Long-Term Variable Milfoil Management and Control Plan for NAMASKE LAKE Manchester/Goffstown, New Hampshire Hillsborough County

Prepared by: New Hampshire Department of Environmental Services (DES),
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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, and are thus not a focus of management efforts in this waterbody. 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.

Namaske Lake is an impoundment on the Piscataquog River. Kelley Falls dam is the impoundment for Namaske Lake. Variable milfoil (*Myriophyllum heterophyllum*) became established in Namaske Lake in Manchester/Goffstown, New Hampshire in 2006 following the Mother's Day Flood, when high flows sent fragments downstream from other infested waterbodies (Scobie Pond (a.k.a. Haunted Lake) in Francestown at the headwater of the river, and from some plants present in Glen Lake in Goffstown). In the three years the plant has been in Namaske Lake it has colonized several acres in shoreline and shallow areas. Figure 1 illustrates the distribution of variable milfoil infestations in this waterbody. Much of the growth is comprised of dense stands of variable milfoil that are topping out at the water's surface, including areas A, B, C, E, and F. Area D has smaller patchier growth.

In terms of the impacts of the variable milfoil in the system, there are 145 houses around the shoreline of Namaske Lake. There are also an estimated 60 back lots with lake rights. Many of these abut areas of dense variable milfoil growth (particularly Areas B and E).

Lake residents have expressed frustration with the exotic plant growth in the last two years, citing fouling of their swim beaches, swim impairments, and a fast rate of spread and increase in the density of the variable milfoil. Specifically, residents have indicated that swimming has become undesirable and nearly impossible in some areas of dense growth; the use of power boats is hindered due to fouling of boat propellers and jet propulsion units; and transient recreational gear is continually bringing tag-along plants out of the lake increasing the risk of spread to other

waterbodies. Additionally, the invasive plant infestation in this waterbody is a continuous threat to the Piscataquog River and the Merrimack River downstream.

Namaske Lake is relatively shallow with silty and organic substrates, essentially creating prime variable milfoil habitat across nearly the whole impoundment where depth is not a limiting factor.

PURPOSE

In September 2008, the Namaske Lake Association requested matching funds from the Department of Environmental Services to conduct an aquatic plant control project during the spring of 2009 to control areas infested with variable milfoil. Unfortunately funds were not available for the project, and the lake association is seeking to perform control actions in 2010.

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 Namaske Lake and the social and ecological impacts of the milfoil infestation. The intent of this strategic plan is to outline an approach to greatly reduce the distribution and density of variable milfoil in Namaske Lake with a 2,4-D treatment in 2010, and then monitor the system and tailor future approaches based on the effectiveness of treatment and patterns of re-growth in the lake using 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 Namaske Lake outlines actions to manage the infestation of variable milfoil in Namaske Lake (*Myriophyllum heterophyllum*, referred to as "variable milfoil" in this plan) while maintaining native plant communities whenever variable milfoil control actions are being implemented.

The goal for Namaske Lake is to greatly reduce the overall distribution and density of variable milfoil within the system using an Integrated Pest Management Approach. Eradication in this system is not feasible at this time due to the presence of upstream infestations in Scobie Pond in Francestown and in Glen Lake in Goffstown. Control activities have been ongoing in both Scobie Pond and Glen Lake for a number of years, and efforts have reduced the milfoil growth in each system, however some growth persists, and fragments can easily flow downstream through

the Piscataquog River and contribute to continued growth in Namaske Lake. Acting now in Namaske Lake, before upstream infestations are fully controlled, is intended to provide relief to shorefront property owners who have experienced use impairments in Namaske Lake since the infestation began.

Town Support

The cities of Manchester and Goffstown have been contacted for providing funding assistance for this project. The town of Goffstown has a warrant article for funds for this project, but unfortunately the City of Manchester was not able to provide financial assistance for the 2010 activities.

Namaske Lake Association Support

Namaske Lake has an active and newly formed lake association. The lake association was formed as a result of the milfoil infestation so that there was a local group that could facilitate control actions and receive grant funds for any projects that are proposed.

The lake association has individuals that are 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 when appropriate.

WATERBODY CHARACTERISTICS

The following table summarizes basic physical and biological characteristics of Namaske Lake.
*Indicates data from 7/31/1980 DES lake assessment

General Lake Information	
Lake area (acres)	192.5 acres
Watershed area (acres)	Approx. 137,000 acres (Piscataquog R. Watershed)
Shoreline Uses (residential, forested, agriculture)	Mainly residential, some forested
Max Depth (ft)	25.41*
Mean Depth (ft)	5.28
Trophic Status	Mesotrophic*
Color (CPU) in Epilimnion	50*
Clarity (ft)	5.61
Flushing Rate (yr^{-1})	311.3
Natural waterbody/Raised by Damming/Other	Impounded river segment
Plant Community Information Relative to Management	
Invasive Plants (Latin name)	*Myriophyllum heterophyllum*
Infested Area (acres)	Approximately 116.6 acres
Distribution (ringing lake, patchy growth, etc)	Widespread infestation along nearly entire shoreline of lake, with dense infestations common
Sediment type in infested area (sand/silt/organic/rock)	Silty/organic

Rare, Threatened, or Endangered Species in or Near Waterbody (according to NH Natural Heritage Inventory)	Brook floater (*Alasmidonta varicose*) Persius dusky wing (*Erynnis persium persius*) Pine Barrens zanclognatha (*Zanclognatha martha*) Blanding's turtle (*Emydoidea blandingii*) Redfin pickerel (*Esox americanus americanus*)

An aquatic vegetation map and key from a summer 2008 survey by the DES Biology Section is shown in Figure 2. A bathymetric map based on soundings from 1980 is provided for reference, but true bathymetric contours are expected to deviate from these.

BENEFICIAL (DESIGNATED) USES

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 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

Fish species present include largemouth bass, smallmouth bass, golden shiner, pickerel, yellow perch, white perch, common white sucker, brown bullhead, and yellow bullhead. A few brook trout are also stocked each year. Fishing pressure is light during open-water and rare during winter.

A Natural Heritage Inventory review yielded five records of species of concern in or near Namaske Lake: Brook floater (*Alasmidonta varicose*), Persius dusky wing (*Erynnis persium persius*), Pine Barrens zanclognatha (*Zanclognatha martha*), Blanding's turtle (*Emydoidea blandingii*), and Redfin pickerel (*Esox americanus americanus*)

Three of these five species were documented outside of the Piscataquog River system. Two of these three were located in pine barren habitat east of Namaske Lake (Persius dusky wing (*Erynnis persium persius*) and Pine Barrens zanclognatha (*Zanclognatha martha*)) and are terrestrial species. The third species, the redfin pickerel, was located in a different water system (Black Brook) that is not hydrologically connected to Namaske Lake.

The remaining two species were both documented downstream of the proposed treatment area (brook floater and Blanding's turtle).

The brook floater mussel is listed as endangered in NH due to rarity or vulnerability, but has no federal listing at this time. Globally the species is listed as rare or uncommon. The NHB record for this species in this area dates to a 1994 sighting in the mainstem of the Piscataquog River, downstream of the Kelley Street Bridge. Approximately 1-10 specimens were documented in a 50 m X 4 m survey lane by the observer. The herbicide of choice for this control activity is 2,4-D (Navigate), which has been shown by EPA to be non-toxic to aquatic life when used according to label restrictions. There are no expected impacts to this species as a result of the milfoil control activities in Namaske Lake. It is not expected that habitat or food sources for the mussel will be affected either.

The Blanding's turtle is listed as endangered in New Hampshire, where it is rare or uncommon. It has no federal listing, and it is listed as globally secure, but a cause for concern. The NHB record for this species in this area dates to a 2007 sighting near the Kelley Street Bridge. One adult was observed at the time. Blanding's Turtles are mostly aquatic and are found in the shallows of lakes and ponds, in marshes, bogs, and small streams. The turtles nest on land, but feed underwater on insects, tadpoles, crayfish, and snails, among other small aquatic organisms. The herbicide of choice for this control activity is 2,4-D (Navigate), which has been shown by EPA to be non-toxic to aquatic life when used according to label restrictions. There are no expected impacts to this species as a result of the milfoil control activities in Namaske Lake. It is not expected that habitat or food sources for the turtle will be affected either.

In any case, sample data from other treatment areas in rivers suggest that 2,4-D concentrations decrease with increasing distance downstream of treatment areas as a function of dilution. In addition, aeration of the water as it flows over the dam serves to break the herbicide molecules down more quickly, further adding to reduction in the concentration of the herbicide with distance downstream of the treatment area. The applicator and DES will work with the dam operator to establish a reservoir type effect to hold the water and herbicide back for a short time in the Namaske impoundment to also allow for degradation of the herbicide and decrease of concentration before the water flows downstream, thereby lessening the concentration of herbicide these species may be exposed to.

RECREATION USES AND ACCESS POINTS

Namaske Lake is used for numerous recreational activities, including boating, fishing, swimming, and water skiing by both pond residents and transient boaters. In the last few years the recreational uses of the waterbody have become impaired by dense growths of variable milfoil, at times inhibiting some types of recreation. There is one designated public access for boats on the southeastern side of the impoundment, off from Electric Street, under the Kelley Street Bridge. Small motor boats, as well as kayaks and canoes can use this launch. There is limited parking for about two vehicles with trailers and a couple of additional vehicles.

In terms of boating activity, lake residents estimate that there are roughly 90-100 power boats using the waterbody on a regular basis, and about 60 non-motorized vessels such as canoes and kayaks.

There are no public beaches on the impoundment (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.*

There are a few small private swim beaches located on private properties around the impoundment, and some floating docks and swim platforms around the waterbody as well. Figure 4 shows the locations commonly used for swimming, and the locations of swim platforms and docks on Namaske Lake.

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 Namaske Lake is characterized by a mix of native and non-native (variable milfoil) plant growth (Figure 2). Native species include a mix of floating plants (floating heart, yellow water-lily, watershield), emergent plants (bur-reed, arrow arum, pickerelweed, iris), and submergent plants (waterweed, grassy spike rush, pondweed, grassy bur-reed, water purslane/false loosestrife, water starwort, water naiad, and grassy arrowhead.). Native plant communities are mixed around the entire lake, and are characterized as 'common' by the DES.

In addition to variable milfoil being present as an invasive species in this system, purple loosestrife was also identified as single plants or small clusters around portions of the shoreline. The lake residents are recommended to carefully hand-remove the purple loosestrife plants and their roots to prevent further spread.

There are no records of state threatened or endangered plant species.

HISTORICAL CONTROL ACTIVITIES ON THIS WATERBODY:

There have been no exotic plant control activities within this impoundment.

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 Namaske Lake. The following table summarizes DES' control strategy recommendations for Namaske Lake.

FEASIBILITY EVALUATION FOR CONTROL ALTERNATIVES

Control Method	**Use on Namaske Lake**
Restricted Use Areas	Not recommended as variable milfoil growth is widespread in the waterbody and there is no way to restrict access to these areas unless access to the entire impoundment is restricted.
Fragment Barrier	A fragment barrier is recommended at the upstream reach of the impounded area, to trap fragments from upstream waterbodies. Lake association members are encouraged to form teams of volunteers to inspect and clean nets throughout the growing season to maintain functionality.
Hand-pulling	DES recommends that the individual stems or small patches of variable milfoil be hand pulled when encountered; however, prior to hand-removal activities being successful, the majority of the variable milfoil biomass must be controlled chemically, otherwise the hand-pull effort will be futile. Upstream areas should be monitored for pioneering growth and that should be hand-removed. Local divers interested in performing hand-removal activities in Namaske Lake are encouraged to become certified Weed Control Divers (WCD) in order to perform these tasks for the lake association as needed.
Mechanical Harvesting/Removal	For Namaske Lake, mechanical harvesting is not recommended due to concerns about plant fragmentation and further spread. This technique also does not target root systems, so re-growth will likely be rapid.
Benthic Barriers	For Namaske Lake, DES recommends installing small benthic barriers in areas of re-growth if small patches of variable milfoil re-grow and can adequately be contained by benthic barriers. Any barrier installation should consider factors such as flow and depth and the feasibility of maintaining the barrier based on those conditions.

Control Method	Use on Namaske Lake
Herbicides	For Namaske Lake, herbicide use is recommended as primary treatment due to extent of infestation. The aquatic herbicide 2,4-D is recommended in 2010 and perhaps in 2011 or 2012 to reduce growths enough to allow for non-chemical controls to be effective. After the 2010 treatment DES will perform an evaluation of the waterbody and determine specific plans for 2011 based on the outcomes of the herbicide treatment.
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 habitat in the system, a 'No Control' option is not recommended. Without control, variable milfoil will eventually take over all available habitat in the littoral zone of Namaske Lake. Variable milfoil has been showing exponential growth in Namaske Lake, therefore action to manage the plants in 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 during September 2009. Based on the evaluation, the following control actions are recommended:

Year	Action	Responsible Party	Schedule
2010	2,4-D treatment of variable milfoil in Areas A-F	Aquatic Control Technology, Inc.	May/June
	Installation of fragment barriers at upstream end (if approved)	DES	May/June
	Survey of impoundment and mapping of persistent milfoil growth	DES	August
	Weed Watcher training and implementation of monitoring activities	DES and Namaske Lake Association	June through September
	Diver hand-removal of persistent growth/new growth	DES (if available) and local or contract divers	August/September

Year	Action	Responsible Party	Schedule
	End of season survey and recommendations for 2011	DES	September/October
2011	2,4-D treatment of persistent areas of growth, as needed	Licensed herbicide applicator	May/June
	Installation of fragment barriers at upstream end (if approved)	DES	May/June
	Weed Watching	Namaske Lake Association	June through September
	Diver hand-removal of persistent growth/new growth	DES (if available) and local or contract divers	August/September
2012	Installation of fragment barriers at upstream end (if approved)	DES	May/June
	Weed Watching	Namaske Lake Association	June through September
	Diver hand-removal of persistent growth/new growth	DES (if available) and local or contract divers	August/September
2013	Installation of fragment barriers at upstream end (if approved)	DES	May/June
	Weed Watching	Namaske Lake Association	June through September
	Diver hand-removal of persistent growth/new growth	DES (if available) and local or contract divers	August/September
	Site assessment and remapping of variable milfoil infestation	DES	August/September
2014	Installation of fragment barriers at upstream end (if approved)	DES	May/June
	Weed Watching	Namaske Lake Association	June through September
	Diver hand-removal of persistent growth/new growth	DES (if available) and local or contract divers	August/September
	Site assessment and remapping of variable milfoil infestation	DES	August/September
2015	Update and revise Long-Term Variable Milfoil Control Plan	NH DES, F&G, and interested parties	Winter

- 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 to native plant communities expected as a result of this treatment. It is expected that a well distributed stand of native aquatic plants will remain following herbicide application.

- 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 impacted as a result of an herbicide treatment.*

- 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, etc). 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 outline herein, all 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 Milfoil Infestation

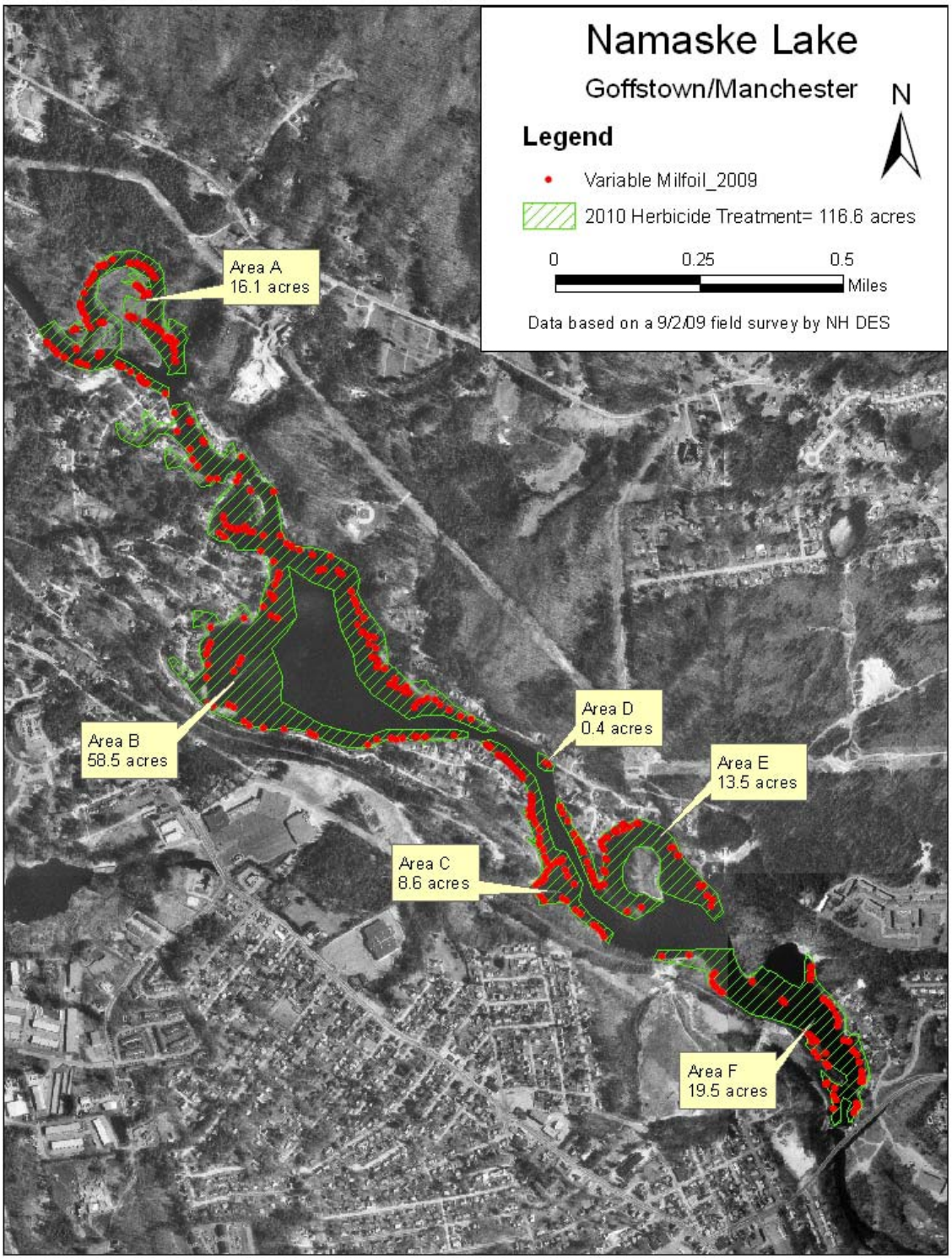
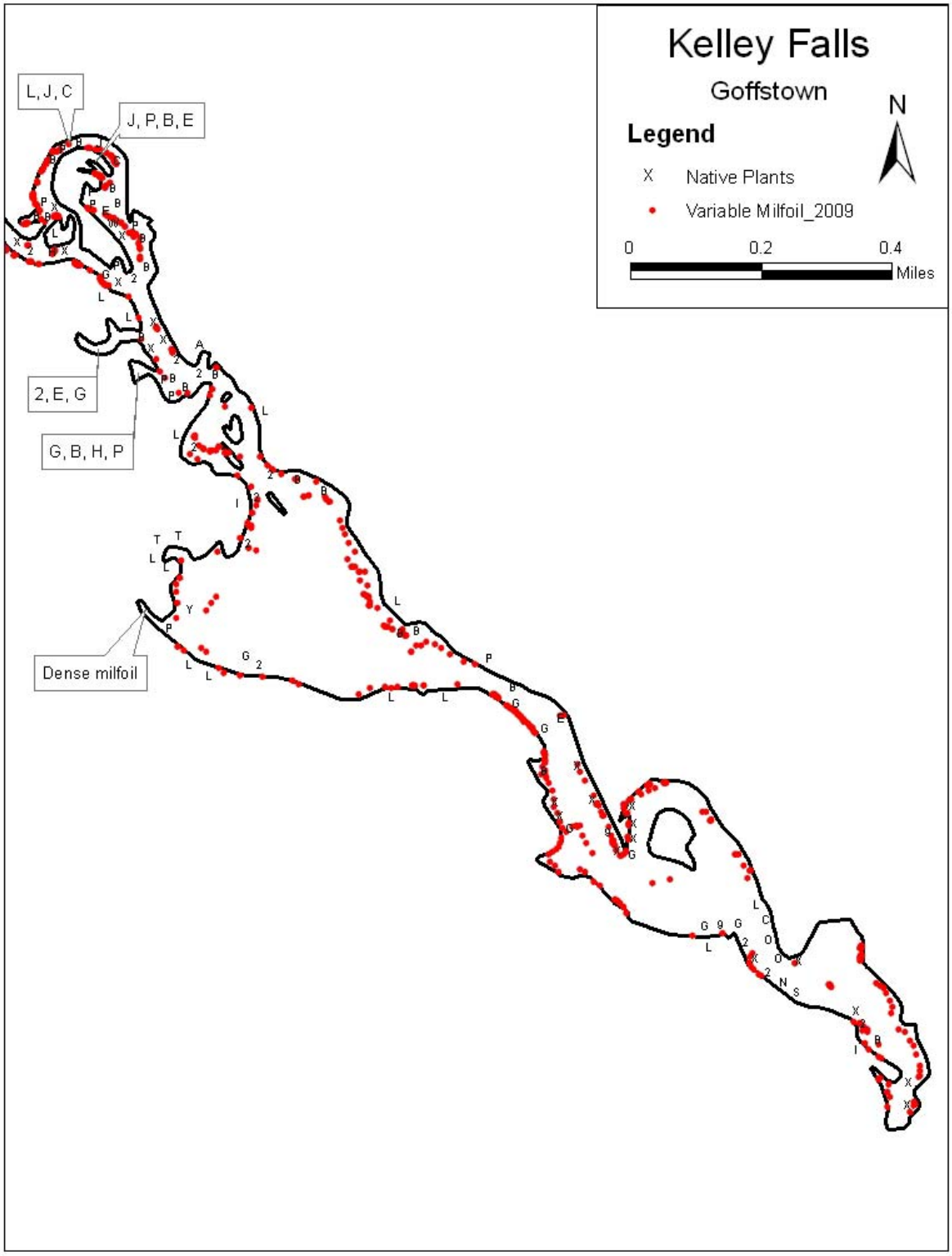


Figure 2- Aquatic Vegetation Map and Key



Symbol	Common Name	Latin Name
H	Floating heart	*Nymphoides cordata*
S	Bur-reed	*Sparganium*
Y	Yellow water-lily	*Nuphar*
A	Arrow arum	*Peltandra virginica*
P	Pickerelweed	*Pontedaria cordata*
E	Waterweed	*Elodea*
I	Iris	*Iris*
9	Grassy spike rush (submersed)	*Eleocharis*
B	Watershield	*Brasenia schreberi*
X	Pondweed	*Potamogeton sp.*
2	Grassy bur-reed	*Sparganium*
O	Water purslane/false loosestrife	*Ludwigia*
C	Water starwort	*Callitriche*
L	Purple loosestrife	*Lythrum salicaria*
G	Grassy arrowhead	*Sagittaria*
N	Water naiad	*Najas sp.*

Figure 3- Bathymetric Map of Namaske Lake, Manchester/Goffstown

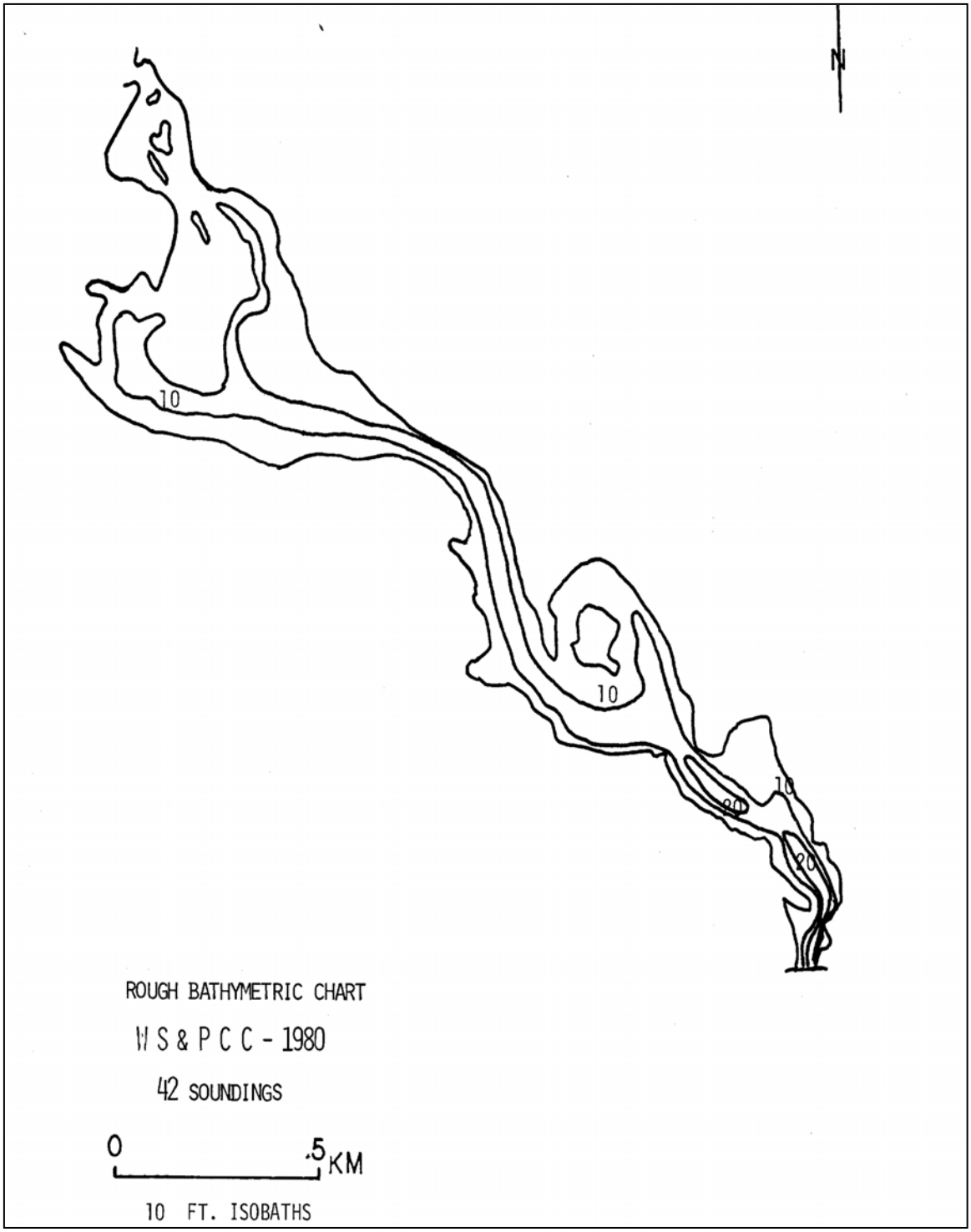
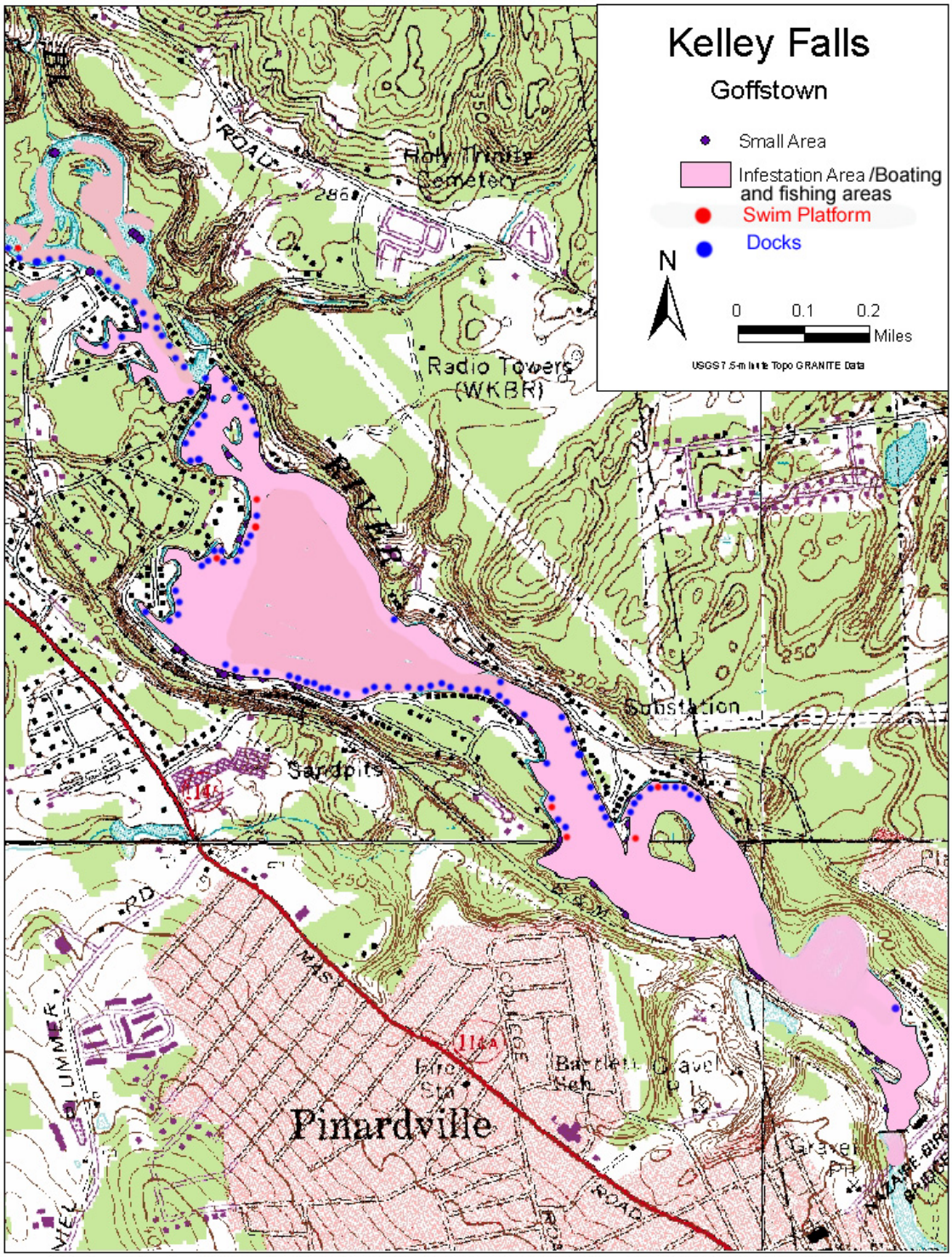


Figure 4- Swim Areas, Docks, and Swim Rafts



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.

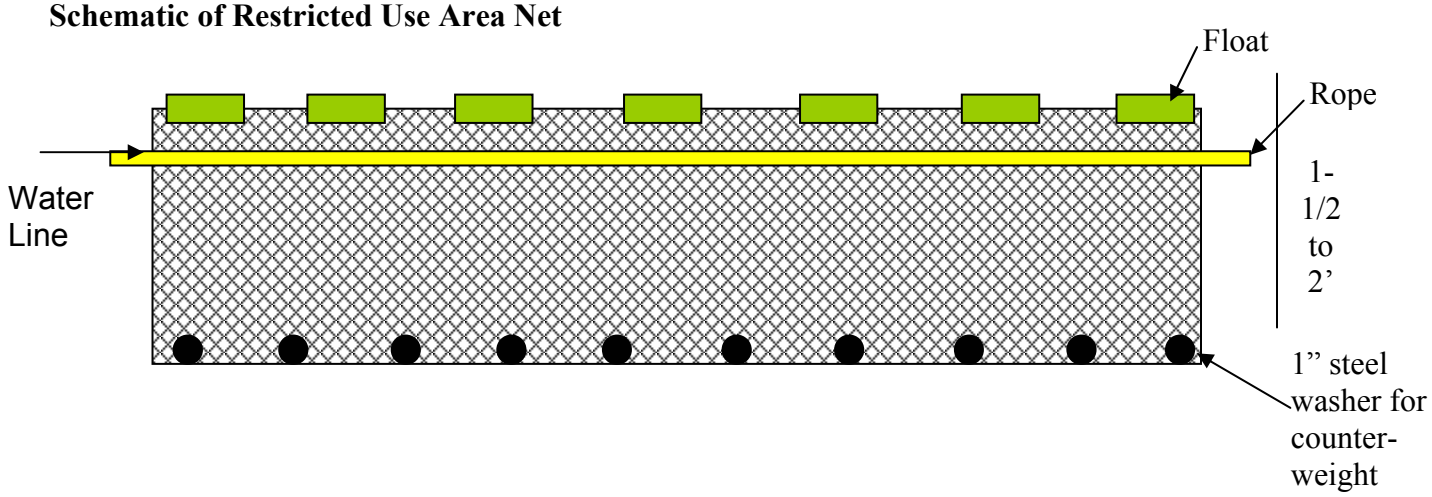
APPENDIX B

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.

Diver Assisted Suction Harvesting

Diver Assisted Suction Harvesting (DASH) is a method whereby a diver works to hand remove exotic plants from the bottom sediments, and rather than depositing them into a dive bag for containment, they are fed into a suction tube that brings the materials topside for containment, de-watering, and disposal. This method can allow for larger-scale removal projects and potentially lower turbidity than simple diving and hand-removal with a dive bag.

Generally, the DASH unit is comprised of a floating platform that is set up with a suction pump and associated hoses, and some type of catchment basin that is lined with fine mesh net to entrain the plants and to filter the water through and back into the lake.

A team comprised of one or two divers and one or two topside tenders are needed to operate the DASH unit.

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 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

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