Silviculture Prescription
Hadley-Aiken - Partial Overstory Removal

Massachusetts Department of Conservation and Recreation
Bureau of Forestry

Mid State District
Templeton State Forest – Hadley Aiken Lot
Templeton, MA

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SITE DATA

Cultural and Historical

The Hadley Aiken lot is part of the Templeton State Forest complex and is located in the western portion of the town of Templeton. It is a conglomeration of several parcels that were acquired by the state over the past 100 years, resulting in a fairly irregularly shaped parcel of land. It is bounded on the south by Route 2 with the remainder of the abutters including the Templeton Developmental Center (TDC) owned by the Commonwealth of Massachusetts Department of Developmental Services to the northwest, private ownership to the south, northeast and southwest, and the United States Army Corps of Engineers (ACOE) to the east. It is believed that this parcel remained active as agricultural land until it was planted to trees in the early part of the 20th century.

The condition of the Hadley Aiken lot is a function of its past use and disturbance. Historically speaking, this property has undergone significant agricultural use, forest cutting/clearing and abandonment followed by reforestation plantings. In this case red pine (*Pinus resinosa*) was the primary species used along with Scots pine (*Pinus sylvestris*) and eastern white pine *(Pinus strobus)*. The intent was to periodically thin these plantations in order to maintain a stand of healthy vigorous trees with the ultimate goal of harvesting for wood products. After decades of neglect, many of these plantations have stagnated and become susceptible to diplodia tip blight (*Sphaeropsis sapinea*), a fungus, and red pine scale (*Matsucoccus resinosae*), an insect. The three forest stands present in this particular harvest differ mainly due to harvesting activity that has taken place within the last 30 years.

Cultural resources that have been located within the project area are almost entirely limited to a series of stonewalls, some delineating the state forest boundary and some interior walls that line old farm roads. A water hole that was constructed by the CCC is located in the western portion of the property. All cultural features that have been identified will remain intact and undisturbed.

Geology and Soils

The terrain varies dramatically throughout the harvest area, containing slopes that range from slight to very steep and include kame landforms. The western portion of the harvest area is dominated by an east facing slope, which levels out to a relatively flat area located in the southwestern corner of stand 1. The eastern half of this harvest area is where the plateau shaped kame landform exists. These kames resulted from glacial deposits and resemble the shape of a small plateau; bearing moderately steep slopes on all sides and being relatively flat on the top. There are three kames with slopes ranging from 15% to greater than 50%. The steepest slopes present are east facing and located on the far eastern boundary.

The property is underlain by an outwash plain of mostly droughty soils that varies from moderately well drained to excessively well drained. Harvesting operations will only take place where the soils are suitable for the use of machinery. The use of harvesting equipment will be limited to specified crossings where soils are described as poorly or very poorly drained; otherwise the use of machinery will be prohibited within areas where wet soils exist. There are five soil types that make up the upland portion of the project area which will support harvesting operations. Additionally there are two soil types which are located in the project area that underlie wetlands which will not support harvesting operations. The soil descriptions and maps were derived from the NRCS Web Soil Survey (Appendix, Soils Map).

The majority of the project area is underlain by the Colton gravelly loamy sand. This soil type is divided into 4 groups based on slope (282B = 3 to 8 %; 282C = 8 to 15%; 282D = 15 to 25%; 282E 25-35%). Despite the difference in slope the soil properties are identical across the 4 groups. This is an excessively well drained outwash soil that is deep (being more than 80 inches to a restrictive feature) and has a very low available water capacity that is comprised of sandy and gravelly glaciofluvial deposits derived from granite. It encompasses 52.7% of the total harvest area. The next most prevalent soil is the Allagash fine sandy loam (281B = 3 to 8% slopes; 281C = 8 to 15% slopes) which encompasses 22.1% of the total harvest area. This is a glacial outwash soil that is well drained with a depth that ranges from 15 to 35 inches

and is primarily located in stand 1. The Becket-Monadnock association (900E = 15 to 45% slopes) encompasses 13.8% of the total harvest area. Being an association, this soil is comprised of two major soil types. Both soil types are well drained and moderately deep with a low available water capacity. Particularly noteworthy is the Monadnock soil which has 9% of its surface area covered with cobbles, stones, or boulders. The Croghan loamy fine sand (284A = 0 to 3% slopes; 284B = 3 to 8% slopes) underlies 4.2% of the total harvest area. It is moderately well drained and is more than 80 inches deep with a low water capacity and is partially located in stand 3. The Adams loamy sand (280B = 3 to 8% slopes) is described as being an excessively drained, very deep soil (more than 80 inches) that has a low available water capacity and is present in stand 1, underlying 1.2% of the total harvest area.

There are two soil types identified within the harvest area that are associated with poorly drained sites. The first is the Bucksport and Wonsqueak mucks (59A = 0 to 3% slopes). The Bucksport soil is a very poorly drained, deep soil (more than 80 inches), which has a very high available water capacity. The Wonsqueak soil is described very similarly, with the only difference being in the parent material and profile. Both soils are derived from highly decomposed herbaceous organic material, with the Wonsqueak soil having a layer of gravelly fine sandy loam where the Bucksport soil does not. This soil underlies the wetlands on the edge of the project area. The soils map delineates a small portion of stand 1 as Bucksport and Wonsqueak muck, although ground conditions are upland and dry throughout the year. The Searsport loamy sand (28A = 0 to 3% slopes) is a very poorly drained, very deep soil that has a low available water capacity, which is comprised of a shallow layer of highly decomposed plant material lying on loamy sand. It is located underneath the larger wetland located centrally within the project area.

Site Productivity

Soil productivity varies greatly throughout the harvest area, but seems to favor the development of upland plant species communities which are suited for these droughty soil types (USDA-NRCS). The two most prominent soil types, Colton gravelly loamy sand (52.7% of harvest area) and Allagash fine sandy loam (22.1% of harvest area) support the growth of white pine in comparison to other native species. The Colton gravelly loamy sand has a site index of 62 for eastern white pine, 61 for sugar maple (*Acer saccharum)* and 52 for red pine. The Allagash fine sandy loam has a site index of 72 for eastern white pine, 71 for red pine, and 52 for white spruce (*Picea glauca*). The Becket-Monadnock soil follows the same trend, with a site index of 69 for eastern white pine, 60 for sugar maple, and 71 for paper birch *(Betula papyrifera)*. The less prevalent soils that are well drained favor the growth of eastern white pine over any other species, while the poorly drained soils encourage more of a spruce/cedar/fir forest type. The overall average site index for the entire harvest area for eastern white pine is 64, whereas other species had a much lower value.

The DCR Management Guidelines of 2012 state that forest stands will be “classed… and considered for silvicultural treatments that generally fit their productivity, structural complexity (or potential thereof) and diversity”. As analysis of stands 1-3 of the Hadley Aiken site history (land use; agriculture/logging) and conditions (soil types, productivity; vegetation cover) suggests that these even-age lower complexity stands on poorer soils led themselves to even-age management (Goodwin and Hill, 2012).

Climate

For this area, the United States Department of Agriculture’s Natural Resource Conservation Service (USDA-NRCS) gives a mean annual temperature between 43 and 54 degrees Fahrenheit with a mean annual precipitation between 45 and 54 inches annually. The National Oceanic and Atmospheric Administration (NOAA) more specifically states that the mean annual temperature of this project area is 46.2 degrees Fahrenheit with a mean annual precipitation of 44.5 inches. There have been no significant disturbances of the project area due to weather.

As is typical for New England, wind and therefore weather patterns in Massachusetts vary greatly from season to season and even day to day. It is typical in the summer and spring for winds to come from the southeast and southwest. It is common for weather patterns to come down from the north and northeast in fall and winter. These weather patterns can contain both high or low pressure systems and any form of weather historically common to New England. Weather

can cause both major and minor forest disturbance in this area of Massachusetts. Hurricanes, wind and ice have had impacts on this landscape in the past and will continue to do so in the future.

Hydrology and Watershed

The Hadley Aiken Lot is located in the southern portion of the Millers River Watershed which encompasses nearly 310 square miles and is located in north central Massachusetts, extending slightly into southern New Hampshire. The headwaters of the Millers River are located in Ashburnham, MA and the river continues through several towns including Winchendon, Royalston, Athol, among others, and westward until it reaches the Connecticut River, which flows into Long Island Sound. The harvest area lies within fairly close proximity to two tributaries to the Otter River which is itself a tributary to the Millers River. The closest of which lies just east of the harvest boundary and is referred to as Trout Brook on ACOE land. This is a slow moving stream with a predominantly muddy bottom. This stream flows in a northerly direction eventually meeting Crow Hill Brook, prior to reaching the Otter River two miles north of the harvest area. The other stream is located north and west of the harvest area and is referred to as Crow Hill Brook. This stream flows in a northeasterly direction eventually meeting Trout Brook, which flows into the Otter River.

There are several water resources located within close proximity to, as well as within the harvest area boundary. A large mixed species wooded swamp lies in the western portion of the state forest. This system consists of a series of wetlands, both large and small that flow south and east across varied topographical gradients. In some cases, the system narrows into stream channels such is the case for the area of stream crossing #2 (Appendix, Harvest Map). There is another large mixed wooded swamp located centrally in the harvest area along the edge of stand 1. A perennial stream connects both of these larger wetland systems (Appendix, Harvest Map). There is one potential vernal pool within the harvest area and it will be treated as though it were a certified vernal pool. There will be three stream crossings for this timber harvest. All stream crossings were utilized in the 2014-2015 harvest, with stream crossing #1 and #3 being permanent. Stream crossing #1 is on the main truck road and stream crossing #3 is adjacent to a CCC constructed fire pond. Stream crossing #2 will be temporarily bridged with corduroy placed on the approaches to the crossing to help stabilize and protect the stream banks. The crossing will be pulled upon completion of harvesting activities. All stream crossings will comply with the Massachusetts Forestry Best Management Practices Manual (BMP's).

Full consideration has been given to impacts that this particular timber harvesting operation will have within the Millers River Watershed. No more than 50% of the basal area will be harvested within 50 feet from the edge of any stream or wetland. There will be no harvesting in wetlands. Appropriate measure will be taken in order to mitigate and prevent erosion (i.e. water bars, seeding, slashing of skid roads, etc.). Slash will be left on site not only to provide nutrients to the soil and for habitat purposes, but to also slow overland flow of water and to promote percolation of water into the soil.

Wildlife

A review of the Natural Heritage and Endangered Species Program (NHESP) atlas shows that there are no habitat restrictions located within the project area. NHESP will review the project prior to any harvesting to determine if any limitations or modifications will be required. There are signs of deer, moose and turkey using this area. Deer browse is not problematic for the regeneration at this time. Large and small mammals and numerous bird species are assumed to utilize the project area. As outlined in the DCR Management Guidelines (Commonwealth of Massachusetts, 2012), selected large trees will be reserved as wildlife trees for future snag and den trees. Snags, dead trees and coarse woody debris will be retained for habitat as well. A minimum of two cords (256 cubic feet) of coarse woody debris (CWD) will be maintained per acre. Browse for wildlife will be enhanced during the harvest and for many years after the harvest as regeneration becomes established. Mast and fruit producing trees such as oak (*Quercus spp.)*, American beech (*Fagus grandifolia*) and black cherry (*Prunus serotina*) will be retained whenever possible.

Recreation

All aesthetic considerations will be made to legal recreational users of the state forest. Slash over 1" in diameter will be lopped to under 2 feet in height above the ground. Larger trees along the edges of trails will be retained. As mentioned in the DCR Management Guidelines for roads and trails, hazard trees will be harvested along the truck roads, skid trails and hiking trails (Commonwealth of Massachusetts, 2012). Harvesting operations will be limited to times when ground conditions are stable. Directional felling to protect residual trees, wetlands, woods roads and trails will also be implemented. Removal of potentially hazardous trees to aid in public safety will be implemented.

Hiking, mountain biking, skiing, snowshoeing and hunting, among others, are potential uses of this state forest. Illegal ORV use has seriously degraded woods roads and trails located in the state forest. Woods roads and trails with serious erosion were permanently closed during the last forest management project (2015). Two gates were installed along the main truck road and many of the interior trails were slashed in to prevent ORV use in the interior of the forest. Illegal ORV use remains problematic throughout the state forest but is limited to the main interior forest road and a few skid trails. The project area will be closed to the public during active harvesting hours. A snowmobile trail that is permitted for use and maintained by the Coldbrook Snowmobile Club is located at the Hadley-Aiken Lot and within the project area. This trail will be utilized as a truck road and the project timeline will be communicated to the snowmobile club to prevent user conflicts.

Current Vegetation

There are 183.9 acres at the Hadley Aiken Lot which consists of non-native plantation red pine, Scots pine and native white pine. Currently this site is dominated by red pine which was planted by the CCC. It is most likely that CCC Camp S-63 (Company 1102) planted these trees. This particular camp was established at Otter River in 1934 and their initial projects included forestry, road construction and water hole establishment for fire protection (Berg, 1999).

Three forest stand types have been differentiated within the greater plantation due to current species composition, size class and past silviculture treatments (Appendix, Harvest Map). The most common overstory species are red pine, Scots pine and eastern white pine. Other associated species include red maple (*Acer rubrum*) and northern red oak (*Quercus rubra*). The largest plantation on the property is of red pine and has been divided into two separate stand types based on the current stand condition as a result of past forest management. In addition, there is a Scots pine plantation (Appendix, Harvest Map). Stand age is estimated to be around 80-85 years old. The plantations are mature, fully stocked and have stagnated in growth. These stand conditions often bring about a higher susceptibility of disease and infestation. Red pine scale and diplodia tip blight often infest and infect declining stands of red pine and are capable of causing mortality within one growing season. Red pine plantations are facing mortality from these causes in central Massachusetts. Red pine scale was positively identified by DCR Forest Health staff at Erving State Forest in the fall of 2019. At this time, it is evident that a large percent of the harvest area is showing signs of dieback from what is suspected to be a combination of red pine scale and diplodia tip blight. It is assumed that much of the areas showing signs of dieback will be dead in the near future.

Stand 1 was most recently harvested with the shelterwood method from December 2014 through September 2015. The majority of the stand stocking was reduced to a basal area of 80 square feet per acre, with some areas remaining at a higher basal area, particularly on steeper slopes. The majority of stand 1 was treated previously in 1988. Additionally, the southwestern portion of stand 1 was treated in 1984 resulting in the most prevalent advanced regeneration and structural diversity within the stand. Thinnings in the 1950's for fence posts in the central portion of stand 1 have had no effect on the current stand conditions. Stand 2 was left uncut in 2014-2015 due to a NHESP restriction which has since been absolved. It was harvested in 1988 along with stand 1. Across all stands, areas of natural mortality and past silviculture entries have increased the plantations structural complexity over the past 35 years. White pine seedlings and saplings are the dominant regenerating species on the site, followed by hemlock (*Tsuga canadensis*), northern red oak, white oak (*Quercus alba*) and poplar (*Populus spp*.) (Appendix, Table 12). The most recent harvest released advanced regeneration as well as improved the growing conditions for regeneration to become established in the areas where it was absent. The ground species are associates of upland forest communities. Lowbush blueberry *(Vaccinium*

angustifolium), highbush blueberry (*Vaccinium corymbosum)*, trailing arbutus (*Epigaea repens)*, northern dewberry *(Rubus flagellaris)*, sweetfern (*Comptonia perigrina)* and sheep laurel (*Kalmia angustifolia*), among others, are common in the ground layer throughout the project area.

STAND DATA

Stand Descriptions

General

The invasive species glossy buckthorn (*Rhamnus frangula)* is present in the harvest area. It is confined to roadside areas along the main truck road that runs through the state forest. These patches have been successfully treated twice since the harvest in 2015. Small pockets of glossy buckthorn can be found and will be treated in combination with this timber harvest.

Stand 1 – Red Pine Plantation

Stand 1 is a 148.2 acre red pine plantation located largely throughout the timber harvest area. This stand was most recently treated in 2015. Previously, portions of the plantation were thinned in the 1950's and in 1984 and 1989. The dominant overstory species is red pine. Eastern white pine and Scots pine also occur in the overstory in lesser amounts (Appendix, Table 1-2). This stand is roughly 85 years old. Currently, the basal area of the stand is 91.1 square feet per acre with 98.6 trees per acre. Approximately 81.2% of the basal area is composed of red pine and 13.7% of the basal area is composed of white pine. The quadratic mean stand diameter is 13.0 inches.

The harvest in 2014-2015 removed a significant portion of the pre-existing stocking within the plantation. As a result, the current structure of this stand is made up of evenly spaced mature trees whereas the density is low enough where direct and diffuse light is reaching the forest floor throughout the entire day. The increased light to the understory has allowed the advanced regeneration to thrive as well as provided the growing conditions for non-stocked areas to regenerate. Portions of this planted stand were left completely unmanaged / uncut until 2015. These areas are mostly on the steeper slopes of the kame topography. The basal area in these locations was maintained at a slightly higher density due to the small live crown ratios of the trees at the time. It was thought that by leaving a higher density the residual stand would be less susceptible to blow down and also provide enough shade in the understory to prevent white pine seedlings from desiccating after germinating.

Unfortunately, drought has slowed the germination success within certain areas of stand 1. Although most areas of the stand contain an abundance of advanced regeneration in the understory there are some areas still lacking. There are approximately 2,736 stems per acre of advanced regeneration in the understory. White pine seedlings and saplings are the most dominant at 917 stems per acre (33.5%), followed by eastern hemlock with 778 stems per acre (28.4%) and northern red oak with 361 stems per acre (13.2%) (Appendix, Table 3). Understory plants include lowbush blueberry, Canada mayflower *(Maianthemum canadense),* northern dewberry*,* trailing arbutus, sweetfern and bracken fern *(Pteridium)*, among others. There are approximately 26.1 snags per acre. There is an estimated volume of 634 cubic feet per acre of CWD in the stand. There are several wetlands located along the edge of stand 1. In addition, there are three wetlands, one intermittent stream, one perennial stream and one potential vernal pool located within the harvest area. An existing stream crossing will be utilized on the perennial stream and a temporary stream crossing will be installed on the intermittent stream. No more than 50% of the basal area within 50 feet of any wetland or stream will be harvested (Appendix, Harvest Map).

Stand health is declining rapidly at this time. Within the past 6 months, significant flagging is occurring and crown dieback is evident. Red pine scale is the likely cause of the stands decline. Widespread mortality is anticipated in the very near future.

Stand 2 – Red Pine Plantation

Stand 2 is 20.2 acre red pine plantation that is located primarily along the eastern boundary of the property. Portions of this stand were harvested in the 1950's and 1980's but were left uncut in 2015. The basal area of this stand is 168.2 square feet per acre with 162 trees per acre. The quadratic mean stand diameter is 13.8 inches (Appendix, Table 4-5). The dominant species present is red pine, which consists of 93.7% of the total overstory basal area, with an occasional occurrence of eastern white pine (3.5%) (Appendix, Table 4-5). The close proximity at which these trees were planted (5 feet by 5 feet) and the lack of thinning through the years has resulted in a high level of competition and crowding, leaving the overstory trees with thin crowns and stagnated growth. Pockets of natural mortality are present from the stagnation in growth and insect and fungal infections. As with stand 1, stand health is declining rapidly at this time, likely a result of red pine scale infestation.

There are approximately 1,667 stems per acre of advanced white pine regeneration in the understory (Appendix, Table 6). Understory vegetation includes lowbush blueberry, huckleberry (*Gaylussacia baccata*), bracken fern, sweetfern, trailing arbutus and Canada mayflower, among others. There are 14.5 snags per acre in this stand and an estimated 79.6 cubic feet of CWD.

There are no wetland resources in this stand. Portions of this stand will remain uncut due to steepness. This will be determined while conducting field work in preparation for filing the forest cutting plan.

Stand 3 – Scots Pine Plantation

Stand 3 is a 15.5 acre Scots pine plantation located in the southeastern portion of the property. Portions of this stand were treated in the 1980's while other areas have died back naturally more recently. The basal area of the stand is 105.9 square feet per acre with 116 trees per acre. Scots pine accounts for approximately 52.2% of the stands basal area, followed by red pine at 22.2% and white pine at 15.6%. The quadratic mean stand diameter is 13.0 inches (Appendix, Table 7-8).

There are approximately 2,125 stems per acre of regeneration in the understory. White pine accounts for nearly half of that stocking at 1,250 stems per acre, followed by northern red oak at 350 stems per acre (Appendix, Table 9). The majority of the regeneration is in the smallest size class, being 3 inches tall to 1 foot in height. This is likely due to recent mortality within the stand but also the presence of increased diffuse light entering from stand 1 as a result of the 2014-2015 harvest. There are 52.4 snags per acre in this stand as well as 332.1 cubic feet of CWD. The majority of the snags are Scots pine.

There are no wetland resources in this stand. As with stand 2, portions of this stand will remain uncut due to steepness. These areas will be determined while conducting field work for the forest cutting plan.

EVALUATION OF DATA AND PROJECTED RESULTS

Project Objectives

There are several overall objectives of this project:

1.) Harvest the remaining red pine overstory prior to its impending mortality.
2.) Release advanced regeneration of native tree species from the plantation which have undergone past forest management.
3.) Demonstrate harvesting techniques and best management practices that protect forest productivity, soil and water resources.
4.) Address illegal ORV use by using project revenues and contractual requirements to repair damage to roads and trails and to prevent future damage from occurring.

Silvicultural Prescription and Desired Results

Stand Exam – Method and Goal

In May 2020, a forest stand exam was conducted within the limits of the timber sale area. The sampling method conducted had two primary goals. The first was to collect regeneration data on the number of stems per acre of

desirable advanced regeneration present. The second was to collect data on the overstory trees to gain a more accurate knowledge of the density, size, volume and condition of the overstory trees. The purpose for collecting regeneration data was to help guide management decisions between conducting a partial overstory removal in areas that had sufficient levels of regeneration (500 stems per acre) compared with areas that do not contain sufficient regeneration to conduct this type of treatment. Points were laid out in a hexagonal grid, equaling one plot per acre. At each point, a 1/500th acre "stocked quadrant" plot was established to check for the presence of at least one desirable seedling. A desirable seedling would be measured if it met the following criteria: one of white pine or an oak species that is one foot in height and of acceptable quality which is free to grow. We also sampled (counted) every live and dead tree greater than 5" diameter at breast height (dbh) by species using horizontal point sampling with a 20 basal area factor (BAF).

At every fourth point (pre-determined to ensure an even geographic coverage), a full regeneration sampling tally was conducted. We still checked for the presence of one desired seedling but also took a full tally of all live seedlings less than 5" dbh. For the overstory, all live and dead trees greater than 5" dbh were sampled using a 20 BAF. Species, diameter and tree class (acceptable growing stock, unacceptable growing stock or cull) were recorded. In addition, a 25-foot CWD transect was conducted at which all pieces of CWD greater than or equal to 3" diameter and 3 feet in length that intersected the transect were recorded.

The results of this stand exam (primarily basal area and tree frequency) combined with data collected in 2014 prior to the harvest (BigBAF/VBAR) can be found in Tables 1-12 of the appendix. It was determined from the data collected that 161.9 acres of the harvest area contained sufficient regeneration in the understory to undergo a partial overstory removal. The remaining 22 acres did not have sufficient regeneration and will be treated with a shelterwood harvest (Appendix, Silviculture Map).

<u>Partial Overstory Removal – 161.9 acres</u>
A partial overstory removal will be implemented in areas that contain sufficient stocking levels of advanced regeneration (500 stems per acre). This treatment is the final harvest of the even age shelterwood regeneration system. The shelterwood regeneration system applies a series of harvests to an area intended to be regenerated which alters the amount of light available to the understory over time to create the optimal growing conditions to regenerate the site with desirable species. The purpose of this treatment is to harvest the majority of the overstory to allow an increase in resource availability to the advanced regeneration that grew as a result of previous shelterwood cuttings. The future desired condition is a young, rapidly growing forest that is dominated by drought tolerant species which are well suited to the site. Removal of the red pine and Scots pine plantations will allow a native forest to take its place. Much of this area has previously undergone the first two stages of the shelterwood regeneration system, the preparatory (1980's) and regeneration harvests (2014-2015). In many cases, the entire overstory is removed as a part of the final overstory removal. At this time, we intend to partially remove the overstory, purposefully retaining portions of the overstory for wildlife habitat. Per the DCR Management Guidelines (Commonwealth of Massachusetts, 2012), 1-3 live, large diameter (>18" dbh) trees per acre and 4 live, 12" to 18" dbh trees per acre will be retained for future snag and den trees for wildlife. Native tree species that meet these requirements will be preferred, while red pine and Scots pine will be the least preferred.

<u>Shelterwood – 22 acres</u>
Another shelterwood harvest will be implemented where there is not adequate regeneration stocking present. The purpose of this harvest is to reduce the stocking level of the overstory so that an increase of light can permeate to the understory to partially release advanced regeneration as well as to provide the conditions suitable for species to seed onto the site. Advanced regeneration will be protected where present. The target residual basal area of this area will be 30 square feet per acre. Trees that are in poor health, that have small crowns and are poorly formed will be targeted for removal while maintaining the healthiest and best formed trees. Trees that exhibit defects will also be targeted for removal.

EXPECTED RESULTS

Partial Overstory Removal

This harvest will create a very drastic change to the aesthetics of the area. There will be few overstory trees in the forest and the advanced regeneration will be flooded with sunlight. At this point, the regeneration will be competing for sunlight, nutrients, water and growing space. Trees will be rapidly allocating their resources for increased height growth while slowly beginning to grow larger in diameter. White pine is likely to outcompete most native species on this site. Some areas that are void of white pine regeneration will grow a mixture of hardwoods and hemlock if present. The residual overstory trees are unlikely to benefit from the increased growing space. The current condition of the overstory is so poor that it is anticipated that most of the residual overstory trees will not live beyond the 2021 growing season. Future entries may focus on improving the growing stock present into the future and could include pruning of white pine and pre-commercial or commercial thinnings. However, this will be several decades into the future. Monitoring of regeneration growth and the presence of invasive species will be necessary to ensure that the management goals are being achieved.

Shelterwood

There will be a considerable amount of light and growing space available for regeneration to become established and for the release of advanced regeneration present in the area treated. There will be relatively few residual overstory trees remaining. The overstory is unlikely to respond to this treatment and is anticipated not to live beyond the 2021 growing season. It is hoped that regeneration can become established in what little shade the overstory will provide before it dies. As stated above, white pine is expected to outcompete most native species on this site. A mixture of hardwoods and hemlock might be present in areas as well as young red pine. Monitoring of regeneration growth, overstory decline and invasive species will be implemented to ensure management goals are being achieved.

Logging System Requirements

This harvest will be completed using a fully mechanized operation and will be limited to the use of a cut to length harvester/processer. This type of harvesting equipment allows for a level of efficiency that is well suited for processing low value products. It is especially well suited for operating in plantations. Previous harvesting operations in the 1980's on this property utilized whole tree harvesting (WTH) systems, which can severely limit the amount of slash and coarse woody debris left behind. The cut to length system will allow for increased levels of slash and woody material to be left on site, effectively replenishing nutrients to the forest soil, providing cover and habitat for wildlife and mitigating erosion by slowing the overland flow of water.

As previously stated, the minimum goal for CWD to be left on site is 256 cubic feet per acre as directed by current Management Guidelines (Commonwealth of Massachusetts, 2012). This will be easily achieved using the above described system. Stands 1 and 3 are already meeting this threshold, while stand 2 is below.

Steep slopes will be subjected to minimal equipment operation due to the highly erodible soils. This harvest area is subject to an abundance of illegal ORV use, which will exacerbate erosion, especially on these steeper slopes. It will be required that the majority of skid roads created on these slopes and within the harvest area be blocked in attempt to curb ORV use. The main truck roads will remain open post harvesting.

Access to this area will be made from a legal ROW off of Route 2A (Patriots Road) from an abutting landowner.

Marking Guidelines

General

1.) Blue marking paint from 2014-2015 remains visible in the woods and therefore cannot be used.

2.) Triple striping with paint will indicate the timber harvest edge, property boundaries, wetland buffer edges, vernal pool buffer edges and any other areas which machinery should not travel beyond. All trees marked with triple striping are not to be harvested.
3.) The filter strip on streams will be marked with double striping with and "F" written intermittently along the edge.
4.) A leave tree marking system will be implemented. Trees having a single horizontal line marked at breast height are to remain uncut. All trees located within the harvest perimeter and that remain unpainted are designated for removal.
5.) Red pine and Scots pine trees are priority for removal followed by white pine and then associated hardwoods that are present in the harvest area.
6.) Trees which exhibit excellent form, regardless of species and size class will be retained to encourage species diversity.
7.) Trees targeted for removal will be poor in health and vigor, have obvious defects such as crook, sweep, excessive limbiness, decay, epicormic branching and multiple leaders or are suppressed.

Partial Overstory Removal

1.) 1-3 live, large diameter (>18" dbh) trees per acre and 4 live, 12" to 18" dbh trees per acre will be retained for future snag and den trees for wildlife.
2.) Retention trees should be native species where present, followed by the healthiest, best formed, most wind firm red pine or Scots pine present.

Shelterwood

1.) Residual basal area stocking will be 30 square feet per acre. Effort will be made to maintain an even spacing. Trees to be retained should be those that are in the dominant and co-dominant size class that exhibit large and healthy crowns and are wind firm.

APPENDIX

CURRENT CONDITIONS

Table 1. Stand 1 - Red Pine Overstory Data Table (Stems ≥ 5" dbh)

Species name	Sawlog BF/acre	Sawlog BF standard error (% of mean)	Pulp cords/acre	Pulp cords/acre standard error (% of mean)	Total BF (stand)	Sawtimber mean height (logs)	Total cords (stand)	Topwood cords (stand)
red pine (*Pinus resinosa)*	10,606	6.2%	0.8	58.2%	1,573,086	2.4	125.4	407.3
eastern white pine (*Pinus strobus)*	849	35.1%	1.5	41.3%	125,998	1.8	223.0	67.3
Scots pine (*Pinus sylvestris)*	39	70.5%	-	91.2%	5,826	2.3	0.5	1.7
eastern hemlock (*Tsuga canadensis*)	-	-	-	58.3%	-	2.3	2.3	-
red maple (*Acer rubrum)*	-	-	-	104.6%	-	2.3	0.6	-
sweet birch (*Bentula lenta)*	-	-	-	-	-	-	-	-
American beech (*Fagus grandifolia)*	-	-	-	84.7%	-	2.3	2.3	-
cottonwood and poplar spp. (*Populus spp.)*	-	-	-	76.9%	-	2.3	1.1	-
black cherry (*Prunus serotina)*	-	-	-	104.6%	-	2.3	0.6	-
white oak (*Quercus alba)*	-	-	-	-	-	-	-	-
northern red oak (*Quercus rubra)*	-	-	-	72.7%	-	2.3	4.6	-
black oak (*Quercus velutina)*	-	-	-	46.2%	-	2.3	6.8	-
ALL	11,495	6.4%	2.5	31.2%	1,704,910	2.3	367.1	476.3

Table 2. Stand 1 - Red Pine Overstory Data Table (Stems ≥ 5" dbh)

Species name	Total trees/acre	Total trees/acre standard error (% of mean)	Total basal area (ft^2/ac)	Total basal area standard error (% of mean)	% basal area by species	QMD	% AGS
red pine (*Pinus resinosa)*	71.5	6.1%	74.0	5.3%	81.2%	13.8	96.7%
eastern white pine (*Pinus strobus)*	21.3	19.7%	12.5	16.6%	13.7%	10.4	52.0%
Scots pine (*Pinus sylvestris)*	0.4	-	0.3	70.5%	0.3%	11.3	100.0%
eastern hemlock (*Tsuga canadensis*)	0.3	-	0.5	49.5%	0.6%	18.1	100.0%
red maple (*Acer rubrum)*	0.2	-	0.1	100.0%	0.2%	12.9	-
sweet birch (*Bentula lenta)*	-	-	-	-	0.0%	-	-
American beech (*Fagus grandifolia)*	0.6	-	0.5	78.9%	0.6%	12.9	-
cottonwood and poplar spp. (*Populus spp.)*	0.2	-	0.3	70.5%	0.3%	15.1	0.0%
black cherry (*Prunus serotina)*	0.2	-	0.1	100.0%	0.2%	12.9	-
white oak (*Quercus alba)*	-	-	-	-	0.0%	-	-
northern red oak (*Quercus rubra)*	2.2	69.1%	1.1	65.8%	1.2%	9.5	50.0%
black oak (*Quercus velutina)*	1.8	-	1.6	34.5%	1.8%	12.9	-
ALL	98.6	6.5%	91.1	4.7%	-	13.0	88.2%

Table 3. Stand 1 - Red Pine Understory Data Table

Species name	3.0 IN. ≤ HT < 1.0 FT.	1.0 FT. < HT < 4.5 FT.	4.5 FT. HT - < 1.0 IN. DBH	1.0 IN. ≤ DBH < 5.0 IN.	TOTAL
red pine (*Pinus resinosa)*	27.8	55.6	-	-	83.3
eastern white pine (*Pinus strobus)*	319.4	305.6	125.0	166.7	916.7
Scots pine (*Pinus sylvestris)*	41.7	-	-	55.6	97.2
eastern hemlock (*Tsuga canadensis*)	208.3	250.0	208.3	111.1	777.8
red maple (*Acer rubrum)*	13.9	-	-	-	13.9
sweet birch (*Betula lenta)*	97.2	27.8	-	-	125.0
American beech (*Fagus grandifolia)*	41.7	-	-	-	41.7
cottonwood and poplar spp. (*Populus spp.)*	69.4	27.8	41.7	-	138.9
black cherry (*Prunus serotina)*	41.7	-	-	-	41.7
white oak (*Quercus alba)*	69.4	27.8	41.7	-	138.9
northern red oak (*Quercus rubra)*	111.1	166.7	83.3	-	361.1
ALL	1,041.7	861.1	500.0	333.3	2,736.2

Table 4. Stand 2 - Red Pine Overstory Data Table (Stems ≥ 5" dbh)

Species name	Sawlog BF/acre	Sawlog BF Standard Error (% of mean)	Pulp cords/acre	Pulp cords/acre Standard Error (% of mean)	Total BF (stand)	Sawtimber mean height (logs)	Total cords (stand)	Topwood cords (stand)
red pine (*Pinus resinosa)*	20,859	10.2%	3.12	58.8%	420,726	2.4	62.8	108.9
eastern white pine (*Pinus strobus)*	370	57.5%	1.23	61.5%	7,462	1.8	24.8	4.0
Scots pine (*Pinus sylvestris)*	-	-	-		-	-	-	-
eastern hemlock (*Tsuga canadensis)*	-	-	0.06	104.6%	-	2.3	1.1	-
red maple (*Acer rubrum)*	-	-	0.11	75.1%	-	2.3	2.3	-
sweet birch (*Betula lenta)*	-	-	-	-	-	-	-	-
American beech (*Fagus grandifolia)*	-	-	-	-	-	-	-	-
cottonwood and poplar spp. (*Populus spp.)*	-	-	-	-	-	-	-	-
black cherry (*Prunus serotina)*	-	-	-	-	-	-	-	-
white oak (*Quercus alba)*	-	-	0.06	104.6%	-	2.3	1.1	-
northern red oak (*Quercus rubra)*	-	-	-	-	-	-	-	-
black oak (*Quercus velutina)*	-	-	-	-	-	-	-	-
ALL	21,229	10.2%	4.57	32.1%	428,187	2.3	92.2	112.9

Table 5. Stand 2 - Red Pine Overstory Data Table (Stems ≥ 5" dbh)

Species name	Total trees/acre	Total trees/acre standard error (% of mean)	Total basal area (ft^2/ac)	Total basal area standard error (% of mean)	% basal area by species	QMD	% AGS
red pine (*Pinus resinosa)*	154.5	11.5%	157.6	9.7%	93.7%	13.7	100.0%
eastern white pine (*Pinus strobus)*	3.2	-	5.9	48.5%	3.5%	18.4	100.0%
Scots pine (*Pinus sylvestris)*	-	-	-	-	0.0%	-	-
eastern hemlock (*Tsuga canadensis)*	1.3	-	1.2	100.0%	0.7%	13.1	0.0%
red maple (*Acer rubrum)*	2.3	-	2.4	68.5%	1.4%	13.8	-
sweet birch (*Betula lenta)*	-	-	-	-	0.0%	-	-
American beech (*Fagus grandifolia)*	-	-	-	-	0.0%	-	-
cottonwood and poplar spp. (*Populus spp.)*	-	-	-	-	0.0%	-	-
black cherry (*Prunus velutina)*	-	-	-	-	0.0%	-	-
white oak (*Quercus alba)*	1.1	-	1.2	100.0%	0.7%	13.8	-
northern red oak *(Quercus rubra)*	-	-	-	-	0.0%	-	-
black oak (*Quercus velutina)*	-	-	-	-	0.0%	-	-
ALL	162.3	11.0%	168.2	9.2%		13.8	95.8%

Table 6. Stand 2 - Red Pine Understory Data Table

Species name	3.0 IN. ≤ HT < 1.0 FT.	1.0 FT. < HT < 4.5 FT.	4.5 FT. HT - < 1.0 IN. DBH	1.0 IN. ≤ DBH < 5.0 IN.	TOTAL
red pine (*Pinus resinosa)*	-	-	-	-	0.0
eastern white pine (*Pinus strobus)*	166.7	333.3	500.0	666.7	1,666.7
Scots pine (*Pinus sylvestris)*	-	-	-	-	0.0
eastern hemlock (*Tsuga canadensis)*	-	-	-	-	0.0
red maple (*Acer rubrum)*	-	-	-	-	0.0
sweet birch (*Betula lenta)*	-	-	-	-	0.0
American beech (*Fagus grandifolia)*	-	-	-	-	0.0
cottonwood and poplar spp. (*Populus spp.*)	-	-	-	-	0.0
black cherry (*Prunus serotina)*	-	-	-	-	0.0
white oak *(Quercus alba)*	-	-	-	-	0.0
northern red oak (*Quercus rubra)*	-	-	-	-	0.0
ALL	166.7	333.3	500.0	666.7	1,666.7

Table 7. Stand 3 - Scots Pine Overstory Data Table (Stems ≥ 5" dbh)

Species name	Sawlog BF/acre	Sawlog BF standard error (% of mean)	Pulp cords/acre	Pulp cords/acre standard error (% of mean)	Total BF (stand)	Sawtimber mean height (logs)	Total cords (stand)	Topwood cords (stand)
red pine (*Pinus resinosa)*	3,628	32.1%	0.24	66.2%	56,301	2.4	3.8	14.6
eastern white pine (*Pinus strobus)*	1,207	43.0%	1.80	48.2%	18,732	1.8	27.9	10.0
Scots pine (*Pinus sylvestris)*	8,526	20.5%	0.57	61.4%	132,306	2.3	8.9	38.7
eastern hemlock (*Tsuga canadensis)*	-	-	0.15	70.7%	-	2.3	2.3	-
red maple (*Acer rubrum)*	-	-	-	-	-	-	-	-
sweet birch (*Betula lenta)*	-	-	0.03	104.6%	-	2.3	0.5	-
American beech (*Fagus grandifolia)*	-	-	0.03	104.6%	-	2.3	0.5	-
cottonwood and poplar spp. (*Populus spp.)*	-	-	-	-	-	-	-	-
black cherry (*Prunus serotina)*	-	-	-	-	-	-	-	-
white oak (*Quercus alba)*	-	-	-	-	-	-	-	-
northern red oak *(Quercus rubra)*	-	-	0.03	104.6%	-	2.3	0.5	-
black oak (*Quercus velutina)*	-	-	0.03	104.6%	-	2.3	0.5	-
ALL	13,361	10.7%	2.88	32.3%	207,338	2.3	44.6	63.2

Table 8. Stand 3 - Scots Pine Overstory Data Table (Stems ≥ 5" dbh)

Species name	Total trees/acre	Total trees/acre standard error (% of mean)	Total basal area (ft^2/ac)	Total basal area standard error (% of mean)	% basal area by species	QMD	% AGS
red pine (*Pinus resinosa)*	23.3	32.7%	23.5	32.0%	22.2%	13.6	100.0%
eastern white pine (*Pinus strobus)*	19.3	68.6%	16.5	29.9%	15.6%	12.5	100.0%
Scots pine (*Quercus sylvestris)*	61.5	22.5%	55.3	20.2%	52.2%	12.8	100.0%
eastern hemlock (*Tsuga canadensis)*	6.3	-	5.9	63.6%	5.6%	13.0	-
red maple (*Acer rubrum)*	-	-	-	-	0.0%	-	-
sweet birch (*Betula lenta)*	1.3	-	1.2	100.0%	1.1%	13.0	-
American beech (*Fagus grandifolia)*	1.3	-	1.2	100.0%	1.1%	13.0	-
cottonwood and poplar spp. (*Populus spp.)*	-	-	-	-	0.0%	-	-
black cherry (*Prunus serotina)*	-	-	-	-	0.0%	-	-
white oak (*Quercus alba)*	-	-	-	-	0.0%	-	-
northern red oak (*Quercus rubra)*	1.3	-	1.2	100.0%	1.1%	13.0	-
black oak (*Quercus velutina)*	1.3	-	1.2	100.0%	1.1%	13.0	-
ALL	115.5	15.2%	105.9	9.8%		13.0	100.0%

Table 9. Stand 3 - Red Pine Understory Data Table

Species name	3.0 IN. ≤ HT < 1.0 FT.	1.0 FT. < HT < 4.5 FT.	4.5 FT. HT - < 1.0 IN. DBH	1.0 IN. ≤ DBH < 5.0 IN.	TOTAL
red pine (*Pinus resinosa)*	-	-	-	-	0.0
eastern white pine (*Pinus strobus)*	625.0	-	375.0	-	1,250.0
Scots pine (*Pinus sylvestris)*	-	-	-	-	0.0
eastern hemlock (*Tsuga canadensis)*	125.0	-	-	-	125.0
red maple (*Acer rubrum)*	-	-	-	-	0.0
sweet birch (*Betula lenta)*	-	-	-	-	0.0
American beech (*Fagus grandifolia)*	125.0	-	-	-	125.0
cottonwood and poplar spp. (*Populus spp.)*	250.0	-	-	-	250.0
black cherry (*Prunus serotina)*	-	-	-	-	0.0
white oak (*Quercus alba)*	-	-	-	-	0.0
northern red oak (*Quercus rubra)*	375.0	-	-	-	375.0
ALL	1,500.0	250.0	375.0		2,125.0

Table 10. All Stands Overstory Data Table (Stems ≥ 5" dbh)

Species name	Sawlog BF/acre	Sawlog BF Standard Error (% of mean)	Pulp cords/acre	Pulp cords/acre Standard Error (% of mean)	Total BF (stand)	Sawtimber mean height (logs)	Total cords (stand)	Topwood cords (stand)
red pine (*Pinus resinosa)*	11,142	10.2%	1.04	89.9%	2,050,113	2.4	192.0	530.8
eastern white pine (*Pinus strobus)*	827	58.4%	1.50	68.4%	152,191	1.8	275.6	81.3
Scots pine (*Pinus sylvestris)*	751	38.8%	0.05	115.1%	138,132	2.3	9.3	40.4
eastern hemlock (*Tsuga canadensis)*	-	-	0.03	83.7%	-	2.3	5.7	-
red maple (*Acer rubrum)*	-	-	0.02	120.0%	-	2.3	2.9	-
sweet birch (*Betula lenta)*	-	-	0.00	205.1%	-	2.3	0.5	-
American beech (*Fagus grandifolia)*	-	-	0.01	140.7%	-	2.3	2.7	-
cottonwood and poplar spp. (*Populus spp.)*	-	-	0.01	150.7%	-	2.3	1.1	-
black cherry (*Prunus velutina)*	-	-	0.00	205.1%	-	2.3	0.6	-
white oak (*Quercus alba)*	-	-	0.01	205.1%	-	2.3	1.1	-
northern red oak (*Quercus rubra)*	-	-	0.03	129.8%	-	2.3	5.0	-
black oak (*Quercus velutina)*	-	-	0.04	85.5%	-	2.3	7.3	-
ALL	12,720	10.1%	2.74	46.3%	2,340,436	2.3	503.9	652.5

Table 11. All Stands Overstory Data Table (Stems ≥ 5" dbh)

Species name	Total trees/acre	Total trees/acre standard error (% of mean)	Total basal area (ft^2/acre)	Total basal area standard error (% of mean)	% basal area by species	QMD	% AGS
red pine (*Pinus resinosa)*	76.5	10.4%	78.9	9.0%	78.3%	13.8	97.6%
eastern white pine (*Pinus strobus)*	19.2	36.4%	12.1	28.3%	12.0%	10.8	59.3%
Scots pine (*Pinus sylvestris)*	5.5	41.5%	4.9	38.4%	4.8%	12.8	100.0%
eastern hemlock (*Tsuga candensis)*	0.9	0.0%	1.1	74.4%	1.1%	14.6	38.0%
red maple (*Acer rubrum)*	0.4	0.0%	0.4	110.8%	0.4%	13.5	-
sweet birch (*Betula lenta)*	0.1	0.0%	0.1	196.0%	0.1%	13.0	-
American beech (*Fagus grandifolia)*	0.6	0.0%	0.5	131.3%	0.5%	12.9	-
cottonwood and poplar spp. (*Populus spp.)*	0.2	0.0%	0.2	138.1%	0.2%	15.1	0.0%
black cherry *(Prunus velutina)*	0.1	0.0%	0.1	196.0%	0.1%	12.9	-
white oak (*Quercus alba)*	0.1	0.0%	0.1	196.0%	0.1%	13.8	-
northern red oak (*Quercus rubra)*	1.9	127.8%	1.0	117.7%	1.0%	9.7	50.0%
black oak (*Quercus alba)*	1.6	0.0%	1.4	64.4%	1.4%	12.9	-
ALL	107.0	10.5%	100.8	7.7%	-	13.1	90.6%

Table 12. All Stands Understory Data Table

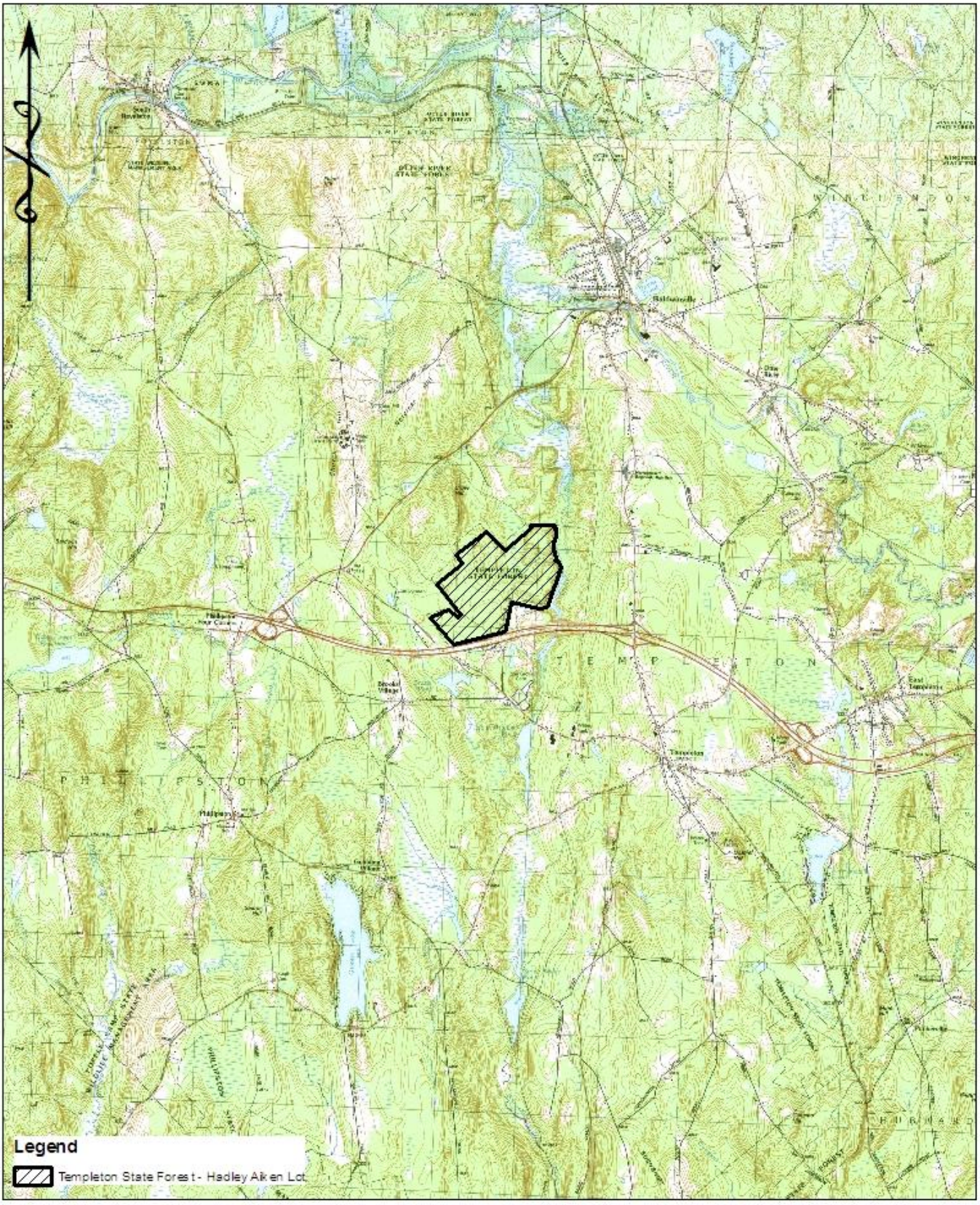
Species name	3.0 IN. ≤ HT < 1.0 FT.	1.0 FT. < HT < 4.5 FT.	4.5 FT. HT - < 1.0 IN. DBH	1.0 IN. ≤ DBH < 5.0 IN.	TOTAL
red pine (*Pinus resinosa)*	22.4	44.8	-	-	67.2
eastern white pine (*Pinus strobus*)	328.5	303.9	187.2	207.4	1,027.0
Scots pine (*Pinus sylvestris)*	33.6	-	-	44.8	78.4
eastern hemlock (*Tsgua canadensis)*	178.5	201.5	167.9	89.6	637.5
red maple (*Acer rubrum)*	11.2	-	-	-	11.2
sweet birch (*Betula lenta)*	78.4	22.4	-	-	100.8
American beech (*Fagus grandifolia)*	44.1	-	-	-	44.1
cottonwood and poplar spp. (*Populus spp.)*	77.1	22.4	33.6	-	133.0
black cherry (*Prunus serotina)*	33.6	-	-	-	33.6
white oak (*Quercus alba)*	56.0	22.4	33.6	-	112.0
northern red oak (*Quercus rubra)*	121.2	134.3	67.2	-	322.7
ALL	984.4	751.7	489.5	341.8	2,567.4

Locus Map

1 inch = 5,000 feet

Hadley Aiken Lot
Templeton State Forest

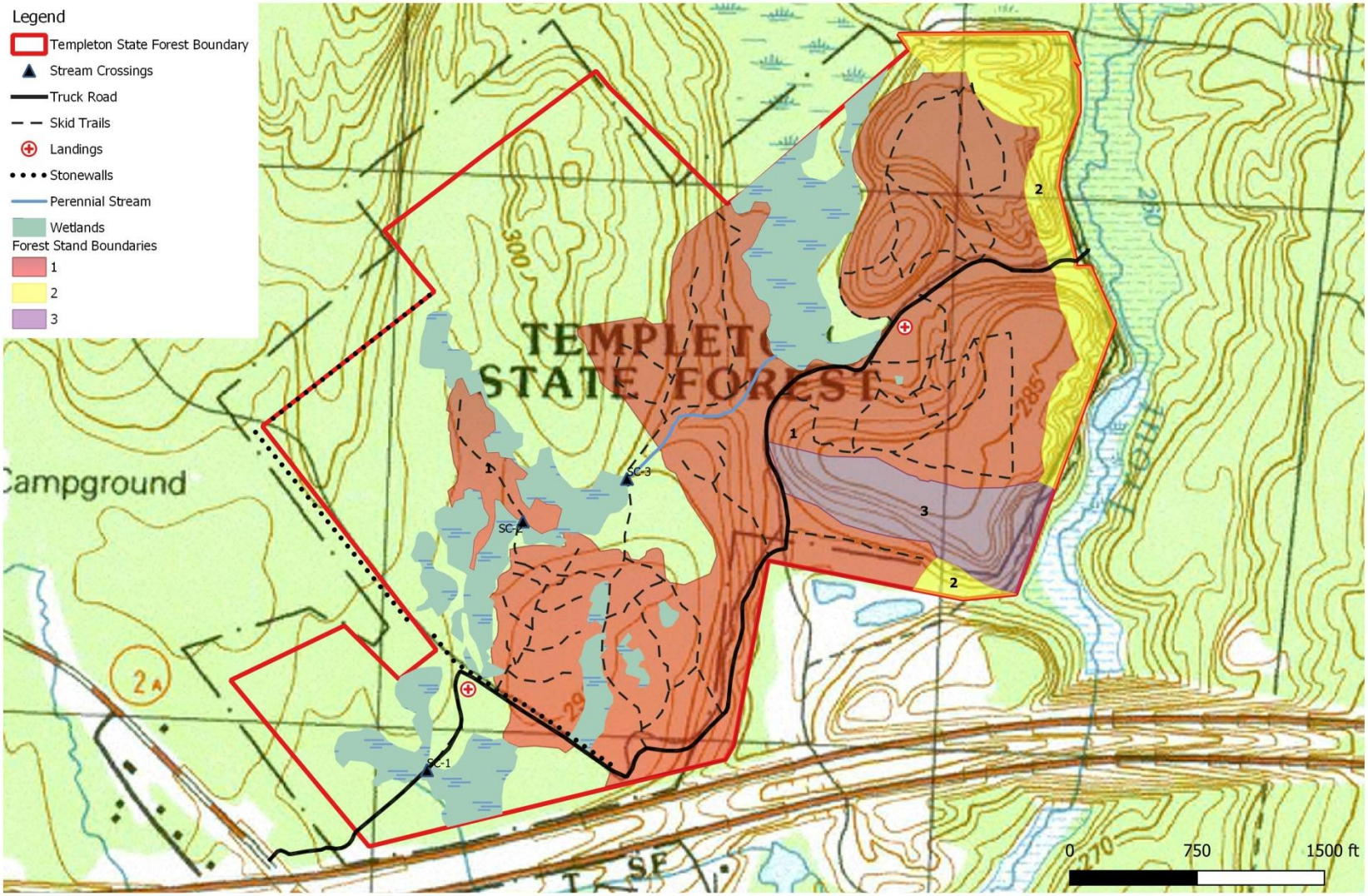
0 2,500 5,000 10,000 Feet



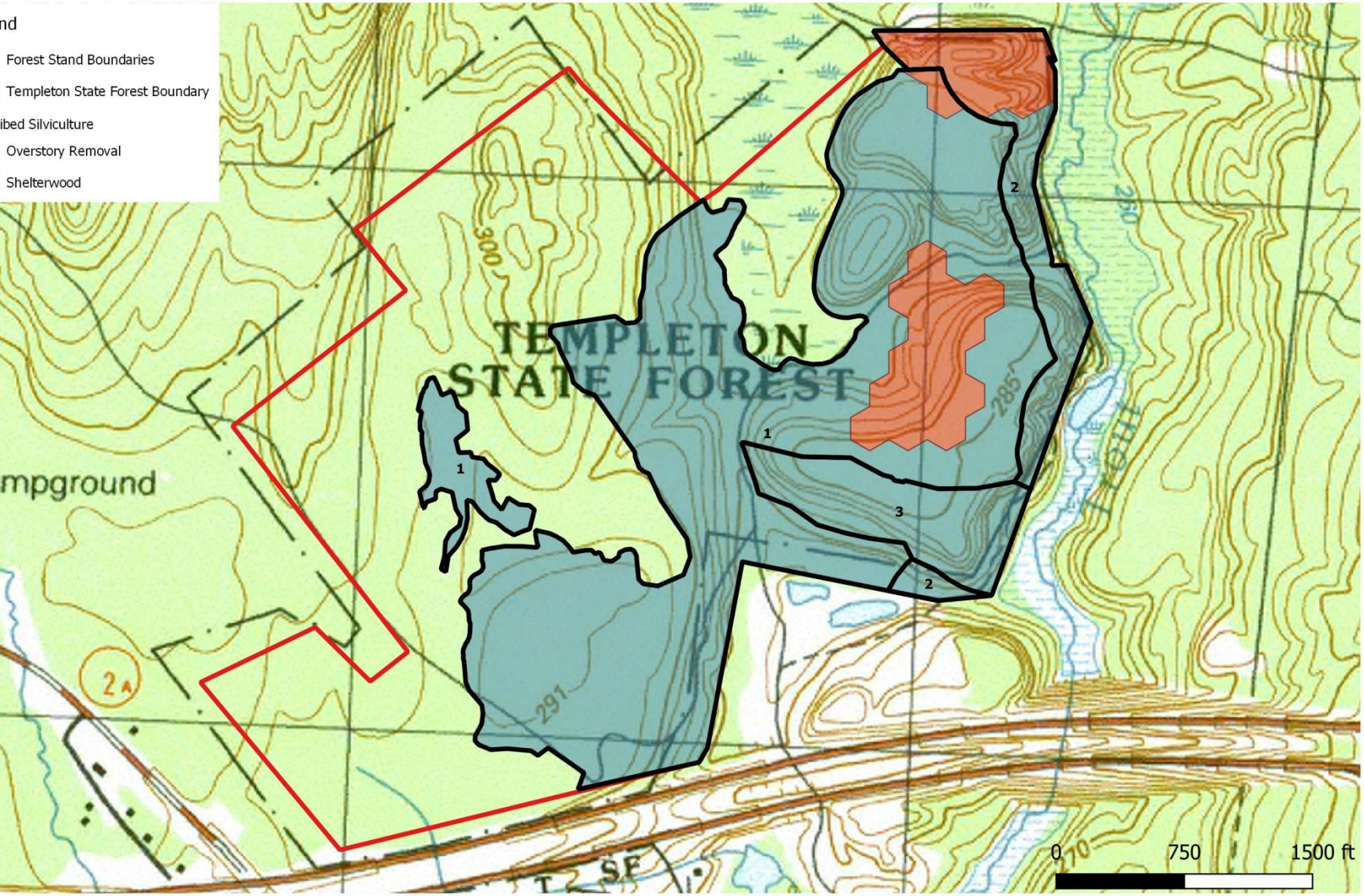
Joelle Vautour & Keith DiNardo

April 2014

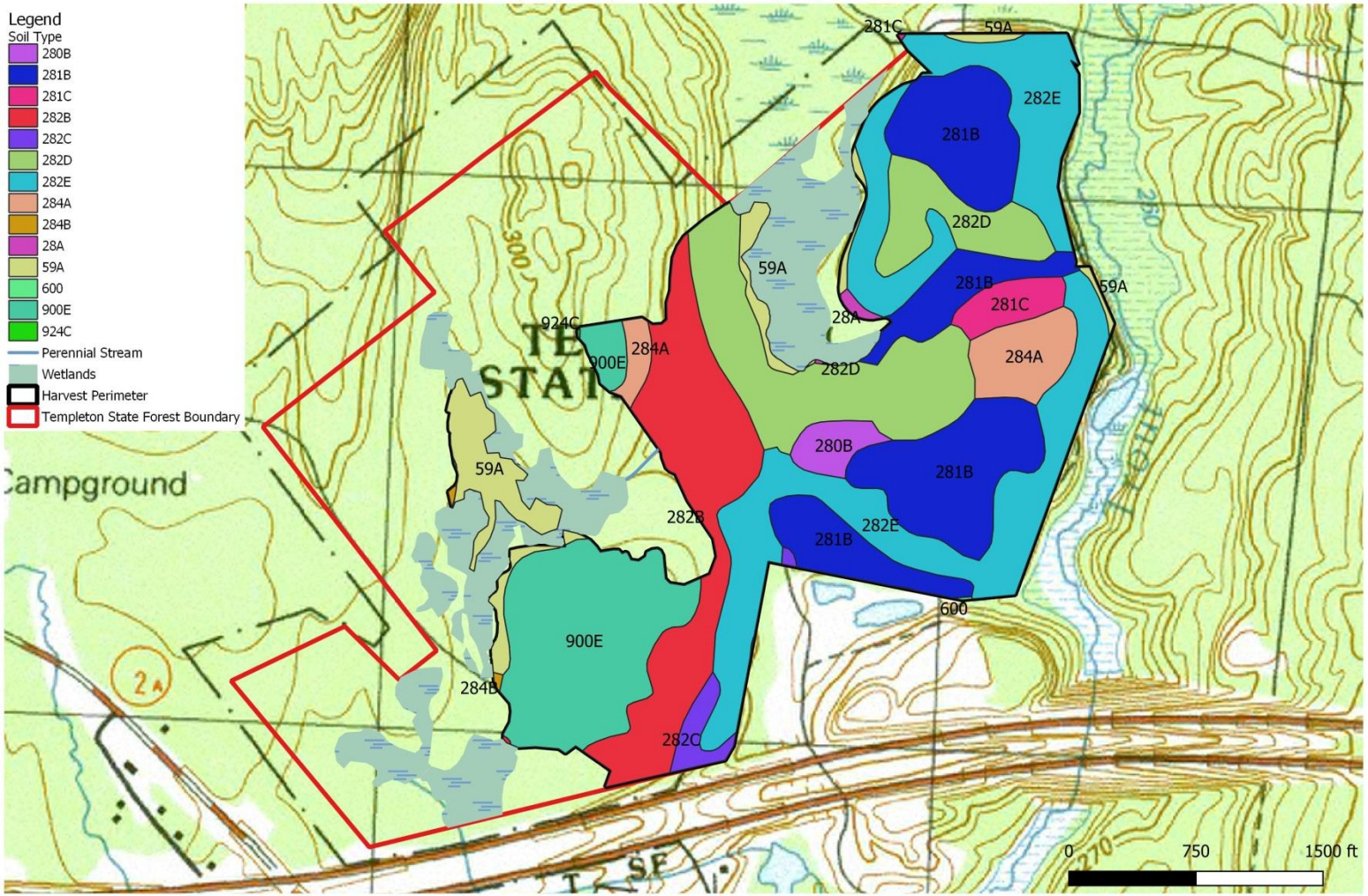
Harvest Map
Templeton State Forest - Hadley Aiken Lot
Map Prepared By: Joelle Vautour - August 3, 2020



Silviculture Map
Templeton State Forest - Hadley Aiken Lot
Map Prepared By: Joelle Vautour - August 3, 2020



Soils Map
Templeton State Forest - Hadley Aiken Lot
Map Prepared By: Joelle Vautour - August 3, 2020



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