MASSACHUSETTS DIVISION OF FISHERIES AND WILDLIFE
NEW ENGLAND COTTONTAIL HABITAT RESTORATION
DAVID SCARPITTI – UPLAND GAME PROJECT LEADER

PROPERTY NAME:	Mashpee Pine Barrens
TOWN/COUNTY:	Mashpee/Barnstable
DFW WILDLFIE DISTRICT:	Southeast
TREATEMENT ACREAGE:	up to 75 acres
TREATMENT TYPE(S):	mechanical tree shearing, mowing

PROJECT SUMMARY

Over the past several decades, the distribution and abundance of New England cottontail (*Sylvilagus transitionalis*) has been in decline, consequently New England cottontail (NEC) has been designated as a species in Greatest Conservation Need in the Massachusetts Division of Fisheries and Wildlife (MDFW) Comprehensive Wildlife Conservation Strategy (CWCS), and also designated as a candidate for federal Endangered Species Act listing. The decline of NEC is attributed to widespread reduction of suitable habitat, particularly early seral habitats such as young regenerating forest and other thicket habitats. The widespread decline of early seral habitats is directly attributed human induced changes on the landscape. For example, fire suppression has changed the composition and structure of forest and thicket habitats used by NEC and numerous other species in conservation need. Further, modern housing and industrial development, and the subsequent loss and fragmentation of habitats have greatly reduced the amount of suitable habitat for NEC. To specifically address these habitat declines across the region, the New England Cottontail Initiative was developed through a State Wildlife Grant funded program; the goals of which are to pre-empt federal listing through the creation and maintenance suitable early seral habitats rangewide, and to develop a coordinated, structured conservation strategy.

To address habitat decline and NEC restoration at the Mashpee Pine Barrens, a section of the Mashpee National Wildlife Refuge, active habitat management is proposed to improve the structure and composition of forested areas. This will encompass a variety of techniques including mechanical tree shearing, brush mowing, and potentially prescribed burning on lands owned by the Division of Fisheries and Wildlife, the Town of Mashpee, and tribal lands of the Wampanoag. Prescribed burning activities may be employed following mechanical vegetation management at some point in the future. All aspects of the habitat management efforts are consistent with the mission of MDFW; to conserve and enhance biodiversity statewide.

1.0 INTRODUCTION

The New England cottontail is the only cottontail species native to the northeast, but in the past several decades NEC have experienced significant declines in distribution and abundance across their range. Population decline of NEC are largely attributed to change and decline of suitable early successional habitat across the region. Early successional habitats used by NEC include old fields, shrublands, young forest (<30 years old), and other areas consisting of dense, thick brush and shrub vegetation. As a result of these declines, NEC have been identified as a Species of Greatest Conservation Need in the MDFW CWCS, and are identified as a candidate for Federal Endangered Species Act listing.

Historically, NEC occupied available habitats from eastern New York through central Vermont and New Hampshire, to southern Maine and throughout Massachusetts, Connecticut, and Rhode Island (Fig. 1). They were present in all 14 counties of Massachusetts up until around 1920 when eastern cottontail (*Sylvilagus floridanus*), a species very similar in appearance and habits to New England cottontails, were imported from the midwest and widely introduced statewide. Currently, New England cottontail range has been greatly reduced over the past several decades due to widespread changes in land use and composition across the region.

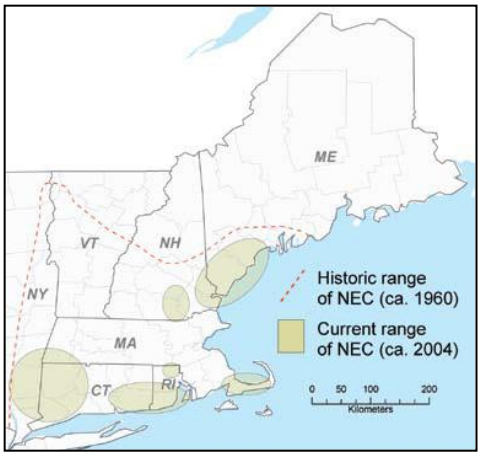

Figure 1. Historical and approximate current distribution of New England cottontail.

NEC are now known to occur only in areas of southern Plymouth County, across Barnstable County, and in isolated portions of southern Berkshire County (Fig. 1). One of the major factors contributing to the decline of early successional habitats across New England has been the human induced alteration of natural disturbance regimes that historically created and maintained areas of grassland, shrub, and young forest habitats required by NEC. For example, wildfire was once a prominent natural disturbance factor in coastal pitch-pine/scrub oak ecosystems of southeastern Massachusetts. Decades of fire suppression have changed the structure and composition of these habitats to the detriment of species associated with early seral conditions. Further, development throughout southern New England has resulted in significant loss of habitat, or greatly hampered the ability of both plants and animals to colonize newly created early successional patches as a result of fragmentation. In addition, most development has occurred in areas that were more prone to natural disturbances, such as coastal areas and riparian corridors. As a consequence of these altered natural disturbance patterns and habitat loss, active habitat management through mechanical mowing and cutting, prescribed burning, treatment of invasive species, and other similar activities is necessary to maintain the biodiversity of habitats and the species dependent on them.

In response to the decline of NEC and in light of current habitat conditions and trends, the USFWS determined that federal listing under the Endangered Species Act was warranted and NEC was subsequently identified as a Candidate Species, having the highest listing priority in the USFWS Region 5. Subsequently, a variety of regional initiatives and funding opportunities are working to help reverse the decline of New England cottontails by increasing the amount of

suitable early successional habitats across their range. Specifically, Massachusetts is part of a multi-state effort across New England and New York to manage and create nearly 500 acres of suitable early successional habitats on public land and approximately 700 acres on private lands to increase rabbit populations and decrease their listing priority; an effort known as the New England Cottontail Initiative. In Massachusetts, these efforts are being coordinated by the MDFW in conjunction with the USFWS and a variety of other state, federal, tribal and private agencies and stakeholders. Concerned landowners, government agencies and nonprofits must work together to restore the landscape's connectivity, biodiversity, and value for early successional wildlife. It is critical that wildlife and natural resource managers are proactive in recovery efforts, before New England cottontail populations decline further. This site plan and corresponding proposed management prescriptions are directly targeted towards habitat restoration to benefit NEC and other species associated with pitch pine/scrub oak ecosystems (Table 1).

2.0 PROPERTY DESCRIPTION/HISTORY

2.1 Property Location

The Mashpee Pine Barrens (MPB) are located in southeastern Massachusetts, in the Town of Mashpee on Cape Cod. MPB also exists as part of the Mashpee New England Cottontail Focus Area by the NEC Technical Committee and also are part of the Mashpee National Wildlife Refuge (Fig. 2). The Mashpee Pine Barrens (MPB) is a collection of properties owned by MDFW, the Town of Mashpee, Mashpee Wampanoag Tribal Nation, and The Nature Conservancy encompassing over 400 acres of pitch pine/scrub oak barrens, oak forest, and Atlantic white cedar swamp habitats. MPB occurs west of Great Neck Road, East of U.S. Route 28, and north of Red Brook Road; Great Hay Road, an unimproved dirt road, bisects MPB (Fig. 3).

2.2 Land-use history

Historically, the lands within and surrounding MPB were used and managed by the Wampanoag tribes for thousands of years, currently the Mashpee Wampanoag Tribal Nation owns property to the east of Great Hay Road and north of Holland Mills Road.

2.3 Existing conditions

The MPB contains a large expanse of pitch pine (*Pinus rigida*) and scrub oak (*Quercus ilicifolia*) (PPSO) barrens habitat. PPSO habitats are unique forest types that support a high diversity of rare plant and wildlife species (see Attachment A). Areas of xeric oak forest, dominated by white oak (*Quercus alba*) overstory and Ericacious (e.g., blueberry, huckleberry) understory vegetation are also found throughout the MPB. Currently, NEC are known to occupy areas in and around Holland Mills Road, as well as the sympatric eastern cottontail.

Historically, frequent natural and human disturbances of the PPSO habitats had created extensive dense shrubby patches with relatively thin overstory canopy conditions (i.e., oak/pine savannah habitat), habitats highly suitable for NEC. However, over time these natural and human induced disturbances have been largely eliminated, thus plant succession is gradually reducing habitat

quality for NEC, and threatening the persistence of numerous species that require these types of thicket, brushy habitats. Moreover, fire suppression in these habitat types has ultimately had the opposite effect, where dangerously high fire risk exists as fuel loads (tree and shrub material) builds up over time. PPSO communities are well adapted to frequent disturbance, rapidly regenerating provided dense thick cover. Consequently, active management is necessary to maintain these habitats on the landscape for NEC and other rare and protected species.

2.4 Natural resources

The MPB lies within the borders of the Mashpee National Wildlife Refuge, where a variety of upland and wetland habitats exist that support a diverse variety of wildlife species. It is the goal of MassWildlife to conserve, protect, and manage the biodiversity of Massachusetts.

2.4.1 Wetland resources

Wetland resource areas are scattered throughout the MPB, and primarily consist of Atlantic White cedar swamps that are considered rare across the region, and other associated shrub swamps. No certified vernal pools are documented by the MDFW Natural Heritage and Endangered Species Program (NHESP). Soils are consistently well to very well drained, resulting in little surface water.

2.4.2 Rare/NHESP protected species

The presence of rare and protected species has been documented across a significant portion of the MPB (see Section 4.3). Management activities proposed by MDFW, including vegetation management and/or any prescribed burning, are intended to provide a benefit to the many rare and protected species (i.e., species of Greatest Conservation Need, GCN) of wildlife associated with PPSO habitats (Table 1). The dense shrub layer understory created through the proposed management actions will provide a large area of unfragmented early successional habitat suitable for NEC and numerous other game and non-game species.

2.4.3 Biomonitoring

Mashpee National Wildlife Refuge and Mashpee Wampanoag staff are currently working to further identify the distribution and habitat use of NEC across the Mashpee National Wildlife Refuge, and have identified New England cottontail on portions of the MPB. Their goal is to document home range and movement characteristics of NEC in PPSO barrens habitat.

In addition, MDFW will employ vegetation surveys prior to proposed habitat management treatments to assess the baseline vegetation characteristics and density. Following completion of management activities, additional monitoring for NEC, stem density, and other vertebrate and invertebrate species will be conducted to evaluate the restoration efforts. Analysis of other biomonitoring efforts (e.g., breeding bird and invertebrate surveys) will provide useful inference to further investigate the effects of habitat management on PPSO barrens habitat restoration.

2.5 Historical/cultural resources

It is the goal of DFW to preserve and protect cultural resources in accordance with all state and federal regulations. Massachusetts Historical Commission has reviewed proposed project plans and determined there will be no significant impact to historical and cultural resources, but

suggested further consultation with the Wampanoag tribe. Additional consultation with the Mashpee Wampanoag has been initiated, and any comments or modifications to the proposed project activities will be reflected as necessary in an updated Site Plan. In addition to management activities on state and town owned lands identified in this plan, similar and complimentary management activities are proposed on Mashpee Wampanoag lands north of Holland Mills Road and east of Great Hay Road.

2.6 Recreation

Passive recreational activities are the dominant activity at the MPB, in addition to hunting, fishing, trapping, hiking, bird watching, and other forms of recreation by the general public. No motorized vehicles are allowed on roads or trails throughout the MPB, except for Great Hay Road and the western section of Holland Mills Road, both of which are unimproved dirt roads.

3.0 PROJECT DESCRIPTION/ACTIVITIES

The primary goals associated with the prescribed management activities at the MPB is to improve habitat quality and longevity for NEC, and other species associated with early successional shrub habitat, specifically pitch pine/scrub oak (PPSO) ecosystems and to reduce wildlife hazard to abutting residential properties in that region. Ecological restoration of PPSO forest habitat, development of a dense shrub understory, and improved in habitat conditions for NEC and numerous Species of Greatest Conservation Need, and other protected and/or rare species are the expected outcomes from these prescribed management activities. Proposed habitat treatments strike a balance between preservation of existing habitat where suitable habitat exists and NEC are documented, and enhancement and restoration of other large patches of habitat to secure suitable habitat for NEC and other PPSO associated species (Table 1) into the future.

3.1 Description of habitat management treatments

Proposed habitat treatments are designed to mimic natural disturbance and cultural land management techniques that would have created thin canopied, savannah-like forest with areas of dense shrub understory. Historically, this was largely accomplished through natural and aboriginal wildfire, but also included disturbance associated with infrequent hurricanes, and more commonly large coastal storms. Also, proposed habitat treatments will reduce the wildfire hazard to surrounding residential communities, and facilitate future prescribed burning operations.

Management activities will be conducted primarily on land owned by MDFW, with a small amount scheduled on land controlled by the Town of Mashpee, and additional potential to facilitate proposed habitat management operations occurring on lands owned by the Mashpee Wampanoag Tribe (MWT) (Fig 4). Approximately 30-75 acres will be initially targeted on state and town land, with the exact amount to be contingent on funding levels across 3 treatment units (Units A-C) (Fig. 5). Approximately 40 acres of habitat treatments are scheduled as part of the

Wildlife Habitat Incentive Program grant on MWT lands. Habitat restoration activities will include mowing and mulching of smaller trees and shrubs (<4" dbh) for fire breaks and within some forested areas with expansive scrub oak understory, and cutting/removal of larger trees (5-14" dbh). Additional efforts may include prescribed burning and invasive plant species treatment, at some point in the future.

The primary goal of habitat management activities at MPB is to reduce the overhead canopy cover of oak and pitch pine, thereby improving the density and vigor of understory shrubs such as scrub oak. In Units A-C and on the MWT lands designated in the WHIP grant (northeast of Holland Mills/Great Hay intersection), overstory tree canopy cover will be reduced by approximately 50-75%. Retention trees will consist of larger oaks (>5-6" dbh) but will include some mature pitch pine and other species (e.g., maple, birch) where possible. Trees <5-6" dbh will be cut and removed from the site; trees may be chipped at a designated landing or removed whole. Retention trees will be marked prior to project implementation; in some areas clusters of trees will be retained. Tree harvesting activities will be conducted under an approved Chapter 132 Forest Cutting Plan. Operations are scheduled to occur when conditions dictate from winter 2012-2013.

In addition to overstory removal, portions of the scrub oak understory in Units A and C will be mowed in advance of overstory tree clearing; understory mowing is not scheduled in Unit B (Fig. 5). Because some small amount of understory mowing will occur within wetland resource area buffers, plans will be filed with the Town of Mashpee Conservation Commission to address these jurisdictional resources. Understory mowing in these Units will remove senescent vegetation, and stimulate the dense regeneration of young, fast growing stump sprouts, suckers, and saplings creating a healthy vigorous shrub thicket. Mowing areas with thick but older senescent vegetation will also reduced the fuel load and consequently, reduce the wildfire risk.

To further support the potential for prescribed burning practices in the future and to continue to reduce fire hazard in the area overall, fire breaks approximately 50-100 feet wide (~6 meters) will be established along Great Hay Road and Holland Mills Road in and around the treatment units (Fig. 5). This mowing will occur on lands owned by the MDFW, Town of Mashpee, and MWT. Within these mowed fire breaks, all understory shrubs and trees <2-3" dbh will be cut/mowed and mulched to within 2" of the ground. All larger trees greater than 4-5" dbh will be **retained**. The proposed firebreak treatments are designed to greatly reduce the shrub ladder fuels while retaining significant tree overstory, thereby maintaining a higher moisture level in the fuels and leaf litter which will enhance the firebreak quality and safety, and aid in potential future prescribed burning operations.

All mechanical operations will be conducted with strict adherence to conditions imposed by any and all regulating entities, such as Natural Heritage and Endangered Species Program or through Chapter 131 wetlands regulations. Further, Massachusetts Forestry Best Management practices will be employed to minimize the impact of equipment on the natural resources onsite. No equipment will operate in wetland resource areas, and no wetland crossings are anticipated. Soil disturbance will be minimal as operations will be limited to firm or frozen ground conditions. Mechanical equipment used will generally exert minimal ground pressure to mitigate soil compaction and disturbance.

In addition to habitat management treatments, some minor road surface improvements may be necessary for equipment to access the treatment areas. Typically, this entails enhancing the road surface with the addition of gravel or mulch fill to improve the road surface and traction where loose powdery sand exists, or where large potholes have formed. The intersection of Holland Mills Road and Great Hay Road may need to be expanded to allow traffic to enter, turn around/back in, and exit with the removed pulpwood material. Road surface/access improvements will be discussed with the Mashpee Wampanoag Tribe as well as the Town of Mashpee.

Overall, the desired future condition in the treatment units is to increase shrub layer density, diversity, and vigor of scrub oak, other native shrubs, and sapling trees, while improving the ability to employ prescribed burning as a management tool. As a whole, these management activities will also greatly reduce the wildfire hazard for the numerous residential developments that occur within this area.

Research has indicated that NEC are most productive in habitats providing at least 20,000 stems/per acre, and the surge of nutrients and resources found following these habitat manipulations will greatly improve shrub density over the next 5-10 years. Management activities will result in an PPSO barrens type habitat with a dense shrub understory consisting of pitch pine, scrub oak, and other native shrub and herbaceous species. In the future, additional units across the MPB will be converted to the oak/pine savannah-forest habitat.

4.0 REGULATORY COMPLIANCE/ENVIROMENTAL PERMITTING

Prior to the initiation of any operation, MDFW will ensure that all required regulatory compliance and/or environmental permitting are addressed. In addition, a public site walk and/or meetings will be held in advance of any treatments to allow for public input. Minor project modifications may occur in light of regulatory review and through public comment.

4.1 Chapter 132 Forest Cutting Practices Act

Tree clearing activities in Units A-C (and potential MWT acreage) will be implemented under a Chapter 132 Forest Cutting Plan. Plans will be filed with the appropriate Department of Conservation and Recreation service forester prior to implementation. No tree clearing is scheduled to occur within any wetland resource area. Details regarding conservation of wetland habitats associated with the tree clearing operations will be included within the Forest Cutting Plan. Massachusetts Forestry Best Management Practices (BMP's) will be employed during all tree harvesting activities. **(Attachment B – Chapter 132 Forest Cutting Plan**)

4.2 Chapter 131 Wetlands Protection Act

Understory and firebreak shrub mowing is scheduled to occur in 2.64 ac (115,216.2 sq ft) of wetland resource buffer zones (41.3 ac of shrub mowing total) (see Fig. 5). Consequently, plans will be filed with the Town of Mashpee Conservation Commission, and any subsequent mowing

activities will adhere to their recommendations. Massachusetts Forestry Best Management Practices (BMP's) will also be employed during mowing activities. Wetland boundaries will be flagged prior to project initiation. Proposed project activities that involve tree clearing will be conducted under a Chapter 132 Forest Cutting plan, which will consequently address conservation of wetland resources areas. No cutting of any kind is currently proposed in any wetland resource area, nor are any wetland crossings anticipated. (**Attachment C1/C2: Town of Mashpee Wetland Filing)**

4.3 Massachusetts Endangered Species Act (MESA)

A significant portion of the MPB occurs within Priority Habitat, including areas scheduled for habitat management (Fig. 6). A copy of this site plan has been furnished to the NHESP for review. Further, NHESP will be able to address where proposed tree clearing aspects of the project occur within Priority Habitat via the Chapter 132 Forest Cutting Plan that will be submitted. Proposed project activities are intended to improve habitat conditions across a large portion of PPSO habitat at MPB, and consequently will likely benefit a large number of rare and protected species, and other species of Greatest Conservation Need (see Table 1). Consequently, a habitat management exemption under MESA is requested for proposed mowing and tree clearing activities. Additional conservation measures can and will be employed where necessary and if prescribed by NHESP. Although the majority of operations are scheduled from January-March, completion of all proposed project activities may necessitate operation in spring/summer months. (**Attachment D: NHESP review letter**).

4.4 USFWS Section 7, National Environmental Policy Act (NEPA)

Section 7 consultation as required under the USFWS Endangered Species Act (ESA) determined that no species listed under the federal ESA exist on the property. New England cottontail is identified as a Candidate Species under the federal ESA, however prescribed management activities developed in coordination with the USFWS are intended to benefit habitat for NEC and therefore will constitute a net benefit for this target species **(Attachment E and F: Section 7 and NEPA Checklist).**

4.5 Prescribed Burn Permits

Permits are required from the air quality staff of the Massachusetts Department of Environmental Protection's (DEP) regional offices to employ prescribed burning in Massachusetts. At this point prescribed burning is not scheduled as part of this plan. Any future prescribed burning activities will be in accordance with local and state regulations, and consistent with a site specific burn plan.

4.6 Massachusetts Historical Commission (MHC)

A project summary was filed with the Massachusetts Historical Commission for their review of historical and cultural resources (**Attachment G: MHC Project Notification Form**). The initial review conducted by MHC has indicated that the project is unlikely to affect significant historic and cultural resources, but consultation with the Mashpee Wampanoag Tribal nation was suggested. Consequently, project plans will be provided, and any additional comments or edits will be reflected prior to project initiation.

APPENDIX A:

Pitch Pine/Scrub Oak habitats: Selected excerpt from the Massachusetts Comprehensive Wildlife Conservation Strategy

Pitch Pine/Scrub Oak (PPSO) applies to a broad suite of closely related, highly dynamic vegetation communities best described as a continuum. There are an infinite number of combinations of scrub oaks, tree oaks, pitch pine, heaths, grasses and forbs all sharing some common denominators. PPSO comprises more than 100,000 acres of Massachusetts and serves as primary habitat for an extraordinary portion of protected Massachusetts animal populations. Only a small fraction of this acreage is receiving appropriate management and restoration actions, without which this suite of natural communities will inevitably disappear from the Commonwealth.

PPSO communities occur on coarse sandy substrates that drain rapidly or on ridgetops with exposed bedrock. PPSO communities are associated primarily with the glacial moraines and outwash plains of southeastern Massachusetts, but inland occurrences were not infrequent historically, especially those that developed on the large sandplains formed when periglacial rivers poured coarse sediments into glacial lakes, forming thick deltaic deposits. PPSO communities are all disturbance-dependent and influenced by periodic fire, ice storms, tropical storms, insect irruptions, salt spray, land use history, and combinations of these and other factors.

PPSO composition and architecture depends on the timing, frequency, severity, intensity, and types of disturbances to which it is exposed. Frequent disturbance produces a community dominated by low multi-stemmed scrub oak, with sparse emergent pitch pines, tree oaks with interspersed heath and grass patches, or a scrub oak savanna, for example. Due to the constant exposure to wind and annual ice storm events, a similar structure and composition is found on ridgetops in the western ecoregions of the state. Reduction in disturbance frequency and intensity results in a more closed-canopy structure, where tree oaks and pitch pine are dominant, though scrub oak, huckleberry and blueberry species, and occasional grass patches remain. Another phase in the continuum is composed of tree oaks over a shrub layer dominated by black huckleberry. Land use history, particularly logging, charcoaling, and agriculture, has had profound influences on PPSO systems. Recent studies have revealed that intense agricultural plowing often resulted in a community typified by a reduced diversity of ericads, under a dense canopy of pitch pine, with sparse scrub and tree oaks. Unplowed areas of PPSO support resprouting tree and scrub oak individuals, whose belowground components are hundreds of years old.

The most important feature of the PPSO continuum is that all the patches are important to maintaining a diversity of rare invertebrate populations and assemblages. Perhaps the simplest expression to convey the dynamism of PPSO communities is:

Disturbance diversity = Habitat heterogeneity = Diversity of plant and animal species.

Some phases of the PPSO continuum include patches of sparsely vegetated mineral soils resulting from severe wildfires that consumed all available organic matter. These patches are

important to some of our rarest invertebrates, but these conditions cannot be attained safely through the application of low-severity prescribed burns. Light soil scarification can provide a surrogate for severe burns, but must be done carefully.

Invariably, the PPSO systems formed on glacial deposits also support important aquifers supplying millions of gallons of freshwater to neighboring towns. This feature may serve to offset a generally negative public attitude toward PPSO systems.

Many rare Lepidoptera in Massachusetts depend on PPSO systems for habitat (Table 1). These moth and butterfly species are not each found in all types of pitch pine/scrub oak, but are often specialists on a microhabitat, such as frost barrens, river corridors, or late-successional stands. In addition, many of the caterpillars of these species eat only pitch pine, or only scrub oak, or specialize on other larval hosts found only or mostly in pitch pine/scrub oak communities. Thus, to maintain metapopulations of these species over time, in a habitat dependent on disturbance, it is necessary to maintain large areas of pitch pine/scrub oak systems, in various stages of recovery from various kinds and severity of disturbances.

A number of vertebrates also depend on pitch pine/scrub oak communities, probably because of the open habitat structure it provides, rather than requiring pitch pine or scrub oak for sustenance. Thus, such early-successional birds as prairie warbler, eastern towhee, and brown thrasher can be found in both PPSO and young forest/shrubland habitats. PPSO systems which are particularly open, such as frost barrens, can support state-listed birds, such as vesper sparrow and northern harrier.

Threats to Pitch Pine/ Scrub Oak

Threats to Pitch Pine/Scrub Oak communities include:

- The exclusion of fire from fire-dependent habitats;
- Development and fragmentation of PPSO areas;
- Groundwater contamination remediation activities;
- Introduction of non-specific biocontrol agents;
- Deer overpopulation, resulting in diminished food and nectar plants;
- Invasive exotic plants; and
- Habitat homogeneity.

Proposed Conservation Actions

Proposed actions aimed at conserving rare and uncommon PPSO species in the future include, assuming adequate funding:

- Determining Species Habitat Polygons for each current occurrence of a state-listed PPSO animal;
- Surveying for tiger beetles, moths, and butterflies associated with PPSO, in areas that have been under surveyed, to determine their range, abundance, and distribution in the state;
- Monitor sites that have been thoroughly surveyed in the past, to determine trends in populations of rare invertebrates;

- Protecting, managing and restoring PPSO areas (and buffer areas when appropriate) supporting populations of rare and uncommon animals, using prescribed fire in most cases;
- Regulating and limiting the impacts of development on PPSO areas used by state-listed animals;
- Researching the natural history of PPSO animals;
- Restoring populations of PPSO animals that were eliminated by insecticide spraying;
- Educating/informing the public about the values of PPSO habitats and the issues related to their conservation, through publications and other forms of public outreach.

Table 1. Species of Greatest Conservation Need (GCN) associated with pitch pine/scrub oak ecosystems.

Scientific Name	Common Name State	Status
Terrapene carolina	Eastern Box Turtle	SC
Circus cyaneus	Northern Harrier	T
Asio otus	Long-eared Owl	SC
Pooecetes gramineus	Vesper Sparrow	T
Cicindela patruela	Barrens Tiger Beetle	E
Nicrophorus americanus	American Burying Beetle	E
Abagrotis nefascia	Coastal Heathland Cutworm	SC
Acronicta albarufa	Barrens Daggermoth	T
Anisota stigma	Spiny Oakworm	SC
Apodrepanulatrix liberaria	New Jersey Tea Inchworm	E
Callophrys irus	Frosted Elfin	SC
Catocala herodias gerhardi	Gerhard's Underwing	SC
Chaetaglaea cerata	Waxed Sallow Moth	SC
Cicinnus melsheimeri	Melsheimer's Sack Bearer	T
Cingilia catenaria	Chain Dot Geometer	SC
Digrammia eremiata	Three-lined Angle Moth	T
Eacles imperialis	Imperial Moth	T
Erynnis persius persius	Persius Duskywing	E
Euchlaena madusaria	Sandplain Euchlaena	SC
Hemaris gracilis	Slender Clearwing Sphinx Moth	SC
Hemileuca maia	Barrens Buckmoth	SC
Hypomecis buchholzaria	Buchholz's Gray	E
Itame sp. 1	Pine Barrens Itame	SC
Lycia rachelae	Twilight Moth	E
Lycia ypsilon	Pine Barrens Lycia	T
Metarranthis apiciaria	Barrens Metarranthis	E
Psectraglaea carnosa	Pink Sallow Moth	SC
Ptichodis bistrigata	Southern Ptichodis	T
Stenoporpia polygrammaria	Faded Gray Geometer	T
Zale sp. 1	Pine Barrens Zale	SC
Zanclognatha martha	Pine Barrens Zanclognatha	T
NOT LISTED		
Coluber constrictor	Black Racer	
Heterodon platirhinos	Eastern Hognose Snake	
Caprimulgus vociferus	Whip-poor-will	
Colinus virginianus	Northern Bobwhite	
Dendroica discolor	Prairie Warbler	
Pipilo erythrophthalmus	Eastern Towhee	
Toxostoma rufum	Brown Thrasher	
Schizura apicalis	Plain Schizura	
Zale curema	No common name	

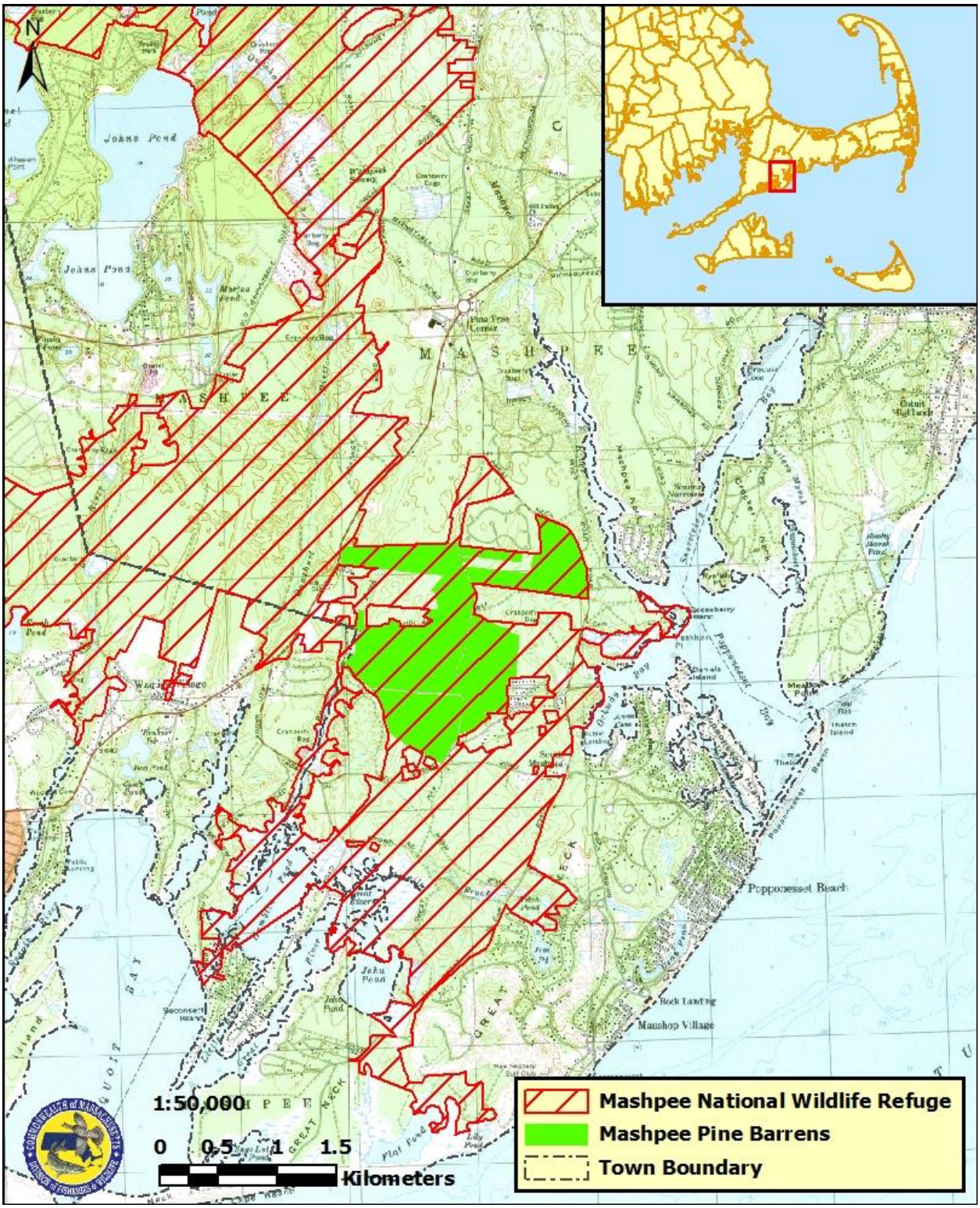

Figure 2. Location of Mashpee National Wildlife Refuge and Mashpee Pine Barrens, Mashpee, MA.

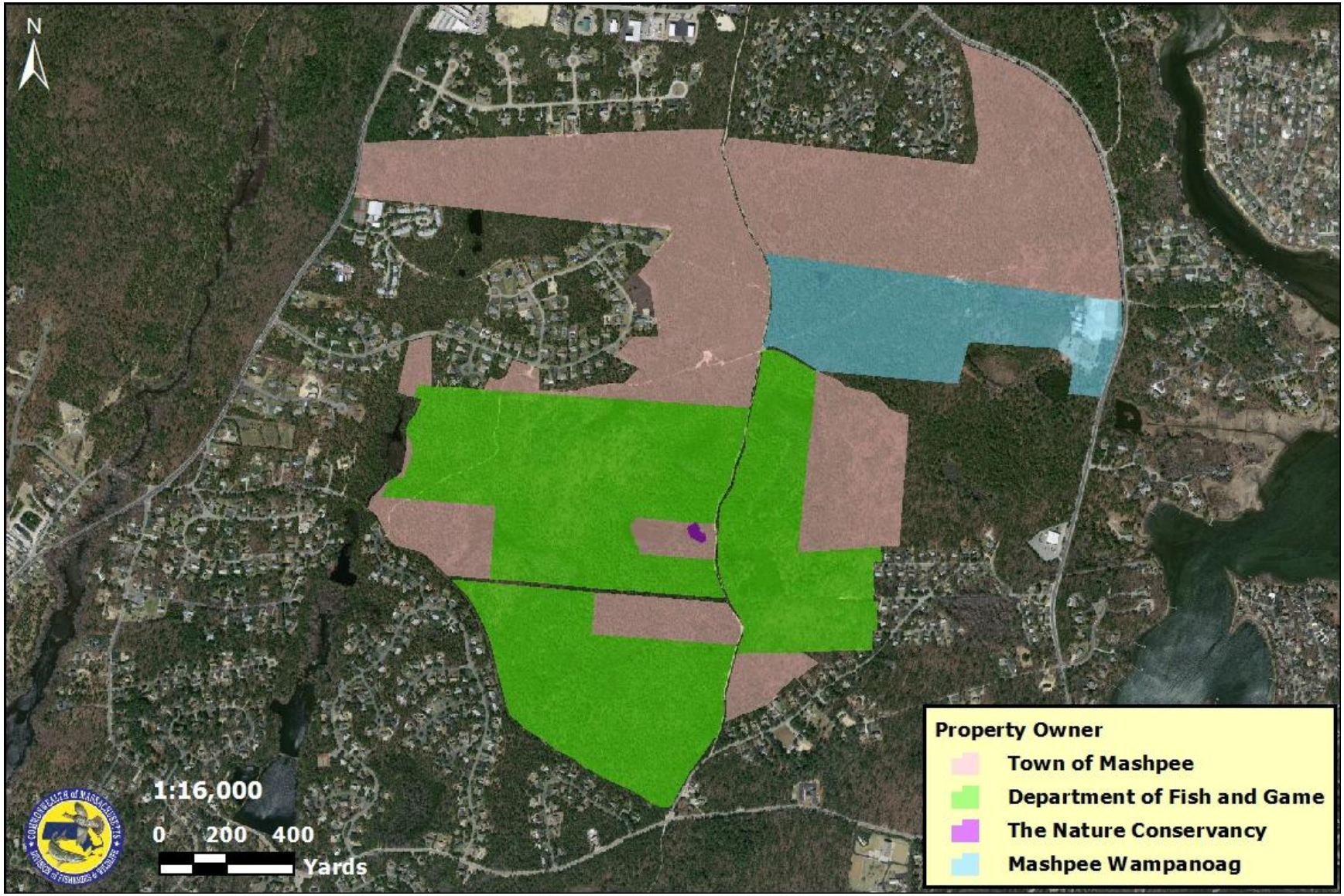

Figure 3. Individual property ownerships within the Mashpee Pine Barrens, Mashpee, MA.

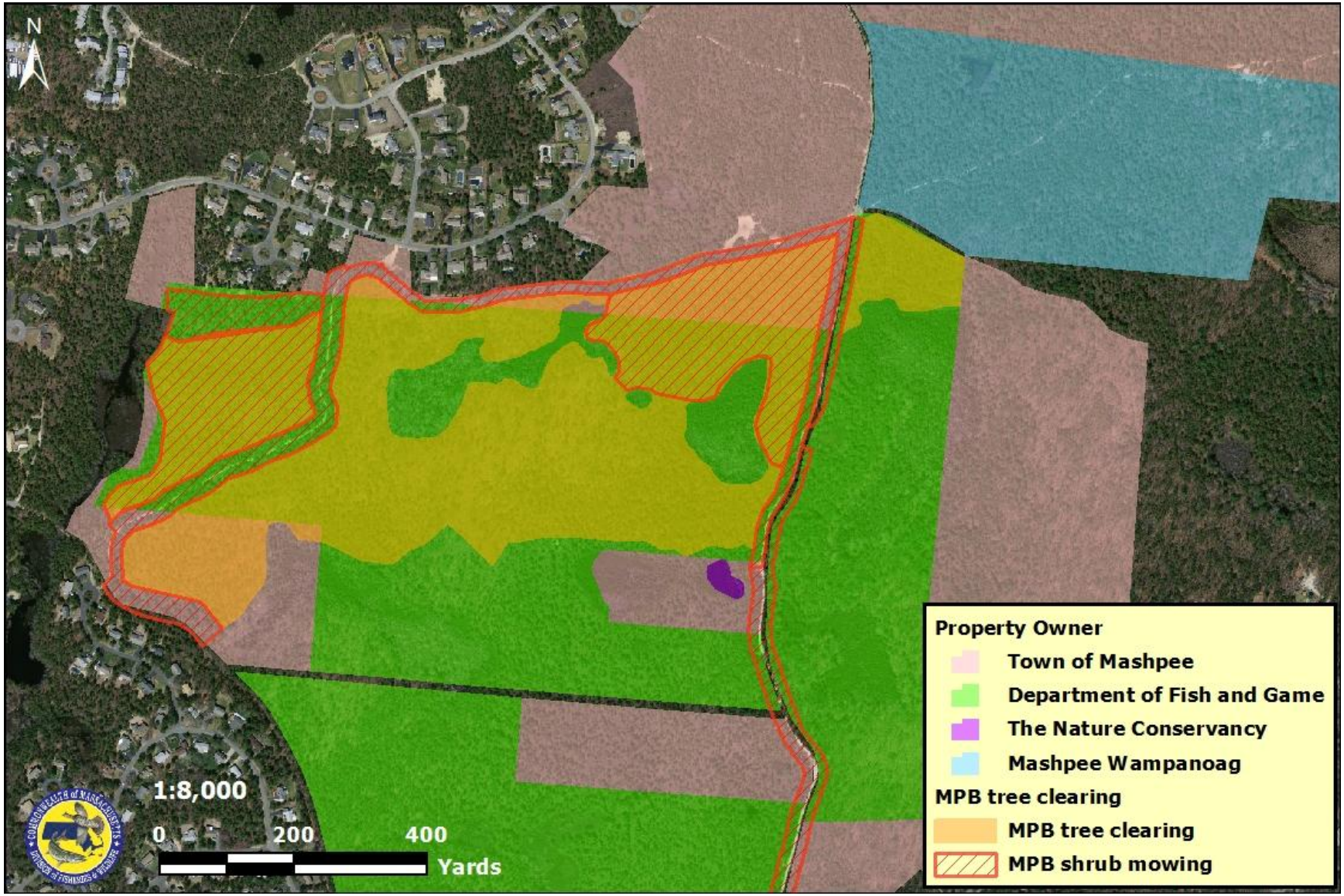

Figure 4. Location of proposed habitat management treatments (tree clearing and shrub mowing) within MDFW and Town of Mashpee lands at the Mashpee Pine Barrens, Mashpee MA.

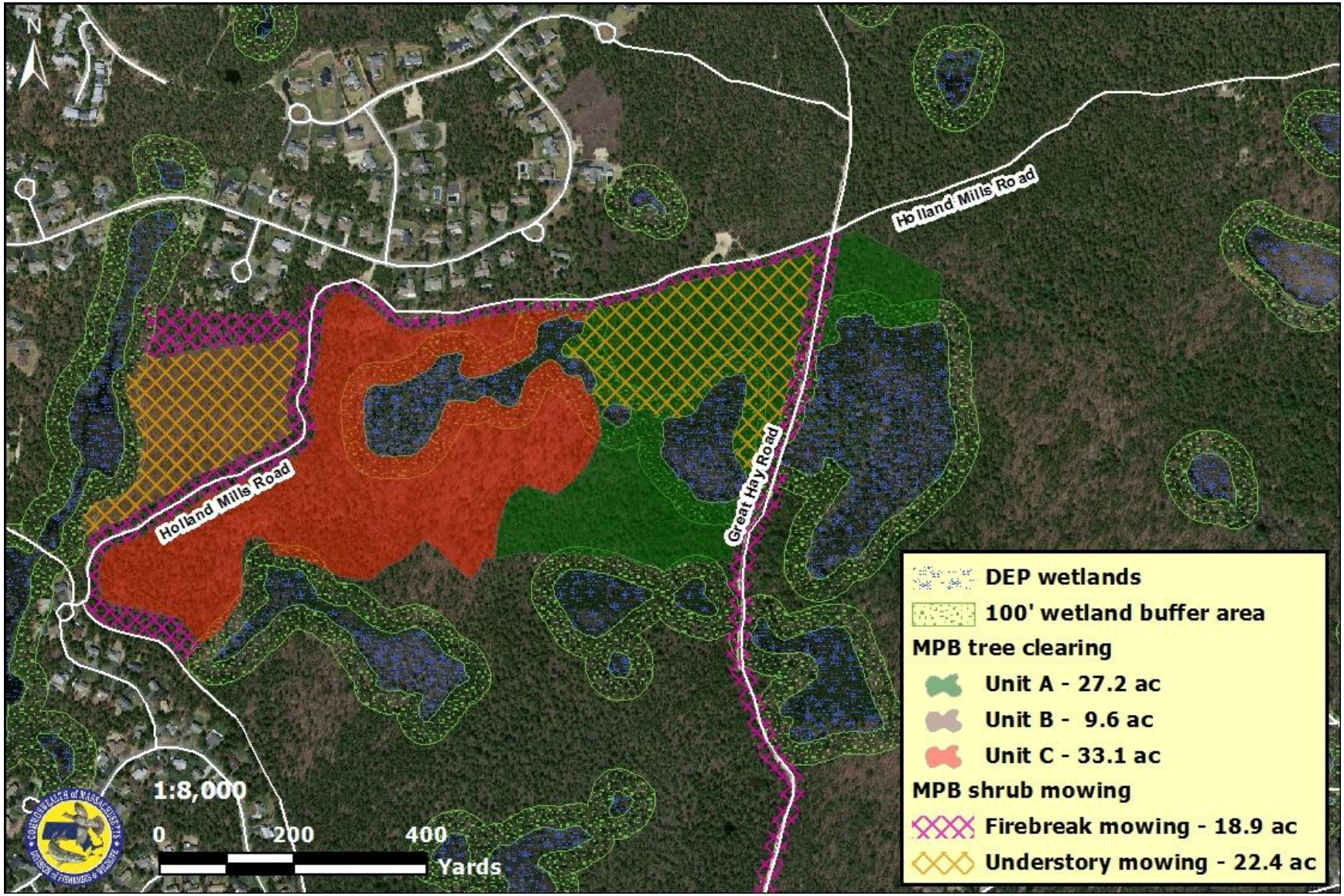

Figure 5. Wetland resource areas, 50' buffer zones, and proposed treatment units (tree clearing and shrub mowing) for NEC habitat restoration at Mashpee Pine Barrens, Mashpee, MA.

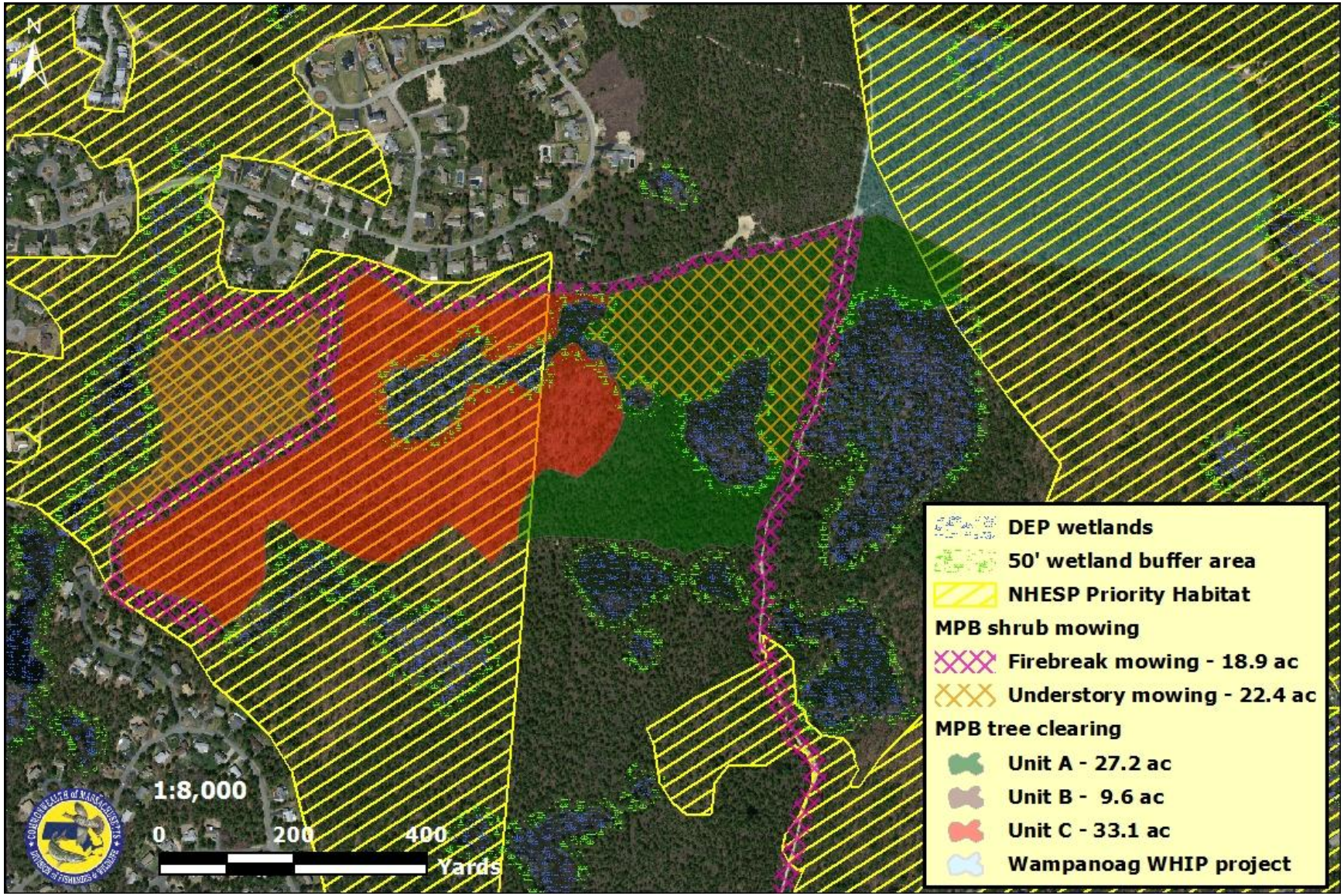

Figure 6. NHESP Priority habitat, and proposed treatment units for NEC habitat restoration at Mashpee Pine Barrens, Mashpee, MA.