Invasive Plant Management Plan for an Emergent Marsh in Branford, Connecticut

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May 11, 2004
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Forward

This management plan was created to assist Ellis Bradley, Robert and Patricia Comfort rehabilitate the corner of the cattail marsh that occurs on their property by removing invasive plants and planting natives in an effort to restore wetland structure and function.

The vision for the restored marsh is a remarkable sight. Native plants, diverse habitat structure for wildlife, invasive plant removal, and the improvement of the buffer zone to the marsh are all components of the restoration process. Boulders will be sporadically embedded in the ground in some areas and natural ledge rock outcroppings will be enhanced. The marsh edge will be regarded into a more natural curving border, thereby providing a more gradual transition from upland to marsh. Native upland and wetland plants will fill in the spaces around the boulders and along the edge. The restored marsh not only will be a refuge for wildlife and a botanist's dream in terms of the native plant diversity.

It will also be a beautiful sight for the people who live on and near the property. Neighbors will want to come and walk by the marsh it will be so inviting. It will be the perfect place for reflection and the appreciation of the natural world. Having these sorts of places these days is absolutely critical to our well being. As more and more land is lost, we have to work locally and globally to protect and restore the natural resource areas we have. This will be an impressive and inspiring local accomplishment, considering the current state of the marsh as an overgrown invasive plant refuge.

The marsh has potential to become this vision, provided we act soon. The marsh *right now* is in a state where we can manage the invasive plants and proactively plant natives with the goal of returning the marsh to a pre-invaded state dominated by cattails. To wait five years would be a dire mistake. In five years the invasive plants, particularly *Phragmites*, yellow flag iris, and swamp willow will consume the cattail habitat. By acting now, we can get this marsh on the right path to recovery and make the vision of the restored marsh a reality.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

List of Primary Recommendations

1. Identify priority invasive plants and management strategies for removal.

   A. ***Phragmites***: Combination control: black tarp & glyphosphate (Rodeo)application

   B. **Yellow flag Iris:** Black tarp & glyphosphate (Rodeo) foliar application

   C. **Swamp willow:** Cut-stump glyphosphate (Rodeo) application; Bulldoze/excavate plant (may need permit)

   D. **Norway maple:** Girdle trees cut-stump glyphosphate application

   E. **Multiflora rose**: Combination control: cut-stump glyphosphate application and repeated cutting.

   F. **Japanese knotweed:** Hand pull, remove rhizomes for young plants glyphosphate foliar application for mature plants

   G. **Japanese honeysuckle:** Hand pull vines.

   H. **Japanese barberry:** Hand pull shrubs, wear gloves.

   I. **Watch List Species:** Monitor for expansion.

2. Implement removal strategies, repeat strategies for challenging plants.
3. Implement Buffer Zone Enhancement Planting Plan.
4. Clean up garbage from marsh and pond.
5. Encourage town to maintain storm drain and culvert.
6. Monitor planting areas for 90% native cover over 2 growing seasons.
7. Monitor for Watch List species invasions and expansion on the property
8. Monitor for re-invasion of priority invasives.
9. Stay updated on invasive plants to identify ones not mentioned in this plan.
10. Enjoy the restored marsh!

CHAPTER ONE

1. Introduction

This management plan identifies strategies for removing selected nonnative and native invasive plants from a small emergent marsh associated with a freshwater coastal pond in Branford, Connecticut. The removal and eradication strategies target specific stages of the biology and ecology of the identified invasive plant species. The strategies are further designed to provide native species with a competitive advantage over the invasive species and were chosen for easy and cost-effective implementation by an individual landowner, and for compliance with local wetland regulations. A wetland buffer zone enhancement planting plan is a component of this management plan as well as a section addressing non native invasive plants to watch out for on the property in the future.

1.1. Invasive Plants

Exotics plants are plants that have been introduced both accidentally and intentionally into areas outside of their natural home range (Hiebert and Stubbendieck 1993). Invasive plants include both native and non-native species that are characterized by their ability to spread rapidly and take over areas and alter ecosystem structures and functions (Goodwin et al. 1999). More than 30% of New England's flora is exotic (Westover 1994). Exotic species have contributed to a 42% decline in native rare and endangered species and are second to habitat destruction in terms of a threat to native species (TNC 2004). Most exotic plants are not invasive and not all invasive plants are exotic (Hiebert and Stubbendieck 1993). However, in the case of the Comfort property, most of the targeted plants for removal are both invasive and exotic.

These plants are of primary concern today for the major ecologic, economic and health risks associated with them (Davis et al. 2000; Mack et al. 2000; With 2002). They have the ability to displace native species, alter ecosystem structure and function, and they are one of the primary causes of native biodiversity loss (With 2002; Stohlgren 2001). Invasive plants often (but not always) share similar biological and ecological characteristics: they can reproduce

both sexually and vegetatively (asexually or clonally), produce many offspring, disperse efficiently, lack natural predators and pathogens, break bud earlier and senesce (lose their leaves) later than native plants, and tolerate a broad range of environmental conditions (Daehler 1998; Goodwin et al. 1999; Mack et al. 2000). These traits give invasive plants a competitive advantage over non-invasive plants which increases their potential to take over an area. Early identification and removal of invasive nonnative plants is the most effective way to prevent their spread into wetlands, woodlands, and fields.

1.2 Project Goals

The ultimate goal of this project is to identify viable strategies for removing the invasive aquatic emergent and upland plants that have invaded the native cattail marsh with the purpose of restoring the wetland system. This restoration effort will revitalize the pond and marsh by improving wetland functions such as storage of flood and storm water, sediment and particulate retention, nutrient and contaminant retention, and providing native plant habitat for various wildlife species (LISS 2003). The development of this management plan also intends to bring together community members who share this resource to work together towards restoring the coastal pond and marsh to a pre-invaded state.

1.3 Methodology

Recommendations for invasive species removal were developed from a review of the scientific and gray (from private non-profits and academic unpublished papers) literature that exists on the targeted invasive plants. Close attention was paid to the specific biological life cycles of the plants to identify the most vulnerable stages and efficient timeframes for the removal of each plant species. An inventory of native and invasive plant species was conducted on the property. A ranking system was developed for high priority species to remove and natives to restore. Strategies were researched with consideration of the small-scale of the project and the goal for cost-effectiveness. A wetland buffer zone (upland area immediately adjacent to the emergent marsh and pond border) enhancement planting plan was also developed to encourage native plant establishment on the property.

CHAPTER TWO

2. General Site Description

2.1 Property and Resource Area Description

The approximately one acre freshwater pond and emergent marsh occur on the Comfort property, located in a residential area in the Double Beach section of Branford, Connecticut (Figure 2.1). A number of single family dwellings surround the pond. An emergent marsh

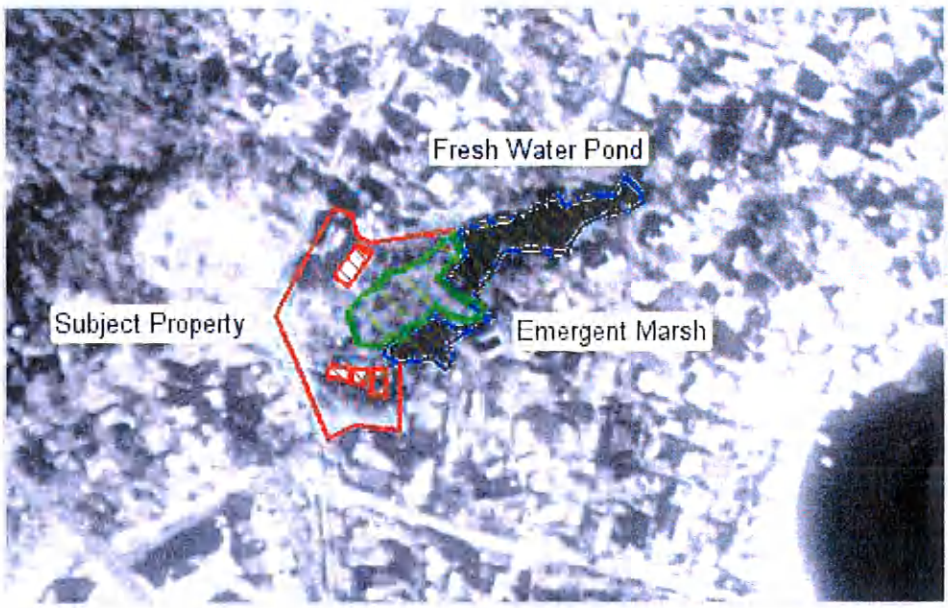

Figure 2.1. 2000 aerial photograph of the Comfort property identifying the subject property, emergent marsh and fresh water pond.
(North is towards the top of the page).

dominated by broad-leaved cattail (*Typha latifolia*) occurs within the western portion of the pond. Three single family dwellings, a woodworking shop and an empty lot occur on the property and are adjacent to the marsh. An unoccupied osprey pole is located within the marsh, erected by the landowner five years ago. The site consists of relatively flat terrain and is comprised primarily of ornamental plants and areas devoid of vegetation.

2.2 Past Land-Use and Disturbance History

The property has been in residential use for over 60 years. Prior to residential use, the property consisted of forested land surrounded by adjacent hay fields. These old fields have since been subdivided and sold for condominium developments and single family dwellings. The area around the pond has been subject to forest clearing, filling and leveling for the existence of outbuildings on the property.

The western portion of the pond was reported to have been drying up and converting from an emergent marsh to a shrub swamp in the early 1990s. In response to the invasion of woody plants into the marsh, the landowner cleared a number of red maple trees and removed swamp willow (*Salix spp.)* seedlings that were invading the cattail area. The landowner also described the invasion and expansion of common reed (*Phragmites australis*) and yellow flag iris *(Iris pseudacorus*) over the last fifteen years (Figure 2.2).

Figure 2.2. Western portion of the emergent marsh invaded by common reed (middle left), yellow flag iris (front center) and swamp willow (back center-right) in April 2004.
North is towards the top of page.

Historical disturbances on the site include adjacent road construction, widening, blasting and direct dumping by the town 25 years ago. Abandoned fire pits overgrown with native and exotic vegetation occupy some of the back yards surrounding the pond and marsh. The land immediately adjacent to the pond and marsh consists of fragmented vegetation cover, lawns, and areas devoid of vegetation. The wetland has endured past decades of waste dumping including tires, household debris and organic materials such as leaves, tree trimmings, stumps and lawn cuttings (Figure 2.3).

Figure 2.3. Dumped debris in marsh (April 2004).

Figure 2.4. Overflowing storm drain during storm (April 2004).

Non point source pollutants including salts, oils and sand enter directly into the pond through a street catch basin in Double Beach Road (Figure 2.4). Leaf piles and other organic debris including wood chips and compost have been intentionally deposited along the upper edge of the marsh in an effort to build soil in anticipation of eventually re-grading the marsh edge into a more natural border. After strong wind storms, some of this organic matter occasionally enters the pond.

In addition to anthropogenic disturbances, the site is subject to a number of natural disturbances including flooding, droughts, hurricanes, snow and ice. These disturbances

have historically maintained the flora and fauna of the pond and marsh. Native plants are adapted to these disturbances; however, anthropogenic disturbances such as those described above are accelerating vegetation change along the pond edge and favoring invasive plants.

2.3 Hydrology, Soils and Geology

The hydrologic dynamics of the pond control vegetation patterns. The marsh and pond comprise a palustrine wetland system (Figure 2.5). Palustrine wetlands are non-tidal, fresh fresh water systems that are less than 20 acres, less than six feet deep and comprised primarily of trees, shrubs and emergent vegetation as well as non vegetated areas (Cowardin et al. 1979).

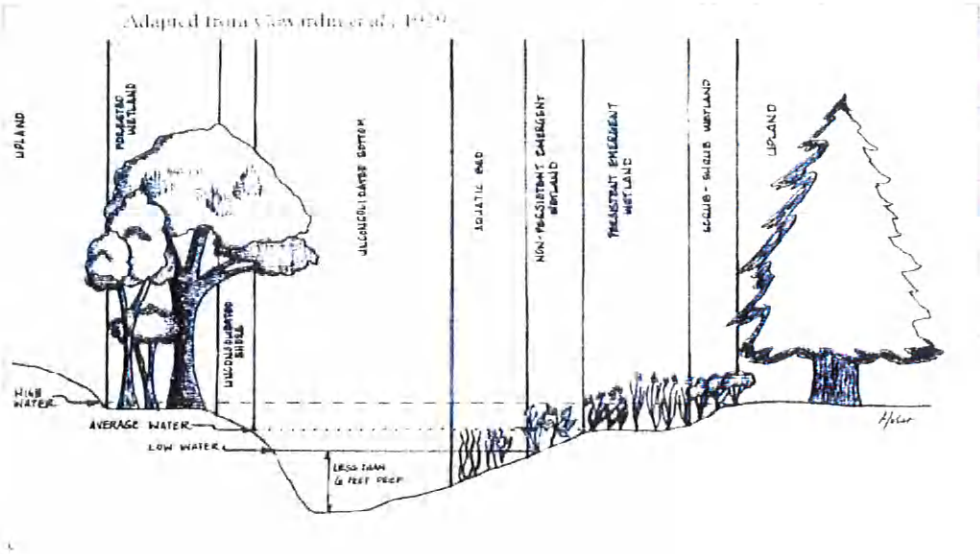

Figure 2.5. Palustrine Wetland System (From LISS 2003).

The western portion of the wetland system contains an emergent marsh which is comprised primarily of herbaceous vegetation adapted to saturated (wet continuously) soil conditions. Vegetation types change along a distinct water-depth gradient from open water to waters-edge to upland. The open water areas contain no vegetation; the wetland edge contains emergent plants, the slopes of the pond and marsh contain plants adapted to dry and wet conditions, and the upper edge of the pond and upland areas contain vegetation adapted to dry conditions.

The marsh and pond system occurs within two enclosed interconnected basins (Figure 2.6). A small stream flows out of the pond in an easterly direction past a number of houses, through a culvert and empties into Lamphier Cove, an outer lobe of Branford Harbor in Long Island Sound. The approximate location of the stream is depicted on the map (Figure 2.6). Water flows into the emergent marsh and pond from a storm drain on Double Beach Road and through an approximately 16 foot diameter culvert that is buried under the western corner of the property. The culvert reportedly drains into the western portion of the marsh underneath large boulders along the marsh edge. The storm drain and culvert are not regularly maintained and blockages often occur in the culvert as indicated by low to zero flow during storm events. A number of boulders were placed along the western edge of the marsh when the adjacent road was expanded. Dense vegetation now grows over and between the boulders, obscuring the culvert from view. Runoff from the lot also flows directly into the pond. Another small six inch PVC pipe funnels water generated by hydrostatic pressure along the impermeable ledge bedrock from under the basement of one off the houses on site (Figure 2-7).

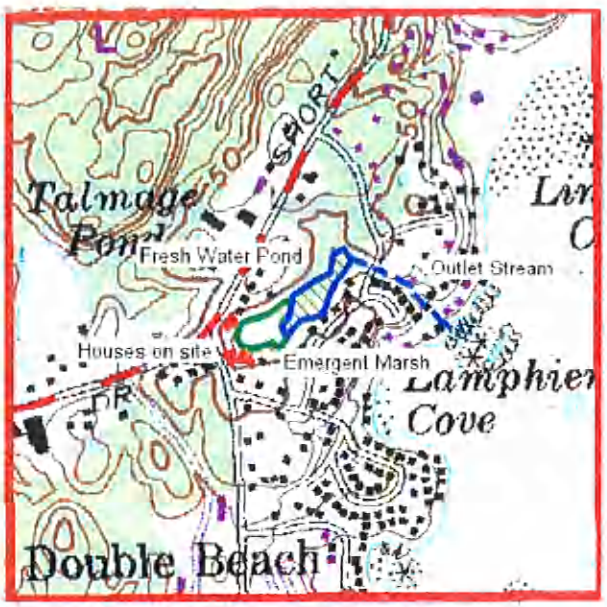

Figure 2.6. USGS topographic map with subject property and wetland resource areas depicted.

Figure 2-7. PVC pipe draining water from ledge under basement into marsh during a rainstorm (April 2004).

The effects of runoff into the pond and marsh include increased nutrient loading which can lower oxygen levels in the fresh water system, and sedimentation which can raise the elevation of the marsh. This upsets the ecological balance in the wetland which can be detrimental to aquatic organisms and cause a shift in vegetation communities (Westover 1994).

The upland soils on site are mapped as Branford-Holyoke silt loams by the Soil Survey of New Haven, Connecticut, compiled by the US Soil Conservation Service. Udorthents, which are soils disturbed by human activity and are composed primarily of fill, also occur on the property in association with adjacent road blasting and building in the 1980s. The marsh and pond contain Adrian and Palms mucks, which are hydric, organic soils that are saturated year round.

The relatively shallow upland soils and the wetland soils are underlain by granite and gneiss bedrock. Larger gneiss outcrops occur to the southeast of the property along the coastal edge. The surficial geology is comprised of thin glacial till, which consists of unsorted sediments deposited by glaciers.

2.5 Local Wetland Regulations

The Town of Branford's Inland and Wetland Regulations are consistent with the Connecticut State Statues Sections 22a-36 through 22a-45a (Appendix A). A permit must be filed with the town when proposing construction, earthmoving and clearcutting within 100 feet of an inland wetland or watercourse (Town of Branford Inland Wetland Regulations, Appendix B). The emergent marsh and pond are classified as inland wetlands. The state and the town both encourage the planting of native species within the buffer zones to inland wetlands and are in favor of invasive plant removal.

For this project, consultations are recommended between the land owner and the town prior to implementing invasive removal, particularly if herbicides are used. It is unlikely that an official permit will need to be issued for the work recommended here in accordance with sections 22a-40(4) and 22a-40(6b1) of the CT General Statues (Appendix A). However, the town may have resources that could aid in the invasive species removal and restoration efforts. If the landowner wants to pursue excavation activities within the marsh for the creation of additional open water habitat, a permit will be needed. The Town of Branford Inland Wetlands Commission supports wetland restoration projects; therefore, obtaining town approval should not be a problem.

CHAPTER THREE

3. Natural Resource Inventory

A natural resource inventory of the flora was conducted on the property in April 2004. Faunal observations were included in the inventory. As the resource area is relatively small (approximately 1 acre), an inventory of the entire area was possible in lieu of traditional ecologic inventories that include transect and/or plot establishment. The pond (approximately 0.54 acres), emergent marsh (approximately 0.45 acres), wetland edge (0.2 acres), and upland area (approximately 0.3 acres) were separated as ecological inventory units. Acreage was estimated using a geographic information systems program.

A list of vegetation species was compiled and percent cover (greater than five percent of the total area for each ecologic unit) was estimated for species occurring within the open water area, the marsh area, the wetland edge and the upland area (Appendix C). The native/invasive status of each plant is included in this list. Identifications were made to the species level when morphologically possible. Because the inventory took place in April, some species may have been underestimated or not included in the inventory, as they were either just emerging or had not emerged from winter dormancy. Because the goal of this management plant is invasive species control, invasive plants prioritized for removal were ranked according to those with the greatest percent cover within each ecological unit.

No formal survey was conducted on wildlife species, however; fauna observations from the botanist and landowner are included in Section 3.3. Wildlife habitat was used as an indicator of obligate (species that require specific vegetation and/or environmental conditions to survive) wildlife species.

3.1 Wetland and Upland Flora

The dominant plants within each ecologic unit are mapped in Figure 3.1. The majority of the pond contains open water; however, the western lobe contains an emergent marsh dominated by broad leaved cattail, common reed, yellow iris, and swamp willow. An aquatic

Figure 3.1 Dominant vegetation types in the emergent marsh.

plant was recently observed within the emergent marsh that has not been identified (Figure 3.2). This plant has a dense rhizome network and is able to grow as a vine up *Phragmites* shoots. Efforts should be made to identify whether this plant is exotic and if a management strategy is necessary to control the plant.

Figure 3.2 Unidentified aquatic weed located in the open water habitat (April 2004).

Along the wetland edge, red maple (*Acer rubrum*) and green ash (*Fraxinus pennsylvanica*) are the dominant trees. These species are adapted to saturated and anaerobic (no oxygen in the soil) conditions. In addition, scattered clumps of skunk cabbage (*Symplocarpus foetidus*) (Figure 3.3) and sensitive fern (*Onoclea sensibilis*) are present amongst the *Phragmites* and yellow flag iris (Figure 3.4).

Figure 3.3. Skunk cabbage in marsh (April 2004).

Figure 3.4. Sensitive fern in marsh (April 2004).

The terrain slopes relatively steeply along the marsh edge and the vegetation shifts from wetland to upland plants over a short distance. The lower and mid slopes of the marsh and pond edges contain native facultative (species that are associated with wetlands but can grow in uplands as well) wetland species including red maple, staghorn sumac (*Rhus typhina*), scattered patches of highbush blueberry (*Vaccinium corymbosum*) (Figure 3.5), as well as occasional individuals of spice bush (*Lindera benzoin*) and silky dogwood (*Cornus amomum*) (Figure 3.6).

Figure 3.5. Highbush blueberry in marsh April 2004.

Figure 3.6. Silky dogwood in marsh April 2004.

Just upslope, upland invasive plants are more prominent. These include Norway maple (*Acer platanoides*), multiflora rose (*Rosa multiflora*), Japanese honeysuckle (*Lonicera japonica*), honeysuckle shrubs (*Lonicera* spp.) and scattered patches of barberry (*Berberis thunbergii*).

Beyond the sparse shrub border, the upland areas to the west and south are generally devoid of vegetation. Some areas within the upland were seeded with clover last year, while other areas were covered with wood chips to prevent erosion and develop organic soil overtime through decomposition. Lawn interspersed with landscape plants including multiflora rose, mulberry (*Morus* spp.), Norway maple, eastern red cedar (*Juniperus virginiana*), black cherry (*Prunus serotina*) and forsythia (*Forsythia* spp.) occurs to the northwest and southwest of the marsh/pond edge. To the southeast of the marsh, a large patch of Japanese knotweed (*Polygonum cuspidatum*) has recently established on disturbed soils interspersed with spotted touch-me-knot (*Impatiens capensis*) (Figure 3.7). Another patch of Japanese knotweed occurs to the north of the marsh.

Figure 3.7 Japanese knotweed (taller plants) and spotted touch-me-nots along the eastern property boundary in April 2004.

3.2 Priority Invasive Plants for Removal

A list of priority invasive plants to remove from the property was generated from the natural resource inventory (Figure 3.8). These plants have invaded the marsh and the upland over the last fifteen years. The remainder of this management plan focuses on the ecology and biology of these specific plants as well as their removal.

Figure 3.8. Priority invasive plants to target for removal based on the floral inventory.

1. Common reed (referred to as *Phragmites*)
2. Yellow flag iris
3. Norway maple
4. Swamp willow
5. Multiflora rose
6. Japanese knotweed
7. Japanese honeysuckle
8. Japanese barberry

3.3 Invasive Species Watch List

In addition to the priority invasives identified on the property, there are a number of other plants that have invasive characteristics and occur in small populations on the property (Figure 3.9). These plants should be monitored for expansion into other portions of the property. Ecological characteristics of these plants as well as removal strategies for are discussed in Sections 4 and 5 of this report. A list of potential invaders that do not occur on the property is also included (Figure 3.9). These species have been identified in other parts of Branford and may appear on the property in the future.

Figure 3.9. Priority invasive plants to watch out for that may spread on the property:

1. Honey suckle shrubs (*Lonicera* spp.)
2. Oriental bittersweet (*Celastrus orbiculatus*)
3. English ivy (*Hedera helix*)
4. Common periwinkle (*Vinca major*)
5. Forsythia (*Forsythia* spp.)

Priority invasive species to watch out for that are not on the property:

1. Purple loosestrife (*Lythrum salicaria*)
2. Burning bush (*Euoynomous alatus*)
3. Garlic mustard (*Allaria petiolata*)
4. See Appendix D

3.4 Wetland and Upland Fauna

The pond is a fresh water refuge for a number of bird species. A colony of red-wing black birds (*Agelaius phoeniceus*) arrives at the marsh every spring and engages in territorial and courtship displays (Figure 3.10). Red-winged black birds prefer cattails for these displays and nest building. American robins (*Turdus migratorius*), grackles (*Quiscalus quiscula*), black-capped chickadees (*Poecile atricapilla*), tufted titmice (*Baeolophus bicolor*), mourning doves (*Zenaida macroura*), swamp sparrows (*Melospiza georgiana*), marsh wrens (*Cistothorus palustris*), mallards (*Anas platyrhynchos*), bluejays (*Cyanocitta cristata*), northern cardinals (*Cardinalis cardinalis*), gray catbirds (*Dumetella carolinensis*), Baltimore orioles (*Icterus galbula*), American crows (*Corvus brachyrhynchos*) and downy woodpeckers (*Picoides pubescens*) are just some of the many birds that have been observed around the marsh, pond and upland areas.

Figure 3.10 Redwing black bird in green ash alongside the marsh. April 2004.

Figure 3.11. Osprey pole in marsh. April 2004.

Although there have been no ospreys yet, a nesting platform was erected in the marsh five years ago and is available for occupation (Figure 3.11). A number of well-stocked bird feeders occur west of the wetland area.

Many mammals also visit the pond including red fox (*Vulpes vulpes*) (Figure 3.12), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), eastern gray squirrel (*Sciurus carolinensis*), eastern chipmunk (*Tamias striatus*), Eastern cottontail (*Sylvilagus floridanus*), masked shrew (*Sorex cinerius*) and opossum (*Didelphis virginiana*). Amphibians including spring peepers (*Pseudacris crucifer*) and green frogs (*Rana clamitans*) are heard in April and May. Eastern bull frogs (*Rana catesbeiana*) also visit the pond. Reptiles including eastern box turtles (*Terrapene carolina*) and snapping turtles (*Chelydra serpentine*) have also been observed in the wetland. Butterflies, dragonflies, damselflies and bees visit the marsh and some act as pollinators for various plant species. Many other vertebrate and invertebrate species potentially utilize the pond and marsh system.

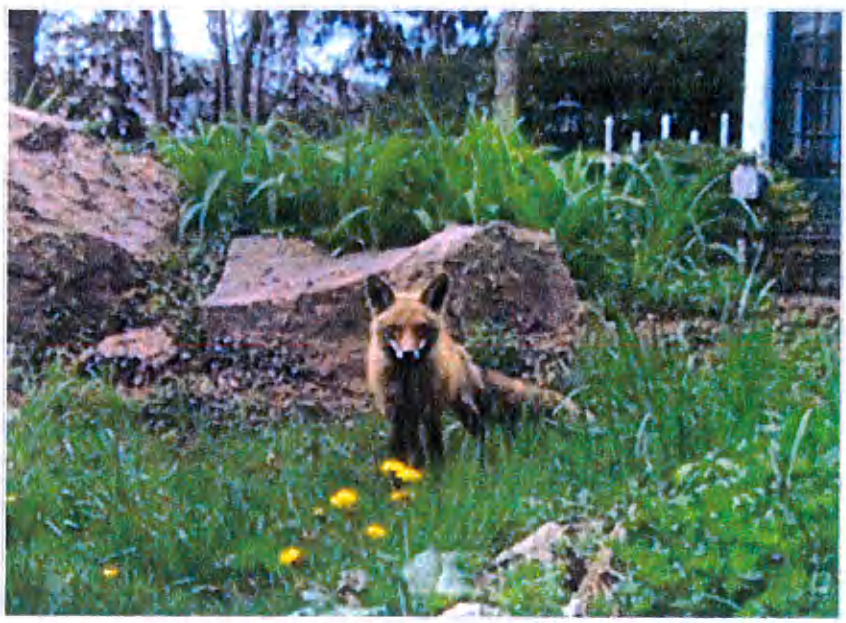

Figure 3.12. Red fox on daily visit to the property (April 2004).

CHAPTER FOUR

4. Invasive Plant Biology and Ecology

The invasive plants common reed, yellow iris, swamp willow, Norway maple, multiflora rose, Japanese knotweed, Japanese honeysuckle, and Japanese barberry occur prominently within and along the edge of the emergent marsh and pond on the Comfort property. These plants are of particular concern because their seeds are easily dispersed by birds, their bud break is earlier and they senesce later, and they out-compete and replace native plants. The Branford Land Trust and Branford Conservation Commission identify invasive plants as primary problems in their reserves. Appendix D includes a list of invasive plants in Connecticut.

Early detection and removal of invasive plants is the most effective way to prevent spread of these species on the property and in adjacent wetland and woodland areas. As the invasion of these plants is relatively recent (in the last 15-20 years), and the populations are relatively small, control of these plants to prevent further spread is a manageable goal for the landowner. The following section describes the ecology and biology of the specific invasive plants on the property. Section 5 identifies management scenarios for each plant.

4.1 Common reed- *Phragmites australis*

Phragmites is a perennial grass that grows to be 13 feet and is adapted to a broad range of environmental conditions. It is associated with both freshwater and salt water wetlands (Cross and Flemming 1989) (Figure 4.1). Although its status as an exotic has been debated, it now appears that the grass has been in the New England botanical record for hundreds of years. However, an aggressive European genetic strain of the plant has become invasive in the last 50 years (Saltonstall 2002; Orson 2003). *Phragmites* is considered

Figure 4.1. *Phragmites* in an emergent marsh.

an invasive plant because it forms dense monotypic stands and reduces plant diversity by shading out native plants and out-competing them for resources including nutrients, sunlight, water and rooting space. Many salt marshes and freshwater wetlands throughout Branford have turned into dense monocultures of *Phragmites*.

Phragmites shoots begin to grow in April and growth slows by the end of June. Leaf development occurs much later, which prevents self shading as the shoot grows. Individual shoots put energy into growing tall, rather than growing thick. The grass flowers in July and sets seed in August. Seeds remain viable through the winter. It takes 5-8 years for the plant to reach full height and 3-4 years to become mature and produce flowers.

Phragmites employs two complex reproduction strategies including the production of both wind and water-borne seeds as well as rhizome production. This gives the plant a competitive advantage over native plants that typically employ only one of these strategies. *Phragmites* produce many wind dispersed seeds per flower-head. Red-winged blackbirds as well as other birds disperse the seeds as they use persisting flowers for nest building (Ailstock et al. 2001). *Phragmites* more aggressive reproduction strategy, however, occurs asexually or vegetatively (clonally) by rhizome (dense network of underground vertical and horizontal roots) growth and development, which occurs after the seeds ripen.

Underground rhizome growth is vigorous and extensive, as it can extend 8-39 inches below the soil surface. Additional roots can extend down up to 3 feet from the rhizome network (Cross and Flemming 1989). *Phragmites* rhizomes contain specialized segmented intercellular air compartments (diaphragms) which protect the roots from flooding waters that may saturate the plant. This specific adaptation allows *Phragmites* to live in wet conditions and gives the plant a competitive advantage over plants that do not contain these air compartments in their roots (Soukup et. al 2000).

The plant responds vigorously to disturbances including alteration of wetland hydrology and increased nutrient and sediment loading into the system. Once *Phragmites* is in an ecosystem it has the potential to alter hydrologic dynamics to favor its own expansion. As shoot growth is vigorous during the growing season, the grass produces a large amount of organic

matter. This organic matter accumulates in the marsh and traps sediment. This process can eventually cause portions of the marsh to dry out. *Phragmites* thrives in these self-created drier conditions.

This may explain the location of the large patch of *Phragmites* in the western edge of the marsh, which is slightly drier than other portions of the marsh. In addition, the culvert from Double Beach Road is located at the base of the *Phragmites* patch. The culvert funnels runoff into the marsh, which carries nutrients and sediment. The combination of past land use at the site, altered hydrology from road construction, and polluted runoff from the street create disturbance regimes favorable to *Phragmites* colonization. Incremental drying-out of the marsh from natural succession combined with *Phragmites*-induced sediment and organic matter accumulation have also contributed to the establishment and spread of this aggressive plant in the marsh.

4.2 Yellow Flag Iris- *Iris pseudacora*

Figure 4.2. Yellow flag iris in bloom.

Yellow flag iris is a showy perennial herbaceous emergent wetland plant adapted to saturated, anoxic conditions (Figure 4.2). It is native to Europe and the Mediterranean and has escaped from cultivation and naturalized in wetlands throughout New England. Local garden centers continue to sell this invasive emergent. Yellow flag iris reproduces both by seeds and rhizomes. It is pollinated by bumble bees and long tongue flies. The buoyant seeds are dispersed primarily by water. The rhizomes typically range from 0.5-1 inch in diameter and extend 5-10 inches deep. When broken, rhizome fragments can produce entirely new plants (Tu 2003).

Despite showy flowers, yellow flag iris is considered a wetland weed. The plants grow in dense clumps and form monocultures that exclude native emergent plants such as cattails. The dense rhizome mat effectively traps sediments in wetlands. This capability functions as a self-reinforcing mechanism for expansion by increasing marsh micro-topographic elevations where the plants grow through increased sediment accumulation. Yellow flag iris prefers high light conditions; however, it is adapted to a broad range of environmental conditions, with the exception of extreme cold (-10°C) (Sutherland 1990). The plant has little value for wildlife species as all parts are poisonous.

Yellow flag iris thrives in areas where there are high levels of available nitrogen, which typically are disturbed areas that receive nutrients. The yellow flag iris colony on the property is located in the western portion of the marsh, in close proximity to the culvert draining Double Beach Road which may be a source of nutrient loading into the pond.

4.3 Swamp Willow- *Salix* spp.

Swamp willow is an example of a native invasive plant that occurs along and within the marsh (Figure 4.3). Willows are adapted to a broad range of environmental conditions and are resistant to ecological and anthropogenic disturbances. They reproduce by producing seeds, suckers, root shoots and sprouts. Their seeds are dispersed by both wind and water. Swamp willows grow up to 10 feet tall and form dense canopies that herbaceous wetland plants can not grow under (WDNR, 2004).

Figure 4.3. Swamp willow suckers expanding into marsh (April 2004).

Swamp willow has expanded into the marsh through suckers and root sprouts. A number of individual saplings—spread by seed— also occur within the middle of the cattail stand and interspersed with *Phragmites* and yellow flag iris. Like *Phragmites* and yellow flag iris, swamp

willow dries out the marsh through its high transpiration rates and large surface area. This favors swamp willow expansion.

4.4 Norway Maple- *Acer platanoides*

Figure 4.4. Norway maple trees along edge of marsh (April 2004).

Norway maple is a non-native maple commonly planted as a street and shade tree and for ornamental purposes in urban and suburban areas (Figure 4.4). It is more aggressive than native maples including red maple and sugar maple (*Acer saccharrum*). Norway maple trees leaf out earlier and hold their leaves longer than other maples. They produce large winged seeds and tolerate a broad range of environmental conditions, and thrive in disturbed and polluted areas.

The best way to identify the tree is by the milky sap that is exuded when a leaf is removed at the base of the leaf stem. Another way to distinguish Norway maple from red maple on the property is by the number of lobes on the leaf. Norway maple typically has five lobes, while red maple has three. The fall foliage of Norway maple is bright yellow, while red maple's foliage turns red. A few Norway maples occur within the upland portions of the property and along the upland border of the emergent marsh (Figure 4.4). Just this spring, a large seed crop of Norway maple sprouted along the marsh edge and in the upland portion of the property near the cottage (Figure 4.5).

Figure 4.5. Norway maple seedlings along upper edge of marsh at base of parent trees (April 2004).

Norway maple spreads by wind dispersed seeds into adjacent woodlands and out-competes native tree and shrub species. Some birds and small mammals may also consume and

disperse the seeds. Norway maple perpetuates itself by forming large canopies that are difficult for other plants to establish under. The extremely shade tolerant seedlings and saplings can grow under the dense leaf cover of mature trees, forming monotypic stands by excluding other species. Norway maple is also a potential host for Asian long horn beetle (*Anoplophora glabripennis*), yet another invasive species, that could devastate New England forests.

4.5 Multiflora Rose- *Rosa multiflora*

4.6. Multiflora rose along upper edge of the marsh (April 2004).

Multiflora rose is a perennial shrub introduced from Japan in the late 1800s as a landscape plant (Figure 4.6). It was planted extensively in the 1930s by the Soil Conservation Service for soil erosion control and used in the 1950s as a natural fence for livestock. The shrub can grow 6-10 feet tall; some have been recorded as tall as 20 feet. Multiflora rose is a thorny shrub with multiple upright and trailing stems. It can be identified from other roses by feathery stipules (leaf like appendages) located at the base of each compound leaf.

The shrub flowers in the late spring and, unlike other roses, it produces many small (1/2-3/4 inch wide) flower heads. The rose hips (fruits containing numerous seeds) ripen in the summer and often remain on the plant through the winter. They are consumed by many species of birds including pheasants (also exotic) and robins as well as mammals such as chipmunks, skunks and opossums. Many birds including catbirds on the property nest in the dense cover provided by multiflora rose.

Multiflora rose, like *Phragmites* has a competitive reproduction strategy that employs both seed and vegetative reproduction. The fragrant flowers and persisting fleshy fruits attract humans, birds and mammals, all of whom are active dispersers of the shrub. Seeds remain

viable in the soil for up to twenty years. Each trailing shoot has the ability to root when it touches the ground, thereby allowing for horizontal above-ground expansion. While multiflora rose prefers to grow in open sunlight, it is adapted to a variety of habitats and appears to be sensitive only to cold, wet and heavily shaded environmental conditions.

Multiflora rose occurs along the northwestern edge of the marsh and in scattered patches alongside the road in the upper lot (Figure 4.6). An abandoned field dominated by multiflora rose occurs to the northwest of the property on the other side of Short Beach Road.

4.6 Japanese Knotweed- *Polygonum cuspidatum*

Japanese knotweed is an aggressive herbaceous plant with hollow shoots that grows up to 9 feet tall in disturbed soils (Figure 4.7). It flowers in late summer, between August and September and then produces wind dispersed seeds. Japanese knotweed also reproduces asexually through rhizome production. Rhizomes on some plants can reach as deep as 15-20 feet and up to 45-60 feet long horizontally (Seiger 1991 & Shaw and Seiger 2002).

Figure 4.7. Japanese knotweed to the south of the marsh (April 2004).

Rhizome growth is the primary mechanism for Japanese knotweed expansion. The plant is resilient, as rhizome fragments persist in the soil and can colonize new areas if the soil is moved. Consequently, Japanese knotweed often occurs on fill and in dump sites. Seiger (1991) reported that Japanese knotweed has emerged even through asphalt. The plants break the soil earlier than other plants in the spring and grow tall very fast (8 cm/day), thereby shading out undergrowth and forming dense monotypic stands in open areas (Seiger 1991). Japanese knotweed tolerates a wide range of environmental conditions and grows alongside wetlands and within uplands; however, the shade intolerant plants prefer sunny, open habitats.

Presently, two relatively small patches of Japanese knotweed occur along the north side of the marsh (to the east of the house) and to the south of the marsh (behind the garage) on disturbed soils. Japanese knotweed does not provide food or suitable habitat for wildlife.

4.7 Japanese Honeysuckle- *Lonicera japonica*

Figure 4.8. Japanese honeysuckle leaf break in early April before all other deciduous plants (2004).

Japanese honeysuckle is an aggressive twining vine introduced from Japan (Figure 4.8). It typically wraps around other plants for support, and can also trail along the ground forming dense mats. Japanese honeysuckle has fragrant pale yellow to white flowers that bloom in June. The vine produces black berries that are consumed by many species of birds. It is adapted to a broad range of environmental conditions and thrives in disturbed, open habitats. The Japanese honeysuckle population is relatively small on the property. It is located along the upland edge of the western portion of the marsh.

Japanese honeysuckle's growth as a vine gives the plant a competitive advantage over other plants. It grows on top of and around plants—often native shrubs—and eventually shades them out or causes them collapse with the weight of the vine. Its trailing and creeping growth along the ground prevents seedlings and herbaceous plants from growing underneath the vine. Japanese honeysuckle reproduces by three different means: sexually by seed, asexually by runners (above ground horizontal stems that give rise to new plants), and asexually rhizomes (Nuzzo 1997).

4.8 Japanese Barberry- *Berberis thunbergii*

Figure 4.9. Japanese barberry along upper edge of marsh flowering in early May, before many plants have their leaves (2004).

Japanese barberry is a 2-6 foot tall shrub with arching branches and distinct barb-like spines (Figure 4.9). The shrub produces fleshy fruits in the end of the summer that birds consume and then disperse the seeds. Japanese barberry can also re-sprout from rootstock if cut. The shrub is one of the first plants with leaves in early April and among the last to lose leaves in the fall. Flowers are out by early may (Brunelle and Lapin 1996).

Associated with disturbance, Japanese barberry often grows alongside trails and in forest openings where it can get light. There are only a few Japanese barberry shrubs on the property, along the upper edge of the wetland.

4.9 Invasive Species Watch List

Potentially Invasive Plants on the Property

In addition to the priority invasive plants, there are a few other plants with invasive potential on the property including Oriental bittersweet, forsythia, honeysuckle shrubs, English ivy and periwinkle (Figure 4.10). Forsythia and honeysuckle were most likely planted as land-

Figure 4.10. Potentially invasive plants on the property from left to right: Oriental bittersweet, forsythia, periwinkle and English ivy.

scape plants. Oriental bittersweet, English ivy and periwinkle most likely escaped from a neighbor's yard, as the concentrated patches of these invasives occur alongside the road. None of these plants have appeared to spread over the last two years; however, they all have the potential to spread and invade other habitats. Forsythia and honeysuckle shrubs can escape and naturalize into woodlands. Both species out-compete native shrubs in the understory as they are fast growing and densely foliated; they also both produce fleshy fruits that are consumed and dispersed by wildlife. English ivy and periwinkle are ground covers, often used as ornamentals in landscapes. Like some of the other invasives discussed, both plants form dense carpets along the ground that shade out other plants and occupy all of the available growing space. Oriental bittersweet is most similar to Japanese honeysuckle, as it is a vine; however, bittersweet is even more voracious in terms of smothering other plants.

Potentially Invasive Plants Not on the Property

There are also exotic invasive plants not occurring on the property that have the potential to invade including (but not limited to) purple loosestrife, burning bush and garlic mustard (Figure 4.11). Additional invasive species in Connecticut are listed in Appendix D that should be monitored for.

Purple loosestrife is an emergent wetland plant. Although attractive with a showy purple flower stalk, this plant can take over cattail marshes and shallow ponds. It aggressively spreads by rhizomes. Garlic mustard looks like a weed with lobed leaves, tall green stems and small white mustard flowers. The smell of garlic is pungent when the leaves are crushed. This plant out competes native wildflowers and other herbaceous plants. Burning bush easily escapes into woodlands and takes over understories. Currently the understory at Branford Supply Ponds is dominated by burning bush. It is one of the last plants to lose its leaves in the fall. The green winged stems and opposite leaves help identify it.

Figure 4.11. Invasive plants not on the property from top to bottom: purple loosestrife, burning bush and garlic mustard.

Aquatic invasive plants are also a problem in Connecticut and the open water areas of the pond and marsh should be monitored for invasion as aquatic weeds can over run a pond and shade out all growth on the marsh floor. Currently, there is one aquatic weed of concern in the southwestern corner of the pond and marsh system that should be investigated.

CHAPTER FIVE

5. Strategies for Invasive Plant Control

5.1 Common Reed

As *Phragmites* has become a pervasive problem plant throughout southern New England and other parts of the country, a number of organizations have developed methods for removing *Phragmites* from areas where native plants are desired. The Connecticut Department of Environmental Protection (CT DEP), The Nature Conservancy, The Branford Land Trust and many other land conservation organizations and academic institutions have launched effective campaigns against *Phragmites*. In fact, *Phragmites* was the most targeted invasive plant for removal in Connecticut between 1999 and 2000. CT DEP spent over $750,000 on over six successful *Phragmites* removal projects (CT Council on Environmental Quality 2002). Successful removal projects include cutting, mowing, burning, herbicide application and increased tidal and freshwater flooding.

Figure 5.1. *Phragmites* patch in the western portion of the marsh (April 2004).

The *Phragmites* patch on the property is relatively small and removal is manageable (Figure 5.1). Action should be taken soon to prevent further spread, as the patch is expanding and encroaching on the cattail marsh. If there is no management of *Phragmites* in the marsh, the most likely scenario will be increased spread of *Phragmites* and a decline in the cattail population, as seen in other parts of Branford. As *Phragmites* gradually takes over the marsh, there will be more organic matter generated from dead and dying shoot matter. The additional organic matter may eventually elevate the soil in the marsh,

thereby creating drier conditions that will favor *Phragmites* expansion and dominance. *Phragmites* will continue to encroach upon the pond and as the pond itself becomes shallower with higher deposition rates of organic matter. Many other coastal ponds in Branford have been completely taken over by *Phragmites*. A number of strategies are listed below to help remove *Phragmites* from the property and prevent further spread.

Mechanical Control

Phragmites is difficult to remove by simply cutting because of the dense rhizome network below the ground. Cutting the shoot alone can encourage vigorous new growth if done at the wrong time. To be most effective, the shoot and the adjacent rhizome must both be cut at the end of the summer. This will discourage new shoot growth, as the rhizome system will use energy to repair itself, rather than energy for shoot growth. Cutting requires annual repetition, which can be labor and time intensive. If cutting is the preferred removal strategy, the rhizomes must be disked (chopped up). This is most effective in late summer and early fall after the seeds have set and when the plants are putting their energy into rhizome growth. There is an associated risk of harming the root systems of other plants, such as the cattails with this method. In addition, care should be taken to remove the flower heads after cutting to prevent seed germination the following spring. A detailed methodology for cutting *Phragmites* from the CT Invasives Working Group is outlined in Appendix E.

A different mechanical technique that has proven to be effective on small *Phragmites* patches is the use of a black tarp. Covering the plants with the tarp prevents the grass from photosynthesizing and eventually kills the plants by smothering them. This method requires cutting the patch in the late summer or early fall, removing the dead debris, and covering the cut patch with a 6 mm thick black plastic tarp. Stakes and/or sandbags are recommended to anchor the tarp. As the sun hits the tarp, it bakes the *Phragmites* underneath. TNC and other organizations have also experimented with burning, mowing and flooding; however, these strategies are not applicable at this site.

Chemical Control

TNC, Sea Grant and a number of environmental organizations and consulting companies have had success removing *Phragmites* and preventing further spread by implementing chemical controls. Glyphosphate is a non-selective systemic herbicide that has a short residual life and breaks down quickly in water, thereby reducing the threat for the chemicals to persist in wetland habitats (Appendix F). The herbicide kills plants by preventing the synthesis of certain amino acids naturally produced by plants, but not animals. These amino acids are required for protein synthesis, which in turn is necessary for plant growth. Great caution should be taken when using this herbicide, particularly near the open water areas. Many herbicides do not break down quickly and persist in the environment as pollutants and are toxic to other plants as well as animals. One drawback of using glyphosphate is that it is not species selective and will kill other plants if broadcasted.

Glyphosphate comes in household form as Roundup and commercial form as Rodeo. Only Rodeo has been approved for use near water as it contains a non-ionic surfactant (Bender, 1987, Balogh 1985). Homeowners are permitted to apply Roundup to plants on their property, provided they read the instructions carefully and use caution in the application process. CT DEP and TNC use Rodeo in wetlands for *Phragmites* removal. Rodeo can be purchased at local home and garden stores. Rodeo and Roundup are relatively inexpensive and typically come in spray bottles, plastic backpack containers with spray guns or in containers from which the herbicide can be painted on to the stem. A five foot wand stem is recommended for reaching the leaves on tall shoots.

To effectively reduce *Phragmites* populations, the herbicide must be applied to each individual shoot and the top-side of every leaf, while being careful not to spill or spray plants targeted for protection. The best time for application is at the end of the growing season (before the plants senesce) when the plants retain maximum foliage (as many leaves as possible). This is typically in the late summer or early fall when the leaves are out and actively transporting sugars down to the rhizomes. The early part of the spring, when the plants are just starting to grow, is also an effective time for application. The chemical enters the leaf and is translocated down to the rhizomes, where it works to kill the plant systemically.

A two stage application of 2 lbs 1.5% Rodeo/acre, one in June and one 15-30 days later, repeated over two successive years has been effective in reducing *Phragmites* populations (Cross and Flemming 1989). If too much glyphosphate is applied, the leaves may die before translocation to the rhizomes can occur. It is important to keep the stem in tact for this process to occur. While one higher concentration application has been reported to work, the two-stage application strategy is considered less stressful to the surrounding environment. Another consideration for application time is to wait until other deciduous plants have shed their leaves to prevent them from possibly absorbing glyphosphate into their systems (Ailstock et. al 2001). Applications should occur in good weather as rain will dilute the herbicide concentration and reduce its effectiveness. A more specific outline of how to implement this strategy step-by-step is provided in Appendix G.

Combination Control

Another strategy to remove *Phragmites* from the property is to use a combination of treatments to monitor which treatment is the most cost-effective, time and labor appropriate. Cutting may seem like it is the easiest and least expensive strategy; however, it is time consuming and must be repeated annually. The rhizomes must also be cut. Cutting could be combined with glyphosphate applications on individual stems. In this case, the shoot is cut and a higher concentration of the herbicide (25%) is applied to the stump. TNC often uses this method in areas where natives and invasives are intermingled and in more sensitive areas where broadcast spraying would be detrimental.

Figure 5.2. *Phragmites* interspersed with cattails and iris (April 2004).

One strategy may incorporate using both the tarp and herbicide applications. The large continuous *Phragmites* patch within the western portion of the marsh could be killed using the plastic tarp method. In the areas where individual *Phragmites* shoots are interspersed more with cattails, glyphosphate applications may work best provided extreme care is taken not to impact the cattails (Figure 5.2). By implementing the combination

control strategy, both options can be explored and tested. This is called adaptive management. Whichever strategy works better may be the one to switch to after the first year of experimentation. The plastic tarp method is inexpensive and less labor intensive than chemical control; therefore, if it succeeds in killing the large *Phragmites* patch, it may be a more cost-effective strategy than herbicides. However, in the areas where *Phragmites* shoots are interspersed with native plants, spot treatments of glyphosphate may be more realistic than placing tarps over individual plants.

Monitoring is a critical component to any and all strategies to identify new invasions and prevent invasive reestablishment. As *Phragmites* thrives on disturbance, it will return to the site unless battled every year.

5.2 Yellow Flag Iris

The yellow flag iris population has expanded considerably over the last ten years. The landowner commented that it has recently invaded the cattail stand and the *Phragmites* patch (Figure 5.3). This aggressive emergent can be controlled mechanically and/or chemically.

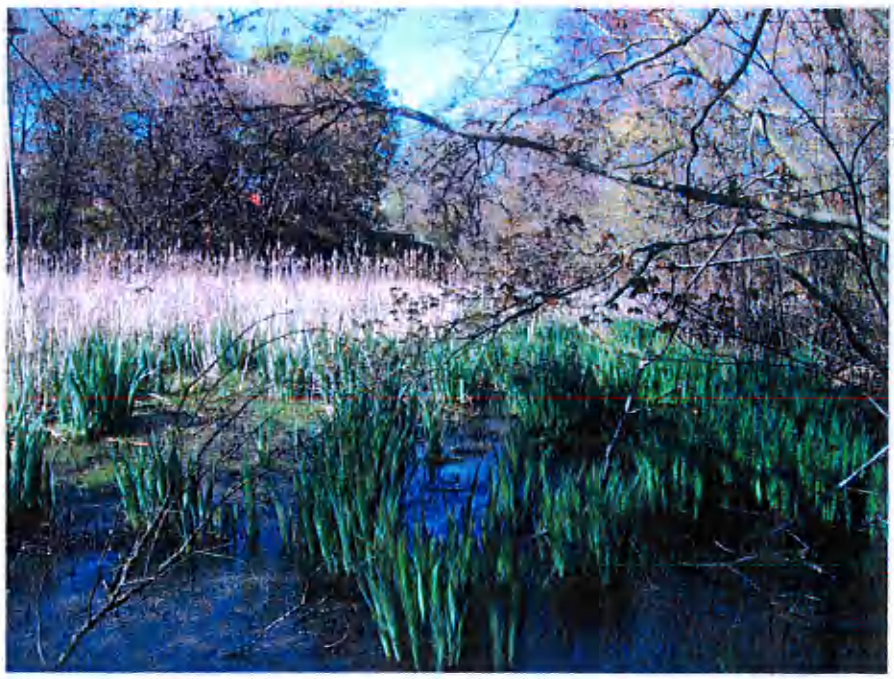

Figure 5.3. Yelllow flag iris in southern portion of marsh (April 2004.)

Mechanical Control

To mechanically remove yellow flag iris, the entire rhizome network must be removed. This may be easier than removing the deeper and denser rhizome network of *Phragmites* because of the iris' shallower rhizomes. However, as the iris is herbaceous, the rhizomes can easily break. New plants can sprout from severed rhizomes, so great care must be taken to remove all of the plant parts. Yellow flag iris contains toxins that may give humans a rash; gloves should be worn when handling this plant.

Chemical Control

Chemical control may be less labor intensive than mechanical control. As mentioned with *Phragmites*, caution should be used when handling herbicides in wetland systems to prevent impacts to non-target plant and animal species. Foliar applications of glyphosphate are recommended for yellow flag iris during the early part of the growing season for effective herbicide translocation to the rhizomes.

5.3 Swamp Willow

Like *Phragmites* and yellow flag iris, swamp willow is also expanding into the marsh (Figure 5.4). Swamp willow can be controlled by flooding. Although this may not necessarily be the

Figure 5.4. Swamp willow expanding into the cattail marsh into along the northern edge.

best strategy for the site, removal of some of the larger willows will raise the water level, which could potentially help kill the remaining willow. This strategy could be experimented with through adaptive management. Additional mechanical and chemical controls for swamp willow are discussed below.

Mechanical Control

Swamp willow is difficult to remove because of its dense network of rhizomes, suckers and root sprouts. Cutting alone is not a sufficient strategy for removal, as swamp willow will re-sprout. Young willow stems less than three inches in diameter can be removed by chopping up the above and below ground plant parts. WDNR (2004) recommends using a double cross-disc for killing willow occurring in dense stands. They also suggest to disc willow 2-3 times during the growing season to slow the growth of seedlings.

Once swamp willow is larger than three inches in diameter, disking will not work. Excavation of the entire plant using a bulldozer is the only mechanical method for removing this plant (WDNR 2004). This strategy may require a permit, as it involves excavation activities within an inland wetland. Excavation, while effective in removing the swamp willow, may upset the water balance and topography of the wetland and may disturb non-target plants.

Chemical Control

As with *Phragmites* and yellow flag iris, a glyphosphate-based herbicide can be used to eradicate swamp willow. The cut-stump method works on willows in which the stems are cut relatively close to the base of the plants, and the stumps are then painted with herbicide. Foliar applications of Rodeo also work and can be applied using the hand swipe method discussed in Appendix G. WDNR (2004) recommends using 7pts/acre of glyphosphate for foliar applications. The best time of year for these applications are when non-target plants are dormant either in the very beginning of the growing season or at the end. Swamp willows in New Zealand have been killed by glyphosphate injections; a hole is drilled at a 45° angle into the base of the stem and 80 ml of glyphosphate are injected (NZ 2004.) This

method is recommended in the summer when the plants are translocating from the leaves to the roots.

5.4 Norway Maple

As the Norway maples population is relatively small on the property, control of this species is manageable. There are a few medium sized trees along the upper boundary of the western edge of the marsh as well as adjacent to the road and behind the cottage. This spring there was a large seed crop of Norway maples outside the cottage and along the upper bank of the marsh (Figure 5.5). These seedlings should be removed by hand before they grow taller. If left on the property, inevitably more Norway maples will sprout on site, and more likely, the tree will disperse into nearby woodlands and escape.

Figure 5.5. Norway maple seedling along upper edge of marsh. Japanese honeysuckle on right (April 2004).

Mechanical Control

The best mechanical way to kill mature trees is to girdle them. Girdling requires cutting the cambium (outer layer of the tree) at the base of the trunk and stripping off that outer layer. This prevents translocation of sugars and water to the roots and eventually kills the tree in approximately 2-3 years. Native trees such as red maple or green ash can be planted nearby to eventually replace the structure and function of the Norway maple. An arborist can assist with this process.

Chemical Control

To kill the trees more quickly, spot applications of herbicide to cut stumps will work effectively. The Connecticut Invasive Species Working Group recommends undiluted Brush-B-Gon (triclopyr 8%) or one part Roundup (glyphosphate) diluted with an equal part of water. The landowner can perform this himself or have an arborist come in and do the work.

5.5 Multiflora Rose

Multiflora rose occurs in dense patches throughout the property. A number of strategies exist to remove this invasive. Cutting and herbicide application are the most applicable strategies for this site. Goats and sheep have been used to reduce multiflora rose populations. Biological controls including a native mite-spread disease known as rose rosette and a European wasp have also been successfully used. While the biological controls may be appealing, the mite also targets other native rose, plum and cherry species and the wasp is a nonnative insect that may attack desired plants. As a result, these controls are not practical options for this site.

Multiflora rose does have some ecologic and aesthetic values. It produces fragrant, showy flowers that may be pleasing to the land owner. A number of shrub dwelling birds including catbirds nest in multiflora rose. It provides food for various birds and mammals, particularly in winter with its persisting fruits. A large vacant field dominated by multiflora rose occurs across the street from the property, so there is potential for invasion from this seed source. Despite this ever present threat of invasion, the wildlife and aesthetic values mentioned above can be maintained by eradicating the shrub and replacing with native shrubs such as other native roses (*Rosa carolina*), highbush blueberry (*Vaccinium corymbosum*) and sweet pepperbush (*Clethra alnifolia*) to name a few. A number of other native shrubs that attract wildlife and are also aesthetic are listed in Appendix H.

Mechanical Control

Hand cutting mature shrubs followed by repeated mowing (3-6 times per year over 2-4 years) has been effective in reducing multiflora rose populations. This approach is labor intensive. Some organizations have been successful cutting once per year, but cutting must be repeated annually. Eradication of the shrub requires removal of the entire root system, which may involve excavation considering the old-age and large size of many of the multiflora roses on the property.

Chemical Control

Foliar applications and stump treatments of glyphosphate have been effective in killing multiflora rose. TNC recommends spraying the leaves late in the growing season, when native plants are dormant to prevent damage to other plants. Stump treatments require cutting the shrub at the base and painting the stump with the glyphosphate based herbicide.

Combination Control

A combination control strategy applicable to the property employs repeated annual cutting of multiflora shrubs near the wetland edge and glyphosphate applications to the landscape shrubs located in the upland. Adaptive management is recommended in the case of multiflora rose removal. If the cutting is not effective along the wetland edge, chemical controls could be implemented so long as care is taken in the application process to not drip or spill the herbicide on nearby native plants including staghorn sumac and red maple.

5.6 Japanese Knotweed

Japanese knotweed has been the target of many invasive plant removal projects. Both mechanical and chemical strategies exist. As the two Japanese knotweed populations are relatively small on the property, management of this species is realistic.

Mechanical Control

As Japanese knotweed seedlings grow fast (up to 8 cm/day) by both shoot and root growth, early removal of young Japanese knotweed seedlings is the most effective way to reduce the population on the property (Seiger 1991). This can be done by manual pulling, making sure to get all of the roots and rhizomes (Figure 5.6).

Figure 5.6. Hand-pulled Japanese knotweed seedlings (April 2004).

Cutting Japanese knotweed is ineffective, as the plant will re-sprout vigorously. However, as grazing has reportedly reduced Japanese knotweed, developing a cutting regime that mimics grazing may be effective (Seiger 1991). This would require cutting the knotweed up to three times during the growing season.

Another option for the mechanical control of knotweed is to use the black tarp method described in the *Phragmites* control section. This strategy works on Japanese knotweed, as the plant is shade intolerant. However, some studies have reported that Japanese knotweed is strong enough to "emerge through asphalt (Seiger 1991)." Regardless of the method selected for Japanese knot weed removal, the strategy must be repeated again and again as this plant is very difficult to eradicate.

Chemical Control

Foliar applications of glyphosphate work effectively to reduce Japanese knotweed. Hand swiping with Rodeo or Roundup early in the growing season is recommended (Shaw and Seiger 2002). The herbicide can also be applied in the fall when the leaves are translocating to the rhizomes.

5.7 Japanese Honeysuckle

Japanese honeysuckle occurs along the upper wetland edge; however, it is not a predominant invasive on the property. This makes it a prime target for removal to prevent future spread. Mechanical and chemical controls have been used to reduce Japanese honeysuckle populations. Fire and grazing have also been viable strategies; however these are not applicable techniques on this site.

Mechanical Control

As the Japanese honeysuckle is patchy and relatively young, removal by hand may be relatively easy because the root networks are not well established. Cutting is not effective in the case of Japanese honeysuckle as it re-sprouts afterward. Re-sprouting can follow hand pulling as well; therefore, all of the roots must be pulled out of the ground if this strategy is preferred (Nuzzo 1997).

Chemical Control

As with many of the other plants described thus far, foliar applications of glyphosphate (Roundup or Rodeo) are effective for killing Japanese honeysuckle (Nuzzo 1997). Cut-stem treatments (cut stem at base and paint on herbicide) also work. Treatments should take place in early spring or late fall when non-target plants are dormant.

5.8 Japanese Barberry

There are only a few Japanese barberry shrubs on the property. As this population is small and relatively contained, management should be relatively easy. Both mechanical and chemical strategies exist for Japanese barberry; however, in the case of this site, mechanical removal is more cost-effective and least time consuming. As the shrub has naturalized into New England forests, there is always a threat of invasion by this shrub because of its fleshy, fruits and bird dispersed seeds.

Mechanical Control

Pulling by hand or weed wrench is an excellent removal strategy for small populations of Japanese barberry (Brunelle and Lupin 1996). As the population on the property is quite small, it will not take too much time to remove the shrubs from the wetland border. The roots are relatively easy to pull up and this can be done any time of year. All roots must be pulled, otherwise the shrub will re-sprout.

The shrub has many spiny thorns; thick gloves should be worn when hand pulling. Fruits, if present, should be bagged on the shrubs. Uprooted plants can be left behind as compost and/or structure for animal habitat, provided there are no fruits remaining (Brunelle and Lupin 1996).

Chemical Control

Chemical control of Japanese barberry is also an option. Foliar applications of glyphosphate work; however, some sources recommend triclopyr (CT Invasives Working Group; Brunelle and Lupin 1996). Either herbicide can be applied by foliar sprays or the cut stump method

in early spring or late fall. Because the Japanese barberry population is small on the site and the plants are easily up-rooted, mechanical is recommended over chemical control.

5.7 Invasive Species Watch List

Invasive Plants on the Property

Honeysuckle shrubs, Oriental bittersweet, English ivy, periwinkle and forsythia occur on the property, but do not exhibit invasive characteristics as of yet. These plants have been identified as invasive or potentially invasive in Connecticut (Appendix D). In addition, an aquatic weed was observed on the property that should be monitored for invasive characteristics. Close attention should be paid to these plants, as they have the potential to take over areas. For now, no immediate control is recommended; however, if the plants appear to spread to other areas on the property, both mechanical and chemical controls such as those listed above can be used.

English ivy can be controlled by a combination of cutting and spraying. Cutting alone will not eradicate the plant. Removing English ivy with a shovel or through weeding are short term control strategies. Foliar applications of glyphosphate will not be effective on English ivy as the leaf is covered with a waxy coating (Morisawa 1999). However, the cut-stump glyphosphate application method works well with English ivy.

Forsythia and exotic honeysuckle shrubs can gradually be removed by repeated annual cutting over 3-5 years. Foliar (2% glyphosphate) and cuts-stump (20-25% glyphosphate) herbicide applications also work for honeysuckle shrubs and forsythia (Batcher and Stiles 1999).

To control periwinkle, the plants can be raked or manually removed. Like English ivy, periwinkle leaves have a waxy surface layer so foliar herbicide applications will not be affective. Glyphosphate has not proven to be affective on periwinkle; therefore, hand pulling is recommended (Bean and Russo 1988).

Similarly, glyphosphate has been ineffective for Oriental bittersweet. The best way to kill bittersweet is through applications of triclopyr (Brush B Gon) after the bittersweet has been cut and allowed to re-sprout (Dreyer, 19994). This kills the roots. The cut-stump method also works for vines climbing in trees. Mechanical removal of bittersweet is challenging unless the vines are relatively young. Weekly mowing will reduce bittersweet populations; however, less frequent mowing (a few times a year) will encourage bittersweet growth (Dreyer 1994).

Invasive Plants Not on the Property

There are a number of potentially invasive species on the "Watch List" that do not occur on the property including purple loosestrife, garlic mustard and burning bush. These invasive plants are common throughout Branford and they could invade the site from wind, bird, mammal or human dispersal and/or as stored seed banks in some of the piled soil/loam used on site for landscaping. While no active management is necessary for these species as of right now, the property should be monitored regularly to prevent the invasion of these species.

If these species are found, they should be removed immediately as early identification and removal are the best strategies for preventing widespread invasions. Hand pulling individual purple loosestrife stalks is effective when small populations are present. The entire rootstock must be removed. Glyphosphate (Rodeo) stump-cut applications (20-30% solution) have also been effective when conducted in late August (Bender 1987). A biological control also exists for purple loosestrife, but would not be applicable unless the entire marsh and pond were taken over by the plant.

Burning bush can be controlled using mechanical and chemical strategies. Seedlings can be hand pulled, the flowers can be cut off, or the cut-stump method with glyphosphate can be applied (Tunyalee 2002). Garlic mustard seed production can be controlled by cutting flower stalks in the late fall (Nuzzo 2000). Foliar glyphosphate applications also kill garlic mustard. Nuzzo (2000) recommends applying 1-3% glyphosphate concentration either on the dormant rosettes in the late fall/early spring or just after seedling emergence.

CHAPTER SIX

6. Buffer Zone Enhancement Plan

After removing the targeted invasives, a plan should be implemented to encourage native species colonization and establishment, particularly in the buffer zone to the marsh and pond, which is the area immediately adjacent to the marsh including the marsh banks. This is a critical step in the wetland restoration process because if the invasives are simply removed, then other invasives from nearby seed sources or dispersed by birds and/or mammals may end up on the property and in the marsh. To prevent this from happening, non-invasive native plantings can be used to occupy the growing space of the removed invasives.

6.1 Planting Strategies and Goals

The goal of the buffer zone enhancement is to remove nuisance invasive vegetation and replace with native species. Planting will not be necessary directly within the marsh and pond, as cattails should fill in the areas where *Phragmites* and yellow flag iris were located. Broad leaved cattails spread by rhizomes, like the two emergent invasives, and will fill in the empty spaces. However, if a replacement species for the iris is desired to maintain diversity in the marsh, there is a native emergent blue flag iris (*Iris versicolor*) that could be planted in the marsh (Figure 6.1).

Figure 6.1. Native blue flag iris.

An area to target for planting is the upland edge and border of the marsh, which currently consists of fragmented patches of primarily invasive plants (Figure 6.2). Targeted invasives should be removed in patches to ensure the land remains stabilized. By re-vegetating this border with native wetland buffer zone plants, there will be increased quality wildlife habitat, soil erosion prevention, and better water filtration and pollutant interception along the wetland edge.

Native plants can be obtained from a local nursery. They should be planted approximately two to three feet on center to form a native shrub layer within buffer zone of greater density and diversity than the current buffer zone area. By planting the shrubs close together, there will be rapid uptake of all the available growing space by natives, which will help prevent opportunistic invasives from invading the planting area. If nonnative invasive species encroach on the area, they should immediately be removed by hand pulling. Within two growing seasons, there should be at least 90% native cover within the buffer zone to the marsh and pond from planting efforts.

The proposed buffer zone enhancement plan will improve the ecological structure, function and overall value of the wetland resource area. The removal of nuisance invasive plants reduces competitive stress on the native species. It also provides the opportunity to introduce other native species that possess greater wildlife habitat and food value as well as deeper rooting systems that add stability to the steep bank of the marsh/pond edge. Increasing native plant diversity will provide greater structural diversity, thereby accommodating more wildlife activity.

6.2 Recommended Native Plants

This section identifies native species to consider for replanting within the wetland buffer zone after invasive plant removal (Figure 6.3). Some of these natives already occur in the marsh and others are native to Branford. A list of Connecticut native plants for landscaping and wetland restoration projects is listed in Appendix H.

Figure 6.3 Natives plants to consider for planting after invasive species removal.

Trees:

Red Maple (*Acer rubrum*)
Green Ash (*Fraxinus pennsylvanica*)
Black Gum (*Nyssa sylvatica*)
Shadbush (*Amelanchier canadensis*)

Shrubs:

Highbush blueberry (*Vaccinium corymbosum*)
Spice Bush (*Lindera benzoin*)
Witch hazel (*Hamamelis virginiana*)
Swamp azalea (*Rhododendron viscosum*)
Winterberry (*Ilex verticillata*)
Sheep laurel (*Kalmia angustifolia*)

Emergents and Herbs:

Blue flag iris (*Iris versicolor*)
Sensitive fern (*Onoclea sensibilis*)
Skunk cabbage (*Symplocaprus foetidus*)

Based on the landowner's goals, the appropriate native species should be selected to satisfy wildlife values (food, shelter and escape cover), aesthetic values, and for biodiversity. In some areas, where vistas are desired, lower growing shrubs could be planted such as sheep laurel. Where views are less important, larger trees and shrubs should be planted. Native emergent wetland species can be planted in the marsh if desired to increase the plant diversity. The proposed buffer zone planting plan is intended to provide inspiration for planting and planting locations after invasive plant removal.

CHAPTER SEVEN

7.1 Recommendations

This invasive plant management plan suggested a number of different strategies for the removal of specific invasive plants from the property in an effort to rehabilitate the pond and marsh wetland system. This section summarizes those strategies and identifies other management suggestions for the property. Both the invasive plant removal recommendations and the management strategies will ultimately help the landowner restore the emergent marsh to a native cattail marsh (Figure 7.1).

Figure 7.1 List of Primary Recommendations

1. Identify priority invasive plants and management strategies for removal.
   a. ***Phragmites***: Combination control: black tarp and glyphosphate application (Rodeo)
   b. **Yellow flag Iris:** Black tarp method and Rodeo
   c. **Swamp willow:** Bulldoze/excavate plant (may need permit), Glyphosphate (Rodeo) cut-stump method
   d. **Norway maple:** Girdle tree, cut-stump glyphosphate application
   e. **Multiflora rose**: Combination control: cut-stump glyphosphate application and repeated cutting
   f. **Japanese knotweed:** Hand pull small plants; glyphosphate foliar application for mature plants
   g. **Japanese honeysuckle:** Hand pull vine
   h. **Japanese barberry:** Hand pull shrubs, wear gloves.
   i. **Watch List Species:** Monitor for expansion
2. Implement removal strategies, repeat strategies for challenging plants.
3. Implement Buffer Zone Enhancement Planting Plan.
4. Clean up garbage from marsh and pond.
5. Encourage town to maintain storm drain and culvert.
6. Monitor planting areas for 90% native cover over 2 growing seasons.
7. Monitor for Watch List species invasions and expansion on the property
8. Monitor for re-invasion of priority invasives.
9. Stay updated on invasive plants to identify ones not mentioned in this plan.
10. Enjoy the restored marsh!

7.2 Conclusion

Several species of invasive vegetation occur throughout the emergent marsh, along the marsh edge and scattered throughout the upland areas of the Comfort property. Most are non-native invasive species that lack natural predators and pathogens. Swamp willow, yellow flag iris and *Phragmites* grow invasively and aggressively in the wetland, displacing other native plants and reducing the overall diversity of the marsh. Multiflora rose, Norway maple, Japanese knotweed, Japanese honeysuckle and Japanese barberry occupy almost all of the growing space along the upper edge of the wetland. A number of other plants that have the potential to become invasive also occur on the property.

Invasive plants often have greater reproductive capacities, multiple strategies for reproduction, as well as faster growth rates that allow them to dominate plant resources including growing space, light, moisture and soil nutrients. Many of these invasives also facilitate their own spread by altering ecosystem structure and function. For example, *Phragmites*, yellow flag iris and swamp willow alter wetland microtopography and hydrology, thereby favoring their spread by drying out the marsh. Native species including cattails are subject to fierce competition and displacement which eventually alters the structure, function and wildlife value of the wetland.

This management plan introduced specific mechanical and chemical control measures for the priority invasive species based on their ecological and biological characteristics. The ultimate goal of this project is to rehabilitate the pond and marsh by invasive plant removal and with native plantings. Buffer zone enhancement planting strategies were discussed for implementation post invasive plant removal. Several native wetland and upland species that will improve wildlife habitat and the structure and function of the marsh are identified in this management plan. Provided invasives are removed soon, and natives are planted accordingly, the marsh will be comprised of native vegetation and on its way to a restored state.

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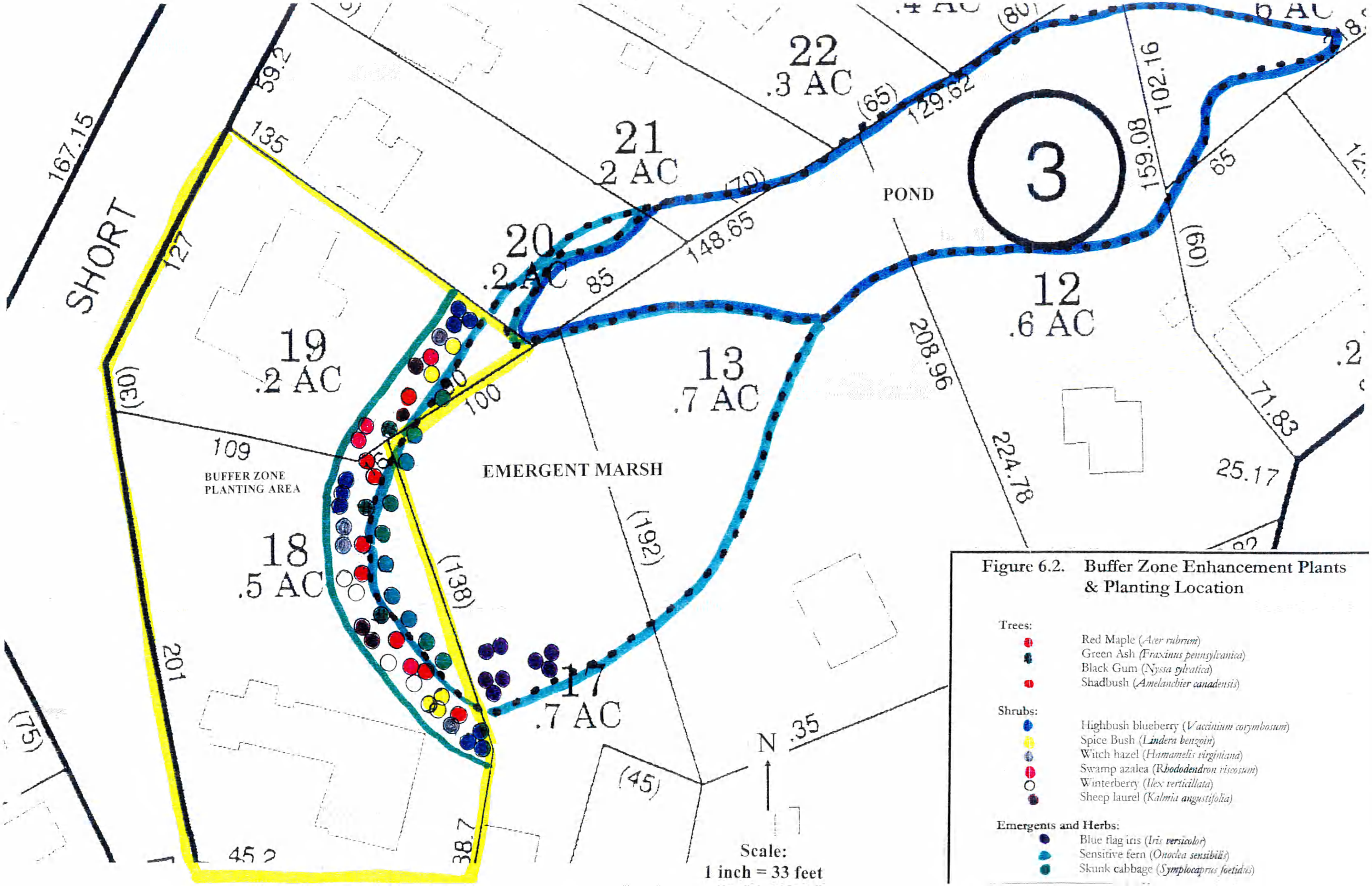
Acknowledgements

This management plan for the rehabilitation of the marsh by invasive plant removal was inspired by Ellis Bradley. Thank you, Ellis for caring so much about your marsh and wanting to rejuvenate it. You are on the right path to making it happen. Thanks are also in order to Pat and Bob Comfort for their support of this project on their property. You have provided great insight to what Branford was like in the past and your stories were much appreciated and enjoyed.

Thank you, also Ann Camp and Mary Tyrrell at the Yale School of Forestry and Environmental Studies for their faculty support and review of this independent study.
Finally, I would like to thank Tim Wadlow and Riley for helping with all parts of this plan and for their patience with me.

We have enjoyed living at 2 Double Beach Road and have a deep fondness for the people who live here and also for the marsh. From the first day we arrived, this backyard oasis has provided us with the songs of spring peepers at night, songs and calls of many birds by day, regular sightings of a mother fox with her squirrel and rabbit kills, and finally a place to study and wonder about. I sincerely hope this management plan will help make the restoration vision a reality and will rejuvenate the native cattail marsh of the past.



Scale:
1 inch = 33 feet

Figure 6.2. Buffer Zone Enhancement Plants & Planting Location

Trees:
- Red Maple (*Acer rubrum*)
- Green Ash (*Fraxinus pennsylvanica*)
- Black Gum (*Nyssa sylvatica*)
- Shadbush (*Amelanchier canadensis*)

Shrubs:
- Highbush blueberry (*Vaccinium corymbosum*)
- Spice Bush (*Lindera benzoin*)
- Witch hazel (*Hamamelis virginiana*)
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