbetts Pond over time through the use of Integrated Pest Management Strategies (IPM). Appendix A details the strategies available for waterbodies with exotic species, and provides more information on each of the activities that are recommended within this plan.

GOALS/OBJECTIVES OF MILFOIL CONTROL ACTIONS

The aquatic plant management plan for Cobbetts Pond outlines actions to reduce the overall footprint of variable milfoil, and eventually eradicate variable milfoil while maintaining native plant communities whenever variable milfoil control actions are being implemented.

To achieve this, we recommend the following:

- 1) To reduce the overall acreage and percent cover of variable milfoil bottom growth in Area A from 17 acres and 35% cover in 2008, with the use of aquatic herbicides, to less than 2 acres and 10% cover.
- 2) To reduce the overall acreage and percent cover of variable milfoil in Area B from 15.5 acres and 50-75% cover to less than 2 acre and 10% cover with the use of aquatic herbicides in 2008.
- 3) To reduce the overall acreage and percent cover of variable milfoil in Area C from 11.6 acres and 75-85% cover to less than 1 acre and 20% cover with the use of aquatic herbicides in 2008.
- 4) To reduce the overall acreage and percent cover of variable milfoil in Area D from 3 acres and 50-85% cover to less than ½ acre and 15% cover with the use of aquatic herbicides in 2008.
- 5) To eradicate variable milfoil infestations located at individual points by hand-removal, suction harvesting, and/or and benthic barrier placement.
- 6) To greatly reduce or potentially eradicate variable milfoil infestations throughout the pond by 2013 by performing variable milfoil control actions on any exotic plants remaining after actions 1 through 5 above, using hand-removal, benthic barriers, and/or

diver-assisted suction harvesting throughout summer 2008, and annually thereafter if new stems or localized patches are present.

To maintain a Weed Watcher program and Lake Host Program for the pond.

Town Support

The Town of Windham, through the local Village District has been very supportive of variable milfoil control efforts in Cobbetts Pond. This is the only infested waterbody in the town at this point, and local officials recognize the need to protect other nearby waterbodies.

The town, through the Village District has been supportive financially by offering matching funds for herbicide applications.

Cobbetts Pond Improvement Association Support

Cobbetts Pond has an active lake association that monitors the water quality of the pond through the Volunteer Lake Assessment Program (VLAP), and that monitors the expansion of the milfoil through the pond.

The lake association is committed to performing follow-up monitoring for milfoil re-growth, and working with DES to coordinate hand-removal and benthic barrier placement for further variable milfoil control.

WATERBODY CHARACTERISTICS

The following table summarizes basic physical and biological characteristics of Cobbetts Pond.

General Lake Information	
Lake area (acres)	344.6
Watershed area (acres)	2,047.1
Shoreline Uses (residential, forested, agriculture)	Residential, forested
Max Depth (ft)	63.4
Mean Depth (ft)	17.2
Trophic Status	Eutrophic
Color (CPU) in Epilimnion	15.5
Clarity (ft)	8.6
Flushing Rate (yr ⁻¹)	0.4
Natural waterbody/Raised by Damming/Other	Natural w/dam
Plant Community Information Relative to Management	
Invasive Plants (Latin name)	<i>Myriophyllum heterophyllum</i>
Infested Area (acres)	Approximately 46.7 acres
Distribution (ringing lake, patchy growth, etc)	Dense areas of milfoil growth around nearly the entire shoreline of the north basin on the pond. Scattered stems or patches of plants in the southern end of the pond.
Sediment type in infested area	Sandy/silty

(sand/silt/organic/rock)	
Rare, Threatened, or Endangered Species in Waterbody (according to NH Natural Heritage Inventory)	There is a downstream site (Golden Brook) flagged as potential for having endangered Brook Floater mussel
Area of Littoral Zone (acres)	203
Area of Profundal Zone (acres)	99
Area of Macrophyte Coverage (native or otherwise) of Plants in Littoral Zone	108
% of Littoral Zone with Macrophyte Cover	53
% of Macrophyte cover comprised of invasives	43
% of Littoral Zone with Variable Milfoil Cover	23

An aquatic vegetation map and key from an August 1, 2007 survey by the DES Biology Section is shown in Figure 2. A bathymetric map is shown in Figure 3.

BENEFICIAL (DESIGNATED) USES

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

Of these, Aquatic Life and Recreation are the ones affected by the presence of invasive plants like variable milfoil.

AQUATIC LIFE

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.

FISHERIES AND WILDLIFE

A barge electrofishing survey of Cobbetts Pond in 2006 recorded bluegill, common sunfish, common white sucker, largemouth bass, yellow perch, and American eel. Landlocked alewives are also known to inhabit the pond.

Shoreline development has become very dense and submerged aquatic vegetation is currently limited to a few small coves according to Fish and Game data (see current plant map in Figure 2, however, and discussion of macrophyte community below for more detail based on 2007 data). Redfin pickerel and banded sunfish were recorded in a survey of the lake conducted by the NHFGD in 1938 as part of a Merrimack River watershed biological survey. These two species were not detected in the 2006 electrofishing survey. The 1938 survey of Cobbetts Pond recorded 12 other species, most of which depend on aquatic vegetation all or part of their life cycles. The scarcity of aquatic vegetation in the pond and the low species diversity recorded in 2006 suggests that some of the 12 species recorded in 1938 may no longer be present in Cobbetts Pond.

In terms of fishing, Cobbetts Pond does not have a public access site that allows large numbers of transient boaters to use the pond. Fishing pressure comes mostly from local residents and nearby town residents that may use the waterbody. Figure 4 illustrates the common fishing areas on Cobbetts Pond, as presented by members of the lake association that track activity on the pond. Some of the areas indicated as prime fishing habitat by local fishing enthusiasts do fall within zones that are heavily impacted by variable milfoil growth.

A Natural Heritage Inventory showed that the brook floater can potentially be found downstream of Cobbetts Pond in Golden Brook (the outflow stream of Cobbetts Pond). The outflow of the stream is roughly 3,075 feet away from the southern-most region of herbicide application in the pond. It is expected that by the time the flow of water from the treatment area reaches the outlet stream, it will have mixed sufficiently to lower the concentration of the herbicide leaving the lake. This, coupled with the fact that the herbicide will be further broken down as it becomes more oxygenated as it flows over the dam, further diminishes any potential threat of the herbicide to downstream organisms.

RECREATION USES AND ACCESS POINTS

Cobbetts Pond is used for numerous recreational activities, including boating, fishing, swimming, and water skiing by both pond residents and transient boaters. There is one designated access for boats on the southern end of the pond, but access is restricted to town residents, and other smaller private access points around the pond. Figure 1 shows the location of both the town owned ramp (southern end) and a larger private ramp in the northern end. Individual and private launches are not noted here. Figure 5 illustrates the typical boat paths for the pond.

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

In addition to the designated beach, there are a numerous small private swim beaches located on private properties around the pond. There are roughly 69 floating docks and swim platforms around the pond as well. Figure 6 shows the locations commonly used for swimming, and the locations of swim platforms and docks on Cobbetts Pond.

MACROPHYTE EVALUATION

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

The littoral zone of Cobbetts Pond is characterized by a mix of native and non-native (variable milfoil) plant growth (Figure 2). Native species include a mix of floating plants (yellow and white lilies), emergent plants (pipewort, iris, cattail, pickerelweed, grassy arrowhead), and submergent plants (pondweeds, waterweed, tapegrass, water naiad, chara). Native plant communities are mixed around the entire lake, and are characterized as ‘common/abundant’ by the DES.

There were no records of rare, threatened, or endangered plants in the pond.

Other species of non-native aquatic plants were observed in isolated areas of the pond, including purple loosestrife and a pink water-lily. DES will work with the lake association to monitor and control these plants (through non-chemical means).

There are no records of state threatened or endangered plant species in the pond according to the NH Natural Heritage Bureau.

HISTORICAL CONTROL ACTIVITIES ON THIS WATERBODY:

Contractor	Management Type:	Chemical Application/Treatment Date	Treatment Area (acres)
Aquatic Control Technology, Inc.	Chemical: Diquat	Completed by June 1996	6.0 acres
Aquatic Control Technology, Inc.	Chemical: Diquat	Completed by September 30 th 1998	6.5 acres
Aquatic Control Technology, Inc.	Chemical: Diquat	May 21 st 2002	6.5 acres
Lycott Environmental, Inc.	Chemical: Diquat	May 21 st 2003	7 acres
Aquatic Control Technology, Inc.	Chemical: Diquat	May 20 th 2004	7 acres
Aquatic Control Technology, Inc.	Chemical: Diquat	May 25 th 2005	7 acres
Aquatic Control Technology, Inc.	Chemical: Diquat	May 30, 2006	7 acres

MILFOIL MANAGEMENT OPTIONS

The control practices used should be as specific to variable milfoil 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/aquatic_bmp.pdf.

Criteria for the selection of control techniques are presented in Appendix A. Appendix B includes a summary of the exotic aquatic plant control practices used by the State of New Hampshire. DES has evaluated the feasibility of potential control practices on Cobbetts Pond. The following table summarizes DES' control strategy recommendations for Cobbetts Pond.

FEASIBILITY EVALUATION FOR CONTROL ALTERNATIVES

Control Method	Use on Cobbetts Pond
Restricted Use Areas	Not recommended as variable milfoil patches are too widely distributed throughout pond.
Hand-pulling	DES recommends that the individual stems or small patches of variable milfoil should be hand pulled when encountered, particularly those along the southeastern shoreline and southern tip of the pond. DES also recommends that the lake residents follow up the herbicide application with hand-pulling of re-growth, if that re-growth is small and scattered. DES divers can lend assistance as well.
Mechanical Harvesting/Removal	For Cobbetts Pond, mechanical harvesting is not recommended due to the threat of spreading variable milfoil to uninfested areas of the lake through the generation of fragments.
Benthic Barriers	For Cobbetts Pond, DES recommends installing small benthic barriers in areas of re-growth if small patches of variable milfoil re-growth can adequately be contained by benthic barriers. We do not recommend installing benthic barriers throughout the lake, however.
Herbicides	For Cobbetts Pond, herbicide use is recommended as primary treatment due to extent of infestation. The aquatic herbicide 2,4-D is recommended in 2008 and possibly in 2009 due to the nature of the growth. Diquat was previously used, but because the milfoil has continued to expand because this herbicide does not target the root systems of the plant. Diquat could be used to prevent further spread in the pond, if 2,4-D is not approved.

Control Method	Use on Cobbetts Pond
Extended Drawdown	Drawdown is not an effective control method for variable milfoil.
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	In order to allow for a healthy stand of mixed native aquatic vegetation, as well as areas of open/unvegetated substrate in the shallows, a 'No Control' option is not recommended. Without control, variable milfoil will eventually take over 100% of the littoral zone of Cobbetts Pond, and could extend into slightly deeper waters. Milfoil has been showing exponential growth in Cobbetts Pond, therefore action to manage the plants is needed.

EXOTIC AQUATIC PLANT CONTROL PLAN

An evaluation of the size, location, and type of variable milfoil infestation, as well as the waterbody uses was conducted by DES on August 1, 2007. Based on the evaluation, the following control actions are recommended:

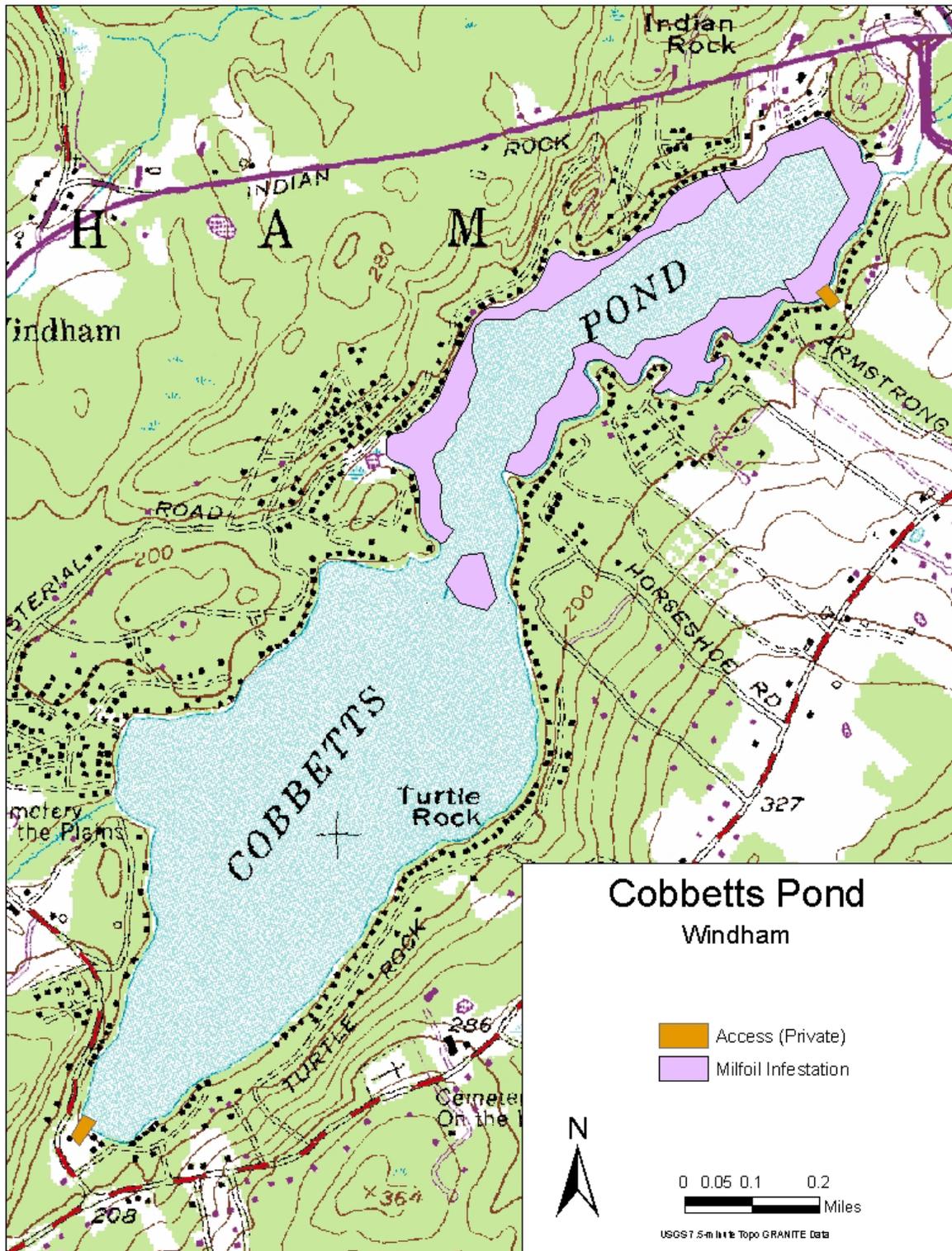
Year	Treatment Type	Responsible Party	Schedule
2008	2,4-D treatment of Areas A-D (Diquat may be used as an alternate if 2,4-D is not approved).	Lycott Environmental, Inc.	May/June
	SCUBA inspection and diver hand-removal of variable milfoil at individual points and at areas of reduced milfoil percent coverage as a result of herbicide application	DES or contracted divers	June through September
	Installation of benthic barriers, as may be appropriate	DES	July/August
	Weed Watching and Lake Hosting Activities	Cobbetts Pond Association and lake residents	June through September
	Site assessment and remapping of variable milfoil infestation, and determination of need for 2009 herbicide application	DES	August/September
2009	Follow-up spot treatments of larger milfoil patches (if needed)	Licensed herbicide applicator	May/June
	SCUBA inspection and diver hand-removal of variable milfoil at individual points and at areas of reduced percent coverage as a result of herbicide application	DES or contracted divers	June through September

Year	Treatment Type	Responsible Party	Schedule
	Installation of benthic barriers, as may be appropriate	DES or contracted divers	July/August
	Weed Watching and Lake Hosting Activities	Cobbetts Pond Association and lake residents	June through September
	Site assessment and remapping of variable milfoil infestation	DES	August/September
2010	SCUBA inspection and diver hand-removal of variable milfoil at individual points and at areas of reduced percent coverage as a result of herbicide application	DES divers or contracted divers	June through September
	Installation of benthic barriers, as may be appropriate	DES and Cobbetts Pond	July/August
	Weed Watching and Lake Hosting Activities	Cobbetts Pond Association and lake residents	June through September
2011	SCUBA inspection and diver hand-removal of variable milfoil at individual points and at areas of reduced percent coverage as a result of herbicide application	DES divers or contracted divers	June through September
	Installation of benthic barriers, as may be appropriate	DES and Cobbetts Pond	July/August
	Weed Watching and Lake Hosting Activities	Cobbetts Pond Association and lake residents	June through September
2012	SCUBA inspection and diver hand-removal of variable milfoil at individual points and at areas of reduced percent coverage as a result of herbicide application	DES divers or contracted divers	June through September
	Installation of benthic barriers, as may be appropriate	DES	July/August
	Weed Watching and Lake Hosting Activities	Cobbetts Pond Association and lake residents	June through September
	Site assessment and remapping of variable milfoil infestation	DES	August/September
2013	Update and revise Long-Term Variable Milfoil Control Plan	NH DES, F&G, and interested parties	Spring 2012

- Approximately 46.7 acres of the waterbody will be impacted by the herbicide treatment (approximately 13.5% of the surface area).

- The Department of Agriculture will impose standard short-term use restrictions for specified days depending on the use (irrigation, contact, etc) and the herbicide used. The shoreline will be posted and public notice will be made.
- By recommending follow-up management practices that utilize integrated plant management strategies such as benthic barrier placement and hand-pulling re-growth, variable milfoil re-growth or population expansion can be slowed.
- It is important to realize that aquatic herbicide applications are conducted in a specific and scientific manner, and that the herbicides that are used can be target-specific when used at appropriate doses/concentrations: this means that the invasive plant can be removed and native plants favored in this type of control practice. *Not all aquatic plants will be affected as a result of an herbicide treatment.*
- Based on the types of native plants that are mixed in with the stands of variable milfoil (Figure 2) where herbicide application is recommended there are no significant impacts expected to native plant communities. It is expected that a well distributed stand of native aquatic plants will remain following herbicide application. Aquatic herbicides are applied at specific doses to affect only the target plant species, and as such, are typically too low in concentration to affect other native vegetation in the pond.

Figure 1- Map of Milfoil Infestation



Symbol	Common Name	Latin Name
6	Pink water-lily	<i>Nymphaea sp.</i>
X	Pondweed species	<i>Potamogeton sp.</i>
E	Waterweed	<i>Elodea sp.</i>
M	Variable milfoil	<i>Myriophyllum heterophyllum</i>
V	Tapegrass	<i>Vallisneria</i>
e	Pipewort	<i>Eriocaulon</i>
3	Clasping-leaf pondweed	<i>Potamogeton perfoliatus</i>
L	Purple loosestrife	<i>Lythrum salicaria</i>
4	Spotted pondweed	<i>Potamogeton pulcher</i>
N	Water naiad	<i>Najas sp.</i>
I	Purple iris	<i>Iris versicolor</i>
C	Skunkweed/Chara	<i>Chara</i>
R	Robbins pondweed	<i>Potamogeton robbinsii</i>
T	Cattail	<i>Typha</i>
W	White water-lily	<i>Nymphaea</i>
Y	Yellow water-lily	<i>Nuphar</i>
P	Pickerelweed	<i>Pontedaria cordata</i>
S	Grassy arrowhead	<i>Sagittaria graminea</i>

Figure 3- Bathymetric Map of Cobbetts Pond, Windham

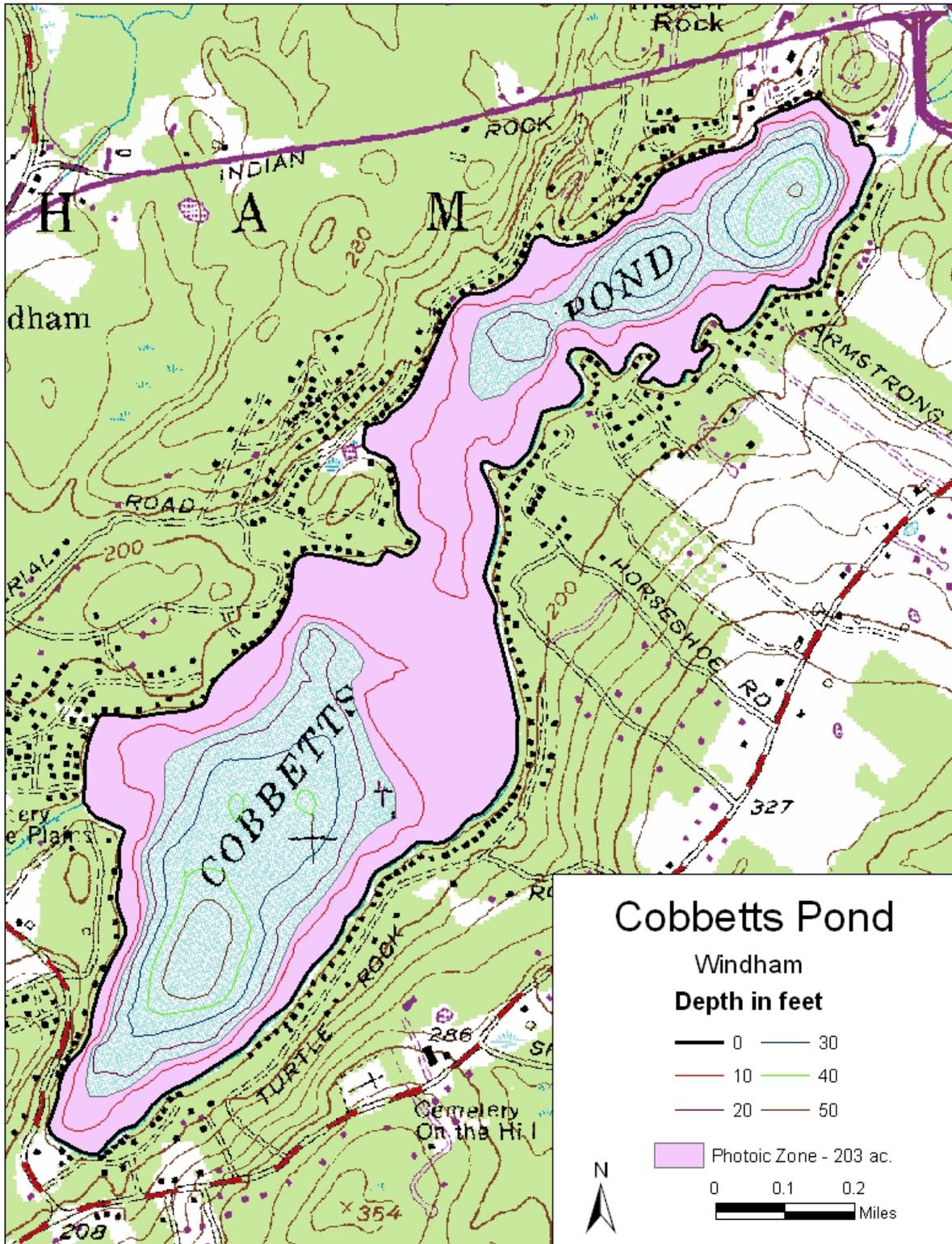


Figure 4- Common Fishing Locations (based on knowledge of lake residents)

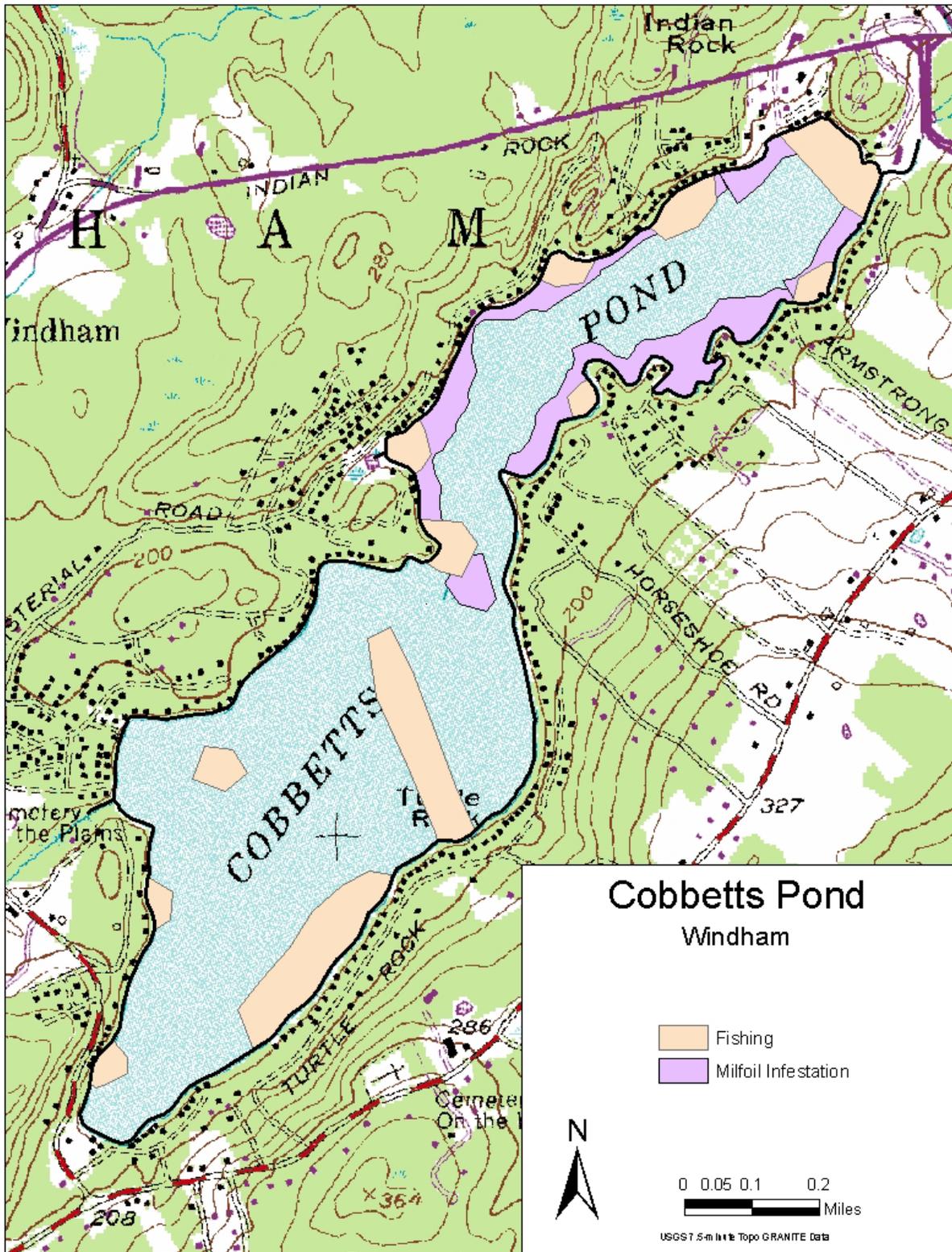


Figure 5- Typical Boat Paths

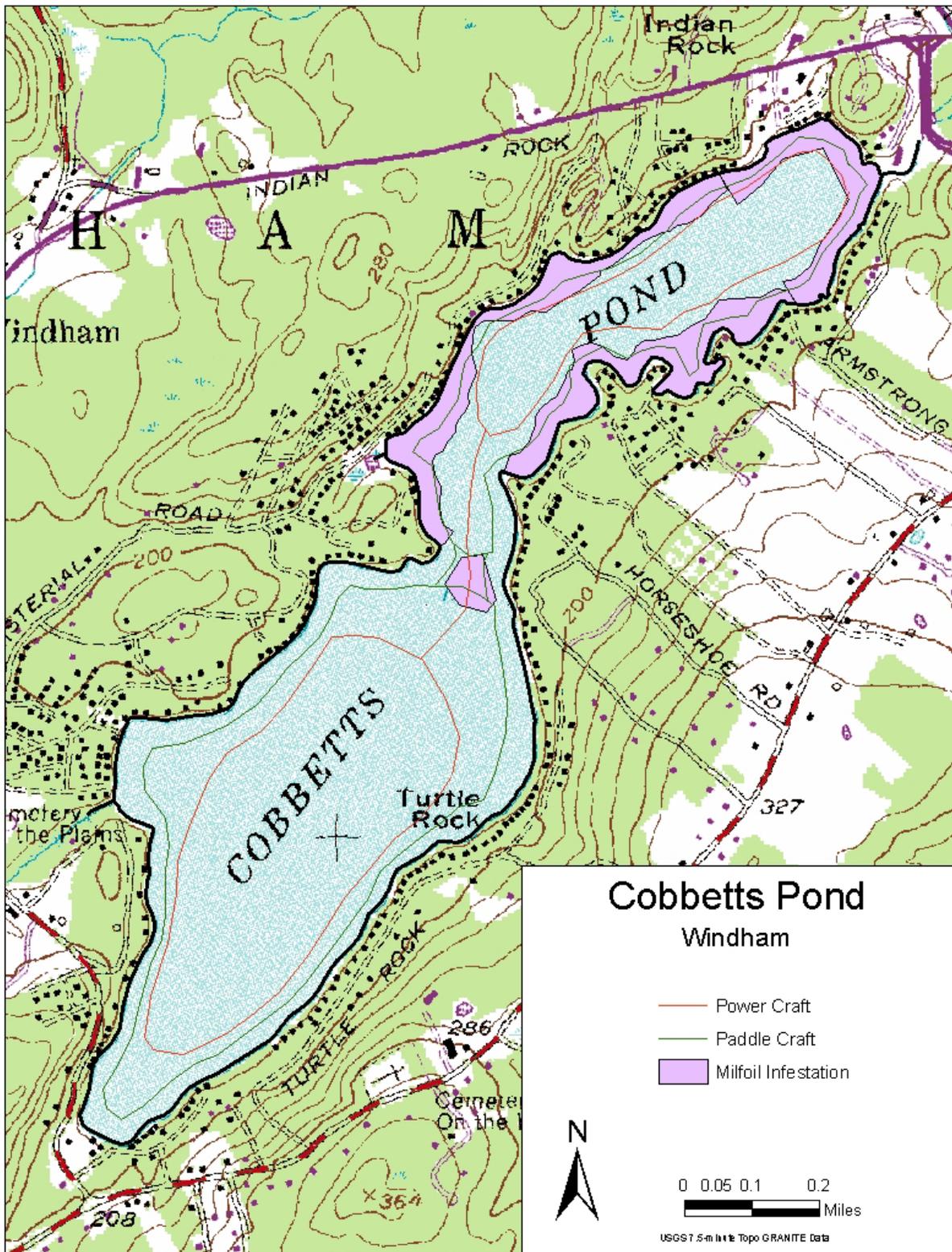
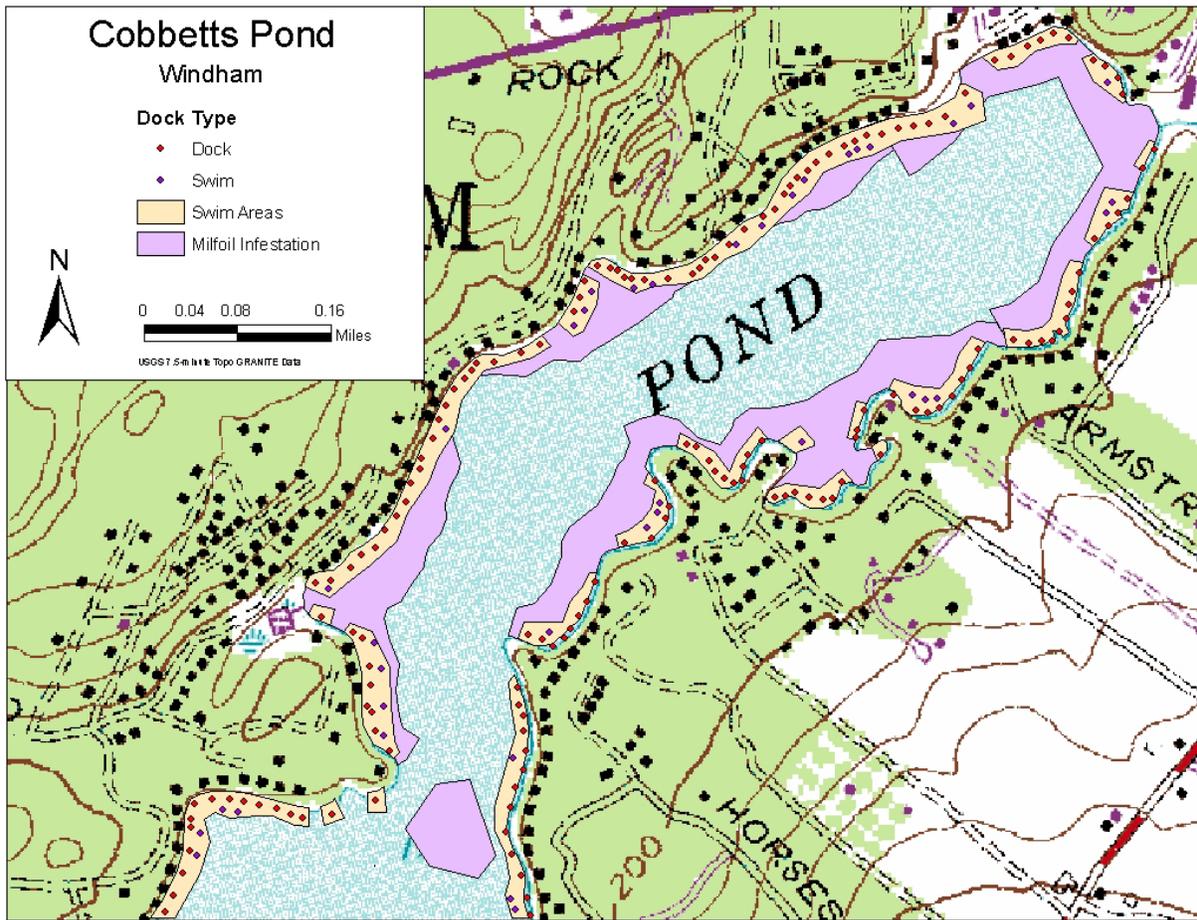


Figure 6- Swim Areas, Docks, and Swim Rafts- North End



APPENDIX A

CRITERIA TO EVALUATE THE SELECTION OF AQUATIC PLANT CONTROL TECHNIQUES

Preliminary Investigations

I. Field Site Inspection

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

II. Office/Laboratory Research of Waterbody Characteristics

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

Overall Control Options

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

- 1) **Eradication:** Herbicide application targeted at exotic aquatic plant to be eradicated, to either eradicate the plant or to reduce overall biomass to a point where alternative non-chemical strategies may be used. This action will be followed by thorough annual monitoring for regrowth and the use of non-chemical actions to achieve the eradication.
- 2) **Containment:** The aim of this approach is to limit the size and extent of the existing infestation. An herbicide application may be used to reduce specified areas down to a percent cover of the exotic species so that it can be maintain or contained with alternative management strategies, including Restricted Use Areas, benthic barriers, and others. Subsequent herbicide applications may be necessary if the target species shows exponential growth and further spread.

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

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

Guidelines and requirements of each control practice are detailed below each alternative.

A. Hand-Pulling

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

B. Mechanically Harvest or Hydro-Rake

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

C. Chemical Treatment

- Can be used if application of chemical is conducted in areas where alternative control techniques are not optimum due to depth, current, use, or 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 (rare or endangered that will not be impacted by chemical treatment).
- 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 chemical treatment as compared with

other treatments.

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

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

E. Bottom Barrier

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

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 RSA211:11 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.
- Exotic controls, such as insects, cannot be introduced to control a nuisance plant.
- Research should be conducted on a potential biological control prior to use to determine the extent of host specificity.

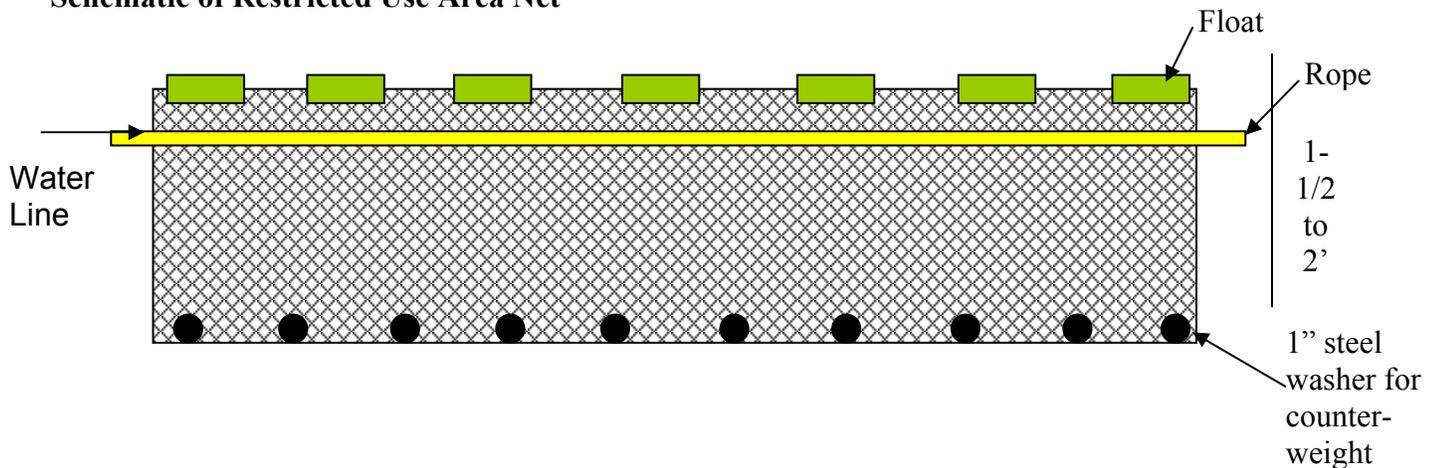
APPENDIX B

SUMMARY OF CONTROL PRACTICES USED IN THE STATE OF NEW HAMPSHIRE FOR EXOTIC AQUATIC PLANTS

Restricted Use Areas:

Restricted Use Areas (RUAs) are a regular control option for lakes with small, contained infestations of exotic plants, limited to small patches or embayments. This is often the case in waterbodies with newly-discovered infestations. RUAs restrict access to all recreational activities in a delineated area to minimize plant fragmentation and thereby reduce the spread of milfoil. As an additional method of protection from fragment migration, RUAs are encircled with a shallow net that is suspended vertically in the water column. The net is approximately 1.5-2.0 feet in height. The top of the net is set to extend four inches above the surface of the water, while the remainder is positioned below the surface of the water (see figure below). This configuration prevents the movement of fragments from infested areas to uninfested areas. Due to the size and nature of net construction, there is no impediment to fish migratory patterns or spawning activities.

Schematic of Restricted Use Area Net



Hand-pulling:

When infestations of exotic aquatic plants begin as single scattered stems or small patches, DES biologists SCUBA dive to hand-pull the plants (and DES can train other certified divers to also perform this management practice). Guidelines for determining feasibility and effective for hand-removal are site specific, but generally sparsely populated patches of up to 5' X 5', single stems, or dense small patch up to 2' X 2' are reasonable.

The whole plant including the roots should be removed in this process, while leaving the beneficial native species intact. This technique works best in softer sediments, with shallow rooted species and for smaller, scattered infestation areas. When hand pulling nuisance species, the entire root system and all fragments of the plants must be collected since small root or stem fragments could result in additional growth of the species. The process must be repeated often to control re-growth of the exotic plants. For a new infestation, hand-pulling activities are typically

conducted several times during the first season, with follow-up inspections for the next 2-5 years or until no re-growth is observed. This control practice has proven successful in many waterbodies.

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:

When a small infestation of exotic aquatic plants occurs in clusters of growth (generally areas $>5 \text{ ft}^2$), as opposed to scattered stems, a permeable fiberglass screen can be placed over the area of infested lake sediments. The permeable fabric screening allows for gas release from the sediments while effectively blocking sunlight and compressing the plants into the sediment, inhibiting photosynthesis and eventually killing the plant. Occasionally, in some lakes, gas release from the sediments or boating activity cause the uplifting of screening. Benthic barriers can effectively control small infestations of less than approximately 10,000 square feet.

Benthic barriers have two basic applications. These practices are used to cover pioneering infestations and prevent the spread of the plant. Bottom barriers are installed across small portions of lake bottoms infested with invasive aquatic plants. The disadvantage of benthic barriers is their non-selectivity and limitation of cover to less than 10,000 square feet. Additionally, these physical barriers prevent the growth of all vegetation, which is a necessary component of fish and wildlife habitat.

Bottom barriers are attached to the bottom of a water body by re-bar attached to the edges and across the middle of the material. Bottom barriers are transported to the shoreline adjacent to where installation is to occur. They are then cut to fit the treatment site and rolled onto a length of pipe. Divers carry the roll into the water at the start of the treatment site and secure one edge of the material to the lake bottom. The divers then roll out the remainder of the material and continue to secure it to the bottom sediments. This process is repeated until the plants in the treatment are covered.

Bottom barriers are generally considered for small localized areas rather than lakewide application. Bottom barriers provide 100% control of this weed in areas where they are installed. They also provide long-term control. An ongoing maintenance operation is required to inspect the bottom barrier and clear the mats of sediment buildup.

Benthic barriers are not recommended for application in river systems, as flow can easily uplift the barrier.

Targeted Application of Herbicides:

The use of chemicals, such as herbicides, for the control of noxious and nuisance plant species represents one of the most widely known and effective management options available. Herbicide control of invasive aquatic plants is often the first step in a long-term integrated control program. In the last 15 to 20 years the use and review of herbicides has changed significantly in order to accommodate safety, health, and environmental concerns. Currently no herbicide product can be labeled for aquatic use if it has more than a one in a million chance of causing significant harmful effects to human health, wildlife, or the environment. Because of this, the number of effective and U.S. Environmental Protection Agency (EPA) approved herbicides for aquatic weeds are limited. In most cases the cost and time of testing and registration, rather than environmental issues, limits the number of potentially effective compounds.

All herbicide applications in New Hampshire are performed under permits issued by the New Hampshire Department of Agriculture, Division of Markets and Food, Bureau of Pesticide Control.

Two herbicides have been used in New Hampshire for the control of milfoil. Diquat (trade name Reward), the most often-used herbicide, is a contact herbicide that can generally provide one season of control for milfoil. Because this herbicide does not target the root systems, the plants eventually re-grow from established roots.

The second herbicide, 2, 4-D (trade name Navigate or Aqua Kleen), is a systemic herbicide. It is absorbed into the sediments and taken up through the root system, killing both the roots and the plant biomass above the sediments. Label restrictions for aquatic application currently limit its use in New Hampshire to waterbodies with no water intakes, and with no wells adjacent to the shoreline.

The aquatic herbicide SONAR has been used in New Hampshire to control growths of fanwort. The chemical acts by limiting photosynthesis when chlorophyll-a is affected by the active ingredient of the herbicide.

Extended Drawdown

Water drawdown is used for control of some species of aquatic macrophytes. Drawdown requires some type of mechanism to lower water levels, such as dams or water control structures and use is thus limited. It is most effective when the drawdown depth exceeds the depth or invasion level of the target plant species.

In northern areas, drawdown will result in plant and root freezing during the winter for an added degree of control. Drawdown is typically inexpensive and has intermediate effects (2 or more years). However, drawdown can have other environmental effects and interfere with other functions of the water body (e.g. drinking water, recreation, or aesthetics). Drawdown can result in the rapid spread of highly opportunistic annual weed species, which in most cases is the plant that is targeted for control.

Drawdowns have been used in the past for plant control. In theory, the drying of the plants in the summer, or the freezing of the plants in the winter, will eliminate or limit plant growth. However, milfoil often forms a more succulent terrestrial form during drawdown conditions and the succulent form of the plant can remain viable for long periods of time without submergence, making the practice ineffective. This strategy can be used for control of some native plant species.

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.