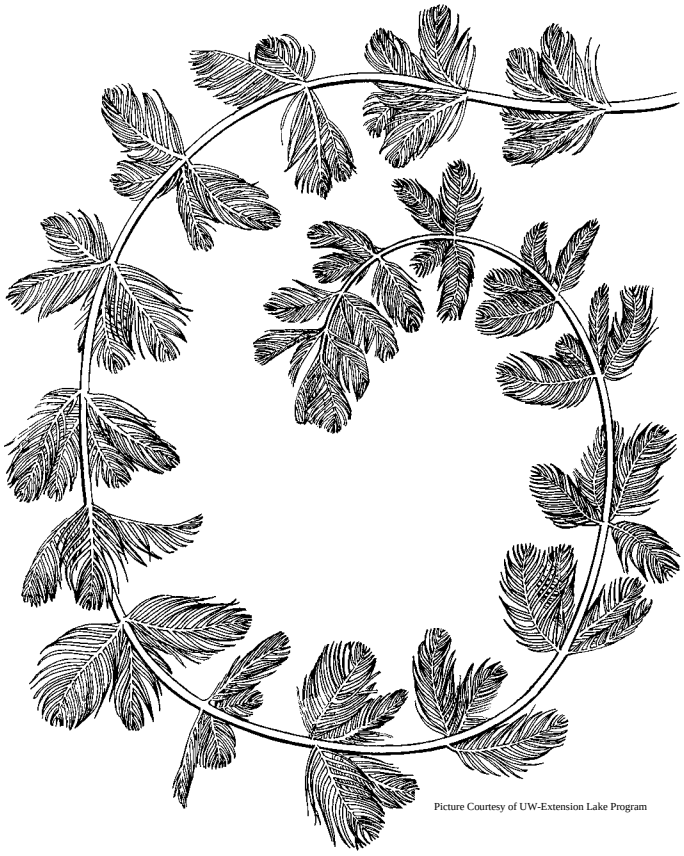
EURASIAN WATERMILFOIL ON CANDLEWOOD LAKE: MANAGEMENT CONSIDERATIONS AND POSSIBLE ALTERNATIVES TO THE DEEP DRAWDOWN



Picture Courtesy of UW-Extension Lake Program

February 2007

Melinda Tarsi, Candlewood Lake Authority

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INTRODUCTION

Eurasian Watermilfoil

This year, as in past years, people on and around Candlewood Lake have commented on the increasing amount of "weeds" in the lake, especially in swim areas and around docks. Virtually all of these aquatic plants are actually Eurasian watermilfoil (*Myriophyllum spicatum*), a highly invasive nuisance plant that originated in Europe and Asia and was brought to the United States sometime in the 1940s. This hardy plant grows anywhere from 3 to 10 feet tall, and is located under the water. The plant grows leaves towards the top of the stem, and the feathery leaves often form a dense canopy on the surface of the water. This allows the milfoil to cut off sunlight to other plants located beneath the surface of the water. The ability of the milfoil to block out sunlight, combined with its hardiness and ability to spread from cuttings, means that the plant can often easily out-compete other species of aquatic plants, especially native ones.[1]

The plant eventually made its way into many water bodies in the country, landing in Candlewood sometime in the 1970s. It soon began to have negative impact upon the various aspects of the lake, including some of the recreational, environmental, and aesthetic values that Candlewood provides. It was this negative impact to a variety of users of the lake that led to an effort to determine the best weed management method at Candlewood Lake.

History of the Eurasian Watermilfoil Problem

In the early 1980s, a technical committee formed of various lake management specialists and scientists was convened to address the increasing problem of milfoil on the lake. This group was comprised of research scientists from Western Connecticut State University, as well as officials from the Connecticut Department of Environmental Protection and representatives from the power company (at the time, Connecticut Light and Power) and the CLA. The committee reviewed various options for the treatment of

[1] Plant Conservation Alliance's Alien Plant Working Group, "Eurasian Watermilfoil." Last updated June 27, 2006. <http://www.nps.gov/plants/alien/fact/mysp1.htm>.

the plants, and eventually settled on the use of a biennial deep winter drawdown – done voluntarily by the power company – which drops the level of the lake by 10 feet from the ordinary high water mark (from approximately 429 feet to 419 feet in elevation). This exposes the milfoil beds to the cold winter temperatures, which freezes and desiccates them, and severely limits their growth during the following spring. This technique worked, with varying levels of success, for over a decade.[2] However, the summer of 2005 brought an alarmingly high density of milfoil that was not mitigated by a deep drawdown the preceding winter, prompting the power company to once again draw the lake level down that winter in an attempt to control the milfoil. This consecutive drawdown did not prove effective (probably due to a warm winter which did not provide the frost necessary to kill the weed beds), and the summer of 2006 saw another increase in the level of milfoil. Therefore, the power company chose to conduct a third consecutive deep drawdown, which is currently occurring – even while some environmental groups express concern over the potential impact to aspects of the ecosystem other than the weeds. Recent correspondence from NE Energy suggests that the company reached the 419-foot mark sometime in early January, and would hold that elevation for roughly two weeks. They would then begin to slowly refill the lake, allowing for additional margins of time for unforeseen difficulties or mechanical problems that could increase the normal refilling time required and affect energy generation and recreational use of the lake this summer.[3]

Although the efficacy of this year's drawdown may not be able to be measured until the next boating season, there are already concerns among those in the lake community that it will not be enough to successfully control the milfoil in the coming months. One reason for the somewhat unpredictable nature of the deep drawdown stems from the lack of concrete data on the effects of both temperature and time on the freezing of the milfoil. Without reliable scientific data on the best combination of cold temperatures and length of exposure of the milfoil beds, it is difficult for the technical committee and others to assess whether or not the deep drawdown this year will be efficacious.

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[2] Northeast Generating Company, "Nuisance Plant Monitoring Plan: Candlewood Lake and Lakes Lillinonah and Zoar (FERC License Article 409)," June 2005. 1.
[3] Robert Gates, NE Energy Services Inc., email. December 29, 2006.

This lack of certainty of the benefits of the water-level manipulation, the trend of unseasonably mild winters, and the recent ineffectiveness of the deep drawdown – is what has led the Candlewood Lake Authority to investigate alternatives to the biennial deep drawdown. However, as mentioned earlier, the CLA does not operate by itself when it comes to the issue of milfoil management. The presence of the technical committee – as well as the new FERC license – makes the issue more complex than it would seem to the layperson in the community. Therefore, this document provides background information on various alternative methods of milfoil control which may be considered by the technical committee for further discussion. While not comprehensive in terms of pricing estimates or treatment schedules, this report does establish realistic overviews of what the use of each method entails, as well as a reasonable estimate of what such a treatment could end up costing.

The FERC License and Milfoil Management

Under Article 409 of the newly-issued license from the Federal Energy Regulatory Commission (FERC), the project owner of the Housatonic River Project (of which Candlewood Lake is a part) must establish an annual reporting program to aid in the monitoring of invasive aquatic plans.[4] The purpose of this plan is to:

> …establish an annual program for monitoring invasive aquatic plants, especially Eurasian watermilfoil, in Candlewood Lake, and Lakes Lillinonah and Zoar. The Licensee is required to develop the Plan in consultation with U.S. Fish and Wildlife Service (FWS), Connecticut Department of Environmental Protection (DEP), Candlewood Lake Authority (CLA), Lake Lillinonah Authority (LLA), and Lake Zoar Authority (LZA), and to establish a technical committee including these entities, exclusive of FWS, to discuss the results of the monitoring.[5]

These reports will then form the basis of the technical committee's recommendations for future management efforts in the lakes. Because of this, the annual report to be issued by the power company is an important tool in determining the extent of milfoil (as well as other species of invasive aquatic plants) in the lake, as well as in the review of the

[4] FERC, "Order Issuing New License: Project Nos. 2576-022 and 2597-019." June 23. 2004. 43.
[5] Northeast Generating Company, "Nuisance Plant Monitoring Plan: Candlewood Lake and Lakes Lillinonah and Zoar (FERC License Article 409)," June 2005.3.

success of a deep drawdown in the previous winter.[6] In fact, FERC's order approving and modifying the plan states that the project owner will: "include the CDEP, CLA, LLA and LZA in a technical committee to oversee the effort of and to review the results of the proposed monitoring program."[7] As such and because of its commitment to the protection of the lake, the CLA has begun researching alternate methods for milfoil management that do not involve a deep drawdown.

PURPOSE AND OBJECTIVES

Purpose and Function of a Management Plan

If the deep drawdown continues to be ineffective, this lake community will undoubtedly need to develop a new management plan for the milfoil. One of the goals of this report is to provide the technical committee members some background information on alternative treatment methods as it considers a new management plan. Another goal of this report is to provide to all community members some insights into the complexities of these types of natural resource management decisions. Many different factors will have an effect on the kind of treatments used, including: cost considerations; amount of area to be treated; impacts on recreational activities; ecological considerations; and efficacy. Therefore, part of the management plan should entail research on not only the methods of treatment available for use on Candlewood, but also the variety of side effects that each one will have on both the environment and the surrounding community.

Objectives of a Management Program

There are both short-term and long-term goals to consider when addressing the issue of milfoil on Candlewood. Although this will necessitate the input of the entire technical committee (as well as those involved in environmental research and protection), some of the short-term goals could include:

- Identification of possible control methods, their advantages and disadvantages;

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[6] Northeast Generating Company, "Nuisance Plant Monitoring Plan: Candlewood Lake and Lakes Lillinonah and Zoar (FERC License Article 409)," June 2005. 5-6.
[7] FERC, "Order Modifying and Approving Nuisance Plant Monitoring Plan Pursuant to Article 409." February 3, 2006. 3.

- Control of milfoil in high-recreation areas;
- Education of the public on removal methods for homeowners on the lake.

In contrast, the long-term goals could focus more on a holistic approach to nuisance plant monitoring that does not focus specifically on one species of plant in certain areas. These could include:

- Creation of a long-term management plan, with stipulations for evaluation and correction at certain intervals;
- Education programs for homeowners and transient users on how they can prevent the spread of invasive aquatic plants among state and local water bodies;
- The accumulation of historical water quality data to help monitor the effects of management practices on the lake itself.

While these goals are merely suggestions (and are very similar to other nuisance plant management plans that have been reviewed by the CLA), they may serve as a starting point for discussions on what the CLA and other members of the technical committee plan to recommend in the future concerning the issue of milfoil. Additionally, future discussions and revisions will always be necessary in order to account for advances in technology and pertinent legal changes.

SELECTION OF CONTROL METHODS AND OPERATIONAL CONSIDERATIONS

There are many different methods available for treating milfoil, and these techniques fall into three main categories: chemical, mechanical, and biological. Each method has both benefits and drawbacks, all of which must be explored before serious consideration of the utilization of that method. Additionally, the cost and maintenance of any treatment program must also be researched, because many hidden costs due to factors such as repeated applications of chemicals or disposal costs can create budgetary problems in the future.

Chemical Treatments

Chemical methods of removal feature aquatic herbicides, which generally kill the stalks of the milfoil, leaving the root system intact. There are different types of chemicals

featured in the various brands of herbicides, with the most notable being: 2,4-D; triclopyr; endothall; diquat; and fluridone. These herbicides are broken down into two categories: systemic and contact. Systemic chemicals kill the entire plant, while those categorized as contact herbicides kill only the exposed stem of the plant.[8]

The three main types of systemic herbicides are 2,4-D, triclopyr, and fluridone. Although these chemicals can kill off other plants (such as native species), literature suggests that, if applied at the correct rate, they can be relatively selective and target only the milfoil. However, depending on the chemical and the level of concentration in the water, certain restrictions on swimming may need to be established for the days following the application to avoid eye irritation. While these chemicals may provide some relatively fast results, they often must be reapplied during the season in order to keep the concentration of chemicals in the water high enough to continue to discourage the milfoil. Because of the nature of these chemicals, those applying the treatment must be licensed by state and possibly federal agencies. Additionally, the water body must be continually monitored to ensure that no harmful water conditions exist which might put wildlife or humans at risk. Because of the monitoring and permitting that is required (as well as the depth of the water in which the milfoil is located), the cost per acre of these chemicals can fall well above the $600-$1,000 price range one can normally expect. Additionally, it is rare that one application is sufficient in reducing the amount of milfoil enough for recreational and aesthetic purposes; therefore, it is often recommended that two or more applications per season be scheduled to reduce the density of milfoil and keep a steady amount of the chemical present in the water body.[9]

In addition to the systemic herbicides, contact herbicides can present another chemical option for milfoil control. Both endothall and diquat fall under this heading, and work in similar fashions. Because these chemicals kill only the part of the plant exposed to the herbicide, the results they provide typically last one season or less, and may not be practical for large areas that require treatment. In low concentrations, the chemical can selectively target milfoil and leave native plants untouched. As with the systemic

[8] Washington State Department of Ecology. "Aquatic Plant Management: Aquatic Herbicides," Last updated June 20, 2006. <http://www.ecy.wa.gov/programs/wq/plants/management/aqua028.html>.
[9] Washington State Department of Ecology. "Aquatic Plant Management: Aquatic Herbicides," Last updated June 20, 2006. <http://www.ecy.wa.gov/programs/wq/plants/management/aqua028.html>.

herbicides, permits are necessary for application, and the water body that these herbicides are applied to must be monitored to ensure water quality. The cost per acre of such treatments generally runs from $250 to $600, but it is not uncommon for the actual cost for a single application to be much higher.[10]

Mechanical Treatments

The mechanical methods of milfoil control range greatly from techniques that can be utilized by homeowners to ones that require professionals equipped with sophisticated machinery. Some methods remove only the stalk of the plant, and others pull the root from the sediment. However, all of these methods are alike in that they may need to be repeated regularly (anywhere from annually to up to several times a season).

The easiest and most cost-effective technique for removing milfoil is hand-pulling, which can be done by private individuals in shallower waters. The cost for this is minimal, requiring only that the person find a method of legally disposing of the pulled plants away from the water.[11] In deeper waters, a professional with SCUBA gear is able to take the plants out through a process called diver dredging. Assisted by a suction hose that helps draw the entire root out of the sediment, the diver is able to effectively eradicate the roots of the plant in a given area. This method of removal is costly, however, as a single diver may charge over $1,000 to do a waterfront lot. Therefore, hand-pulling – whether by a professional or a private homeowner – can be an effective control method for small areas of land, but is not practical for large areas of milfoil.[12]

Another technique that can be utilized is cutting or raking, whereby the stalk is cut and removed from the water, leaving the root of the plant in the sediment (much like mowing grass). This can be done by private homeowners, who can purchase weed rakes and blades for anywhere from $50 to $200; these tools are designed to be used by people maintaining a small area, and allow the user to stand on shore (or a dock), throw the tool

[10] Washington State Department of Ecology. "Aquatic Plant Management: Aquatic Herbicides," Last updated June 20, 2006. <http://www.ecy.wa.gov/programs/wq/plants/management/aqua028.html>.
[11] State of Connecticut Public Act 04-203, "An Act Concerning Fines for Banned Invasive Plants." (June 3, 2004).
[12] Washington State Department of Ecology. "Aquatic Plant Management: Aquatic Herbicides," Last updated June 20, 2006. <http://www.ecy.wa.gov/programs/wq/plants/management/aqua028.html>.

out, and drag it back into the shore (bringing the cut milfoil along with it).[13] Another method of manual removal that can be used involves boat-mounted cutters, which attach to small vessels and can be used to cut milfoil stems (up to a certain depth), letting the cuttings float to the top where they can be collected and disposed of. These weed management devices range in price from under $1,000 to $11,000 each, and the amount of area they can cover is reliant solely upon the operator of the boat.[14] [15]

In addition to the above, mechanical harvesters present the opportunity to cover larger areas of vegetation and allow a professional to take care of the plant cutting and removal. Buying a mechanical harvester outright can cost anywhere from $30,000 to $110,000, so many that use this service prefer to rent the machine as well as pay the operator. These large cutters with collection baskets attached to them can cover anywhere from ½ to 1 acre a day, depending upon the density of the milfoil and the topography of the bottom of the lake. Costs range from $250 to $800 per acre of removal; alternatively, some contractors prefer to charge clients by the hour, which can be between $100 and $200 (not including getting the harvester to and from the work site and disposing of the cut plants). Harvesters, like hand rakes, cut off only the tops of the plants, leaving the root systems intact beneath the sediment. This means that several treatments may be necessary per season in order to obtain manageable levels of milfoil.[16]

Other methods of milfoil control involve affecting the actual sediment at the bottom of the water body. One such technique is the use of rotovating (or rototilling), which uses a machine to turn over the sediment in an attempt to prevent the milfoil from beginning to establish root systems. This process can help remove the roots of the plant – as opposed to merely cutting the tops of the stems like raking and cutting methods – but it may also disturb fish and other species that rely on the lakebed for habitat. The machinery itself is costly, and most of those who use this technique hire a professional to operate the machine and remove the plants that were cut before the rotovating began. The costs can run from $1,000 to $2,000 per acre, depending on the contractor. This, like

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[13] The Lake Weeders Digest, "Weed Equipment." 2006. <http://www.weedersdigest.com>.
[14] Washington State Department of Ecology, "Aquatic Plant Management: Mechanical Cutting." Last updated June 20, 006. <http://www.ecy.wa.gov/programs/wq/plants/management/aqua025.html>.
[15] The Lake Weeders Digest, "Weed Equipment." 2006. <http://www.weedersdigest.com>.
[16] Washington State Department of Ecology, "Aquatic Plant Management: Mechanical Harvesting." Last updated June 20, 2006. <http://www.ecy.wa.gov/programs/wq/plants/management/aqua026.html>.

other manual methods, is another option that proves useful for consideration on small areas only.[17]

Still another technique that can have an effect on the growth of milfoil is the use of so-called automatic weed control technology. These systems consist of a power source that drives a type of mechanical arm positioned a few inches off the lake bottom. They then comb continuously over the area, in effect discouraging the establishment of milfoil by tilling the sediment underneath the water. With a relatively small diameter (depending on the model, it can run as small as 16 feet), the machines do need to be moved around in order to be able to work on the entire vegetated area. Additionally, these systems cannot work once weeds are already growing, so it may be necessary to harvest the weeds in a given area before installation. The base price for such devices is approximately $2,000, and they require various permits before they can be installed in a water body.

Besides devices that rely on motion to deter weed growth, benthic barriers also provide a low-cost solution, and one that works in a similar way. These barriers are blankets (made from a variety of materials, ranging from window screening to more advanced polyester blends) that are laid upon the lake bottom over the area where they plants are growing. They prevent the plants from receiving light, and thus discourage plant growth. Although the materials are inexpensive (as low as $0.22 per square foot), regular maintenance is needed to prevent sediment from accumulating on top of the screen, which would create a new area for the weeds to grow in. There are professionals who will install and maintain benthic barriers for their clients, and their prices can average $750 or more for the installation of 1,000 square feet, with maintenance costs of about $100 per year.[18]

Biological Treatments

Although not widely used at this point, biological control techniques are gaining popularity across the United States as viable alternatives to chemical and mechanical methods of milfoil control. Because these methods function within the ecosystem, there is

[17] Washington State Department of Ecology, "Aquatic Plant Management: Rotovation." Last updated June 20, 2006. <http://www.ecy.wa.gov/programs/wq/plants/management/aqua027.html>.
[18] Washington State Department of Ecology. "Aquatic Plant Management: Bottom Screening." Last updates June 20, 2006. <http://www.ecy.wa.gov/programs/wq/plants/management/aqua023.html>.

less concern over the effect that they will have upon the environment. Additionally, biological controls are seen as the only sustainable method of continuous treatment that does not involve huge applications of chemicals or costly human labor to continue. The two most popular forms of biological control involve two species whose presence in a water body may prove detrimental to milfoil stands.

The first such species is the grass carp, or white amur, which is a fish that feeds upon aquatic plants. Although milfoil is not the species of plant preferred most by the fish, it will eat away at milfoil stalks once it has nothing else that it prefers. The fish will not completely eradicate the plant, though they will reduce the amount of plant cover (hopefully by anywhere from 20 to 40%), but such results can take several years before they are shown. Additionally, since the only grass carp that can be allowed into the water body must be sterile, issues of grass carp control and restocking must also be considered. For a vegetated acre of milfoil, some 9 to 25 fish are recommended, with the price of grass carp running anywhere from $5 to $20 per fish depending on number purchased and shipment method. Though this is not necessarily the least expensive method, it is one that has worked with some success in Connecticut and other parts of the country, and one that does not necessitate the use of chemicals or land-disturbing machinery.[19]

The other type of biological control that can be considered is the use of the Eurasian watermilfoil weevil, or *Euhrychiopsis lecontei*. This small insect prefers to feed on milfoil (unlike the grass carp), and can procreate and survive within a water body, even throughout the winter months. While there may be a great deal of promise for the use of the weevil, there is a lack of concrete studies that prove that the weevil can sustain long-term damage to milfoil. Many different sources suggest that weevil concentrations of as low as 1.5 to 2.0 weevils per stem can be effective in reducing the amount of milfoil in a water body; however, at $1 per egg, it can be expensive if there are large acres of vegetation that need to be controlled.[20]

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[19] Washington State Department of Ecology. "Aquatic Plant Management: Triploid Grass Carp." Last updated June 20, 2006. <http://www.ecy.wa.gov/programs/wq/plants/management/aqua024.html>.
[20] Washington State Department of Ecology. "Aquatic Plant Management: Biological Control." Last updated June 20, 2006. <http://www.ecy.wa.gov/programs/wq/plants/management/weevil.html>.

CONCLUSION

Overall, there are a wide variety of methods that one can consider when it comes to managing milfoil. However, before the discussion of methods begin, one must first outline a plan that will have identifiable goals and objectives which can be reevaluated in the future to continually monitor the success of the management efforts. As was the case in the past, the technical committee would play a significant role in the development of a management by reviewing the relevant data on milfoil management as well as the annual mapping efforts provided by NE Energy Services. Therefore, it seems that, while more research and discussion is needed before a milfoil management plan for Candlewood can be put into action, discussion of the various alternatives available can certainly begin to take shape.

APPENDIX

The Work of the Connecticut Agriculture Experiment Station in Mapping Milfoil

Over the last several years, the Connecticut Agriculture Experiment Station (CAES) has conducted numerous nuisance aquatic plant mapping projects in order to assess the magnitude of aquatic invasives in Connecticut. This process included the physical reconnaissance and mapping, with the aid of global positioning system (GPS) technology, of various stands of milfoil, as well as the establishment of transects in the water to use as a gauge for the types and densities of various aquatic plant species in the lake. Over the course of two years (2005 and 2006), CAES conducted a survey of Candlewood Lake and compiled its results into a geographic information system (GIS) format so that the data could be represented symbolically on a map and compared to future mappings to assess trends. The data was overlaid on to an aerial image of Candlewood Lake, making it easy to see where CAES found the milfoil and where the transects were located. CAES covered the entire lake, and milfoil was found near the shorelines of each of the five towns that border the lake. This GIS data was used to make maps of each of the towns' shorelines to show estimations of where milfoil beds were in the past two growing seasons. The maps of Sherman (Figure 2), New Milford (Figure 3), New Fairfield (Figure 4), Brookfield (Figure 5), and Danbury (Figure 6) are included, as well as a map of the entire lake (Figure 1). More information about the invasive species identification work done by the CAES can be found at its website: http://www.caes.state.ct.us/AquaticPlants/index.htm.

Figure 1

Location of Invasive Aquatic Weeds
Candlewood Lake

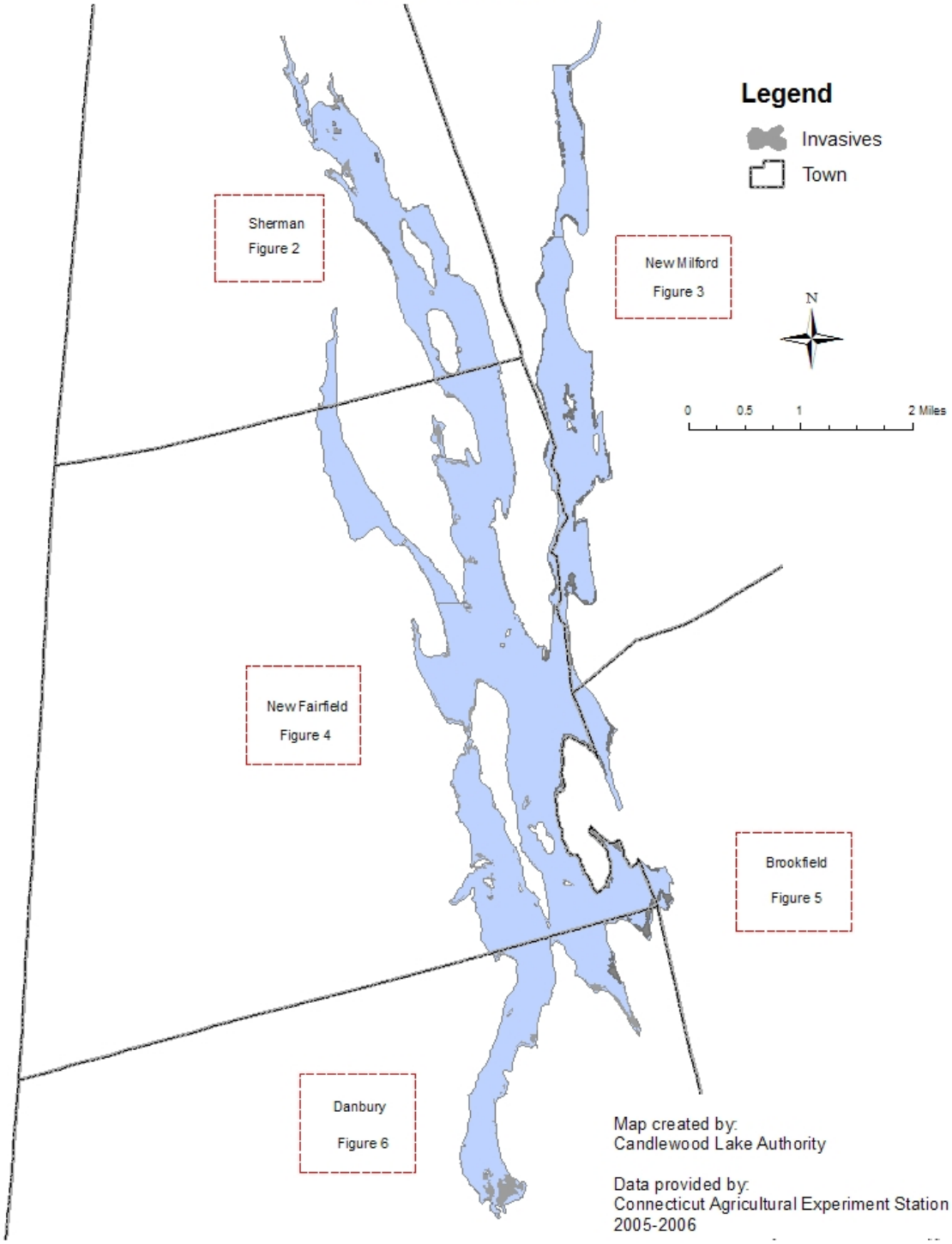
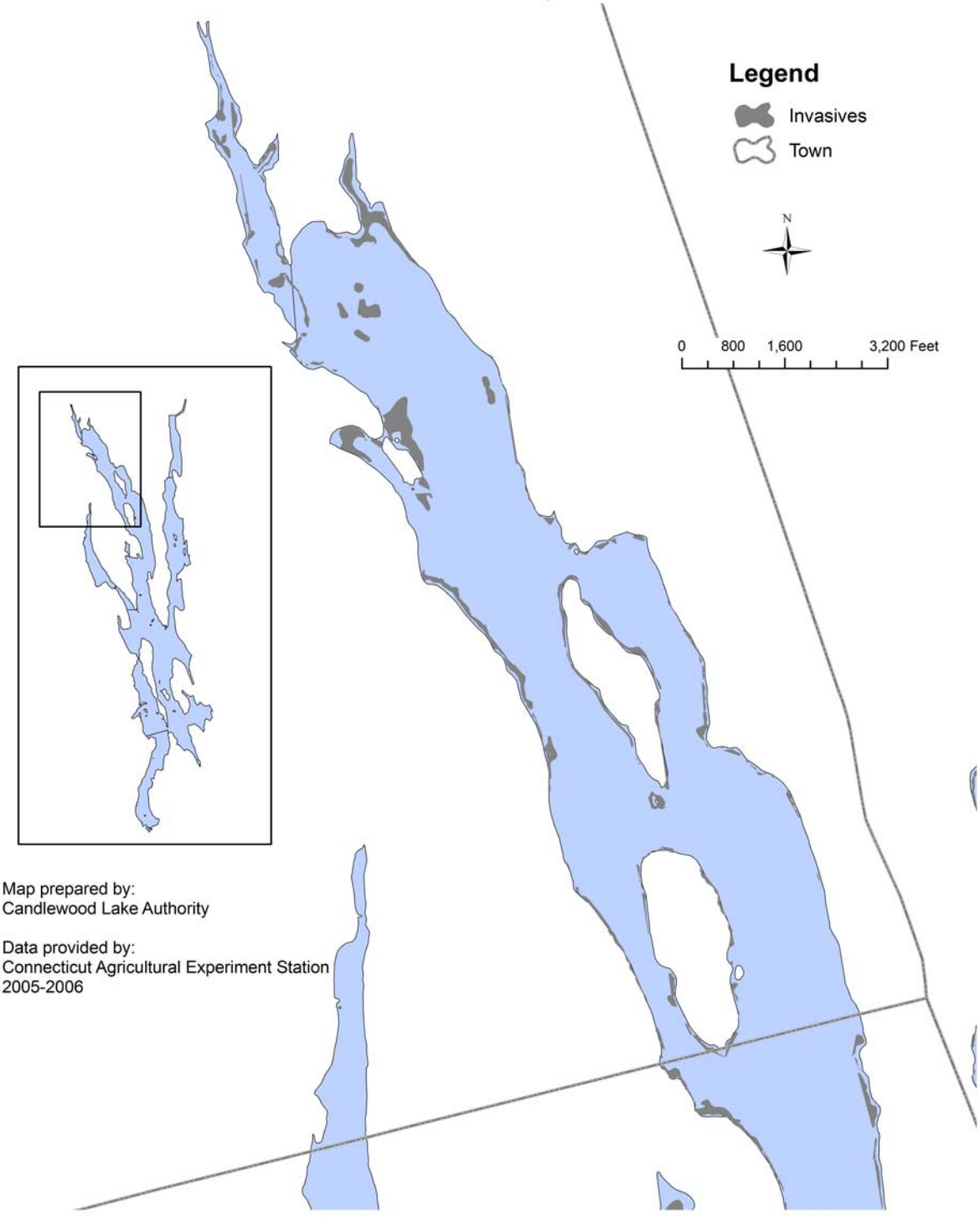


Figure 2

Location of Invasive Aquatic Weeds
Sherman, CT



Map prepared by:
Candlewood Lake Authority

Data provided by:
Connecticut Agricultural Experiment Station
2005-2006

Figure 3

Location of Invasive Aquatic Weeds
New Milford, CT

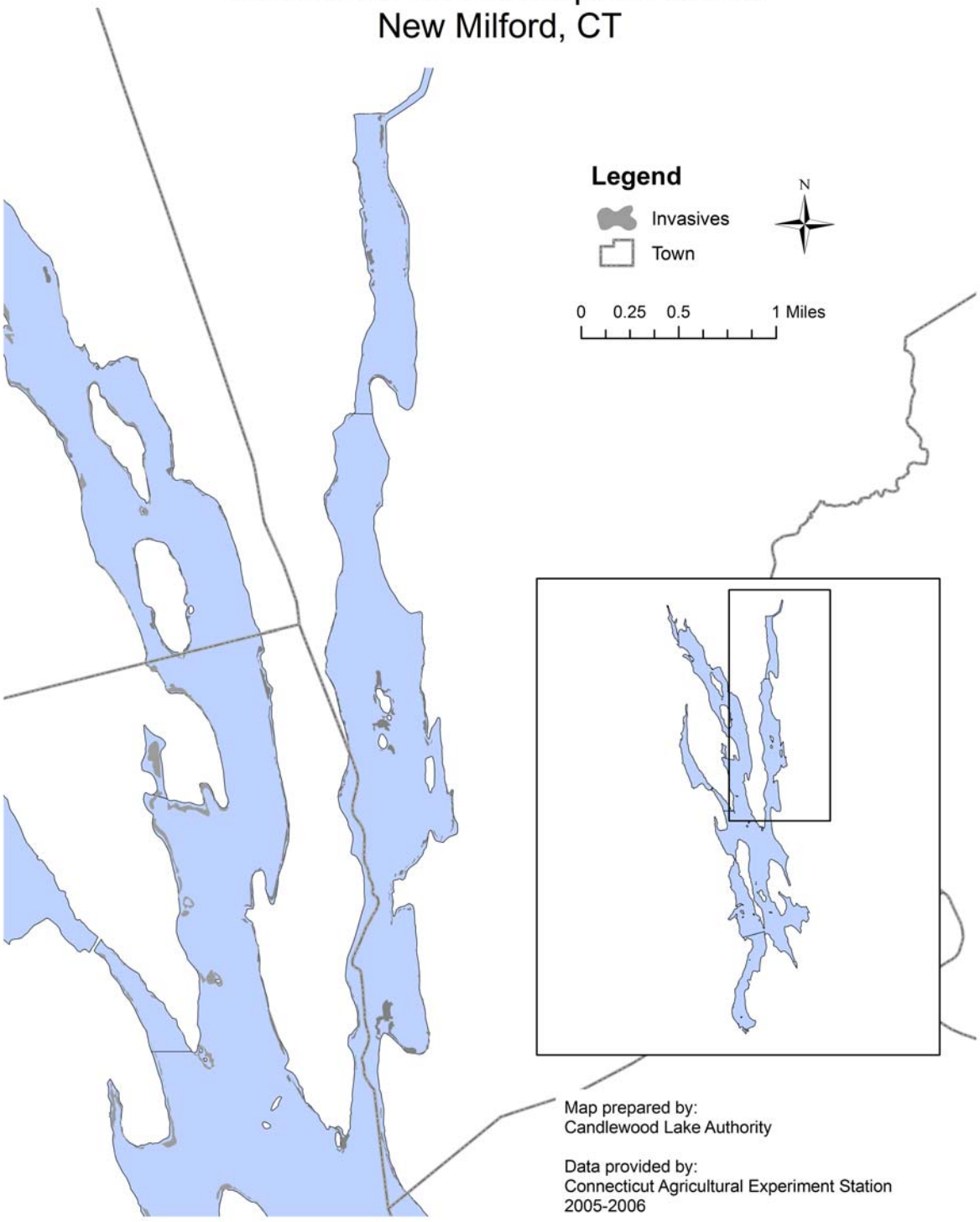
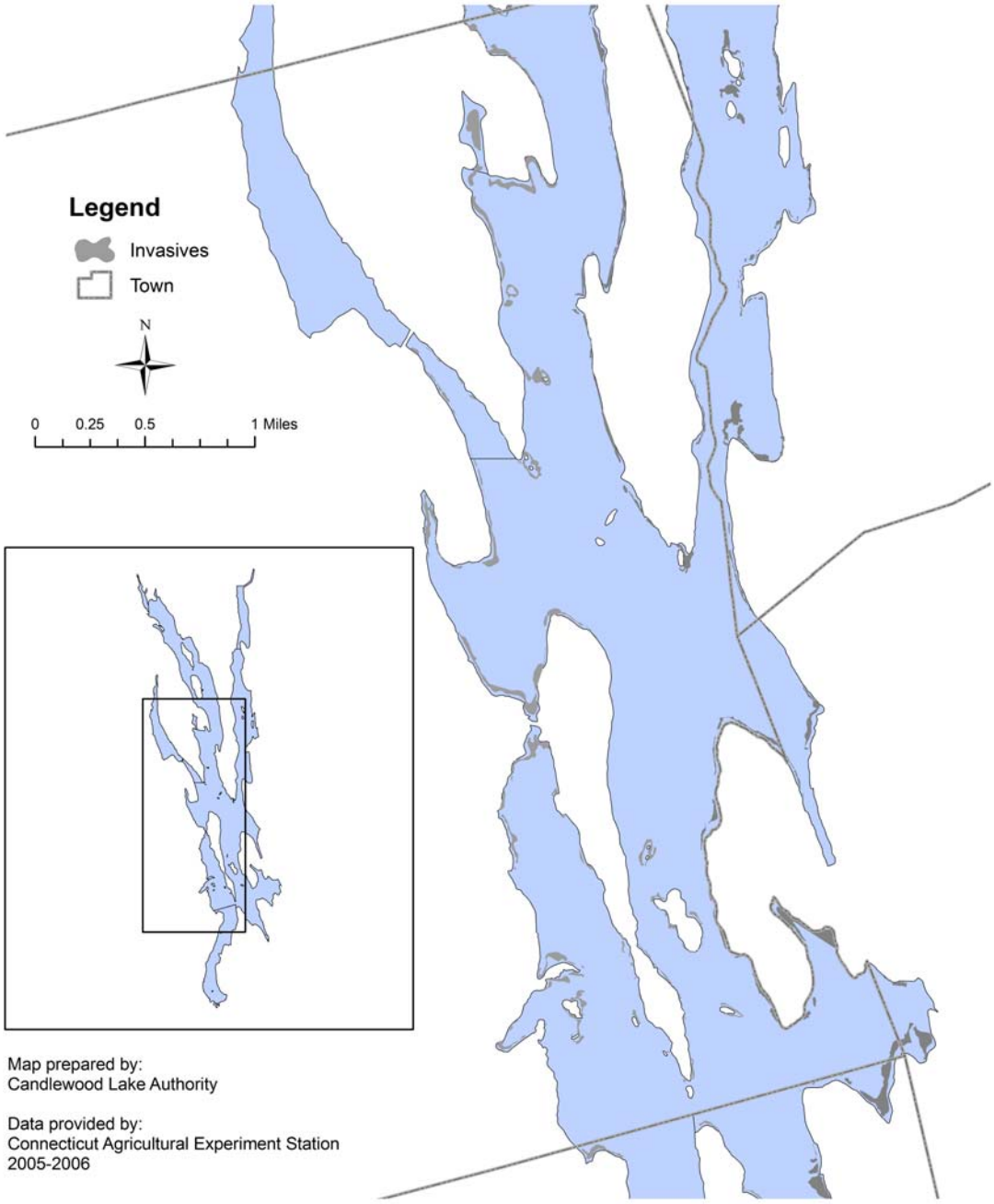


FIgure 4

Location of Invasive Aquatic Weeds
New Fairfield, CT



Map prepared by:
Candlewood Lake Authority

Data provided by:
Connecticut Agricultural Experiment Station
2005-2006

Figure 5

Location of Invasive Aquatic Weeds
Brookfield, CT

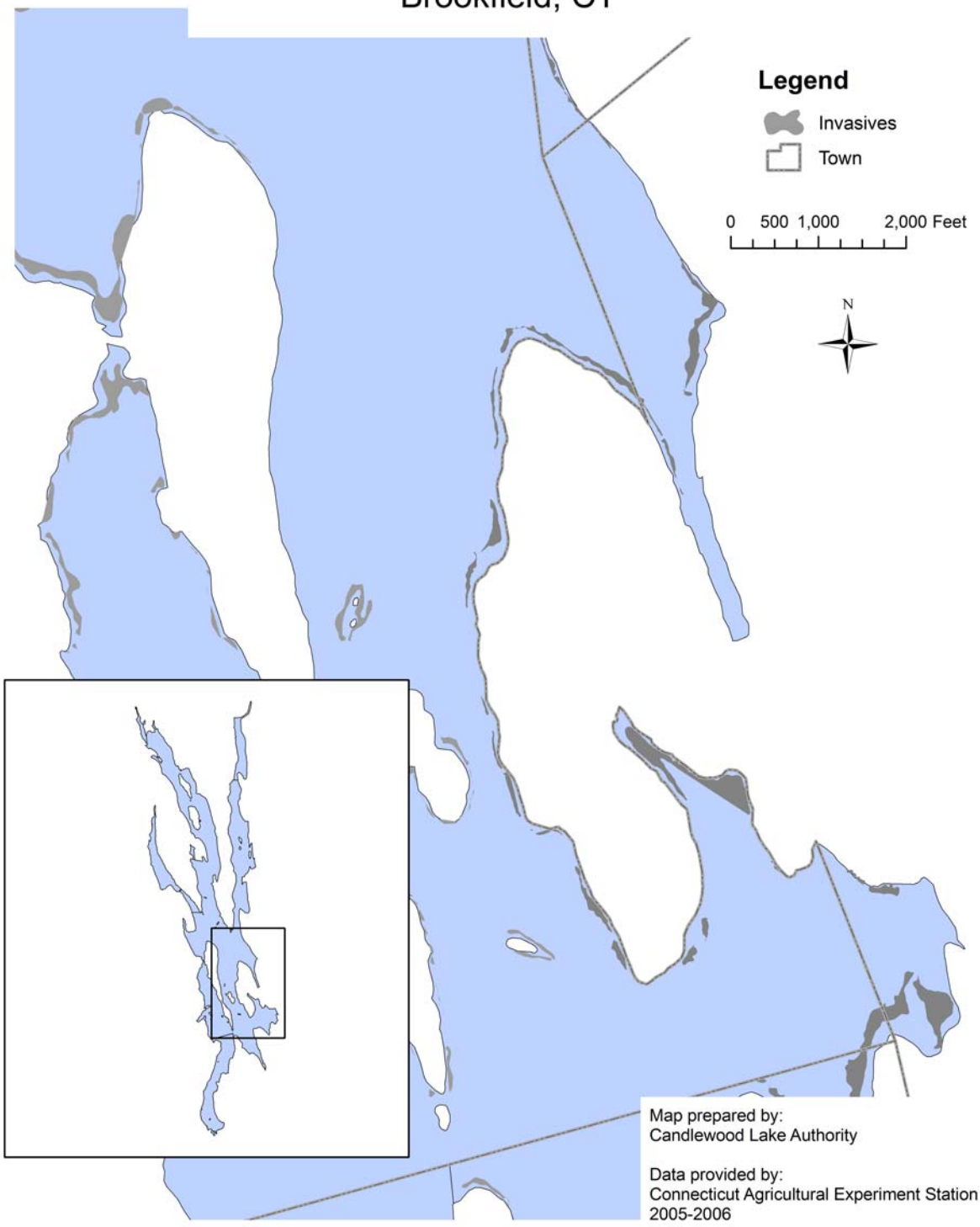
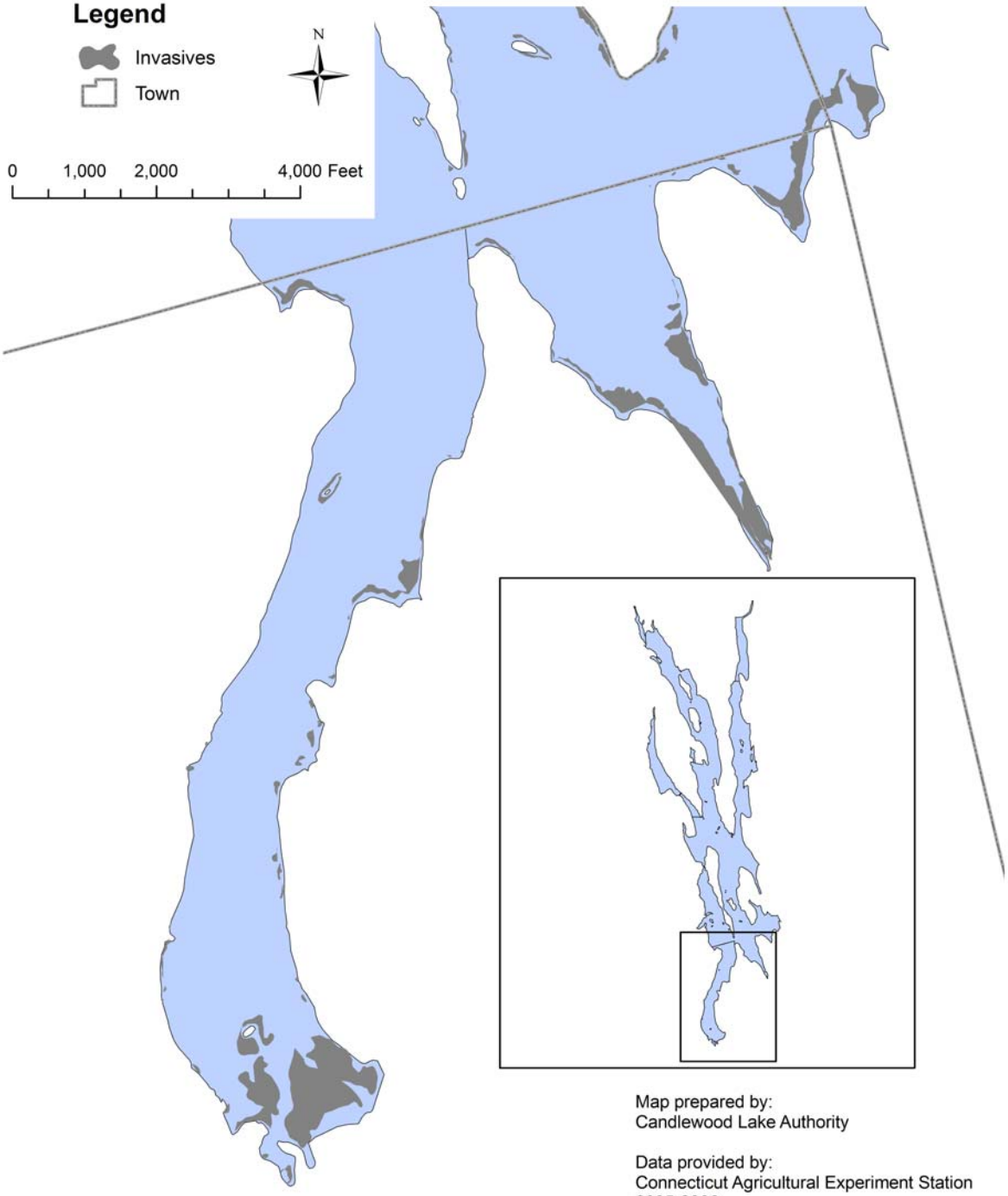


Figure 6

Location of Invasive Aquatic Weeds
Danbury, CT



Map prepared by:
Candlewood Lake Authority

Data provided by:
Connecticut Agricultural Experiment Station
2005-2006