
Long-Term Spiny Naiad Management Plan



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*Country Pond
Kingston/Newton, NH*



Contents

Purpose	4
Invasive Aquatic Plant Overview	4
European/Spiny Naiad Infestation in Country Pond	5
Spiny Naiad Management Goals and Objectives	6
Local Support	6
Country Pond Lake Association.....	6
Waterbody Characteristics	6
Beneficial (Designated) Uses of Waterbody	8
Aquatic Life.....	8
Recreational Uses and Access Points.....	9
Macrophyte Community Evaluation	9
Wells and Water Supplies	10
Historical Control Activities	11
Aquatic Invasive Plant Management Options	11
Feasibility Evaluation of Control Options in this Waterbody	11
Recommended Actions, Timeframes and Responsible Parties	13
Notes	16
Target Specificity.....	16
Adaptive Management	16
Figure 1: Map of Spiny Naiad Infestations Over Time	18
Figure 2: Map of Control Actions Over Time	19
2022 Proposed	19
Figure 3: Map of Native Aquatic Macrophytes	20
Key to Macrophyte Map	21

Figure 4: Bathymetric Map.....22

Figure 5: Critical Habitats or Conservation23

Figure 6: Public Access Sites and Beaches25

Figure 7: Wells and Water Supplies, 1:48,000 scale.....26

Appendix A Selection of Invasive Aquatic Plant Control Techniques27

Appendix B Summary of Control Practices Used in NH.....32

Restricted Use Areas and Fragment Barrier: 32

Hand-pulling: 32

Diver Assisted Suction Harvesting 33

Mechanical Harvesting 33

Benthic Barriers: 34

Targeted Application of Herbicides: 34

Extended Drawdown 35

Dredging..... 36

Biological Control 36

References37

Purpose

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

1. To identify and describe the historic and current exotic aquatic infestation(s) in the waterbody;
2. To identify short-term and long-term exotic aquatic plant control goals;
3. To minimize any adverse effects of exotic aquatic plant management strategies on non-target species;
4. To recommend exotic plant control actions that meet the goals outlined in this plan; and
5. To evaluate control practices used in this waterbody over time to determine if they are meeting the goals outlined in this plan.

This plan also summarizes the current physical, biological, ecological, and chemical components of the subject waterbody as they may relate to both the exotic plant infestation and recommended control actions, and the potential social, recreational and ecological impacts of the exotic plant infestation.

The intent of this plan is to establish an adaptive management strategy for the long-term control of the target species (in this case Spiny naiad) in the subject waterbody, using an integrated plant management approach.

Appendix A and Appendix B detail the general best management practices and strategies available for waterbodies with exotic species, and provide more information on each of the activities that are recommended within this plan.

Invasive Aquatic Plant Overview

Exotic aquatic plants pose a threat to the ecological, aesthetic, recreational, and economic values of lakes and ponds (Luken & Thieret, 1997, Halstead, 2000), primarily by forming dense growths or monocultures in critical areas of waterbodies that are important for aquatic habitat and/or recreational use. Under some circumstances, dense growths and near monotypic stands of invasive aquatic plants can result, having the potential to reduce overall species diversity in both plant and animal species, and can alter water chemistry and aquatic habitat structure that is native to the system.

Since January 1, 1998, the sale, distribution, importation, propagation, transportation, and introduction of key exotic aquatic plants have been prohibited (RSA 487:16-a) in New Hampshire. This law was designed as a tool for lake managers to help prevent the spread of nuisance aquatic plants.

New Hampshire lists 27 exotic aquatic plant species as prohibited in the state (per Env-Wq 1303.02) due to their documented and potential threat to surface waters of the state.

According to the federal Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology (CALM), “exotic macrophytes are non-native, fast growing aquatic plants, which can quickly dominate and choke out native aquatic plant growth in the surface water. Such infestations are in violation of New Hampshire regulation Env-Wq 1703.19, which states that surface waters shall support and maintain a balanced, integrated and adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region” (DES, 2006). In fact, waterbodies that contain even a single exotic aquatic plant do not attain water quality standards and are listed as impaired.

European/Spiny Naiad Infestation in Country Pond

European naiad, also known as spiny naiad or brittle naiad (*Najas minor*) was documented in Country Pond, in Kingston/Newton, New Hampshire by a lake resident in 2021, and confirmed by NHDES. Based on an initial survey of the pond by NHDES in September 2021, spiny naiad is scattered along the nearshore area. The plant is low growing (<12 inches tall).

Figure 1 illustrates the distribution of spiny naiad in Country Pond since it was first documented. The table below outlines the details of the growth each year since it was documented.

Area	Location/Area Description	Year	Description of Spiny Naiad Growth
B1, C1, D1	Northern shoreline	2021	Patchy growth along shore, less in D1
D2, D3	Eastern shoreline	2021	Single scattered plants, very low density
C3, D3	South-central shoreline	2021	Scattered plants, mostly on western side of peninsula

Area	Location/Area Description	Year	Description of Spiny Naiad Growth
B1, B2, B3, B4	Western shoreline	2021	Scattered growth, some patches locally abundant
C2	Island	2021	A few scattered plants, mainly on the western side of the island

Spiny Naiad Management Goals and Objectives

The aquatic plant management plan outlines actions to eradicate the infestation of spiny naiad (*Najas minor*) in Country Pond while maintaining native plant communities whenever spiny naiad control actions are being implemented. The plan also addresses early detection activities and preventing further establishment of spiny naiad in Country Pond.

Local Support

Country Pond Lake Association

The Country Pond Lake Association (CPLA) was formed in 2017 by a group of residents around the pond. They are active in water quality monitoring through the Volunteer Lake Assessment Program (VLAP), and they also coordinate two programs related to the prevention (through the Lake Host Courtesy Boat Inspection Program) and early detection (Weed Watcher Program) of aquatic invasive species. It is through the Weed Watcher Program that the spiny naiad was detected.

Town of Kinston and Town of Newton Support

The Town of Kingston, through the Conservation Commission, supports CPLA's participation in the Volunteer Lake Assessment Program (VLAP). The Town of Newton supports CPLA's participation in the Lake Host Program, through a warrant article.

Waterbody Characteristics

The following table summarizes basic physical and biological characteristics of Country Pond, including the spiny naiad infestation. Note that a current review of the Natural Heritage Bureau (NHB) database was requested and the results from that search are included below, as well as in other relevant sections of this plan.

Parameter/Measure	Value/Description
Lake area (acres)	247.6
Watershed area (acres)	10,427.6
Shoreline Uses (residential, forested, agriculture)	Forested, beaches, residential, marina
Max Depth (ft)	31
Mean Depth (ft)	8.5
Trophic Status	Mesotrophic
Color (CPU) in Epilimnion	60
Clarity (ft)	7.9
Flushing Rate (yr-1)	6.2
Natural waterbody/Raised by Damming/Other	Natural w/dam
Invasive Plants (Latin name)	Spiny naiad (<i>Najas minor</i>)
Infested Area (acres)	See Figures 1 & 2
Distribution (ringing lake, patchy growth, etc)	See Figures 1 & 2
Sediment type in infested area (sand/silt/organic/rock)	Sandy/rocky/silty
Rare, Threatened, or Endangered Species in Waterbody (according to NH Natural Heritage Bureau (NHB) Inventory review)	<p><u>2022 Review:</u></p> <p><u>Invertebrates</u> Coppery Emerald (<i>Somatochlora georgiana</i>) Eastern Pond Mussel (<i>Ligumia nasuta</i>) Hessel's Hairstreak (<i>Callophrys hesseli</i>) Ringed Boghaunter (<i>Williamsonia lintneri</i>)</p> <p><u>Natural Communities</u> Atlantic white cedar -leatherleaf swamp Atlantic white cedar - yellow birch - pepperbush swamp Medium level fen system Poor level fen/bog system</p>

A native aquatic vegetation map and key is shown in Figure 3. A bathymetric map is shown in Figure 4.

Beneficial (Designated) Uses of Waterbody

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

Of these, Aquatic Life, Wildlife and Recreation are the ones most often affected by the presence of invasive plants, though drinking water supplies can also be affected as well.

Following is a general discussion of the most potentially impacted designated uses, including water supplies and near shore wells, as they relate to this system and the actions proposed in this long-term plan.

The goal for aquatic life support is to provide suitable chemical and physical conditions for supporting a balanced, integrated and adaptive community of aquatic organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of the region.

Aquatic Life

Fisheries Information

According to the NH Fish and Game Department, this is a warmwater fishery, with species including smallmouth bass, largemouth bass, Eastern chain pickerel, brown bullhead, black crappie, bluegill, white perch, American eel, yellow perch, and pumpkinseed (formerly known as common sunfish).

Wildlife Information

According to Natural Heritage Bureau (NHB) reviews, there are four invertebrate species of special concern in Country Pond, as follows:

- Coppery Emerald (*Somatochlora georgiana*) – Species of Concern
- Eastern Pond Mussel (*Ligumia nasuta*)- Threatened
- Hessel's Hairstreak (*Callophrys hesseli*)- Threatened
- Ringed Boghaunter (*Williamsonia lintneri*)- Threatened

Figure 5 shows an historic map provided by NHB relative to their review.

Recreational Uses and Access Points

Country Pond is used for numerous recreational activities, including boating (motor boats, sailboats and sunfish, canoes/kayaks), fishing, and swimming by both pond residents and transient boaters.

There is one designated public access site on Country Pond; it is located on the southern shoreline of the western basin. This sand/gravel access site has somewhat limited parking. There is also a marina with a boat launch and boat slips on the lake, located on the northwestern tip of the lake, that is part of the Country Shores Campground, that campground visitors can use to access the lake.

There are two designated beaches on Country Pond, one (eastern shoreline) is owned by the Town of Newton, and the other (western shoreline) is a private beach for the Country Shores Campground. 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 private swim beaches located on private properties around the pond. Figure 6 shows the locations of access sites and beaches on Country Pond.

Macrophyte Community Evaluation

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

The littoral zone of Country Pond is characterized by a mix of native and non-native (spiny naiad) plant growth (Figure 3). Native species include a mix of floating plants (white and yellow water-lilies, watershield and floating heart), emergent plants (bur-reed, pickerelweed, rushes, cattail), and submergent plants (pondweeds, bladderwort). Native plant communities are mixed around the entire lake, and are characterized as 'common/abundant' by the NHDES. The pond has also experienced higher densities of southern naiad (*Najas guadalupensis*) growth in past years. While abundant, this plant is not a state-listed invasive, and the Natural Heritage Bureau classifies it as a naturalized species.

In addition to the species listed above, there are several natural communities documented around the pond (mostly upstream/to the north of the pond), including (see Figure 5 for locations):

- Atlantic white cedar -leatherleaf swamp
- Atlantic white cedar - yellow birch - pepperbush swamp
- Medium level fen system
- Poor level fen/bog system

Wells and Water Supplies

Figure 7 shows the location of wells, water supplies, well-head protection areas, and drinking water protection areas around the subject waterbody, based on information in the DES geographic information system records. Note that it is likely that Figure 7 does not show the location of all private wells.

Note that the map in Figure 7 cannot be provided on a finer scale than 1:48,000. Due to public water system security concerns, a large-scale map may be made available upon agreement with DES' data security policy. Visit NHDES' OneStop Web GIS, <http://www2.des.state.nh.us/gis/onestop/> and register to Access Public Water Supply Data Layers. Registration includes agreement with general security provisions associated with public water supply data. Paper maps that include public water supply data may be provided at a larger-scale by DES' Exotic Species Program after completing the registration process.

In the event that an herbicide treatment is needed for this waterbody, the applicator/contractor will provide more detailed information on the wells and water supplies within proximity to the treatment areas as required in the permit application process with the Division of Pesticide Control at the Department of Agriculture. It is beyond the scope of this plan to maintain

updated well and water supply information other than that provided in Figure 7.

Historical Control Activities

No control actions have taken place as of the writing of this plan (March 2022).

Aquatic Invasive Plant Management Options

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

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

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

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

Feasibility Evaluation of Control Options in this Waterbody

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

Control Method	Use on Country Pond
Restricted Use Areas (RUAs) and/or Fragment Barriers	The purpose of RUAs and fragment barriers is to contain small areas of exotic aquatic plant growth to prevent them from spreading further in a system. If spiny naiad is reduced by other integrated approaches outlined in this plan, then RUAs and

Control Method	Use on Country Pond
	fragment barriers may be a future consideration based on the size, configuration and location of remaining areas of growth. Due to the configuration of Country Pond (basically a circle), there are no deep embayments, so this approach may be a challenge, but will still be considered as appropriate.
Hand-harvesting and/or Diver-Assisted Suction Harvesting (DASH)	Hand harvesting of spiny naiad can be challenging due to the brittle nature of the plant. Plants can fragment easily, and if bearing seed, can drift and spread the infestation. If hand harvesting is used, we recommend it be done early before the plants produce seed.
Mechanical Harvesting/Removal	Not recommended due to the risk of fragmentation and drift, and subsequent further spread of the invasive plant. The spiny naiad is very brittle and fragments easily in this waterbody.
Benthic Barriers	Recommended for small patches that are 20' x 20' in size or less, and where practical. Fragment barriers may be used on a wider scale in some areas of Country Pond, but are not recommended for widespread or common usage.
Herbicides	Herbicide treatment is recommended as a primary means of control only where infestations of the exotic plant are too widespread and/or dense for non-chemical means of control to be effective, or where native plants are too thick to effectively allow divers to hand remove stems of the spiny naiad. This plant is hard to manage even with herbicides, mainly due to timing of treatment and seed production, or incomplete control of fragments of plants that have drifted outside of treatment areas.
Extended Drawdown	Not feasible or practical for this waterbody due to lack of an impoundment structure, and not a reliable control technique for this plant species.
Dredge	Cost prohibitive and not often effective for controlling invasive aquatic plants.
Biological Control	No biological controls are yet approved for use on spiny naiad.
No Control	The spiny naiad infestation has been spreading quickly in this waterbody, and a no-control option

Control Method	Use on Country Pond
	would only lead to widespread growth around the pond, in the entire photic zone of the pond.

Recommended Actions, Timeframes and Responsible Parties

An evaluation of the size, location, and type of infestation, as well as the waterbody uses was conducted at the end of the last growing season (see attached figures for findings). Based on this survey the following recommendations are made for Spiny naiad control in the system:

Year	Action	Responsible Party	Schedule
2022	Train lake residents to properly identify spiny naiad to increase awareness and monitoring efforts	NHDES and local interested residents	Summer
	Weed Watching and marking/reporting of naiad growth	Local Weed Watchers	Once a month from May through Sept
	Survey and planning for control actions	NHDES	June through August
	Diver/DASH work as needed and recommended (areas to be determined based on updated spring survey)	TBD	TBD
	Herbicide treatment (areas to be determined based on updated survey)	SOLitude Lake Management, LLC.	As appropriate based on germination and seed production
	Survey waterbody and planning for next season's control actions	NHDES	September

Year	Action	Responsible Party	Schedule
2023	Weed Watching and marking/reporting of naiad growth	Local Weed Watchers	Once a month from May through Sept
	Survey and planning for control actions	NHDES	June through August
	Diver/DASH work as needed and recommended (areas to be determined based on updated spring survey)	TBD	TBD
	Herbicide treatment (areas to be determined based on updated survey)	SOLitude Lake Management, LLC.	As appropriate based on germination and seed production
	Survey waterbody and planning for next season's control actions	NHDES	September
2024	Weed Watching and marking/reporting of naiad growth	Local Weed Watchers	Once a month from May through Sept
	Survey and planning for control actions	NHDES	June through August
	Diver/DASH work as needed and recommended (areas to be determined based on updated spring survey)	TBD	TBD
	Herbicide treatment (areas to be determined based on updated survey)	SOLitude Lake Management, LLC.	As appropriate based on germination and seed production

Year	Action	Responsible Party	Schedule
	Survey waterbody and planning for next season's control actions	NHDES	September
2025	Weed Watching and marking/reporting of naiad growth	Local Weed Watchers	Once a month from May through Sept
	Survey and planning for control actions	NHDES	June through August
	Diver/DASH work as needed and recommended (areas to be determined based on updated spring survey)	TBD	TBD
	Herbicide treatment (areas to be determined based on updated survey)	SOLitude Lake Management, LLC.	As appropriate based on germination and seed production
	Survey waterbody and planning for next season's control actions	NHDES	September
2026	Weed Watching and marking/reporting of naiad growth	Local Weed Watchers	Once a month from May through Sept
	Survey and planning for control actions	NHDES	June through August
	Diver/DASH work as needed and recommended (areas to be determined based on updated spring survey)	TBD	TBD

Year	Action	Responsible Party	Schedule
	Herbicide treatment (areas to be determined based on updated survey)	SOLitude Lake Management, LLC.	As appropriate based on germination and seed production
	Survey waterbody and planning for next season's control actions	NHDES	September
2027	Update and revise Long-Term Spiny Naiad Control Plan	NHDES and Interested Parties	Fall/ Winter

Notes

Target Specificity

Aquatic herbicide applications are conducted in a specific and scientific manner. To the extent feasible, the permitting authority favors the use of selective herbicides that, where used appropriately, will control the target plant with little or no impact to non-target species, such that the ecological functions of native plants for habitat, lake ecology, and chemistry/biology will be maintained. *Not all aquatic plants will be impacted as a result of an herbicide treatment.*

Adaptive Management

Because this is a natural system that is being evaluated for management, it is impossible to accurately predict a management course over five years that could be heavily dependent on uncontrolled natural circumstances (weather patterns, temperature, adaptability of invasive species, etc).

This long-term plan is therefore based on the concept of adaptive management, where current field data (from field survey work using DES established field survey standard operating procedures) drive decision making, which may result in modifications to the recommended control actions and timeframes for control. As such, this management plan should be considered a dynamic document that is geared to the actual field conditions that present themselves in this waterbody.

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



Figure 1: Map of Spiny Naiad Infestations Over Time

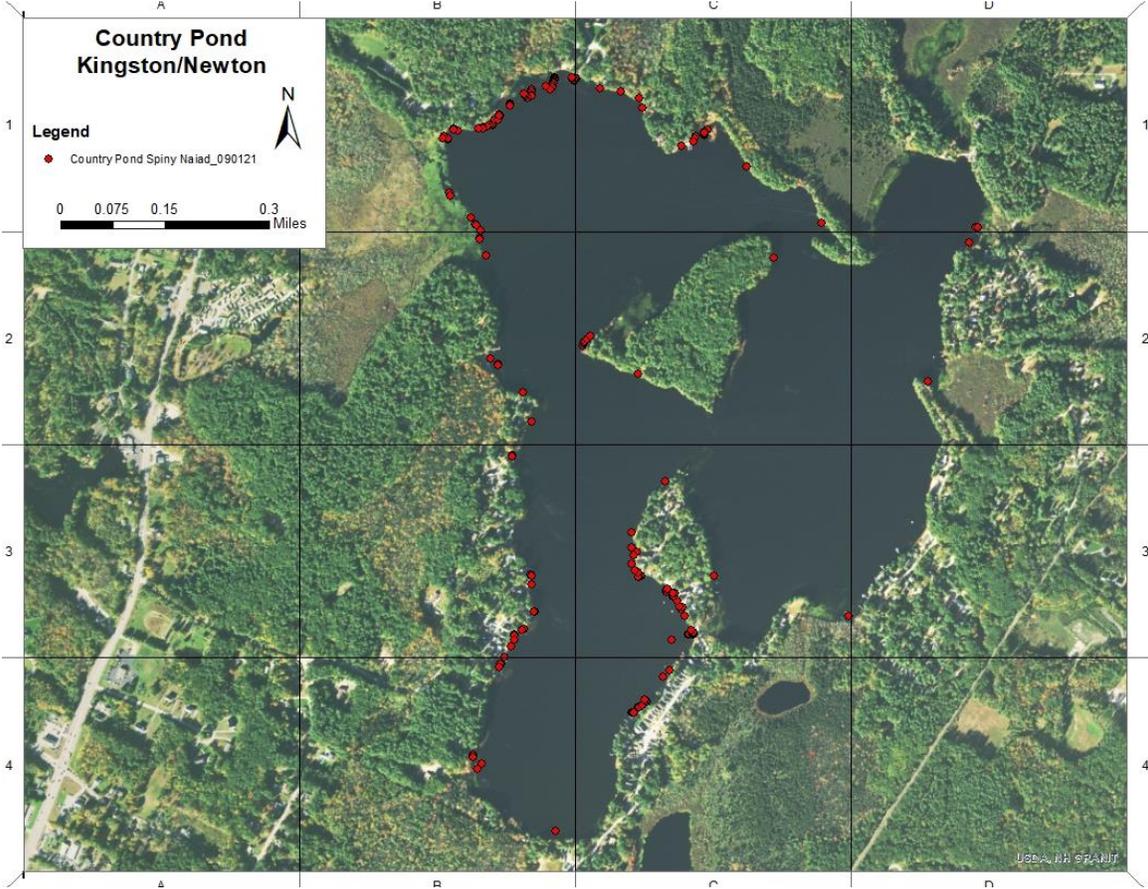


Figure 2: Map of Control Actions Over Time

2022 Proposed

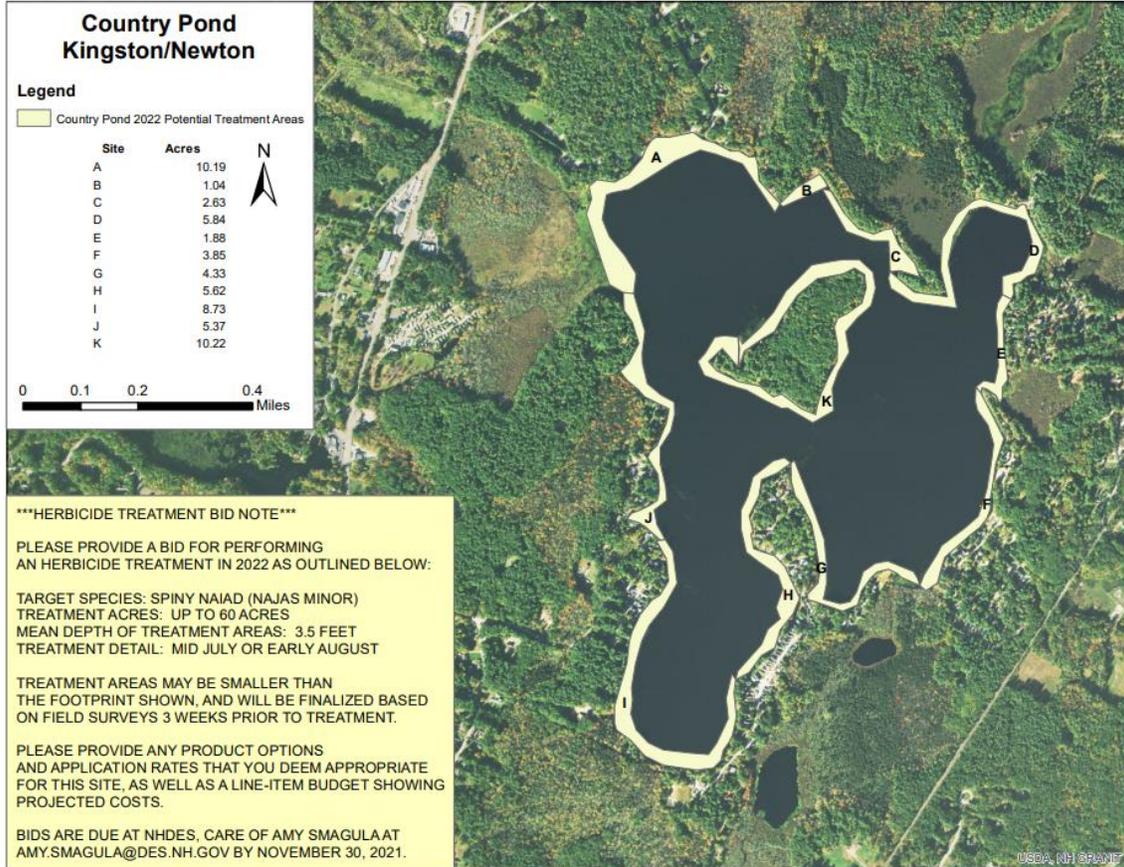


Figure 3: Map of Native Aquatic Macrophytes

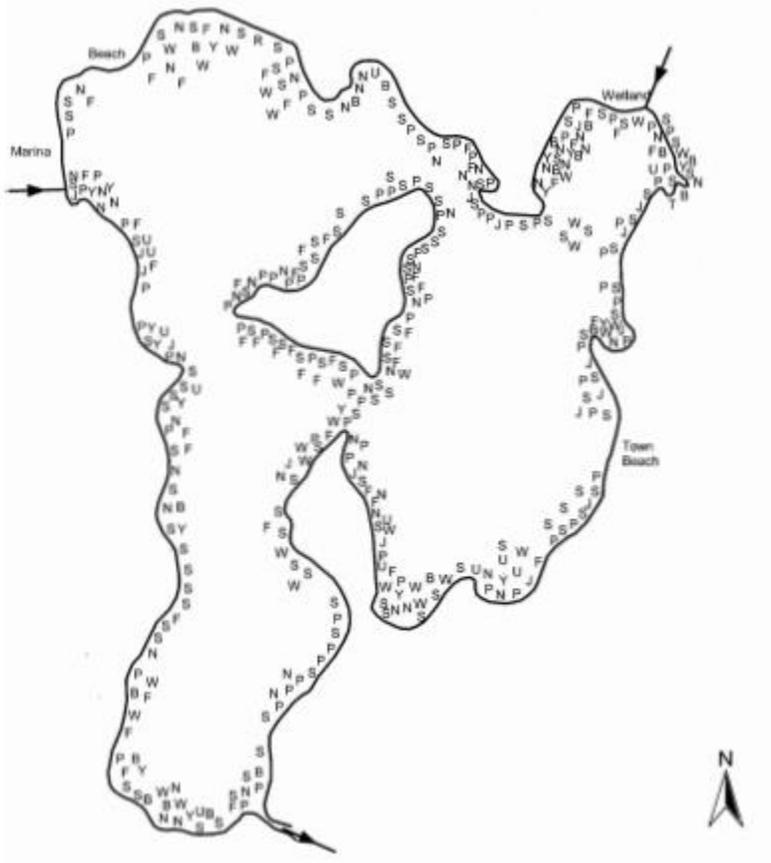


Figure 4: Bathymetric Map

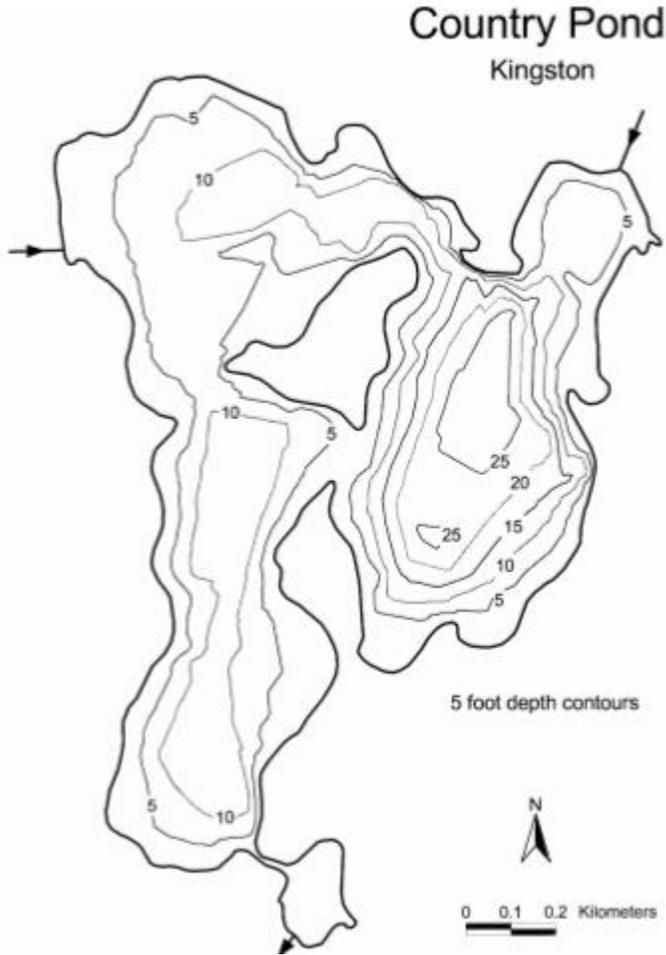
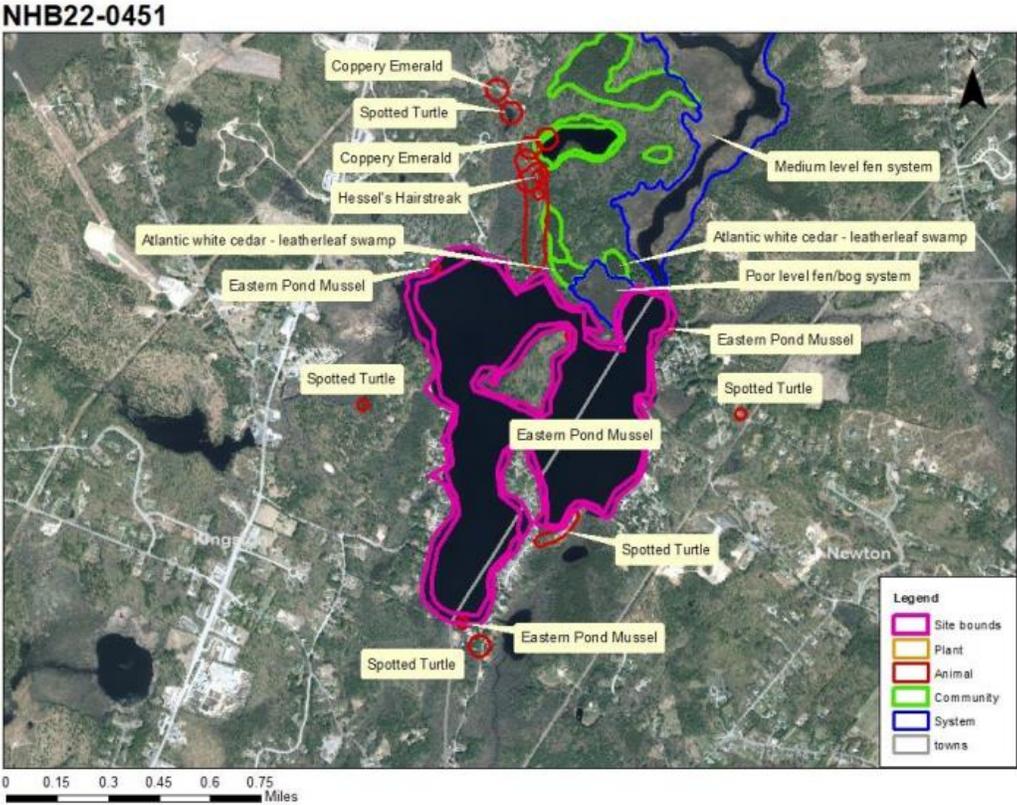


Figure 5: Critical Habitats or Conservation



For fishing regulation information, please refer to the NHFGD Freshwater Fishing Digest. Contact: NHFGD Inland Fisheries Division, Concord E-mail: fish@wildlife.nh.gov Phone: 603-271-2501

**COUNTRY POND
Kingston, Newton**

FISHERY: Warmwater ACRES: 306

TROPHIC LEVEL: MESO

AVG. DEPTH: 16 MAX. DEPTH: 25

SPECIES: SMB,LMB,ECP,BBH,BC,
BG,WP,AE,CSF,YP

ADDITIONAL INFO:

ACCESS: Town Beach, limited access

Please contact NH Dept of Safety, Marine Patrol for info. on water body/boat/motor restrictions: (603) 293-2037 www.nh.gov/safety

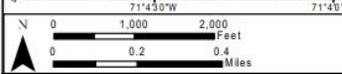
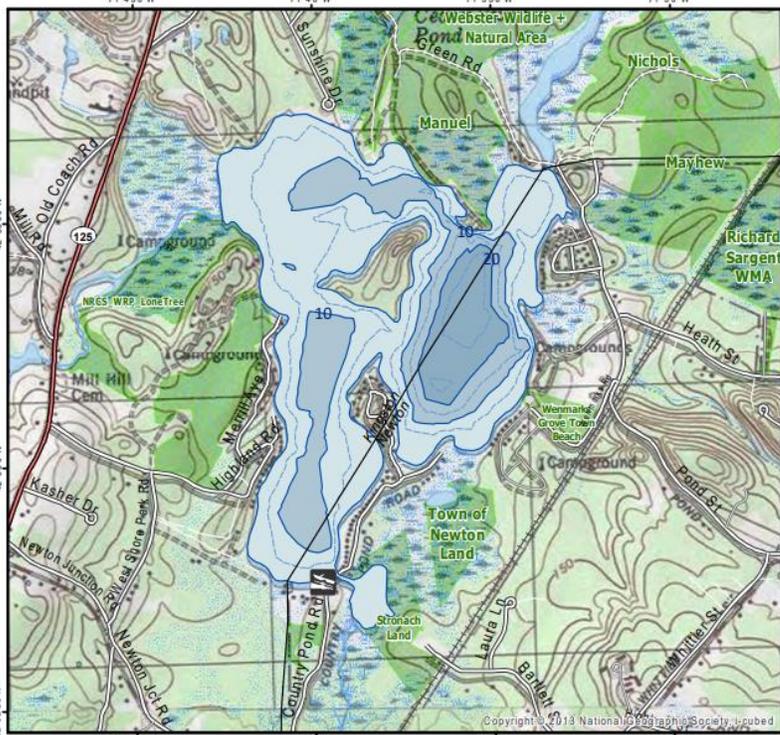
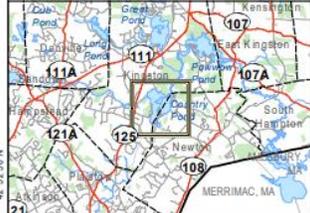
Public Water Access site

- Canoe/cartop
- Shorebank
- Ramp

Bathymetric contour (feet)

Bathymetry provided by the NH Department of Environmental Services, Watershed Mgt Bureau

- Town boundary
- Primary Route
- Road or Street
- Trail or other
- Stream or Shoreline
- Surface Water
- Wetland
- Conservation or Public land
- Cleared Forest
- Contour
- Building
- Source: USGS
- Restricted Access Conservation



Base map data from NH GRANIT at Earth Systems Research Center (UNH) and Open Street Map contributors. UNH, NH Fish & Game and the cooperating agencies make no claim as to the validity or reliability or to any implied uses of these data. NOT INTENDED FOR BOAT NAVIGATION.

Directions:

Figure 6: Public Access Sites and Beaches

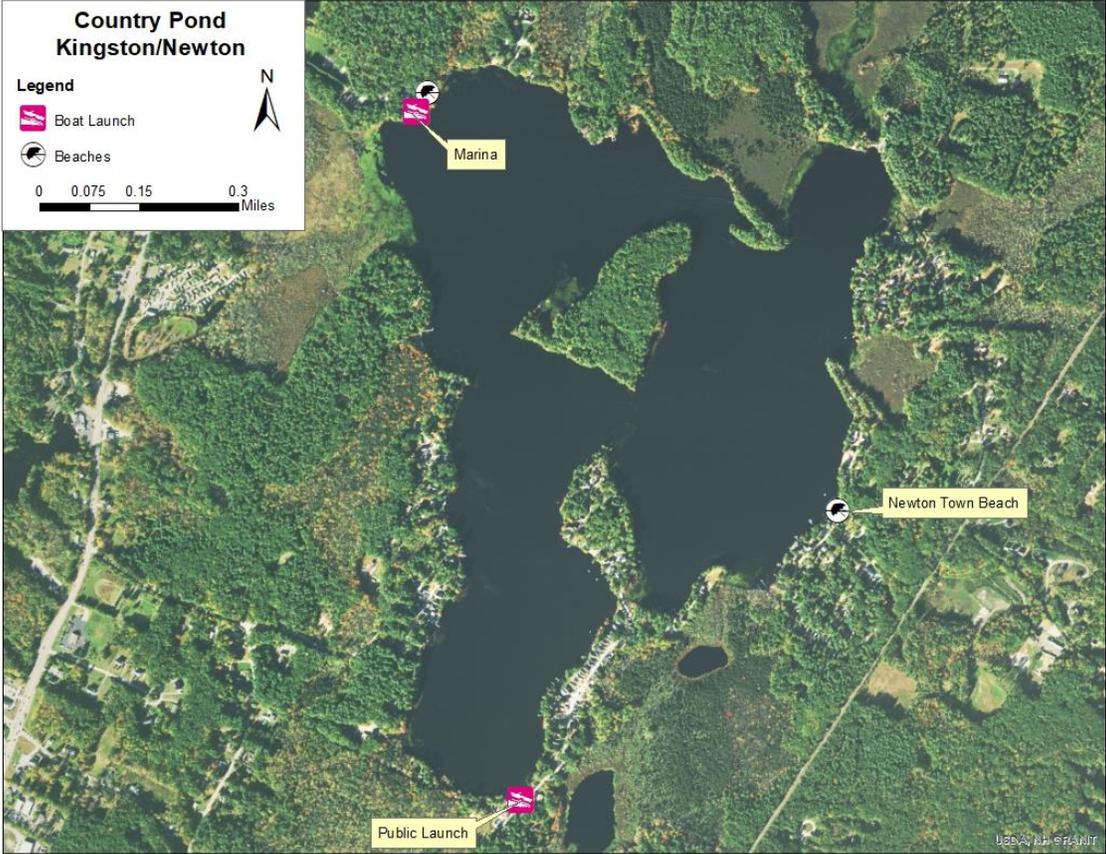
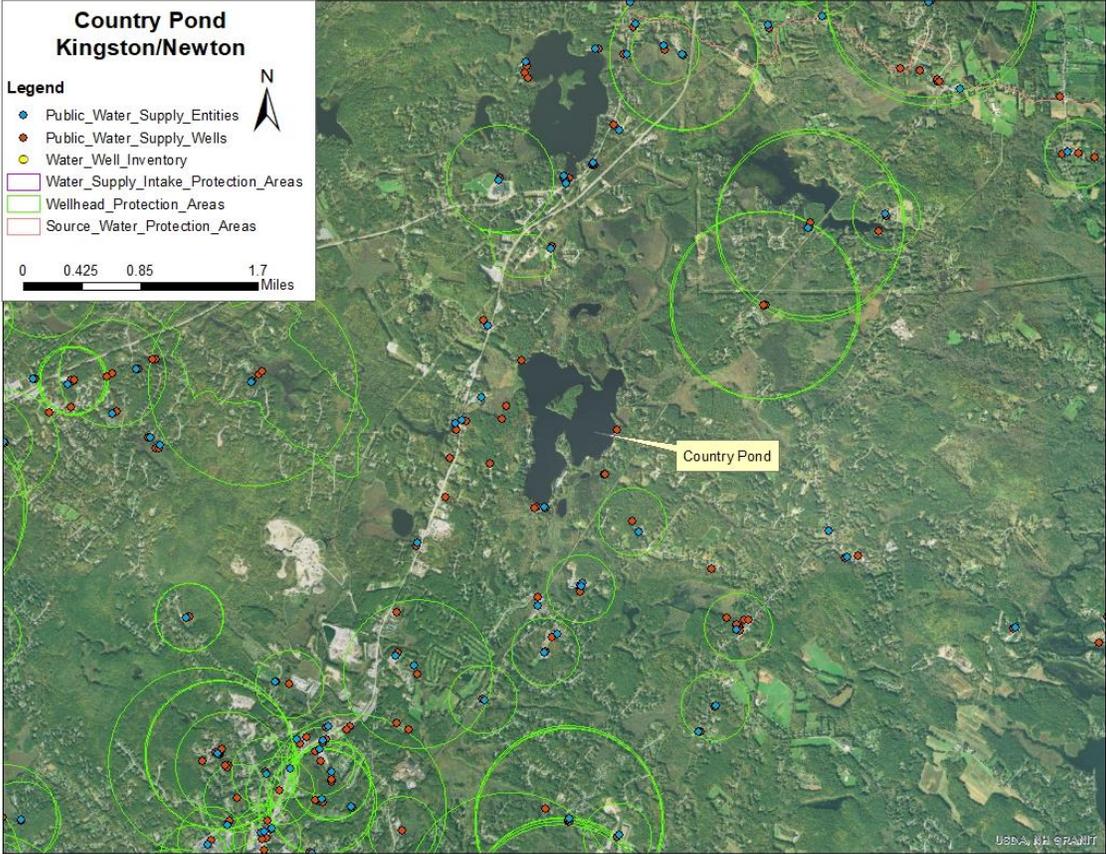


Figure 7: Wells and Water Supplies, 1:48,000 scale



Appendix A Selection of Invasive Aquatic Plant Control Techniques

Preliminary Investigations

I. Field Site Inspection

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

II. Office/Laboratory Research of Waterbody Characteristics

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

Overall Control Options

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

- 1) **Eradication:** The goal is to completely remove the exotic plant infestation over time. In some situations this may be a rapid response that results in an eradication event in a single season (such as for a new infestation), in other situations a longer-term approach may be warranted given the age and distribution of the infestation. Eradication is more feasible in smaller systems without extensive expanded growth (for example, Lake Winnepesaukee is unlikely to achieve eradication of its Spiny naiad), or without upstream sources of infestation in other connected systems that continually feed the lake.
-

- 2) **Maintenance:** Waterbodies where maintenance is specified as a goal are generally those with expansive infestations, that are larger systems, that have complications of extensive wetland complexes on their periphery, or that have upstream sources of the invasive plant precluding the possibility for eradication. For waterbodies where maintenance is the goal, control activities will be performed on the waterbody to keep an infestation below a desirable threshold. For maintenance projects, thresholds of percent cover or other measurable classification will be indicated, and action will occur when exotic plant growth exceeds the threshold.
- 3) **Containment:** The aim of this approach is to limit the size and extent of the existing infestation within an infested waterbody if it is localized in one portion of that waterbody (such as in a cove or embayment), or if a whole lake is infested action may be taken to prevent the downstream migration of fragments or propagules. This could be achieved through the use of fragment barriers and/or Restricted Use Areas or other such physical means of containment. Other control activities may also be used to reduce the infestation within the containment area.
- 4) **No action.** If the infestation is too large, spreading too quickly, and past management strategies have proven ineffective at controlling the target exotic aquatic plant, DES, in consultation with others, may elect to recommend 'no action' at a particular site. Feasibility of control or control options may be revisited if new information, technologies, etc., develop.

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

Guidelines and requirements of each control practice are suggested and detailed below each alternative, but note that site specific conditions will be factored into the evaluation and recommendation of use on each individual waterbody with an infestation.

A. Hand-Pulling and Diver-Assisted Suction Harvesting

- Hand-pulling can be used if infestation is in a small localized area (sparsely populated patch of up to 5' X 5', single stems, or dense small patch up to 2' X 2'). For larger areas Diver-Assisted Suction Harvesting (DASH) may be more appropriate.
 - Can be used if plant density is low, or if target plant is scattered and not dense.
 - Can be used if the plant could effectively be managed or eradicated by hand-
-

- pulling or DASH
- Use must be in compliance with the Wetlands Bureau rules.

B. Mechanically Harvest or Hydro-Rake

- Can not be used on plants which reproduce vegetatively by fragmentation (e.g., milfoil, fanwort, etc.) unless containment can be ensured.
- Can be used only if the waterbody is accessible to machinery.
- Can be used if there is a disposal location available for harvested plant materials.
- Can be used if plant depth is conducive to harvesting capabilities (~ <7 ft. for mower, ~ <12 ft. for hydro-rake).
- If a waterbody is fully infested and no other control options are effective, mechanical harvesting can be used to open navigation channel(s) through dense plant growth.

C. Herbicide Treatment

- Can be used if application of herbicide is conducted in areas where alternative control techniques are not optimum due to depth, current, use, or density and type of plant.
- Can be used for treatment of exotic plants where fragmentation is a high concern.
- Can be used where species specific treatment is necessary due to the need to manage other plants
- Can be used if other methods used as first choices in the past have not been effective.
- A licensed applicator should be contacted to inspect the site and make recommendations about the effectiveness of herbicide treatment as compared with other treatments.

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

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

E. Bottom Barrier

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

F. Drawdown

- Can be used if the target plant(s) are susceptible to drawdown control.
- Can be used in an area where bathymetry of the waterbody would be conducive to an adequate level of drawdown to control plant growth, but where extensive deep habits exist for the maintenance of aquatic life such as fish and amphibians.
- Can be used where plants are growing exclusively in shallow waters where a drawdown would leave this area “in the dry” for a suitable period of time (over winter months) to control plant growth.
- Can be used in winter months to avoid encroachment of terrestrial plants into the aquatic system.
- Can be used if it will not significantly impact adjacent or downstream wetland habitats.
- Can be used if spring recharge is sufficient to refill the lake in the spring.
- Can be used in an area where shallow wells would not be significantly impacted.
- Reference RSA 211:11 with regards to drawdown statutes.

G. Dredge

- Can be used in conjunction with a scheduled drawdown.
- Can be used if a drawdown is not scheduled, though a hydraulic pumping dredge should be used.
- Can only be used as a last alternative due to the detrimental impacts to environmental and aesthetic values of the waterbody.

H. Biological Control

- Grass carp cannot be used as they are illegal in New Hampshire.
 - Exotic controls, such as insects, cannot be introduced to control a nuisance plant
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- unless approved by Department of Agriculture.
Research should be conducted on a potential biological control prior to use to determine the extent of target specificity.



Appendix B Summary of Control Practices Used in NH**Restricted Use Areas and Fragment Barrier:**

Restricted Use Areas (RUAs) are a tool that can be used to quarantine a portion of a waterbody if an infestation of exotic aquatic plants is isolated to a small cove, embayment, or section of a waterbody. RUAs generally consist of a series of buoys and ropes or nets connecting the buoys to establish an enclosure (or exclosure) to protect an infested area from disturbance. RUAs can be used to prevent access to these infested areas while control practices are being done, and provide the benefit of restricting boating, fishing, and other recreational activities within these areas, so as to prevent fragmentation and spread of the plants outside of the RUA.

Hand-pulling:

Hand-pulling exotic aquatic plants is a technique used on both new and existing infestations, as circumstances allow. For this technique divers carefully hand-remove the shoots and roots of plants from infested areas and place the plant material in mesh dive bags for collection and disposal. This technique is suited to small patches or areas of low density exotic plant coverage.

For a new infestation, hand-pulling activities are typically conducted several times during the first season, with follow-up inspections for the next 1-2 years or until no re-growth is observed. For existing infestations, hand-pulling may be done to slow the expansion of plant establishment in a new area or where new stems are removed in a section that may have previously been uninfested. It is often a follow-up technique that is included in most management plans.

In 2007 a new program was created through a cooperative between a volunteer monitor that is a certified dive instructor, and the DES Exotic Species Program. A Weed Control Diver Course (WCD) was developed and approved through the Professional Association of Dive Instructors (PADI) to expand the number of certified divers available to assist with hand-pulling activities. DES has only four certified divers in the Limnology Center to handle problems with aquatic plants, and more help was needed. There is a unique skill involved with hand-removing plants from the lake bottom. If the process is not conducted correctly, fragments could spread to other waterbody locations. For this reason, training and certification are needed to help ensure success. Roughly 100 divers were certified through this program through the 2010 season. DES maintains a list of WCD divers and shares them with waterbody

groups and municipalities that seek diver assistance for controlling exotic aquatic plants. Classes are offered two to three times per summer.

Diver Assisted Suction Harvesting

Diver Assisted Suction Harvesting (DASH) is an emerging and evolving control technique in New Hampshire. The technique employs divers that perform hand removal actions as described above, however, instead of using a dive bag a mechanical suction device is used to entrain the plants and bring them topside where a tender accumulates and bags the material for disposal. Because of this variation divers are able to work in moderately dense stands of plants that cover more bottom area, with increased efficiency and accuracy.

Mechanical Harvesting

The process of mechanical harvesting is conducted by using machines which cut and collect aquatic plants. These machines can cut the plants up to twelve feet below the water surface. The weeds are cut and then collected by the harvester or other separate conveyer-belt driven device where they are stored in the harvester or barge, and then transferred to an upland site.

The advantages of this type of weed control are that cutting and harvesting immediately opens an area such as boat lanes, and it removes the upper portion of the plants. Due to the size of the equipment, mechanical harvesting is limited to water areas of sufficient size and depth. It is important to remember that mechanical harvesting can leave plant fragments in the water, which if not collected, may spread the plant to new areas. Additionally harvesters may impact fish and insect populations in the area by removing them in harvested material. Cutting plant stems too close to the bottom can result in re-suspension of bottom sediments and nutrients. This management option is only recommended when nearly the entire waterbody is infested, and harvesting is needed to open navigation channels through the infested areas.

Benthic Barriers:

Benthic barriers are fiberglass coated screening material that can be applied directly to the lake bottom to cover and compress aquatic plant growth. Screening is staked or weighted to the bottom to prevent it from becoming buoyant or drifting with current. The barriers also serve to block sunlight and prevent photosynthesis by the plants, thereby killing the plants with time. While a reliable method for small areas of plants (roughly 100 sq. ft. or less), larger areas are not reasonably controlled with this method due to a variety of factors (labor intensive installation, cost, and gas accumulation and bubbling beneath the barrier).

Targeted Application of Herbicides:

Application of aquatic herbicides is another tool employed for controlling exotic aquatic plants. Generally, herbicides are used when infestations are too large to be controlled using other alternative non-chemical controls, or if other techniques have been tried and have proven unsuccessful. Each aquatic plant responds differently to different herbicides and concentrations of herbicides, but research performed by the Army Corps of Engineers has isolated target specificity of a variety of aquatic herbicides for different species.

Generally, ProcellaCOR or 2,4-D (Navigate formulation) are the herbicides that are recommended for control of variable milfoil. Based on laboratory and field trials, these are the most effective herbicides in selectively controlling variable milfoil in New Hampshire's waterbodies.

A field trial was performed during the 2008 summer using the herbicide Renovate to control Spiny naiad. Renovate is a systemic aquatic herbicide that targets both the shoots and the roots of the target plant for complete control. In this application it was dispersed as a granular formulation that sank quickly to the bottom to areas of active uptake of the milfoil plants. A small (<5 acre) area of Captains Pond in Salem was treated with this systemic herbicide. The herbicide was applied in pellet form to the infested area in May 2008, and showed good control by the end of the growing season. Renovate works a little more slowly to control aquatic plants than 2,4-D and it is a little more expensive, but presents DES with another alternative that could be used in future treatments.

During the summer of 2010, DES worked with other researchers to perform field trials of three different formulations of 2,4-D in Lake Winnisquam, to determine which product was most target-specific to the Spiny naiad. Navigate formulation was used, as were a 2,4-D amine formulation, and a 2,4-

D amine and triclopyr formulation (MaxG). Although the final report has not been completed for this study, preliminary results suggest that all three products worked well, but that Navigate formation may be the most target specific of all three.

Another herbicide, Fluridone, is sometimes also used in New Hampshire, mainly to control growths of fanwort (*Cabomba caroliniana*). Fluridone is a systemic aquatic herbicide that inhibits the formation of carotenoids in plants. Reduced carotenoids pigment ultimately results in the breakdown of chlorophyll and subsequent loss of photosynthetic function of the plants.

Other aquatic herbicides are also used in New Hampshire when appropriate (glyphosate, copper compounds, etc). The product of choice will be recommended based on what the target species is, and other waterbody-specific characteristics that are important to consider when selecting a product.

In 2018, a new aquatic formulation of an herbicide was labeled and licensed for use. ProcellaCOR is a reduced-risk liquid formulation herbicide that is a systemic. Based on New Hampshire field data, it works well on variable milfoil, it is taken up very quickly following treatment (hours) and it degrades quickly in the water column, with typical non-detect readings within 24-48 hours post treatment.

Extended Drawdown

Extended drawdown serves to expose submersed aquatic plants to dessication and scouring from ice (if in winter), physically breaking down plant tissue. Some species can respond well to drawdown and plant density can be reduced, but for invasive species drawdown tends to yield more disturbance to bottom sediments, something to which exotic plants are most adapted. In waterbodies where drawdown is conducted exotic plants can often outcompete native plants for habitat and come to dominate the system.

Some waterbodies that are heavily infested with exotic plants do conduct drawdowns to reduce some of the invasive aquatic plant density. During this reporting period both Northwood Lake (Northwood) and Jones Pond (New Durham) coordinated deep winter drawdowns to reduce growths of variable milfoil (the drawdown on Northwood Lake is primarily for flood control purposes, but they do see some ancillary benefits from the technique for Spiny naiad control).

Dredging

Dredging is a means of physical removal of aquatic plants from the bottom sediments using a floating or land-based dredge. Dredging can create a variety of depth gradients creating multiple plant environments allowing for greater diversity in lakes plant, fish, and wildlife communities. However due to the cost, potential environmental effects, and the problem of sediment disposal, dredging is rarely used for control of aquatic vegetation alone.

Dredging can take place in to fashion, including drawdown followed by mechanical dredging using an excavator, or using a diver-operated suction dredge while the water level remains up.

Biological Control

There are no approved biological controls for submersed exotic aquatic plant at this time in New Hampshire.

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