Odiorne Point State Park

Invasive Plant Management Plan

Rye, NH

MAY 2010

Seacoast Science Center

NHCP

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

NEW HAMPSHIRE DIVISION OF PARKS AND RECREATION

ROCKINGHAM COUNTY CONSERVATION DISTRICT

ODIORNE POINT STATE PARK

INVASIVE PLANT MANAGEMENT PLAN

Prepared by FB Environmental Associates, Inc.
in cooperation with Odiorne Point State Park, the Seacoast Science Center, New Hampshire Department of Environmental Services, and the Rockingham County Conservation District.

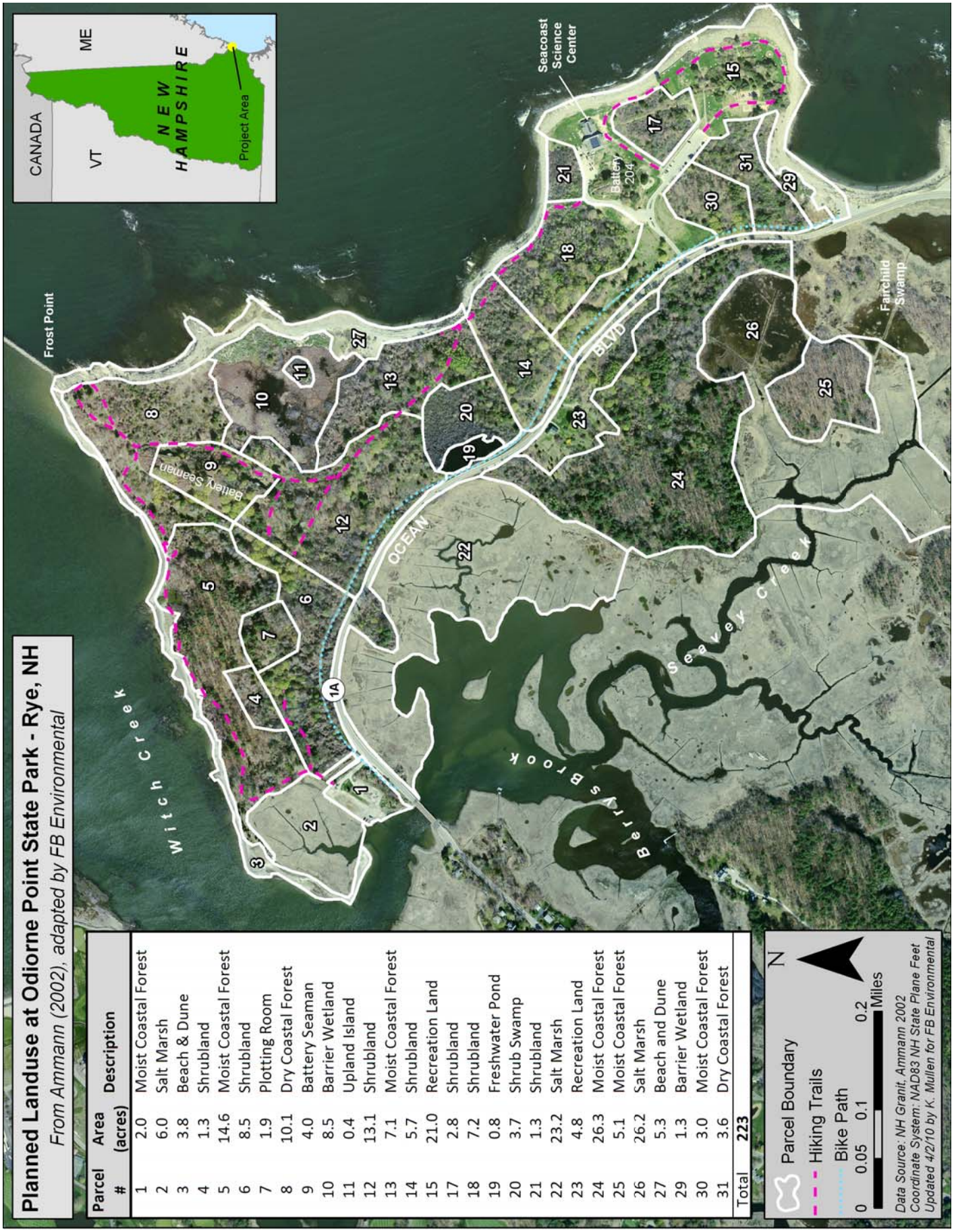
May 2010

Contact:
Odiorne Point State Park
Rt. 1A
Rye, NH 03870
Phone:(603) 436-7406

or

Seacoast Science Center
570 Ocean Boulevard
Rye, NH 03870
Phone: (603) 436-8043

Cover: Odiorne Point State Park hosts a diverse landscape featuring both rocky and sandy beaches, dunes and coastal forest, as well as brackish and salt marshes, and historical features such as the Battery Seaman.
Photos: FB Environmental and Nathan Hamilton (Battery Seaman).



Planned Landuse at Odiorne Point State Park - Rye, NH

From Ammann (2002), adapted by FB Environmental

Parcel #	Area (acres)	Description
1	2.0	Moist Coastal Forest
2	6.0	Salt Marsh
3	3.8	Beach & Dune
4	1.3	Shrubland
5	14.6	Moist Coastal Forest
6	8.5	Shrubland
7	1.9	Plotting Room
8	10.1	Dry Coastal Forest
9	4.0	Battery Seaman
10	8.5	Barrier Wetland
11	0.4	Upland Island
12	13.1	Shrubland
13	7.1	Moist Coastal Forest
14	5.7	Shrubland
15	21.0	Recreation Land
17	2.8	Shrubland
18	7.2	Shrubland
19	0.8	Freshwater Pond
20	3.7	Shrub Swamp
21	1.3	Shrubland
22	23.2	Salt Marsh
23	4.8	Recreation Land
24	26.3	Moist Coastal Forest
25	5.1	Moist Coastal Forest
26	26.2	Salt Marsh
27	5.3	Beach and Dune
29	1.3	Barrier Wetland
30	3.0	Moist Coastal Forest
31	3.6	Dry Coastal Forest
Total	**223**	

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Kailee Mullen, FB Environmental Associates
Tricia Rouleau, FB Environmental Associates

Survey Team Members & Survey Volunteers
Ingrid Brack, University of Southern Maine
Tracy Degnan, Rockingham County Conservation District
Theresa Galvin, FB Environmental Associates
Marilyn Gilmoreu, Seacoast Science Center
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Jennifer Jespersen, FB Environmental Associates
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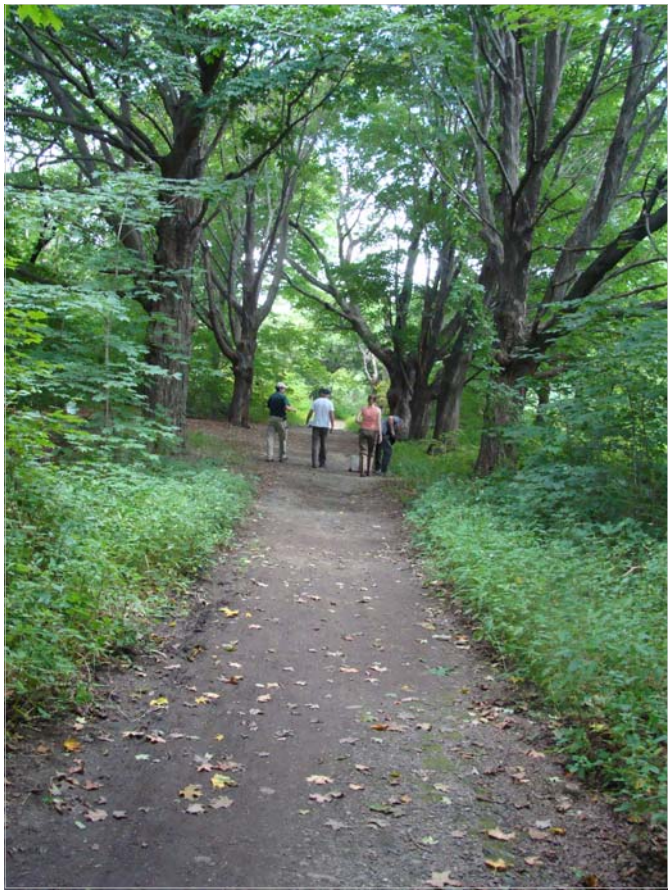
1. Introduction

1.1 Background and Purpose

Invasive plants dominate the landscape within Odiorne State Park, killing off native plant populations, destroying native plant and animal habitat, and limiting access for public recreation. In July 2009, the Seacoast Science Center (SSC) received funding from the New Hampshire Department of Environmental Services (NHDES) and hired FB Environmental Associates to conduct an invasive plant inventory and archeological sensitivity analysis, and to develop an Invasive Plant Management Plan for Odiorne State Park.



Recreational opportunities abound in Odiorne State Park, including walking/biking trails like this mature oak-lined trail above. Unfortunately, a high percentage of trails in the park are overgrown with invasive plant species making access difficult. (Photo: FB Environmental)

The Plan builds upon previous surveys of invasive species and natural communities in the park, examining the types, size and status of invasive populations and the threats that they pose to native plant communities. Detailed maps are provided with descriptions of management actions that are needed on a parcel by parcel basis. Recommendations focus on restoring native plant communities, controlling infestations and eradicating new infestations.

Project partners, consisting of individuals from four different programs came together to help lead the project. These include: The SSC, NH State Parks, Rockingham County Conservation District (RCCD), and the NH Department of Environmental Services (NHDES). The Project partners formally met three times during the course of the project to discuss project goals and objectives, and progress. All of the Project partners participated in on-the-ground site walks during the survey period, and many provided time to participate in the survey. Project partners will help guide funding and implementation efforts, and to garner community support for the plan.

1.2 Goals and Objectives

Considering the wealth and breadth of ecologically and historically significant features, and recreational opportunities in the park, four primary objectives for invasive species management were identified:

1) Restore native habitats
2) Improve recreational opportunities for park visitors
3) Improve access to historically significant sites
4) Improve the safety of park visitors

This management plan provides protocols for implementing invasive species control measures on state land, and will describe:

1) Which invasive plant species should be targeted
2) What management practices are acceptable
2) When they should be implemented
3) Who can be authorized to implement the management practices

This management plan is a living document and should be revisited and revised periodically to reflect the dynamic nature of invasive species and the state of knowledge of best management practices (BMPs). Land managers should include or reference these protocols in ongoing management strategies, and provide a current inventory and list of management actions related to invasive plant control within the park to the project partners on an annual basis.

View from the top of the Battery Seaman overlooking extensive infestations of bittersweet, honeysuckle, and Norway maple. (Photo: FB Environmental)

2. Site Description

2.1 Location

Odiorne Point State Park covers approximately 330 acres along the seacoast in Rye, New Hampshire. Known for having the longest stretch of undeveloped shoreline in the state, the park is bound to the east by the Atlantic Ocean, to the north by Little Harbor, to the west by Witch Creek, and to the south by Route 1A. The park also includes an extensive system of marshes including Berry's Brook, and Seavey Creek.

Odiorne Point State Park is located in Rye, New Hampshire, along Route 1A, approximately 3 miles south of Portsmouth.

The land was once home to Native American tribes such as the Pennacook and Abanaki, as well as one of the first European settlements beginning in the 1600's. The land experienced drastic changes during World War II that resulted in the building of military structures (bunkers) which were camouflaged with non-native vegetation. The state of New Hampshire purchased the property from the federal government in 1961.

Today the park is managed by the New Hampshire Division of Parks and Recreation, and is home to the SSC. The SSC provides engaging and interactive public programs and exhibits about the coastal environment and its history. Park visitors number 150,000 annually. The Division of Parks and Recreation believes that the park should be managed for educational and recreational purposes, while restoring and protecting valuable coastal habitats.

2.2 Previous Studies

This Plan builds on prior work conducted by Strauss (1973) and Ammann (2002). Both studies describe the extensive disturbance to natural ecosystems to the detriment of salt marshes, upland and freshwater wetlands, and the flora and fauna that depend on them. Major land use changes have changed the landscape from forests and open fields to military installations and associated roads thick with invasive plants.

In her report entitled, *Floristic Study and Plant Communities of the Odiorne Point Area*, Straus divides the Odiorne Point State Park into fourteen sections, representing "characteristic habitat for the successful

establishment of certain plant species". She notes that several communities are composed primarily of native American plant species, while others are a mixture of native and naturalized species, or composed of groups of "artificially composed groups" planted as ornamentals, for food, or by the military. In her survey, Straus documented 347 species of plants within 76 families within these fourteen "communities". The same invasive plants that she documented in 1973 have spread throughout the park and have taken over many of the native communities. Below is a list of the fourteen communities from Straus (1973) and the location of these communities within the park (Table 2.1).

Table 2.1. *Fourteen Plant Communities in Odiorne Point State Park as described by Straus (1973).*

14 Plant Communities of Odiorne State Park (Straus, 1973)			
Section	**Community**	**Description**	**Location**
1	The shore	Includes intertidal gravel and mud, Upper-pebble beach, and sand beach.	Continuous shoreline
2	The pebble barrier	Accumulation of pebbles and rocks above the shore during storms and highest tides.	Along rocky shore from Frost Pt. to southern extemity of the Park
3	The south shore salt marsh	Includes salt marsh, and brackish marsh and shrubby border.	Along Rt. 1A at southern end of park
4	The ledges	Exposed ledge, or areas with thin soil over ledge supporting ericaceous shrubs and composites. Includes exposed ledge and low ground bordering the ledges.	Corresponds to Fields 30 and 31
5	The house and garden sites and the lawn	Most extreme impact to native plant community as a result of human habitation and military installations.	Includes current location of the Sea Coast Science Center, and grassy area
6	The moor	Adjacent to the shore, and dominated by native shrubs, largely blueberry, huckleberry, bayberrry. Threats include sumac and quaking aspen.	Eastern portion of Fields 18 and 21
7	The barrier pond	Includes open water and marsh, and shrubby border and marsh island.	Corresponds to Fields 10 and 11.
8	The thicket	Formed by high shrubs and scattered trees, and fairly impenetrable.	East of the central road and contiguous with the moor, and the shrubby border of the brackish pond
9	The bunkers and the central roads	Human activities have completely altered the natural communities in this portion of the park. Many species were planted as ornamentals or for camouflage for military installations.	A large portion of land near Frost Pt. including Fields 8, 9, and 12
10	The open fields, the orchards and garden sites	Includes presence of apple, crabapple, and pear trees as swell as remains of flower gardens and naturalized ornamentals from early settlement.	Corresponds with Fields 6, 7 and 12 west of the freshwater pond
11	The open woods	Populated by pines, oaks and shagbark hickory growing in moderatly dry soil (sand and rock ledges).	Corresonds with Field 5, Moist Coastal Forest
12	The north shore salt marsh	Part of the Seavey Creek salt marsh system, and flooded only at the highest "spring tides".	Correponds with Field 2, Salt Marsh
13	The fresh water pond	A man-made pond created when Rt 1 A was built. Communities incldude aquatic species within the pond, and plants of the pond margin.	Corresponds to Fields 19 and 20, Freshwater wetlands
14	The gravel pit	A steep slope of rocks and gravel with habitat suited to plants adapted to dry conditions. The bottom of the pit is a flat, moist, grassy meadow bordered alder.	Part of Field 20, south east of the fresh water pond

A second survey was conducted by Ammann (2002). In his report entitled, *Conceptual Plan for Ecological Restoration of Odiorne State Park*, Ammann describes the effects that invasive plants have had on the native ecosystems in the park. Like Straus, Ammann divided the land within the park into sections to describe native ecosystems (Figure 2.1, Table 2.2). These ecosystems and their boundaries were used as the basis for the invasive plant inventory reported in this Plan.

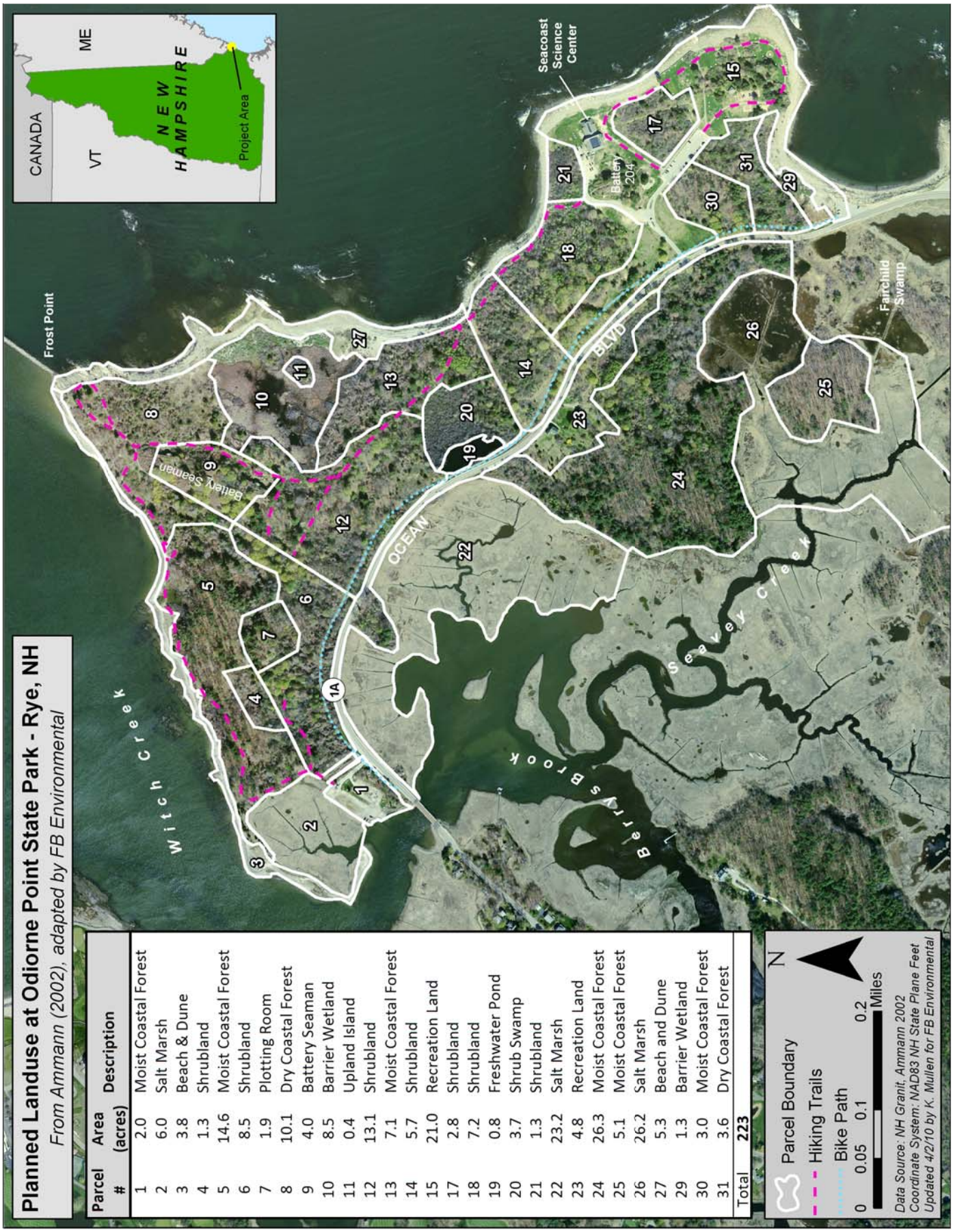


Figure 2.1. *Map showing the seven different native ecosystems, across 29 "Fields" within Odiorne Point State Park.*

Table 2.2. *Seven native ecosystems in Odiorne Point State Park.*

Seven Native Ecosystems of Odiorne Point State Park			
#	**Habitat Type**	**Description**	**Location**
1	Moist Mesic Forest	Enriched hardwood forests growing on soils with fairly high levels of moisture, mineral nutrients, and high-quality organic matter. Species include an overstory of oaks, hickories, white pines and an understory of alternate leaved dogwood, red elderberry, ironwood and Christmas fern.	Fields 1,5,23,24,25,30
2	Dry (Xeric) Forest	Occur on dry, sandy or rocky sites maintained by periodic fire. Species commonly found in the overstory are red oak, white and pitch pine with blueberry and black huckleberry, and distant sedges occupying understory.	Fields 8, 31
3	Barrier Marsh	In NH, this community only occurs at Odiorne Point State Park. Vegetation is located along hydrologic gradients (flood and saturation duration and salinity).	Fields 10, 29
4	Dune & Beach	Areas of actively shifting sand associated with the coastal environment. Onshore winds and salt spray affect the types of vegetation that grow here. Beach grass dominates this habitat type at the waters edge, as well as seaside goldenrod and beach heather. Shrub thickets (bayberry, beach plum) dominate the backdune area.	Fields 3, 27
5	Salt Marsh	Situated along the coast behind rocky spits, barrier beaches, and sand bars, this habitat is protected from wave action, and supports a broad diversity of vegetation including spike-grass, salt-meadow cord-grass, salt marsh rush and Scotch lovage. Soils consist of thick organic materials over sand, silt, or bedrock.	Fields 2, 22, 26
6	Freshwater Wetlands	Formations resulted from human activity and natural depressions and drainage routes for perennial and temporal streams. well-decomposed muck and mineral soils along small, low-gradient, seasonally flooded streams and depressions.	Fields 19, 20
7	Warm Seasonal Grassland	Former agricultural fields and areas leveled for construction of military installation. Soils typified by depth to bedrock, shallow organics over mineral or smoothed udorthents.	Former agricultural fields

(Sources: Ammann, 2002; NHDFL, 2010)

2.3 Natural Resources

Natural resources within Odiorne Point State Park are protected under the NH Coastal Shoreland Protection Act, Section 404 of the federal Clean Water Act, the federal Endangered Species Act, and the NH Native Plant Protection Act. In the majority of cases, permits are required by NHDES if soil is to be altered, or native (natural) species are to be removed within the shoreland zone. Application of herbicides of any kind within the shoreland zone requires a special permit issued by the Division of Pesticide Control under Title L Water Management and Protection (RSA 483-B:9(A). All wetlands are protected by state law in New Hampshire. Projects that propose impacts (of any size) to wetlands require a permit from the NHDES Wetlands Bureau. A full list of regulations related to invasive plant control is described in Section 5.3.4.

2.3.1 Soils

A majority of the soils within the project area are classified as smoothed Udorthents, excessively drained to moderately well drained human influenced and disturbed soils that have been altered by cutting and filling

(NRCS 2010; Appendix A, Figure A.1). These soils resulted from the construction of the military base and fortifications at Fort Dearborn. Fields 12, 14, 15, 17, 18, 21, 29, 30 and 31 (Figure 2.1), which house the SSC, parking areas, interior trails to Frost's Point and the playground are dominated by smooth Udorthents, making them suitable for parking and recreation.

Chatfield-Hollis-Canton complex soils are well drained glacial till soils characterized by shallow to bedrock conditions and are found in Fields 4 and 8 (Figure 2.1). They remain relatively intact and are considered productive forest soils and currently support mature pines and oaks throughout Field 4. These soils are located on thin deposits of glacial till with ledge typically encountered within a few feet of the surface.

Pawcatuck mucky peat is found in the boat launch area and within the barrier wetland in Field 10 (Figure 2.1). These nearly level, very poorly drained soils are located in very shallow depressions in tidal marshes and are mainly covered with salt-tolerant grasses. Most areas have depressions and ditches which allow tidal water to recede quickly.

2.3.2 Wetlands

Within the park boundary there exist several prominent coastal and freshwater wetlands (Figure 2.2). Wetlands serve important functions including flood control, drinking water supplies, wildlife habitat, nurseries for finfish and shellfish and recreation. In New Hampshire there are several different kinds of wetlands including marine, estuarine and terrestrial.

Marine and estuarine wetlands were grouped into "coastal" wetlands in Figure 2.2. These include salt marshes, rocky intertidal wetlands, and wetland communities within the beach zone. Freshwater wetlands in the park include the large barrier wetland south of Frost's Point, the man-made pond and adjacent forest east of Rt.1A, and various forested wetlands throughout the park that have formed as a result of natural depressions on the landscape.

View of the barrier wetland and upland island located in fields 10 and 11 south of Frost's Point. Invasive common reed, and purple loosestrife have found refuge within this rare plant community.
(Photo: FB Environmental)

Several unmapped wetlands were documented within the park during the invasive plant survey. As such, all wetlands will require a wetland delineation prior to implementation of invasive plant control efforts in order to avoid any negative impacts to these important systems.

Figure 2.2. *Natural Resources within Odiorne Point State Park.*

2.3.3 Exemplary Natural Communities and Threatened or Endangered Plants and Animals

Odiorne Point State Park is home to several ecologically exemplary natural communities (Table 2.3). These are communities in which the very essence of natural diversity is threatened as a result of development, or in the case of Odiorne, recreation. Land management activities, such as limiting recreational access to sensitive communities (such as dunes with rare dune grass), and eliminating introduced and invasive plant species, will help protect these communities and the values they provide well into the future.

Figure 2.2 (previous page) highlights the areas of exemplary natural communities (green), as well as the rare plant or animal occurrence (red stripes). On the north side of Rt. 1A there are three different Exemplary Natural Communities. These include: the Bayberry-beach plum maritime shrubland and Coastal salt pond marsh located within the barrier wetland south of Frost's Point. These communities are home to four different species of rare or threatened plants including: the endangered horned pondweed and coast-blite goosefoot, and the threatened salt-loving spike-rush, and small spike-rush. The other exemplary natural community within the survey area (east of Rt. 1A) includes a small Beach Grass community on the dune which supports a threatened species of beach grass (*Ammophilia breviligulata*). This plant is considered imperiled due to rarity or vulnerability state-wide. Limiting recreational access to this area will protect this habitat into the future.

Exemplary Natural Communities of Odiorne Point State Park	
Community	**Status**
Bayberry-beach plum maritime shrubland	Listed in NH as a Critically imperiled due to rarity or vulnerability. Located south of Frost's Point between the shore and the salt pond.
Beach grass grassland	Listed in NH as critically imperiled due to rarity or vulnerability. Located at southern corner of Little Harbor mouth.
Coastal salt pond marsh	Listed in NH as critically imperiled due to rarity or vulnerability. Located due south of Frost's Point.
High Salt marsh	Listed in NH as rare or uncommon. Located near the mouth of Berry's Brook between Sagamore Road and Brackett Road and east, and along Seavey Creek.
Low salt marsh	Listed in NH as rare or uncommon. Located near the mouth of Berry's Brook between Sagamore Road and Brackett Road and east, and along Seavey Creek.
Saline/brackish intertidal flat	Listed in NH as rare or uncommon. Located near the mouth of Berry's Brook between Sagamore Road and Brackett Road and east, and along Seavey Creek. Occurs between estuarine marshes or other coastal communities landward and subtidal communities seaward and include tidal creek channels exposed at low tide.
Saline/brackish subtidal channel/bay bottom	Listed in NH as rare or uncommon. Located near the mouth of Berry's Brook between Sagamore Road and Brackett Road and east, and along Seavey Creek. Occurs in permanently flooded saline tidal channels and bays.
Tidal creek bottom	Listed in NH as rare or uncommon. Located near the mouth of Berry's Brook between Sagamore Road and Brackett Road and east, and along Seavey Creek. Occurs in permanently flooded creek-bottoms draining water from the high and low salt marsh into the main channel of the bay.

Table 2.3. *Exemplary Natural Communities within Odiorne Point State Park. (Source: NHB, 2006)*

West of Rt. 1A are two additional exemplary salt-marsh communities (primarily low salt marsh, and intertidal creek bottom), which provide habitat for the endangered dwarf glasswort, threatened salt-marsh gerardia, and the saltmarsh sharp-tailed sparrow, a species of special concern in New Hampshire.

The Saltmarsh Sharp-tailed Sparrow is a species of special concern in the park. Its survival depends on protection of these habitats. (Photo: CT Audubon)

The New England cottontail *(Sylvilagus transitionalis)* is being considered for federal protection under the Endangered Species Act and is currently listed as an endangered species in the state of New Hampshire. Populations are predominantly found in areas near the Seacoast and Merrimack Valley regions. The New Hampshire Fish and Game Department administers the New England Cottontail and Early Successional Habitat Project -Nongame and Endangered Wildlife Program as part of the New Hampshire Wildlife Action Plan. The purpose of this program is to gain a better understanding of the distribution of New England cottontails in New Hampshire, identify areas where land management would increase suitable habitat, and restore New England cottontail population numbers through relocation (Arbuthnot (2008).

Restoration efforts are focused on developing networks of early successional habitat in landscapes currently occupied by New England cottontails by protecting key habitat, restoring degraded habitat and creating new habitat. Odiorne Point State Park includes early successional habitat that would likely support the cottontail, yet no cottontail have been documented.

Invasive plant control activities should be designed to avoid impacts to endangered or threatened plant and animal species and exemplary natural communities. Before activities begin in these areas of the park, the NH Natural Heritage Bureau (NHB) should be briefed by sending a letter describing the work to be conducted, and a map showing the project area. NHB will determine whether a site review is needed. The NH Fish & Game Dept. has legal authority over wildlife in NH, and should be contacted if work will commence near sparrow habitat.

2.4 Invasive and Nuisance Plant Species

2.4.1 Invasive Plant Species

The State of New Hampshire has established a list of twenty-five prohibited invasive plant species (NAMF, 2005, Appendix B) which fall under the State's Invasive Species Act. The Act states, "*that no person shall knowingly collect, transport, sell, distribute, propagate or transplant any living or viable portion of any listed prohibited invasive plant species including their cultivars, varieties, and specified hybrids"* (HB 1258-FN, Agr 3800).

At least eighteen of the twenty-five prohibited species on the state list have been documented within Odiorne Point State Park (Table 2.4). A full description of the eighteen species of invasive plants within the park listed are described in Chapter 4 and listed in Appendix B.

Table 2.4. *List of documented invasive plant species in Odiorne Point State Park.*

Latin Name	Common Name
Acer platanoides	Norway Maple
Ailanthus altissima	Tree of Heaven
Berberis thunbergii	Japanese Barberry
Berberis vulgaris	European Barberry
Celastrus orbiculatus	Oriental/Asiatic Bittersweet
Cynanchum nigrum	Black Swallow-Wort
Elaeagnus umbellata	Autumn Olive
Euonymus alatus	Burning Bush
Lepidium latifolium	Perennial Pepperweed
Ligustrum obtusifolium	Blunt-Leaved Privet
Lonicera japonica	Japanese Honeysuckle
Lonicera morrowii	Morrow's Honeysuckle
Polgonum cuspidatum (Fallopia japonica)	Japanese Knotweed
Rhamnus catartica	Common Buckthorn
Rhamnus frangula	Glossy Buckthorn
Rosa multiflora	Multiflora Rose
Lythrum salicaria	Purple loosestrife
Phragmites australis	Common Reed

Species with the greatest threat to freshwater and brackish barrier wetlands in the park include purple loosestrife, and common reed. These two plants are known to spread rapidly, forming monocultures that outcompete native wetland species in relatively short time spans. Perennial pepperweed poses a major threat to the grassy coastal wetlands along the beach south of Frost's Point. Pepperweed has only been documented in one other location in NH, and is currently a significant problem in Massachusetts. Bittersweet, honeysuckle, and glossy buckthorn are the major threat to the forested upland communities throughout the park. These species are known to have the greatest density and distribution park-wide.

Other species of plants that are not listed on the NH list of prohibited invasive plants, but should be watched as they have invasive qualities include common catbriar (*Smilex rotundifolia*) and black locust (*Robinia pseudoacacia*), a prohibited species in Massachusetts. These plants have been documented in the park, and should be watched closely, or surveyed periodically.

2.4.2 Non-Regulated Naturalized, or Nuisance Plant Species

Ammann (2002) describes several species of plants that pose threats to native ecosystems in the park, yet are not on New Hampshire's list of invasive species. While Ammann describes these plants as invasive plants in his report, several of these species are actually native species that have outcompeted other native plants. These include poison ivy (*Rhus radicans*), rugosa rose (*Rosa rugosa*), staghorn sumac (*Rhus typhina*), and narrow-leaved cattail (*Typha angustifolia*). Since these plants are native, they are regulated differently than the NH list of prohibited plant species. For example, removal of sumac from the shoreland zone is not allowed without a permit from NHDES.

In addition to the state listed invasive plant species, these plants are a concern within the park. Some of this concern is related to recreational use. For example, rugosa rose and poison ivy are the primary nuisance species that limit access to trails, and poison ivy in particular can be considered a public health threat due to its toxicity. As such, the project partners asked the survey team to note the location of these species throughout the park along with the invasive species of concern.

3. Archaeological Survey

3.1 Introduction

3.1.1 Site Location and Description

A Phase IA archaeological survey was conducted in coordination with the invasive plant survey for Odiorne Point State Park, located along Route 1A (Ocean Boulevard) in Rye, Rockingham County, New Hampshire. The USGS map (Appendix C, Figure C.2), and aerial photograph (right), illustrate the project location. The 331.5 acre property is roughly rectangular in shape, extending approximately 5,000 feet south to north and varies from under 1000 to over 2500 feet east to west.

At the time of the Phase IA survey the north and south end of the parcel, adjacent to Route 1A, had remains of two WWII military batteries, "Seamans" Battery (103) and Battery 204 and as well as associated structures and roads (Figures 3.1-3.3). One former dwelling was modified as the present SSC. The Odiorne Homestead functioned as a facility for the Park Service. The Odiorne family cemetery is also present at the west end of the property.

The survey area is wooded with former fields overgrown. There are open wetlands which contain a network of tidal creeks particularly on the west side

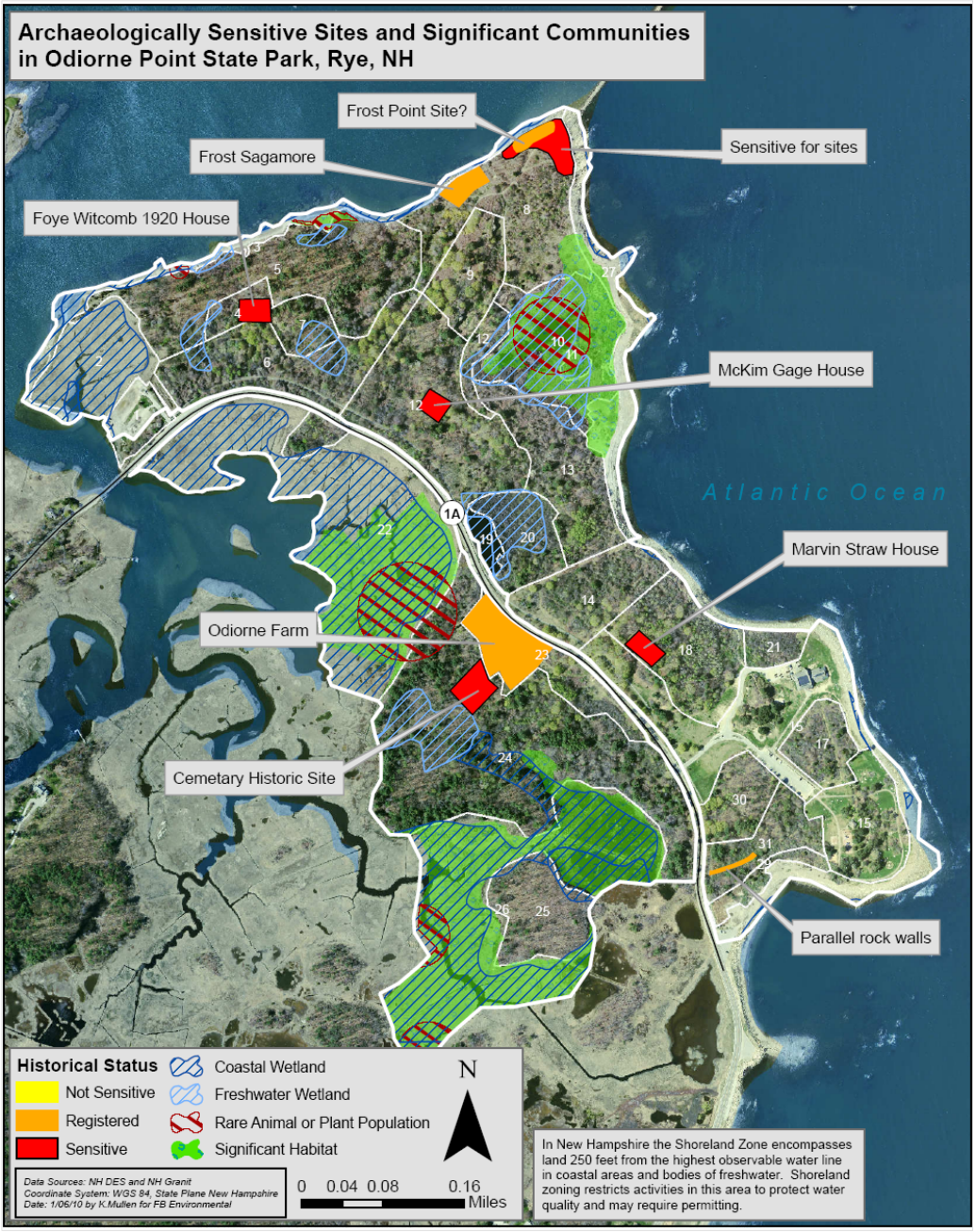


Figure 3.1. *Location of archeological sensitive sites. (See Appendix C for larger map)*

Figure 3.2. *Battery Seaman, back entrance to one of the casements, facing south east. (left). Battery Seaman, front entrance to one of the casements, facing north west (right). (Photos: Nathan Hamilton)*

of the park that ultimately discharge to the Seavey Creek - Little Harbor watershed to the north. The Atlantic Ocean borders the park to the north, east, and south. Route 1A, military fortifications, the Odiorne homestead, the SSC, playground, and associated parking areas can be seen. Route 1A bisects the project area.

Soils within the project area are primarily classified as smoothed udorthents (soils having undergone excavation or filling with regrading) (Kelsea and Gove 1994) as a result of landscape modification for construction of WWII era fortifications.

Figure 3.3. *Panama gun mount south of Battery 204, facing south. The gun mount is directly on the shore of the ocean. (Photo: Nathan Hamilton)*

3.1.2 Archaeological Assessment

In New Hampshire, a number of environmental laws administered by the NHDES and New Hampshire Division of Historical Resources (NHDHR) require environmental impact studies to be performed as part of the permitting process. Of concern to the NHDHR are projects that may have archaeological sensitivity, including potential Native American sites, as well as projects with historic structures 50 years or older.

A project's potential impact on cultural resources is also assessed under guidelines issued by the Department of the Interior. Cultural impact studies include the identification of potentially significant architectural resources as well as historic or prehistoric archaeological sites. The NHDHR has been directed by the Department of the Interior to identify, preserve and protect significant cultural resources.

Most of the State's 9,350 square miles have never been professionally surveyed for potentially significant archaeological resources. Odiorne Point State Park has had several archaeological investigations. The survey

area is comprised of assorted glacially deposited, sandy-silt to gravel strata, within close proximity to potential water sources. Throughout the northeast similar landscapes (sandy soils overlooking primary water sources) have been found to contain the remains of camp sites utilized by Palaeoindian hunter-gatherers more than 10,000 years ago, as well as subsequent Archaic and Ceramic period prehistoric Native American peoples. Furthermore, the beach and marsh margins of the open ocean and estuaries have good potential for human habitat. Therefore, NHDHR has asked that a Phase IA archaeological survey be conducted.

The purpose of the survey was to assess the archaeological sensitivity of the proposed project area with regard to historic and Native American site potential. A prehistoric Native American site may be considered significant if it contains intact cultural components in good stratigraphic context, and if it will make a contribution to the State's prehistoric cultural record. Sites considered significant by NHDHR will then be eligible for inclusion to the National Register of Historic Places (NRHP). Similarly, on-site structures over 50 years old are assessed for integrity and potential historical significance relative to NRHP and NHDHR criteria.

3.1.3 NHDHR Division Review

A file review was conducted at the New Hampshire Division of Historic Resources (Concord, NH) in September 2009. As a result of the file review we obtained archaeological survey reports conducted in previous years (Wheeler *et. al.* 2000, Wheeler and Roach 2000, Wheeler 2003), archaeological site designation forms for four sites located within Odiorne Point State Park, and historic maps (Appendix C). The four sites previously designated and on the Division inventory are listed in Table 3.1.

Table 3.1. *List of archaeological sites designated within Odiorne Point State Park.*

SITE NAME	SITE NUMBER	TYPE	TIME PERIOD	REPORTED BY	DATE	IMPACTED
Frost's Point	NH 40A-0004 27-RK-0072	Unknown Prehistoric, and Residential Historic	Prehistoric, Native American and Historic Euro American beginning 1623	Eugene D. Finch (Finch and Johnson)	26 August 2002	Yes, eroded or buried
Sagamore House Hotel	NH 40A-0023 27-RK-0087	Residential, Recreational, Hotel	Historic Euro American 1759-1872	Louise Tallman, NHAS (Parsons) (Vannell)	26 August 2002	Yes, burned
Odiorne Farm	NH 40A-0022 27-RK-0308	Residential, Agricultural	Historic *ca.* 1650-1700	Ellen Marlatt, IAC	28 August 2002	Yes, relocated
Stone wall and foundations	NH 40A-0008 27-RK-116	Stone wall, burned building foundations	Historic	R. Ewing	30 June 2003	Yes, destroyed for bike path (under monitoring)

Source: New Hampshire Division of Historic Resources, 19 Pillsbury Street, Concord, New Hampshire 03301.

Archaeological survey reports included a Phase 1B survey reported in 2003 by Independent Archaeological Consulting, LLC. ("IAC") of subsurface testing on the area now containing the playground (Field 15). The report by Wheeler (2003), notes two Native American sites not found in our file review at NHDHR: "a woodland period assemblage of flakes and pottery along Witch Creek" and the "Indian Well" containing Native American pottery on John Odiorne's property on the inland side of Route 1A. Additional surveys, also conducted by IAC and reported in 2000 describe a Phase IB and II test excavation of the 17th Century occupations at the Odiorne Farm Site and adjacent area in advance of the development of the salt marsh walking trail.

3.2 Survey Methods and Results

The archaeological assessment began with a review of geological maps, soils maps, and the topographic survey plans provided, and a walkover (Phase IA) survey of the property to define an appropriate Phase IB scope of work in accordance with NHDHR. Phase IA surveys focus on the potential for Native American and historic site sensitivity, and are comprised of a visual assessment of the site and surrounding areas, background research, interviews, and NHDHR site file research. Field work was carried out between August 10 and October 15, 2009, by archaeologist Nathan D. Hamilton, Ph.D., and assisted by Ingrid B. Brack, M.Sc., and Kate E. McMahon, B.A.

At least thirteen historic domestic structures were inventoried as foundations and activity areas of former structures, several of these are extant structures (*e.g.* the Odiorne Homestead) (Table 3.2). Most of the domestic structures were condemned and taken by eminent domain by the United States Military in the early 1940's. The extant Odiorne Homestead just west of Route 1A is listed on the NHDHR records as an architectural building.

Table 3.2. *Odiorne Point State Park historic domestic structures.*

NAME	YEAR BUILT	YEAR DESTROYED	ARCHAEOLOGICALLY SENSITIVE	LOCATION	Crosby *et. al.* 1994 page
Kathryn A. Stevens	*1920s*	*1942*	*no*	*Field 15B*	*12-15*
Helen and David Graves	*1927*	*1942*	*no*	*Field 15B*	*16-18*
Cyrus & Charles Eastman House, Barn	*early 1870s*	*moved in 1921 to west edge of route 1A, building extant*	*no*	*Historic map 14, Field 15*	*31-33*
Marvin/Straw Estate, Fountain	*1920s*	*unknown*	*yes*	*Historic map 11, Field 18*	*38-42*
Odiorne Homestead	*1800*	*extant*	*yes*	*Historic map 17, Field 23*	*44-47*
Early Odiorne House	*1660*	*unknown*	*yes*	*Historic map 19, Field 23*	*44-47*

Table 3.2 Cont.

NAME	YEAR BUILT	YEAR DESTROYED	ARCHAEOLOGICALLY SENSITIVE	LOCATION	Crosby *et. al.* 1994 page
Odiorne Blacksmith Shop	*after 1800*	*unknown*	*yes*	*Historic map 18, Field 23*	*47*
Odiorne Cemetery	*unknown*	*extant*	*yes*	*Historic map 18, Field 23*	*47*
Oldest house in NH	*1623*	*1902 (gravel pit)*	*no*	*Historic map 8, Field 14*	*51*
Foye/ Whitcomb Heritage Garden and Homestead	*ca. 1800*	*1942*	*yes*	*Historic map 3A and 3, Field 7*	*60-62*
Sagamore House	*by G. Frost 1750, additions in 1850s-60s, and in 1868-70*	*burned 1871*	*yes*	*Seen in 1805 map, corps of engineers map. Historic map 4, Field 8*	*68-69*
McKim/Gage House and Outbuildings	*late 1890*	*1942?*	*yes*	*Sugar maple lined driveway, historic map 6, Field 12*	*83-85*
Peaslee	*subdivision of McKim land, built after 1924*	*after 1942*	*no*	*Shore of little harbor, historic map 5, Field 8*	*84-85*
Waldron House (McKim's Organ House)	*expanded after 1924*	*after 1942*	*no*	*Shore of little harbor, Field 8*	*84-85*

Sources: *Crosby, Howard S., Wendy W. Lull and Richard T. MacIntyre. 1994. Footprints in Time: A Walk where New Hampshire began. Arcadia Publishing, Portsmouth; Tallman, Louise H. 1973. "Odiorne Point: Highlights of History" in Odiorne Point State Park: Natural Science and Historical Studies. Seacoast Science Center, Rye; Mawson, Julia Steed (Editor). 1992. Exploring Odiorne Point: A Guide to its Natural & Social History. Seacoast Science Center/ Great Northern Printing Co., Rye."Historical Map of Odiorne Point Area" pages 6 and 7.*

Extant World War II era structures are listed in Table 3.3. The largest of the structures, Battery Seaman (103) and Battery 204 are easily accessible to the public (Appendix C, Figures C.9-C.11). The WWII structures are not listed in the NHDHR filed but the sites are well known (*e.g.* Wysong 1997) and under supervision of the park rangers and staff of the state park.

Table 3.3. *Odiorne Point State Park World War II military structures.*

NAME	TYPE	ARCHAEOLOGICALLY SENSITIVE	LOCATION
Battery 204 Gun Mounts	Panama Gun Mount	no	Field 15
Battery Seaman Gun Mount	Panama Gun Mount	no	Field 9
Battery 204	Battery	no	Field 15
Battery Seaman	Battery	no	Field 9
Plotting Room	Bunker	no	Field 7
TNT Storage	Building	no	Field 24/25/26

A small number of other historic period structures including the 17th century "salt works", Columbus Road, the Cemetery, the old Native American well at the Odiorne Homestead, and an early cellar hole are documented (Table 3.4).

Table 3.4. *Odiorne Point State Park other historic structures.*

NAME	YEAR BUILT	YEAR DESTROYED	REMAINS/ SENSITIVE?	LOCATION
Salt Works	1631	unknown	yes	Historic map 7, Field 11
Columbus Road	built 1838	intact	no	Historic map 9, Field 13, 14, 20 border
Cemetery	unknown	intact	yes	Field 23
Odiorne Area Old Well	unknown	intact?	yes	Historic map 20, Field 23
Cellar Hole	unknown	intact?	yes	Historic map 21, Field 24

Source: *Mawson, Julia Steed (Editor). 1992 Exploring Odiorne Point: A Guide to its Natural & Social History. Seacoast Science Center/ Great Northern Printing Co., Rye."Historical Map of Odiorne Point Area" pages 6 and 7.*

Pertinent historical features are depicted in Appendix C (Figure C.1). and are identified by name of the last historical occupant. Photographic documentation of relevant areas were compiled. Surface collection of select artifacts from the Marvin/Straw Estate and Dolphin Fountain was carried out. Artifacts are curated at the University of Southern Maine Archaeology Laboratory (317 Bailey Hall, Gorham, Maine).

3.3 Conclusions and Recommendations

Based upon this Phase IA, walkover assessment, file review research conducted at the NHDHR offices in Concord, and testing requirements defined by NHDHR, we recommend six sites suitable for prehistoric and/or historic archaeological (Phase IB) testing (Table 3.5), and can be used for assessing potential site eligibility to the National Register of Historic Places.

Table 3.5. *Odiorne Point State Park Phase IB recommendations for each site.*

SITE NAME	RECOMMENDATION	LOCATION
Frost's Point	40 50cm^2 test pits in 7 meter intervals	Fields 8, 3, and 27
Sagamore House Hotel	20 50cm^2 test pits in 7 meter intervals	Fields 8 and 3
Foye Whitcomb House	Map foundation, photography, 15-20 test pits	Field 5
Odiorne Farm	n.a.	Outside project area
McKim - Gage House	Map foundation, photography, 15-20 test pits	Field 12
Marvin - Straw House	Map foundation, photography, 15-20 test pits	Field 14 and 18
Salt Works	8-10 50cm^2 test pits in 7 meter intervals	Field 11
Cemetery	n.a.	Outside project area

The number of recommended test pits and associated Phase IB survey techniques in Table 3.5 will only be necessary if the ground is to be broken (by hand or mechanically) to remove invasive plants. If only herbicides are used, and the ground is not disturbed, then a Request for Project Review should be submitted to NHDHR describing the scope of work, location and results of this Phase IA survey. By selecting a strategy that minimizes disturbance to the soil near historic structures, then minimal Phase IB testing will be required. Registered prehistoric sites are given the highest priority for protection, followed by sites identified as "sensitive".

If a Phase IB test is necessary for the sites identified in Table 3.5, then the following information may aid in this process:

The area of Frost's Point has produced prehistoric materials. A collection was made by Eugene Finch and one lithic flake is curated at the University of New Hampshire**.** The point exhibits WWII era disturbance although there remains good possibility of the burial of undisturbed prehistoric deposits. The construction of the granite breakwater just prior to the 20th century has changed the coastal configuration. We recommend *ca.* 40 standard test pits (STP's) (50 cm^2) in this area (Figure 3.4).

The short-lived late 19th century Sagamore House Hotel site also located on Frost's Point exhibits archaeological potential of Hotel and earlier uses of this area. Louise Tallman's Historic Assessment of Odiorne State Park noted no surface evidence of the former structure but suggested that deposits may be buried from WWII construction activities (Tallman 1973). We recommend *ca.* 20 STP's (50 cm^2) at this site.

Figure 3.4. *Frost's Point, north east shore, facing north east (left). Note the accumulation of sandy sediment inshore of breakwater. Frost's Point south west shore, facing south (right). Note the eroding shoreline and exposed bedrock. Location of surface collected lithic flake by Eugene Finch. (Photos: Nathan Hamilton)*

Three other former historic period structures of the 19th and 20th centuries were all taken down in the 1940's in conjunction with the building of Fort Dearborn. The residential buildings were removed and intact vestiges of the fieldstone foundations are visible, with some in structurally good condition. These foundations from north to south include the Foye-Whitcomb House, McKim-Gage House (Figure 3.5), and the Marvin-Straw House (Figure 3.6). All three of these historic features have associated material culture documented on the surface during the walkover Phase IA survey.

Figure 3.5. *McKim-Gage house foundation and stone wall, facing north. Nathan Hamilton and Gary Bashline documenting the site. McKim-Gage house foundation area, facing west (right). (Photos: Nathan Hamilton)*

Figure 3.6. *The Dolphin Fountain on the Marvin-Straw estate, facing north east (left). The Dolphin Fountain, Marvin-Straw estate, facing east (right). Ingrid Brack (left) is standing on the former corner of the Marvin-Straw house, built above an old cellar hole. Surface artifacts were recovered here. A path leading to the ocean runs between Ingrid and Kate McMahone (right). (Photos: Nathan Hamilton)*

Further documentation of the extant foundations is recommended, including detailed mapping, photography, and *ca.* 15-20 STP's at each location. The STP's will characterize the sediment and determine the nature of the cultural deposits.

One smaller feature located in the near shore wetlands could possibly relate to the 17th century "Salt Works". The cultural affiliation remains unknown at present. Recommendations include the excavation of 8-10 STP's to evaluate the condition and affiliation.

The Fort Dearborn WWII military construction remains in good condition and is now over 50 years old. It may be appropriate to complete building survey forms for activity areas and individual structures within the park. This aspect can be done after consultation with the NHDHR.

In addition, a portion of the Eastman House foundation adjacent to the old road and stone wall in Field 31 was uncovered during invasive plant removal in late December following the Phase IA walk over. The ground surrounding the foundation structure was extensively disturbed during WWII fortification construction. Therefore, no additional Phase IB testing is recommended for this location.

A portion of the Eastman House foundation was buried beneath a thick stand of invasive honeysuckle, and was uncovered in December 2009 during the invasive plant pilot project in Field 31. (Photo: Joe Anderson)

4. Invasive Plant Survey

4.1 Survey Methodology

4.1.1 Survey Area

Individual parcels from Ammann (2002) served as the basis for conducting the invasive plant inventory. Due to the large project area, the complexity of different habitat types, and the immensity and complexity of invasive plants present, a preliminary meeting was conducted with key project partners in August of 2009 to determine which parcels the project team would survey. Seventeen parcels were selected for the survey representing an area of approximately 104 acres east of Rt. 1A (Figure 4.1).

4.1.2 Description of Methods

The invasive plant survey was led by FB Environmental Associates, and included assistance by natural resource professionals from the York County Soil & Water Conservation District, RCCD, NHDES, and volunteers from the SSC. The surveys were conducted between August 28 and September 25, 2009.

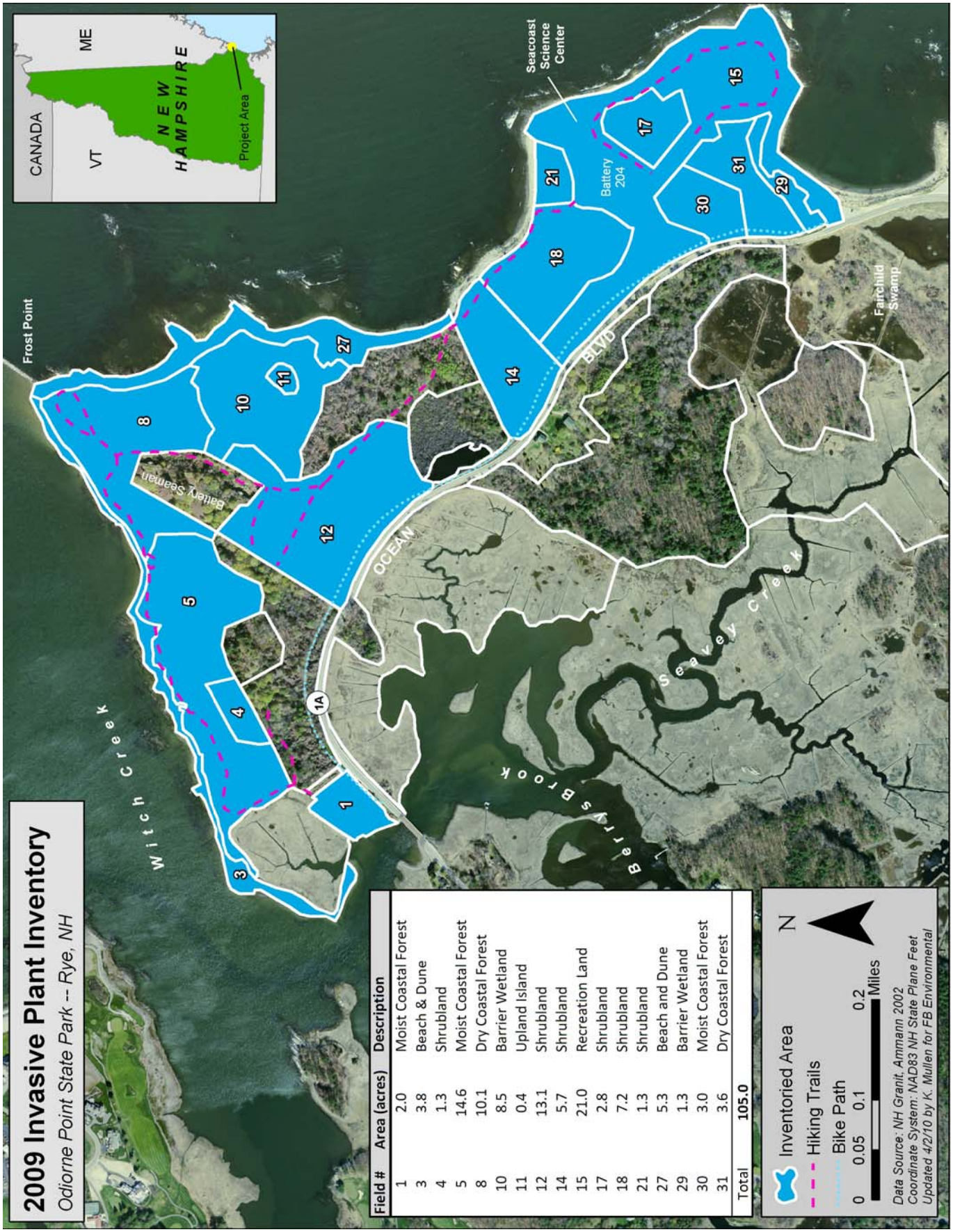
Individual observations on foot documented isolated invasive plants, like this small patch of bittersweet behind the SSC. (Photo: FB Environmental)

The sampling strategy utilized three different survey methods including: 1) Individual observations on foot with use of transects; 2) A 10 x 10 meter plot method; and 3) Use of aerial photos with parcel boundaries to delineate large infestations with limited access.

Data collection included the use of a field datasheet, entry of invasive plant occurrences into handheld GPS units, and photos of representative plant communities. Attribute data collected for the survey is based on The Nature Conservancy's Weed Information Management System (WIMS). The datasheet, including a field "cheatsheet" is presented in Appendix D. Data sheets and corresponding GPS data were entered into a common spreadsheet for mapping purposes at the end of each field day.

The first two days of surveying focused on Fields 15, 17, 29, 30 and 31 (Figure 4.1), and utilized individual observations on foot and use of transects. Isolated and satellite plant communities were captured as waypoints within, and at the edges of each parcel. Multiple waypoints were used to create polygons representing the area covered by each invasive species. Native species growing within the project area were documented as notes on the field sheets, as well as plants considered "nuisance".

After the first two days of the survey, the survey team re-assessed the survey methodology and determined that the existing methodology would be too time consuming given the lack of available volunteers to pair-up with



Field #	Area (acres)	Description
1	2.0	Moist Coastal Forest
3	3.8	Beach & Dune
4	1.3	Shrubland
5	14.6	Moist Coastal Forest
8	10.1	Dry Coastal Forest
10	8.5	Barrier Wetland
11	0.4	Upland Island
12	13.1	Shrubland
14	5.7	Shrubland
15	21.0	Recreation Land
17	2.8	Shrubland
18	7.2	Shrubland
21	1.3	Shrubland
27	5.3	Beach and Dune
29	1.3	Barrier Wetland
30	3.0	Moist Coastal Forest
31	3.6	Dry Coastal Forest
Total	**105.0**	

Figure 4.1. *Seventeen fields were inventoried for invasive plants at Odiorne Point State Park in 2009.*

survey team leaders. As such, a representative sampling methodology was adopted which utilized 10 x 10 m (1,086 sq. ft.) sample plots placed subjectively within representative locations within each parcel. Individual waypoints were used to collect data about isolated or satellite invasives that were not located within the sampling plot. Handheld GPS units were used to mark the center of each plot, thereby providing a location for post control monitoring.

4.1.3 Mapping Methods

The field survey maps are presented in several different ways depending on the approach that was used to survey. In some cases, data are presented as points, representing an isolated or satellite community. Other times they are presented as polygons, different sized shapes representing the area that the plant community was documented in. If the invasive plant population was not documented as either a point or a polygon, then the results are presented as a pie chart.

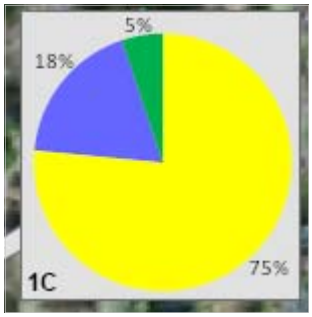
Thick sections of invasive plants were more suitable to the representative sampling methodology. (Photo: FB Environmental)

Pie charts are primarily used to represent the total % cover of the survey area. This method was used for all the parcels that were surveyed using the plot method, and in a few cases, for areas surveyed as a distinct plant community.

For the plot method, percent cover was estimated in the field for each species within the plot. The % cover in the pie chart represents the % cover of each species within the plot.

For a larger community within a field (plotless method), percent cover was calculated as follows:

$$\frac{\text{(Area of Invasive Species)} \times \text{(\% Cover within that area of Invasive Species)}}{\text{(Total Area Surveyed)}}$$



Example of pie chart used to represent % cover.

For example in Field 1, small glossy buckthorn saplings were estimated to cover ~ 1,000 sq. feet at 38% cover within a 2,000 sq. ft. survey area. Therefore:

$$\text{Glossy Buckthorn} = \frac{\text{(1,000 sq. ft.)} \times \text{(38\%)}}{\text{(2,000 sq. ft.)}} = 19\% \text{ cover}$$

Final calculated percent cover numbers were rounded to the closest % cover value used in the field where 1 = <1%, 5 = 1-10%, 18= 11-25%, 38=26-50%, and 75=51-100%. In the example above, 19% falls within the range 11-25%, or 18, and therefore is listed as 18% on the pie chart.

For sake of comparison, pie charts were prepared for final survey maps in fields that were surveyed by documenting individual observations on foot (Fields 15, 17, 29, 30 and 31). Percent cover is based on the dominant cover class of each species within each field.

4.2 Survey Results

4.2.1. Results by Parcel

Field 1:

Field 1 was classified as Moist Coastal Forest by Amman (2002), and encompasses approximately two acres of land on the northwest corner of Odiorne Point State Park. The southern boundary of the parcel is bound by a walking/biking trail and Route 1A, the western boundary is bound by Berry's Brook, a tidally influenced stream that flows north to Witch Creek, which flows into Little Harbor and the Atlantic Ocean. The northern edge of the parcel is bound by a large (~ 6 acres) salt marsh (Figure 4.2).

Field 1 contains the boat launch parking lot in the western corner of the park. (Photo: FB Environmental)

More than half of the area of this parcel is comprised of unpaved road and parking area, and a boat launch that provides access for recreationalists that want to access Berry's Brook by boat, walk or ride on the paved bike path, or access the network of trails that leads to the beach to the northeast.

Community C in Field 1 includes a narrow stretch of vegetation between the parking lot and an unmapped wetland. (Photo: FB Environmental)

The largest extent of invasive plants were documented in Community 1A (between the parking lot and Route 1A), and Community 1C (eastern border). The survey area for Community 1C includes all the land between the access road and an unmapped freshwater wetland to the northeast. Bittersweet is the dominant vegetation type in both Community 1A and 1C. In Community 1A, bittersweet is growing thick, covering native trees such as white oak, and cedar. The vines are dense along the chain link fence that runs the length of the bike path. Glossy buckthorn, multiflora rose, and honeysuckle are also present in moderate density in this section. Purple loosestrife, and common buckthorn were also documented as satellite plants within this parcel. Autumn olive, a plant that has only been documented in a few locations in the park has established a healthy population of mature shrubs in the southwest corner of this parcel.

While classified as moist coastal forest, this parcel is largely used for recreational purposes. The vegetated areas within this parcel are currently being consumed by invasive plants. Bittersweet in particular is climbing up native trees such as poplar, birch, and oak, and shrubs, forbes and grasses including bay laurel and spirea are being outcompeted by glossy buckthorn and honeysuckle. Of particular concern are the plants that are

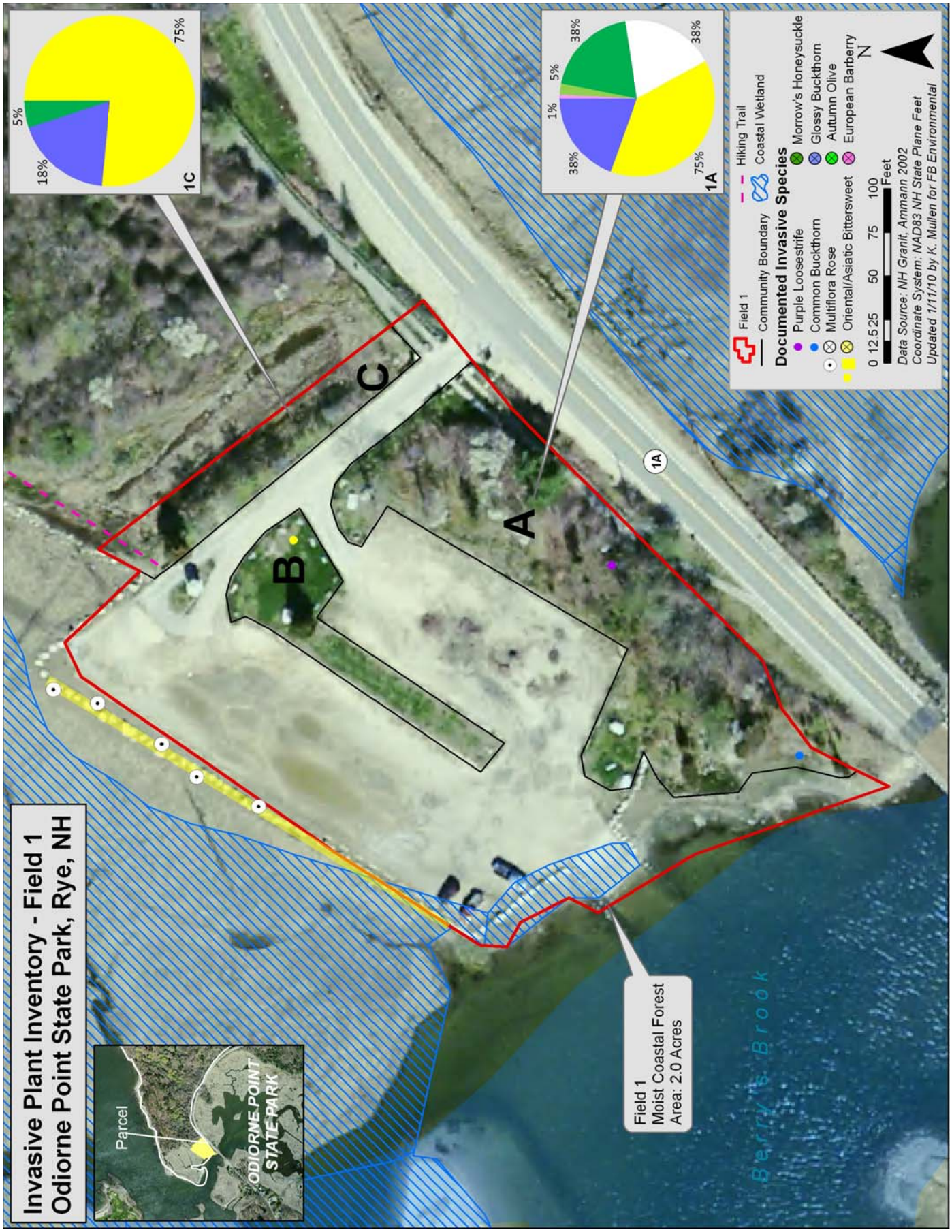


Figure 4.2. *Invasive Plant Inventory Map for Field 1 at Odiorne Point State Park.*

colonizing within the salt marsh along the rockwall. The two purple loosestrife plants documented in Community 1A should be eradicated immediately so they will not spread to the nearby freshwater wetlands.

Field 3:

Field 3 is classified as Beach and Dune habitat by Amman (2002), and Sand Beach by Straus (1973), and encompasses approximately 3.8 acres of land stretching from the salt marsh adjacent to Field 1, to Frost's Point. The majority of this parcel is bordered by the Atlantic Ocean to the north, and forestland to the south. Coastal wetlands are prevalent throughout the parcel, as well as freshwater wetlands, significant habitat (Grassland), and two populations of a rare beach grass (*Ammophilia breviligulata*) (Figure 4.3). Other seed-bearing plants that colonize this parcel include seabeach sandwort (*Arenaria peploides*), dusty miller (*Artemisia Stelleriana*), common mugwort (*Artemisia vulgaris*), scotch lovage (*Ligustricum scothicum*), saltwort (*Salsola kali*) and sea blite (*Suaeda richii*).

Field 3 supports a rare species of beach grass. Rerouting foot traffic in this section will help reestablish beach grass communities and provide habitat for nesting shorebirds. (Photo: FB Environmental)

No invasive species were documented within the survey area, due primarily to the sandy substrate which makes it difficult for invasives to establish themselves in, as well as the harsh coastal climate (wave action, diurnal inundation by tides, etc.). However, the back dunes are thick with nuisance vegetation including poison ivy. Invasive plants including bittersweet, buckthorn, and multiflora rose grow along the upland edge of this parcel. These plants were surveyed as part of the adjacent upland parcels.

Fields 4 & 5:

Fields 4 and 5 are classified as Shrubland and Moist Coastal Forest, respectively (Amman, 2002), and Open Woods (Straus, 1973). The Shrubland parcel area covers approximately 1.3 acres, while the Moist Coastal Forest covers approximately 13.3 acres. Field 4 was visited by two different two person survey crews on two different days. It was determined that Field 4 and Field 5 are synonymous. There are a number of unique natural and man-made features within the survey area of these parcels. This includes three mapped freshwater wetlands, and a sensitive archaeological site known as the Foye-Whitcomb House. Due to the large size of the parcel, the survey area was divided into four different "communities", with five different survey plots. These communities represent either a change in the dominant plant community structure, or a major shift in the extent and type of invasives present. A fifth survey plot (5C-Plot1) represents a slightly different plant composition than is found in the remainder of Community 5C, but was not separated out as an individual community type. The major difference is the presence of burning bush, which is thick through this portion of the park, and only documented in a few other locations as satellite plants park-wide, including Community 5D in the southeast corner of Field 5, and along the path from the boat launch.

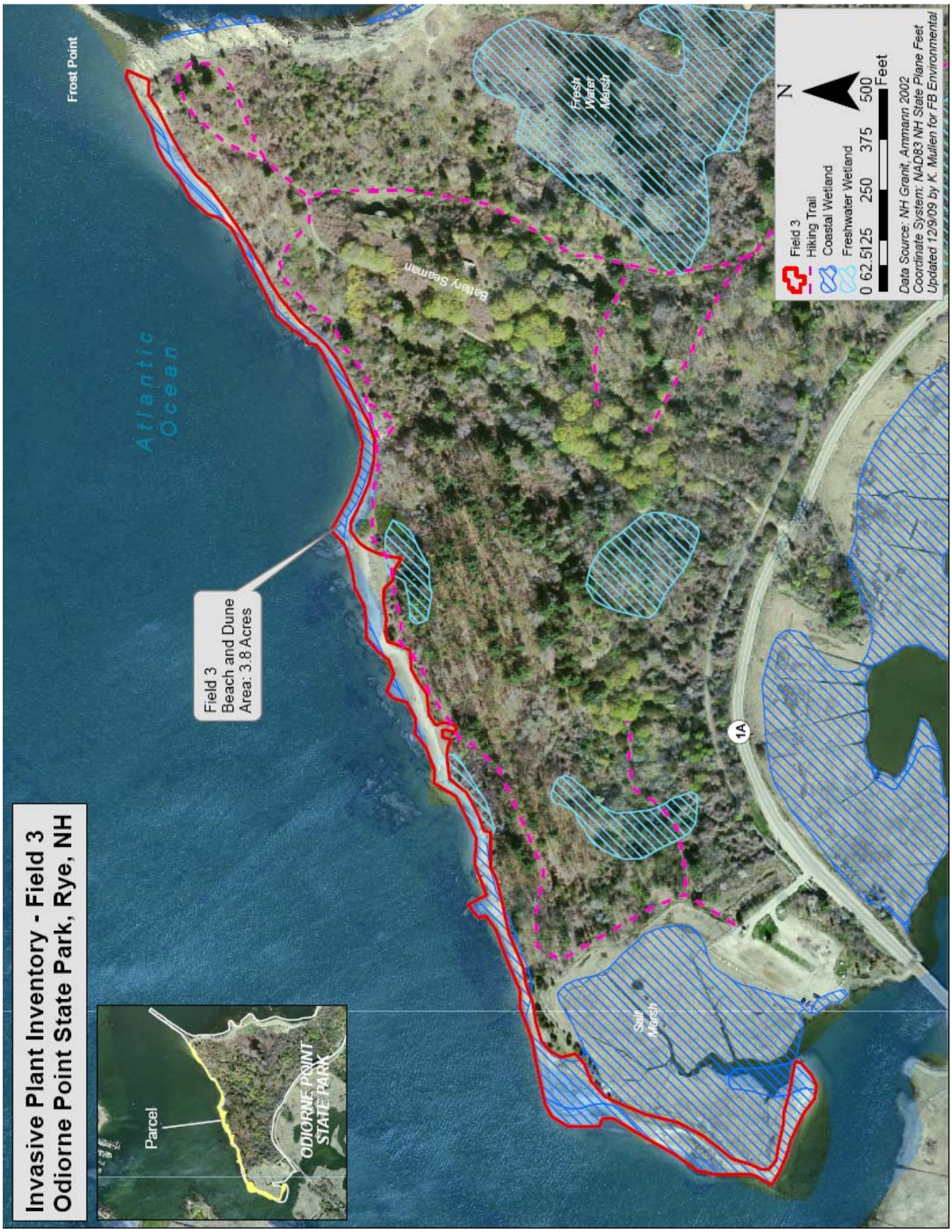


Figure 4.3. *Invasive Plant Inventory Map for Field 3 at Odiorne Point State Park.*

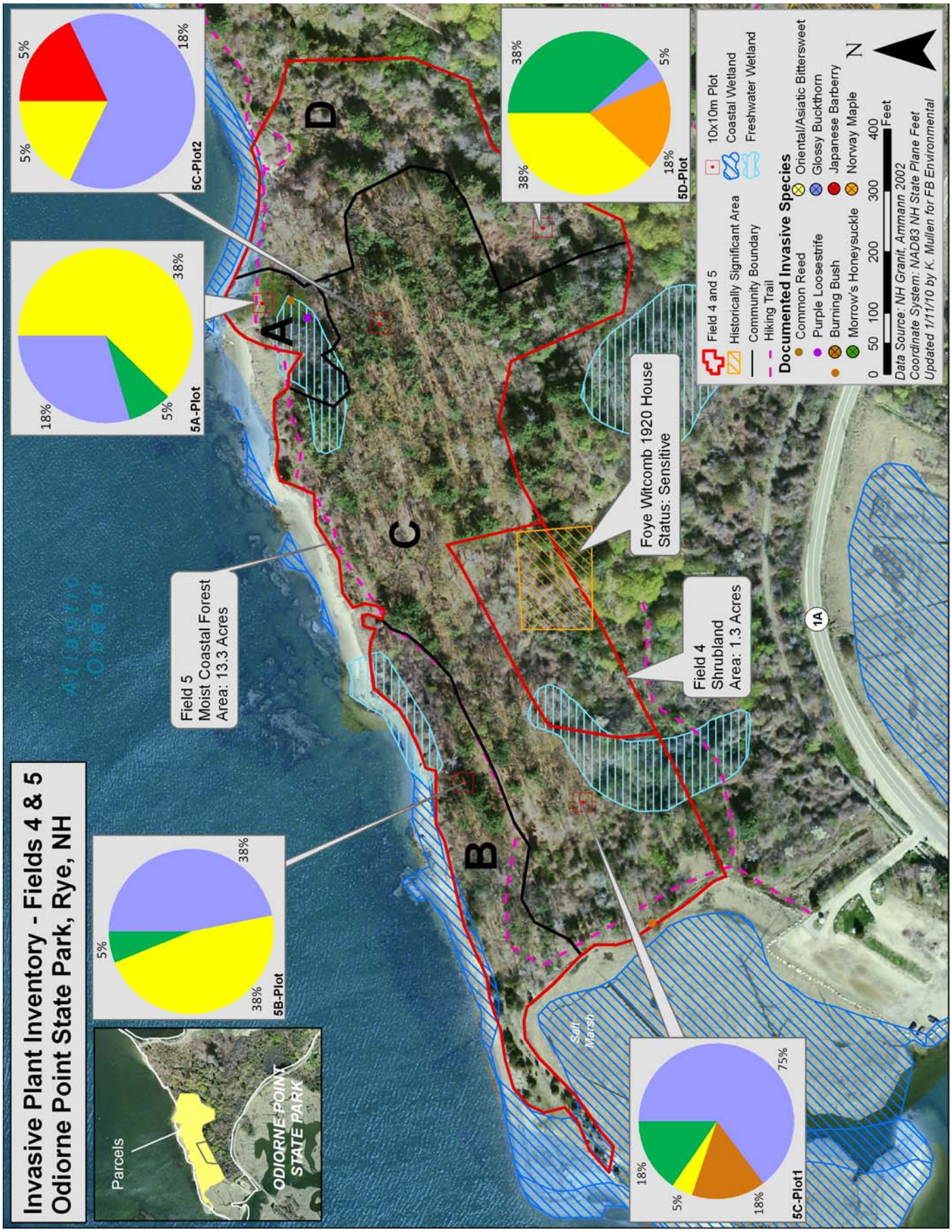


Figure 4.4. *Invasive Plant Inventory Map for Fields 4 & 5 at Odiorne Point State Park.*

Community 5A covers a portion of the freshwater wetland in the northwest corner of this parcel. Five different species of invasives were documented in this area. Four out of five of these species are considered satellite communities, and should be treated immediately. This is especially true of common reed (~15 plants, and purple loosestrife (< 100 plants). These two species are notorious for outcompeting native freshwater wetland species, creating monocultures, and changing the entire wildlife habitat structure over short periods of time.

Field 5 supports a number of different habitat types including this freshwater wetland located behind the beach in Community A. Note the prevalence of the purple loosestrife. (Photo: FB Environmental)

Community 5C stands out among many of the parcels surveyed due to its unique community structure. The large stand of mature red (*Quercus rubra*) and white oak (*Quercus alba*), white pine (*Pinus strobus*), and shagbark hickory (*Carya ovate*), the heavy leaf litter, and very little understory give this portion of the park a very picturesque wooded-park atmosphere. Walking trails through this section of forest connect visitors from the boat launch parking lot to the beach. This portion of the park should be considered high on the list of management priorities because of its aesthetic qualities, unique stand type, low occurrence of invasive plant species, proximity to the beach.

Field 8:

Field 8 has been previously classified as Dry Coastal Forest by Amman (2002) and The Bunkers and the Central Roads by Straus (1973). The soils in the area are shallow to bedrock, including deposits of glacial and ocean deposited sands and gravels. These soils have historically supported pitch pines, but have been overgrown in the past due to fire suppression and other major landscape changes as a result of military use during WWII.

A view of Community 8A from the beach looking toward a large stand of sumac bordering the freshwater marsh. (Photo: FB Environmental)

Field 8 includes approximately 10 acres of land located behind the beach at Frost's Point (Figure 4.4). This area includes a number of sensitive archaeological sites from a number of time periods including the Frost-Sagamore House which burned in 1871, as well as potential prehistoric, Native American, and historic Euro American artifacts beginning in 1623. For survey purposes, Field 8 was divided into five different communities. Each community represents a

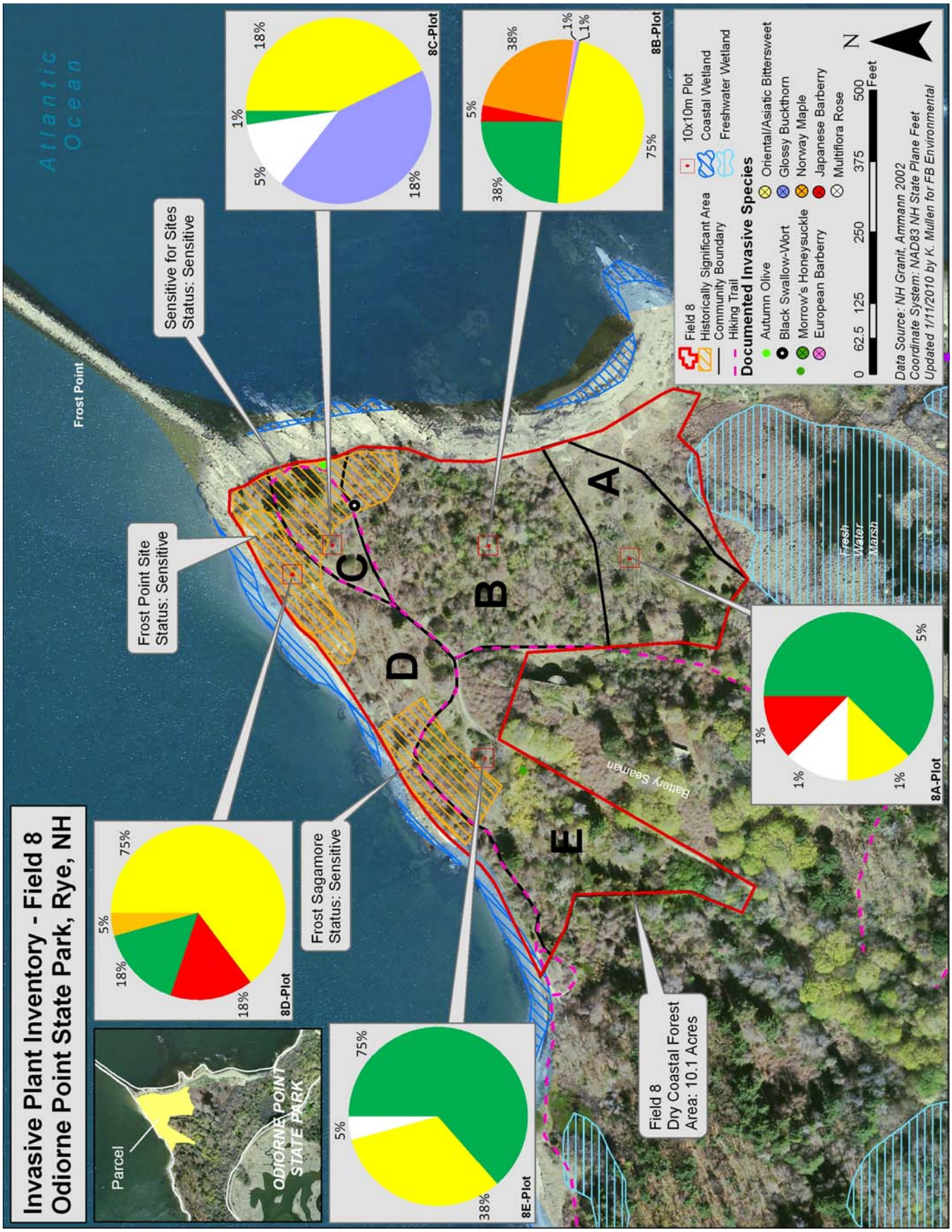


Figure 4.5. *Invasive Plant Inventory Map for Field 8 at Odiorne Point State Park.*

change in the plant community structure. Survey plots documented the extent of invasive species in each community. Communities 8A-8C are located on the east side of Frost's Point, while Communities 8D and 8E are located on the west side of Frost's Point. Bittersweet was documented in all five sites, with the greatest occurrence at Communities 8B and 8D (75% cover), followed by Community 8E (38%), 8C (18%) and 8A (1%). Japanese barberry was documented in three of the five plots surveyed, with highest density of plants in Community 8D (18%). Individual occurrences of invasive plants were documented in two locations on the border of Communities 8B and 8C. This includes a large specimen of autumn olive growing along the path at the edge of the beach, and patch of black swallow-wort growing at the edge of the trail among bittersweet.

A large stand of mature oak and pine in Community C within Field 5, stands out as a unique community with high restoration potential. (Photo: FB Environmental)

Communities 8B-8E should be considered important for remediation because of the possible archeological significance, and for high value recreation land including walking trails, and potential camp sites. Though no known archeological site has been documented in Community 8A, this area has ecological importance. For one, this section of Field 8 has the least number of invasive species, and therefore would require the least amount of effort to remediate, Secondly, this parcel is adjacent to an important freshwater marsh to the south. Community A is a unique site consisting of mature sumac trees, a thick understory of native grasses, scattered white pines, and small cedar saplings. Other documented species include tansy, several species of fern, rose, golden rod and poison ivy.

Communities 8B, 8D and 8E will require significant effort to remove the thick understory and overstory of invasive bittersweet and honey suckle. Several large Norway maples will need to be removed in Communities 8B and 8D.

Fields 10 & 11:

Fields 10 and 11 include the Barrier Wetland and Upland Island (Amman 2002), also referred to as the Barrier Pond including open water and marsh, and shrubby border and marsh island, as well as "The Pebble Barrier" by Straus (1973). The barrier wetland is approximately 8.5 acres, while the island is approximately 0.4 acres (Figure 4.6).

The salinity in the marsh pond varies depending on the extent of freshwater from rainfall, or inputs of seawater from large storms. This area has been classified as significant habitat (bayberry-beach plum maritime shrub-land), and home to two endangered plant species including horned pondweed (*Zannichellia palustris*) and coast-blite goosefoot (*Chenopodium rubrum*). Two state listed threatened species in this parcel include salt-

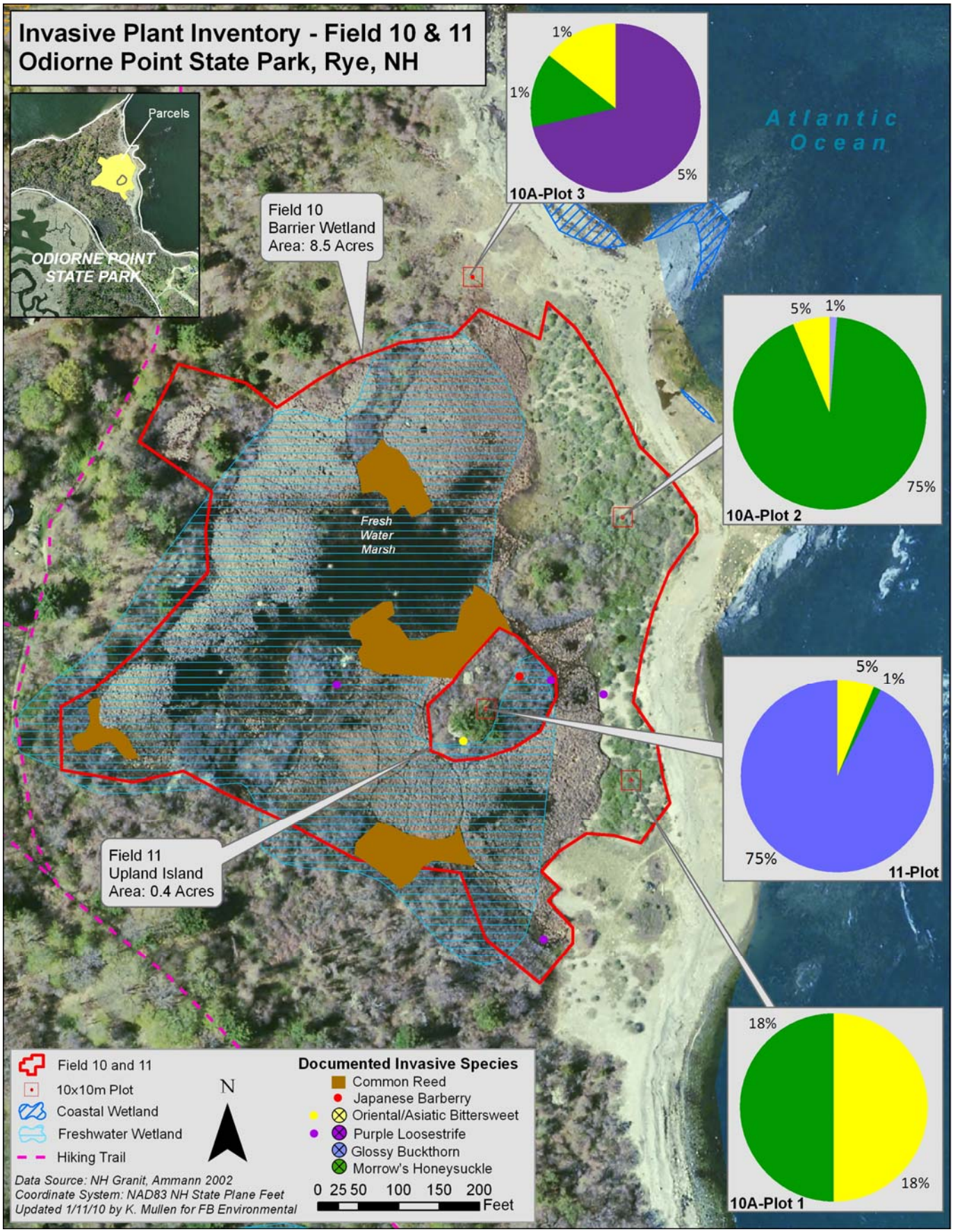


Figure 4.6. *Invasive Plant Inventory Map for Fields 10 & 11 at Odiorne Point State Park.*

loving spike-rush (*Eleocharis uniglumis*) and small spike-rush (*Eleocharis parvula*). The pond is surrounded by an extensive marsh comprised of marsh -ferns, cat-tails, grasses and sedges (Straus, 1973).

Both Amman (2002) and Straus (1973) documented the occurrence of narrow-leaved cat-tail, a plant that is known to create a monoculture in brackish marshes, thereby outcompeting native plants. Amman (2002) also documented two small patches of invasive phragmites (common reed) in the marsh. Like cat-tail, phragmites spreads rapidly in wetlands, creates monocultures, hence damaging native ecosystems by outcompeting native plants.

View of the Upland Island (background) overlooking open water within the Barrier Wetland (foreground). (Photo: FB Environmental)

The field survey for this portion of the park was divided into three different survey areas. Area one is represented by three survey plots labeled 10A, Plots 1-3. This area is described by Straus (1973) as the Pebble Barrier, built up by the accumulation of pebbles and rocks above the shore during storms and highest tides. The NH Natural Heritage Bureau (NHB) has designated his area as an 'Exemplary Natural Community', further defined as a 'Bayberry-beach plum maritime shrubland'. These habitats are considered critically imperiled due to state-wide rarity or vulnerability from development and recreation. Plants in this area are tolerant of occasional salt water and drying and include Staghorn-sumac, honeysuckle, bayberry, rose, beachpea, goldenrod, and poison ivy, among others. Purple loosestrife was documented to occur in small patches (12 -100 plants) throughout the survey area. honeysuckle grows in dense patches (75% cover) in the central portion of this community.

Fields 10 & 11 are home to two exemplary natural communities, as well as two endangered, and two threatened plant species.

The second area surveyed was the marsh itself. The marsh area is also an NHB 'Exemplary Natural Community', designated as a 'Coastal salt pond marsh'. As mentioned previously, invasive phragmites was documented by Amman (2002) to occur in two patches in the marsh. Results of the current survey

documented four locations throughout the marsh with greater than 1,000 plants at each location (Figure 4.6). All told, phragmites is estimated to cover an area of approximately 5,600 sq. ft. at 75% cover. These results indicate that the phragmites population is growing and spreading since Amman (2002) completed his survey.

The third survey area focused on Field 11, the upland island. The island is considered part of the Bayberry-beach plum maritime shrubland, and contains a thick understory of glossy buckthorn, and a large isolated patches of honeysuckle. Both low and mature high bush blueberry, poison ivy, and white pine seedlings mingle with the buckthorn and bittersweet in the understory, while the over story is dominated by mature oak, white pine, and black cherry. A stone structure was documented on the south-western end of the island, but was not verified for archeological significance. With the exception of some large vines on the west side of the island near the large white pine and stone structure, bittersweet is scattered across the island as small plants (< 3 ft. tall). A single Japanese barberry stem was documented on the northeast corner of the island, and a small patch of purple loosestrife was documented on the eastern edge of the island, on the island/marsh fringe, and appeared to have been recently browsed by wildlife.

Remediation of these two exemplary communities and the rare plant species that grow within should be considered a high ecological priority for the park.

Field 12:

Field 12 was classified as Shrubland by Amman (2002), and as the Open Fields, the Orchard, and Garden Sites by Straus (1973). The western border of this parcel is bound by a gated access road that accesses the Battery Seaman to the north, and Frost's Point. The southern edge of the parcel is bound by Route 1A, and the north and eastern edges of the parcel are bound by freshwater wetlands (Figure 4.7). A number of recreational trails run through this parcel, as well as a paved biking/walking trail that runs adjacent to Rt. 1A.

The Sumac/Grassland Community seen here in 12B is similar to the community documented at Community 8A. Both areas are adjacent to freshwater wetlands. (Photo: FB Environmental)

Of archeological sensitivity in this parcel is the McKim - Gage House and outbuildings located near the center of the parcel (Figure 4.7). The house was built in the late 1890's, and is believed to have been destroyed in 1942 (See Table 3.2, Appendix C).

The survey area divided this parcel into five separate communities that reflect changes in the plant community structure. Survey results document five different invasive plant species in this parcel. Glossy buckthorn, is clearly the dominant species accounting for 75% cover in all three communities (12C-12E), and 38% cover in Community 12C. Populations of bittersweet were heaviest in Communities 12D and 12E, located east of the access road.

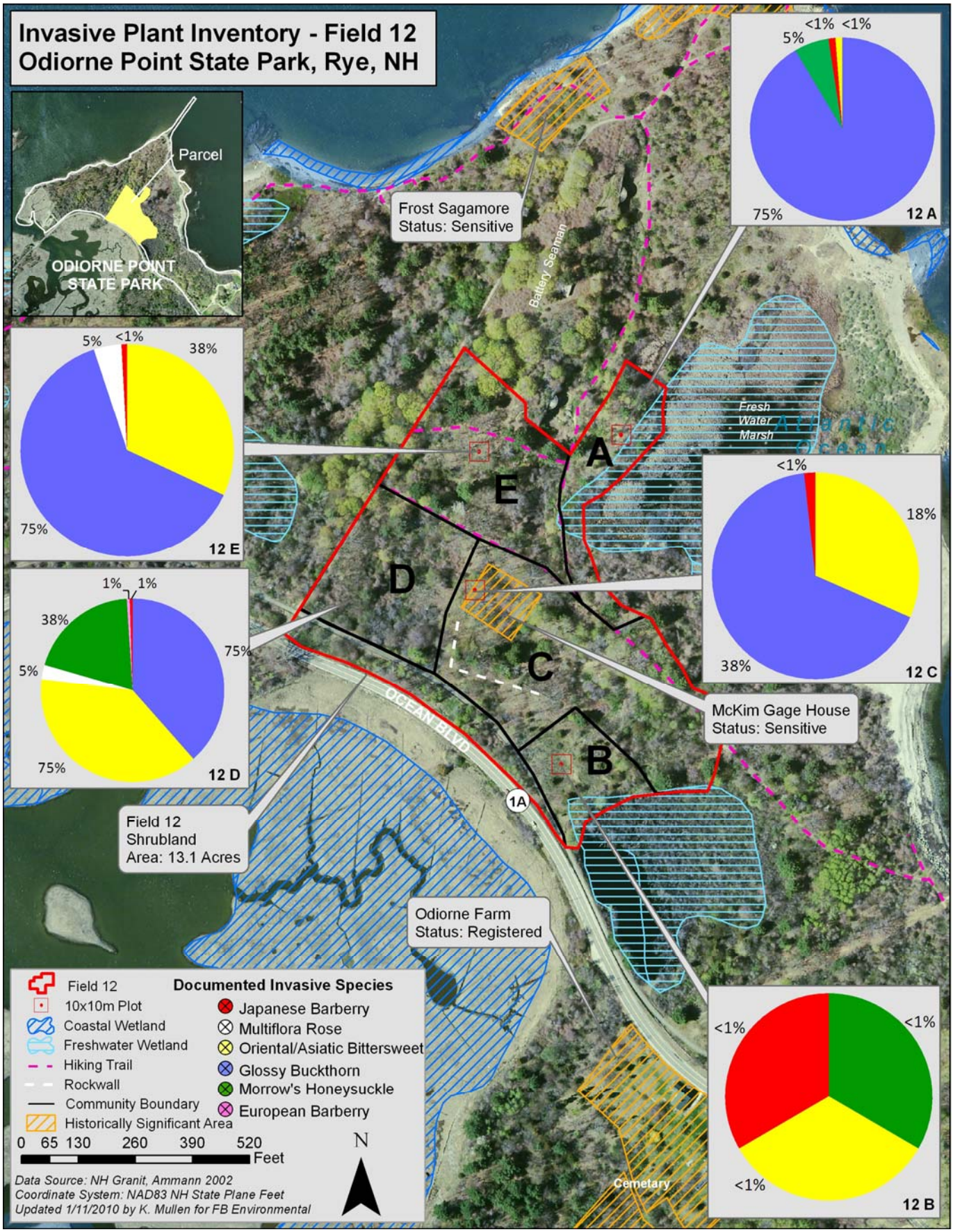


Figure 4.7. *Invasive Plant Inventory Map for Field 12 at Odiorne Point State Park.*

Community 12A is notably a community with high restoration potential in a unique physical setting. This community runs adjacent to, and includes portions of the barrier wetlands containing endangered and threatened plant species, and exemplary natural communities, and is located across from the Battery Seaman in Community E, just off the main trail. While percent cover of buckthorn is high (75%) in this parcel, other invasive species are limited to only a few plants that have not yet outcompeted the native forbes and shrubs. Among the large exposed bedrock in this area, the survey documented low-bush blueberry, starflower, dew-berry, Canada lily, goldenrod, pine saplings, and sheep laurel, as well as some patches of poison ivy. The overstory includes red oak and white pine.

Example of the size and thickness of bittersweet vines in Community 12C. Vines this large have taken down mature native tree species throughout the park. (Photo: FB Environmental)

Community 12B stands out from the other plant communities in this parcel. The community structure is similar to the sumac/grassland area documented near the barrier marsh. Documented invasive species occur in small quantities that would be easy to treat with very little time and financial resources. This area may have once been open fields (as described by Straus (1973). Other plants documented in this parcel include golden rod, vetch, cherry saplings, tansy, and milkweed.

Field 15:

Field 15 includes approximately 24 acres of recreational land at Odiorne Point. The recreational land includes the park entrance and main parking lot, SSC, playground, bathrooms, walking trails, and a bunker.

Straus (1973) grouped this area into three different plant communities, including: the house and garden sites and the lawn which corresponds with Community 15B closest to Odiorne Point and the area around the SSC; the ledges, which includes a portion of Community 15B along it's northeastern border; and Bunkers and central roads, which includes the Bunker in Community 15A, and the land area in Community 15C. The beaches along the edge of these communities were surveyed separately with the remainder of the beaches in the park.

Survey results for Community 15A reveal nine different plant species over an area of approximately 6.5 acres (Figure

Field 15 includes heavily used public areas at the SSC, and Odiorne Point. (Map: FB Environmental)

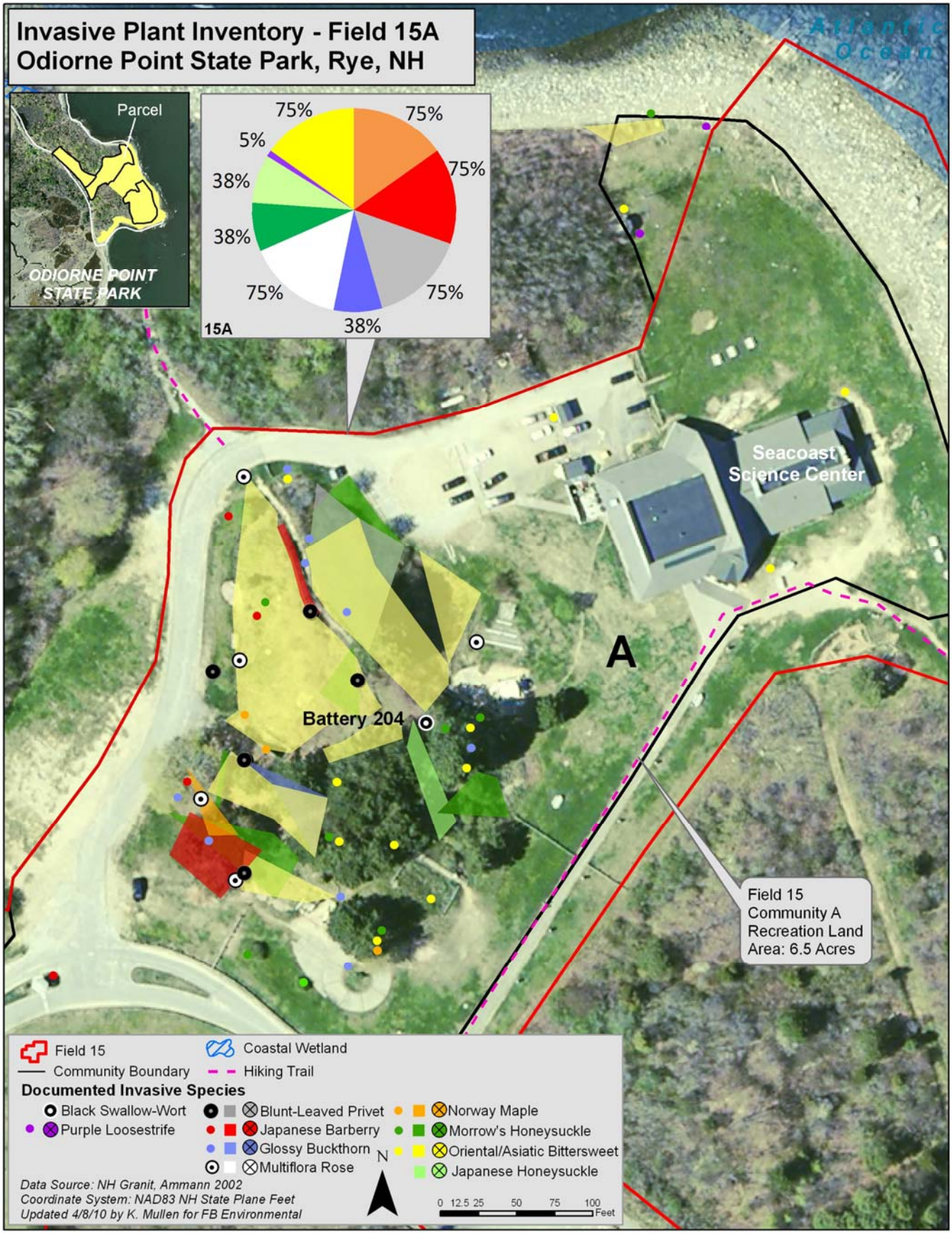


Figure 4.8. *Invasive Plant Inventory Map for Field 15A at Odiorne Point State Park.*

4.8). Community 15A encompasses the grassy area south of the park entrance, the bunker, and the SSC and mowed lawn area to the beach. Two main trails access the top of the bunker, from the east and from the north. The northern trail is completely overgrown with bittersweet (5-75% cover), Japanese barberry (18-75% cover), and honeysuckle (1-75% cover), making access for the public difficult. The stairs that access the top of the bunker from the east is overgrown with Japanese honeysuckle (38% cover), an invasive vine that was not previously documented in the park. The field survey estimated more than 1,000 plants growing in this area.

Several invasive plants, including purple loosestrife were documented at the edge of Community 15B between the beach and the lawn. (Photo: FB Environmental)

The north side of the bunker is covered with an impenetrable thicket of privet (5-75% cover) and honeysuckle, while the west is dominated by bittersweet. A small population of black swallow-wort (18% cover) was documented behind the cement structure on top of the bunker. Several mature Norway maples and hundreds of seedlings (38-75% cover) are dispersed on the southwest corner of the bunker. Japanese barberry (18-75% cover) was found throughout the bunker area, with a large patch on the southwest corner, and planted as an ornamental behind the park parking kiosk. Multiflora rose was documented to occur near the edges of the lawn and thick shrubbery at the edge of the bunker.

This bittersweet plant rooted eight feet up in the crux of an invasive Norway maple in Community 15C. (Photo: FB Environmental)

Several small populations of invasive plants were documented around the SSC buildings and parking area including bittersweet, honeysuckle, and purple loosestrife at the edge of the mowed lawn area. Continued mowing and spot herbicide treatment of these plants will help keep these plants from spreading.

Community 15B includes managed recreational land, including mowed lawn area, and trimmed hedges. Despite the management, there are still six different species of invasive plants in this area covering approximately 5.2 acres. Privet, a flowering shrub that is appreciated for its fragrant flowers, and historic hedges, was documented in seven locations in this community. Bittersweet was documented in four locations, with the largest occurrence north of the bathrooms. Honeysuckle was documented in eleven locations, with the majority in the center of this parcel east of the bathrooms. A single occurrence of Japanese barberry and Japanese knotweed, and glossy buckthorn were documented in this community (Figure 4.9).

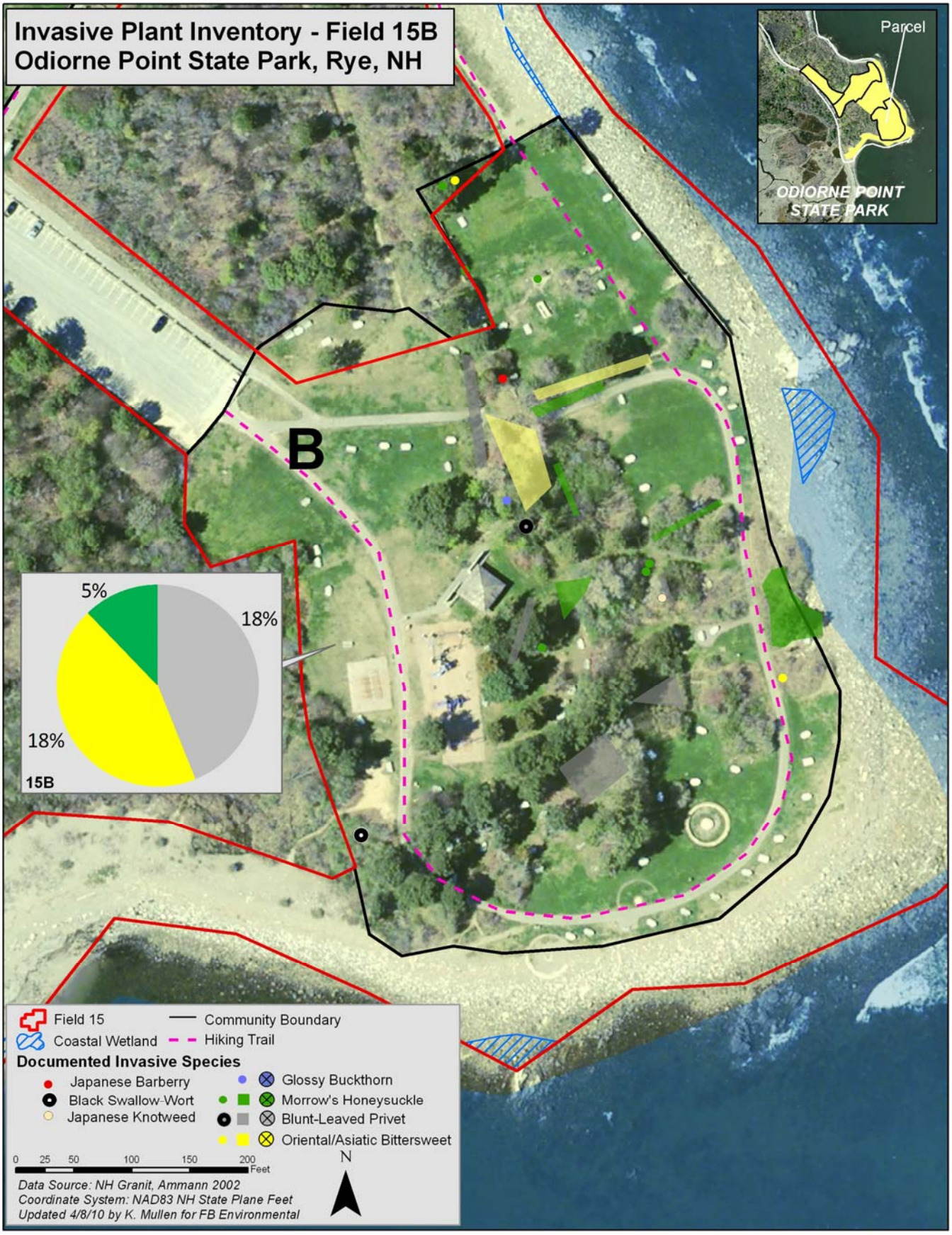


Figure 4.9. *Invasive Plant Inventory Map for Field 15B at Odiorne Point State Park.*

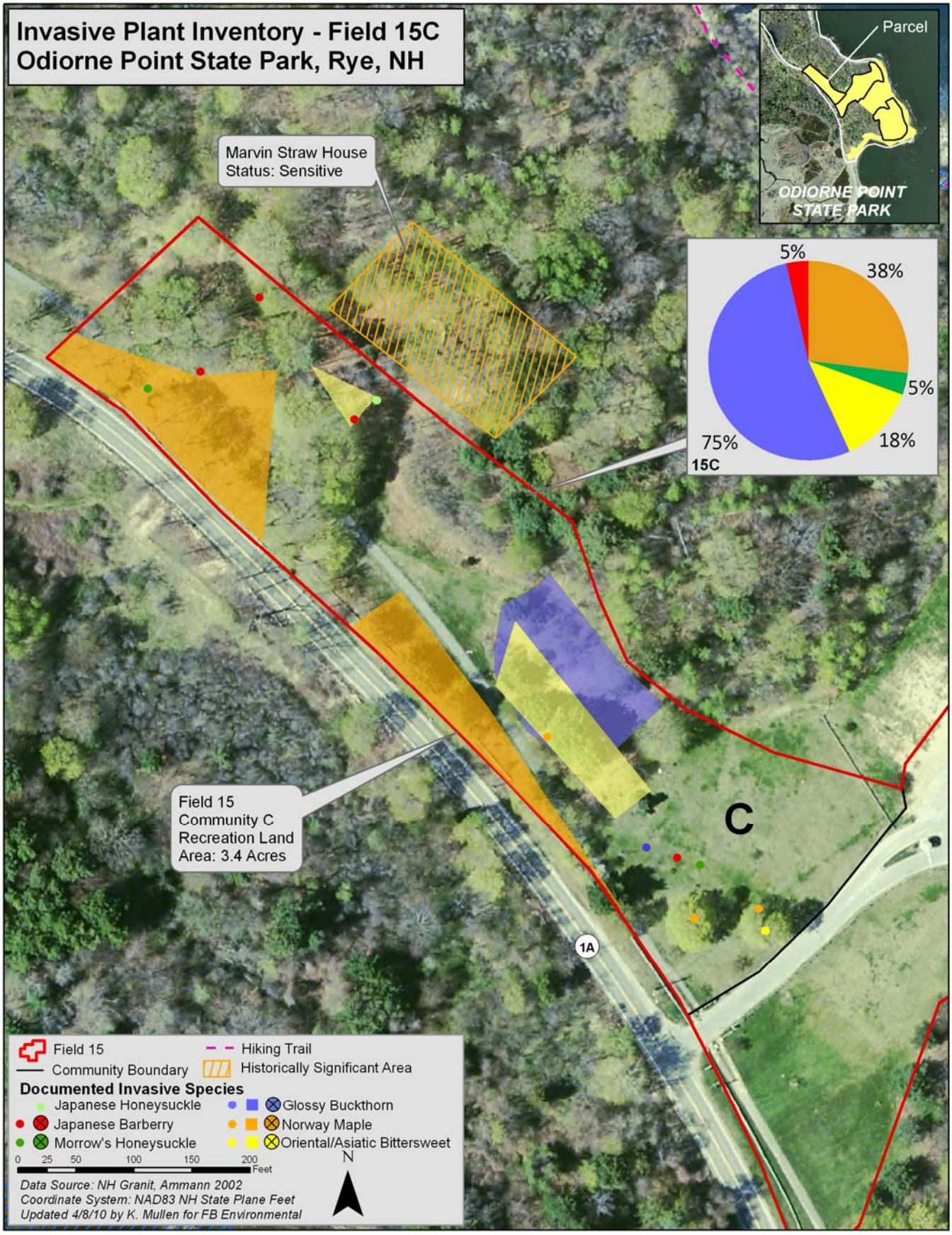


Figure 4.10. *Invasive Plant Inventory Map for Field 15C at Odiorne Point State Park.*

Community 15C was the final community surveyed, and includes the long stretch of mowed lawn west of the park entrance, and east of Route 1A (Figure 4.10). Large Norway maples line the roadway and spot the lawn throughout this community. Bittersweet and buckthorn cover several large patches, while honeysuckle and Japanese barberry show up as satellite populations.

Field 17:

Field 17 is located between Community 15A and 15B, south of the SSC. This area was classified as Shrubland by Ammann (2002), and has recently been mowed by park staff to allow recreational access and better views of Odiorne Point. Because this parcel had been mowed within several months of the field survey, it made it very difficult to identify individual stems. Park staff have indicated that annual mowing will continue indefinitely in this area to keep the invasives down.

The black swallow-wort, showing its characteristic elongate seed pod, growing among invasive honeysuckle. (Photo: FB Environmental)

One of the most significant findings in this parcel is the large extent of black swallow-wort growing in the southeast corner near the path leading from the parking lot (Figure 4.11). The plants are estimated to cover approximately 3,000 sq. ft. at 38-75% cover. According to SSC staff, this is a significant increase in the number of plants from the previous year.

Overall, bittersweet, buckthorn, and honeysuckle occur throughout this parcel in relatively equal amounts (5-75%). Purple loosestrife was documented to grow along the rockwall on the southeast corner of the parcel (> 100 plants), and single Japanese barberry plant was found growing toward the center of this parcel to the east of the walkway that runs down the middle.

Several rabbit holes were located on the north end of this parcel. This parcel and several others in the park may provide habitat for the New England cottontail rabbit, a candidate species for the endangered species list. The New England cottontail spends its entire life in early successional habitat and is dependent upon its existence and prefers species such as Canada goldenrod, red maple, highbush blueberry, alder, and raspberry (Arbuthnot, 2008). Promoting early successional habitat in varying types of vegetative cover differs from coastal shrublands and shrub swamps to old fields and abandoned orchards. Generally, annual monitoring of stem density and plant diversity, together with on-going plant management every 5 to 15 years (depending on management method, soil, and vegetation type) should be sufficient to maintain appropriate habitat for the New England cottontail (Arbuthnot, 2008). UNH Cooperative Extension staff are available to walk properties and help identify options for creating or maintaining habitat for New England cottontails.

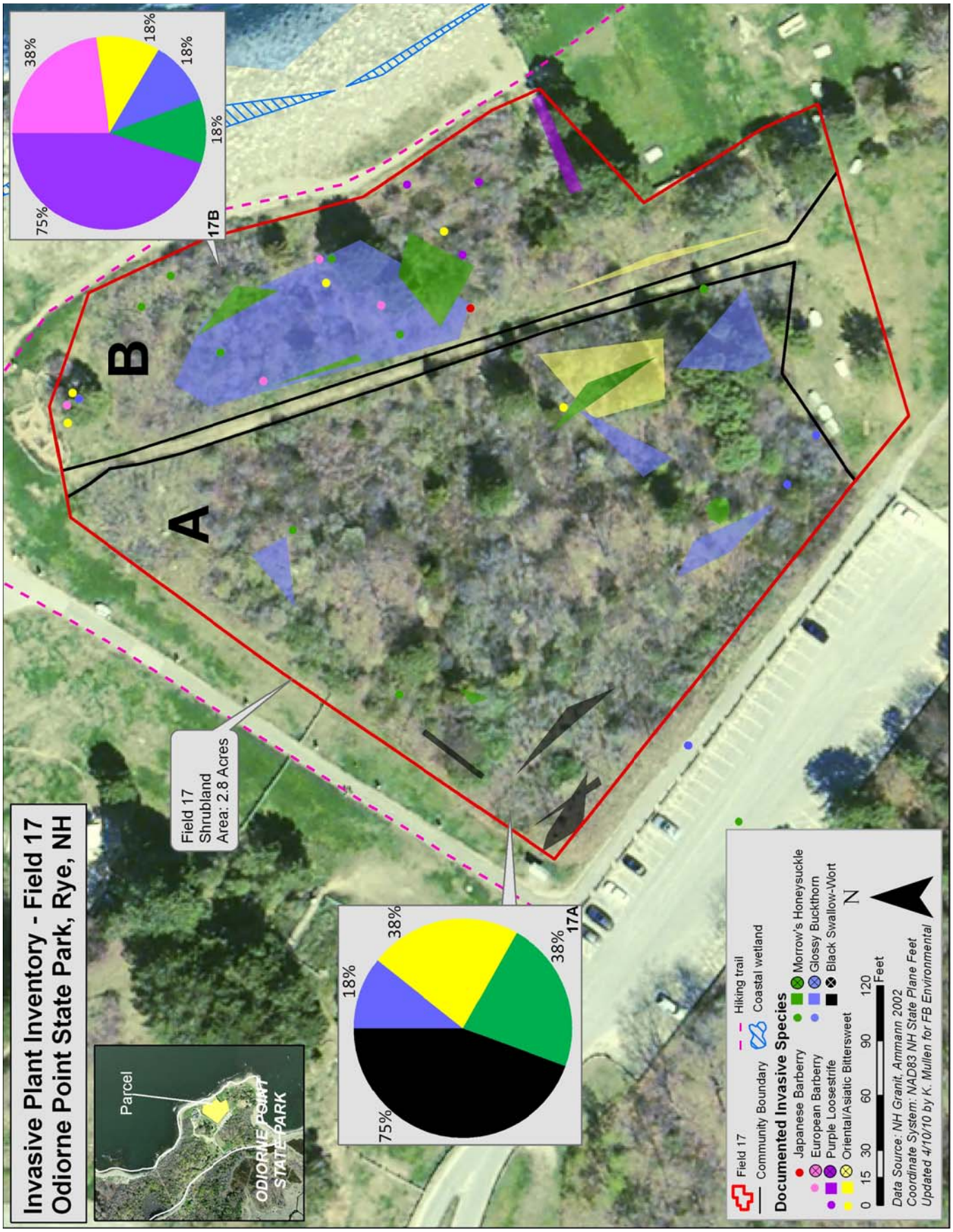


Figure 4.11. *Invasive Plant Inventory Map for Field 17 at Odiorne Point State Park.*

Fields 14 & 18:

Fields 14 and 18 are located north and east of Odiorne Farm, and west of Battery 204 and the roads and parking area that serve the SSC. Both parcels are classified as shrubland (Ammann, 2002). Field 14 includes approximately 5.7 acres adjacent to the walking/ biking path across from Odiorne Farm, north to the beach. Field 18 includes 7.2 acres and is located between Field 14 and the SSC (Figure 4.12). Straus (1973) grouped this land area into three different community types that run parallel to the coastline. These include (from south to north): the bunkers and central roads; the thicket; and the moor.

The Dolphin Fountain marks the location of the Marvin Straw Estate in Field 18. (Photo: Nathan Hamilton)

Field 18 is home to the Marvin Straw Estate which was built in the 1920's. All that remains of the estate today are some stone pillars marking the driveway to the estate and "the Dolphin Fountain". There are small patches of mapped coastal wetlands on the edge of this parcel where it abuts the beach. Straus (1973) also reported a lone plant of lady's slipper (*Cyprepidium acaule*), and one clump of wild columbine (*Aquilegia canadensis*) in the center community known as the thicket. The rare mountain mint (*Pycnanthemum tenuifolium*) was also documented in this parcel.

Large Norway maple trees like this one above near the edge of Field 18 out-compete native trees species in the park and are prolific seeders. (Photo: FB Environmental)

For survey purposes Fields 14 and 18 were grouped together as one. The survey area was divided into four different communities (18A-18D) and includes seven different survey plots (Figure 4.12). This portion of the park is laden with invasive species, and in some cases is so thick it becomes impenetrable. Lying in the shadows of these invasive plants, survey teams documented what may have been an old orchard which included apple trees, cherry saplings, grape vines and currants across the road from the farm. Poison ivy was found throughout the survey area.

Community 18A the smallest, and eastern most community, which runs parallel to a major access road to the rear of the SSC. Glossy buckthorn is thick through this community with a heavy growth of seedlings in the center of the parcel. Glossy buckthorn is also dominant in Communities 18C and 18D (38% cover). Honeysuckle is limited primarily to the outer perimeter of Community 18A, to approximately 15 feet back, and bittersweet grows thick around the perimeter of this community.

Large, mature Norway maples as well as numerous seedlings and saplings dominate the overstory in community B and the southern and eastern portion of Community 18C. The northwestern border of Community 18C

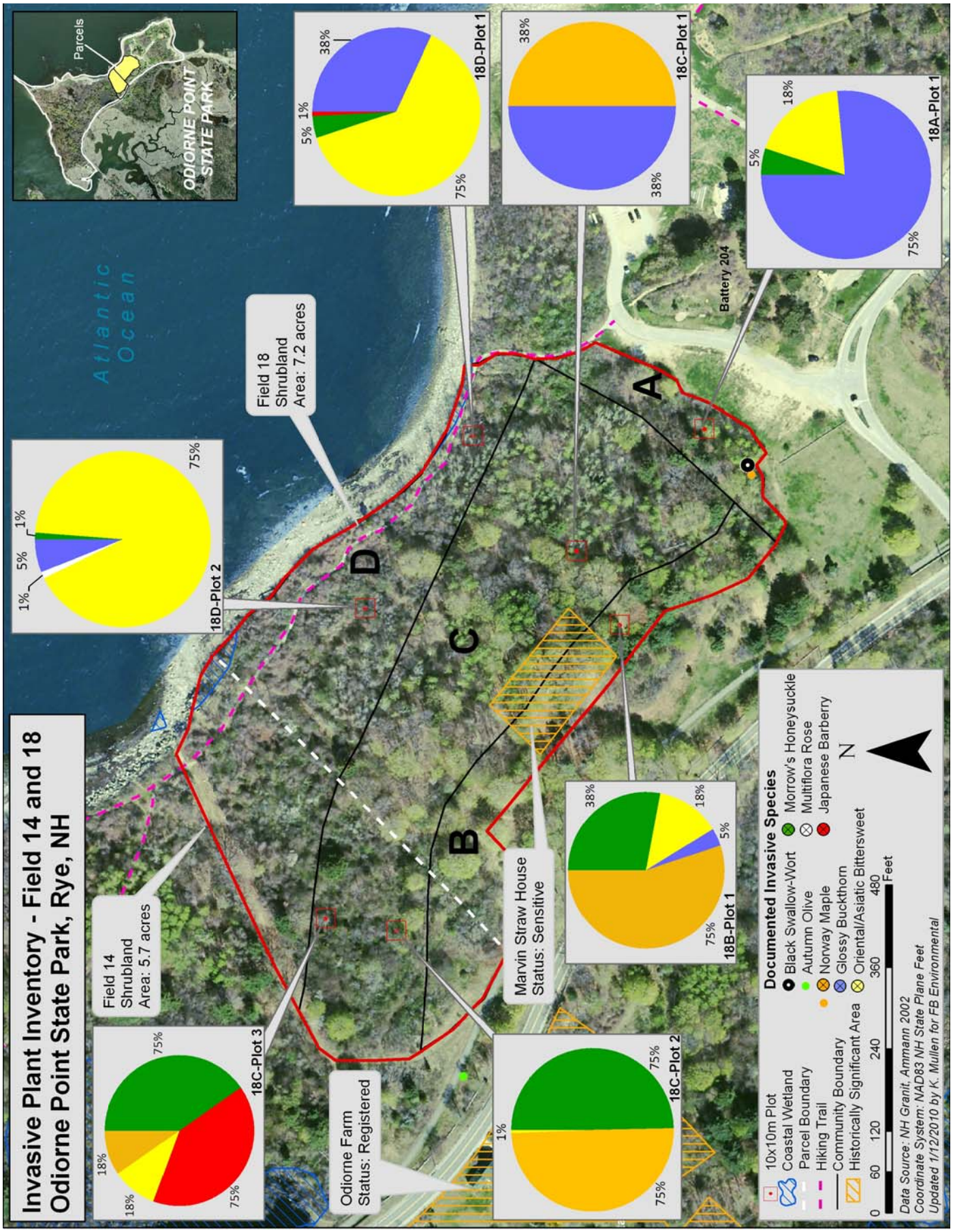


Figure 4.12. *Invasive Plant Inventory Map for Fields 14 & 18 at Odiorne Point State Park.*

and 18D have a large population of Japanese barberry. Bittersweet is thickest in Community 18D, the long stretch of land that runs parallel to the beach. A walking trail follows the coastline in this community. Other invasive species documented in this parcel include a mature autumn olive along the bike path across from the farm, black swallow-wort (100-1,000 plants) on the southeast corner of community 18A, and multiflora rose (single plant) in Community 18D.

Field 21:

Field 21 is classified as shrubland (Ammann, 2002), and encompasses approximately 1.3 acres between the back parking lot on the north side of the SSC, and the beach (Figure 4.13). Straus classified this area as part of the moor, and thicket as described above. Straus lists sumac and quaking aspen as a major threat to the survival of this plant community.

Large sumac, buckthorn, honeysuckle, and bittersweet make access to Community 21C difficult. (Photo: FB Environmental)

Community 21A is virtually impenetrable due to a thick growth of 8-10 foot high honeysuckle. Privet, buckthorn, and bittersweet make up the remainder of the bulk of invasive plant species in this community. Several large Norway maples stand tall on the southeastern end of this community, and multiflora rose was documented near the trail at the northwest corner.

Community 21B makes up the largest portion of this parcel. Buckthorn is the dominant invasive species (75% cover), followed by honeysuckle (38% cover). This community has high restoration potential because there are still many native plants that are flourishing despite the encroachment by invasives.

Community 21C was separated from 21B because of increase in the amount of bittersweet and large sumac. This community is located at the northeast corner of the back parking lot, along the lawn to the gazebo. This area is dominated by buckthorn, and bittersweet, as well as areas of honeysuckle. Purple loosestrife, multiflora rose and privet were documented as isolated populations at the edge of this community.

Field 27 (and other beach and dune areas):

Field 27 includes approximately 5.3 acres of beach and dune on the eastern side of Frost's Point. This area is classified as 'The Upper Pebble Beach' by Straus (1973), which is the splash zone. Native flora in this portion of the beach are salt tolerant and include sea rocket (*Cakile edentuala*), bind weed (*Convolvulus sepium*), jimsonweed (*Datura stramonium*), and beach pea (*Lathyrus japonicas var. glaber*), among others.

Significant features within this stretch of land include coastal wetlands, exemplary natural community (Bayberry-beach plum maritime shrubland), and sensitive archeological sites at Frost's Point.

On July 18, 2006, perennial pepperweed (*Lepidium latifolium*) was identified for the first time in NH on a rocky beach at Odiorne Point State Park. The pepperweed at Odiorne was hand pulled by volunteers in

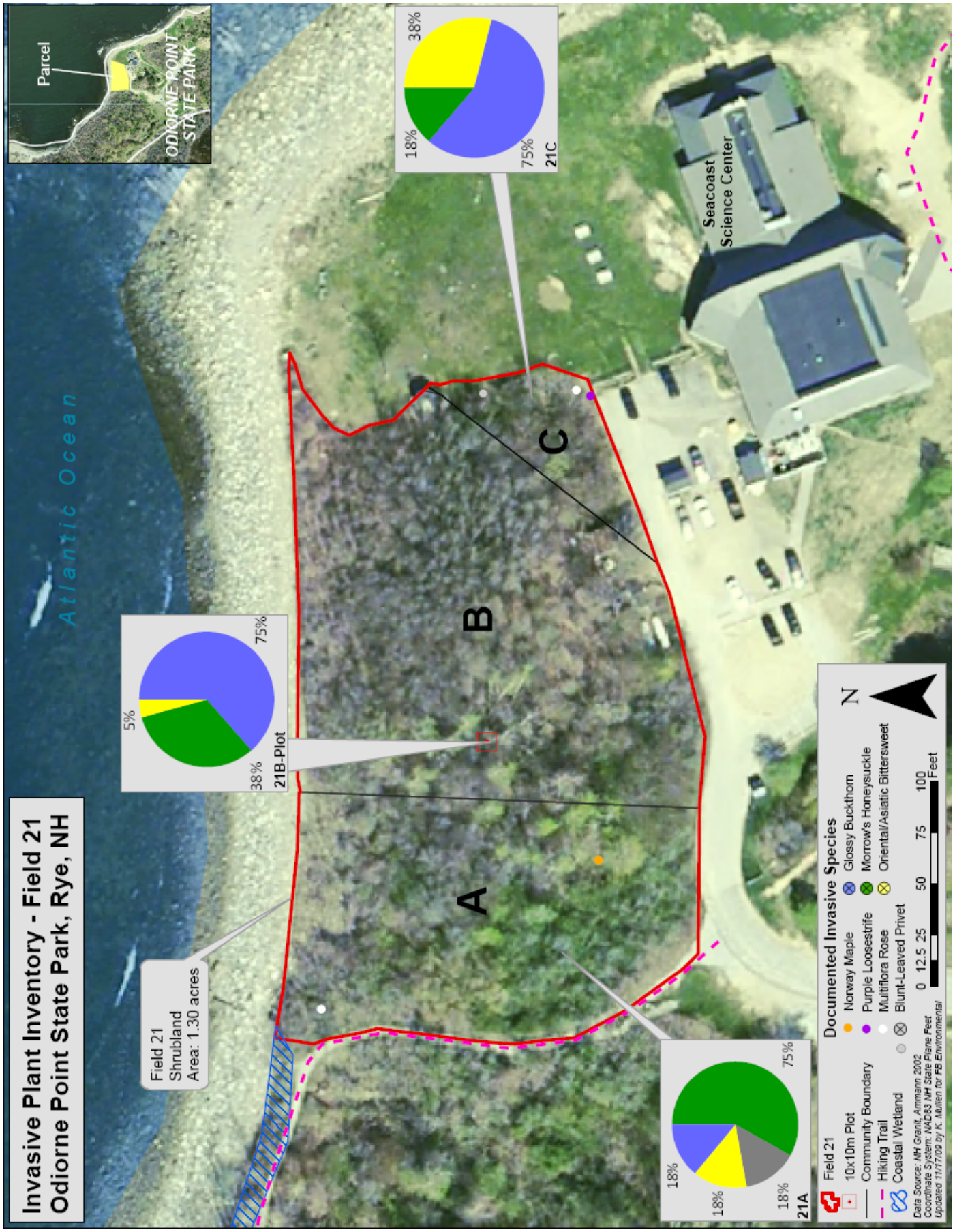


Figure 4.13. *Invasive Plant Inventory Map for Field 21 at Odiorne Point State Park.*

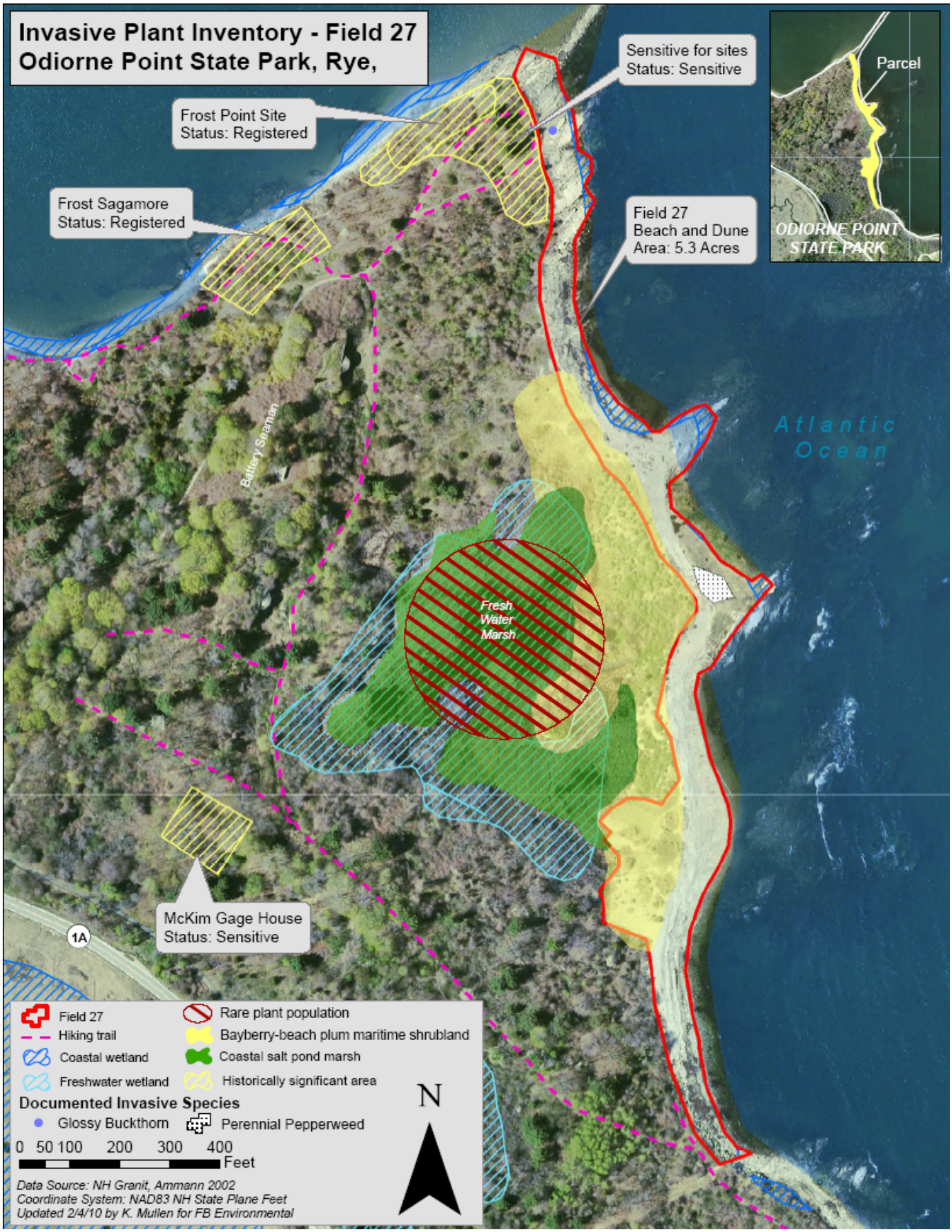


Figure 4.14. *Invasive Plant Inventory Map for Field 27 at Odiorne Point State Park.*

2006. In 2008, with funding from the US Fish and Wildlife Service-Partners for Fish and Wildlife Program, the NHDES-Coastal Program implemented an early detection-rapid response initiative to assess coastal habitats for the presence of pepperweed and to control new populations through hand pulling or herbicide application. Pepperweed was hand pulled twice during 2008 (7/1/08, 8/20/08) and twice during 2009 (7/29/09, 10/1/09).

A patch of pepperweed, growing among seaside golden rod in Field 27, continues to spread despite recent efforts manually eradicate it. (Photo: FB Environmental)

The pepperweed site was revisited by the survey team, which included NH Coastal Program staff that were part of previous efforts to eradicate this plant. At the time of this survey in September 2009, the pepperweed had strong vegetative regrowth, and a few of the plants were in flower. The survey estimated between 100 and 1,000 plants covering an area the size of approximately 3,400 square feet (Figure 4.14).

With the exception of the pepperweed, and single isolated populations of buckthorn and bittersweet, invasive plants are located on the upland fringe of the beaches at Odiorne Point. (Photo: FB Environmental)

The remainder of the beach was surveyed from end to end for invasive plant occurrences. With the exception of the pepperweed population described above, an isolated population of buckthorn (2 small plants) growing among the rocks near Frost's Point, and a small population of bittersweet south of Field 29, the beaches of Odiorne are free of invasive plants. The inundation by flooding, high tides, salt-spray, and lack of suitable substrate provide somewhat of a natural barrier for these plants. Foot traffic, and nuisance species such as poison ivy and staghorn sumac will continue to pose the greatest threat to the habitat in this community.

Field 29:

Field 29 is the southernmost parcel of land within the survey area. The area is classified as Barrier Wetland by Ammann (2002), and as Thicket & shrubby border of marsh, and Salt marsh by Straus (1973). The salt marsh was once connected to the great salt marsh of Wallis Sands and Rye before Rt. 1A was built (Straus, 1973). The area today is more like Straus's description of the adjacent brackish swamp and shrubby border.

A patch of bittersweet was found among the rocks on the beach adjacent to Field 29. (Photo: FB Environmental)

A formal wetland delineation should be conducted for this parcel to ensure that invasive plant remediation efforts do not make contact with the surface waters and negatively affect the native plants and animals that live there. No archeologically sensitive features were documented in this parcel.

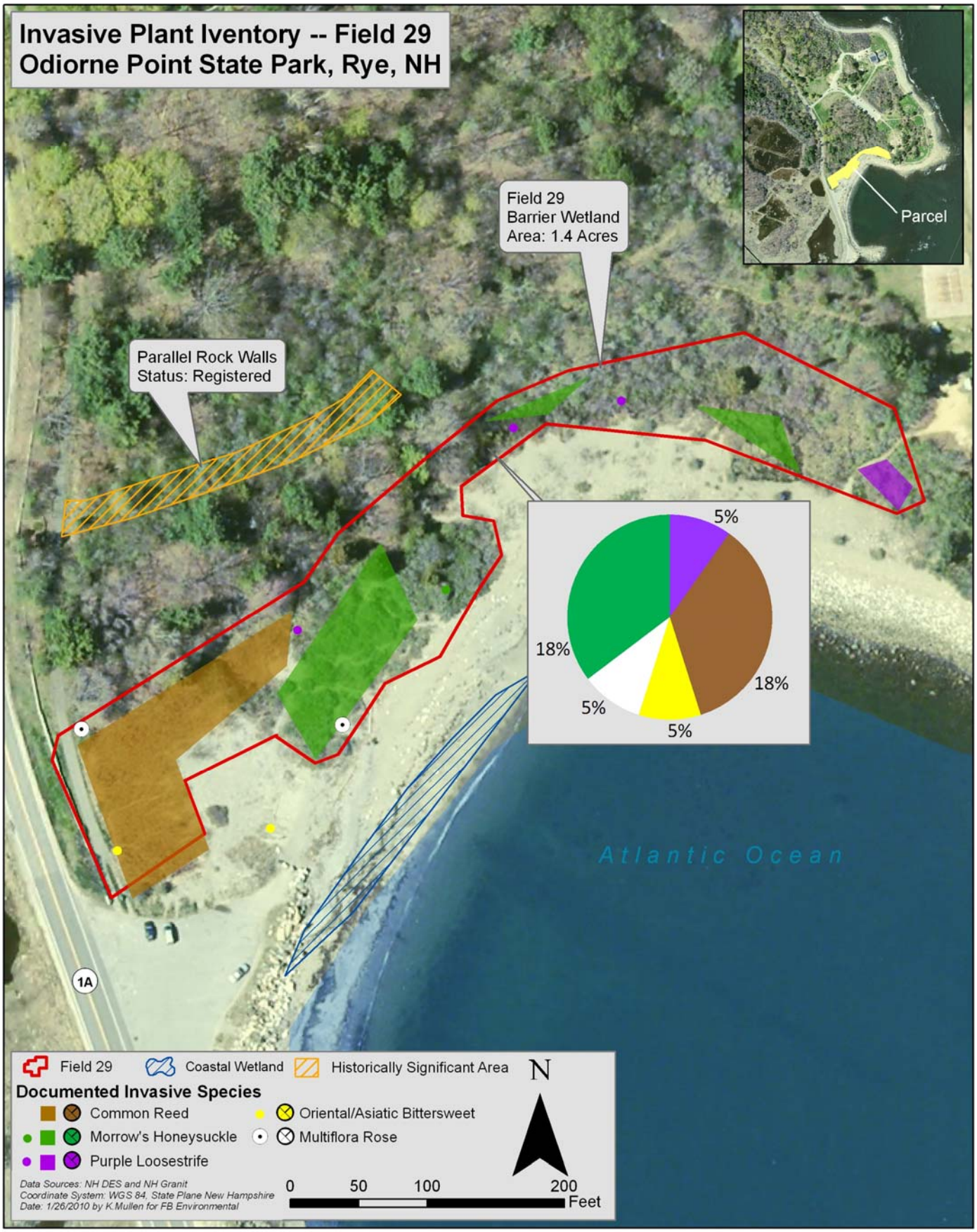


Figure 4.15. *Invasive Plant Inventory Map for Field 29 at Odiorne Point State Park.*

The survey for this 1.4 acre parcel revealed a large monoculture of common reed, numbering greater than 1,000 plants on the western edge of this parcel in the area of the brackish marsh (Figure 4.15). The infested area is estimated at 35,000 sq. ft. at 18% cover. Additionally, four populations of honeysuckle (15-38% cover) were documented within this parcel, with the largest population east of the common reed. A heavy infestation of common catbriar (*Smilex rotundifolia*) a shiny-leafed, thorny, nuisance vine was found growing among the honeysuckle. Purple loosestrife (1% cover) was documented in four locations across the parcel with the largest patch east of the trail leading from the playground to the beach. Multiflora rose and bittersweet were also documented as single plants in the parcel.

Field 30:

Field 30 is a 3 acre parcel classified as Moist Coastal Forest by Ammann (2002). Straus (1973) classified this area as 'The Ledges', as well as 'The House and Garden Sites and the Lawn'. This section of the park is known for its exposed ledge and thin soils over ledge which supports a broad assemblage of shrubs including shadbush (*Amelanchier canadensis*), huckleberry (*Gaylussacia baccata*), and low-bush blueberry (*Vaccinium angustifolium*) among others, and forbes such as yarrow (*Achillea millefolium*), St. John's wort (*Hypericum perforatum*), three-toothed cinquefoil (*Potentilla tridentate*), goldenrod (*Solidago sp.)*(Strauss, 1973). The low ground bordering the ledges supports similar plant assemblages, as well as red oak, black cherry, choke cherry, and high-bush blueberry in the over story.

Field 30 abuts the northwest corner of the Seacoast Science Center parking lot and Rt. 1A. (Photo: FB Environmental)

The field survey for this parcel documented six different invasive plant species in varying degrees of succession. Glossy buckthorn accounts for the majority of the parcel (Figure 4.16). Coverage is thick (75% cover), and uniform. Honeysuckle (18% cover) was documented in a large area in the center of the parcel, while a large bittersweet populations were documented along the edge of the lawn on the north west corner of the parcel (38% cover), and along the walkway on the western side of the parcel (75% cover). Both mature and seedlings of Norway maple were mix in with the buckthorn and bittersweet along the walking trail east of Rt. 1A. Other invasive species that were documented in this parcel include a single European barberry seedling on the northwest corner, and a 100 sq. foot area of black swallow-wort (< 100 plants at 38% cover within 100 sq. ft.).

Field 31:

Field 31 is located southwest of the main parking area at the entrance that serves the SSC (Figure 4.17). This site is classified as Dry Coastal Forest by Ammann (2002). A site walk and inventory of invasive species in this parcel identified two different habitats within this parcel. The first is a 2.1 acre area typical of the Dry

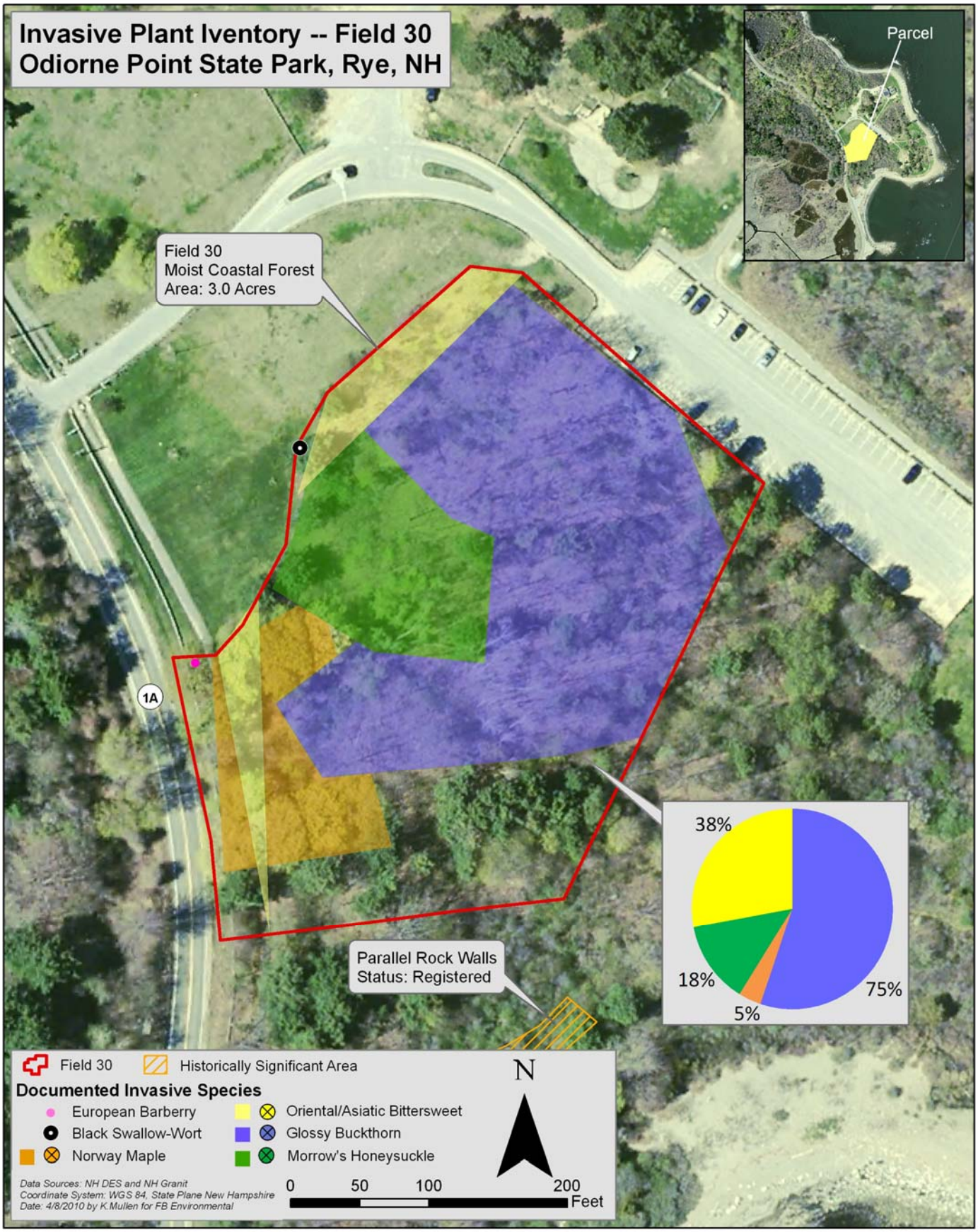


Figure 4.16. *Invasive Plant Inventory Map for Field 30 at Odiorne Point State Park.*

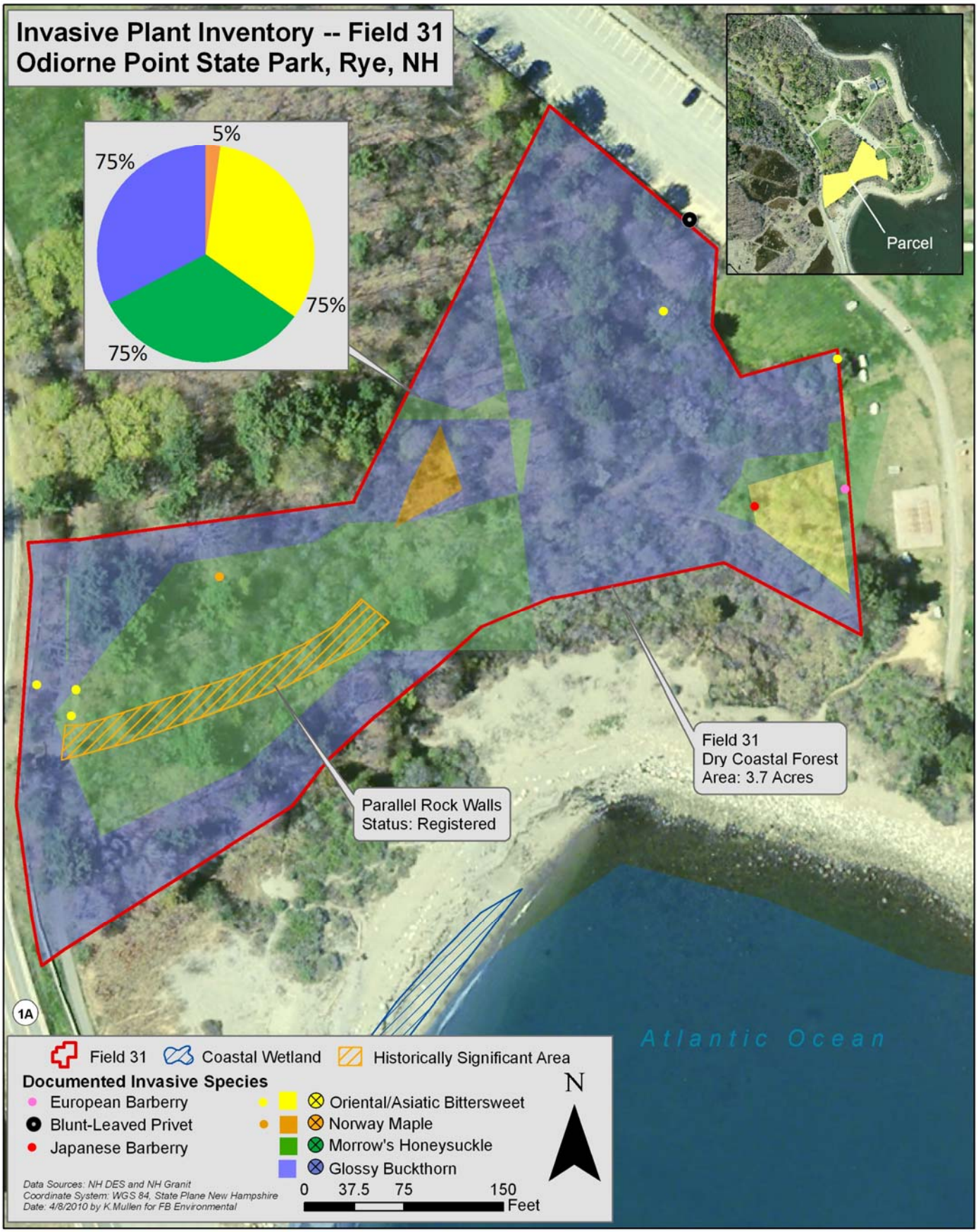


Figure 4.17. *Invasive Plant Inventory Map for Field 31 at Odiorne Point State Park.*

Coastal Forest, characterized by an existing stand of pitch pine (*Pinus rigida*) and shallow soils with areas of exposed bedrock. Field 31 is on the north side of an old access road. The second habitat is approximately 1.6 acres, and is more typical of a Moist Coastal Forest, characterized by moderately drained glacial till soils, oaks, hickories, and white pines. This area is located south of the old access road between Field 30 and the Barrier Wetland (Field 29). The total estimated area for Field 31 is 3.7 acres.

The rock walls in Field 31 were deemed, "Not Sensitive" by project archeologist Nate Hamilton (right) and Division of Historic Resources staff. (Photo: FB Environmental)

Field 31 is characterized by stunted eastern red cedar (*Juniperus virginiana)* and black oak *(Quercus velutina)*. Wetlands were documented south of the old road within the Moist Coastal Forest during field surveys, and later flagged by the RCCD in November 2009 in preparation for the implementation of a Pilot Invasive Species Project in this parcel.

Six species of invasive plants were documented within Field 31. Glossy buckthorn was the most prominent species in this parcel, followed by honeysuckle. A thick population of bittersweet (75% cover) was documented on the eastern edge of the parcel near the playground. Other species in this parcel include Norway maple (5% cover), European barberry (2 plants), and blunt-leaved privet (1 plant). A Management Plan was developed for this parcel (FB Environmental, 2009), and Phase 1 of the implementation work began in December 2009. Follow-up work, including herbicide application and a native planting project is scheduled for the fall of 2010.

4.2.3 Summary of Results

Results of the invasive plant survey reveal that invasive plants have surpassed the point of "threat" at Odiorne Point State Park. Seventeen species of invasive plants were documented within the survey area at various degrees of coverage (Table 4.1). Bittersweet and honeysuckle were documented in all but two parcels (Field 3 and 27), while glossy buckthorn was documented in all but three parcels (Fields 3, 14, and 29). Several species, including common buckthorn, common reed, and Japanese knotweed were described as satellite populations. These populations should be targeted as high priority for removal to prevent further spread.

All but one parcel surveyed (Beach in Field 3) has invasive plants. In some cases (e.g. shrublands), the invasive plants dominate the plant community and have completed choked out any native plant species. In other cases (wetlands), invasive species such as purple loosestrife and common reed have just begun to establish themselves, and if not controlled immediately, could eventually consume the wetlands, outcompeting more sensitive native plants (including threatened and endangered species). In other locations (recreational land), mowing and other mechanical controls are keeping invasive plants at bay.

Table 4.1. *Summary of documented invasive plant species by field and percent cover.*

Field/ Community	Approximate Area (acres)	Oriental/Asiatic bittersweet	Glossy buckthorn	Morrow's honeysuckle	Norway maple	Japanese barberry	Multiflora rose	Blunt-leaved privet	Burning bush	European barberry	Autumn olive	Purple loosestrife	Japanese honeysuckle	Japanese knotweed	Perennial pepperweed	Common reed	Black swallow-wort	Common buckthorn
1A	0.6	75%	38%	38%			38%			1%	5%	S						S
1B	0.1	S					S											
1C	0.1	75%	18%	5%														
5A	0.6	38%	18%	5%								S				S		
5B	2.0	38%	38%	5%														
5C1	7.9	5%	75%	18%					18%									
5C2		5%	18%			5%												
5D	2.8	38%	5%	38%	18%													
8A	1.6	1%		5%		1%	1%											
8B	3.0	75%	1%	38%	38%	5%				1%							S	
8C	0.6	18%	18%	1%			5%				S							
8D	2.0	75%		18%	5%	18%												
8E	2.5	38%		75%			5%											
10A1	8.5	18%		18%								S				S		
10A2		5%	1%	75%												S		
10A3		1%		1%								5%				S		
11	0.4	5%	75%	1%		S						S						
12A	1.4	1%	75%	5%		1%												
12B	1.1	11%		1%		1%												
12C	4.7	18%	38%			1%												
12D	2.2	75%	75%	38%		1%	5%			1%								
12E	2.8	38%	75%			1%	5%											
15A	5.7	75%	38%	38%	75%	75%	75%	75%				5%	38%				S	
15B	5.9	18%	S	5%		S		18%						S			S	
15C	3.4	18%	75%	5%	38%	5%							S					
17A	1.7	38%	18%	38%													75%	
17B	0.9	18%	18%	18%		S				38%		75%						
18A	0.6	18%	75%	5%	S												S	
18B	1.9	18%	5%	38%	75%						S							
18C1	5.0		38%		38%													
18C2		1%		75%	75%													
18C3		18%		75%	18%	75%												
18D1	3.5	75%	38%	5%		1%												
18D2		75%	5%	1%			1%											
21A	0.5	18%	18%	75%	S		S	18%										
21B	0.7	5%	75%	38%														
21C	0.1	38%	75%	18%			S	S				S						
27	5.3		S												5%			
29	1.4	5%		18%			5%					5%				18%		
30	3.0	38%	75%	18%	5%					S							S	
31	3.7	75%	75%	75%	5%	S		S		S								

** S= Satellite population*
*** Percent Cover Classes: 1%= <1%; 5%= 1-10%; 18%=11-25%; 38%= 26-50%; 75%= 51-100%*

Two species that were not documented in previous studies include burning bush and common buckthorn. Similarly, two species that were thought to occur in only one or two locations in the park were documented in multiple locations. These include autumn olive, and black swallow-wort.

4.2.3 Previously Surveyed Parcels

Due to the large expanse of area, the plethora of different natural communities, and the over abundance of invasive plant species, not all parcels could be surveyed within the scope of this project. As such, the project partners agreed early on in the planning process which parcels should be a priority for the current round of funding. Those parcels that were agreed upon have been described above, and are located east of Rt. 1A.

Approximately 112 acres within the park were not part of the invasive plant survey described above. Two of the largest areas include salt marsh (> 50 acres). Table 4.1 lists the parcels that were not surveyed in 2009, including the extent of known invasive species in those parcels from previous surveys. It is highly recommended that future funding be used to survey these parcels using the same methodology as used in this plan. Parcels 2-20 are located on the east side of Rt. 1A, while parcels 22-26 are located west of Rt. 1A.

Parcels and their respective natural habitat in Table 4.2 should be surveyed within the next three years using the similar survey methodology for a park-wide invasive plant database that can be tracked over time.

Table 4.2. *List of Unsurveyed/Previously Surveyed Parcels at Odiorne Point State Park.*

Unsurveyed Parcels			
Field #	**Description**	**Area (acres)**	**Documented Invasive Species**
East of Rte 1A			
2	Salt Marsh	6	None reported
6	Shrubland	8.5	Norway Maple
7	Plotting Room	1.9	Norway Maple
9	Battery Seaman	4.0	Norway Maple, Glossy Buckthorn, Japanese Honeysuckle, Bittersweet,
13	Moist Coastal Forest	7.1	Norway Maple, Glossy Buckthorn,
19	Freshwater Pond	0.8	Glossy Buckhorn
20	Shrub Swamp	3.7	European Barberry
West of Rte 1A			
22	Salt Marsh	23.2	Unkown
23	Recreation Land	4.8	Unknown
24	Moist Coastal Forest	26.3	Unknown
25	Moist Coastal Forest	5.1	Unknown
26	Salt Marsh	21.1	Unknown
TOTAL		**112.5**	

Source: Ammann, 2002 and Straus, 1973.

5. Invasive Control Methods

There is no single action, whether it is mechanical, biological or physical, that can provide optimal control of multiple invasive species in the moderate to high densities located throughout Odiorne Point State Park. Any management plan that attempts to address the control of invasive species will have to rely on a multi-faceted approach that will protect the safety of park visitors and secure the long-term commitment of partners and stakeholders if any action is to have lasting effects. While some populations of invasive species are isolated such as autumn olive and burning bush, others such as bittersweet and buckthorn exist as dense thickets, leaving little else, native or nonnative, to occupy the site. Control methods that combine treatments and are timed to be most effective should be used to allow native plants the opportunity to once again thrive within the park. Disrupting the timing and colonization abilities of invasive species allowing native plant communities to succeed and dominate the landscape community.

Mechanical control measures, like the use of a rubber tracked skid steer with a front mounted flail hydraulic brush mower can mulch thick invasive vegetation . (Photo: Joe Anderson)

The work plan described below will guide invasive species management efforts using a multi-phased approach within Odiorne Point State Park. The success of long-term restoration efforts will depend on how well implementation efforts are carried out. Due to the number and density of invasive species in the park, it will not be feasible to eliminate all occurrences of all invasive species. With determination, led by steadfast project partners, dedicated volunteers, and adequate funding, invasive species populations can be greatly reduced, or in the case of isolated or satellite communities, eliminated. Ongoing monitoring and invasive plant management including native plantings will be needed to avoid recolonization of treated areas, and new infestations.

This chapter outlines the invasive control strategies for Odiorne Point State Park. It includes: a) **A listing of significance criteria by parcel***;* b) **A description of control measures** including equipment, staffing and/or volunteers needed; and, c) **Parcel specific recommendations** including control, monitoring and on-going invasive plant management.

5.1 Identifying Invasive Plant Management Priorities

When working in an area heavily infested with invasive plants there is no one method that will completely eliminate each species. Management priorities are set with the goal of achieving greatest benefit while minimizing the total, long-term workload and project costs. It is difficult to clearly define, rank, or prioritize

where invasive plant control methods should begin, because the ranking is often subjective, especially when the invasive plants dominate the majority of the land area. Rather than prioritize each parcel on the basis of highest to lowest priority for restoration, significance criteria were used to identify which parcels have either ecological, archaeological, or recreational, significance. The significance criteria are in line with the overall project goals and objectives described in chapter 1, and are presented in Table 5.1.

Table 5.1. *Significance criteria applied to surveyed parcels at Odiorne Point State Park in 2009.*

Significance by Parcel				
Field #	**Description**	*Ecological*	*Archeological*	*Recreational*
1	Moist Coastal Forest	x		x
3	Beach & Dune	x	x	x
4	Shrubland	x	x	
5	Moist Coastal Forest	x		x
8	Dry Coastal Forest	x	x	x
10	Barrier Wetland	x		x
11	Upland Island	x	x	
12	Shrubland	x	x	x
14	Shrubland	x		x
15	Recreation Land	x		x
17	Shrubland	x		x
18	Shrubland	x	x	x
21	Shrubland	x		
27	Beach and Dune	x	x	x
29	Barrier Wetland	x		
30	Moist Coastal Forest	x		x
31	Dry Coastal Forest	x		x

Ecological Significance: This includes freshwater and coastal wetlands, exemplary natural communities, parcels with rare, threatened or endangered species, or high value wildlife habitat, or unique plant community.

Archaeological Significance: The archaeological history of the park is closely related to the improvement of recreational opportunities in the park. May include registered or sensitive archaeological sites.

Recreational Significance: The beaches, trails, playground and open space around the SSC are heavily used by park visitors. Recreational significance may include areas with prominent hiking trails, bird watching, vistas, potential camping, swimming, etc.

Since funding can be variable, the end purpose of using the significance criteria is to help guide funding efforts to implement invasive species control efforts within many different natural plant communities in the park.

5.2 General Invasive Management Techniques

There are a number of techniques for controlling invasive species, with some being more cost effective than others. In addition, it can be easier, safer, more cost effective, and more ecologically beneficial to manage certain species than others. It is important to make management decisions based on the ability to control one or more species, the techniques available at a specific site, the concerns for impact to native species, and the safety of park visitors.

Due to the extensive coverage, uniform distribution, and heavy seed bank of invasive species present, it is recommended that disturbance be kept to a minimum and management be timed so that populations of park

An Integrated Vegetation Management (IVM) approach should be implemented to provide the most effective, long-term control strategy. This includes minimizing impacts to non-target plants and animals through a series of techniques that allow native plant communities to dominate, while suppressing invasive plant species. Hand cutting and pulling, and mowing as well as selective herbicide treatments, including cut surface, cut stump, low-volume stem basal and foliar herbicide applications using state registered products applied by registered commercial applicators holding supervisory certificates (Category B).

5.2.1 Mechanical/Manual Treatment Methods

- **Pull**- Manually pulling entire plant, including roots. Volunteers can be organized annually to uproot seedlings from infested areas.
- **Cut-Stem**- Cutting stem with hand or power tools can be used alone or in combination with application of systemic herbicide. Herbicides will prevent resprouting.
- **Mowing**- Utilizing brush mowers and large mechanical machines (*e.g.* hydro ax, brontosaurus brush mower).
- **Grazing**- Utilizing penned goats to graze over specified locations. Grazing is equivalent to mowing and will not eliminate invasive species. Grazing is also not selective, so it is best utilized in an area where invasives are the dominant species. This might offer a lower impact approach, especially in areas that are frequented by park visitors who may be opposed to chemical applications. It also offers an opportunity to create outreach and education materials which may reach an entirely different audience.

Integrated Vegetation Management (IVM)- *a systematic method that utilizes all available strategies to manage invasive plant species including mechanical, biological, cultural and chemical treatment methods. IVM prevents the spread of invasive plants through proper knowledge of weed species, accurate inventory and mapping, specific design of control methods and strategies, implementation, and evaluation and/or modification of strategies to achieve desired goals.*

5.2.2 Biological Treatment Methods

- **Galerucella spp**- Biological treatment for invasive plants with natural controls to restore native vegetation by reducing the number of invasive plants within the plant community. Between 1997 and 2001, the New Hampshire Department of Transportation (DOT) released *Galerucella spp*. leaf-eating beetles for the control of purple loosestrife (*Lythrum salicaria*) in surrounding towns of Northampton and Portsmouth.

5.2.3 Cultural Treatment Methods

- **Regeneration**- Utilize methods (herbicide selectivity, land clearing, native species delineation) that create conditions appropriate to enhance habitat for native species (e.g. light, moisture, soils).
- **Revegetation**- Replanting or reseeding with native species is highly desired. This control method is aimed at reducing or eliminating invasive species so that natives are encouraged to grow, and stable conditions are reestablished so that the site is no longer conducive to invasive recolonization. A site specific project plan should be in place prior to any remediation efforts to prevent erosion, revegetate and stabilize cut areas. Since vegetative types and cover vary from site to site, it is important to select and plant only native species adapted to the site conditions, matching remediation efforts with management goals tailored to habitat types found in Table 2.2. If bringing in top soil, nursery soil, or mulches, check the source for weed seeds and root stock.
- **Browsing**- Prevent over-browsing by reducing and maintaining white-tailed deer populations at levels appropriate for available habitat.
- **Sanitation**- Inspect and clean all equipment and other vehicles of soil and vegetative material before entering and after leaving site.
- **Communication**- Contractors, volunteers, and other land use managers should be educated and trained to recognize native species. Prior to any implementation efforts to remove invasive plants, native species should be flagged or areas marked to delineate where treatments should be concentrated so that non-target species will be protected and promoted. Mechanical and/or cultural methods should limit ground disturbance in proximity to these areas and any chemical treatments should be considered for their selectivity and methods (foliar, basal-stem, cut-stem) designed to limit application and drift onto non-target native species. Monitoring and long-term management should include provisions for flagging, documenting, promoting and replanting native species.

5.2.4 Chemical Treatment Methods

- **Low-Volume Foliar Backpack**- State of New Hampshire licensed applicators walk established transects over the entire area directing herbicide and water tank mixture to the foliage of invasive plants. Herbicide and water tank mixture are to registered for use by the Federal EPA and State of New Hampshire and include an anti-drift agent to keep spray directed on target species and to enhance sensitivity. No applications will be made to, or be allowed to enter standing or flowing water.

- **Cut-Surface Treatment**- State of New Hampshire licensed applicators will use this method to effectively treat target species that are either in the Shoreland Zone or wetlands, in close in proximity native species to avoid overspray and harm, or combined with cut-stem method to control resprouting in the case of honeysuckle, buckthorn and bittersweet.
- **Basal Bark Treatment**- Basal treatment is herbicide with oil that is applied to the lower 15 inches of a tree trunk or brush stem to the ground line. This method is especially effective when treating species such as buckthorn to minimize disturbance and control resprouting. State of New Hampshire licensed applicators will use the basal application method to selectively treat individual woody plants. This method also lengthens the period of time that brush can be sprayed. Basal applications are effective from February to November.

5.3 Site Specific Invasive Management Techniques

Based on the identified ecological and land-use priorities within the project area, and the realities of invasive plant control (available resources and known techniques for plant control) identified immediately below, we recommend site specific control actions. Cutting alone, without some other form of treatment (chemical or otherwise) is not recommended due to the inherent nature of these particular invasive plants which are known to resprout quickly and have a heavy seed bank. Treatment should occur over several seasons and will need to be continually monitored and adjusted accordingly.

In 2009, the New Hampshire Division of Pesticide Control began amending certain pesticide use restrictions in relation to invasive species. A number of different options are becoming available to resource managers that were not accessible before. It is recommended that before any implementation begins, a review of treatment options relative to the recent amendments be conducted to ensure that the best possible management design is in place which is effective, efficient and safe. A partial list of currently registered herbicides in New Hampshire are listed in Table 5.2.

Table 5.2. *List of common herbicides registered for use in New Hampshire.*

Chemical Name	*Examples* of Brand Names	Target Use	Target Species
Triclopyr	Garlon3A®; Habitat®; Garlon 4®	Cut surface and/or basal bark treatment; foliar spray. Broad-leaf selective.	Bittersweet, autumn olive buckthorns, barberry, multiflora rose, burning bush, privet
Glyphosate	Roundup®	Cut surface and/or basal bark treatment; foliar spray. Non-selective.	Honeysuckle, burning bush, barberry, Norway maple, autumn olive, buckthorns, privet,
Glyphosate (aquatic formulation)	Rodeo®; Aquamaster®; Accord®	Cut surface; application near or in open water. Non-selective.	Honeysuckle, barberry, Norway maple, knotweed, purple loosestrife, buckthorns, Phragmites
Imazapyr	Habitat®; Arsenal®	Foliar, cut surface. Non-selective. Habitat® labeled for aquatic applications.	Knotweed, autumn olive, perennial pepperweed, Phragmites

5.3.1 Keys to Successful Restoration Effort

The key to long-term restoration of native plant communities and habitats in Odiorne Point State Park depend on a number of key variables. These include:

1) A sustainable long-term funding plan

2) Successful Phase 1 invasive plant control treatment

3) Ongoing– biannual monitoring of treated sites

4) Long-term invasive plant management based on monitoring results

The recommendations below focus on items 2-4 above for each parcel within the survey area. A site specific project plan should be developed on a site-by-site basis as funding becomes available using these recommendations as a guide. Funding will be discussed in Chapter 6.

Control- There is no single action, whether it is mechanical, biological or physical, that can provide optimal control of multiple invasive species in the moderate to high densities located throughout Odiorne Point State Park. Any management plan that attempts to address the control of invasive species will have to rely on a multi -faceted approach that will protect the safety of park visitors and secure the long-term commitment of partners and stakeholders if any action is to have lasting effects. While some populations of invasive species are isolated such as autumn olive and burning bush, others such as bittersweet and buckthorn exist as a monoculture leaving little else, native or nonnative, to occupy the site. Control methods that combine treatments and are timed to be most effective can be utilized to promote a balance between natives and invasives, disrupting the timing and colonization abilities of invasive species allowing native plant communities to succeed and dominate the landscape community.

Monitoring- Monitoring plays an important role in managing invasive plants. Monitoring provides information to make well-informed management decisions that can be used to demonstrate where management actions (mechanical, biological and chemical control treatments) are meeting invasive plant management objectives, where new populations exist, and to detect and modify actions that are ineffective. A monitoring plan should be developed after a survey of the management area is conducted, threats to high-value ecological sites/resources are identified, target plant species or populations prioritized, and invasive plant management objectives developed. Elements of a monitoring regime should include:

Occurrence: determining the presence (or absence) of invasive species in a specific area and the recording of new invasive species.

Abundance: recording changes in numbers, density or area covered.

Expansion: measuring the rate of expansion or population within a site .

Impact: identifying replacement of native species; change in use of areas by animals.

Depending upon the area being monitored, species being controlled and timing of control efforts monitoring can take place annually, semi annually and/or coincided with other activities such as a "BioBlitz". Volunteers, land managers and contractors can carry out varying levels of monitoring regarding the management objectives. If volunteers are conducting monitoring activities, there needs to be an authority in place that oversees and confirms results, and adjusts management accordingly.

Volunteers and land managers should be trained to:

- Identify invasive plant species.
- Collect and preserve samples, and submit preserved samples for identification.
- Fill out survey data sheets completed with GPS marks and return to designated individual who can confirm ID and follow up with management activities.

Ongoing Invasive Plant Management- The eradication of invasive plants on a site is temporary due to the aggressive nature and dispersal methods of these plants. It is not possible to fully eradicate invasive species on any one site altogether. Education, outreach, monitoring, adaptive management and long-term control will all be essential to any management plan and its success or failure. A balanced approach to management will need to incorporate a number of factors:

- Look at the entire park system and identify factors which allow for invasive species to proliferate (historical, human activities, environmental factors, funding).
- Plant native species with a high chance of survival suited to conditions and soils. Establish caretakers to be responsible for daily watering and maintenance until established.
- Minimize soil disturbance, identify and protect native vegetation and key habitats such as "edge effect" and threatened or endangered species.
- Minimize conflicts that contribute to undermining efforts (high recreation use through newly planted area, planting too soon before treatments are complete, limited funding and participation).
- Monitor and manage site on a regular basis and revise strategies accordingly.

Keep partners and stakeholders informed, principally others engaged in similar efforts. Advertise your efforts and success, balance setbacks with modifications of the ongoing invasive plant management strategy, and continue to move forward.

Ongoing invasive plant management is often the last thought of any plan. Without proper funding and participation, volunteers and staff who participated in control efforts will likely not take part in future projects that are not maintained and become overrun with invasive species. If volunteers, or other land managers are

responsible for ongoing invasive plant management, offer training and oversight. Some programs such as the United Way's "Day of Caring" or having a business adopt a site or parcel may encourage others to participate.

5.3.2. Site Specific Control Recommendations

Recommendations below focus on three of the four key elements to successful implementation of invasive plant control efforts. These recommendations should be viewed as general guidance for long-term management of invasive plants at Odiorne Point State Park based on field survey results. A site specific project plan should be developed for each parcel, or a combination of parcels as funding becomes available.

Field 1:

Control- Due to the proximity of Witch Creek and Little Harbor, in addition to heavy boat and recreational traffic, it is advised to keep management primarily mechanized with minimal targeted herbicide application. Any herbicide treatment within 50' of the HWM (High Water Mark) requires a special permit from the New Hampshire Board of Pesticide Control. The large amount of impervious surface located in Field 1 can also contributes to runoff of herbicides possibly contaminating surface waters.

With ease of access and relatively concentrated infestations, crews can hand cut invasive species in Community A and (bordering Route 1A) with care exercised to avoid clearing non-target native species. Communities B and C can be hand mowed and maintained with a string trimmer. With routine mowing and cutting, scheduled ongoing management strategies can be incorporated into seasonal land management activities.

Field 1 also offers an excellent opportunity for outreach and education, particularly signage placed in parking area and trail head for invasive management projects occurring throughout the park.

Monitoring- Annual monitoring should occur later in the season, August through September to observe purple loosestrife populations as they are blooming and easy to pick out. With the proximity to park headquarters and the possibility of incorporating park users by use of signage and outreach, regular and repeated observations of this area can be utilized as well. While populations are low, it is easily identifiable and one of the major threats to this area. Monitoring can also provide data on non-effective treatments and non-target damage to desirable natives.

Ongoing Management- Seasonal invasive plant management in Field 1 could be incorporated into a bimonthly schedule every year. Following initial mechanical treatment, populations of invasive species can be kept in check by mowing twice a month throughout the season till the park closes and continue the following season. Any lapse in ongoing management strategies can result in uncontrolled growth in species such as glossy buckthorn and will result in significant effort to reclaim the area.

Field 3:

No invasive species were documented in the survey area. However, due to the moderate to heavy infestations of invasives occurring in Fields 4 and 8 and presence of perennial pepperweed (*Lepidium latifolium*) in Field 27, it is advised that annual monitoring take place and any new infestations be documented and managed accordingly.

Field 4 & 5:

Control- Fields 4 & 5 are represented by four separate communities. Due to the size, unique natural and archeological features, it is recommended that management take place on site specific basis taking into account Shoreland Zone setbacks, wetland delineations, historical preservation and Early Detection Rapid Response (EDRR) for satellite populations such as Phragmites in Community 5A. Due to the proximity to shoreland zone and wetlands, a special permit from the New Hampshire Board of Pesticide Control will most likely be required.

Community 5A contains a satellite community of Phragmites. This low density allows for EDRR measures to eradicate the stand before it becomes established. A cut stem application of an aquatic approved glyphosate formulation in late summer/early fall, once tassels have appeared, can be very effective. Biological control for purple loosestrife using the *Galerucella calmariensis* beetle should be incorporated immediately. Releases are typically of pupae and adult beetles. The larger the numbers released, the better the chance for establishment. A minimum of 2,000 to 3,000 beetles per site are recommended. Releases in 3 successive years will improve the chance for establishment (Kenning, 2006). Given the low densities and number of satellite populations throughout the park, releases could be coordinated with a number of different fields. In proximity to the Foye Whitcomb House, basal stem treatments of glossy buckthorn and bittersweet should take place in the fall and early winter to minimize disturbance. In Communities 5B, 5C and 5D mechanical treatment of understory in late fall should be followed by a selective low volume foliar application to achieve root control of resprout the following late summer/early fall. Burning bush is located sporadically and at low densities in this area. Populations could be specifically targeted with either cut surface or basal stem herbicide applications.

Monitoring- Management of any treatments for Field 4 & 5 should include monitoring semi-annually, spring and fall, to take advantage of early leafout of invasive species such as honeysuckle and burning bush and in the fall to monitor Phragmites and purple loosestrife treatments.

Ongoing Invasive Plant Management- Ongoing management will need to be conducted semi annually over 10 years to ensure adequate control in areas mechanically treated. Following the 1st year of mechanical treatment and subsequent foliar application, targeted broadleaf foliar applications can be administered to reduce pesticide use while enhancing native vegetation. Additional native plants and shrubs should be established once invasive populations have been reduced, preferably in the second year of treatment.

Field 8:

Control- Field 8 is quite varied and differentiated from other Fields in that it contains a significant number of archeological sites which will require test pits to be analyzed before any control measures can be started. Treatments will have to be defined by the inventory and significance of data collected on those sites. Recreation trails ring the area as they lead to Frost's Point and beaches.

Because of the archeological significance of the parcel, only low impact treatments will be considered. To limit disturbance, early spring selective low volume foliar applications of for bittersweet, barberry and honeysuckle and fall basal stem treatments for buckthorn will allow for native grasses and shrubs to occupy the site reducing the establishment of seedlings due the heavy seedbank present. Saplings of Norway maples over 5" caliper should be removed and Cut-Stem treated in the fall and larger trees removed as time and effort allows. Consideration should also be given to possible New England cottontail (*Sylvilagus transitionalis*) habitat before conducting any treatments.

Field 8, as with Field 1, offers an excellent opportunity to conduct education and outreach with many visitors accessing the area and signage sites plentiful. Treatment activities can also coincide with archeological restoration efforts to open the site to historical and invasive species education.

Monitoring- Monitoring should be conducted annually, in the spring to take advantage of early leaf out of species present and implement ongoing management strategies before park visitors are numerous.

Ongoing Invasive Plant Management Strategy- Document and treat invasives semi- annually over 10 years to ensure adequate control in areas mechanically treated. Following the 1st year foliar application, targeted broadleaf foliar applications and basal stem treatments, targeted foliar applications can be administered in the spring and fall to reduce pesticide use while enhancing native vegetation. Additional native plants and shrubs should be established once invasive populations have been reduced, preferably in the second year of treatment.

Field 10 & 11:

Control- One of the most effective routes to control Phragmites and narrow-leaved cat-tail is to restore tidal flow. Spill-over of seawater from spring tides and storm surges would normally raise the salinity to intolerable levels and would restrict their growth and movement within the wetland. Since Phragmites is intolerant of salinities greater than 18 ppt, reintroduction of salt water results in a gradual replacement of Phragmites by native vegetation. Due to the establishment of honeysuckle and rugosa rose on the barrier edge, seawater washes over only in extreme storms. Because of the ecological significance of this Field and the endangered and threatened species occupying it, mechanical and biological controls are recommended.

Mechanical treatment of honeysuckle and rugosa rose would entail pulling stems and roots less than 3" within the reach of the barrier based on delineation of wetland. Mechanical means such as "Weed Wrenches" could be employed to limit disturbance from larger machines or a small skid steer could be utilized without creating significant impacts.

Field 10 and 11 is another area that could be incorporated for a comprehensive beetle release to control purple loosestrife populations throughout the park.

Monitoring- Because of the significance of the parcel ecologically, monitoring should occur semi annually, both spring and fall to assure that honeysuckle and rugosa rose have not reestablished. Surveyors should be keyed into specific invasives and have an understanding the importance of tidal flow in reducing invasive species populations. Monitoring should also include impacts to non-target native species and effectiveness of treatment on existing stands.

This area would be important in the control of Phragmites as colonies are becoming established up and down the coast. Investigations into possible research opportunities in tidal flow restoration and control of Phragmites could be coordinated with SSC, local colleges and universities.

Ongoing Invasive Plant Management- Because tidal flow and storm surges would breach the barrier after from removal of invasive species, it is vital that the barrier remain free of invasives. Early spring and late fall would be ideal times to coordinate a pull of any new infestations of honeysuckle and rugosa rose.

Field 12:

Control- A multifaceted approach will be best suited for Field 12, incorporating mechanical, chemical, and prescribed grazing.

Communities 12E and 12D are significantly degraded as a result of invasive species. Mechanical cutting of the understory in late fall or early spring followed by a selective low volume foliar application the following late summer/early fall will achieve root control of resprout. Stems 5" or larger to be hand cut and Cut-Stem treated.

Community 12A and 12C, due to their proximity to archeological sites and wetland delineations, only basal stem treatments will be applied to buckthorn and Norway maple stands leaving stems intact to minimize disturbance and any contamination of historical sites by foliar drift. A special permit from the New Hampshire Board of Pesticide Control will need to be obtained before any herbicide applications to Community A.

Community 12B is an interesting site based on its location, limited invasive species cover and native species present. One possibility that exists is prescribed grazing, utilizing penned goats to graze over specified locations. Grazing is equivalent to mowing and will not eliminate invasive species. Grazing is also not selective so it is best utilized in an area where invasives are the dominant species. This might offer a lower impact approach, especially in areas that are frequented by park visitors who might be opposed to any

chemical applications. It also offers another opportunity to create outreach and education materials which may reach an entirely different audience.

Monitoring- Monitoring should be conducted annually, in the spring to take advantage of early leaf out of species present and develop ongoing management strategies before park visitors are numerous. Surveyors should be careful to note any archeological artifacts that come uncovered as a result of mowing or control treatments and report them to park staff immediately. Prescribed grazing will entail daily monitoring to assure animals are not over grazing native species present and will be moved accordingly.

Ongoing Invasive Plant Management- Should be conducted semi annually over 10 years to ensure adequate control in areas mechanically treated. Following the 1st year foliar application, targeted broadleaf foliar applications and basal stem treatments can be administered in the spring and fall to reduce pesticide use while enhancing native vegetation. Additional native plants and shrubs should be established once invasive populations have been reduced, preferably in the second year of treatment. This area may be frequented by New England cottontails and could also be managed as grassland habitat.

Field 15:

Control- Field 15 requires a multi-faceted approach, much like Field 12. Mechanical, chemical, biological and prescribed grazing can all be incorporated into management which would be an obvious attribute given the location of the parking area, SSC, trail head and beaches and playground. Many methods can occur at once proving an excellent opportunity to educate users as to the approach and long-term benefits of invasive species management.

Because of proximity of park users, chemical controls should be kept at a minimum and used only when deemed necessary.

Community 15A is a gateway to the SSC. The primary invasive species population is located on and around the bunker. Because the bunker is blanketed in Japanese honeysuckle and bittersweet, a spring selective low volume foliar application should be followed by a targeted fall application which will allow grasses on site to continue stabilizing bunker walls. Care must be given to existing junipers which help stabilize bunker slopes. Erosion control mulch can be applied to slopes if treatment creates bare spots. Morrow's honeysuckle, with large diameter stems, can be Cut-Stem treated. It is advised that a native replacement planting plan be in effect to stabilize the site and provide an aesthetically pleasing counter point to ongoing control efforts. Again, this provides the perfect opportunity to garner volunteer support and while initiating a successful outreach campaign.

Community 15B is circled by picnickers and playground visitors. It stands as an important link between science and recreation. Most infestations are characterized by single satellite communities and are best controlled by repeated mechanical hand cutting alone with combined with a Cut-Stem treatment in the fall. Knotweed should be left to grow for one season and treated with a low volume foliar application in the fall

after flowers appears. This will allow for sufficient leaf area to make foliar treatment effective. Blunt-leaved privet occurs as an established ornamental, most likely planted in prior settlement. These can be cut with chainsaws and Cut-Stem treated in the fall.

Community C can be utilized as another potential prescribed grazing area. The concentrations of bittersweet and buckthorn allow for site specific grazing. Otherwise, the area can be maintained by mechanically mowing, as it is now. Japanese and Morrow honeysuckle and barberry can be Cut-Stem treated. The mature Norway maples that line Route 1A should be culled as they mature. Once one fails, it should be removed and a native replacement planting can be substituted as needed.

Monitoring - Given the location, volunteers would be able to be trained and utilized annually in the spring to walk the grounds. Most of the invasives present are easy to learn and leaf out early in the season making them quickly identifiable. Monitoring can also be done on a daily basis by volunteers. There should be training made available to educate them regarding plant identification and timing of treatments.

Ongoing Invasive Plant Management- Given the location, the area is constantly maintained during the season. Following chemical applications on the bunker area in Community A, volunteers, or land managers should check any erosion issues that result from control of invasives. Follow up herbicide treatments should occur spring and fall to treat any sprouts, new infestations and reoccurring populations.

Field 17:

Control- Field 17 was recently cleared and is now managed as a field through semiannual mowing with a brush hog. It is recommended that this area not be mowed for one season to allow invasive species present to grow enough leaf surface to make chemical application effective. After one season of growth, apply a low foliar selective herbicide in the fall to target invasive species while leaving grasses intact. Mow after three weeks to stress kill remaining populations and resprout. Mow bimonthly to effectively stress kill any resprout and new infestations.

Monitoring- Long-term monitoring can be conducted by volunteers and land managers. Surveyors should be trained in plant identification and control methods which can be incorporated into daily tasks.

Ongoing Invasive Plant Management- Bimonthly mowing of Field 17 could be incorporated into seasonal land management activities. If the area cannot be incorporated into seasonal activities, additional foliar treatments will be needed to maintain grounds.

Fields 14 & 18

Control- Communities A, C and D are marked by significant communities of invasive species, so thick as to restrict access by foot. Due to the archeological significance of the Marvin Straw house site in Communities B and C, treatments in that area will be designed to cause minimal impact and not disturb soils.

In Community D and C, the mature overstory oaks and maples are being overwhelmed by bittersweet. Beginning in the fall, mechanical cutting of the understory will provide access along the trails and to the interior of the parcel. An application of a selective low volume foliar application after one growing season will achieve root control of resprout. Stems close to native species or 5" or larger to be hand cut and Cut-Stem treated.

Community C is further characterized by populations of barberry and honeysuckle. As they leaf out earlier than native species, they are best controlled by low volume foliar application in the spring.

Community B and A, due to the archeological evidence and proximity to trails, buckthorn and Norway maple will be basal stem treated in the fall and left intact to minimize soil disturbance. Stems larger than 5" are to be Cut-Stem treated.

Monitoring- Monitoring should be conducted annually, in the spring to take advantage of early leaf out of species present and develop ongoing management strategies before park visitors are numerous. Surveyors should be careful to note any archeological artifacts that come uncovered as a result of mowing or control treatments and report them to park staff immediately.

Ongoing Invasive Plant Management– Ongoing management strategies will need to be conducted semi annually over 10 years to ensure adequate control in areas mechanically treated. Following the 1st year foliar application, targeted broadleaf foliar applications and basal stem treatments can be administered in the spring and fall to reduce pesticide use while enhancing native vegetation. Additional native plants and shrubs should be established once invasive populations have been reduced, preferably in the second year of treatment. This area may be frequented by New England cottontails and could also be managed as grassland habitat.

<u>Field 21:</u>

Control- Field 21 sits next to the SSC and abuts an area used for social functions. This is significant in that it acts as a link to the shoreline trail network. Remediating this area could improve access and use by park visitors. Remediation would include a detailed native planting replacement plan that would invite, educate and beautify the surroundings, enlarging the function area by affording views and access.

For Communities 21A, 21B and 21C, beginning in the fall, mechanical cutting of the understory will provide access along the trails and to the interior of the parcel. A subsequent fall application of a selective low volume foliar application after 1 growing season will achieve root control of resprout. Stems close to native species or 5" or larger to be hand cut and Cut-Stem treated. Care should be exercised in the center of Community 21B, which has a significant pocket of native species. It is recommended that this area be delineated prior to any action.

Monitoring- Given the location, volunteers could be trained and utilized annually in the spring to walk these grounds. Most of the invasives present are easy to learn, and leaf out early in the season. Monitoring can be conducted on a daily basis. Volunteers and land managers frequent and maintain the area constantly during the season. There should be training made available to educate staff to identification, timing and treatments.

Ongoing Invasive Plant Management- Ongoing management strategies should be conducted semi annually over 10 years to ensure adequate control in areas mechanically treated. Following the 1st year foliar application, targeted broadleaf foliar applications and basal stem treatments can be administered in the spring and fall to reduce pesticide use while enhancing native vegetation. Additional native plants and shrubs should be established once invasive populations have been reduced, preferably in the second year of treatment. It is important that resources be appropriated for long-term monitoring and ongoing management strategies; otherwise areas such as Field 21, with its high density of invasive species and large seed bank, will revert back to being dominated by invasive species.

Field 27:

On July 18, 2006, perennial pepperweed (*Lepidium latifolium*) was identified for the first time in NH on a rocky beach at Odiorne Point State Park. The pepperweed at Odiorne was hand pulled by volunteers in 2006. In 2008, with funding from the US Fish and Wildlife Service- Partners for Fish and Wildlife Program, the NHDES -Coastal Program implemented an early detection-rapid response initiative to assess coastal habitats for the presence of pepperweed and to control new populations through hand pulling or herbicide application.

The pepperweed population in Field 27 was mapped, and monitored to generate a baseline data set, and hand pulled. Hand pulling occurred twice during 2008 (7/1/08, 8/20/08) and twice during 2009 (7/29/09, 10/1/09). The New Hampshire Coastal Program (NHCP) will continue to implement control strategies to remove pepperweed at Odiorne Point State Park via hand pulling; and monitor the effectiveness of control techniques.

Field 29:

Control- Field 29 will require wetland delineation prior to any invasive treatments being conducted. Special care will also be called for as the beach is a popular destination for visitors and a parking area abuts the southern edge of the parcel. Any chemical treatment will require a special permit from the Board of Pesticide Control.

A large stand of Phragmites extends from the southern edge. Restoring tidal flow would be a difficult given the day use and protected nature of the cove. Mature stands of honeysuckle rim the barrier edge with a uniform distribution of poison ivy extending inland staggered with pockets of purple loosestrife.

In late summer and early fall, conditions can be dry depending on seasonal variations. This would be an ideal time to coincide chemical treatments for Phragmites using an aquatic approved glyphosate based product after

tassel set. *Galerucella* beetle release site for purple loosestrife control could be coordinated with other Fields. Basal stem treatments of upland populations of buckthorn and honeysuckle in the fall, leaving stems intact, would minimize disturbance of shoreland soils. This area would also be advantageous for prescribed grazing, in particular, the area of Catbrier, where chemical and mechanical treatments might be limited.

Monitoring- First time applications to Phragmites rarely are 100% effective and often require 3-5 years of follow-up treatments. Monitoring should coincide with Field 31 surveys so that timing and methods of treatment can coincide with and compliment ongoing efforts.

Ongoing Invasive Plant Management- Ongoing management strategies should be conducted semi annually over 10 years to ensure adequate control in areas mechanically treated. Following the 1st year foliar application on Phragmites and basal stem treatments on honeysuckle and buckthorn, targeted broadleaf foliar applications and basal stem treatments can be administered in the spring and fall to reduce pesticide use while enhancing native vegetation. Care must be given to avoid native species and surface water conditions. Additional native plants and shrubs should be established once invasive populations have been reduced, preferably in the second year of treatment. It is important that resources be appropriated for long-term monitoring and ongoing management strategies; otherwise with its high density of invasive species and large seedbank, will revert back to being dominated by invasive species.

Field 30:

Control- This site is accessible from the parking area and Route 1A. There are a number of mature pitch pines, in addition to red oak and white pine. Care needs to be exercised when treating the area to maintain these native species. It also is bordered by a paved trail which sees much use from pedestrians and bicyclists. This area offers excellent opportunities for successful remediation as the Pilot Project is located on adjacent Field 31 and is already under way. A trail-way could be set up highlighting native species, ecology and habitat and invasive species control efforts and techniques. Beginning in the fall, mechanical cutting of the understory, focused on honeysuckle populations, will provide access along the trails and to the interior of the parcel. A subsequent application of a selective low volume foliar application the following fall will achieve root control of resprout. Invasive plants with stems 5” or greater should be treated by cut stem or basal stem treated.

Monitoring- Monitoring should be conducted annually, in the spring to take advantage of early leaf out of species present. Surveyors should be careful to note any archeological artifacts that come uncovered as a result of mowing or control treatments and report them to park staff immediately. Due to the large seed bank present and high levels of invasive species present across Route 1A it is likely that new sprouts will always be present, and monitoring would discover satellite colonies before they become established.

Ongoing Invasive Plant Management- Ongoing management strategies should be conducted semi-annually over 10 years to ensure adequate control in areas mechanically treated. Following the 1st year foliar application, targeted broadleaf foliar applications and basal stem treatments can be administered in the spring and fall to reduce pesticide use while enhancing native vegetation. Additional native plants and shrubs should be established once invasive populations have been reduced, preferably in the second year of treatment. It is important that resources be appropriated for long-term monitoring and ongoing management strategies so that work being conducted on the Pilot Project in adjacent Field 31 will be aligned with treatment, monitoring and ongoing management of Field 30.

Field 31:

Control- The first phase of control for Field 31 included mechanical mowing and prep cutting in December of 2009 as part of the pilot project to manage invasive plant species in Odiorne Point State Park. Target vegetation over 6' tall was mowed, and tall buckthorn and Norway maples too big for mowing were hand-cut with chainsaws and cut-stem treated with herbicide to prevent resprouting. A follow-up herbicide treatment is scheduled for early fall of 2010 to achieve root control of resprouts from the mowing, to treat smaller concentrations of invasives, and populations in close proximity to the rockwalls (FB Environmental, 2009).

Monitoring- Monitoring should be conducted semi-annually (spring and fall), and may coincide with other activities such as the "BioBlitz". If volunteers are conducting monitoring activities, there needs to be an authority in place that sees and verifies results, and adjusts management accordingly.

Ongoing Invasive Plant Management- Cut areas should be revegetated immediately following the first year of treatment. Replanting or reseeding with native species is highly desired, and is scheduled for October 2010 as part of the pilot project. This is aimed at reducing or eliminating invasive species so that natives are encouraged to grow, and stable conditions are reestablished so that the site is no longer conducive to invasive recolonization

Areas desirable as "open field" should be mowed 2-3 times during the growing season in order to control invasive plants (especially buckthorn) without the use of herbicides. Events such as a "Buckthorn Pull" could be used to engage volunteers to uproot invasive plants from infested areas. Before clearing buckthorn shrubs, native trees such as black cherry, hawthorn, ironwood, basswood and dogwood that can be mistaken for buckthorn need to be tagged or marked. Volunteers can pull buckthorn seedlings (less than 1" diameter) on coordinated transects within Field 31 each spring when the soil is soft and plants can be easily pulled by volunteers.

5.3.2 Costs of Controlling Invasive Plants

Costs associated with control and management of invasive species can vary greatly. Access, level of infestation and species present, safety of park visitors, presence of threatened or endangered species and habitat, and long-term control strategies will affect the costs associated with control. Based on 2007 labor rates (Manning, 2007), and recent costs from the Odiorne Pilot Project in Field 31, control estimates using a two-person crew (based on $75/hr) will cost approximately $1,200/day. Labor and machine rates can increase costs dramatically. Any Phase 1 treatment should be followed by a Phase 2, or second year treatment in order to increase the effectiveness of control. Invasive plants are opportunistic and thrive in disturbed soils. Therefore, the existing seed bank, resulting soil disturbance, and increase in the amount of sunlight available following treatment can all affect Phase 2 treatment costs. Control estimates should include costs associated with planting native species in areas where invasives are removed.

Method-ology	Level of Intensity	Cost Per Acre	Cost Per Day
Basal Bark			
	High	$2,400.00	$1,250.00
	Medium	$1,200.00	$1,250.00
	Low	$600.00	$1,250.00
Foliar Spray with Backpacks or Spot Spray			
	High	$1,200.00	$1,250.00
	Medium	$600.00	$1,250.00
	Low	$300.00	$1,250.00
Foliar Spray with Truck or Tractor Boom			
	High	$200.00	$1,250.00
	Medium	$200.00	$1,250.00
	Low	$200.00	$1,250.00
Cut and Treat Stumps			
	High	$5,000.00	$1,250.00
	Medium	$2,500.00	$1,250.00
	Low	$1,000.00	$1,250.00
Hand Pull	High	$8,000.00	$1,250.00
	Medium	$4,000.00	$1,250.00
	Low	$2,000.00	$1,250.00

Source: Manning, 2007

5.3.3 Disposal of Invasive Plant Species

Proper disposal of invasive plant material is critical to the invasive control process. Leftover plant material can cause new infestations or re-infest the existing project area. Care should be taken in the disposal of all invasive plants. Several species need extra attention, particularly the ones that have the ability to sprout vigorously from plant fragments. Burning, piling, composting, landfill disposal, and/or drying should be considered on a species specific basis as described below. On-site composting, chipping and burning should take place at established and documented locations within the park that are carefully managed by park staff. The boat launch parking lot has been identified as one area where plants could be stockpiled and burned.

The boat launch parking lot has been identified as an area where invasive plants could be burned. Care would need to be taken to ensure that transfer of plants to this location would not result in new infestations.

Below are common disposal methods for five of the most prominent species in the park.

Using biological control, purple loosestrife (above) can be treated on-site without the expense and effort involved in disposal.

Blunt-leaved privet (*Ligustrum obtisifolium*) can be disposed of in brush piles, or by chipping or burning.

Common reed (*Phragmites australis*) can be dried in the sun before mulching or composting, or placed in a heavy duty black plastic bag head first to minimize risk of dispersing seed.

European barberry (*Berberis vulgaris*) can be disposed of in brush piles, or by chipping or burning.

Glossy buckthorn (*Rhamnus fragula*) can be disposed of by stacking brush in piles, chipping or burning. Special care must be given during fruiting stage as mature fruit will seed easily in disturbed soil.

Morrow's honeysuckle (*Lonicera morrowii*) can be disposed of in brush piles, or by chipping or burning.

Norway maple (*Acer platanoides*) can be disposed of in brush piles, or by chipping or burning.

Oriental/Asiatic bittersweet (*Lonicera morrowii*) should <u>not be composted, nor should cut stems be allowed to lie on the ground</u> due to its ability to vegetatively reproduce. Disposal is best suited for burning, or plants should be bagged and disposed of at a landfill.

Purple loosestrife (*Lythrum salicaria*) can be placed headfirst in a heavy duty black plastic bag and disposed of. If biological controls are used (beetles), then disposal is not necessary.

5.3.4 Permitting/Regulations

There are many different geographic and geophysical as well as historical settings within Odiorne Point State Park that require consideration when determining appropriate control methods and the regulatory instruments needed prior to implementing any invasive plant control recommendations. The following information relates to the rules for protecting natural or historical resources, and the appropriate agency to contact before control efforts begin.

Comprehensive Shoreline Protection Act (CSPA)

Application of pesticides or herbicides of any kind within the Shoreland Zone requires a special permit issued under Title L Water Management and Protection Chapter 483-B, Comprehensive Shoreline Protection Act, Section 483-B:9 (A): *No chemicals, including pesticides or herbicides of any kind shall be applied to ground, turf, or established vegetation except as allowed under special permit issued by the division of pesticide control under rules adopted by the pesticide control board under RSA 541-A, or fertilizers of any kind except those specified in RSA 483-B:9, II(d).*

No permit is required under the CSPA for mechanical and biological control of invasive species within the shoreland zone. A permit would be required if soil is altered or native (natural) species are removed under the

NHDES Shoreland permit Application for a permit to excavate, fill or construct new structures within the protected shoreland as regulated under RSA 483-B.

Wetlands (Federal and State Regulations)

Wetlands are defined as those areas that are inundated or saturated at a frequency and duration sufficient to support, and that under normal circumstances support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas. Wetlands tend to be located in depressions, at the toe of slopes or in other areas where one might envision water collecting. Wetlands in New Hampshire are identified using a three-parameter approach of 1) hydrophytic (wetland) vegetation, 2) hydric soils and 3) wetland hydrology.

Federal Regulations- Federal wetland regulations are covered under section 404 of the Clean Water Act (CWA) and are regulated by the U.S. Army Corps of Engineers (USACE). The activities identified as routine maintenance are covered under a State Programmatic General Permit (SPGP), which is an agreement between the USACE and the NHDES that allows these activities to be regulated by the State.

State Regulations- the NH DES Wetlands Bureau administers the state wetland regulations. These regulations (Env-Wt 100-800 Organizational Rules) require a permit for all impacts (disturbance, fill, and dredge) whether temporary or permanent.

No permit is required for mechanical and biological control of invasive species within the wetland or shoreland zone. A permit would be required if soil is altered such as excavation of root mass and rhizomes relating to Phragmites and purple loosestrife. Further, a permit would be required if soil is altered by rutting from equipment.

Endangered, Threatened , Rare or Special Concern Species & Exemplary Natural Communities

The New Hampshire Natural Heritage Bureau (NHNHB) is mandated by the Native Plant Protection Act of 1987 to determine protective measures and requirements necessary for the survival of native plant species in the state, to investigate the condition and degree of rarity of plant species, and to distribute information regarding the condition and protection of these species and their habitats.

The NHNHB DataCheck Tool was developed as a collaborative effort between the NHB, the Department of Environmental Services (DES), and the NH Fish and Game Department. When a regulatory authority (*e.g.,* the DES Wetlands Bureau) requires consideration of the impacts the project may have on state or federally listed endangered or threatened species, rare or special concern species, or exemplary natural communities allows anyone planning a project to find out if there are NHB records in the vicinity of the project.

If there are NHB records in the vicinity of the project area, NHNHB staff need to assess potential impacts of the project; and users can request this assessment using the Tool. The results will be sent to the user in the form of an official letter, which can then be submitted to regulatory agencies as part of a permit application. A NHNHB DataCheck was last conducted in March 2006 for Odiorne Point State Park (NHNHB, 2006).

A letter of intent needs to be sent to the NH Natural Heritage Bureau (NHB) with a map showing the project area and location of rare, threatened, or endangered species. The NHB will then determine if a site visit is required, and whether habitat needs to be flagged.

Historical Resources

The National Historic Preservation Act of 1966, Section 106 explains that *"...prior to the approval of the expenditure of any Federal funds on the undertaking or prior to the issuance of any license, as the case may be, take into account the effect of the undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register. The head of any such Federal agency shall afford the Advisory Council on Historic Preservation established under Title II of this Act a reasonable opportunity to comment with regard to such undertaking.*"

Section 106 review is the process of assisting federal and state agencies and their applicants in determining whether or not their projects will affect significant historic properties. The process allows for consideration of alternatives that may avoid or reduce any potential effect while the projects are still in the planning stages. To initiate Section 106 review in New Hampshire, submit a completed Request for Project Review form (RPR) to the Division of Historical Resources. The RPR must be submitted by mail (project submissions will not be accepted via facsimile or e-mail). The DHR submits its comments to project proponents in writing, not by telephone or e-mail. The RPR and instructions for completing the form can be downloaded from the DHR website: http://www.nh.gov/nhdhr/review. A flowchart to explain the process can be downloaded which can aid in the application process: http://www.nh.gov/nhdhr/review/documents/Section106FlowChart.pdf. A RPR was submitted to DHR to implement the pilot invasive plant control project in Field 31 in December 2009.

Herbicides

Administrative Rules Pes. 1001.01 (NH Dept. of Agriculture) restricts the use of pesticides adjacent to wetlands and the shoreland zone, and may only be applied by a licensed applicator with a permit from the NH Agricultural Department. The rules require that:

1) In or within 25' of wetlands requires a special permit from the New Hampshire Board of Pesticide Control. A wetland delineation should be conducted within all potential control areas prior to the start of work. The delineation should clearly mark wetland boundaries so that management actions can progress without environmental impact.

2) Within 50' of the High Water Mark (HWM) of the Shoreland Zone on private or public lands requires a special permit from the New Hampshire Board of Pesticide Control. Once filed, the permit may take 60 -90 days before being issued.

6. Plan Implementation

As discussed in Chapter 5, successful implementation of an invasive plant management plan will depend on several key elements including success of initial control efforts, as well as long-term monitoring and ongoing management. However, there are other variables that will weigh heavily on the success of this plan. These include a sustainable funding plan, project partners dedicated to implementing the plan, strong local support from volunteers, and an adaptive management approach that allows for flexibility in scheduling of implementation efforts, and an action plan containing a schedule of activities with goals to accomplish and track over time. Figure 6.1 (next page) presents an implementation hierarchy that highlights the key stages to successful implementation efforts.

6.1 Sustainable Funding

The extent to which the *Odiorne Point State Park Invasive Plant Management Plan* can be successfully implemented will be related to the project partners' ability to secure outside funding for the execution of the individual components of the plan. It is unlikely that a single funding source or a combination of funding sources will be secured at one time for the long-term, wholesale implementation of the invasive plant species management effort outlined in this document. This plan has been conceived and developed, parcel by parcel, to encourage a more "opportunistic" funding model.

A parcel-based approach provides the project partners a plan structure suited to matching requests for outside funding to the magnitude and ecological priorities of potential funders. Provided the funders will respond favorably to the topic of the control of invasive plant species within a state park, there is very likely an important aspect this plan that can be advanced in a manner consistent with its management objectives and the often limited resources of the project partners. When submitting funding applications, the project partners will look for opportunities to both advance new invasive plant control activities as well as to support follow-up for previous invasive plant control efforts.

6.2. Coordinating Volunteers

Long-term remediation of native ecosystems as improved public safety and recreational access is dependent on volunteer support. This support could include annual monitoring for regrowth of invasive plants each spring, manual pulling, replanting of native species, and even financial support. Volunteers would receive education and training in order to identify invasive plant species.

Volunteers, including local high school students, could contribute to control efforts through long-term monitoring of invasive plant populations following treatment efforts. (Photo: FB Environmental, 2010)

Below are several ways that volunteers can contribute to invasive plant control efforts:

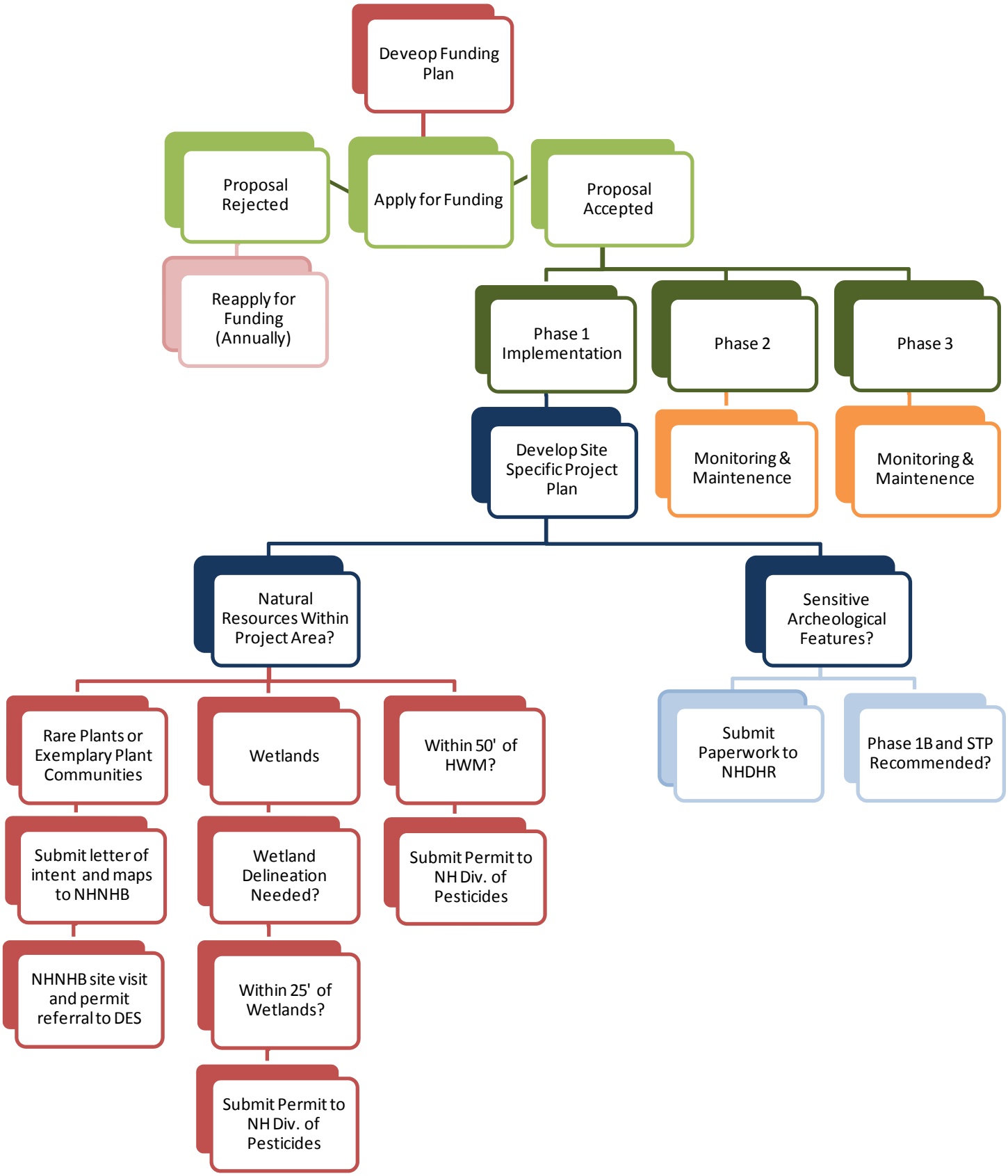


Figure 6.1. *Implementation Hierarchy for Odiorne Point State Park.*

Earth Day (April 22nd)- Bring in volunteers for annual invasive monitoring, manual pulling, or replanting.

Corporate Day- Utilize corporate sponsors such as EMS, UNH, and Timberland to monitor, pull and replant.

Corporate Sponsorship- Consider an "Adopt-a-Plot" approach. A corporate sponsor would maintain trails, and report new invasive species occurrences to the Project partners. Possible use of discreet signage to identify who manages the parcel. Financial contributions from the corporate sponsor could be used for hiring a licensed herbicide applicator to eliminate new occurrences.

Community Service- Contact corrections to see if there are local youth in need of community service projects, and use for manual pulling or replanting projects.

Local Schools- Contact local high schools to see if there would be interest in long-term monitoring. Students would keep track of number, type, extent, and location of new populations over-time, and provide an annual report to the park.

Buckthorn Pull- Local volunteers are invited to a "Buckthorn Pull". Volunteers would be trained over breakfast and be fed lunch.

6.2 Schedule

Both short and long-term schedules need to be followed in order to successfully reduce or eradicate invasive species at Odiorne Point State Park. The schedule should be adapted on an annual basis by the project partners as funding becomes available. A basic schedule is presented below (Table 6.1).

The project partners, composed of representatives from the SSC, State Park, RCCD, and NHDES will meet annually to incorporate new implementation strategies, update timeframes, and track progress made. Existing project partners should consider recruiting new partners from the public to assist with long-term implementation efforts, subgroups should be formed to address the five topic areas listed in Table 6.1.

Table 6.1. *Implementation schedule for control of invasive plants at Odiorne Point State Park.*

Implementation Schedule		
Funding	**How**	**Goal**
Develop a Sustainable Funding Plan	Form a subcomittee, and develop a draft w/in 6 months, final plan w/in 1 year	Develop plan within 1 year
Apply for grants	Coordinate efforts to submit grants	Submit minimum of 3 applications/yr
Solicit donations from private entities and corportations	Develop a contact list; Use public outreach as a means for soliciting interest	Raise $10,000 in first year, $15,000 annually thereafter
Coordinate volunteers	Develop a volunteer list.	Twenty dedicated volunteers within 3 years

Table 6.1. Cont.

Education & Outreach	How	Goal
Develop signage at visible locations throughout the park	Acquire funding to post educational signage regarding invasive control efforts	12 signs located along trails and the beach by 2015
Provide educaction and hands-on-learning opportunities for local schools	Contact local high schools to see if teachers would be interested in a long-term invasive plant monitoring project that can be tracked using GPS equipment	Two local schools participating by 2015
Sponsor a Buckthorn Pull	Kick-off a long-term maintenance project with a buckthorn pull with free food and education	50 attendees help remove buckthorn seedlings and saplings in pilot project area
Control Efforts	**How**	**Goal**
Implement invasive control practices on 10 acres each year	Agressively acquire funding and set priorities for implementation	100 acres in 10 years
Look into use of grazing using goats	Contact succesfull grazing programs around the country and acquire funding	Grazing on 20 acres of public land in the park by 2015
Revegetate using native plants	Develop a native plant list, and incorporate into site specific project plans; use volunteers for planting	Revegetate 100 native plants in control areas annually
Develop Site Specific Project Plans for each funded project	Develop RFP for plan and treatment	Combine parcels where possible
Use Bioblitz volunteers and college interns for assisting with Phase 1B archaeological surveys	SSC and USM work together to solicit volunteer interest	Complete recommended STP's for one sensitive site each year
Monitoring	**How**	**Goal**
Survey remaining parcels north of Rt. 1, and all south of Rt. 1	Acquire funding to conduct an inventory of invasive plants on unsurveyed/ previously surveyed parcels using same methodology	Survey 50 acres in 2011, and remaining 50+ acres in 2012
Conduct biannual monitoring of parcels that have received Phase 1 treatment	Develop a monitoring field form; data collection by single entity	TBD

Table 6.1. Cont.

Long-Term Management	How	Goal
Conduct follow-up treatment (Phase 2 and 3) to treated parcels following monitoring	Acquire funding to follow-up with treatment efforts	All surveyed parcels in Phase 2 and 3 (monitoring and long-term management mode) by 2020.
Train volunteers to locate, document, and remove seedlings within treatment area	Annual plant ID training; data entry training, maintenance training	20 trained and dedicated volunteers by 2015
Develop an-Adopt-a-Parcel Program	Solicit interest in local business adopting a parcel to monitor and manage over the long-term	15 Adopt-a-Plot Businesses montitoring by 2015

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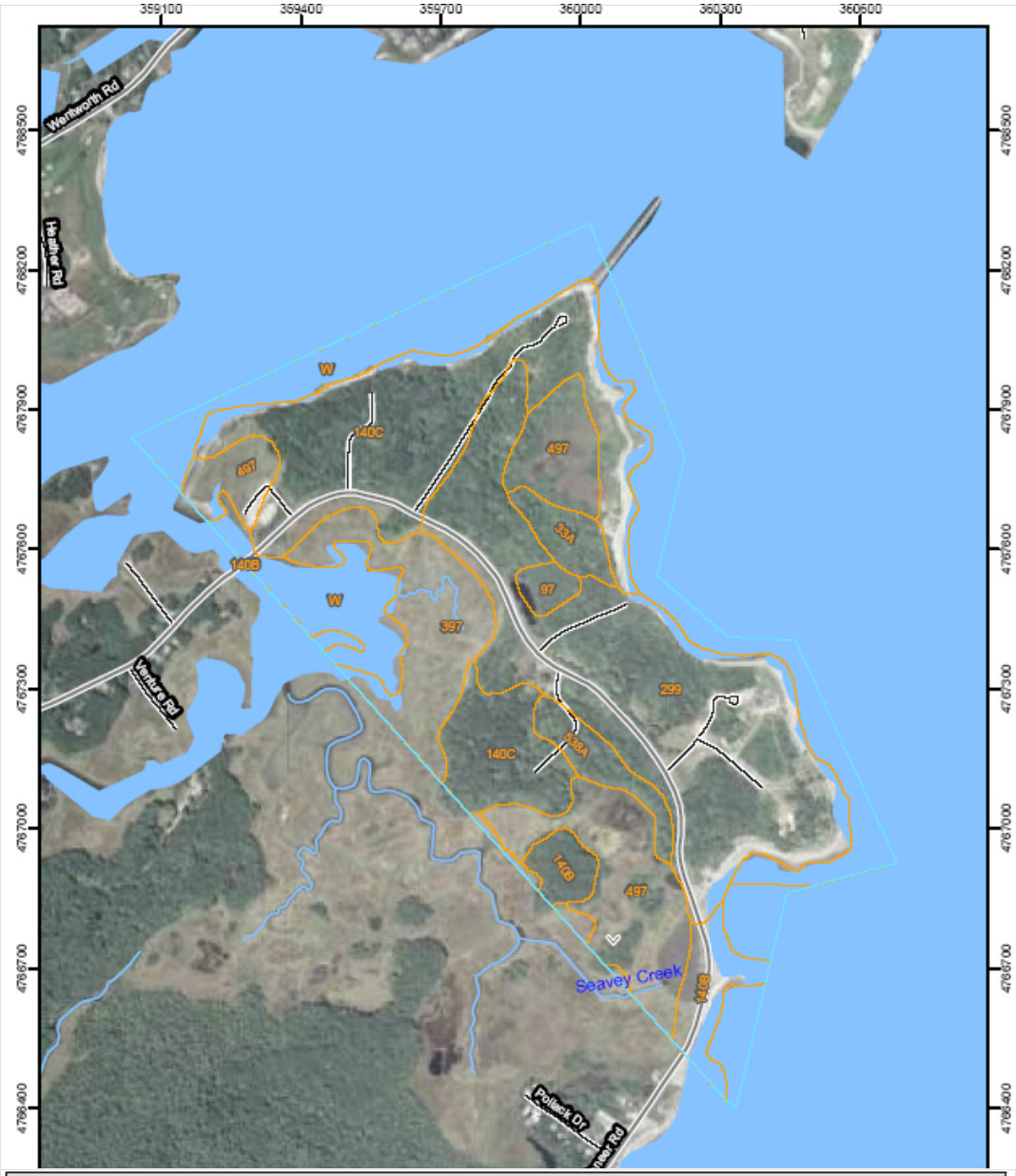
Appendix A– Soil Map



Rockingham County, New Hampshire (NH015)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
33A	Scitico silt loam, 0 to 5 percent slopes	5.5	1.7%
97	Greenwood and Ossipee soils, ponded	2.7	0.8%
140B	Chatfield-Hollis-Canton complex, 3 to 8 percent slopes, very stony	12.8	4.0%
140C	Chatfield-Hollis-Canton complex, 8 to 15 percent slopes, very stony	71.5	22.1%
299	Udorthents, smoothed	82.5	25.5%
397	Ipswich mucky peat	26.2	8.1%
497	Pawcatuck mucky peat	40.3	12.5%
538A	Squamscott fine sandy loam, 0 to 5 percent slopes	6.8	2.1%
W	Water	65.7	20.3%
Subtotals for Soil Survey Area		**314.2**	**97.3%**
Totals for Area of Interest		**323.0**	**100.0%**

Table A.1. *Soil Survey Map for Odiorne Point State Park, Rye, NH. (NRCS, 2010).*

Appendix B– Description of Invasive Plant Species

Norway Maple (*Acer platanoides*)

Norway maple, a deciduous tree, reaches a height of 40-50 feet. The leaves are dark green, simple, opposite, 4”-7” wide with 5 lobes. The mature tree is a prolific seeder has a rounded crown of dense foliage and the bark is grayish-black and furrowed. The tree leafs out and produces seeds earlier than other maples. Norway maple is well adapted to various soil extremes, such as sand, clay or acid. It grows in hot and dry conditions, and it can tolerate shade, ozone and sulfur dioxide air pollution and were planted as street tress due their resilient nature. Once the tree is established, through a process known as allelopathy, it leaches substances called phytoxins into the soil that prevent native seeds from germinating around the tree. Mature stands are located along Route 1A (planted as street trees).

Tree of Heaven (*Ailanthus altissima)*

Tree of heaven, also known as stinking sumac, originates from China and was introduced first to Pensylvania by a gardener in the late 1700’s. It is an ornamental plant that produces a poison that kills native plants around it, attaches to building foundations, and damages urban areas by cracking pavement and infrastructure. The plant is now widely distributed across the U.S. A full mature tree can be upwards of 80 feet (24 m) in height with smooth stems and pale gray woody bark. Tree of heaven has large compound leaves that can be 1 to 4 ft (0.3-1.2 m) in length with smaller leaves growing alternately along the stems. The leaves can be recognized by their dark green color on top and a pale green underneath. The stem bark is also brown which contrasts with the light gray main stem. In June the tree has small yellow-green flowers followed by flat hanging fruit in the late summer that can persist through the fall. Abundant reproduction is triggered by cutting or breaking of the tree. Tree of Heaven was documented by Straus (1973) in Section 10 (west of the freshwater pond).

Source: http://www.nps.gov/plants/alien/pubs/midatlantic/aial.htm

Japanese Barberry (*Berberis thunbergii)*

Japanese barberry is a shrub that can grow 2 to 4.5 ft (0.6-1.3 m) tall. It was introduced as an ornamental plant when seeds from Russia were planted in the Arnold Arboretum in Boston, MA in 1875. The species now covers much of New England and Midwest states occurring in a broad range of habitats. Japanese barberry is a shrub that consists of long woody grooved stems with small, smooth-edged, oval leaves growing in clusters of 2 to 6. At each cluster node is a single spine which sets it apart from the european variety. The leaves range in color from green to bluish-green, to dark red. In late spring the plant has pale yellow flower clusters transitioning to bright red oblong berries in late summer through the winter. Its primary mode of transport is through small mammals and birds that eat the red fruit. This shrub is found throughout the park and usually individually, with few large thickets.

Source: http://www.nps.gov/plants/alien/pubs/midatlantic/beth.htm

Picture source: http://extension.unh.edu/FHGEC/graphics/JapaBarb.jpg

European Barberry (*Berberis vulgaris*)

European barberry was introduced as an ornamental in the 1850's. European barberry is a deciduous shrub that can reach 13 ft. (4 m) in height. The leaves are oval, serrate and occur in clusters of 2-5. Each cluster of leaves is subtended by a short, three-branched spine. Flowering occurs in May to June, when small, yellow flowers develop in panicles. Berries are red, oblong and less than 1/3 in. (10 mm) in length. Common barberry is native to central and southern Europe and occurs in shaded areas. It forms dense stands in natural habitats including canopy forests, open woodlands, wetlands, pastures, and meadows and alters soil pH, nitrogen levels, and biological activity in the soil. Once established, barberry displaces native plants and reduces wildlife habitat and forage. Only one stand was found on the eastern edge of the parcel, but populations occur throughout Odiorne Park including adjacent fields.

Oriental/Asiatic Bittersweet (*Lonicera morrowii*)

Oriental bittersweet was introduced from China around 1860 as an ornamental. It is a deciduous, climbing, woody vine that can grow to lengths of 60 ft. (18.3 m). The alternate, elliptical leaves are light green in color and 2-5 in. (5-13 cm) long. Small flowers develop in the spring. Fruits are round and green when young and ripen to yellow and split to reveal showy, scarlet berries that persist into winter. Some shade tolerance allows it to also grow in open forests. Prolific vine growth allows it to encircle trees and girdle them. Vines can completely cover other vegetation and shade, out-compete and kill even large trees. It can be dispersed widely and quickly due to birds eating the berries and spreading the seeds.

Black Swallow-Wort (*Cynanchum louiseae***)**

Black swallow-wort was introduced intentionally as an ornamental plant from Southern Europe in the 1850's. It is a vine that forms extensive patches among native species and dominates the habitat suffocating native plants. Leaves of this plant grow opposite one another along the stem and can be 3-4 in (7.6-10 cm) long. Clusters of small dark purple star flowers emerge in June and give way to oblong seed pods in late summer. Seed pods can be green to brown depending on their developmental stage and the number of pods is directly dependant on the amount of light the plant receives. This plant is part of the milkweed family and also mainly disperses in the wind. Plants are resistant to herbicides until they flower because the leaves are not large enough until late in the season. Most black swallow-wort was found in five locations in the park including Field 17 (along the walking path to the SSC), and Field 15 at the top of Battery 204. Source: http://www.nps.gov/plants/ALIEN/fact/cylo1.htm

Autumn Olive (*Elaeagnus umbellate*)

Autumn olive is a medium to large shrub that occurs in few places in Odiorne Point State Park. It was originally from East Asia and planted in North America in 1830 to promote wildlife habitat, provide windbreaks, and encourage reforestation in disturbed areas. It can grow up to 20 ft (6 m) tall and overshadow native species and understory plants. It has alternate, oval leaves that are gray-green on the surface and silvery underneath giving the tree a silver look. The branches are smooth and vary from gray to rusty brown in color. Small cream to yellow flowers bloom in late spring and the tree bears fruit in fall that appears silvery orange to red. Autumn olive can thrive in drought and nutrient poor conditions allowing it to displace native species.
Source: http://www.nps.gov/plants/alien/pubs/midatlantic/elum.htm

Burning Bush (*Euonymus alatus*)

Burning bush has widely been planted in landscaping since its introduction in the 1860's from Eastern Asia. The shrub attracts people and animals through highly colored leaves that are bright red in the fall months. The leaves are dark green along the stem during the other seasons and grow in pairs. The bush can be upwards of 20 ft (6 m) in height and can be equally as wide. It has small green flowers in the late spring that give way to red-purple fruits in early fall. Birds are attracted to the fruits and digest the seeds spreading them throughout the habitat. Burning bush was found along the pathway in Field 5 and dispersed throughout Fields 4 and 5.
Source: http://www.nps.gov/plants/alien/pubs/midatlantic/eual.htm

Perennial Pepperweed (*Lepidium latifolium*)

Perennial pepperweed is thought to have entered the United States through a shipment of beet seed from Europe prior to 1940 and is known by multiple names. It can grow in masses up to 5 ft (1.5 m) tall and is multiple stemmed. The stems are smooth and woody at the base and form a crown when entering the soil fanning roots that can grow to 6 ft (1.8m) long. This plant mainly spreads through sprouting off of its own roots because its small flattened seeds are fragile and not usually viable. Leaves are bright green and round with smooth teeth. The pepperweed flowers in early summer to fall with abundant small white cluster flowers near the stem tips. Pepperweed thrives in marsh areas and can adapt to conditions to quickly establish a community. In the park perennial pepperweed has been found growing along the eastern shore on the beach of Field 27.
Source: http://www.nps.gov/plants/ALIEN/fact/lela1.htm

Blunt-Leaved Privet (*Ligustrum obtisifolium*)

Blunt-leaved privet was introduced into the United States in the early 1852 as an ornamental and is primarily used as border hedges around homes and yards. Trunks usually occur as multiple stems with many long, leafy branches. Leaves are opposite, oval and pubescent on the underside. Flowering occurs in late spring, when small, white flowers develop at the end of branches in 2-3 in. (5-7.6 cm) long clusters. Fruit are oval, fleshy and persist into winter. Privet commonly forms dense thickets in fields or in the understory of forests. It shades and out-competes many species and, once established, is very difficult to remove. Privet is located in an isolated location adjacent to the parking lot, as well as a number of other locations throughout the Park.

Japanese Honeysuckle (*Lonicera japonica***)**

Japanese honeysuckle was imported to North America as an ornamental bush in the mid 1800's as erosion control and wildlife habitat. It spread quickly in the eastern U.S. through its ability to propagate by its roots and easily carried seeds. Japanese honeysuckle is a vine that can grow up to 25 ft (7 m) and has oblong leaves that grow in pairs along the main stem. In the winter months the leaves fall off due to the cold weather. Birds are attracted to this plant because of the white to pink tubular flowers that produce a very sweet smelling nectar in the springtime to midsummer. This plant produces seeds in autumn that are a black fruit about a quarter inch across. Japanese honeysuckle is confined to Field 15 in Odiorne Point State Park and is found growing along the staircase leading to the top of Battery 204.Source: http://www.nps.gov/plants/ALIEN/fact/loja1.htm

Morrow's Honeysuckle (*Lonicera morrowii*)

Morrow's honeysuckle is a native of eastern Asia and was first introduced into North America in the late 1800s. It has been planted widely as an ornamental and for wildlife food and cover. It is a multi-stemmed, upright, deciduous shrub that grows up to 7 ft. (2.1 m) tall. The leaves are opposite, round, long and hairy underneath. Often it is one of the first shrubs to leaf out in the spring. The fragrant flowers are tubular, white to cream-colored and develop in the mid-spring. The abundant berries ripen to orange or red in color, and often persist throughout winter. The bark is light brown and often pubescent on young stems. Several species of exotic bush honeysuckles occur and distinguishing individual species can be difficult. Morrow's honeysuckle readily invades open woodlands, old fields and other disturbed sites. It can spread rapidly due to birds and mammals dispersing the seeds and can form a dense understory thicket which can restrict native plant growth and tree seedling establishment. Honeysuckle is widespread throughout the park, and was documented in all but three of the parcels surveyed.

Japanese Knotweed (*Fallopia japonica*)

Japanese knotweed is a medium to large shrub with greenish, hollow stems much like bamboo. It has simple, alternate leaves that are smooth, largely ovate with a pointed tip. Greenish-white flowers appear in summer and are located at the base of the leaves along the main stem. The flowers are small and give way to winged fruits very quickly in the early fall. Populations are extremely persistent due to the very small seeds that can be transported in dirt and the plant can spread through its root system. Japanese knotweed was first introduced as an ornamental plant from east Asia in the late 1800's and was intended for erosion control and landscaping. In the park, this invasive is found in Field 15. Source: http://www.nps.gov/plants/ALIEN/fact/faja1.htm

Common Buckthorn (*Rhamnus catartica*)

Common buckthorn was introduced to the U.S. as an ornamental shrub used for fences rows and wildlife habitat. It is a very hardy plant and can thrive in varied conditions that threaten most native species. Unlike glossy buckthorn, common buckthorn has toothed broadly oval, tipped leaves and a spine at the end of each branch. The leaves are without hair on either side and appear dark green and glossy on the surface. The branch bark is grey to dark brown and woody and is easily confused with native plum trees. Common buckthorn grows in dense thickets that can be 22 ft tall preventing native species from receiving light. In spring the plant produces yellowish-green flowers in clusters of 2-6 at the base of the leaf stalks. These flowers mature to small black fruits in the fall. Common buckthorn was documented in Field 1. Source: http://www.nps.gov/plants/ALIEN/fact/rhca1.htm

Glossy Buckthorn (*Rhamnus fragula*)

Glossy buckthorn is native to Europe and was first introduced into the United States in the mid 1800s as an ornamental. It is a large shrub or small tree that can grow to heights of 30 ft. (9.1 m). The dark green leaves are shiny, alternate (sometime opposite) and simple with prominent venation. The flowers are inconspicuous, pale yellow in color and occur in clusters in the leaf axis. Flowering occurs in the spring. The fleshy fruit ripens to a dark purple color. The bark is gray to brown with white lenticels. It invades moist woodlands and disturbed areas throughout the Northeast and Midwest. Its rapid growth and prolific seed production make these plants an aggressive invader that can form dense thickets which shade and displace native understory plants, shrubs, and tree seedlings. Glossy buckthorn was documented in all but two of the survey parcels, and like bittersweet, it dominates the forested landscape of Odiorne Point State Park, and is found in varying stages of development.

Multiflora Rose (*Rosa multiflora*)

The U.S. Soil Conservation Service promoted the use of multiflora rose in the early 1900's for erosion control and wildlife habitat. It grows as a perennial, thorny bush made of hardy stems that can be about 10 to 15 ft (3-4.5 m) tall. Leaves are sharply toothed, alternate, and arranged in leaflets of five to eleven. The base of each leaf has distinctive fringed stipules. The plant grows clusters of white or pink flowers in June that last through July before forming red rosehips in the fall. This species is now found throughout the eastern United States and evenly dispersed in Odiorne Park.

Source: http://www.nps.gov/plants/ALIEN/fact/romu1.htm

Purple Loosestrife (*Lythrum salicaria*)

Purple loosestrife is native throughout Europe from Great Britain to Central Russia, and parts of Asia. It was introduced to the northeastern U.S. and Canada for ornamental and medicinal reasons and is still sold in many garden stores. It is recognized by its cone shaped purple flowers that bloom during the summer and persist until fall. Purple loosestrife can grow up to 10 ft tall but usually occur around 4 ft. The stems are square and woody and have opposite or whorled leaves that are lance shaped along the stalk and rounded at the base. Mature plants can have 30 to 50 stalks rising from the same root system. Purple loosestrife is most likely found outcompeting native grasses and wetland species in low-lying areas in all states but Florida. This invasive is growing in disturbed wet areas throughout the park.

Source: http://www.nps.gov/plants/ALIEN/fact/lysa1.htm

Common Reed (*Phragmites australis*)

Common reed, also called *Phragmites*, is a perennial grass that can grow to be 15 ft in height. It is easily confused with its native relatives that grow naturally in the southwestern U.S. This introduced species established itself along the Atlantic coast after arriving through ballast water from European ships in the late 18th century. It grows in wetland conditions and quickly alters the hydrology of the area shading out native species with long, thin leaves. Stands of common reed are made up for both live and dead stems from the past years growth quickly crowding native species. The grass flowers in late summer and are purple to golden in color. As the seeds mature, the ends of the stalks take on a furry cone appearance in early fall and turn gray as the season passes. Common reed is spread very easily through water systems creeping along the banks of rivers and wetlands. In the park it is found in disturbed wetland areas of Fields 5, 10, and 29.

Source: http://www.nps.gov/plants/ALIEN/fact/phau1.htm

New Hampshire Prohibited Invasive Plant Species

* Denotes that these species shall be prohibited as of ***January 1, 2007***

Scientific Name	Common Name	Page
Acer platanoides	Norway Maple *	5
Ailanthus altissima	Tree of Heaven	5
Alliaria petiolata	Garlic Mustard	6
Berberis thunbergii	Japanese Barberry *	6
Berberis vulgaris	European Barberry	7
Celastrus orbiculatus	Oriental Bittersweet	7
Cynanchum nigrum	Black Swallow-Wort	8
Cynanchum rossicum	Pale Swallow-Wort	8
Elaeagnus umbellata	Autumn Olive	9
Euonymus alatus	Burning Bush*	9
Heracleum mantegazzianum	Giant Hogweed	10
Iris pseudacorus	Yellow-Flag Iris	10
Ligustrum obtusifolium	Blunt-Leaved Privet	13
Lonicera x bella	Showy Bush Honeysuckle	11
Lonicera japonica	Japanese Honeysuckle	12
Lonicera morrowii	Morrow's Honeysuckle	11
Lonicera tatarica	Tatarian Honeysuckle	12
Polygonum cuspidatum / (Fallopia japonica)	Japanese Knotweed	13
Rhamnus cathartica	Common Buckthorn	14
Rhamnus frangula / (Frangula alnus)	Glossy Buckthorn	14
Rosa multiflora	Multiflora Rose	15

New Hampshire Prohibited Aquatic Invasive Plant Species

Cabomba caroliniana	Fanwort	16
Myriophyllum heterophyllum	Variable milfoil	16
Lythrum salicaria	Purple loosestrife	17
Phragmites australis	Common reed	17

Table B.1. *List of twenty-five prohibited invasive plant species in NH (NAMF, 2005).*

Appendix C– Archeological Maps

Figure C.1. *Archaeologically sensitive sites and significant communities in Odiorne Point State Park.*

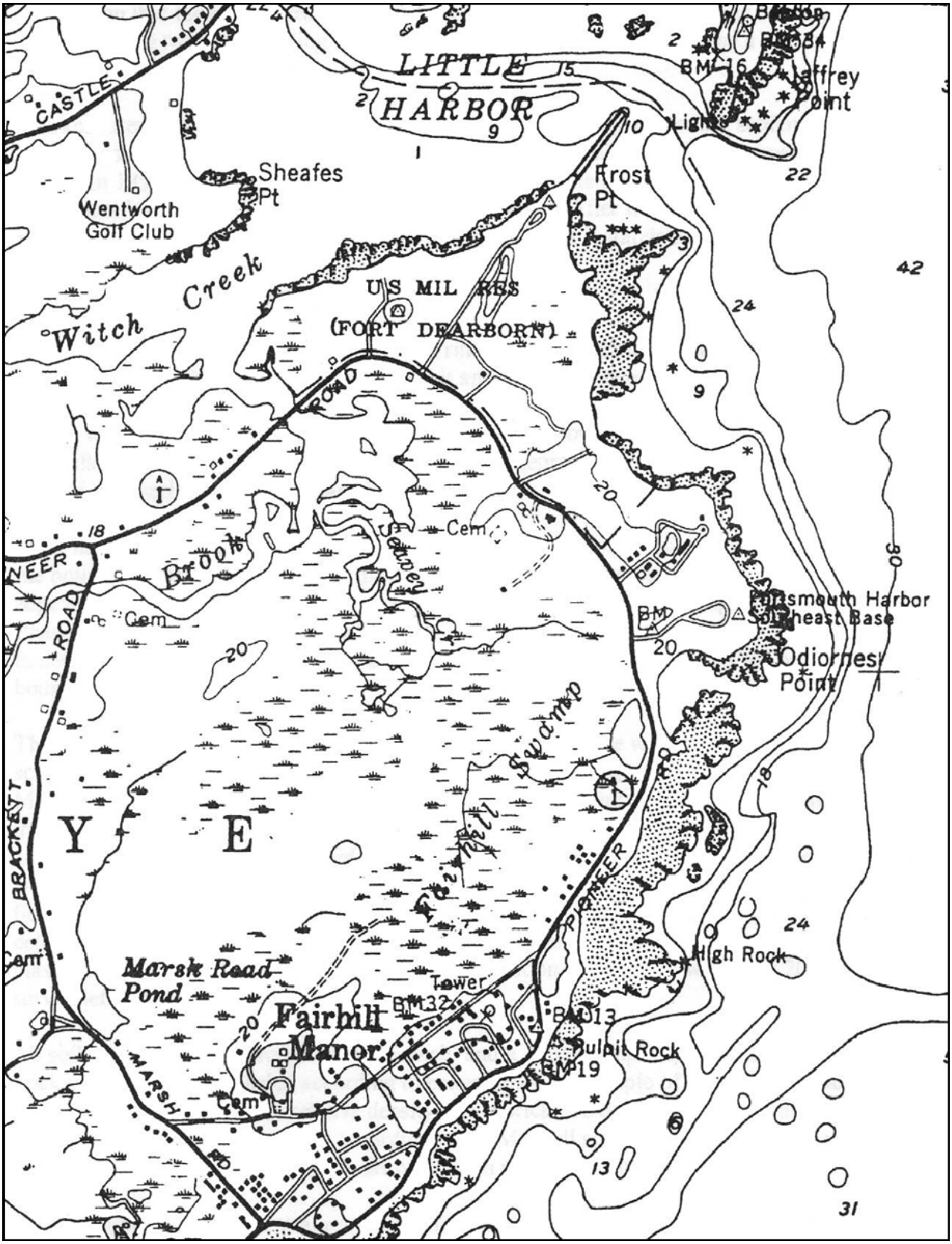


Figure C.2. *USGS topographic map of Rye and Odiorne Point State Park. ((USGS 15' Series, York Quadrangle)*

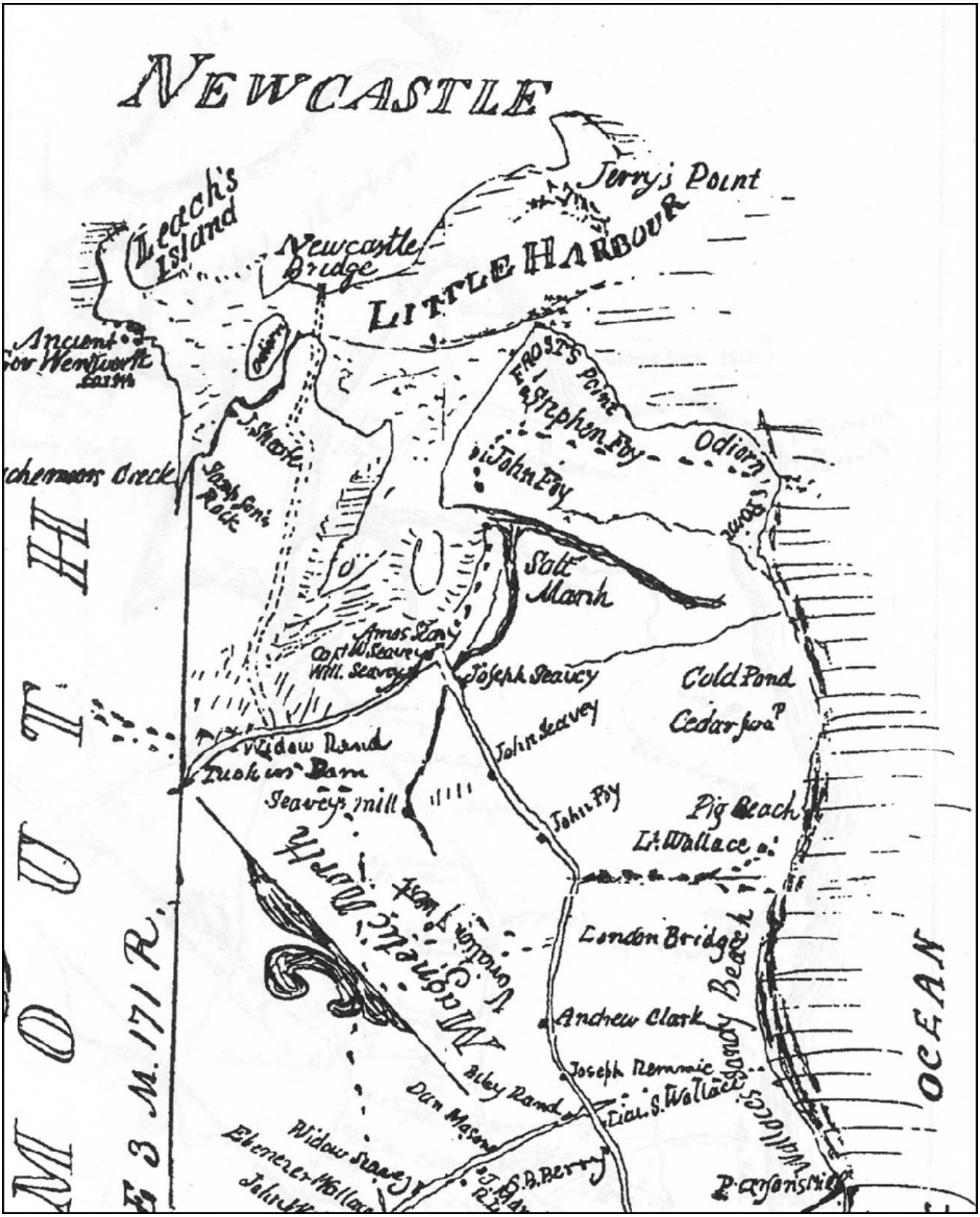


Figure C.3. *Redraft of Phineas Morril, "A Plan of the Town of Rye" for 1805. This figure documents the location of houses and roads (After Wheeler 2000, page 9, NHHS, HML)*

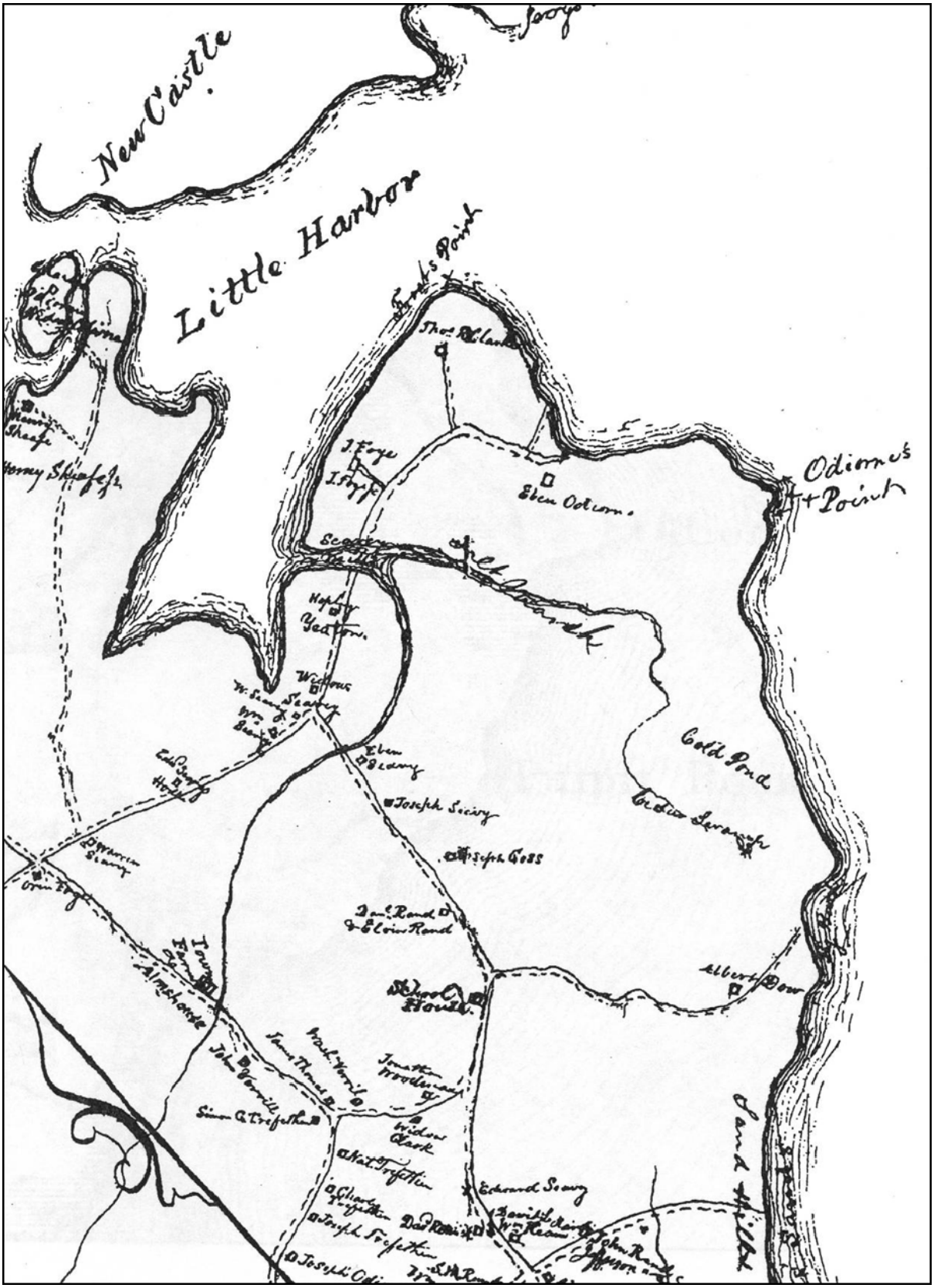


Figure C.4. *Map of Rye and Odiorne Point with reconstructed late 18th and 19th century settlements, as well as roads. Note the opening of Columbus Road to the ocean in the lower right. (After Parsons 1905 and courtesy of NHDHR)*

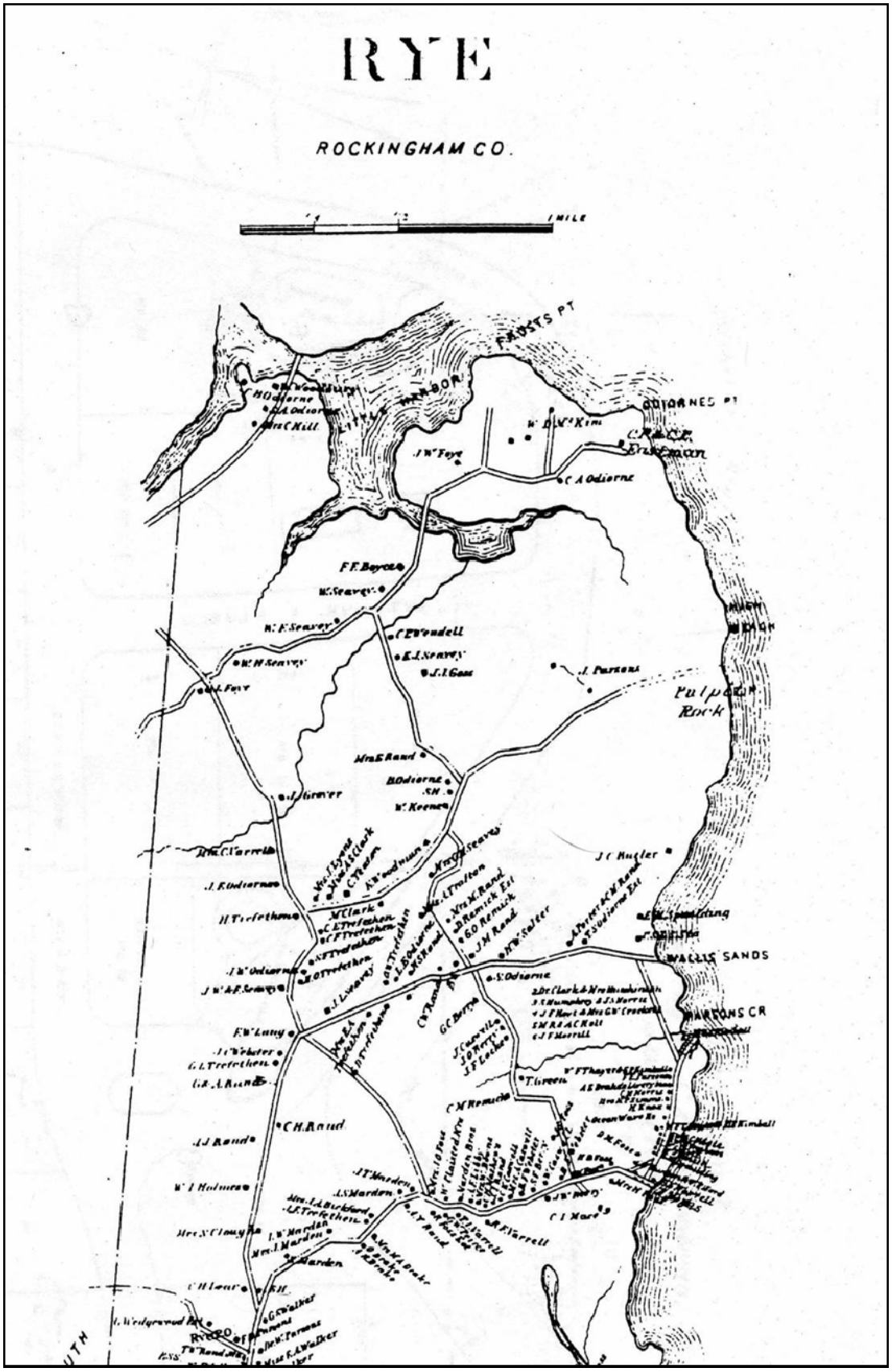


Figure C.5. *Map of Rye from County Atlas "Published Book of Maps" dated 1892. (Courtesy of NHDHR on file at NHHS as HM2)*

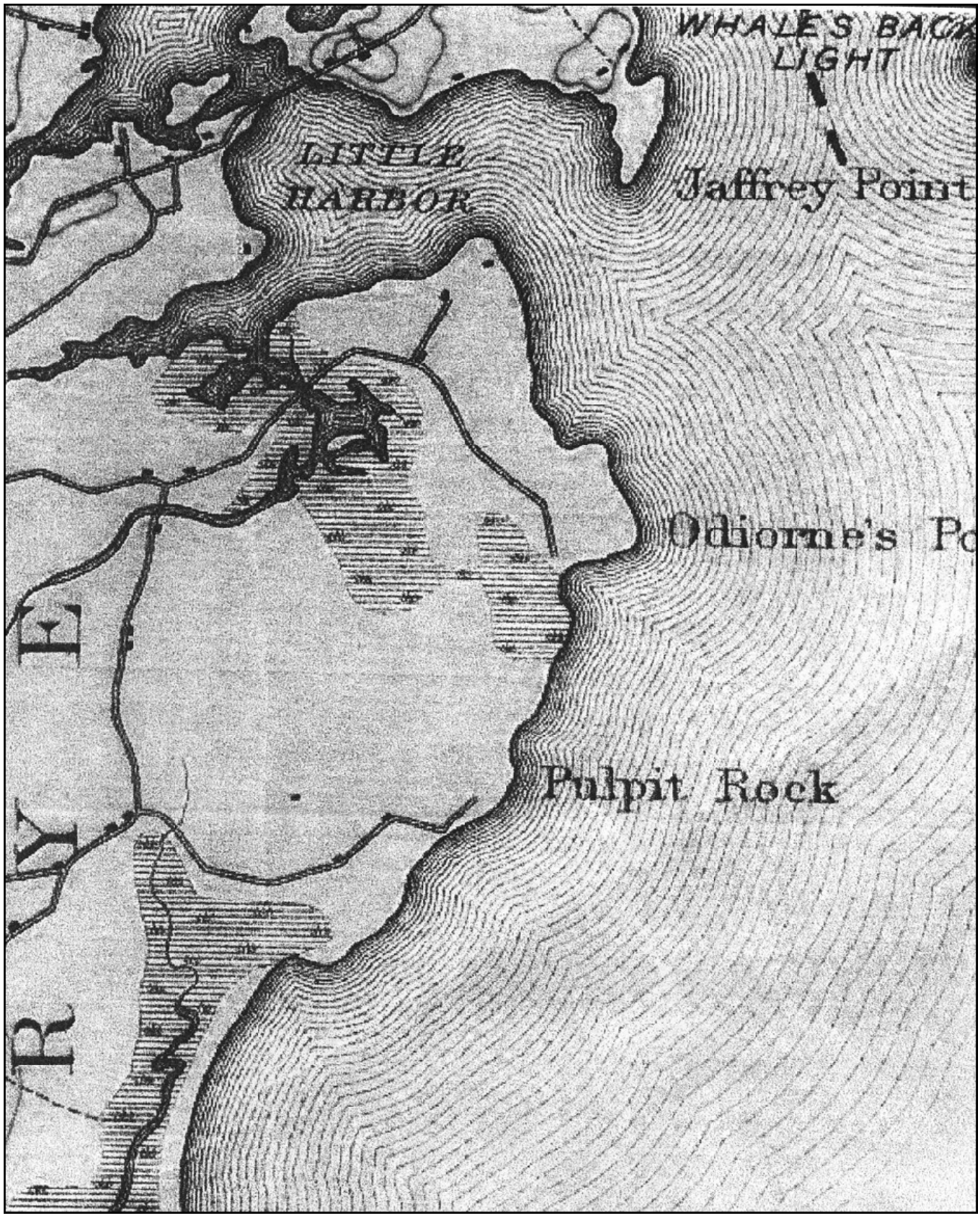


Figure C.6 *USGS topographic map of Rye, Odiorne Point and Little Harbor in 1893. Note the granite spit constructed at Frost's Point is built just after this date. (USGS 15' Series, York Quadrangle)*

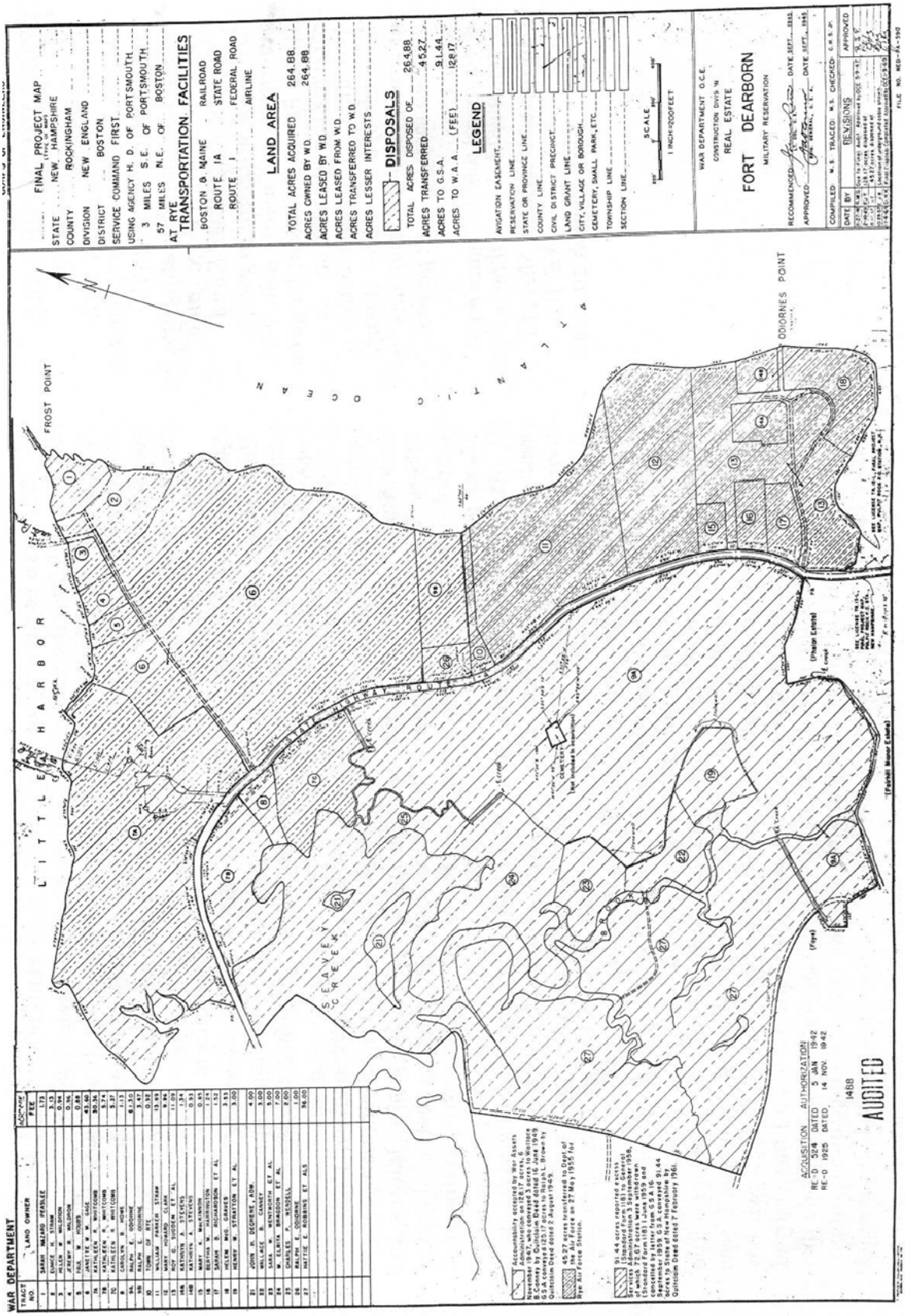


Figure C.7. *Plan view of Real Estate holdings as compiled by the construction division of the War Department O.C.E. for Fort Dearborn Military Reservation. Note parcel key in upper left designates owners and disposals. (After Mawson 1992 p. 15)*

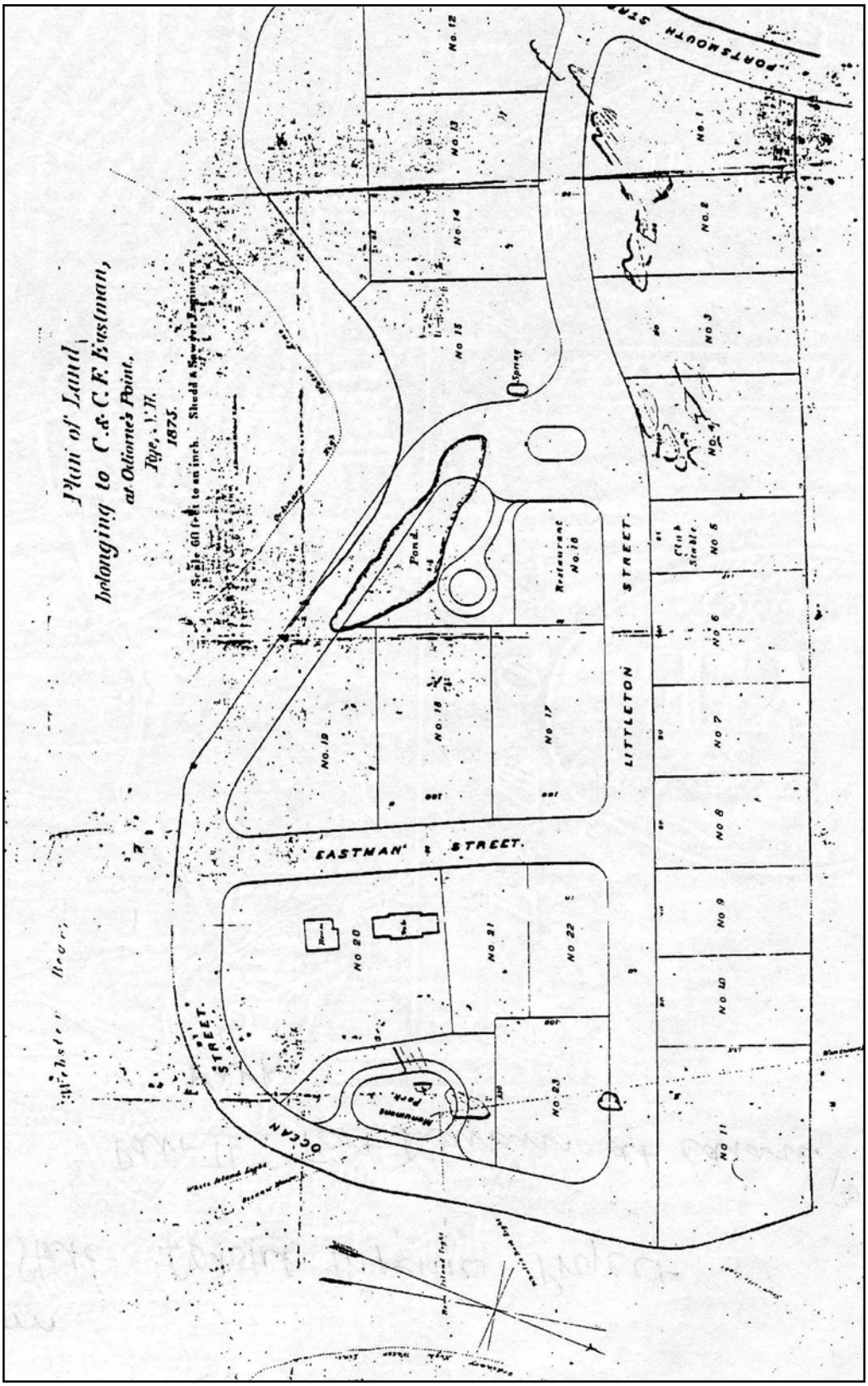


Figure C.8. *Plan view map of proposed development of land "belonging to "C. & C.F. Eastman at Odiorne's Point, Rye, NH, 1875". Drafted by Shedd S. Sanger, Engineer. (Courtesy of NHDHR on file at NHHS as HM3)*

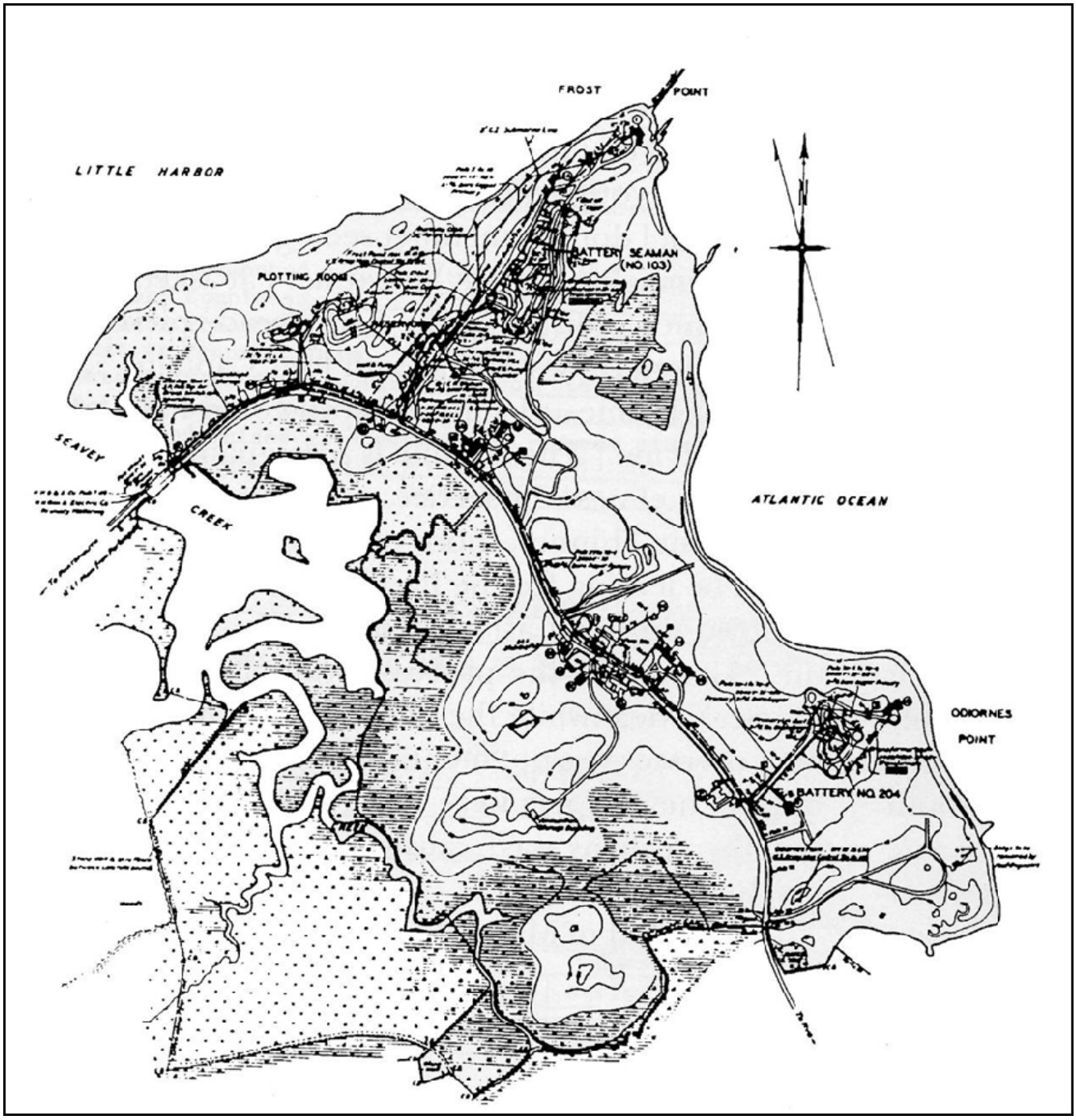


Figure C.9. *Plan view map from the War Department shows Battery Seaman and Battery 204. The TNT Building west of present Route 1A and south of the Odiorne Homestead is shown. (After Wysong 1997, p. 65, upper)*

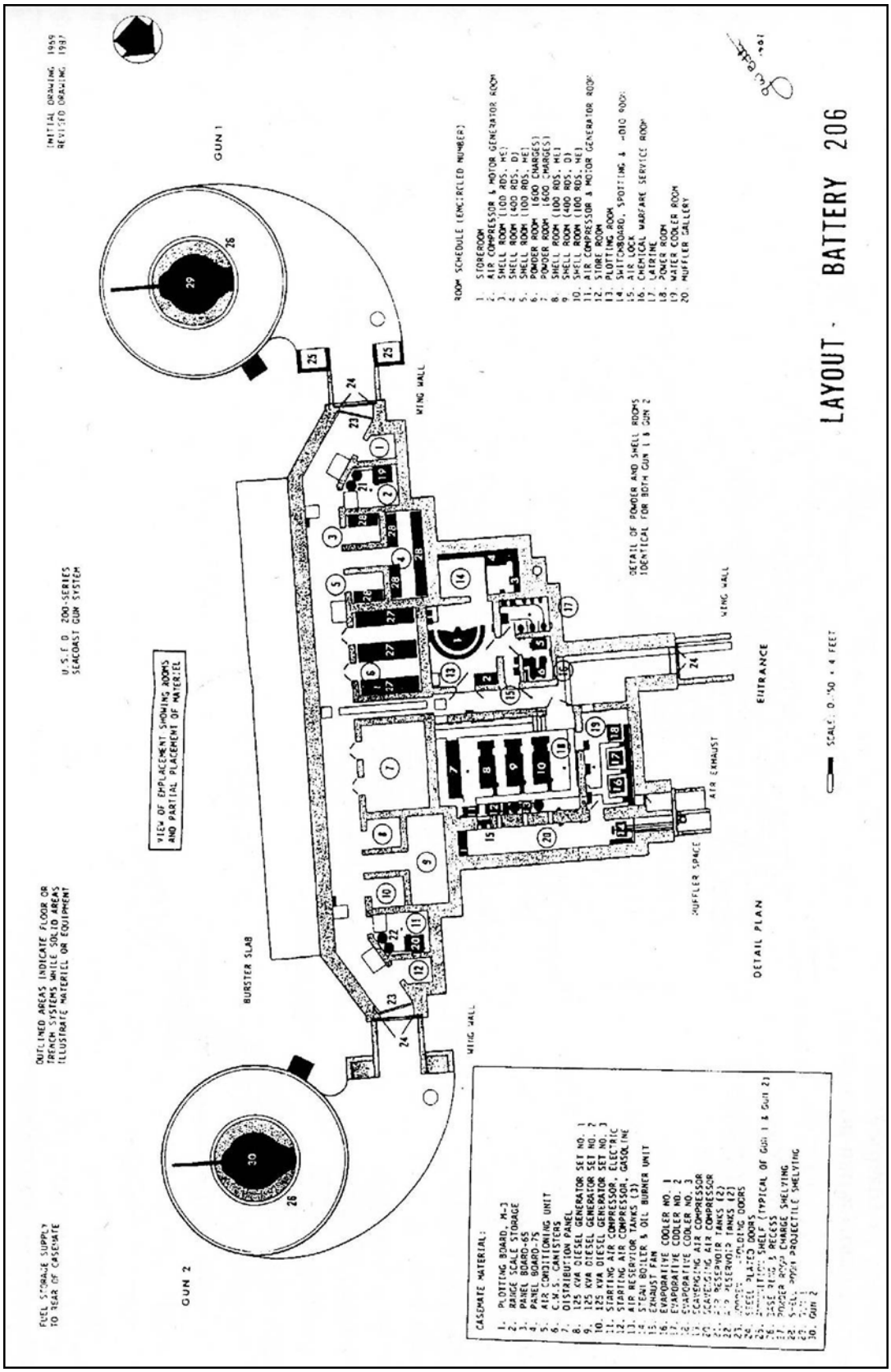


Figure C.10. *Plan view of map from the War Department of Battery 206 shows a similar setup as Seamans Battery with central structure and two guns located at each end. (After Wysong 1997, p. 66)*

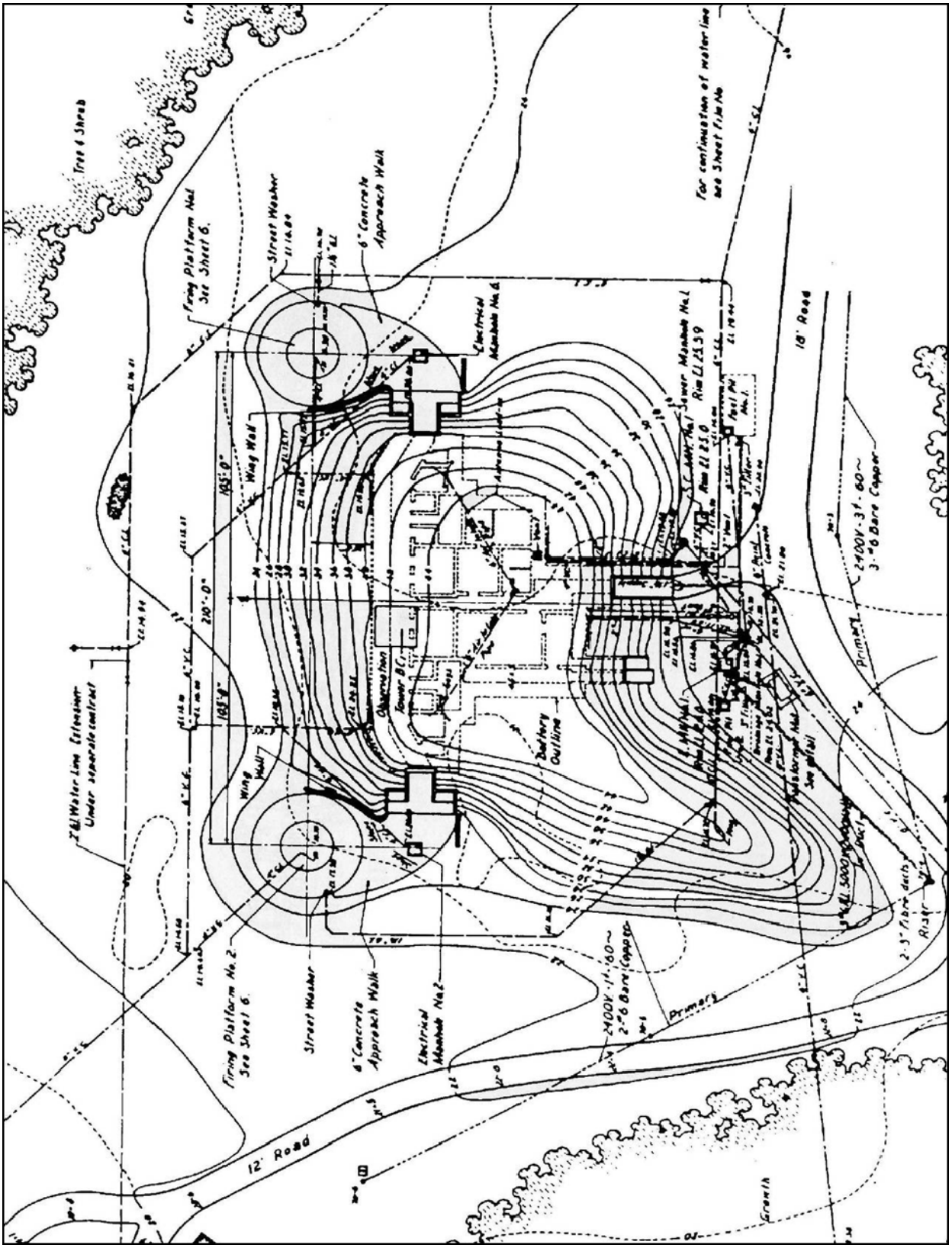


Figure C.11. *Plan view map from the War Department of Battery 204. This feature is just north of the public entrance and parking lot to Odiorne Point State Park. (After Wysong 1997, p. 65, lower)*

Appendix D– Invasive Plant Survey Forms

Figure D.1. *Invasive Plant Survey Data Collection Sheet.*

Odiorne Point State Park Inventory Invasive Species Mapping Form 2009

Name(s)/ Affiliation:_____
Date (dd/mm/yyyy):_____ **Time:**_____
Survey Start GPS Location: UTM N_____ **UTM E**_____ **Survey End GPS Location: UTM N**_____ **UTM E**_____
Survey Type (circle one): Random Transect 10x10m plot **Width of transects:**_____
Field Number and Site Description:_____
GPS ID:_____

Field # - Waypoint Name (e.g. 17-1)	Waypoint (WP) Multiple WP (MWP)	Species Code	Phenology (plant stage)	Abundance	Distribution	Disturbance	Vegetation	Area (sq ft)	% Cover	Comments

Documented Invasive Species in Odiorne

ELUM	Autumn Olive	*Elaeagnus umbellata*	**LOMO2**	Morrow's Honeysuckle	*Lonicera morrowii*
CYLO11	Black Swallow-Wort	*Cynanchum nigrum*	**ROMU**	Multiflora Rose	*Rosa multiflora*
LIOB	Blunt-Leaved Privet	*Ligustrum obtusifolium*	**ACPL**	Norway Maple	*Acer platanoides*
PHAU7	Common Reed	*Phragmites australis*	**CEOR7**	Oriental/Asiatic Bittersweet	*Celastrus orbiculatus*
BEVU	European Barberry	*Berberis vulgaris*	**LELA2**	Perennial Pepperweed	*Lepidium latifolium*
FRAL4	Glossy Buckthorn	*Rhamnus frangula*	**LYSA2**	Purple loosestrife	*Lythrum salicaria*
BETH	Japanese Barberry	*Berberis thunbergii*	**LOBE**	Showy Bush Honeysuckle	*Lonicera x bella*
LOJA	Japanese Honeysuckle	*Lonicera japonica*	**AIAL**	Tree of Heaven	*Ailanthus altissima*
POCU6	Japanese Knotweed	*Polgonum cuspidatum (Fallopia japonica)*			

Figure D.2. *Invasive Plant Survey "Cheat Sheet".*

Phenology/Stage	Vegetation	% Cover
V = Vegetative	**1.** EDGE:Upland/wetland	*(Mid value/Range*)*
BD = Bud	**2.** EDGE: Field/forest	**1.** <1%
D = Dead/Skeleton	**3.** EDGE: Lake edge	**5.** 1-10%
FR = Fruiting	**4.** EDGE:Roadside	**18.** 11-25%
FL = Flowering	**5.** FOREST: Aspen/birch	**38.** 26-50%
S = Seedling	**6.** FOREST: White pine	**75.** 51-100%
Abundance Codes	**7.** FOREST: Oak/pine	**NH Invasive Plants (Not yet documented at OPSP)**
1. Single plant	**8.** FOREST: Oak	**ALPE4** *Alliaria petiolata* Garlic Mustard
2. < 20 plants*	**9.** FOREST: Floodplain	**CESTM** *Centaurea biebersteinii* Spotted knapweed
3. 21-99 plants	**10.** FOREST: N. hardwood	**CYRO8** *Cynanchum rossicum* Pale Swallow-Wort
4. 100-999 plants	**11.** FOREST: Upland red maple	**EUAL13** *Euonymus alatus* Burning Bush
5. > 1,000 plants	**12.** FOREST: Oak/hickory	**HEMA17** *Heracleum mantegazzianum* Giant Hogweed
Distribution	**13.** FOREST: Pitch pine	**HEMA3** *Hesperis matronalis* Dame's Rocket
I = Isolated	**14.** FOREST: Hemlock	**IRPS** *Iris pseudacorus* Yellow-Flag Iris
L = Linear	**15.** FOREST: Spruce/fir	**LOTA** *Lonicera tatarica* Tatarian Honeysuckle
M = Monoculture	**16.** WTLND: Herbaceous marsh	**MIVI** *Microstegium vimineum* Japanese stilt grass
S = Satellite	**17.** WTLND: Bog	**POPE10** *Polygonum perfoliatum* Mile-a-Minute Vine
U = Uniform	**18:** WTLND: Fen	**Other species to document while surveying**
O = Other	**19.** WTLND: Shrub wetland	*Rhus radicans* Poison Ivy
Disturbance	**20.** WTLND: Cedar swamp	*Rosa rugosa* Rugosa Rose
AG = Agriculture	**21.** WTLND: Red maple swamp	*Rhus typhina* Staghorn Sumac
BV = Beaver	**22.** WTLND: Salt marsh	*Typha angustifolia* Narrow-leaved cattail
CH = Cellar Hole	**23.** MISC: Dune	
FL = Flooding	**24.** MISC: Open Field	
M = Mowing	**25.** MISC: Old Field	
RS = Residential Dev.	**26.** MISC: Stream bank	
	27. MISC: Yard/garden	
RD = Road	**28.** MISC: Agriculture field	
SW = Stonewall	**29.** MISC: Right-of-way	
TR = Trails	**30.** MISC: Rocky outcrops	
OH = Other (human)	**31.** MISC: Beach	
ON = Other (natural)	**32.** MISC: Rocky coast	
N = None	**33.** MISC: Abandoned houselot	

** For < 20 plants document the actual # of plants*

Survey Data Collection (Filling in the Datasheet)

Data entry will include the use of the field datasheet for Odiorne Point (see Attachment A) and entry of invasive plant occurrences into a handheld GPS unit (see Attachment B for GPS Basics). Key data collected for this survey is based on The Nature Conservancy's Weed Information Management System (WIMS). The datasheet, including "cheatsheet" for codes, is located in Appendix C. Begin by filling in the top of the datasheet for each parcel you survey. Fill in the data sheet to the best of your ability, and submit it to FB Environmental for mapping.

Site Description

This section is intended to help identify who conducted the survey, and when and where the invasive plant population is located. This section is very important for repeat surveys, and to organize the data, so fill out all the fields. The "Time" and the "Survey Start GPS Location" fields are especially important. These are the only links between the information on the datasheet and the GPS data. The best time to fill in some of the information is before you leave home. Once you've decided to conduct a survey, fill in your name, and the survey date and location on a few datasheets before you head out.

1 – Note **WHO** is conducting the survey, with full names and affiliation.
2 – Note the **DATE** of the survey using the day, month, year format.
3 – It is important to note the **TIME** of the start of the survey, as this will help match up the GPS data. The GPS automatically collects a date and time field, so this is an additional check for matching files.
4 – At the start of your survey, you will mark a waypoint using your GPS unit, and you will record the Northing (UTM N) and Easting (UTM E) coordinates in the **SURVEY START GPS LOCATION** field. To mark a waypoint, see GPS methods detailed in Appendix B.
5 – Easting (UTM E) coordinate for survey start location.
6- Record the type of survey as either random or transect, and estimate the width of transects used.
7 – On the data sheet under the **SITE DESCRIPTION**, identify the location of the survey (e.g. Field 17).
8- Document the type of **DISTURBANCE** using the Disturbance Codes on the "cheatsheet".
9- Record the type of **VEGETATION** that is representative of the area of the invasive population using the Habitat Code on the "cheatsheet".
10 – If you are using a GPS unit borrowed from FB Environmental, enter the **GPS ID** onto the field sheet.
This step is essential to ensure the proper GPS data is recorded with the correct unit at the time of download. To review how to mark a waypoint and check your GPS settings, see Appendix B.

Name(s)/Affiliation: _____1_____
Date (dd/mm/yyyy): _____2_____ Time: _____3_____
Survey Start GPS Location: UTM N_____4_____ UTM E_____5_____
Survey Type (Random or Transect): _____6_____width_____
Site Description (as specific as possible): _____7_____
Disturbance: _____8_____ Vegetation:_____ 9_____
GPS ID: _____10_____

Plant Checklist

This section contains the actual species found (**SPECIES CODE**), whether they are in flower, fruit or seed (**PHENOLOGY**), approximations of how many plants there are at the site (**ABUNDANCE**), and their **DISTRIBUTION**. In order to describe the population's "Flower Stage" or "Fruit Stage", more that 50% of the plants must meet the qualifications described on the "cheatsheet". If the invasive species appears to be diseased or have insect damage, please note this as there may be a pest that has developed an appetite for the species. It is very important to know this.

NOTE: You must use the field codes provided on the "cheatsheet" to complete the table. The "cheatsheet" is on the back of the datasheet.

11 – Record the **WAYPOINT NAME**. Assign a name to the waypoints using the GPS using the field # from your survey map followed by a unique number for each point (e.g. Field 17-1, 17-2, etc). If using multiple waypoints to document a large population use a numbering/letter system (e.g. Field 17-1a, 17-1b, etc.). You must record the waypoint names on the datasheet to ensure that the proper GPS data is recorded with the correct unit at download.
12 – At each stop, identify the invasive plant species observed at that site by selecting the **SPECIES CODE**. The common names for the codes are provided in a "cheatsheet" on the datasheet. If more than one species is observed, note this and record the names. Each plant species requires its own GPS CODE.
13 – Document the **NUMBER OF PLANTS** if there are less than 20 plants.
If there are more than 20 plants, estimate the number of plants present, and assign a category from the "cheatsheet".
14- Estimate the **AREA** in square feet. This is especially important if taking a single waypoint. If creating a polygon using multiple waypoints or using the GPS tracking feature, the GPS will calculate the area automatically.
15-Estimate the approximate **% COVER** of the invasive plants within the designated area using the midvalue of each cover class in the "cheatsheet".
16- Write down any additional **COMMENTS** including the presence of saplings or rhizomes, directions of spread, anything observed eating or dispersing the seeds, or general comments about the population.

NOTE ON PHOTOGRAPHS: If you have a digital camera with you, it would be helpful to photograph the invasive plant populations you survey. To do this, take the photograph from the same point you collected the waypoint (WAYPOINT NAME). Indicate if this is in the center or edge of the population. Indicate the photo point on your site map. To determine the photo direction, use the compass on the GPS, or compass. You may know the photo direction based on the direction of the road (e.g. facing west). If you cannot take a photograph from the waypoint location, describe where you did take the photo from (for the purpose of re-photographing in future years). Be sure to record your photo sequence on the datasheet so that each photo can be associated with a specific plant, or GPS waypoint.

Important Datasheet Notes

At the end of your survey, check the following:
- Make sure the Start GPS Location and End GPS Location are filled in.
- Make sure you've documented the survey date and start time.
- Be sure to specify whether you surveyed using random sampling, or transects, and width of transects.

If you don't see any invasive plants while conducting your survey, please complete a datasheet (be sure to include the route you traveled) and submit it. This will allow us to know the area has been checked and no species were observed. Information about where invasive species are not present is as important as information about where invasive species are present! Make sure all fields are either filled in or crossed out to indicate the information was not applicable.