dcr | **Massachusetts Department of Conservation and Recreation**

Silviculture Prescription
Warwick State Forest – Bass Swamp

Massachusetts Department of Conservation and Recreation
Bureau of Forestry

Eastern Connecticut Valley District
Warwick State Forest
Warwick, MA

Prepared by:

Keith DiNardo –ECV District Management Forester
Massachusetts Department of Conservation and Recreation
40 Cold Storage Dr. Amherst, MA 01004
Keith.DiNardo@state.ma.us – 413.545.5749

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Approved by:

Management Forestry Program Supervisor _____ Date: February 4, 2020

William N. Hill, CF

Project Overview/Summary

Location: **Warwick State Forest, Bass Swamp Road**

Approximate Size: **148 Acres**[1]

Management Objectives:

- Establish early successional habitat.
- Identify areas suitable for late successional forest structure development
- Increase structural complexity and species diversity.
- Encourage the regeneration of native species and establishment of a new age class.
- Improve/maintain forest infrastructure with the utilization of in-kind services.

Silvicultural Systems:

- Clearcuts with reserves (<5 acres) – Complete removal of trees in a given area, with the exception of designated reserve trees.
- Expanding gap irregular shelterwood – A variation of group selection, where openings up to ½ acres in size are established in the overstory and expanded upon in future entries; resulting in multiple age classes over multiple entries. Also, variable density thinning will be implemented to increase structural complexity and establish variable growing conditions throughout the stands.

Inventory Specifications:

A systematic grid of sample plots was established using ArcGIS on the basis of 1 plot per 3 acres; resulting in 43 variable radius plots (additional plots were added in underrepresented stands). Each plot included the measurement of overstory trees, regeneration and coarse woody material (CWM). The Big BAF sampling method was utilized for overstory estimates, with the two angle gauges used being 20 factor and 80 factor. Regeneration and ground cover data was gathered by establishing a 1/300 acre plot at the center of each inventory plot. The size classes utilized in regards to regeneration are as follows; size class 1 = 0-1’ in height, size class 2 = 1’ – 4.5’ in height, size class 3 = 4.5’ tall – 1” diameter at breast height (dbh), and size class 4 = 1” dbh – 5” dbh. CWM estimates are a result of a 100’ transect at each plot. Programs utilized to interpret data include, NH Fox DS Cruiser for overstory data and a series of calculations completed within excel for ground cover, regeneration, and CWM.

[1] The increase in acreage in comparison to the original proposal document is due to GIS inaccuracies which were corrected in preparation of the prescription.

Geology/Soils/Landforms

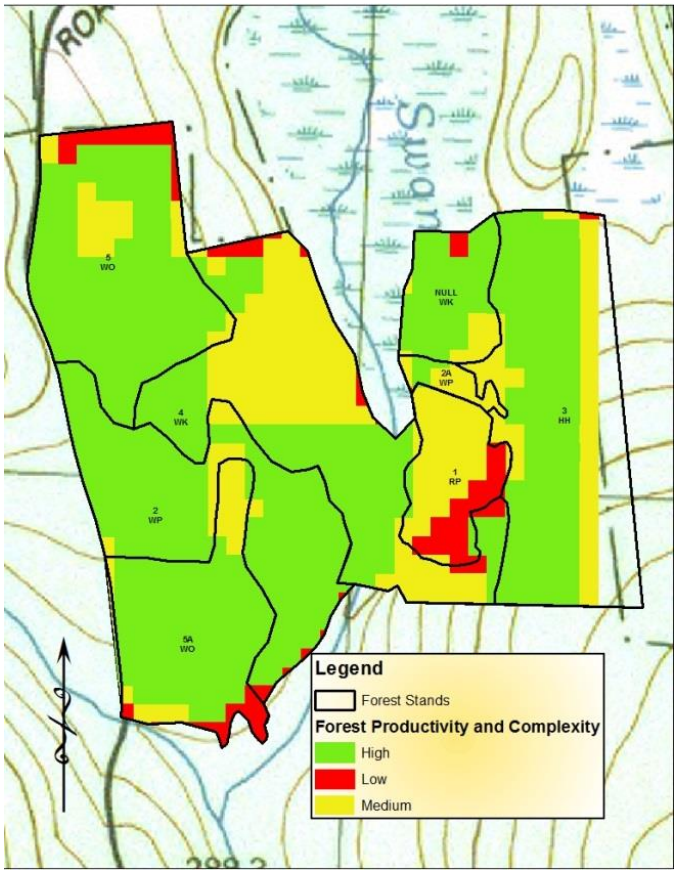
The project area lies at approximately 900' in elevation, with a maximum elevation of approximately 985'. Topography is generally mild, with some slight to moderate slopes located primarily in the eastern half of the project area (USGS topographical map). Soils present include Ridgebury fine sandy loam, Whitman fine sandy loam, Scituate fine sandy loam, Metacomet fine sandy loam, Gloucester sandy loam, Canton fine sandy loam, and Newfields fine sandy loam. The majority of the soils present on site (covering approximately 85% of proposed harvest area) are described by the NRCS soil survey to be "moderately" or "well" suited for timber harvest operability. All of the above listed soils are classified as well drained, moderately well drained, or somewhat excessively well drained, with the exception of Whitman fine sandy loam and Freetown muck which are described as being very poorly drained.

It is speculated that the Whitman fine sandy loam soil type, or a differing poorly or very poorly drained soil type, is more prominent than what is indicated on NRCS soil survey maps. Extensive wetlands were identified throughout the project area during field work; many of these wetlands appear to be underlain with a poorly to very poorly drained soil.

Site Productivity

The majority of the soil types are classified as well drained to somewhat excessively well drained and will favor the growth and regeneration of upland species, more specifically a mix of oak, pine, and other assorted hardwoods.

The DCR Management Guidelines document states that forest stands will be "classed…and considered for silvicultural treatments that are generally suited for their productivity, structural complexity (or potential thereof) and diversity." In 2012, a "Forest Complexity and Diversity" shapefile was created by modeling data from an array of sources in an attempt to classify current and potential levels of forest diversity, complexity and potential forest productivity throughout DCR-DSPR properties. Analysis of the project area using the Forest Productivity and Stand Complexity model (Goodwin, Hill, 2012) indicates that approximately 68% of the project area is considered to have high forest productivity and complexity, 27% is considered medium, and 5% is considered low.



Hydrology

The project area lies within the Connecticut River watershed, which encompasses approximately 450,000 acres in the central/western portion of the state. The Connecticut River is one of the more prominent rivers in the region, with a watershed that extends north into Vermont and New Hampshire and south into Connecticut.

There are several wetland resources located in the immediate vicinity of the project area, including Stevens Swamp, Bass Swamp, a perennial stream known as Mill Brook, as well as an array of vegetated wetlands, intermittent streams, and at least one vernal pool. The Mill Brook is an estimated 7.5 miles long and originates in Stevens Swamp and flows in a northerly direction through Bass Swamp, then westerly toward the Connecticut River. This stream has been subject to several small dams throughout history, many of which are now defunct or nonexistent. The stream crosses through the project area, passing under an old county road (the Fifth Massachusetts Turnpike). The culvert crossing along this old road is now washed out and unpassable. A temporary bridge crossing may be implemented during harvesting activities in order to provide access to the eastern portion of the project area.

Wetlands located within the project area encompass an estimated 24.6 acres. These wetlands are primarily forested and have been subject to harvesting operations in the past. Overstory species present within these wetlands are eastern hemlock, red maple, white pine, and assorted hardwood species, along with an occasional spruce. No harvesting is expected to take place within the defined wetlands; wetland crossings will be implemented where deemed necessary.

Cultural Resources

DCR Archeology has reviewed the proposed project and determined that the project area was not considered culturally sensitive and stated that there are “no known or significant historic or archaeological resources in the project parcel.” Early forest stand maps indicate the presence of stonewalls lining both sides of the “Fifth Massachusetts Turnpike” and during a preliminary site visit a cellar hole was identified and mapped. Disturbance to the stonewalls and the cellar hole will be avoided if possible, at this time it is planned that a no cut buffer (distance to be determined) will be implemented around the cellar hole.

The Civilian Conservation Corps (C.C.C.) camp S-86 was located just south of the project area, along the southern side of Bass Swamp Road. This camp was active from 1936 to 1939 and performed a considerable amount of work in the vicinity. Specific to the project area, the CCC was responsible for early forest management activities including, planting red and white pine, fuel load management, pest and invasive species control work, road construction and maintenance, and thinning and tending of naturally regenerated stands.

Recreation

Warwick State Forest is home to miles of trails and roads which are utilized year round by hikers, skiers, snowmobiles, hunters, birders, and more. A section of the New England National Scenic Trail (NET) crosses through the project area, along a section of the old county road known as the Fifth Massachusetts Turnpike. The NET, formerly known as the Metacomet-Monadnock trail, received the federal designation as a National Scenic trail in 2009. Since then, DCR has signed onto a Memorandum of Understanding with the Appalachian Mountain Club (AMC) regarding trail maintenance and activities in and around the trail. The AMC has provided DCR with formal comments regarding aesthetic buffers and recommendations

pertaining to possible temporary trail closures and reroutes. DCR will continue to work closely with AMC as the project continues.

Wildlife/Natural Heritage and Endangered Species

According to the most recent Natural Heritage and Endangered Species Program (NHESP) layer available at www.mass.gov/mgis, there are two separate primary habitat areas located around Stevens Swamp and Bass Swamp. Prior to the start of harvesting operations this project will be reviewed by NHESP, where recommendations will be made in regards to harvesting in and around these priority habitat areas.

There are currently no known priority natural communities within the stands proposed for forest management according to Massachusetts Division of Fish and Wildlife's State Wildlife Action Plan. Wildlife observed during inventory including visual evidence of deer, squirrels, chipmunks, pileated woodpecker and wild turkey. Despite deer presence observed and the potential for moose presence, minimal browse damage was observed throughout the project area. In accordance to a provision set forth in DCR's Management Guidelines document, the following wildlife habitat considerations will be implemented:

- Retention of at least 1 to 3 large diameter trees (where possible >18" dbh) and 4 live 10"-12" dbh trees per acre that have the potential to serve as cavity and den trees and future snags.
- Retention of all dead snags and stubs in harvest area as safe operating conditions allow.
- Retention of on average one of the oldest, largest diameter, well-formed dominant trees (where possible > 18" dbh) per acre in harvest area to serve as legacy trees.
- Maintain a minimum of 256 cubic feet (or 1 cord) per acre of coarse woody material within the harvest area.

Historic Forest Management

This portion of Warwick State Forest was purchased by the Commonwealth of Massachusetts in 1935 from the New England Box Company and was referred to as the "Pond Soderman Parcel." The 1936 forest type map indicates several different stands located within the project area. The majority of the project area appears to have been heavily cut over and/or cleared in 1932. These areas were subject to further clearing in 1936 by the C.C.C. and subsequently planted to white pine and red pine. Portions of the project area were identified as being a result of natural regeneration and were not converted to plantations. Two of these natural regenerated stands were located west of Bass Swamp and Mill Brook and have been included in more recent forest management activities. The first was a white pine, hemlock, red oak, red maple, and birch stand that was estimated at approximately 20 years old. This stand was located along the edge of Bass Swamp Road (formerly White Road) and was "released and pruned" during the winter of 1936-1937. This is a management strategy where trees are pruned of their lower limbs and individual crop trees are selected and "released" by removing competition. The second stand was located along the immediate western edge of Bass Swamp and Mill Brook and was described as containing a mix of hemlock, red maple, yellow birch, red spruce, white pine, and northern red oak. This stand was estimated at approximately 50 years old at the time of the survey in 1936. The last stand within the project area which was not subject to forest management in the 1930s was identified along the eastern edge of Bass Swamp and included a mix of hemlock, yellow birch, red maple, ash, sugar maple and white birch and was estimated at approximately 50 years of age at the time of the

survey. There are no records that indicate any forest management activities occurring within this stand since owned by the Commonwealth of Massachusetts.

In 1959 the first of several forest management projects was implemented on a portion of the project area, this project was referred to as the "Soderman Lot". During this harvest a total 935 trees were removed with volume estimates totaling about 90 thousand board feet (MBF) of white pine, 23 MBF of hemlock and 12 MBF of miscellaneous hardwood species. This harvest area was bounded on the west by Bass Swamp Road, on the north by private property, on the east by Bass Swamp and Mill Brook, and on the south by the old Fifth Massachusetts Turnpike. Tree removal occurred over all size classes (see Figure 2) and appears to have been fairly evenly distributed. Unfortunately, there is little information pertaining to the intent of this harvest or the silvicultural strategies which may have been implemented.

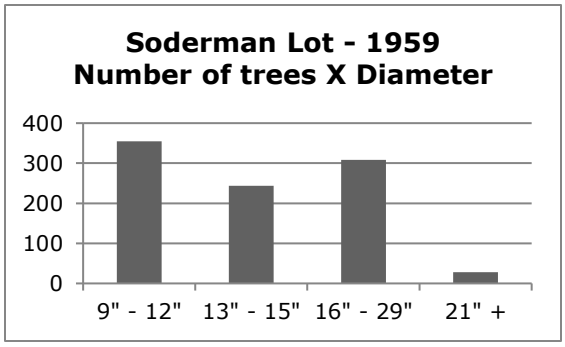


Fig. 2 Diameter Distribution of trees removed in the 1959 forest management project.

The next entry was located just south of the above mentioned harvest area and was bounded on the west by Bass Swamp Road, on the north by the old Fifth Massachusetts Turnpike and on the south and east by Mill Brook and a fairly expansive wetland. This harvest occurred in 1980 and focused primarily of the removal of low quality, smaller diameter hardwoods and was referred to as a "Cordwood Sale." It was estimated that approximately 73 cords of firewood were removed.

The most recent activity occurred in 1988 and was referred to as the "White Road – East Timber Sale." This forest management project encompassed the same area as the 1959 "Soderman Lot" project. During this harvest 1,616 trees were removed and many were girdled and left on site. The total volume removed was estimated at approximately 200MBF of sawtimber, 101 cords of firewood and 95 cords of pulp. Eastern white pine accounted for the large majority of the total sawtimber harvested during this operation, with about 33% of the total volume having a dbh of 20" or greater.

Stand Data

Stand 1 – Red Pine

This ±9 acre, even aged, red pine stand is located north of the NET and to the south east of Bass Swamp. This plantation was established by the C.C.C. in the spring of 1937 with the planting of 10,000 seedlings. There are no records of forest management activities within this stand since it was planted.

The overstory of this stand is heavily dominated by red pine (*Pinus resinosa*), with scarce occurrences of native species such as black oak (*Quercus velutina*) and eastern hemlock (*Tsuga canadensis*). The estimated basal area per acre is 290 ft^2/acre, the total number of trees per acre (TPA) is estimated at 443, and the quadratic mean diameter (QMD) is 11.0" dbh. Red pine accounts for approximately 90% of both the total basal area per acre and TPA throughout the stand. This stand is currently classified as overstocked, resulting in stagnant overstory growth rates and high levels of competition between individuals.

Understory advance regeneration is present throughout and includes species such as white pine (*Pinus strobus*), eastern hemlock, red maple (*Acer rubrum*), American beech (*Fagus grandifolia*), and black birch (*Betula lenta*). There are no records indicating previous management in this stand, although it is evident that some smaller trees have been removed in the past 30 years. The total number of understory stems per acre is estimated at approximately 2,100 across all size classes and species. The most prevalent understory species is eastern hemlock, which is estimated at 1,425 stems per acre or approximately 68% of the total stems present. The current overstory conditions allow for very little sunlight to reach the forest floor, resulting in an understory dominated by more shade tolerant species. Understory plants were scarce due to the nearly closed overstory canopy and the large presence of eastern hemlock regeneration. Species observed include partridgeberry (*Mitchella repens*) and lowbush blueberry (*Vaccinium angustifolium*). CWM present on the site is estimated at 113.8 ft^3/acre, all recorded instances of CWM were smaller than 6" in diameter.

Stand 2 – White Pine

This ±23.6 acre white pine plantation is the direct result of planting by the C.C.C. in the 1930s. Old planting maps indicate that over 30,000 white pine seedlings were planted within the project area between the years of 1936 and 1937. This stand is a remnant of the original plantations and although extensive forest management has occurred, white pine remains the most prevalent overstory species.

Eastern white pine comprises the majority of the overstory, with occurrences of eastern hemlock, northern red oak, and white oak (*Quercus alba*). The total basal area is estimated at 194ft^2/acre, total TPA is estimated at 147 and the QMD is 15.4" dbh. Eastern white pine accounts for nearly 75% of the basal area and about 78% of the recorded TPA. This stand is considered fully stocked based on a recently revised white pine stocking guide (Leak and Lamson, 1999).

Regeneration present consists of a mix of native species, including American beech, eastern hemlock, red maple, black birch, paper birch (*Betula papyrifera*), and red oak. The total number of stems per acre is 1,987 across all species, with hemlock (30%) and American beech (35%) comprising the majority of the total stem count. Understory species present include, partridgeberry, tree clubmoss (*Lycopodium obscurum*), maple leaved viburnum (*Viburunum acerifolia*), wintergreen (*Gaultheria procumbens*), Canada mayflower (*Mianthemum canadense)*, and assorted fern species. CWM present on the site is estimated at 935.8 ft^3/acre and ranged in size from 3" diameter to 12" diameter.

Stand 2A – White Pine, Unmanaged Plantation

This small white pine stand encompasses ±1.5 acres and is located east of Mill Brook and just north of the red pine stand. Approximately 3,000 white pine seedlings were planted in the spring of 1937. Comparing the original planting map to the current stand map, it appears that some the original plantation had failed and allowed for the incorporation of more native naturally regenerated overstory trees. The primary difference between this stand and the white pine stand west of Mill Brook, is that this stand has seen no forest management since the trees were planted. The small size of this stand has resulted in a small sample size, resulting in less statistically sound estimates.

The overstory is dominated by eastern white pine, with scattered occurrences of eastern hemlock and northern red oak. The total basal area is estimated at 250 ft^2/acre, total TPA is estimated at 579.4, and the QMD is 8.9" dbh. White pine comprises 80% of the total basal area in the stand and approximately 70% of the total TPA. This stand is considered overstocked based on the most recent white pine stocking guide

published by the USFS (Leak and Lamson, 1999). Overstocked stands are subject to stagnant overstory growth, extreme competition between individuals and limited sunlight for understory vegetation.

Eastern hemlock was the only tree species identified in the understory inventory. Due to the current canopy conditions, light availability to the understory is limited resulting in a heavy abundance of shade tolerant species. Total stems per acre was estimated at 5,550; all of which being eastern hemlock between 1' tall and 1" in dbh. Understory plants recorded include wintergreen and partridgeberry. CWM present on the site is estimated at 557.9 ft^3/acre.

Stand 3 – Hemlock - Hardwood

This ±\31.9 acre stand is located along the eastern boundary of the project area and has been subject to some more recent forest management. There are no records of management since the Commonwealth of Massachusetts acquired the parcel, but it is clear that some type of harvesting activity has occurred over the past 50 years. This two aged stand has an overstory consisting of larger dominant eastern white pine and northern red oak trees with a second smaller sized cohort of eastern hemlock and assorted hardwood species. Previous stand conditions and forest management practices implemented across this stand are mere speculation at this point. But, it is believed that the current stand is a result of forest management which favored retention of overstory red oak and eastern white pine. It is most likely that forest conditions prior to forest management exhibited a nearly closed canopy dominated by white pine and northern red oak, with moderate amounts of natural regeneration comprised of more shade tolerant species. (i.e. eastern hemlock). Forest management practices resulted in the release of said regeneration resulting in an intermediate layer of hemlock and other shade tolerant species.

The overstory of this stand is dominated by eastern hemlock; other species present include eastern white pine, red maple, black cherry (*Prunus serotina*), black birch, and northern red oak. Total basal area for the stand is estimated at 155 ft^2/acre, TPA is estimated at 281, and the QMD is approximately 10.1" dbh. There is considerable variation in size amongst species. Hemlock comprises 69% of the total TPA and 55% of the total basal area per acre and has a QMD of 9.0" dbh. eastern white pine and northern red oak account for only a small percentage of the total TPA and basal area per acre, but have a QMD of 32.8" dbh(eastern white pine) and 17.3" dbh (northern red oak) and represent nearly 41% of the total volume per acre.

Understory regeneration present includes eastern hemlock, American beech, yellow birch (*Betula alleghaniensis*) and black birch. The total stem count per acre is estimated at 566 and is dominated by eastern hemlock comprising approximately 58% and American beech comprising approximately 23% of the total. Current stand conditions, predominantly the large presence of hemlock, allow for very little available sunlight in the understory resulting in an understory dominated by shade tolerant species. The only understory plant sampled during the inventory was partridgeberry and it was only observed at 1 plot. CWM is abundant throughout the stand and is estimated at 822.4 ft^3/acre.

Stand 4 – White Pine/Hemlock

This ±31.4 acre stand is located along the western edge of Bass Swamp and encompasses a stretch of the Mill Brook. The original project proposal document indicates that this is a ±38 acre stand which is comprised of two separate polygons; one approximate ±30 acre portion west of Bass Swamp and another ±8 acre portion east of Bass Swamp. The eastern 8 acre portion of the stand has been removed from the project area due to its unique characteristics and current condition. The 1936 forest stand type maps indicate this 8 acre portion of the project area to be approximately 50 years of age at the time it was

surveyed, making this stand approximately 133 years in age, with no records or evidence of active forest management. The intent of removing these 8 acres from the project is to allow for this stand to naturally progress, contributing to an older age class of naturally regenerated, unmanaged white pine hemlock stand on the landscape. Portions of the 30 acre stand which lies west of Bass Swamp were also indicated as being approximately 50 years of age in 1936, but have been subject to more recent forest management.

The overstory is comprised of a mix of eastern white pine and eastern hemlock, with occasional instances of red maple, black cherry, and northern red oak. White pine is generally larger in size and occupies much of the dominant/codominant crown class, with hemlock being a bit smaller and occupying the intermediate crown class. The total basal area per acre is estimated at 157.5 ft^2/acre, TPA is estimated at 146, and the QMD is 14.1" dbh. Eastern white pine accounts for 49% of the total basal area per acre, 27% of the total trees per acre, 65% of the total volume per acre and has a QMD of 18.8" dbh. Eastern hemlock accounts for about 42% of the total basal area per acre, 65% of the total trees per acre, 30% of the total volume per acre, and has a QMD of 11.4" dbh.

Regeneration is present throughout with densities varying across the stand. The total number of stems per acre is estimated at 5,850, with hemlock accounting for 87% of the total. Other species present include American beech, red maple, northern red oak, and black birch. Understory plants present include wintergreen, partridgeberry, starflower (*Triantalis borealis*), tree clubmoss, and assorted fern and grass species. The total amount of CWM is estimated at 537 ft^3/acre.

Stand 5 – White Pine /Oak (North)

This ±25.6 acre stand is located in the northwest portion of the project area and borders Bass Swamp Road. This stand has seen some fairly intensive forest management over the past 100 years. The northern half of the stand was originally established by clearing and planting to white pine in 1937, while the southern half was comprised of natural regeneration which was subject to "release and pruning" in 1936 and 1937. This stand, in its entirety, was subject to two subsequent forest management projects, one in 1959 and another in 1988.

The overstory is dominated by eastern white pine, with inclusions of northern red oak, eastern hemlock, black birch and red maple. The total basal area per acre is estimated at 142.5 ft^2/acre, TPA is estimated at 91.9 and the QMD is estimated at 16.9"dbh. White pine accounts for approximately 70% of the total basal area per acre and approximately 56% of the total TPA.

Regeneration is dominated by eastern hemlock and American beech, encompassing approximately 55% of all stems tallied. Other understory species present include black birch, red maple, and northern red oak. The total number of stems per acre, across all species and size classes, is estimated at 3,637. Understory plants include partridgeberry, wintergreen, tree clubmoss, lowbush blueberry, dewberry (*Rubus flagellaris*) and assorted fern species. CWM present is estimated at 447 ft^3 /acre.

Stand 5A – White Pine/ Oak (South)

This ±17.5 acre stand is located in the south west portion of the project area. There are no records of previous forest management activities implemented by the C.C.C. The only record pertaining to historic forest management being conducted in this stand is the "Cordwood" sale which occurred in 1980.

The overstory is dominated by a mix of larger diameter eastern white pine and red oak, with occurrences of red maple and hemlock in the intermediate crown class. The total basal area per acre is estimated at 165 ft^2/acre, TPA is estimated at 88.2, and the QMD is 18.5" dbh. White pine and oak, although are less represented in the TPA estimates, account for approximately 36% of the total basal area per acre and 47% of the estimated volume per acre.

Regeneration is dominated by American beech and eastern hemlock, with red oak, paper birch, red maple, and black birch also being present. The total number of stems per acre is estimated at 975 across all species and size classes. Hemlock and American beech account for approximately 61% of all stems present. Understory species include partridge berry, Canada mayflower, tree clubmoss, wintergreen, sheep laurel (*Kalmia angustifolia*), northern wild raisin (*Viburnum nudum* var.*cassinoides*), lowbush blueberry, star flower, serviceberry (*Amelanchier spp.*), Indian cucumber root (*Medeola virginiana*) and a variety of fern, grass and moss species. CWM is estimated at 360 ft^3/acre.

Stand 6 – White pine/Hemlock

This stand was originally included within the limits of the proposed forest management activities. Upon further inspection, it was determined that no management was to be implemented at this time. This stand was not included in the inventory and specifics regarding total basal area, volume/acre, etc. are unavailable. The 1934 forest stand map indicates that this stand was approximately 50 years at the time of the survey and there is no record of forest management since that time. It is possible that some overstory damage was incurred during the 1938 hurricane and salvage operations may have occurred as a result, but this is mere speculation. There are no records indicating any forest management operations occurring within this stand since 1934.

The decision to limit forest management in this stand was made with the intent of allowing this stand to mature and grow naturally, contributing to the diversification of forest conditions on the landscape.

Prescribed Management and Intended Goals

Stand 1 – Red Pine

This stand has no history of active forest management since the establishment of the plantation in 1936. Due to the overstocked condition, many of the trees exhibit stagnated growth and small live crown ratios. Over the last several years, red pine monocultures throughout the region have been subject to large scale mortality due to the stressed growing conditions and the introduction of the red pine scale (*Matsucoccus resinosae*). Red pine scale was positively identified in Wendell State Forest and Erving State Forest in November of 2019, the stands infected with the scale insect are declining at a fairly rapid rate and 100% mortality is expected. Although, red pine scale has not yet been positively identified in this particular stand, it is expected to spread throughout the region over the next decade.

Prescribed management for this stand will incorporate the use of two different even aged methods of regeneration, with the intent of maximizing the removal of the red pine overstory. Clearcuts, up to 5 acres, will be implemented on portions of the stand, while the remaining area will be subject to a uniform thinning.

The intention of the clearcuts is to harvest the red pine overstory, providing the conditions for native tree regeneration, subsequently establishing early successional habitat and increasing diversity amongst

the advanced regeneration. The patches of young forest conditions created through these openings will provide important habitat criteria for an array of wildlife species. Early successional habitat conditions have been in decline through the region for a number of years (Alerich, 2000), resulting in a subsequent decline in specialist wildlife species dependent on these conditions. Portions of the advanced regeneration will be cut in order to increase diversity by allowing the establishment of more shade intolerant species. As stated in the current DCR Forest Management Guidelines, "1 to 3 live, large diameter (where possible <18" dbh) trees per acre and 4 live, 12"-18" dbh trees per acre…" as well as all snags which lie within the clearcut area will be retained (Commonwealth of Massachusetts, 2012). The goal is to regenerate 80% of the total stand utilizing this method, resulting in approximately 7.2 acres of clearcutting throughout the entire stand. Two clearcuts will be implemented, neither of which will exceed 5 acres in size. Advanced regeneration within these clearcut areas will be partially removed in order to allow for the establishment of more shade intolerant species and increase species diversity. Areas heavily dominated by eastern hemlock, American beech, and/or black birch will be subject to such regeneration removal. This will occur during harvesting operations and will include both the cutting of existing regeneration and scarification of the site.

Approximately 16% of the stand (1.3 of the total 8.6 acres) is currently designated as 'no cut' due to the presence of wetlands and buffers associated with said wetlands. Forest management operations, with the exception of necessary wetland crossings, will not occur within these areas.

The uniform thinning will occur on the remaining areas and will serve as a buffer between the two clearcuts. This thinning will focus on the removal of poorly formed, less vigorous individuals. Native, mature overstory trees such as white pine, eastern hemlock and red oak will be retained where possible. All red pine retained on the site are expected to succumb to pest pressures within the next decade and will remain as snags. Basal area will be reduced from 290 ft^2/acre to an average of approximately 80 ft^2/acre, resulting in the removal of approximately 73% of current stocking levels.

Due to the expected rapid decline of the residual red pine, it is anticipated that future stand conditions will not vary significantly between the two silvicultural methods. Areas subject to thinning may exhibit a slight increase in the presence of mid tolerant to tolerant species present in the understory. Both methods will result in a fairly even aged stand containing a diverse mix of native regeneration.

Stand 2 – White Pine

This 83 year old stand has been subject to two previous forest management projects over the past 70 years. Advanced regeneration established as a result of the most recent harvest is predominantly composed of shade tolerant species, specifically eastern hemlock and American beech. Both of these species are susceptible to decline due to pest pressures. The majority of pole and sawtimber sized American beech in the project area being infected with beech bark disease and hemlock are susceptible to pressures from elongate scale, hemlock looper, and hemlock woolly adelgid. Forest management in this stand is intended to increase structural diversity, increase residual growth rates, increase species diversity, and establish areas of early successional habitat.

Clearcuts up to 5 acres in size will be implemented throughout the stand. These clearcuts will be limited to areas which are heavily dominated by hemlock and American beech regeneration, with the intent of establishing a more diverse mix of species in the understory, while providing for early successional

habitat conditions. Minimum retention specifications (described above) will be implemented within each clearcut. The intent is to regenerate a maximum of 30% of the total stand area utilizing this approach, which will result in a total of 4.7 acres across the 23.6 acre stand. Advanced regeneration within the clearcut areas will be partially removed in order to provide conditions appropriate for the establishment of more shade intolerant species. Areas dominated by eastern hemlock and American beech regeneration will be subject to removal via cutting and scarification of the site. This work will be implemented in conjunction with the prescribed forest management strategies as they pertain to the current overstory.

Approximately 34% of the stand (8.2 of the total 23.6 acres) is currently designated as 'no cut' due to the presence of wetlands and buffers associated with said wetlands. Forest management operations, with the exception of necessary wetland crossings, will not occur within these areas.

The remaining portions of the stand will be subject to an irregular shelterwood which will consist of a variable retention thinning across all size classes. The intent is to aid in the establishment and release of desirable advanced regeneration, increase structural diversity throughout the stand, and attempt to increase residual growth rates. The current basal area of 194 ft^2/acre will be reduced to a minimum retention of 30 ft^2/acre and overall residual basal areas will vary between these two parameters. Trees across all size classes exhibiting poor form and vigor will be focused for removal. Variations in residual densities will be determined by the condition and composition of advanced regeneration and current overstory condition. Areas where advanced regeneration is currently lacking or is dominated by American beech, eastern hemlock, and black birch will be subject to a heavier thinning; resulting in lower residual overstory basal area and an increase in available sunlight. Areas with a high prevalence of American beech, eastern hemlock, and black birch advanced regeneration will also be subject to the partial removal of said advanced regeneration. This will be done with the intent of increasing species diversity through the stand by creating more favorable conditions for the establishment of a wider array of overstory tree species. The overall goal is that the implementation of clearcuts in conjunction with a variable density thinning will provide the appropriate conditions for the establishment of a wide array of shade intolerant, mid tolerant and tolerant species, while increasing structural diversity throughout the stand.

Stand 2A – White Pine, Unmanaged Plantation

Prescribed management for this 1.5 acres stand will consist of the removal of the majority of the overstory by implementing a clearcut across the entire stand with the intent of increasing diversity and structural complexity. In its current state, this stand is quite uniform and excessively overstocked. Individuals in the overstory exhibit very small live crown ratios and are not expected to respond to release. Several individuals will be retained across the stand in order to meet the minimum requirements regarding retention trees as stated above.

Stand 3 - Hemlock Hardwood

The expanding gap variant of the irregular shelterwood system will be implemented throughout this stand. About 12-13 small openings (no larger than ½ acre) will be established with the intent of regenerating 20% (6.38 acres) of the total stand area (31.9 acres). These openings will be variably shaped and scattered throughout.

An estimated 13% (4.17 acres) of the total stand area is designated as 'no cut' due to the presence of wetlands and buffers associated with said wetlands. These 'no cut' areas will not be subject to forest management, with the exception of wetlands crossing where deemed necessary, and are expected to increase slightly as layout continues.

A variable density thinning will occur on the remaining 20 acres, which will maintain a minimum basal of 30ft²/acre. This thinning will occur across all size classes and species and will aim at retaining a diverse mix of species, while attempting to maximize structural complexity. Total retention will vary and will be based on the current condition of the overstory as well as the composition and condition of regeneration present. The intent is to create an array of growing conditions to allow for the establishment of a diverse mix of native overstory tree species, while also increasing structural complexity throughout the stand.

Future stand conditions will consist of a more structurally complex forest containing a more diverse mix of regenerating tree species. Areas that are subject to ½ acre openings are expected to have a higher concentration of more shade intolerant to mid tolerant species. Areas that are thinned are expected to contain a mix of species varying from mid tolerant to very tolerant, depending on the density of the overstory retention in any given area.

Future management will focus on the expansion of the gaps created this entry, with the intent of creating multiple age classes over several decades.

Stand 4 – White Pine/Hemlock

The expanding gap variant of the irregular shelterwood system will be implemented throughout this stand, with the goal of regenerating approximately 20% of the stand by establishing small openings (not to exceed ½ acre) in the overstory. This will result in the creation of 12-13 variably shaped openings, totaling approximately 6.3 acres.

Nearly 50% (15.7 acres) of the total stand area is currently designated as 'no cut' due to the presence of wetlands and the no cut filter strip established along Bass Swamp and Mill Brook. These 'no cut' areas will remain virtually free of forest management activities with the exception of possible wetland crossings and minimal vegetation removal associated with wetland crossings.

A variable density thinning will occur on the remaining area, which will maintain a minimum basal of 30ft²/acre. This thinning will occur across all size classes and species and will aim at retaining a diverse mix of species, while attempting to maximize structural complexity. Total retention will vary and will be based on the current condition of the overstory as well as the composition and condition of regeneration present. The intent is to create an array of growing conditions that will allow for the establishment of a diverse mix of native overstory tree species, while also increasing structural complexity throughout the stand.

Future forest management will focus on further expansion of the openings and will aim to establish a mosaic of different age classes throughout the stand.

Stand 5 – White Pine/Oak (North)

The expanding gap variant of the irregular shelterwood system will be implemented throughout this stand, with the goal of regenerating approximately 20% of the stand (+/- 5 acres) by establishing small

openings (not to exceed ½ acre) in the overstory. This will result in the creation of about 10-12 variably shaped openings, totaling approximately 6.3 acres.

Nearly 44% (11.4 acres) of the total stand area is currently designated as 'no cut' due to the presence of wetlands and buffers associated with said wetlands. 'No cut' areas will remain intact and uncut, with the exception of the installation and utilization of wetland crossings where deemed appropriate and necessary.

A variable density thinning will occur on the remaining area, which will maintain a minimum basal of 30ft²/acre. This thinning will occur across all size classes and species and will aim at retaining a diverse mix of species, while attempting to maximize structural complexity. Total retention will vary and will be based on the current condition of the overstory as well as the composition and condition of regeneration present. The intent is to create an array of growing conditions that will allow for the establishment of a diverse mix of native overstory tree species, while also increasing structural complexity throughout the stand

Future forest management will focus on further expansion of the openings and will aim to establish a mosaic of different age classes throughout the stand.

Stand 5A – White Pine/Oak (South)

The expanding gap variant of the irregular shelterwood system will be implemented throughout this stand, with the goal of regenerating approximately 20% of the stand (+/- 3.5 acres) by establishing small openings (not to exceed ½ acre) in the overstory. This will result in the creation of about 6-8 variably shaped openings, totaling approximately 3.5 acres.

Nearly 47% (8.3 acres) of the total stand area is currently designated as 'no cut' due to the presence of wetlands. 'No cut' areas will remain intact and uncut, with the exception of the establishment and utilization of wetland crossings where deemed necessary.

A variable density thinning will occur on the remaining area, which will maintain a minimum basal of 30ft²/acre. This thinning will occur across all size classes and species and will aim at retaining a diverse mix of species, while attempting to maximize structural complexity. Total retention will vary and will be based on the current condition of the overstory as well as the composition and condition of regeneration present. The intent is to create an array of growing conditions that will allow for the establishment of a diverse mix of native overstory tree species, while also increasing structural complexity throughout the stand.

Future forest management will focus on further expansion of the openings and will aim to establish a mosaic of different age classes throughout the stand.

Stand 6 – White Pine/Hemlock

Due to the history and current condition of this stand no management is prescribed at this time. Minimal disturbance in expected and will only occur in the form of hauling and or skidding. The intent of removing this stand from the active harvest area is to allow the stand to mature and evolve naturally. This stand will provide for late successional forest structure and will aid in further diversifying forest structure and condition across the landscape.

Operational Information

Logging Requirements

Primary and secondary skid roads may require the implementation of erosion control measures, including but not limited to, the construction of water bars, installation of culverts, and slashing of roads. Culturally sensitive areas (C.C.C. structures, stone walls, etc…) will be protected and minimal disturbance will be tolerated in and around these areas. No limitations to equipment type are expected except that which would facilitate whole tree logging and processing. Whole tree skidding will be prohibited; processing of trees (limbing, bucking, etc.) must be completed within a reasonable distance from the individual trees point of origin and not on the landing or otherwise established decking area.

General Guidelines

Harvesting will be limited to dry, frozen or otherwise stable conditions. A NHESP review of the forest cutting plan will occur and any restrictions regarding priority habitat will be implemented at that time. Some interior forest roads may require plowing if operations are conducted during winter months, therefore impacting snowmobile and other winter recreation opportunities. This portion of the state forest will be closed for recreational use during active harvesting operations due to hazardous conditions. Notifications will be sent to local snowmobile clubs to inform users of these temporary access restrictions.

As requested by the AMC, a 100 foot buffer will be implemented along the edge of the NET trail. This will include a 50' no cut buffer along the immediate edge of the trail, with the exception of the removal of potentially hazardous trees, along with an additional 50' buffer where a minimum of 50% basal area retention will be implemented. The trail will be utilized for skidding and or hauling of trees and a landing area will be established along the edge of the trail near Bass Swamp Road. Any damage to the trail as a result of harvesting operations will be rectified once harvesting is complete.

A 50' aesthetic buffer will be implemented along Bass Swamp Road, where no more than 50% of the current basal area will be removed. All operations pertaining to this sale will adhere to the guidelines and restrictions set forth in the Massachusetts Best Management Practices Manual (2013).

Timber Marking Guidelines

Project wide guidelines:

- Trees marked with a single blue stripe will be removed for harvest
    - Horizontal stripe indicates sawtimber
    - Vertical stripe indicates pulp or cordwood
    - "X" indicates cull tree to be cut and left on site (no tally)
- Tree making along the NET trail will be limited to one side of the tree for aesthetics
- Skid roads will be painted in red, all trees marked with red paint are to be cut and removed (the same marking scheme mentioned above applies to skid trail marking).
- Filter strips, vernal pool and wetland buffers and harvest boundaries will be marked with three horizontal blue stripes, indicating an area where cutting is prohibited; these trees will remain uncut.

Retention specifications

- Variable Density Thinning
    - Heavier removals will occur in areas where regeneration is lacking or is dominated by American beech, eastern hemlock, and or black birch, with a minimum overstory retention of 30 ft^2/acre . Areas where advanced regeneration is dominated by American beech, eastern hemlock and/or black birch will be subject to the partial removal of said regeneration.
    - Areas where more mid tolerant species are present in the understory will maintain an average basal area of 70-120 ft^2/acre.
      Retention trees will be selected with the intent of maximizing forest structure and species diversity. Individuals selected for retention will represent all overstory species currently present and will occur across all size classes. Individuals exhibiting good form and vigor will be favored for retention.

Appendix

Table 1. Soil Type/Site Index Information

Soil Type	Common Trees	Site Index
Freetown muck		
	American elm	55
	Atlantic white cedar	60
	Balsam fir	45
	Eastern hemlock	55
	Green ash	35
	Red maple	50
	Red spruce	50
Ridgebury fine sandy loam, extremely stony		
	Eastern white pine	63
	Elm	—
	Northern red oak	57
	Red maple	62
	Red spruce	47
	Sugar maple	52
	White ash	60
Whitman fine sandy loam, extremely stony		
	Blackgum	52
	Eastern white pine	56
	Northern red oak	70
	Red maple	60
	Red spruce	44
	White oak	57
Scituate fine sandy loam, very stony		
	Eastern white pine	65
	Northern red oak	61
	Red pine	70
	Sugar maple	55
Metacomet fine sandy loam		
	Balsam fir	57
	Eastern white pine	80
	Sugar maple	60
	White spruce	60
Canton fine sandy loam		
	Eastern hemlock	—

	Eastern white pine	58
	Northern red oak	52
	White oak	—
Canton fine sandy loam, very stony		
	Eastern hemlock	—
	Eastern white pine	58
	Northern red oak	52
	Red maple	55
	Shagbark hickory	—
	Sugar maple	55
	White oak	—
Newfields fine sandy loam		
	Eastern white pine	55
	Northern red oak	60
	Red maple	55
Gloucester sandy loam		
	Eastern white pine	61
	Northern red oak	60
	Red pine	49
	Sugar maple	53
Gloucester sandy loam, very stony		
	Eastern white pine	61
	Northern red oak	60
	Red pine	49
Gloucester sandy loam, very stony		
	Eastern white pine	61
	Northern red oak	60
	Red pine	49

Stand 1 – Red Pine

Table 2. Stand 1 – Red Pine Overstory Data

Species	Trees/Acre	BA/Acre	BF/Acre	QMD	Avg. SawtimberHt (logs)	Total BF (Stand)
Red Pine (*Pinus resinosa*)	397.2	265.0	40,359.3	11.1	2.7	304,147.6
Eastern Hemlock (*Tsugas canadensis*)	31.8	20.0	1,552.3	10.7	-	-
Black Oak (*Quercus velutina*)	14.1	5.0	-	8.0	-	-
Total	443.1	290.0	41,911.6	29.8		304,147.6

Table 3. Stand 1 - Red Pine Regeneration Data (TPA)

	Size Class				
SPECIES	**1**	**2**	**3**	**4**	**Total**
American Beech (*Fagus grandifolia*)	0	0	225	75	300
Eastern White Pine (*Pinus strobus*)	0	225	0	0	225
Eastern Hemlock (*Tsugas canadensis*)	225	750	375	75	1425
Black Birch (*Betula lenta*)	0	0	150	0	150
Total	225	975	750	150	2100

Table 4. Stand 1 – Red Pine Understory Shrub/Herbaceous Data

SPECIES	AVG. % Cover	# plots observed	% of plots observed
No Tally	0	1	25
Partridgeberry (*Mitchella repens*)	15	3	75
Lowbush Blueberry (*Vaccinium angustifolium*)	25	1	25

Stand 2 – White Pine

Table 5. Stand 2 – White PineOverstory Data

Species	Trees/Acre	BA/Acre	BF/Acre	QMD	Avg. SawtimberHt (logs)	Total BF (Stand)
Eastern Hemlock (*Tsuga canadensis*)	4.5	5.7	402.4	15.3	2.0	9,497.2
Eastern White Pine (*Pinus strobus*)	115.0	145.7	22,951.8	15.2	2.8	541,662.4
Northern Red Oak (*Quercus rubra*)	25.7	37.1	3,877.1	16.3	1.7	91,499.5
White Oak (Quercus alba)	2.2	2.9	469.5	15.4	-	11,080.3
Total	145.2	188.5	27,231.3	15.6		642,659.1

Table 6. Stand 2 - White Pine Regeneration Data (TPA)

	Size Class				
SPECIES	**1**	**2**	**3**	**4**	**Total**
American beech (*Fagus grandifolia*)	0	112.5	150	450	712.5
Black Birch (*Betula lenta*)	0	0	0	150	150
Eastern Hemlock (*Tsugas canadensis*)	37.5	262.5	225	75	600
Northern Red Oak (*Quercus rubra*)	75	0	0	0	75
Paper Birch (*Betulapa pyrifera)*	0	0	112.5	0	112.5
Red Maple (*Acer rubrum*)	0	0	225	112.5	337.5
Total	112.5	375	712.5	787.5	1987.5

Table 7. Stand 2 – White Pine Understory Shrub/Herbaceous Data

SPECIES	AVG. % Cover	# plots observed	% of plots observed
Assorted Fern Species	1.50	3	37.50
Assorted Moss Species	0.63	1	12.50
Canada Mayflower (*Mianthemum canadense*)	0.63	1	12.50
Maple Leaved Viburnum (*Viburnum acerifolia*)	0.63	1	12.50
Partridgeberry (*Mitchella repens*)	13.13	8	100.00
Tree Clubmoss (*Lycopodium obscurum*)	1.38	3	37.50
Wintergreen (*Gaultheria procumbens*)	1.25	1	12.50

Stand 2A – White Pine Plantation

Table 8. Stand 2 – White Pine Plantation Overstory Data

Species	Trees/Acre	BA/Acre	BF/Acre	QMD	Avg. Sawtimber Ht (logs)	Total BF (Stand)
Eastern Hemlock (*Tsugas canadensis*)	136.0	30.0	1,777.5	6.4	-	3,110.6
Eastern White Pine (*Pinus strobus*)	396.5	200.0	10,665.1	9.6	1.5	18,663.9
Northern Red Oak (*Quercus rubra*)	46.9	20.0	0.0	8.8	-	0.0
Total	579.4	250.0	12,442.6	8.9		21,774.5

Table 9. Stand 2 - White Pine Plantation Regeneration Data

	Size Class				
SPECIES	**1**	**2**	**3**	**4**	**Total**
Eastern Hemlock (*Tsugas canadensis*)	0	3600	1950	0	5550
Total	0	3600	1950	0	5550

Table 10. Stand 2 – White Pine Plantation Understory Shrub/Herbaceous Data

SPECIES	AVG. % Cover	# plots observed	% of plots observed
Partridgeberry (*Mitchella repens*)	10	2	100
Wintergreen (*Gaultheria procumbens*)	5	1	50

Stand 3 – Hemlock/Hardwood

Table 11. Stand 3 – Hemlock/Hardwood Overstory Data

Species	Trees/Acre	BA/Acre	BF/Acre	QMD	Avg. Sawtimber Ht (logs)	Total BF (Stand)
Black Birch (*Betula lenta*)	4.0	2.2	0.0	10.0	-	0.0
Black Cherry (*Prunus serotina*)	8.1	4.4	260.2	10.0	-	8,301.0
Eastern Hemlock (*Tsugas canadensis*)	196.1	86.7	3,066.5	9.0	1.5	97,819.8
Eastern White Pine (*Pinus strobus*)	0.4	2.2	637.0	32.8	4.0	20,320.8
Northern Red Oak (*Quercus rubra*)	16.4	26.7	2,708.8	17.3	1.8	86,409.7
Red Maple (*Acer rubrum*)	56.1	33.3	1,394.4	10.4	1.2	44,480.8
Total	281.1	155.6	8,066.8	10.1		257,332.1

Table 12. Stand 3 - Hemlock/Hardwood Regeneration Data

	Size Class				
SPECIES	**1**	**2**	**3**	**4**	**Total**
American beech (*Fagus grandifolia*)	0.0	100.0	0.0	33.3	133.3
Black Birch (*Betula lenta*)	0.0	0.0	0.0	33.3	33.3
Eastern Hemlock (*Tsugas canadensis*)	66.7	0.0	0.0	266.7	333.3
Yellow Birch (*Betula allegheniensis*)	0.0	0.0	0.0	66.7	66.7
Total	67.7	102.0	3.0	337.3	500.0

Table 13. Stand 3 – Hemlock/Hardwood Understory Shrub/Herbaceous Data

SPECIES	AVG. % Cover	# plots observed	% of plots observed
No Tally	0.0	8.0	88.9
Partridgeberry (*Mitchella repens*)	0.2	1.0	11.1

Stand 4 – White Pine/Hemlock

Table 14. Stand 4 – White Pine/Hemlock

Species	Trees/Acre	BA/Acre	BF/Acre	QMD	Avg. Sawtimber Ht (logs)	Total BF (Stand)
Black Cherry (*Prunus serotina*)	2.9	5.0	421.4	17.9	1.0	13,230.5
Eastern Hemlock (*Tsugas canadensis*)	94.9	67.5	5,347.1	11.4	1.5	167,899.7
Eastern White Pine (*Pinus strobus*)	40.2	77.5	11,463.9	18.8	2.0	359,965.5
Northern Red Oak (*Quercus rubra*)	5.9	5.0	522.8	12.5	1.5	16,415.1
Red Maple (*Acer rubrum*)	2.2	2.5	0.0	14.3	-	0.0
Total	146.0	157.5	17,755.1	14.1		557,510.9

Table 15. Stand 4 -White Pine/Hemlock Regeneration Data

	Size Class				
SPECIES	**1**	**2**	**3**	**4**	**Total**
American beech (*Fagus grandifolia*)	0	37.5	75	0	112.5
Black Birch (*Betula lenta*)	75	150	0	37.5	262.5
Eastern Hemlock (*Tsugas canadensis*)	2962.5	1987.5	37.5	112.5	5100
Northern Red Oak (*Quercus rubra*)	37.5	0	0	0	37.5
Red Maple (*Acer rubrum*)	262.5	0	0	75	337.5
Total	3337.5	2175	112.5	225	5850

Table 16. Stand 4 – White Pine/Hemlock Understory Shrub/Herbaceous Data

SPECIES	AVG. % Cover	# plots observed	% of plots observed
Assorted Fern Species	10.375	2	25
Assorted Grass Species	2	2	25
Assorted Moss Species	8.75	2	25
Partridgeberry (*Mitchella repens*)	5.25	4	50
Starflower (*Triantalis borealis*)	0.375	2	25
Tree Clubmoss (*Lycopodium obscurum*)	0.25	1	12.5
Wintergreen (*Gaultheria procumbens*)	0.625	1	12.5

Stand 5 – White Pine/Oak (North)

Table 17. Stand 5 – White Pine/Oak (North) Overstory Data

Species	Trees/Acre	BA/Acre	BF/Acre	QMD	Avg. Sawtimber Ht (logs)	Total BF (Stand)
Black Birch (*Betula lenta*)	1.7	2.5	0.0	16.2	-	0.0
Eastern Hemlock (*Tsugas canadensis*)	19.7	12.5	548.5	10.8	1.0	14,040.4
Eastern White Pine (*Pinus strobus*)	52.4	100.0	20,095.0	18.7	2.8	514,431.3
Northern Red Oak (*Quercus rubra*)	16.2	25.0	3,187.0	16.8	1.9	81,588.3
Red Maple (*Acer rubrum*)	1.7	2.5	441.3	16.2	-	11,297.4
Total	91.9	142.5	24,271.8	16.9		621,357.4

Table 18. Stand 5 - White Pine/Oak (North) Regeneration Data

	Size Class				
SPECIES	**1**	**2**	**3**	**4**	**Total**
American beech (*Fagus grandifolia*)	37.5	187.5	412.5	375	1012.5
Black Birch (*Betula lenta*)	0	37.5	450	337.5	825
Eastern Hemlock (*Tsugas canadensis*)	300	600	37.5	75	1012.5
Northern Red Oak (*Quercus rubra*)	600	0	0	0	600
Red Maple (*Acer rubrum*)	37.5	0	0	150	187.5
Total	975	825	900	937.5	3637.5

Table 19. Stand 5 – White Pine/Oak (North) Understory Shrub/Herbaceous Data

SPECIES	AVG. % Cover	# plots observed	% of plots observed
Assorted Fern Species	1.25	1	12.5
Dewberry (*Rubus flagellaris*)	0.375	1	12.5
Lowbush Blueberry (*Vaccinium angustifolia*)	2.375	5	62.5
Partridgeberry (*Mitchella repens*)	9.75	6	75
Tree Clubmoss (*Lycopodium obscurum*)	1	5	62.5
Wintergreen (*Gaultheria procumbens*)	3.375	5	62.5

Stand 5A – White Pine/Oak (South)

Table 20. Stand 5A – White Pine/Oak (South) Overstory Data

Species	Trees/Acre	BA/Acre	BF/Acre	QMD	Avg. Sawtimber Ht (logs)	Total BF (Stand)
Eastern Hemlock (*Tsugas canadensis*)	29.0	40.0	3,390.4	15.9	1.3	59,331.9
Eastern White Pine (*Pinus strobus*)	15.8	35.0	2,690.4	20.2	1.5	47,081.6
Northern Red Oak (*Quercus rubra*)	5.4	25.0	3,449.5	29.0	2.0	60,366.8
Red Maple (*Acer rubrum*)	38.0	65.0	3,465.6	17.7	-	60,647.4
Total	88.2	165.0	12,995.9	18.5		227,427.6

Table 21. Stand 5A - White Pine/Oak (South) Regeneration Data

	Size Class				
SPECIES	**1**	**2**	**3**	**4**	**Total**
American beech (*Fagus grandifolia*)	150	150	0	75	375
Black Birch (*Betula lenta*)	75	0	0	0	75
Eastern Hemlock (*Tsugas canadensis*)	150	0	75	0	225
Northern Red Oak (*Quercus rubra*)	75	0	0	75	150
Paper Birch (*Betula papyrifera)*	0	0	0	75	75
Red Maple (*Acer rubrum*)	75	0	0	0	75
Total	525	150	75	225	975

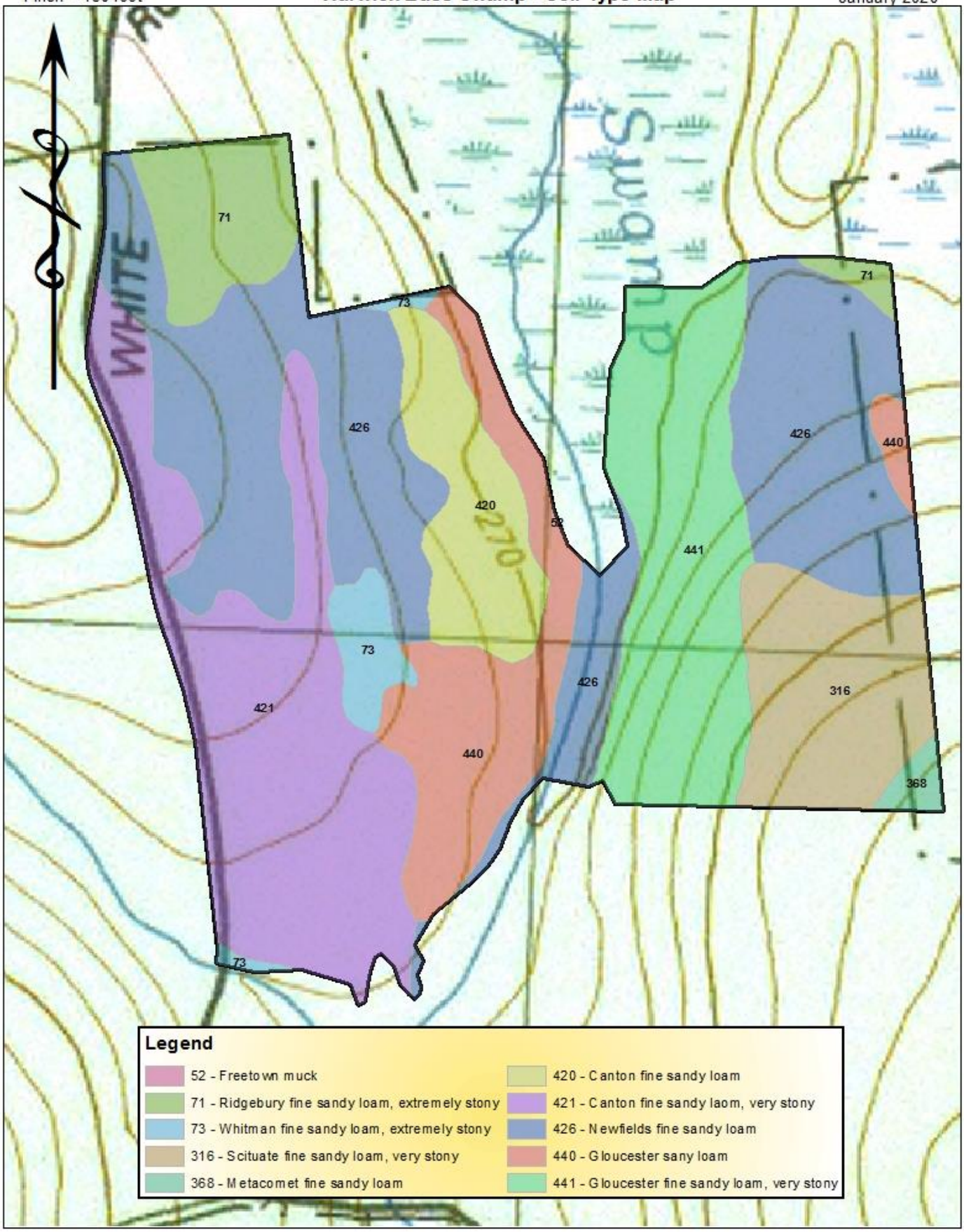
Table 22. Stand5A – White Pine/Oak (South) Understory Shrub/Herbaceous Data

SPECIES	AVG. % Cover	# plots observed	% of plots observed
No Tally	0.0	8.0	88.9
Partridgeberry (*Mitchella repens*)	0.2	1.0	11.1

1 inch = 450 feet

Warwick Bass Swamp - Soil Type Map

January 2020



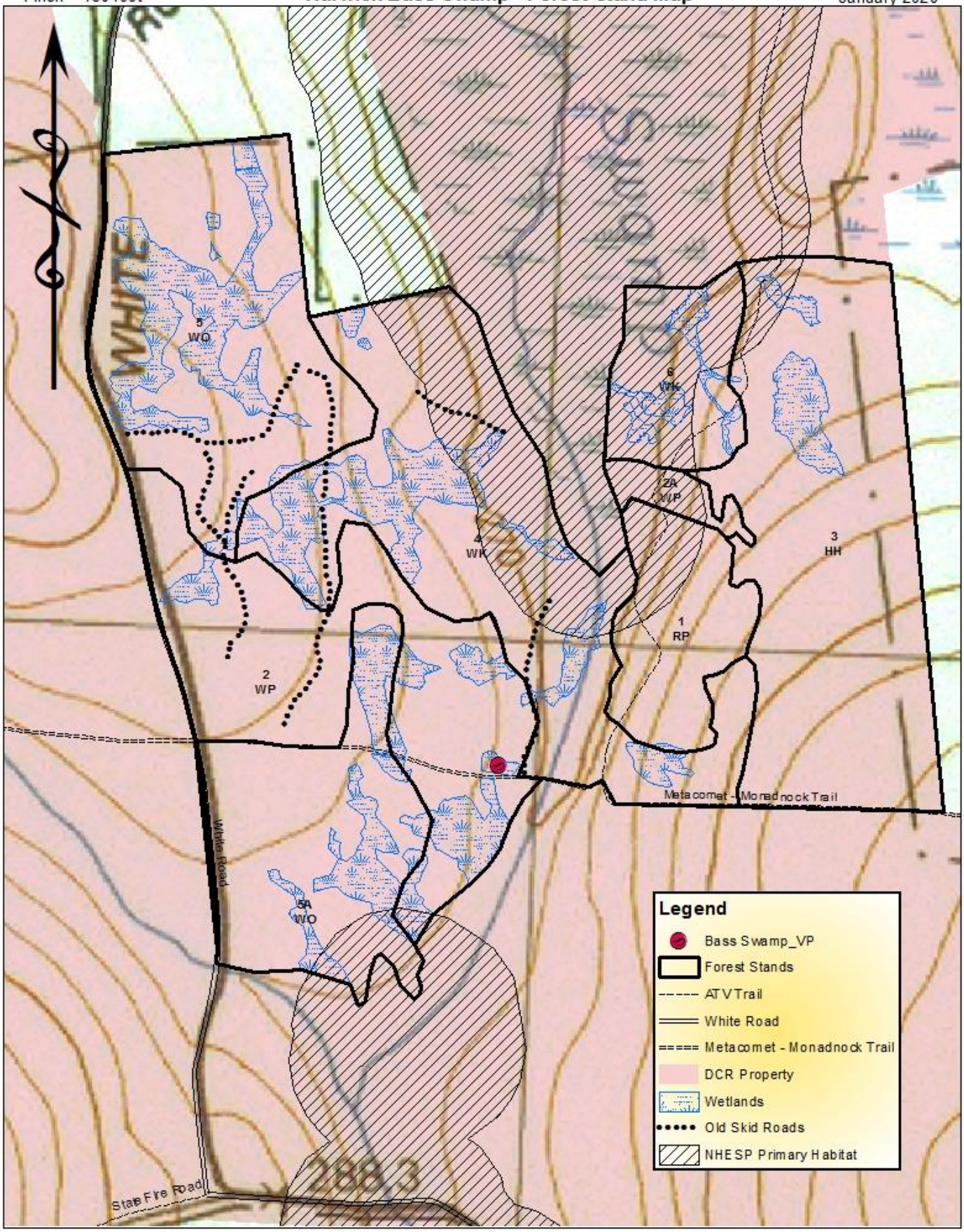
Legend

- 52 - Freetown muck
- 71 - Ridgebury fine sandy loam, extremely stony
- 73 - Whitman fine sandy loam, extremely stony
- 316 - Scituate fine sandy loam, very stony
- 368 - Metacomet fine sandy loam
- 420 - Canton fine sandy loam
- 421 - Canton fine sandy laom, very stony
- 426 - Newfields fine sandy loam
- 440 - Gloucester sany loam
- 441 - Gloucester fine sandy loam, very stony

1 inch = 450 feet

Warwick Bass Swamp - Forest Stand Map

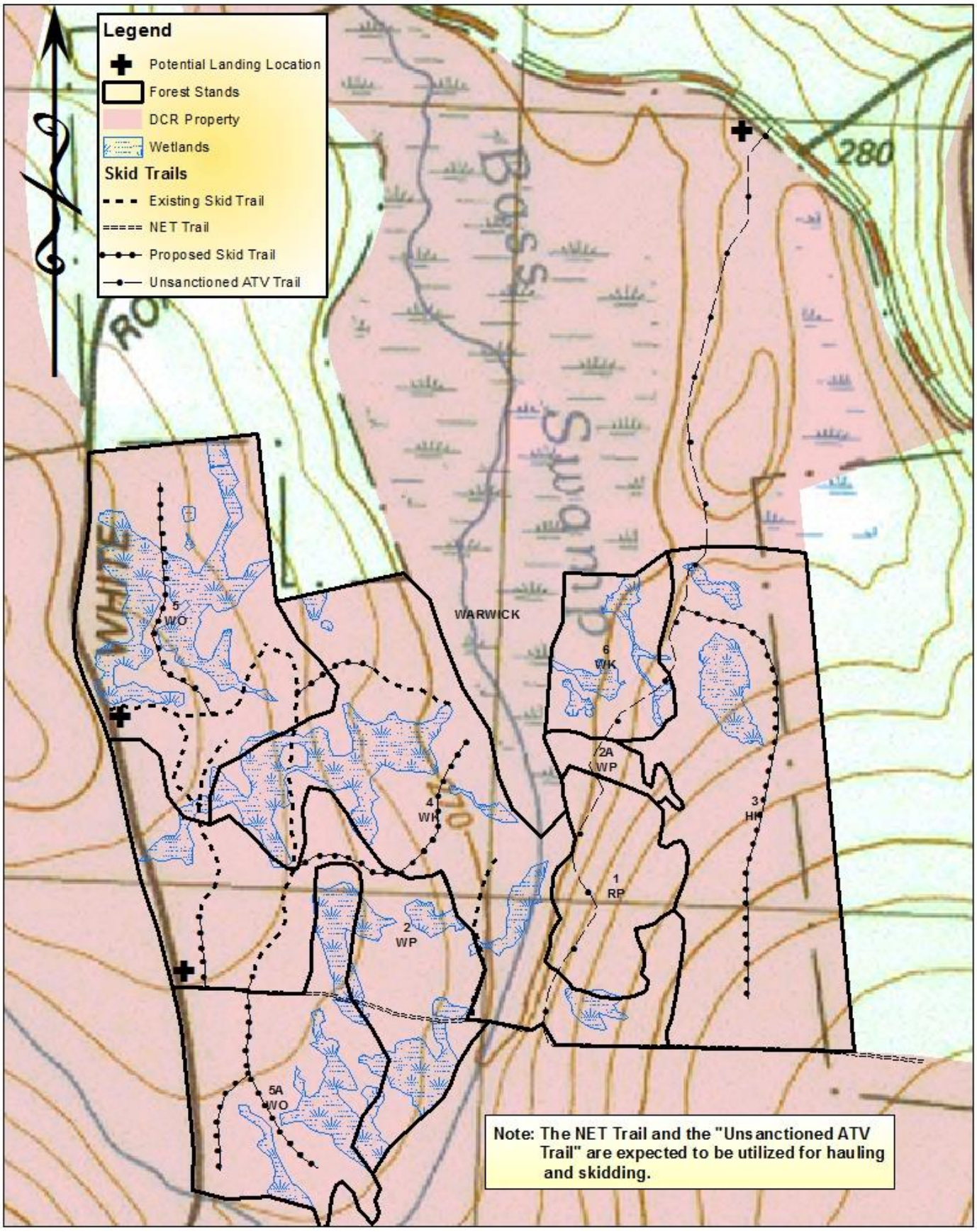
January 2020



1 inch = 500 feet

Warwick Bass Swamp
Potential Harvest Layout

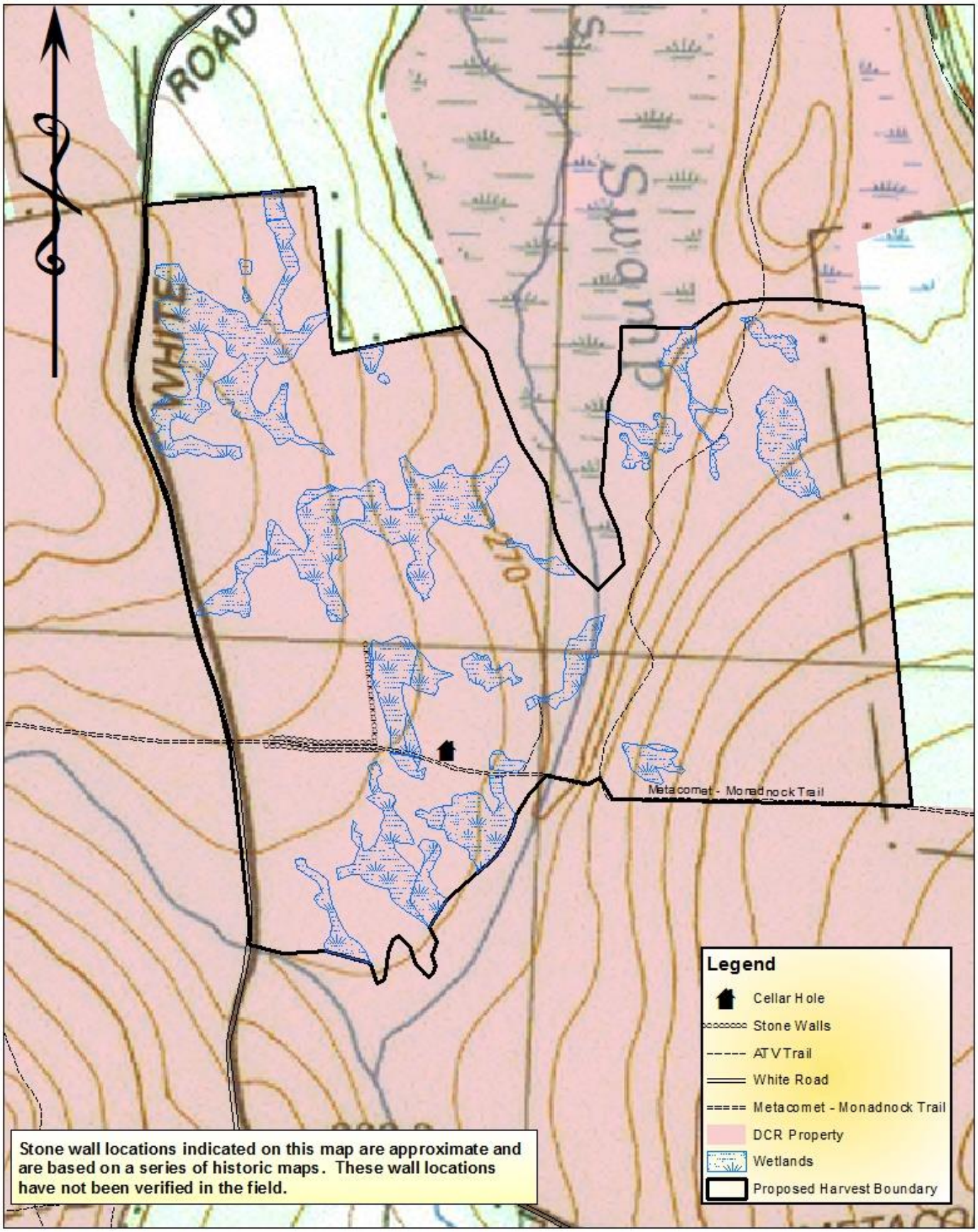
January 2020



1 inch = 500 feet

Warwick Bass Swamp
Potential Cultural Resources

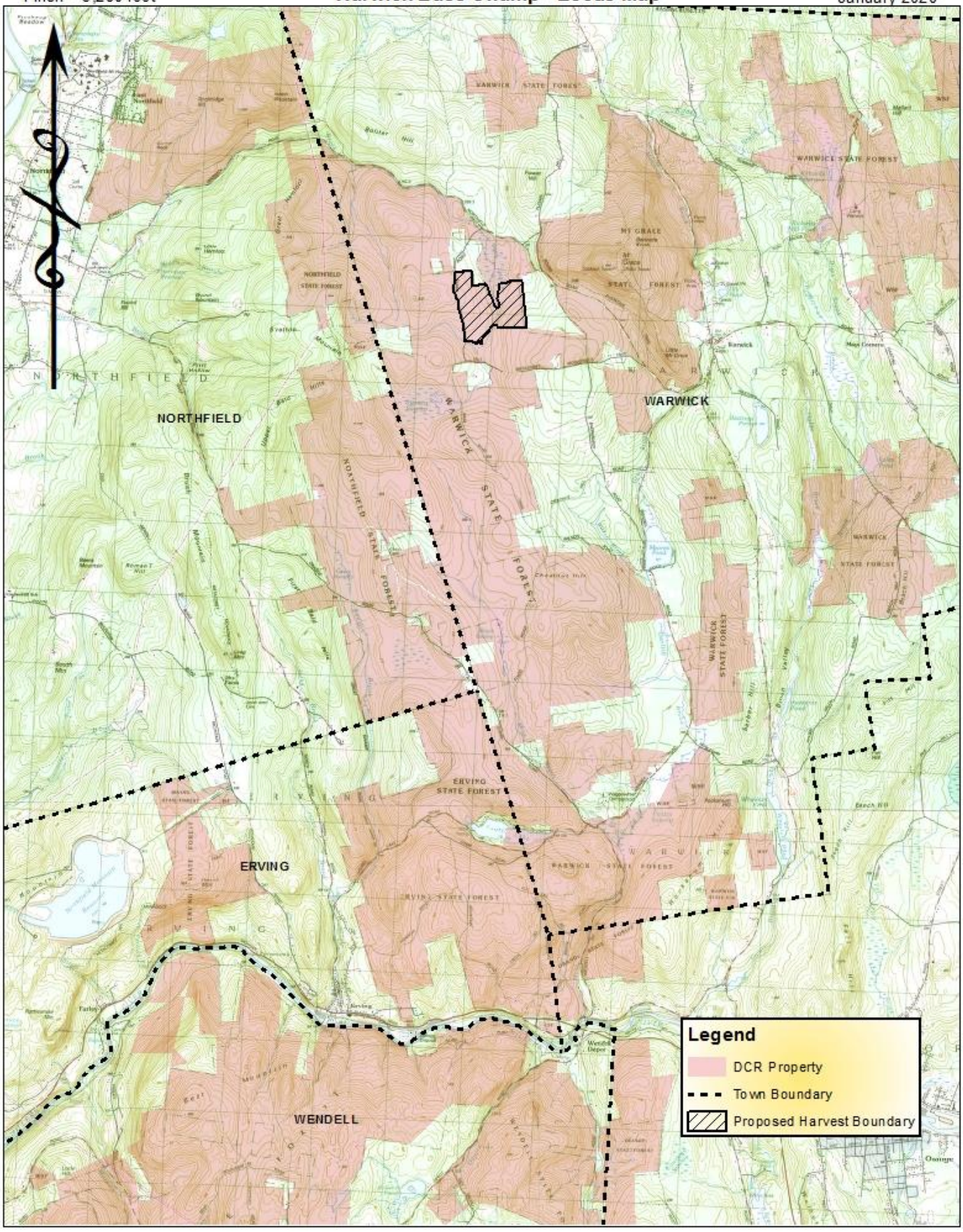
January 2020



1 inch = 5,280 feet

Warwick Bass Swamp - Locus Map

January 2020



References

Alerich, Carol L. 2000. Forest statistics for Massachusetts: 1985 and 1998. Resour. Bull. NE-148. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station. 104 p.

Commonwealth of Massachusetts. Department of Conservation and Recreation. *Landscape Designations for DCR Parks & Forests: Selection Criteria and Management Guidelines*. March 2012.

Goodwin, D.W. and W.N. Hill. 2012. Forest Productivity and Stand Complexity Model [A GIS Grid Analysis using ArcGIS®]. Massachusetts Department of Conservation and Recreation, Amherst, MA.

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov/. Accessed [December 2019].

Benzie, J.W. 1977. Red pine in the north-central states. Gen. Tech. Rep. NC-33 St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 22 p.

USDA Forest Service, Northeastern Area, State and Private Forestry, null 2005. Timber Management Field Book. United States Department of Agriculture, Forest Service, Northeastern Area State and Private Forestry, Newtown Square, PA NA-MR-02-08 August 2008

MA DCR, Bureau of Forestry, Feb. 2014. Manual for Continuous Forest Inventory Field Procedures. Massachusetts Department of Conservation and Recreation, Bureau of Forestry.

Leak, William B.; Lamson, Neil I. 1999. Revised white pine stocking guide for managed stands. NA-TP-01-99. U.S. Department of Agriculture, Forest Service, Northeastern Area State and Private Forestry. 2 p

Massachusetts Division of Fisheries and Wildlife. 2015. *Massachusetts State Wildlife Action Plan 2015*. Westborough, MA.