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Silviculture Prescription
Sheep Ranch Rendezvous

Massachusetts Department of Conservation and Recreation
Bureau of Forestry

Western Connecticut Valley District
H.O. Cook State Forest
Heath, MA

Prepared by:

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Approved by:

Management Forestry
Program Supervisor  Date: August 18, 2017

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Overview:

The H.O. Cook State Forest is located in northern Franklin County along the Vermont border in the towns of Heath and Colrain. It is currently over 1600 acres and was originally purchased under the Massachusetts Reforestation Law in 1909 with the purchase of 450 acres from Ira Lowe, a wholesale meat dealer in Gardner, MA. He had operated a sheep ranch on the property and had pastured around 400 sheep but was unable to remain profitable due to the depredation of dogs which preyed on the lambs. It was due to this past land usage that at least 70% of the land in the original purchase was open field. Plantations of Norway spruce (Picea abies), Eastern white pine (Pinus Strobus) and White ash (Fraxinus americana) were established in 1910 and 1911. Later plantings were established in 1915-1921 and the final plantings were carried out during the 1930's by the Civilian Conservation Corps which had established a camp on the forest. The stands chosen for this forest management project consists of approximately 164 acres of Norway spruce plantation, 25 acres of adjacent White pine- Hardwoods and 10 acres of White pine plantation. This project will continue silvicultural practices which have been ongoing in this forest for over 100 years.

The conditions that led to selecting this project for forest management are:

- This project area offers an excellent opportunity to demonstrate and fulfill objectives for DCR Woodlands.
- It contains large acreage of non-native plantations.
- Weather events have adversely affected the project area.

The Sheep Ranch Rendezvous Forest Management Project proposes to:

- Demonstrate harvesting techniques and best management practices that protect forest productivity, soil and water resources.
- Produce wood products that are ecologically and economically sustainable that benefit local communities.
- Protection and enhancement of local water supplies.
- Produce diverse habitats.
- Increase carbon sequestration.
- Begin regeneration in areas of Norway spruce that have had minimal silvicultural treatments.
- Provide an opportunity to repair drainage and erosion issues on Newton Road.

1.) Site Data

Geology and Landforms: The H.O. Cook State Forest sits on a plateau at the eastern edge of the Berkshire Hills. The bulk of the forest sits on moderately level to gentle slopes with the eastern and southern portions dropping off to the West branch of the North River and Saunders Brook. It was these flat uplands that encouraged agricultural use and homesteading. The soils in the project area of the forest developed from glacial deposits derived mainly from micaceous schist. The well-drained Berkshire and Marlow soil types are sandy loams with varying amounts of stones while the Lyman soils are slightly droughty and tend to have mores stones, rocks and bedrock outcroppings.

Soils: Berkshire (BbC,BcC) fine and very stony sandy loam, Lyman (LxC) extremely rocky loam and Marlow (MeB)very stony loam are the dominant soil types. The Berkshire and Marlow are well-drained soils suitable for growing crops and trees while the Lyman soil is somewhat shallow to bedrock and does not have the water holding capacity of the other soils. Northern hardwoods, white pine and red spruce grow very well on these soils while the productivity of the Lyman soils is much lower due to the amount of rocks and stones. Another important factor to consider is that the operability of the area is determined by the ability of the soil to dry out when saturated such as in the spring or in periods of heavy rain. Care must be taken in the Berkshire and Marlow soils when operating equipment to only do so when the ground is dry, frozen or otherwise stabile. This can also be mitigated through the use of low-ground pressure equipment.

Climate: The project location lies in an area of mild summers and moderate winters with year round precipitation possible. The elevation reaches close to 1600'which often leads to early and late season snowfall. Winds generally come from the west. Although major weather events can happen in any given year, the chances of hurricanes, tornadoes, ice storms or other forest changing events are seldom but do occur. The figures below (Table 1) are excerpt from the National Weather Service 2012 Climatological Report for Pittsfield, MA. The climate period used to determine normal value is 1981 through 2010.

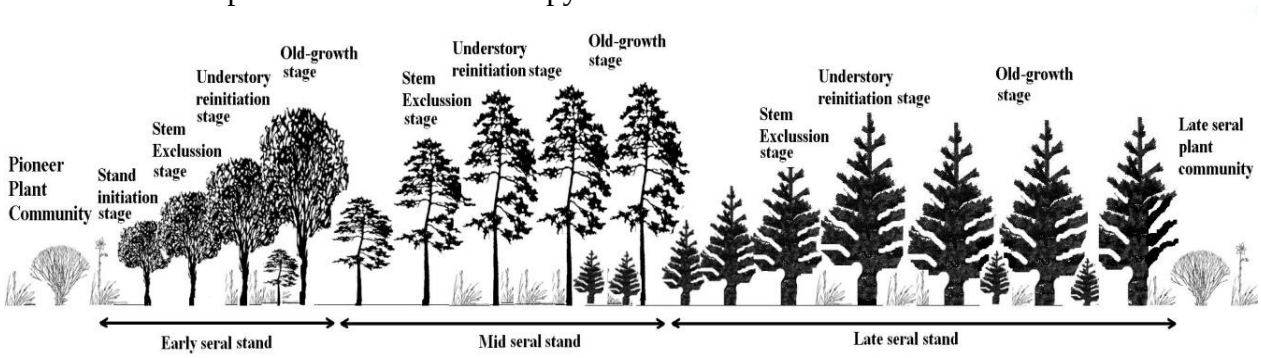
Table 1:

	2012 Annual	2011 Annual	Normal Annual Value	Normal Winter	Normal Spring	Normal Summer	Normal Fall
Annual Maximum Temp	58.4	56.5	55.3	31.7	54.3	76.7	57.9
Annual Minimum Temp	39.2	37.4	35.4	15.4	32.9	55	38
Annual Mean Temp	50	50.2	48.3	23.6	43.6	65.8	48
Total Precipitation (in)	36.36	59.46	45.38	8.6	11.44	12.74	12.6
Days with >= .01 Precipitation	144						
Average Wind Speed	6.1						

The three most recent major events which damaged this project area were a wind event in 1997, the ice storm of 2008 and the 2011 hurricane Irene. The ice storm event produced ice amounts of 0.5 – 1.5 inches thick on all surfaces causing extensive tree damage by breaking limbs and uprooting due to the ice's weight. Hurricane Irene caused extensive road damage due to flooding and the wind event of 1997 created a large opening which exposed portions of the Norway spruce plantation to prevailing westerly winds.

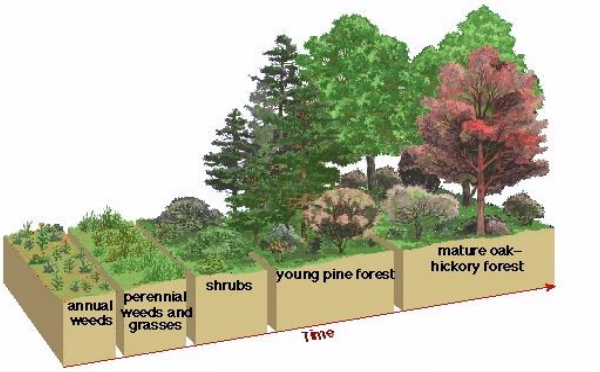
Hydrology and Watershed: The project area falls entirely within the Deerfield River Watershed. All rainfall within this project area drains directly into intermittent or perennial streams which flow westerly into Sanderson Brook, then into the West Branch of the North River which flows into the Deerfield River. There are no mapped certified vernal pools by NHESP however several potential vernal pools are mapped just outside of the project area. There may also other seasonal seeps, intermittent streams or small forested wetlands areas located throughout the project area not seen during initial site visits.

Potential Vegetation: The plantations are a mix of Norway spruce (Picea abies) and eastern white pine (Pinus strobus)approximately 100 years old having been established around 1910 and later. The canopy is mostly closed and minimal overhead light reaches the forest floor. Diffuse light enters the edges of the stand and in areas open from storms, natural disturbance or prior harvests. The plantations were established on abandoned agricultural fields with areas not planted allowed to regenerate naturally. The diagrams below illustrate the seral stages in natural forest succession as it transitions from open fields to closed-canopy forests.



1. Forest seral stages

Based on vegetation found on neighboring properties, non-plantation areas of the state forest and regeneration currently present on the forest it is expected that northern hardwoods (sugar maple (Acer saccharum), yellow birch (Betula alleghaniensis) , black birch (Betula lenta), beech (Fagus grandifolia), white ash (Fraxinus americana) and other associated species) will be the predominate forest type with variations of hemlock-hardwoods, white pine-hardwoods and pockets of red-spruce and balsam fir depending on slope, aspect, elevation and available soil moisture. The Norway spruce regenerates easily and will continue to be in future forest stands.



***2. Forest* succession**

Site Productivity: General overall site quality is good based on the soil types and available soil moisture with the Lyman soils rated lower. Site index numbers range from 60-70 in the better soils to 45-50 in the rockier portions of the Lyman soils. The current complexity level is moderate and this is based on stand diversity and structure. The even-aged plantations are a monoculture with little to no species diversity in the overstory. Stand structure is similar throughout the stand as they are the same height and vary only slightly in diameter. Based on the soils these stands can support a wider range of tree species which will be encouraged through silvicultural treatments. Future modeling of these stands will show a marked increase in complexity as the plantations transition into a mix with a higher percentage of native hardwoods.

Cultural and Archeological Features: There are no known pre-contact sites within the proposed project, however several CCC era historic features occur just outside of harvest area. This includes stone chimneys, foundations, fire ponds and dam remnants from the camp established in 1935-1937 on the forest. These features, along with other stone walls and foundations will be protected from disturbance during any harvesting operations and will be treated according to the "Bureau of Forestry – Cultural Resource Management Protection Standards & Guidelines". A review by the DCR office of Cultural Resources is part of this prescription process.

2.) Stand Data

Forest Stand Attributes: The proposed project area consists of approximately 164 acres of Norway Spruce Plantation, White Pine Plantation and White Pine-Hardwood forest types. Timber harvests and pre-commercial thinning have been carried out on much of the project area. This includes some strip shelterwood harvests in the Norway spruce stands in the 1980s and a salvage sale in the white pine plantation in 1998 following a high wind event. A salvage operation was also done on the northern edge of the sale in the early 1970s in red spruce adjacent to Norway spruce damaged by a late winter storm.

Stand Structure-Norway Spruce: The structure of the Norway spruce plantations can be described as a single-storied even-aged forest established in 1910 or sometime shortly thereafter. It is dominated by large Norway spruce and eastern white pine greater than 15" average diameter with a relative stand density of approximately 70 percent. These are dense stands with variable size gaps interspersed at random throughout the canopy which are created through individual tree mortality or storm damage. There are two stands which have not been treated and have minimal disturbed perimeter edge. The result is that very little sunlight reaches the interior of the stand resulting in slightly smaller trees and minimal regeneration on the forest floor. Large amounts of standing dead and down material cover the forest floor making it difficult to walk through. The remainder of the stands has been treated with strip-shelterwood cuts in the 1980s and 1990s. These strips were approximately 66' wide with uncut areas approximately 150' in width. The uncut areas were not thinned and are similar in density to the uncut spruce stands. There is dense regeneration present in the strips and along the cut edges of the residual stands. It is also interesting to note that in some occasions several rows or blocks of eastern white pine were planted in among the spruce which accounts for some of the species mix. The alignment of the strip cuts was along and east-west axis and anchored into an uncut section of white pine plantation. In 1998 a wind event destroyed much of this stand and left the spruce strips open to the prevailing westerly winds resulting in increasing amounts of windthrow.

Norway spruce volume and stocking in blocks that have been treated with strip cuts.

Volume Sheep Ranch Treated Spruce

Spp	Spp Code	Sawlog Bf/Acre	Pulp Cords/Acre	Sawtimber Mean Ht (logs)	Total Bf (Stand)	Total Cords (Stand)	Topwood Cords (Stand)
EWP	1	14,015		3.4	560,612		42
RM	7	165		1.5	6,591		4
WA	8	210		2.0	8,397		2
BC	10	2,183			87,304		
NSPR	26	25,832	6.38	3.6	1,033,285	255.3	65
Total		42,405	6.38		1,696,189	255.3	

Stocking Diagnostics Sheep Ranch Treated Spruce

Spp	Spp Code	Total Trees/Acre	Total BA/Acre	% BA/ac by Spp	QMD	Rel Density	% AGS
EWP	1	32.5	69.2	30%	19.8	23.3	89%
RM	7	3.3	4.6	2%	16.1	3.6	67%
WA	8	0.9	1.5	1%	18.1	1.2	100%
BC	10	8.3	12.3	5%	16.5	0.0	88%
NSPR	26	110.4	140.0	61%	15.2	41.3	99%
Total		155.3	227.7	100%	16.4	69	95%
				Median Stand Diameter ->>	18.2	73	*<<- Estimated Relative Density*

Norway spruce volume and stocking in untreated stands.

Volume Sheep Ranch Untreated Norway Spruce Stands

Spp	Spp Code	Sawlog Bf/Acre	Pulp Cords/Acre	Sawtimber Mean Ht (logs)	Total Bf (Stand)	Total Cords (Stand)	Topwood Cords (Stand)
NSPR	26	25,081	8.71	3.0	1,203,884	417.9	152
EWP	1	6,576		3.0	315,644		42
Total		31,657	8.71		1,519,528	417.9	194

Stocking Diagnostics Sheep Ranch Untreated Norway Spruce Stands

Spp	Spp Code	Total Trees/Acre	Total BA/Acre	% BA/ac by Spp	QMD	Rel Density	% AGS
NSPR	26	182.5	166.0	73%	12.9	51.6	86%
EWP	1	19.2	34.0	15%	18.0	11.5	94%
Total		201.7	226.0	88%	14.3	63	77%
				Median Stand Diameter ->>	15.9	71	*<<- Estimated Relative Density*

Regeneration tables.

Stand:	EWP	NS	SM	BB	RM	BC	WA	BE	YB	HK	ASP
Norway Spruce											
Stem Count	34	288			202	31	24	18	44	4	1
Stems/Acre	600	5082			3564	547	423	317	776	70	17

Ground cover table.

	Ground Cover Species		``	Norway Spruce	
Species:	Ferns	Canada Mayflower	Indian Cucumber	Lady slipper	Rubus spp.
% cover:	20	20	10	20	20

Stand Structure-White Pine- The structure of the white pine plantation can be described as a single-storied even-aged forest established in 1910 or sometime shortly thereafter. It is dominated by large eastern white pine greater than 15" average diameter with a relative stand density of approximately 70 percent. These are dense stands with variable size gaps interspersed at random throughout the canopy which are created through individual tree mortality or storm damage. There are three stands which have seen some past treatments or are adjacent to areas that have had silvicultural treatments. Regeneration is variable due to diffuse sunlight reaching the forest floor from adjacent stands and a lack of ground disturbance to scarify the soil. Coarse woody debris can be heavy due to the stand mortality incurred from dense stands of conifers

Volume **Sheep Ranch WP**

Spp	Spp Code	Sawlog Bf/Acre	Pulp Cords/Acre	Sawtimber Mean Ht (logs)	Total Bf (Stand)	Total Cords (Stand)	Topwood Cords (Stand)
EWP	**1**	**46,403**		**3.4**	**464,026**		**35**
WA	**8**	**1,091**			**10,913**		
BC	**10**	**523**		**1.5**	**5,229**		**3**
Total		**48,017**	**0.00**		**480,167**	**0.0**	**38**

Stocking Diagnostics **Sheep Ranch WP**

Spp	Spp Code	Total Trees/Acre	Total BA/Acre	% BA/ac by Spp	QMD	Rel Density	% AGS
EWP	**1**	**112.2**	**215.0**	**96%**	**18.7**	**72.9**	**98%**
WA	**8**	**2.8**	**5.0**	**2%**	**18.3**	**0.0**	**100%**
BC	**10**	**3.7**	**5.0**	**2%**	**15.7**	**3.9**	**100%**
Total		**118.7**	**225.0**	**100%**	**18.6**	**77**	**98%**
				Median Stand Diameter ->>	**20.3**	**79**	***<<- Estimated Relative Density***

White pine - Regeneration table**.**

SPECIES:	RM	WA	NS	BC	HK	WP	RO	BE	WB	YB
Stem Count	14		5				2	6		2
Stems/Acre	1050		375				150	450		150

White pine - Ground cover table.

	Ground Cover Species:				
Species:	Ferns	Canada Mayflower	Partridge berry	Starflower	Clubmoss
% cover	10	40	10	10	10

Stand Structure: White Pine- Hardwoods. This stand is an even-aged white pine stand with associate species of red maple, sugar maple and hemlock. It developed at the same time as the plantations but may have been on rockier sites and not planted. The overall form is fair to good with some multiple-stemmed white pine in the overstory. In areas adjacent to the Norway spruce stands it has ample amounts of spruce in the understory in addition to red maple, beech and some yellow birch. White pine dominates the overstory with the hardwood species filling the gaps. The red maple is of poor quality with large quantities of rot present in the stems. The site quality is good but the presence of rocks and stones detract from the amount of growing space available to ensure proper root development. Relative stand density numbers indicate dense stands with a mostly closed canopy.

White Pine- Hardwoods
Volume and Stocking

Stocking Diagnostics **Sheep Ranch WH**

Spp	Spp Code	Total Trees/Acre	Total BA/Acre	% BA/ac by Spp	QM D	Rel Density	% AGS	
EWP	**1**	**144.4**	**190.0**	**86%**	**15.5**	**66.8**	**92%**	
HEM	**3**	**11.3**	**10.0**	**5%**	**12.7**	**4.6**	**100%**	
SM	**6**	**4.1**	**5.0**	**2%**	**14.9**	**0.0**	**100%**	
RM	**7**	**14.6**	**15.0**	**7%**	**13.7**	**11.9**	**33%**	
Total		**174.4**	**220.0**	**100%**	**15.2**	**83**	**89%**	
				Median Stand Diameter ->>	**18.8**	**85**	***<<- Estimated Relative Density***	

White pine hardwood - Regeneration table.

Species:	RM	WA	BC	NS	BE	WP	RO	YB
Stem count	25		1	5	7		1	2
Stems/Acre	1875		75	375	525		75	300

Ground cover table.

	Ground Cover Species:					
Species:	Ferns	Partridge berry	Canada mayflower	Rubus sp.	Starflower	Grass
% Cover	10	10	20	20	10	10

White Pine –Hardwood Stand
Cavity Trees per Acre

Species Group	<12"	12.1" to 15"	15.1" or more	Total
Softwood				**0.0**
Hardwood		**4.7**		**4.7**
Total	**0.0**	**4.7**	**0.0**	**4.7**

3. **Black Knot on cherry**

Forest Protection Concerns: A variety of insect pests and tree diseases are found in the state forest. These include Black knot fungus (*Apiosporina morbosa*) on Black cherry, Cytospora canker (Cytospora kunzei) on Norway spruce, White pine Weevil (*Pissodes strobi Peck*) and Emerald ash borer (*Agrilus planipennis Fairmaire*). The Black knot fungus attacks the twigs and stem of Black Cherry and can be fatal to the tree. Some trees are more resistent to the disease and should be selected as residuals while those tree heaviliy infected should be removed to prevent additional spread. The Cytospora canker is a fungus that enters the tree through branch stubs and wounds. The best prevention is the removal of environmentally stressed trees (drought, excess shading) and promotion of trees with healthy crowns and vigorous appearance. The White pine weevil is a native insect that feeds on the terminal shoots of white pine and Norway spruce. It is mostly a problem in field-grown trees without any overstory or in low density patches of regeneration. The most practical defence against this insect is to use some form of the shelterwood regeneration system in order to keep the regeneration partially shaded. Research has shown that as the stems exceed 16-20’ they become much less susceptible to this insect. The Emerald Ash Borer is a non-native invasive insect

that is decimating stands of white ash. This will impact the regeneration in the management area as it will contain an ash component. While the harvest is going to treat mainly spruce and pine stands it will also be promoting northern hardwood regeneration such as beech, birch, maple and ash. These species will be affected by additional insect and diseases that may not be readily apparent for many years. These will include Sugar Maple Borer(Glycobius speciosus), Eutypella Canker in Sugar maple (Eutypella parasiticus) and Beech Bark Disease(an insect/fungal complex). Storm damage is common on this forest due to the elevation and its effects on temperature, exposure to prevailing westerly winds and winter storms out of the north. This will influence what types of silvicultural treatments are used and how openings are oriented towards prevailing winds. It should be noted that in many cases storm damge will occur and very little can done to counter it. Maintaining aquedate infrastructure in order to allow timely salvage will help recover damaged trees and prevent additional damage from increased fire risk. Other protection concerns are illegal dumping, unauthorized vehicle access, illegal tree cutting and non-permited campfires. Wildfire is not a common occurrence on the forest but several small fires have been started by untended campfires. There are five CCC era fire ponds on the forest that were created with the intent of providing fire suppression capability for local fire departments. Flooding and road washouts occurred during Tropical Storem Irene which have damaged some of the secondary roads.

Recreational and Aesthetic Resources: The main access to the state forest is State Farm Road in Heath and it becomes Forestry Road in Colrain. This road is owned by the towns of Heath and Colrain and is not a designated scenic byway. A secondary gravel road, Newton Road, is owned by DCR and will provide access to the northern portion of the management area. Additional access will be from Truck Trail Road to the south of State Farm Road, which is also owned by the DCR and was built by the Civilian Conservation Corps in the 1930s. H.O.Cook State Forest is open to all legal passive recreation activities that are allowed on DCR properties including hunting, fishing, snowshoeing, hiking and birding. There is an official snowmobile trail on the eastern portion of the forest maintained by the Colrain Sno-Drifters. The project area has no authorized hiking, biking or horseback riding trails present.

Wildlife Habitat Conditions: The majority of the project area is in closed forest canopy with scattered openings from previous silvicultural activity and natural disturbances. The gradual transition of the monoculture Norway spruce to a mixed hardwood and softwood stand will add to both the diversity of plant species and wildlife. Within the project area a minimum of 1-2 trees per acre at least 18 inches in diameter will be left that show characteristics favorable to wildlife such as large holes and dead branches. Large standing dead snags that will not pose a danger to the operator will be retained. These are important as nesting habitat to more than 60 cavity nesting birds and mammals. Current conditions show large quantities, 16-18 tons per acre, of coarse woody debris (cwd) in the form of dead trees on the ground. This material is important to a variety of species for denning habitat as well as suitable habitat for mammals foraging for invertebrates. Research has shown that CWD of diameters greater than 10” and lengths greater than 12’ to begin to be useful and there is currently large amounts of this material present.. Areas that have been previously treated are covered in dense regeneration useful to wildlife in terms of browse and cover. The planned treatments will add additional regeneration to maintain this valuable habitat.

3.) Evaluation of Data, Silviculture and Projected Results

Primary/Secondary goals: The primary goal of treatment in these stands will be to ensure future diversity of age, size and species mixture of these stands by demonstrating several types of silviculture. This is being accomplished by creating a well planned and balanced science based forestry plan.

Secondary goals of this project are to capture value of damaged and/or diseased trees and to provide raw materials to the forest products industry. This project will also assist the community by repairing the forest roads / trails and provide income to the town from the Forest Product Trust Fund.

White Pine Plantation: Silvicultural practices in these stands will demonstrate the irregular shelterwood method of managing white pine to provide additional space, light and water resources for remaining overstory trees and regeneration. These stands will be managed for optimal growth of high quality sawlog trees. Forest management efforts will also be aimed at retaining wildlife trees and ensuring adequate course woody debris.

- **Silviculture Methods:** The irregular shelterwood system will be applied throughout these stands to reduce density/basal area to allow for adequate resources for remaining growing stock. This will remove approximately one third to one half of the currently over stocked stand. Priority for trees to be removed will be based on quality (poor form, structural damage) and crown class (understory and intermediate) and species with white pine, black cherry, sugar maple and black birch being preferred. This method has been used in northern Europe to transform even-aged spruce plantations of similar structure into a natural appearing forest of multiple age classes and varied species composition. Focus will be on residual trees and creating openings to release existing regeneration and also create favorable conditions for establishing new regeneration of desirable species.

4. **Irregular shelterwood in Europe**

- **Desired and Expected Results:** The harvesting activity will create variable sized openings which will allow a mix of hardwood and softwood species to regenerate. These openings will eventually be occupied by a young stand of diverse tree and plant species. Further entries into the area will create a mosaic of age classes mimicking a natural disturbance regime. This stand should be examined in approximately 10 years to verify if the goals treatment were met. It is anticipated that the next silvicultural treatment will occur roughly 20 years after this current harvest and will continue the process of regenerating the stand.

Norway Spruce Plantations: Silvicultural practices in these stands will demonstrate the irregular shelterwood method of managing Norway spruce to provide additional space, light and water resources for remaining overstory trees and regeneration. These stands will be managed for optimal growth of high quality sawlog trees. Forest management efforts will also be aimed at retaining wildlife trees and ensuring adequate course woody debris.

The primary goal of treatment in these spruce plantations is to reduce competition in the overstory and increase growth of spruce and other preferred tree species for high quality wood products in the future. Secondary goals of this project are to capture the commercial value of low vigor, damaged and/or diseased trees for low grade forest products and pulpwood markets.

- **Silviculture Methods:** The irregular shelterwood system will be applied throughout these stands to reduce density/basal area to allow for adequate resources for remaining growing stock. This will remove approximately one third to one half of the currently over stocked stand. Priority for trees to be removed will be based on quality (poor form, structural damage) and crown class (understory and intermediate) and species. This method has been used in northern Europe to transform even-aged spruce plantations of similar structure into a natural appearing forest of multiple age classes and varied species composition. Focus will be on residual trees and creating openings to release existing regeneration and also create favorable conditions for establishing new regeneration of desirable species.
- **Desired and Expected Results:** This harvest should lead to stands of high quality Norway spruce and other northern hardwood species. The stand will be fully stocked with desirable regeneration and residual trees will have ample opportunity to grow. As the stand matures wildlife trees will become larger and provide more habitat opportunities. This stand should be examined in approximately 5 years to verify if the treatment goals were met. It is anticipated that the next silvicultural treatment will occur roughly 20 years after this current harvest and will continue the process of regenerating the stand.

White Pine-Hardwoods: Silvicultural practices in these stands will demonstrate the irregular shelterwood method of managing white pine-hardwood to provide additional space, light and water resources for remaining overstory trees and regeneration. These stands will be managed for optimal growth of high quality sawlog trees. Forest management efforts will also be aimed at retaining wildlife trees and ensuring adequate course woody debris.

- **Silviculture Methods:** An irregular shelterwood will be applied throughout the stands where the basal area or density of the stand will be reduced to allow for adequate resources for remaining growing stock. This will remove approximately one third to one half of the currently over stocked stand. Priority for trees to be removed will be based on quality (poor form, structural damage) and crown class (understory and intermediate) and species. This method has been used in northern Europe to transform even-aged plantations of similar structure into a natural appearing forest of multiple age classes and varied species composition. While this stand is not a plantation, it has developed adjacent to several plantations and is also an even-aged stand. The focus will be on improving the quality of the forest by removing poorly formed stems and providing space for regeneration. Portions of this stand have Norway spruce and native red spruce regeneration which will factor into the future development of the forest.
- **Desired and Expected Results:** The residual stand will have a higher proportion of quality overstory trees. Existing regeneration will be released from completion and growing into a stand of high-quality mixed-wood species. The next entry into the stand will be when it is time to release the saplings from overstory completion. This would be in approximately 20 years but will be determined by future forest inventory work.

Logging System Requirements: The harvesting of these stands can be accomplished with a cut-to-length harvester and an eight-wheel forwarder to ensure safety, lower ground pressure and efficiency. This will also permit the use of smaller landings and have less impact on the residual trees. Coarse woody debris (CWD) will be retained to meet minimum standards of 2-3 tons per acre. Many portions of the plantations exceed this amount and may hamper harvesting operations. These areas will be treated to disperse heavy fuel conditions while allowing CWD resource objectives to be met. This type of harvesting system will allow for adequate CWD retention as opposed to systems that remove the entire tree from to site.

Project Access and landings: Access to the proposed project area will be from Colrain (Ed Clark Road) or Heath (Route 8A) Road to State Farm Road in the town of Heath. Several existing landings will be utilized be along State Farm Road and Newton Road. Tractor trailers will be allowed for log transport out of the forest. Upon completion of all harvesting activity landings will be free of debris and graded to prevent erosion. Cleared portions that are not graveled will be seeded with "Berkshire Conservation Mix" grass seed and mulched with straw. Where possible, boulders will block access to the forwarder / skid trails from illegal vehicles.

- **Forwarder Road and Skid Trails:** Throughout the project area forwarder / skid trails will be laid out to avoid water features and to avoid slopes. Primary skid trails will be laid out and marked prior to the project being placed out to bid. Any unavoidable stream or wetland crossing will be designed at or above the standards of the "Massachusetts Forestry Best Management Practices". Upon completion of all harvesting activity all forwarder / skid road will be left in a stable state and water bars will be installed according the "Massachusetts Forestry Best Management Practices". All stream/wetland crossing will be stabilized and entrances will be blocked to prevent illegal access.

Wildlife Resources: Current snags will be retained; however operators have the right to remove any snag that poses a safety hazard to themselves or equipment. Operators will not be required to utilize cull trees, if left behind they will add to the amount of large diameter CWD. Limbs and tops (slash) will also be left in place to augment existing CWD and add soil nutrients through decomposition.

In-kind Services: Upon final tally of product the extent of in-kind services will be determined. These may include repair and restoration of drainage features on Newton Road and several unnamed access roads installation of metal pipe gates in multiple locations to limit unauthorized access by motor vehicles. This should also limit illegal dumping on the state forest, gravel and grading on several state roads in the project area And beech control in areas to be regenerated as needed.

Climate Change and Potential Impacts

Climate change will present challenges and opportunities for accomplishing the management objectives of this project. The degree of change is uncertain, however based on current predictions and recent weather events it would be prudent to plan for future climate shifts. The DCR forester

responsible for preparing this timber sale used the Adaptation Workbook to develop identify how the proposed timber sale could help the area to adapt to climate change.

Challenges

- Conditions may become wetter during the period when operations are likely to occur, which would increase the potential for soil erosion or damage and limit the success of the project.
- Climate change will accelerate the spread of Hemlock woolly adelgid, which will impact an important species in the riparian zone.
- Warmer temperatures or more open canopy conditions as a result of stress on the overstory trees may allow for invasive and undesirable species to increase in the understory.
- Warmer temperatures will favor different a species composition. Those more tolerant of warmer temperatures and increased rainfall will slowly dominate the landscape.

Opportunities

The proposed activities reduce risks to the site from extreme precipitation events and other changes in climate. Anticipated changes in climate only increase the need to implement these activities sooner rather than later. The following matrix is taken from the Forest Adaptation Workbook and is focused on protecting riparian zones from expected climate change and also to enhance species diversity throughout the project area. The proposed silviculture will shift the species composition by increasing species diversity and both horizontal and vertical structure.

Area/Topic	Approach	Tactics
Stream crossings	1.3. Maintain or restore riparian areas. 1.4. Reduce competition for moisture, nutrients, and light.	Remove failing culverts and replace with bridges. Ensure stream connectivity and a naturalized stream bottom.
Riparian forest	2.2. Prevent the introduction and establishment of invasive plant species and remove existing invasive species.	Control of invasive plants using herbicides pre- and post-harvest.
	5.1. Promote diverse age classes. 5.2. Maintain and restore diversity of native species. 9.5. Disfavor species that are distinctly maladapted.	Use of uneven-aged silviculture to promote age and species diversity. Remove hemlock and ash because of susceptibility to insect pests and encourage regeneration of a diversity of tree species.
	5.2. Maintain and restore diversity of native species. 5.3. Retain biological legacies.	Maintain at least 50% of the basal area along streams, per current regulations.
	5.2. Maintain and restore diversity of native species.	Consider the use of artificial regeneration to shift the composition in the riparian zone, using species

Area/Topic	Approach	Tactics
	9.1. Favor or restore native species that are expected to be adapted to future conditions. 9.2. Establish or encourage new mixes of native species.	such as northern red oak, hickory species, or American chestnut.

Prescription Documentation:

Project Marking Guidelines: Follow the directions below for marking instructions of sale and stand level features.

1. Locate, flag (blue wetlands) and paint with two red diagonal stripes the buffers and filter strips along all wetland and associated streams.
2. Locate, flag and paint with two red diagonal stripes the remaining wooded project boundary line. This will not be done where the project boundary is a road.
3. Flag temporary layout of the primary forwarder trail network with orange flagging. Using blue paint mark small non commercial stems or stems already marked for removal located along adjusted skid trails upon completion of marking.
4. Flag temporary layout of any unavoidable wetland and stream crossing with labeled orange flagging. Using Red paint mark and label each crossing upon completion of marking and any final adjustment to location.
5. Locate and mark perimeter of landing with one red diagonal stripe.
6. General tree marking guide:

Marking type	Type of Tree	Tally Method	Mark Type
Leave Tree	Leave Tree	As needed	Red Horizontal Line
Cut Tree	Cut Saw Log	Individual tally DBH + height	Blue Horizontal Line
Cut Tree	Cut Pulp/Cord Wood	Individual tally DBH + height	Blue Diagonal Stripe
Cut Tree	Cut Live Cull Tree	No tally	Blue X
Cut Tree	Dead Tree Warning	No tally	Blue X

Norway Spruce Plantations: Irregular Shelterwood: Remove 30 to 50% of the basal area reducing the stand to approximately 140-160$^{sq/ft}$ by following the prioritized guide below. Remove no more than 50% of the basal area within the road buffer.

1. Unacceptable growing stock* \ Understory Norway spruce
2. Any Diseased spruce or black cherry
3. Unacceptable red maple, American beech or birch
4. Unacceptable black cherry

Retention of mature seed producing black cherry, sugar maple, black and yellow birch within the stand is preferable.

* Defined in terms of high enough quality to produce a sawlog. Stem shape, form and crown asre part of the characteristics used in making this determination.

White Pine Plantations: Irregular Shelterwood: Remove 30 to 50% of the basal area reducing the stand to approximately 140-160$^{sq/ft}$ by following the prioritized guide below. Remove no more than 50% of the basal area within the road buffer.

1. Unacceptable white pine
2. Any Diseased black cherry
3. Unacceptable red maple, American beech or birch
4. Unacceptable Black Cherry

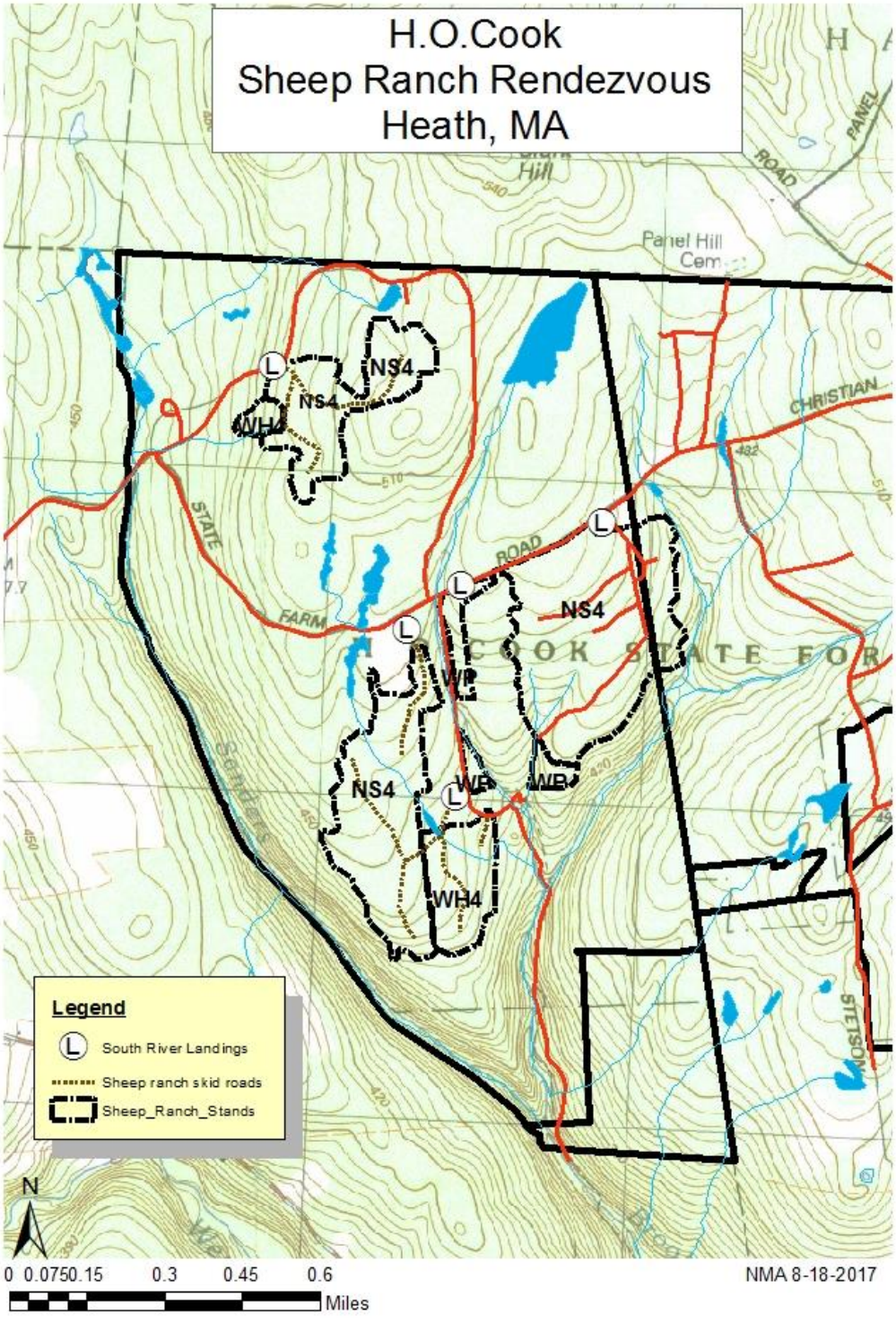
Retention of mature seed producing black cherry, sugar maple, black and yellow birch within the stand is preferable.

White Pine/Hardwood Forest Type: Irregular Shelterwood: Remove 30 to 50% of the basal area reducing the stand to approximately 140-160$^{sq/ft}$ by following the prioritized guide below.

1. Unacceptable white pine
2. Any Diseased black cherry
3. Unacceptable red maple, American beech or birch
4. Unacceptable Black Cherry
5. Other Acceptable Hardwood

Retention of mature seed producing black cherry, sugar maple, black and yellow birch within the stand is preferable.

Attached: Stand Map and Locus Map showing location of Forest Products Sale Area


H.O.Cook
Sheep Ranch Rendezvous
Heath, MA
Panel Hill Cem
PANEL ROAD
CHRISTIAN
STATE FARM ROAD
NS4
NS4
WH4
NS4
WB
WB
WB
NS4
WH4
H.O. COOK STATE FOR
STETSON
Legend
South River Landings
Sheep ranch skid roads
Sheep_Ranch_Stands
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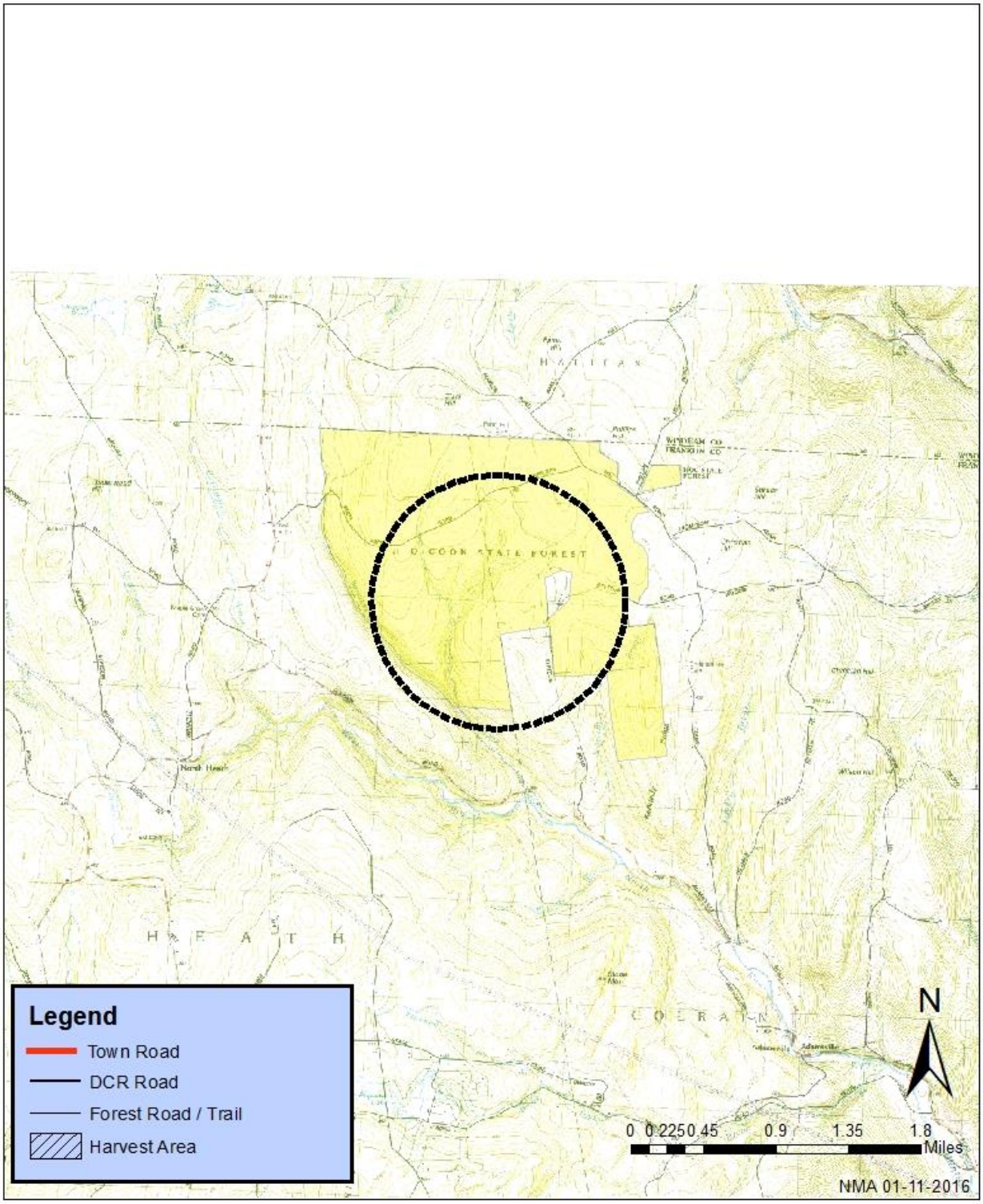
0 0.0750.15 0.3 0.45 0.6
Miles
NMA 8-18-2017

Sheep Ranch Lot - Locus Map
H.O. Cook State Forest



References

Smallidge, P.J. and R.D. Nyland. 2009. *Woodland Guidelines for the Control and Management of American Beech*. Cornell Univeristy Cooperative Extension Forest Connect Fact Sheet. P. Smallidge, ed. 6pgs.

Kochenderfer, Jeffrey D.; Kochenderfer, James N. 2009. *Effects of Herbicide Concentration and Application Timing on the Control of Beech Root and Stump Sprouts Using the Cut-stump Treatment*. Gen. Tech. Rep. NRS-48. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 10 pgs.

Houston, David R. and O'Brien, James T. 1983. *Beech Bark Disease*. Forest Insect & Disease Leaflet 75. U.S. Department of Agriculture, Forest Service.

Leak, William B. 2003. *Best Density and Structure for Uneven-Aged Northern Hardwood Management in New England*. Northern Journal of Forestry, Vol. 20, No. 1

Malcolm, D.C. (1992). The development of a transformation from even-aged plantations to an irregularly-structure forest. Report to the Scottish Forestry Trust. School of Forestry, Institute of Ecology and Resource Management, University of Edinburgh, Edinburgh.

Wilson, E. R., McIver, H. W. and Malcolm, D. C. (1999). Transformation to irregular structure of an upland conifer forest. Forestry Chronicle 75, 407-412.

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

Massachusetts Department of Conservation & Recreation. 2015. *Western Connecticut Valley District Forest Resource Management Plan (Revised).*

Kerr, G., Morgan, M., Blyth, J.F. and Stokes, V. (2010). Transformation from even aged plantations to an irregular forest: the world's longest running trial area at Glentress, Scotland. Forestry 83, 329-344.

Kittredge Jr., David B. and Parker, Michael. 2000. *Massachusetts Forestry Best Management Practices Manual*. Massachusetts Department of Environmental Protection, Office of Watershed Management and U.S. Environmental Protection Agency, Region I, Water Division, Water Quality Section.

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.

Hoffard, William H. and Marshall, Philip T. 1978. *How To Identify and Control the Sugar Maple Borer*. United States Department of Agriculture, Northeastern Area State & Private Forestry. NA-GR-1

Janowiak, Maria K, et al. 2014. *A Practical Approach for Translating Climate Change Adaptation Principles into Forest Management Actions. J.For112(5):424-433.*

Jensen, Sandra. Updated 2011. *Plant Disease Fact Sheet: Black Knot*. Cornell University, Plant Disease Diagnostic Clinic

Frank, Robert M. and Bjorkbom, John C. 1973. *A Silvicultural Guide for Spruce-Fir in the Northeast.* USDA Forest Service General Technical Report NE-6.

Bottorff, Jim. 2009 Revised. Snags, Coarse Woody Debris, and Wildlife. Washington State Department of Natural Resources.