Long-Term Variable Milfoil Management and Control Plan for BACK BAY Wolfeboro, New Hampshire Carroll County

Prepared by: New Hampshire Department of Environmental Services (DES),
in consultation with the
New Hampshire Fish and Game Department (F&G)
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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. 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 Back Bay in Wolfeboro, New Hampshire in the late 1960s. The plant quickly colonized the whole of Back Bay in just a few short years. Figure 1 illustrates the distribution of variable milfoil infestations in this waterbody, essentially showing that the whole bay is infested (35.03 acres).

As show in Figure 1, the entire bay (35.03 acres) has been targeted for treatment. Most of the bay has a variable milfoil percent cover ranging from 65-75+%, with some smaller isolated areas with growths that are less than 50%.

In terms of the impacts of the variable milfoil in the system, there are many (20) houses and condominiums around the shoreline of Back Bay. In addition, the public town docks, town owned property, the marketplace, marinas, and condominium and rental docks each abut portions of the bay.

Lake residents have indicated that recreational uses of the bay are impaired as a result of the variable milfoil growth, and that navigation is also impaired due to the clogging and fouling of marine engines.

In August of 2006, the Town of Wolfeboro's Milfoil Control Committee requested matching funds from the Department of Environmental Services to conduct an aquatic plant control project

during the spring of 2007 to control areas infested with variable milfoil. At that time, it was determined that variable milfoil infestations in upstream waterbodies (Lake Wentworth and Crescent Lake) be addressed prior to moving on to controlling the variable milfoil in Back Bay. Herbicide treatments and hand-pulling activities in both Lake Wentworth and in Crescent Lake in 2007 have greatly reduced milfoil populations in those waterbodies, making it more realistic to move on to managing milfoil growths in Back Bay in 2008 and beyond.

Back Bay is shallow, with organic substrates, essentially creating prime variable milfoil habitat across nearly the whole basin. The sediment is also mixed with historical contributions of sawdust from shoreline sawmills, further adding to the organic nature and nutrient richness of the sediments.

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. No biological integrity surveys have been conducted, however, as part of this plan preparation.

PURPOSE

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 bay'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 Back Bay and the social and ecological impacts of the milfoil infestation.

The intent of this strategic plan is to outline the management of milfoil in Back Bay 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 Back Bay outlines actions to manage variable milfoil while maintaining native plant communities whenever variable milfoil control actions are being implemented. The goal for Back Bay is the long-term management of variable milfoil within this basin using an Integrated Pest Management Approach. Due to the direct connection with Wolfeboro Bay, and the variable milfoil infestation in there and in Lake Winnipesaukee as a whole, eradication of milfoil from Back Bay is not likely: even if it is eradicated in the short term, there will be a continuous source of fragments entering the bay, and constant monitoring

and hand-removal will be needed to prevent reinfestation. The management of milfoil in Back Bay will be a long-term project that will require a multitude of strategies and occasional herbicide applications to keep the plant in check.

To achieve this management goal, we recommend the following:

1) To reduce the overall acreage and percent cover of variable milfoil bottom growth in Back Bay from 35.03 acres and 65-75% cover in 2008 with the use of 2,4-D, to less than 10 acres and 20% cover. In 2009, conduct another herbicide application, if needed, to further reduce the variable milfoil growth to less than 1 acre and 5% cover, to allow for the integration of non-herbicide approaches to control variable milfoil.

2) In 2008 and beyond, use diver-assisted suction harvesting, hand removal, and benthic barriers to strategically control areas of regrowth or areas not fully controlled by the herbicide.

3) To maintain a Weed Watcher program and Lake Host Program for the bay.

Town Support

The Town of Wolfeboro has been very supportive of variable milfoil control efforts in Back Bay.

The town has been supportive financially by offering matching funds for herbicide applications. There is money appropriated in the town budget, a Wolfeboro milfoil trust fund and private donations which have been used for two years (2005 and 2007) to control milfoil. Funding is again earmarked for matching funds in 2008 and anticipated for future years to complete the long range management plan.

Back Bay Association Support

Back Bay now has an active Back Bay Association, including partners from the various groups and entities surrounding the bay. There are also divers that live in the area that have been mapping and tracking the extent of the variable milfoil infestation over time. In 2007, local divers hand-picked variable milfoil at pilot monitoring sites within the bay, to experiment with the success of using divers to control the plant in small plots. Estimates of time/unit area to pick were estimated, and re-growth was monitored. They plan to continue these efforts as part of this management initiative using contract divers.

The Wolfeboro Milfoil Control Committee is also 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 Back Bay.

General Lake Information	
Area of Back Bay (acres)	35.03

Shoreline Uses (residential, forested, agriculture)	Residential, commercial
Max Depth (ft)	12
Mean Depth (ft)	5.5
Trophic Status	Oligotrophic
Clarity (ft)	Secchi disk visible on bottom at deep spot of bay
Plant Community Information Relative to Management	
Invasive Plant(s) (Latin name)	*Myriophyllum heterophyllum*
Infested Area (acres)	Approximately 35 acres
Distribution (ringing lake, patchy growth, etc)	Dense infestation throughout entire bay. Figure 1.
Sediment type in infested area (sand/silt/organic/rock)	Silty/organic/sawdust
Rare, Threatened, or Endangered Species in Waterbody (according to NH Natural Heritage Inventory)	None on record
Area of Littoral Zone (acres)	35.03
Area of Profundal Zone (acres)	0
Area of Macrophyte Coverage (native or otherwise) of Plants in Littoral Zone	32
% of Littoral Zone with Macrophyte Cover	91%
% of Macrophyte cover comprised of invasives	98%
% of Littoral Zone with Variable Milfoil Cover	89%

An aquatic vegetation map and key from a September 13, 2007 survey by DES biologists is shown in Figure 2. No bathymetric map is available at this time.

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

The principal fisheries of Lake Winnipesaukee, and likely the associated bays such as Back Bay, include both warm and coldwater species. Coldwater species of primary interest are; landlocked Atlantic salmon, lake trout, and rainbow trout; coldwater species of less interest are lake whitefish, round whitefish (species of concern in Wildlife Action Plan), burbot, brook trout, and rainbow smelt, and cusk.

Warmwater species of primary interest are; largemouth bass, smallmouth bass, white perch, yellow perch, chain pickerel, black crappie, brown bullhead, and bluegill. The bass fishery is extremely popular with anglers as numerous fishing tournaments are held on the lake each year.

Numerous warmwater species are present in littoral areas of the lake and constitute the prey fish sought by larger gamefish (warmwater). These species include; banded killifish, common shiner, common white sucker, creek chubsucker, bridle shiner (species of concern in Wildlife Action Plan), fallfish, golden shiner, pumpkinseed, redbreast sunfish, rock bass, slimy sculpin, and yellow bullhead.

The American eel, a catadromous species, resides up to 4-9 years in our inland lakes, such as Lake Winnipesaukee, where they reach sexual maturity and migrate down the rivers and outlets of our large lakes to the Atlantic Ocean.

Figure 3 illustrates the common fishing areas on Back Bay, as presented by members of the local lake association that track activity on the pond. All of the areas indicated as prime fishing habitat by local fishing enthusiasts do fall within zones that are heavily impacted by variable milfoil growth.

The New Hampshire Natural Heritage Program has no listings or records of rare, threatened, or endangered fish or wildlife species within Back Bay.

RECREATION USES AND ACCESS POINTS

Back Bay is used for numerous recreational activities, including recreational boating, fishing, and water skiing (there is an established course with a jump in the bay), and for parking and access at private and public docks for visitors to Wolfeboro. Figure 4 illustrates the locations of the public access sites and the locations of the larger private and community docking structures. There is one designated public access, owned by the Town of Wolfeboro, for boats on the southeastern shoreline of the bay. Small/medium motor boats, as well as kayaks and canoes can use this facility.

There are no public beaches on the shores of Back Bay.

There are a number of dock systems, including both privately owned docks at marinas or condominiums, or public docks owned by the Town of Wolfeboro. Figure 5 shows the locations of smaller docking systems on the bay: larger docks on Back Bay are shown in Figure 4.

There are generally 60-80 vessels that use the bay on a daily basis. There are a few canoes, kayaks, and row boats that also use the bay. Figure 6 illustrates the typical boat paths for the 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.

All of Back Bay can be considered littoral zone, as it is shallow (12 feet deep or less) and sunlight penetrates to the bottom sediments throughout the bay. The aquatic vegetation in the bay 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, watershield), emergent plants (grassy arrowhead, pickerelweed, cattail), and submergent plants (waterweed, Robbins pondweed, tape-like bur-reed, bladderwort, bassweed, and other pondweed species). Native plant communities are mixed around the entire lake, and are characterized as 'scattered/common' by the DES.

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

HISTORICAL CONTROL ACTIVITIES ON THIS WATERBODY:

Contractor	Management Type:	Treatment Date	Treatment Area (acres)	Effectiveness of treatment (if data are available in folder, summarize)
Aquatic Control Technology, Inc.	Herbicide: 2,4-D	June 8, 2005	32 acres	High rate of re-growth due to maturity of plant and thick silt layer on bottom.
Local Divers	Hand-pulling	July/August 2007	<1 acres of pilot plots	Good/moderate control in test patches

MILFOIL MANAGEMENT OPTIONS

The control practices used should be as specific to 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 Back Bay. The following table summarizes DES' control strategy recommendations for Back Bay.

FEASIBILITY EVALUATION FOR CONTROL ALTERNATIVES

Control Method	**Use on Back Bay**
Restricted Use Areas	The variable milfoil is too widespread at this point in time to reasonably/feasibly use a Restricted Use Area.
Hand-pulling	DES recommends that local divers perform routine diving and hand-pulling following the herbicide treatment to prevent rapid reinfestation and to remove any milfoil that may have not been removed as a result of the herbicide treatment.
Mechanical Harvesting/Removal	For Back Bay, mechanical harvesting is not recommended due to the threat of spreading more variable milfoil downstream into Wolfeboro Bay.
Benthic Barriers	For Back Bay, 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. We do not recommend installing benthic barriers throughout the bay, however.
Herbicides	For Back Bay, herbicide use is recommended as primary treatment due to the extent of infestation. The aquatic herbicide, 2,4-D, is recommended in 2008 and in 2009 due to the well-established nature of the variable milfoil. The 2,4-D is a systemic herbicide and will translocate to the roots and target those, as well as above-sediment biomass of the plants. Additionally, DES recommends that the bay be monitored annually by local residents, and if the infestation re-grows to a benchmark level (i.e., greater than 25% cover in the bay) that an herbicide treatment be conducted.
Extended Drawdown	Drawdown is not an effective control method for variable milfoil, and would be infeasible in this bay.
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 bare substrate in the shallows, a 'No Control' option is not recommended. Variable milfoil has taken over Back Bay, and recreation and navigation in the cove

Control Method	Use on Back Bay
	are already impaired.

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 biologists on September 13, 2007. Based on the evaluation, the following control actions are recommended:

Year	Treatment Type	Responsible Party	Schedule
2008	2,4-D treatment of 35.03 acres of variable milfoil in Back Bay (Figure 1)	Aquatic Control Technology, Inc.	May/June
	Weed Watcher monitoring and mapping of re-growth	Local lake residents	June through September
	Diver removal of variable milfoil re-growth	Local divers/contract divers	June through September
	Re-mapping site assessment of Back Bay/determination of treatment in 2009	DES	August/September
	Prevention activities including Lake Host activities and/or installation of fragment barriers	Local lake residents	June through September
2009	2,4-D treatment of variable milfoil in Back Bay, if needed (footprint to be determined in fall 2008)	TBD	May/June
	Weed Watcher monitoring and mapping of re-growth	Local lake residents	June through September
	Diver removal of variable milfoil re-growth	Local divers/contract divers	June through September
	Re-mapping site assessment of Back Bay/determination of treatment in 2009	DES	August/September
	Prevention activities including Lake Host activities and/or installation of fragment barriers	Local lake residents	June through September
2010	Weed Watcher monitoring and mapping of re-growth	Local lake residents	June through September
	Diver removal of variable milfoil re-growth	Local divers/contract divers	June through September
	Re-mapping site assessment of Back Bay	DES	August/September

Year	Treatment Type	Responsible Party	Schedule
	Prevention activities including Lake Host activities and/or installation of fragment barriers	Local lake residents	June through September
2011	Weed Watcher monitoring and mapping of re-growth	Local lake residents	June through September
	Diver removal of variable milfoil re-growth	Local divers/contract divers	June through September
	Prevention activities including Lake Host activities and/or installation of fragment barriers	Local lake residents	June through September
2012	Weed Watcher monitoring and mapping of re-growth	Local lake residents	June through September
	Diver removal of variable milfoil re-growth	Local divers/contract divers	June through September
	Re-mapping site assessment of Back Bay	DES	August/September
	Prevention activities including Lake Host activities and/or installation of fragment barriers	Local lake residents	June through September
2013	Review and updating of Management Plan, and possible herbicide application, if needed.	DES and interested parties	Spring/Summer

- Approximately 35 acres of the waterbody will be impacted by the herbicide treatment (approximately 100% 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. The Town of Wolfeboro, and private donations have committed funds and diver assistance towards this project.

- 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. It is expected that a well distributed stand of native aquatic plants will remain following herbicide application. It is important to note that the herbicide will not affect all of the plants in the bay, and that many of the native plants will continue to grow throughout and after the herbicide application.

- 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 here, 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

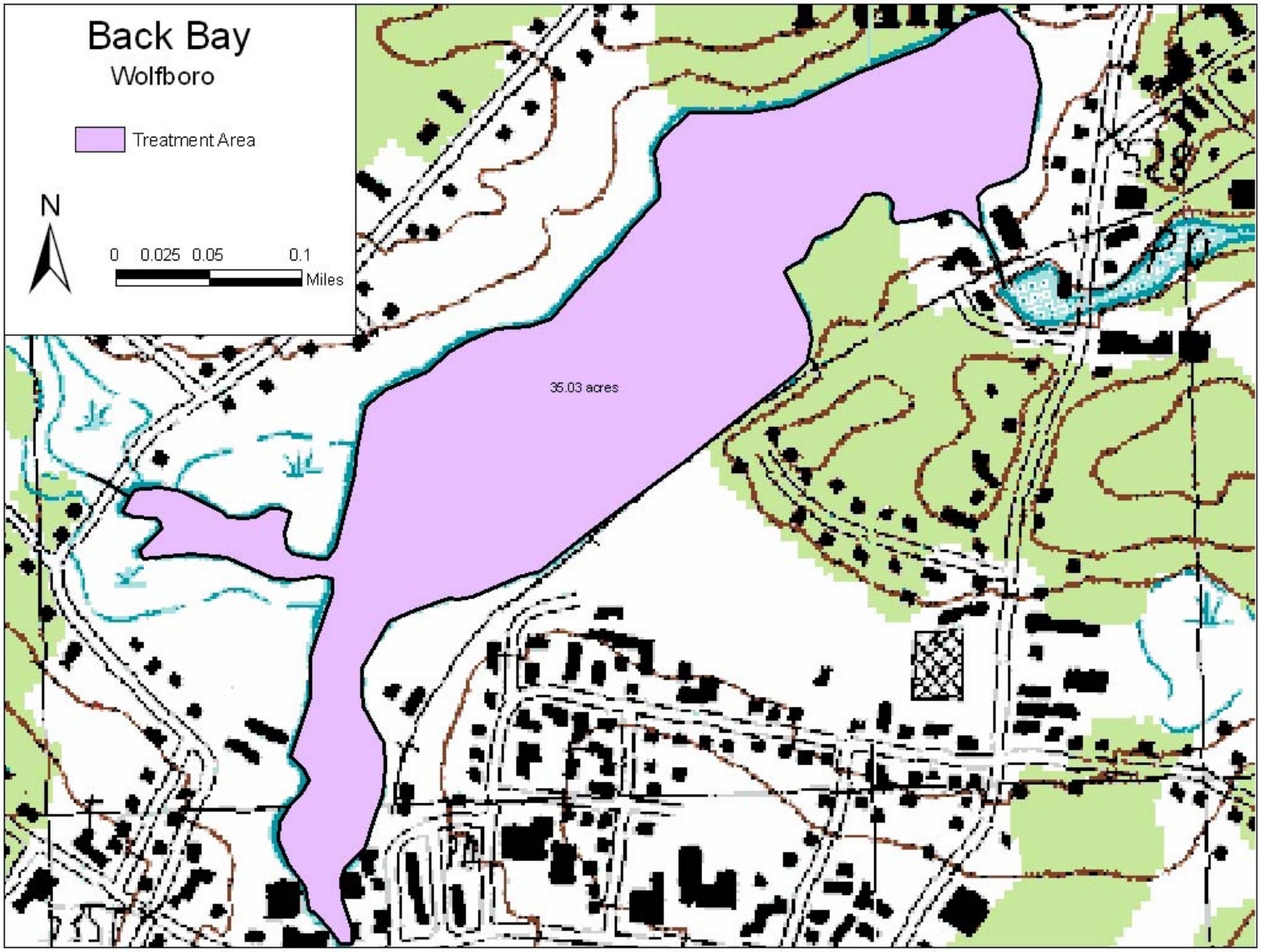
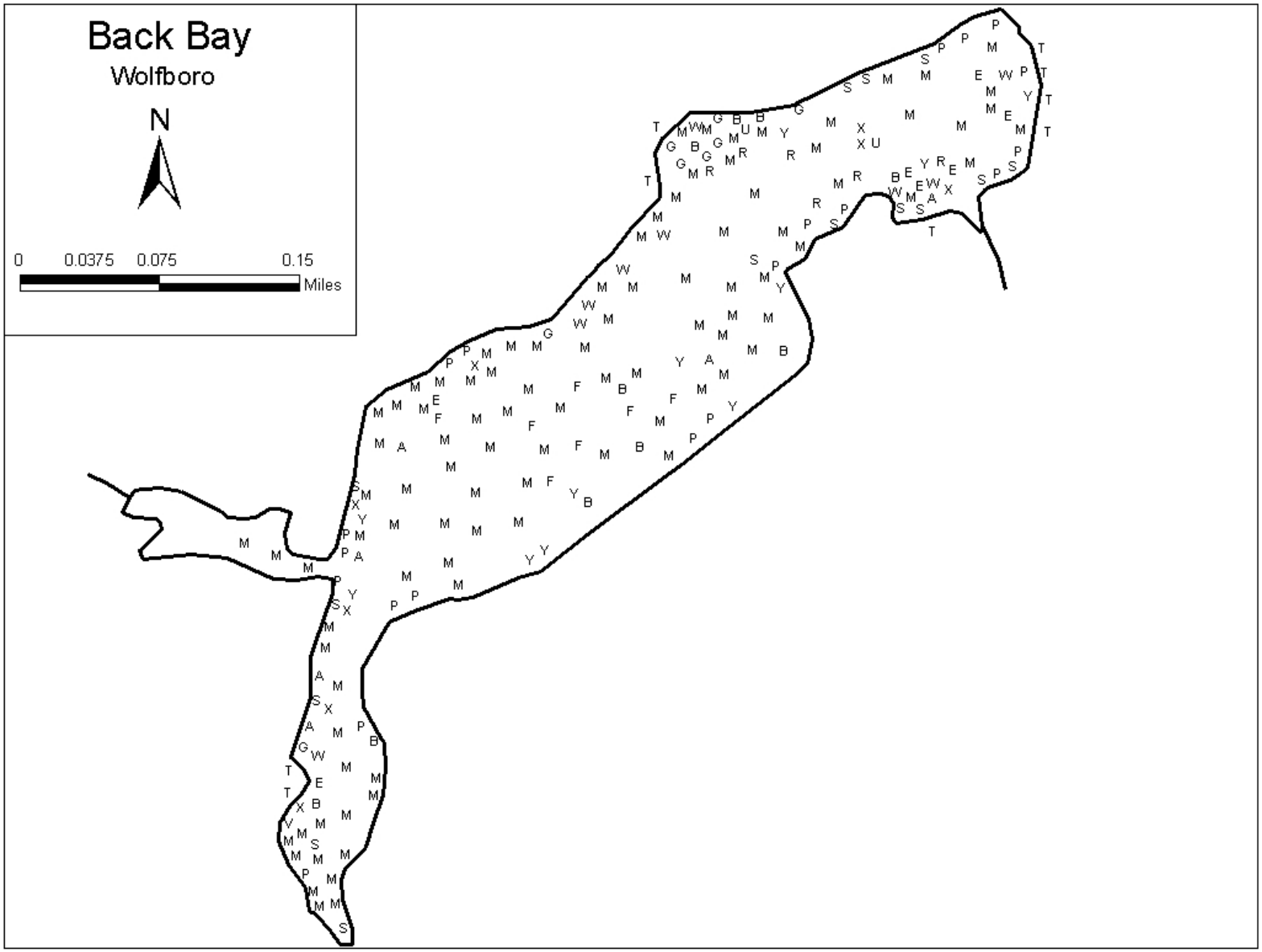


Figure 2- Aquatic Vegetation Map and Key



Symbol	Common Name	Latin Name
G	Grassy arrowhead	*Sagittaria graminea*
W	White water-lily	*Nymphea*
E	Waterweed	*Elodea sp.*
B	Watershield	*Brasenia schreberi*
M	Variable milfoil	*Myriophyllum heterophyllum*
S	Tape-like bur-reed	*Sagittaria sp.*
P	Pickerelweed	*Pontedaria cordata*
U	Bladderwort	*Utricularia*
T	Cattail	*Typha*
F	Filamentous green algae	*Not identified microscopically but likely Mougeotia, Zygnema, and/or Spirogyra*
A	Bassweed	*Potamogeton amplifolius*
X	Pondweed species	*Potamogeton epihydrous*
R	Robbins pondweed	*Potamogeton robbinssi*

Figure 3- Common Fishing Locations (based on knowledge of lake residents)

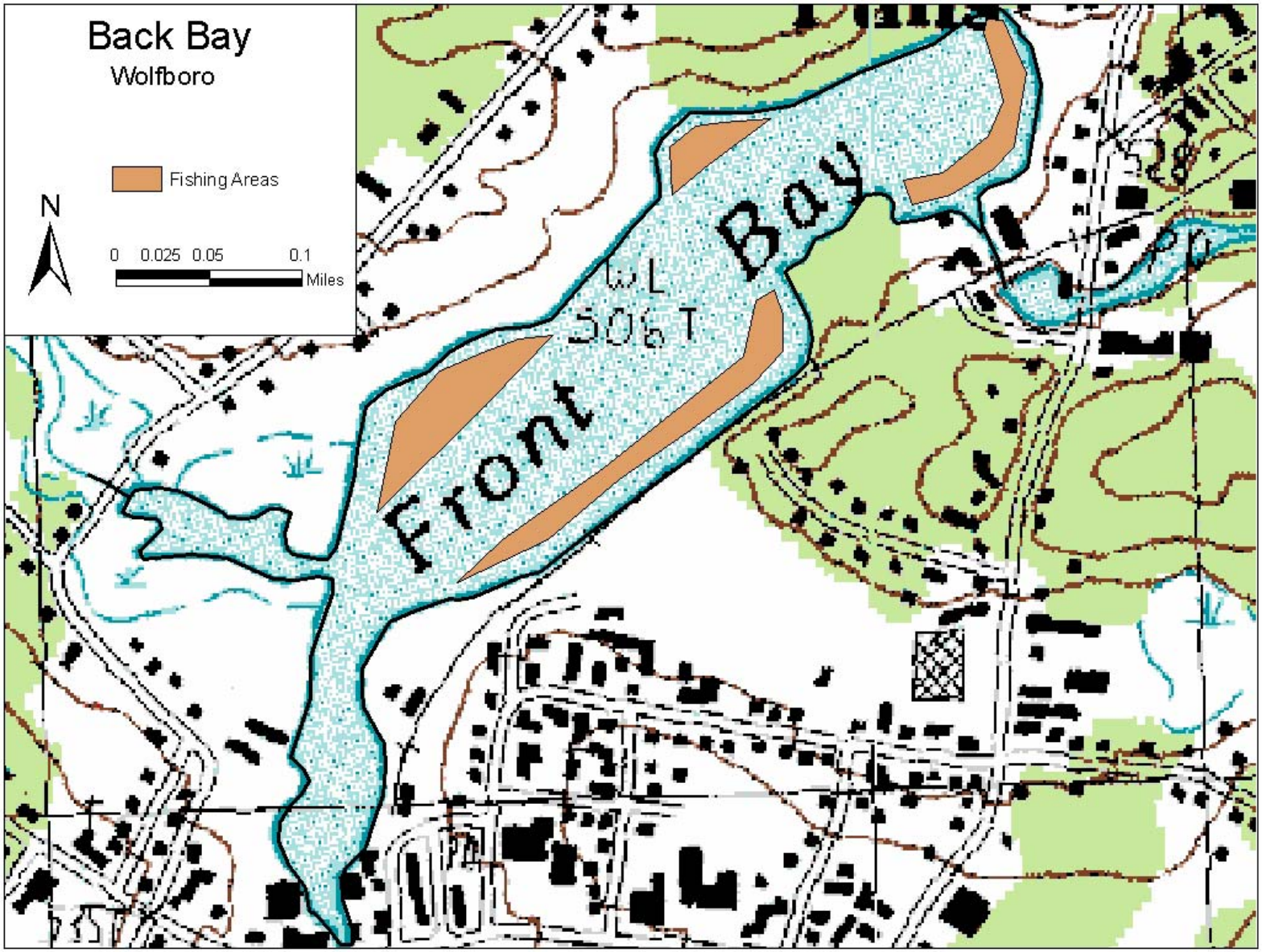


Figure 4- Public Access Points and Larger Docking Systems

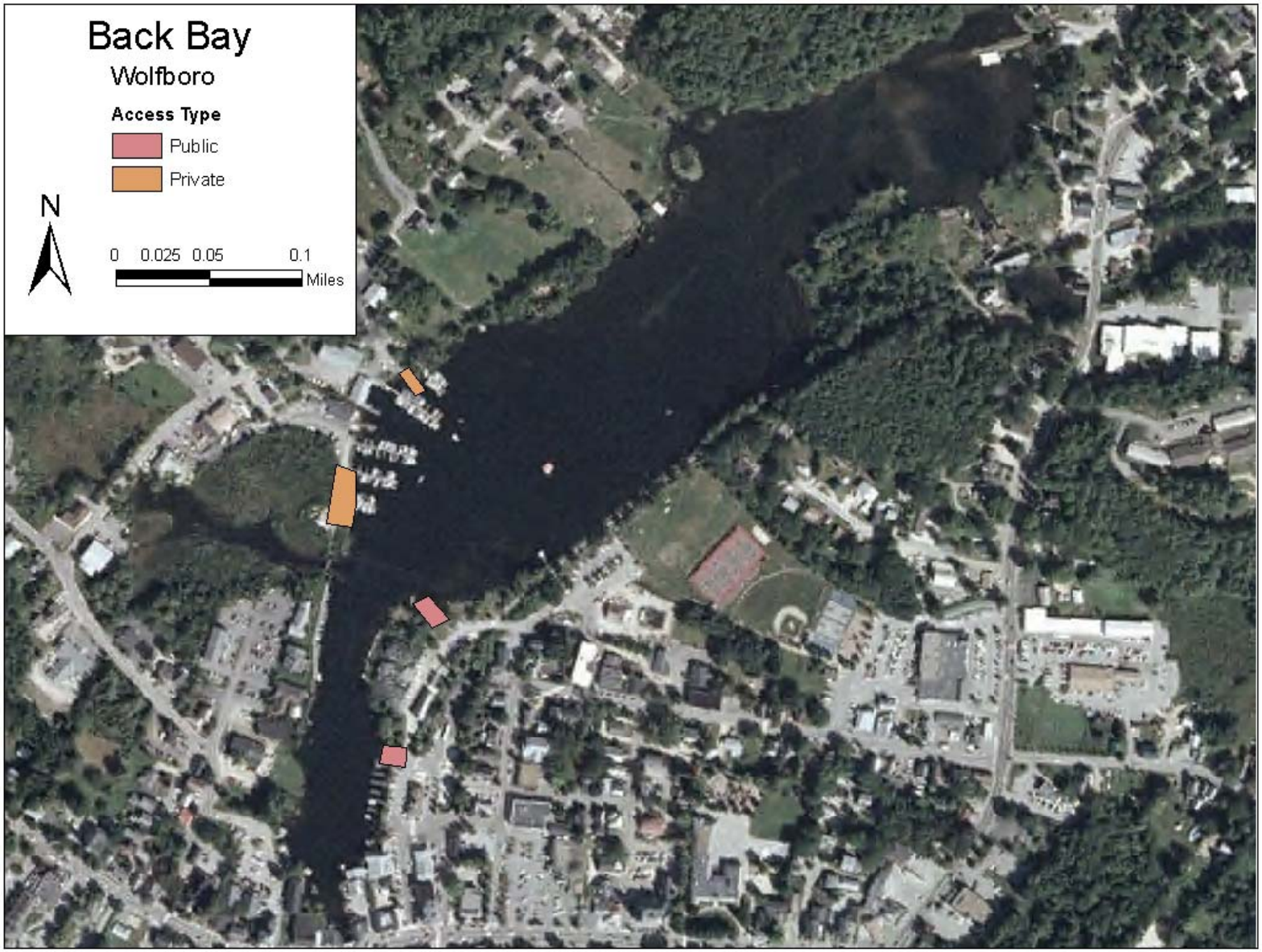


Figure 5- Docks

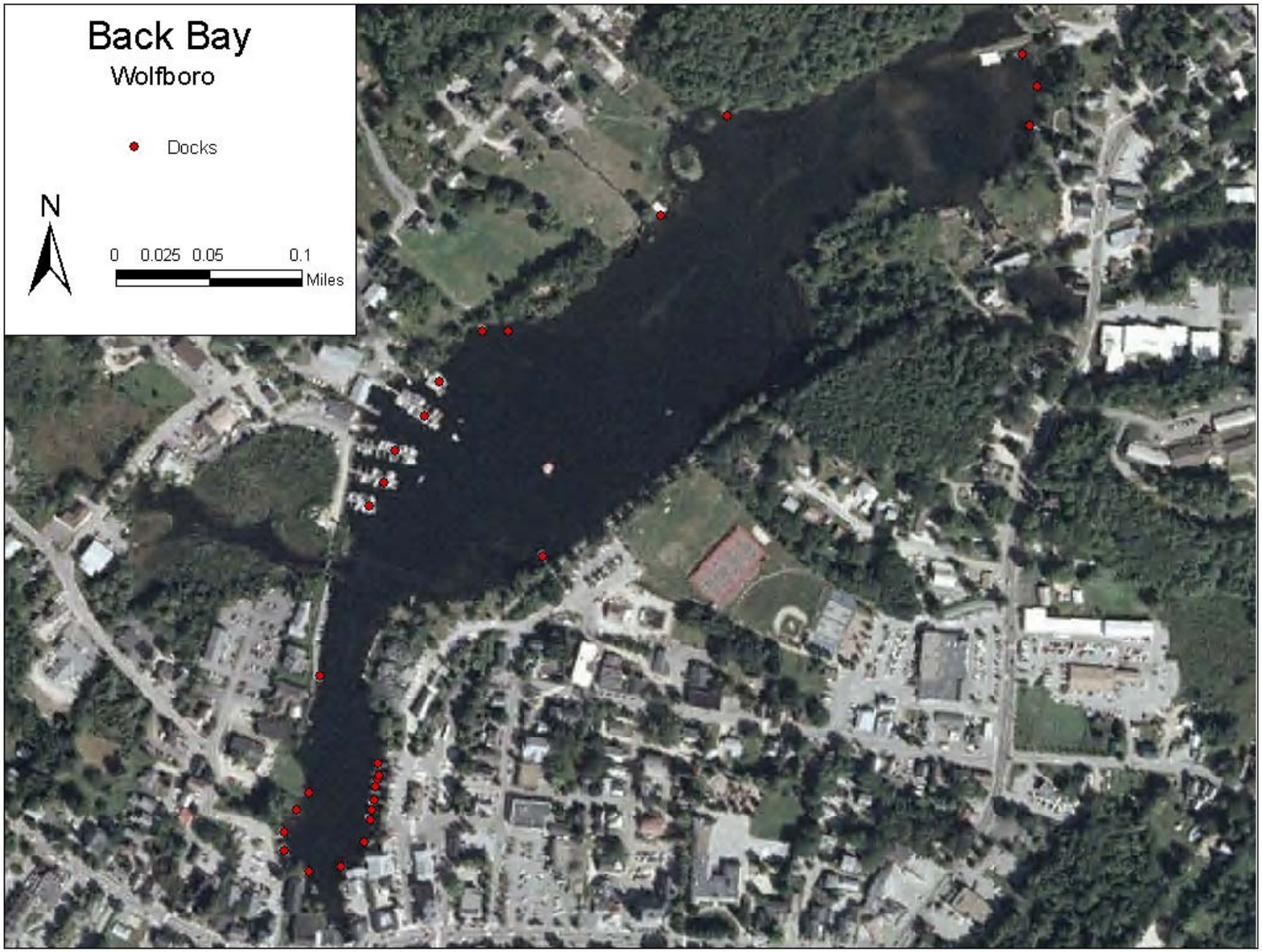
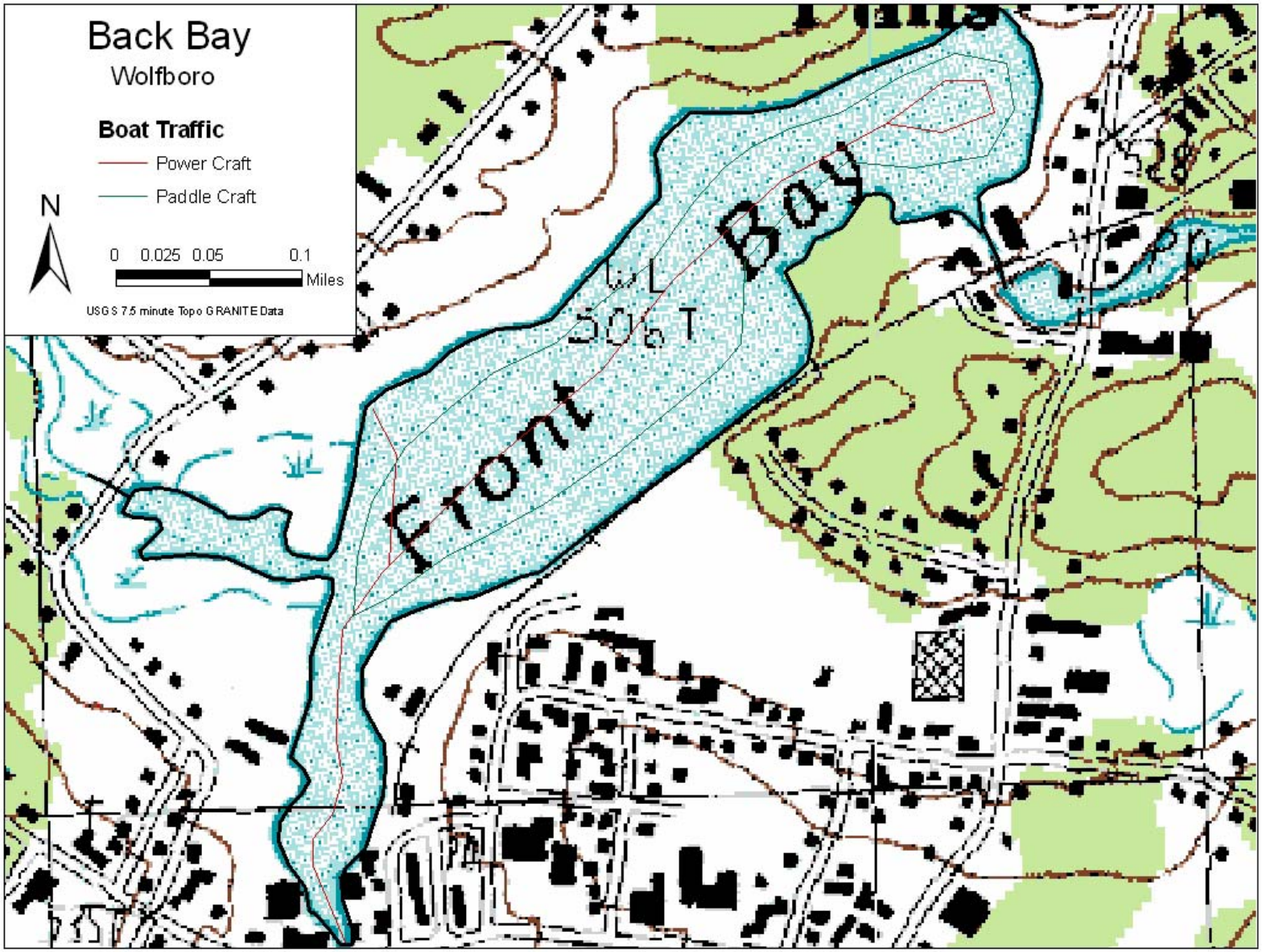


Figure 6- Common Boating Lanes



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.

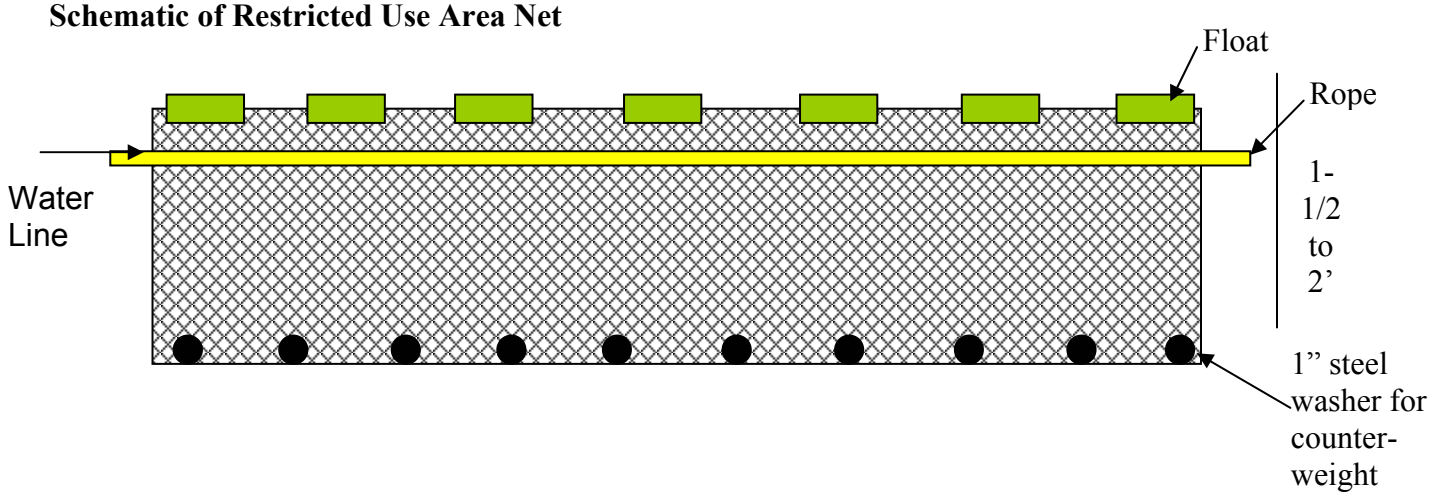
APPENDIX B

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 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.

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