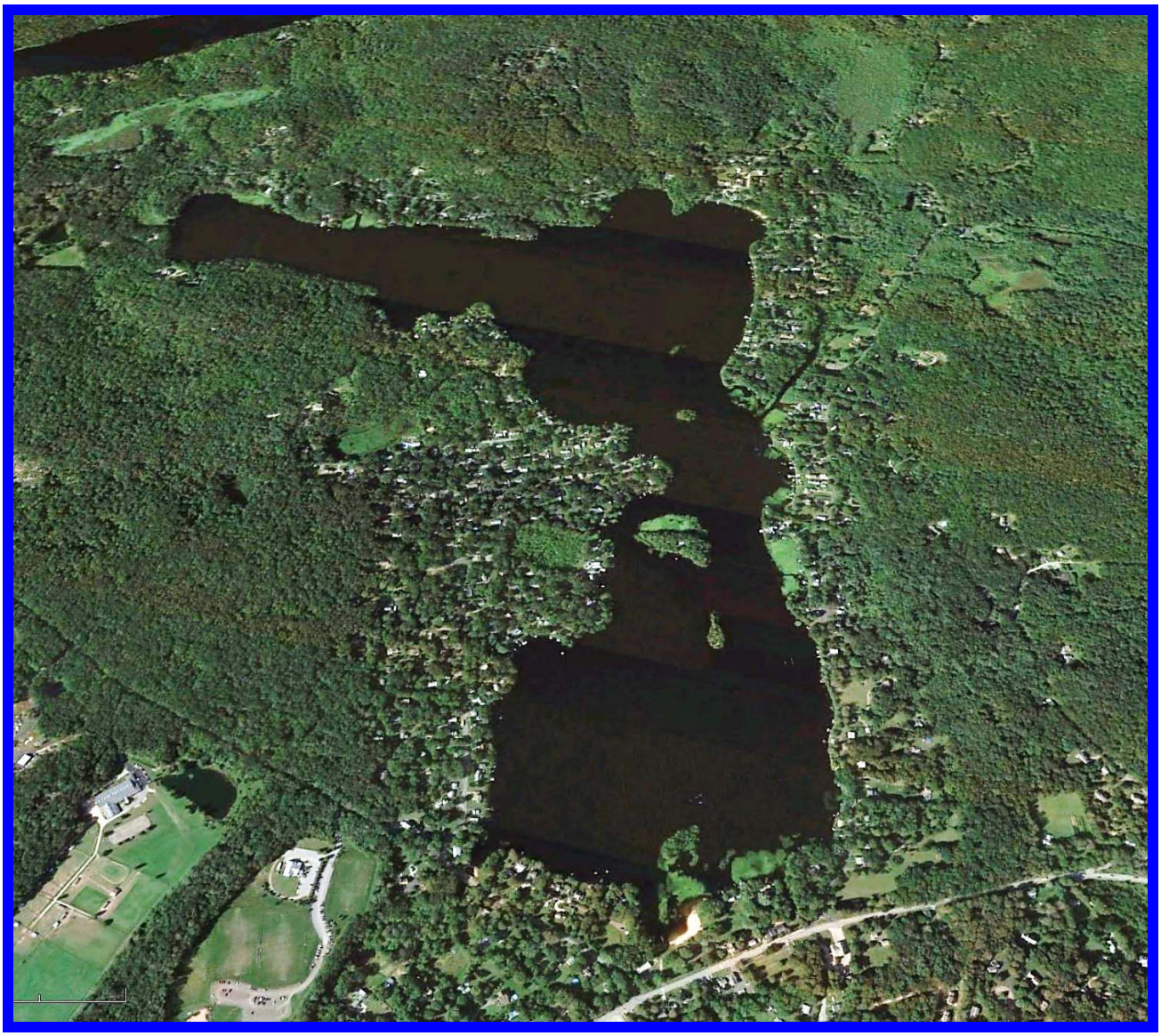
Rogers Lake Aquatic Plant Management Plan



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January 20, 2012

Executive Summary

1. Rogers Lake has been infested with the non-native invasive aquatic plant variable-leaf milfoil for many years.
2. Variable-leaf milfoil is widely distributed in shallow waters, 2-4 feet deep, around the lake.
3. Dense growths of variable-leaf milfoil cover about16 acres in the center shallow area of the lake.
4. Variable-leaf milfoil is still slowly spreading into new areas of the lake.
5. Maximum area eligible for colonization by milfoil is about 120 acres in size comprising area of 0 – 10 feet depth around the perimeter of the lake.
6. Variable-leaf milfoil in the center area of the lake is best controlled using herbicides.
7. An herbicide application of 16 acres is likely to cost between $12, 000 to $15,000 depending on the chemical used.
8. Smaller areas of the variable-leaf milfoil to be controlled can be identified and treated during subsequent years.
9. The non-native invasive aquatic plant fanwort recently invaded Rogers Lake probably during the summer of 2009.
10. In 2011, fanwort was found in the channel leading to the public boat ramp and along the eastern shore in the vicinity of the channel to the boat ramp.
11. Fanwort is rapidly spreading in the lake.
12. An aggressive and immediate response to the fanwort invasion is strongly recommended.
13. Suction harvesting / hand pulling is suggested as the best method to remove the small number of fanwort plants found in 2011.
14. Removal needs to be accomplished in 2012 with follow-up later that same year and in 2013 is likely to cost between $ 6,000 and $ 8,000 in 2012.
15. In additional to these two non-native plants, floating-leaved plants species water lilies and watershield, are persistent in several shallow coves.
16. Coves that are choked with floating leaved plants can be opened to provide boating lanes.
17. Hydroraking is the best method to remove beds of floating leaved plants, although herbicides can also be used.
18. Each area of floating-leaved plant control needs to be identified and planned so that specific goals are accomplished at each site. Hydro-raking will likely cost about $ 5,000 / acre.

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Introduction

Rogers Lake is a 260 acre lake in Lyme and Old Lyme, Connecticut. The lake has a maximum water depth of 63 feet, and a mean depth of 16.3 feet. Aquatic plants have presented recreational impairment in Rogers Lake for several years. A diagnostic study completed for the lake in 2003[1], recognized variable-leaf milfoil (Myriophyllum heterophyllum) as the dominant threat. This species of milfoil is a non-native invasive aquatic plant that infests many lakes in eastern and southern Connecticut. That report identified certain areas of the lake where milfoil had become dense with growths reaching the surface causing serious recreational impairment. Limited control options have been used to management the infestation of milfoil in Rogers Lake since that time.

In 2010, Northeast Aquatic Research found fanwort (Cabomba carolininia) at the State of Connecticut public boat ramp, in the channel leading to the lake from the ramp, and in a limited area in the lake at the mouth of that same channel. The location of these growing plants, and fragments, indicate that the plant was introduced to the lake by infected boats using the public boat ramp.

This report summarizes results of recent aquatic plant surveys of Rogers Lake, updates knowledge of the status of these plants in the lake, and provides new information on other aquatic plant problems in the lake. And outline of a comprehensive management plan for controlling aquatic plants in Rogers Lake into the future is provided.

Survey History

The first survey of aquatic plants in Rogers Lake was conducted by Aquatic Control Technologies (ACT) and Northeast Aquatic Research (NEAR) during the summer of

[1] 2002 Diagnostic / Feasibility Study of Rogers Lake, Lyme/Old Lyme, Connecticut by Aquatic Control Technologies, Inc. and Northeast Aquatic Research, LLC. December 2003.

2002. The Connecticut Agricultural Experiment Station (CAES) surveyed aquatic plants in Rogers Lake on July 12, 2006. Northeast Aquatic Research conducted a late season survey on October 14, 2010, and returned to the lake in 2011 to thoroughly survey the lake taking two days on July 21, 26, 2011. During each of the above mentioned surveys, aquatic plant density and distribution were noted and a list of the species was prepared.

The most frequently found species observed by NEAR during 2011 surveys are listed in **Table 1**. Several similar species have been grouped together. Bladderworts include the four species of bladderwort found in the lake; floating-leaved species include three species. Fanwort is added to the bottom of the list for comparison purposes.

Table 1 - Aquatic plants with highest frequency of observation

Most Abundant Species	2011
Bladderworts	87.9
Variable-leaf Milfoil	40
Southern Naiad	27
Floating Leaved Plants	62
Tape Grass	23
Pondweeds	
Large-leaf	12
Robbins	10
Fanwort	8.4

A complete list of all aquatic plant species found during the three NEAR surveys, 2002, 2010, and 2011, and the CAES 2006 survey is given in **Table 2** along with percent occurrence values for each species. There have been 28 species observed in the lake so far, with some variation between surveys but essentially the same plants at similar levels of abundance. However, the four surveys were not conducted in similar ways so are not strictly comparable meaning differences in abundance are expected.

Table 2 – Species lists and comparable abundances from four surveys

Common Name	Scientific Name	2002	2006	2010	2011
Bladderwort	Utricularia gibba	30	21	16	44

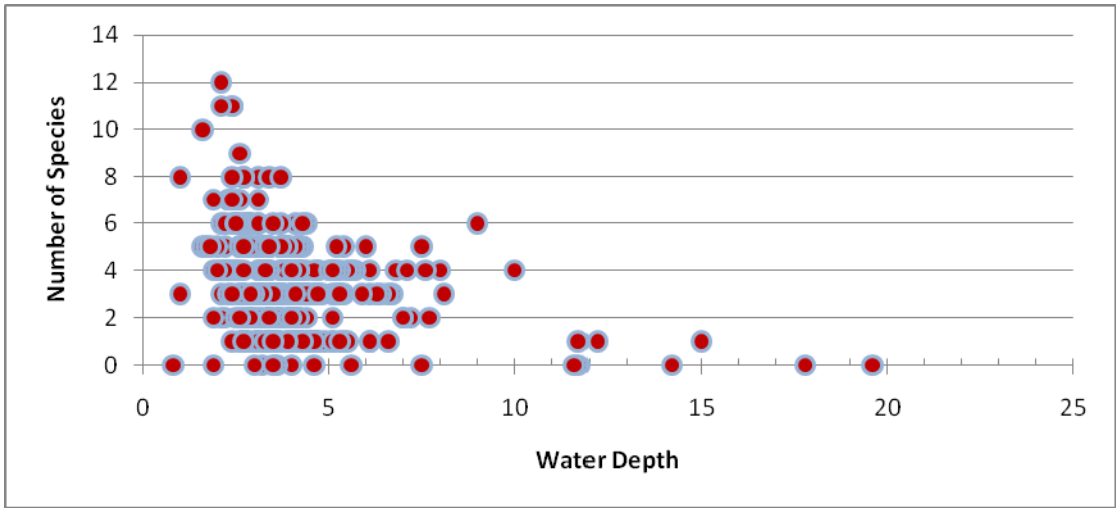
Variable-leaf Milfoil	Myriophyllum heterophyllum	38	14	54	40
Bladderwort	Utricularia radiata	10	18	4	34
Southern Naiad	Najas guadalupensis	44	31	18	27
White Water Lily	Nymphaea odorata	8	8	14	25
Watershield	Brasenia schreberi	4	8	7	24
Tape grass	Vallisneria americana	36	16	37	23
Yellow Water Lily	Nuphar variegata	6	5	10	13
Large-leaf Pondweed	Potamogeton amplifolius	16	2	13	12
Robbins Pondweed	Potamogeton robbinsii	44	17	20	10
Bladderwort	Utricularia vulgaris	30	3	7	9
Fanwort	Cabomba caroliniana	-	-	13	8
Primrose	Ludwigia sp.	-	-	13	7
Stonewort	Nitella sp.	30	-	1	7
Spike Rush	Eleocharis robbinsii	-	-	21	5
Floating Burreed	Sparganium fluctuans	-	-	2	4
Waterweed	Elodea nuttallii	16	-	1	4
Red-leaf Pondweed	Potamotegon epihydrus	4	-	3	4
Filamentous algae	Spirogyra	-	-	9	3
Floating Pondweed	Potamogeton natans	2	-	2	3
Arrowhead	Sagittaria graminea	-	-	8	3
Spike Rush	Eleocharis sp.	-	-	3	2
Waterwort	Elatine sp.	-	-	1	1
Bladderwort	Utricularia striata	-	-	2	1
Thin-leaved	Potamogeton bicupulatus	-	-	1	1
Thin-stemmed	Potamogeton zosteriformis	-	2	-	-
Waterweed	Elodea canadensis	-	5	-	-
Mudmat	Glossostigma sp.	-	1	-	-
Mermaid Weed	Proserpinaca palustris	-	3	-	1

Throughout this report both common and scientific names are used. Although scientific names are intimidating and difficult to pronounce, they can be trusted, that is one name always refers to one specific species. Common names on the other hand, may be easy to pronounce and remember but are not to be trusted, one common name can refer to many different species or one species can have many different common names. It is vital as lake managers that you learn the scientific names for each species that you're attempting to control. This is critical when looking for different options of control because each species has a specific set of techniques that work on that particular plant

and others that don't. The internet is a great place to learn about each of the species below, simply type in the species name and you will get a great wealth of photos and information on each one.

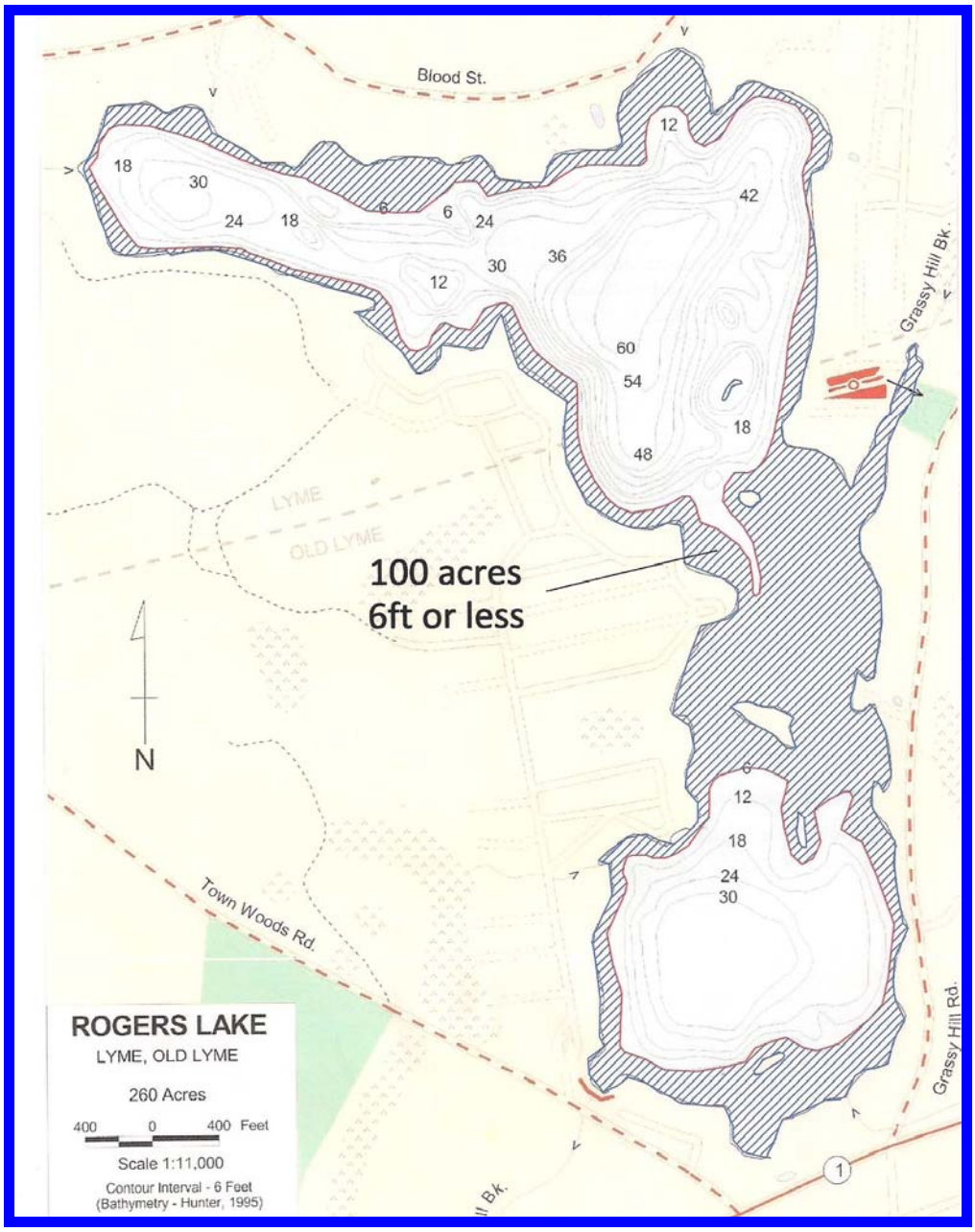
Distribution of species with depth is shown in **Figure 1** below. The chart shows that Rogers Lake has a high diversity of species in shallow water of 2 – 4 feet, and a moderate number of species between 4 and 8 feet. Few species were found in water depths between 8 and 10 feet and only one species in depths between 10 and 15 feet (southern naiad – most commonly found rooted aquatic plant in deeper waters). No plants were found in water deeper than 15 feet.

Figure 1 – Number of species occurring at different water depths in July 2011



The surface area of the lake between the shore and 6 feet of water depth (mapped contour on DEP bathymetric map) is 100 acres (see **Figure 2**), which captures most of the high growth areas of the lake. The topography of the bottom is steep below 6 feet so adding the area of the lake between 6 feet and 10 feet, to include most of the points on **Figure 1**, would increase the growth zone by only an additional 20 acres. This illustrates the area of the lake where invasive weeds can be expected to colonize if nothing is done to limit their spread and distribution.

Figure 2 Bathymetric map of Rogers Lake showing area of potential plant colonization

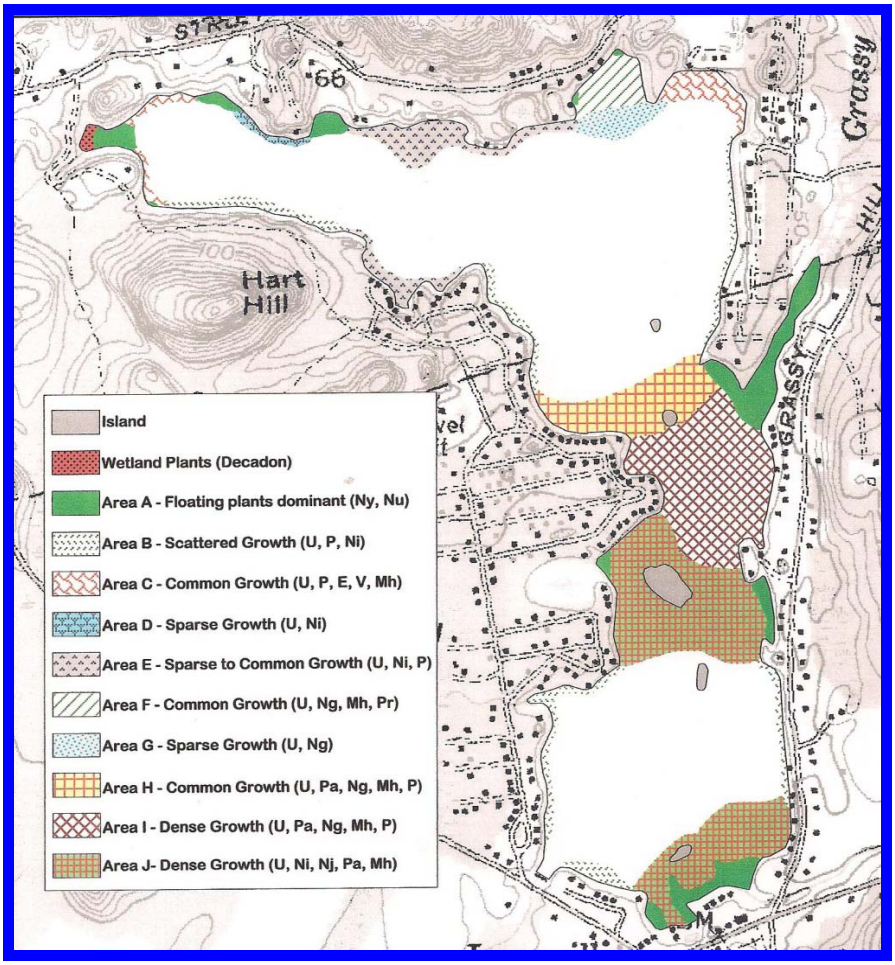


The area of the lake between the shore and 6 feet deep, approximately 100 acres, agrees well with the general weed distribution map prepared by ACT and NEAR in the 2003 diagnostic study report, see **Figure 3** below. The colored/hatched area correspond to associations of different aquatic plants dominants. The table imbedded

into the chart below includes abbreviations of different species that were found to dominate each area. The abbreviations are as follows:

- Ny White Water Lily
- Nu Yellow Water Lily
- U Bladderworts
- P Pondweeds
- Ni Stonewort
- V Tape grass
- Mh Variable-leaf Milfoil
- E Waterweed
- Ng Southern Naiad
- Nj Naiad
- Pa Large-leaf Pondweed

Figure 3 Aquatic Plant Distribution Map Presented in 2003 Diagnostic Study



Specific Plant Concerns

Fanwort

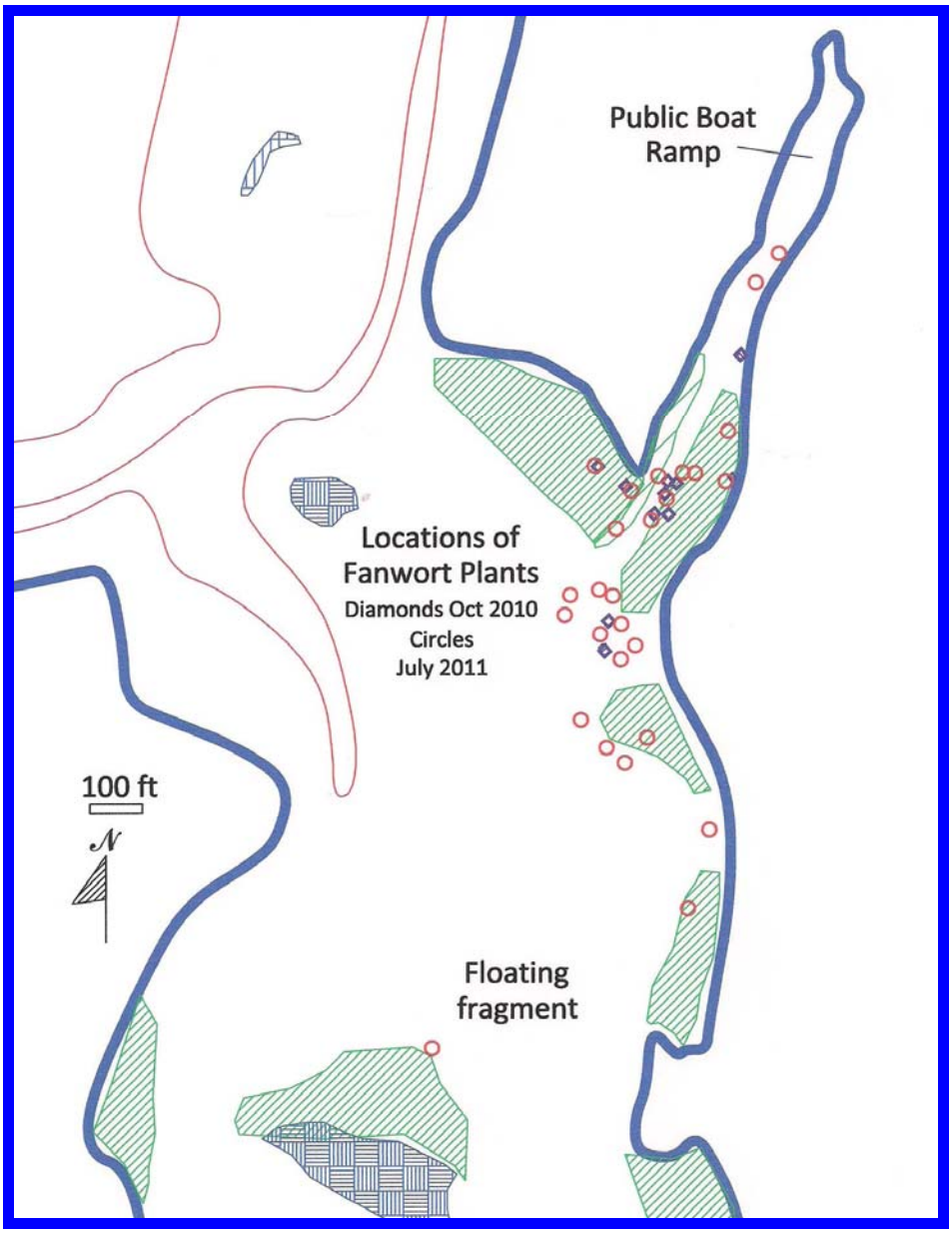
Fanwort (Cabomba caroliniana) is a non-native invasive aquatic plant in Connecticut. This species has invaded several lakes in the southeast part of the State. Fanwort is

newly introduced to Rogers Lake, probably during the summer of 2009 or maybe a year earlier. This species was first found by NEAR during a survey in October 2010 in close proximity to the public boat ramp. Fanwort is an extremely prolific species expected to spread rapidly in the lake. When NEAR surveyed the lake in 2011 more plants were found despite hand harvesting that occurred late in October 2010. Locations where NEAR found fanwort in Rogers Lake are shown in **Figure 4**. The map shows diamonds for locations in 2010 and circles for locations in 2011. The infestation is in its early expansion and establishment phase.

The plant is spreading rapidly from established clumps of plants on the eastern shore. Fanwort is a perennial plant that dies back in the winter leaving winter buds in the water and rhizomes in the sediments. The following spring rhizomes growth begins again with new axillary shoots, and winter buds form new plants. Although flowers are produced during the summer months, viable seeds have not been found in northern US states.

The plant is extremely aggressive often crowding out native species. The plant forms dense stands that clog natural water mixing and diffusion of dissolved oxygen causing suffocation of benthic habitats rendering littoral zones devoid of invertebrates and fisheries function. Fanwort tends to be sensitive to low light conditions so is typically found in shallower water, although it has the potential to reach the surface in water as deep as 10 feet. This species can be expected to continue to spread quickly eventually filling the area shown in **Figure 2** above.

Figure 4 – Locations of Fanwort in Rogers Lake from Surveys in 2010 and 2011



This species of aquatic plant is a serious threat to the health of Rogers Lake and needs to be controlled immediately. The rate of spread can be inferred from the increase in number of sites the plant was found between October 2010 and July 2011. There were 13 locations in 2010 and 28 locations in 2011, indicating that the plant doubled its distribution in the nine months elapsed between the two surveys. Also shown in the map in **Figure 4** is the location of a fanwort fragment several hundred feet to the south on the edge of the large water lily bed (this fragment was removed by NEAR). This plant spreads voraciously due to human induced fragmentation, auto-fragmentation,

winter buds, and root stolon's, runners that spread out laterally from existing plants producing many new plants as they go. In these ways, existing fanwort plants generate ever expanding beds and dislodged fragments move to other areas of the lake and form new beds. This makes it difficult to control because new grow appears later in the season, usually beginning as tiny plants in June, continuously sprouting new plants well into October.

It is critical that all fanwort plants are removed from the lake and monitored to ensure that 1) no plants were missed, this is possible because tiny seedlings can be over looked, because either they were under existing native plants or had not sprouted at the time of harvesting, and 2) no new plants enter the lake from boats launched at the public ramp.

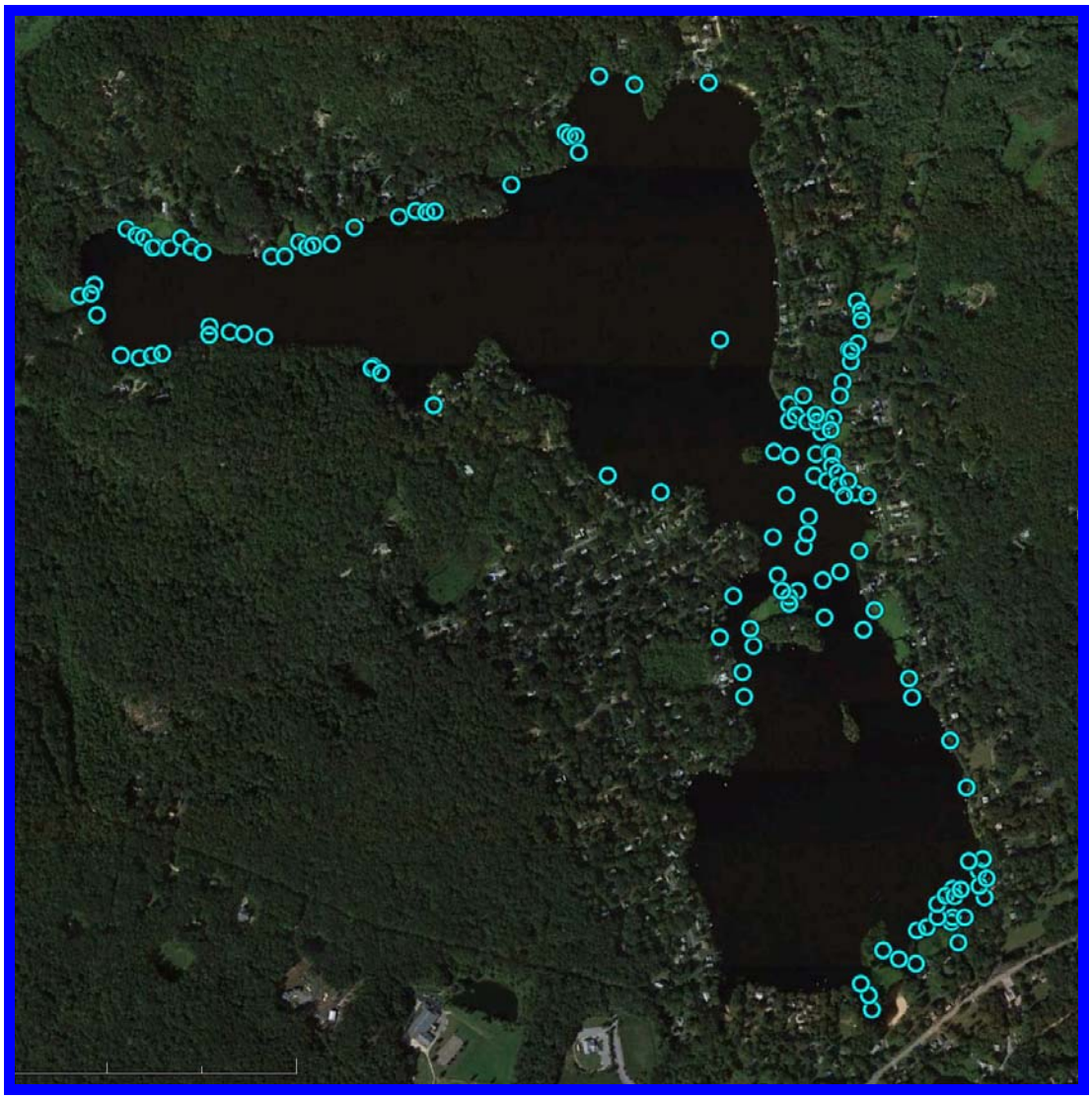
Variable-leaf Milfoil

Variable-leaf milfoil (Myriophyllum heterophyllum) is widely distributed in Rogers Lake. Map in **Figure 5** shows 132 locations around the lake where milfoil was found during the July 2011 surveys. The distribution appears to show clusters of milfoil in the center, along the southeastern shore, the southern shore, and in the northwestern end of the lake. Sporadic milfoil was found along the western and northern shores. Very little milfoil was found along the northeastern and southwestern shorelines.

Milfoil has been in Rogers Lake for several years and is now well established. It is unclear if milfoil is continuing to spread but the likelihood is that it is because a significant portion of the lake had no milfoil beds. Milfoil is a persistent aquatic plant that forms dense clumps of long shoots that can reach the surface in water as deep as 20 feet. The plant is perennial, forming aerial flowering spikes in mid to late summer. The plant auto-fragments with roots developed on upper portions of stems before the plant breaks apart. Although some parts of the plant die back during the winter often

the plant overwinters intact. New growth sprouts from winter buds, roots, overwintering plants, auto fragmented shoots and possibly from seeds. The plant forms dense stands that clog natural water mixing and diffusion of dissolved oxygen causing suffocation of benthic habitats rendering littoral zones devoid of invertebrates and fisheries function.

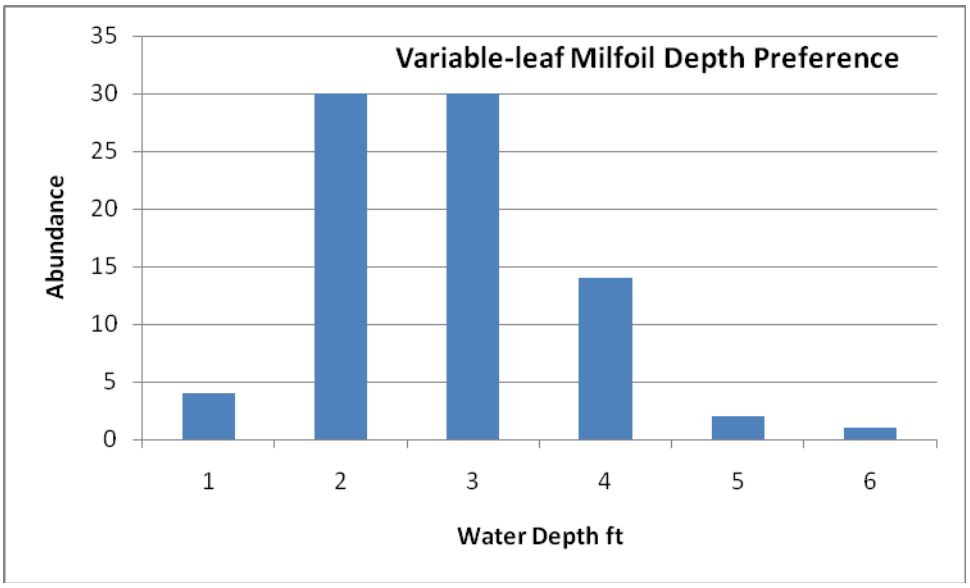
Figure 5 - Distribution of Variable-leaf Milfoil in Rogers Lake July 2011



In Rogers Lake, milfoil was found most commonly in 2-4 feet of water with diminishing frequency in deeper water. **Figure 6** shows the water depth preference of milfoil during the July 2011 survey. Although milfoil tended to be found in shallower sections of the

littoral zone, in clearer water the plant can grow to 20 feet of water depth. This indicates that milfoil may be present in deeper water areas of Rogers Lake not searched during any of the prior surveys.

Figure 6 – Frequency of occurrence of milfoil with water depth in July 2011



Because variable-leaf milfoil is widely distributed in the lake, it is unlikely that it can be eradicated completely. Eradication is used here to mean that the lake-wide population is reduced to virtually zero, although it would never actually be completely eliminated. There are no lake-wide methods that would target variably-leaf milfoil throughout the whole of Rogers Lake at one time. The plant will need to be controlled in specific areas where it is most problematic. Because the lake has many species of native plants growing together with milfoil, targeting milfoil will necessarily involve impacting native plants also. NEAR did not find any State of Connecticut protected species in the lake during the 2011 survey.

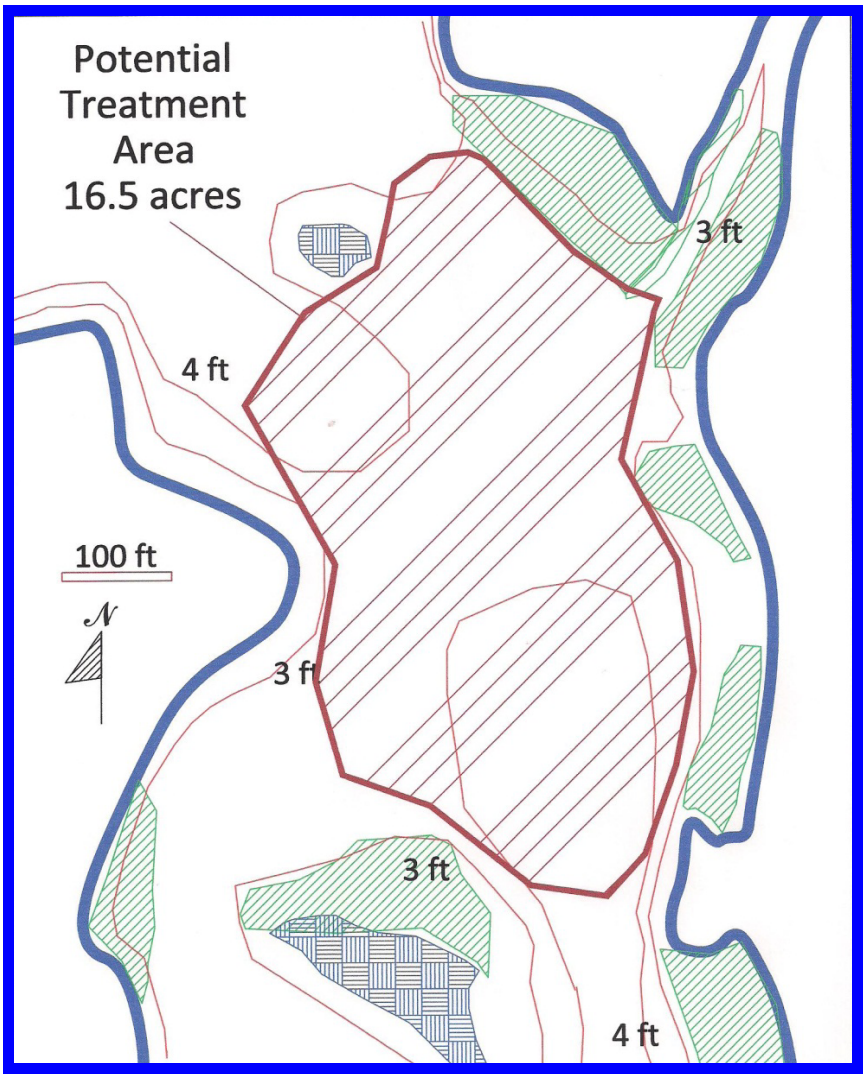
The most problematic of the milfoil beds in Rogers Lake is the center region of the lake (see **Figure 7**). This area of shallow water has very dense growths milfoil and of several native species that fill the water column and reach the water surface. Water depth measurements made during the July 2011 survey showed that the lake is

between 2 and 4 feet deep in the center area. Because this area is contiguous to, and in-line with, the channel leading to the boat ramp, boating traffic must pass through this central area prior to accessing the deeper open water areas. This means that milfoil in this area is regularly fragmented by prop action, acting as a vector causing spreading to other parts of the lake.

Plants in the central area of the lake should be suppressed for two reasons, 1) to reduce the recreation use impairment caused by excessive growths of milfoil and native plants, and 2) to limit the spread of milfoil to other areas of the lake. One possible area of treatment using aquatic plant herbicides is shown in **Figure 7**. The 16.5 acre area shown encompasses most of the shallow water where plant growth is severely limiting use.

Based on the success of this application of herbicides other areas around the can be targeted. Specific areas that could be considered are the along the southern shore and in location along the northwest shore.

Figure 7 – Central region of Rogers Lake showing water depth contours and potential treatment zone



Floating Leaved Plants

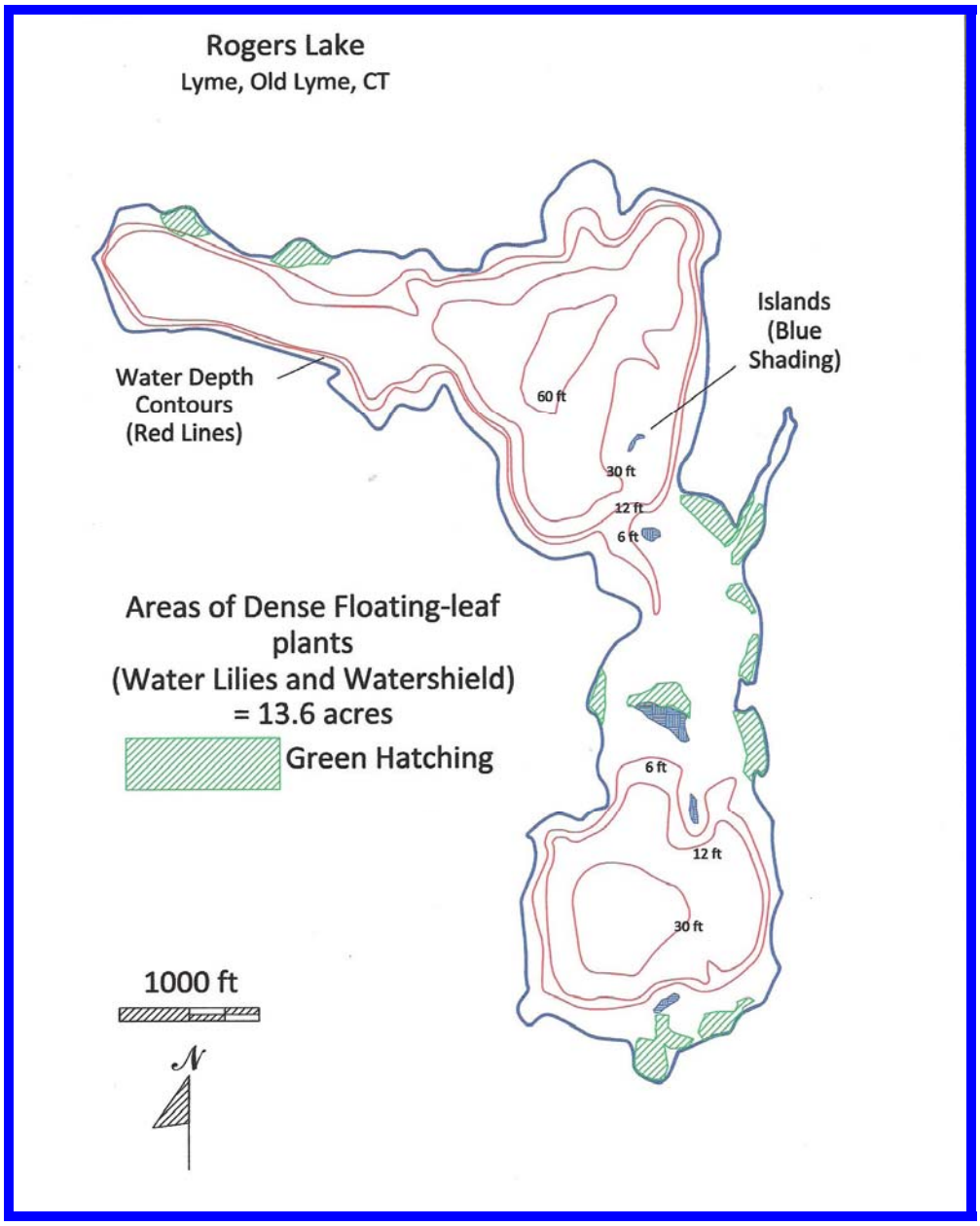
The group of plants referred to as floating-leaved plants include the two water lilies, White Water Lily, Yellow Water Lily, and Watershield. Each of the three plants grows "lily pads" that float on the water surface. The pads typically grow crowded together forming an unbroken covering over the water surface. These plants generally require shallow water to begin growth but can expand out into deeper water as the beds become established. That is why the lily pad beds are almost always found along the shore in shallow sheltered coves. A general rule of thumb is that floating-leaved plants will be in water between the shore and about 4 feet deep. However the outer edge of the beds will attempt to expend into deeper water by sending root runners out into the

lake. Some of these runners succeed in forming new plants while some don't, resulting in the outer edge being somewhat broken without a clear edge. The maximum depth that floating leaved plants can successfully colonize is around 7 feet although deeper growing plants have been found.

The areas in Rogers Lake where floating leaved plants have become established is shown in **Figure 8**. Each of the green hatched areas in the map is where water lilies and watershield have become extremely dense with 100% of the water surface composed of overlapping pads. In some of the locations the lilies are so dense that pads are layered on top of one another. There are about eleven separate beds of dense floating-leaved plant totaling 13.6 acres. The map in **Figure 8** is not all inclusive in that it does not include smaller beds that either did not form a surface covering or were small isolated plants. However, it is clear from the map that several coves are completely choked with water lilies. Dense beds depicted in **Figure 8** are impossible swim through and only with great difficultly can boats be taken through them.

Water lilies spread principally by lateral extension of the rhizome or roots, which although appears to be slow moving will eventually colonize all sheltered shoreline areas to about 7 feet of water depth. Some estimates suggest that water lily beds can spread about 1 foot / year. Water lilies can also spread by seeds allowing the plant to become established in new areas of the lake. Typically, water under the pads becomes stagnant with low dissolved oxygen and high amounts of organic peat that can decompose causing water quality to become poor.

Figure 8 - Locations of dense beds of floating-leaved plants in Rogers Lake


Rogers Lake
Lyme, Old Lyme, CT
Islands
(Blue
Shading)
Water Depth
Contours
(Red Lines)
60 ft
30 ft
12 ft
6 ft
Areas of Dense Floating-leaf
plants
(Water Lilies and Watershield)
= 13.6 acres
Green Hatching
6 ft
12 ft
30 ft
1000 ft
N

Summary of aquatic plant threats to Rogers Lake

Fanwort

Fanwort is newly introduced to Rogers Lake. In 2010, about 13 plants were found expanding 28 plants in 2011. Fanwort is a serious new threat to the lake. Fanwort is expected to spread rapidly to new areas of the lake and to quickly increase in density in areas currently infested.

Variable-leaf Milfoil

Variable-leaf milfoil is an existing threat that has caused impairment in specific areas around the lake. Milfoil is likely to continue to spread to new areas of the lake as well as increase in density in currently infested areas.

Floating-leaved Plants (Water lilies and Watershield)

Water lilies and watershield have encroached and choked several shallow coves around the lake making access to the open water difficult. Floating-leaved plants probably will not become serious threats in new areas of the lake as most of the sheltered coves where this plant would have an advantage are already colonized. However, currently choked coves will see increased density of plant growth and continued degradation of water quality under the pads.

Suggested Control Methods:

1. Hand harvesting

Plants are removed by hand by a professional suction harvesting company. In this way each individual plant and cluster of plants is removed without impacting associated native plants. This option is best for new, small infestations because plants are still limited to one area of the lake. However, because the plant is located directly in the boat lane to the public boat ramp, further fragmentation and dispersal is certain. Each fragment represents the formation of a new bed in another area of the lake. As the number of beds increase the utility of suction

harvesting diminishes because of the increasing scope of the infestation. Costs of suction harvesting vary widely depending on a number of factors including; the density of the beds to be removed, the diversity and density or native species associated with the target plants, sediment type, and distance to shore. Expected cost to remove the fanwort using suction harvesting is to be between $6,000 and $8,000 in 2012. Because new plants are likely to spout after harvesting a second round will be needed. One possibility is to wait until late in the season in hopes of getting all the fanwort in one event but this allows established plants to be fragmented by boat traffic all summer causing significant spreading in the interim.

2. Herbicides

Variable-leaf milfoil is susceptible to one systemic herbicide 2-4D (Navigate). The use of this herbicide would probably not be permitted at Rogers Lake due to the proximity of domestic potable water wells near the lake. Contact herbicides either Diquat (Reward) or Flumioxazin (Clipper) would provide short term control of variable-leaf milfoil, probably between 1 and 2 years depending on the dose and timing of treatment. Other herbicides show little to effect on the plant.

Fanwort is resistant to most herbicides except Fluridone (Sonar) and Clipper which is a newly registered herbicide in Connecticut proving to be very affective against fanwort. Herbicides will have only short or moderate duration of control, with plants returning to the treated area after one to three years depending on the chemical used. However, repeated doses reduced biomass each successive year. Sometimes after repeated use plant density is reduced to levels that allow hand pulling of the remainders.

Sonar has a systemic mode of action that affects roots and stems while clipper is a contact herbicide that affects only shoots and leaves that are contacted by the chemical. Liquid Sonar requires a long contact time so the pellet formulation would need to be used in this case. The drawback to this strategy is plants would need to be heavily dosed in order to get the concentration to an effective level. However an advantage of pellets may be in getting more chemical to the root system of the plants. Clipper, which is very fast acting may only have a short duration of control, with plants returning the next season. Plants treated with clipper could be hand harvesting the following year when fewer plants grow back.

Herbicide best used against floating-leaved plants is Glyphosate (Rodeo). This has long lasting effect but typically requires more than one treatment in the first year and at least one follow-up treatment the next year to completely clear an area. Herbicide treatments of floating-leaved plants also cause floating mud island to appear after the treatment. These may or may not sink after coming up to the surface. If they don't sink they need to be removed.

3 - Hydro raking

Hydro-raking is removal of biomass, rhizomes, shoots and lily pads by mechanical means. The rake is pulled through the bed removing both biomass and peat. The costs of hydro-raking generally run around $ 5,000/acre but depend largely on the distance to the off-loading site, with longer distances causing the cost to increase drastically due to time spent traveling between work zone and off-load site.

2012 Work Plan

1. Suction harvest or treat with herbicides all fanwort.
    a. Contact a suction harvesting vendor early in the season to schedule a harvesting event and to obtain specific unit costs.
    b. Plan a harvesting event in June or early July.
    c. Plan for a second harvesting event in September or early October.
2. Treat with herbicides shallow center area of the lake.
    a. Contact a vendor during the winter of 2012 to obtain specific chemical use recommendations and file a permit with CT DEEP.
    b. Organize a pre-treatment survey with the selection applicator.
    c. Plan for a herbicide treatment in late spring as director by the applicator.
    d. Plan for a post treatment survey in September.
3. Develop a sequenced strategy to remove water lilies and provide access lanes.
    a. Develop a lily removal strategy that will focus on selected problem areas around the lake.
    b. In 2013 contact a vendor for hydro-raking time for an event to take place in September of October.