Massachusetts Department of Conservation and Recreation

Silviculture Prescription
Cricket Hill Road

Massachusetts Department of Conservation and Recreation
Bureau of Forestry

Western Connecticut Valley District
Conway State Forest
Conway, MA

Prepared by:

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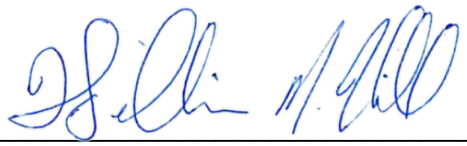
Approved by:

Management Forestry Program Supervisor  Date: February 4, 2020

William N. Hill, CF

Overview:

General Information: The Conway State Forest was formed in the 1920's when parcels of land were purchased under the Massachusetts Reforestation Act of 1908. The majority of these parcels were abandoned farmland that was growing back into forests. The result is that the area is an even-aged forest that is approximately 80 -100 years old. Stand stocking is variable, ranging from dense, overstocked plantations to medium density northern hardwoods. The plantations were established in the 1920's prior to the Civilian Conservation Corps (CCC) period of the 1930's. Documentation suggests that only a small amount of tree planting was done on the forest during the CCC period. The project area contains a mix of plantations comprised of Norway spruce (*Picea abies*), red spruce (*Picea rubens*), white pine (*Pinus strobus*) and native forest types consisting of northern hardwoods and white pine-hardwood mixes. The primary tree species found in these types are white ash (*Fraxinus americana*), sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), yellow birch (*Betula alleghaniensis*), black birch (*Betula lenta*), black cherry (*Prunus serotina*), basswood (*Tilia americana*), white pine (*Pinus strobus*), red oak (*Quercus rubra*), American beech *(Fagus grandifolia*) and hickory (*Carya spp*). A timber harvest was completed in 1972 in the white pine-hardwood stand along the southern edge of the project area and also in a portion of the red spruce stand adjacent to the white pine-hardwood stand. This prescription, Cricket Hill Road will cover 100 of the 275 acres in the Cricket Hill Road proposal document.

The DCR Management Guidelines state that forest land will be classed and considered for silvicultural treatments that generally fit their productivity, structural complexity (or potential) and diversity. An analysis of the Conway State Forest using the Productivity/Complexity Data Layer (land use, forest type, and soil types) suggests a medium to high productivity throughout the project area. This implies the site is suited for both even-aged and uneven-aged management. This will be reflected in the types of silvicultural treatments utilized to regenerate the forest.

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

- Norway spruce and red spruce plantations are in decline.
- The maturing even age forest types are generally low in species diversity.
- Forest road infrastructure is in need of repair.
- The project offers an opportunity to demonstrate and fulfill an ecosystem services approach to forest management on DCR Woodlands.

The Cricket Hill Forest Management Project will:

- Demonstrate harvesting techniques and best management practices that protect and enhance forest productivity, soil, and water resources.
- Demonstrate the irregular shelterwood silvicultural system that when applied will create diverse forest structure.
- Create and provide ecosystem services from this Woodland as directed by the Landscape Designations for DCR Parks and Forests: Selection Criteria and Management Guidelines (2012). These services include:
    - Provide the conditions for early seral or regenerating forest that will support a suite of diverse species.
    - Create a more diverse forest structure that is resilient to disturbance.
    - Provide locally grown forest products to the local economy.

- Sequestered carbon in retained overstory trees, permanent forest products produced from the harvest, and in the vigorous regenerating forest.

1.) Site Data

Geology and Landforms: The proposal area is located in the town of Conway and the landform is the typical streams and ridges found in the hill towns of western Franklin County. Cricket Hill rises to 1294' elevation on the northeast corner of the forest and Dry Hill is 1352' at the southern end of the forest. Avery Brook flows to the southeast and terminates at the Northampton Reservoir in Whately. A number of smaller brooks and streams wind their way through the forest creating complex terrain features as they merge to form larger channels.

Soils: The soil types are predominately Westminster extremely rocky loam (WrD) with several small pockets of Buckland extremely stony fine sandy loam (BwB) and Colrain extremely stony fine sandy loam (CxF). The Buckland and Colrain soils are well-drained and suitable for growing crops and trees while the Westminster 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 Westminster soils is much lower due to the amount of rocks and stones. Another important factor to consider is that the operability of the area as 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 Buckland and Colrain 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. The names of these soils indicate the presence of rocks and stones scattered above and below the surface of the ground. These can inhibit tree growth and vigor in addition to providing access considerations.

Climate: The project location lies in an area of mild summers and moderate winters with year round precipitation possible. The elevation of the forest is high enough that it 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 seem to occur more often. The figures below (Table 1) are excerpt from the National Weather Service Climatological Data for Pittsfield, MA. The climate period used to determine normal value is 1981 through 2010.

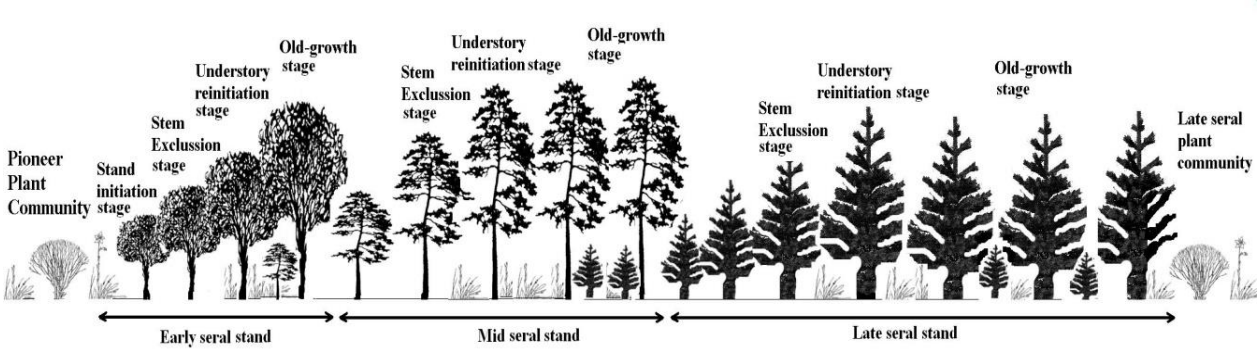
Table 1: Average annual weather data

	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 the ice storm of 2008 and 2011 tropical storm Irene. The recent tornado in 2016 passed just to the north and caused only minor damage in the state forest. 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. Tropical Storm Irene caused extensive road damage due to flooding.

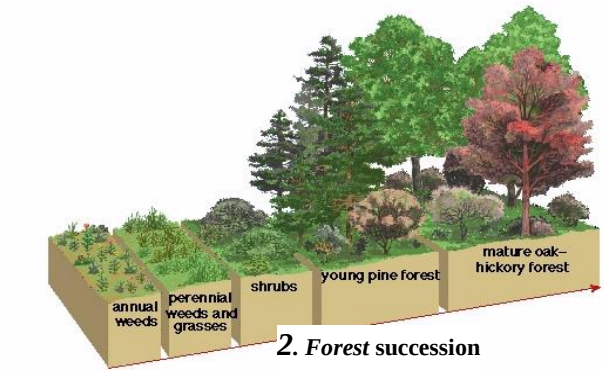
Hydrology and Watershed: The project area falls entirely within the Connecticut River Watershed. All rainfall within this project area drains into intermittent or perennial streams which flow southeasterly into Avery Brook or Roaring Brook, then into a network of waterways leading eventually to the Mill River and finally into the Connecticut River. Avery Brook flows into the Northampton water supply lands and Roaring Brook flows into South Deerfield water supply land. There are no mapped certified vernal pools by the Natural Heritage and Endangered Species Program present. Any seasonal seeps, intermittent streams or small forested wetlands areas located throughout the project area during the timber sale preparation process will be mapped and protected.

Potential Vegetation: The plantations are a mix of Norway spruce (Picea abies), red spruce (Picea rubens) and eastern white pine (Pinus strobus) nearly 100 years old having been established around 1923 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), northern red oak (Quercus rubra) and other associated species will be the predominate forest type with variations of hemlock-hardwoods and white pine-hardwoods 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 Westminster soils rated lower. Site index numbers range from 60-70 in the better soils to 45-50 in the rockier portions of the Westminster 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 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: A review by the DCR office of Cultural Resources was conducted prior to this prescription process. It was reported by the DCR Staff Archeologist that there are no known pre-contact sites within the proposed project. There are many stone walls and foundations that 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".

2.) Stand Data

Forest Stand Attributes: The proposed project area consists of approximately 100 acres of Norway spruce, white pine, white pine-hardwoods and red spruce plantation. There has been some scattered pre-commercial thinning operations carried out in the 1960s or 1970s and commercial harvesting has occurred in the red spruce and white-pine hardwood stand. The pre-commercial thinning work was done to increase spacing between the residual trees and provide room for the crowns to grow. The overall conditions of the plantations are very dense stands of coniferous trees dominated by a heavy buildup of dead woody material on the forest floor and many standing dead stems. Sections of the plantations with the canopy still intact have little to no regeneration or understory vegetation and are covered with a dense mat of dead tree needles and fine twigs. Portions of the plantations with gaps in the overstory or enough diffused sunlight from the edges have regeneration growing into the forest overstory. A portion of the red spruce was harvested and has black birch, beech and other hardwood regeneration present. Much of the residual overstory of red spruce is in decline and starting to die and topple over.

A.) Stand Structure-Norway spruce (47 acres): The structure of the Norway spruce plantations can be described as a single-storied even-aged forest established in 1932 or sometime shortly thereafter. It is dominated by large Norway spruce greater than 15" average diameter with a relative stand density of approximately 70 percent. Relative density is a quantification of the current density of a forest stand in comparison to the maximum level of site occupancy. Very dense forests at high levels of relative density will result in poor crown development which leads to poor root development and increased levels of tree mortality. Low to mid-range values of relative density indicate room for larger crown and root development, both important to increased tree growth and development.

These are dense stands with variable size gaps interspersed at random throughout the canopy which were 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 these forest stands. The following tables illustrate the stand structure, composition, relative density, quadratic mean-stand diameter (QMD), regeneration and understory vegetation.

Norway Spruce Volume and Stocking

Volume	Norway spruce						
				Sawtimber	Total	Total	Topwood
		Sawlog	Pulp	Mean	Bf	Cords	Cords
Species	Species Code	Bf/Acre	Cords/Acre	Ht (logs)	(Stand)	(Stand)	(Stand)
White pine	1	0			0		
Norway spruce	26	44562.51		3.2713649	1916188		173.24294
Total		44562.51	0		1916188	0	173.24294

Stocking Diagnostics Norway spruce								
				%				
		Total	Total	BA/ac				
Species	Species Code	Trees/Acre	BA/Acre	by Spp	QMD	Rel Density	% AGS	
EWP	1	16.991552	20	0.0655738	14.690646	0	0	
NSPR	26	229.45542	285	0.9344262	15.09092	84.431018	0.8245614	
Total		246.44697	305	1	15.063664	84.431018	0.7704918	
			Median Stand Diameter ->>		15.5	90.356002	<<- Estimated Relative Density	

Regeneration Information – Norway spruce

Stand	Plot#	RM	WA	NS	BC	HK	WP	RO	BE	WB	YB
Norway Spruce											
Stems/Acre		225		375		75		150	300		225

Ground Cover Information- Norway spruce and red spruce stands

Ground Cover Species	Norway Spruce and Red Spruce		
Species:	Ferns	Duff	Rubus spp.
% Cover:	15	65	10

Coarse Woody Debris Amounts: 385 cubic feet / 4.6 cords per acre.

B.) Stand Structure – Red spruce (13 acres): The red spruce plantations are similar to the Norway spruce in terms of structure and development. Variations occur where past harvests have altered the stand density. The untreated section has full stand stocking and the treated section is of a lower stand density and also has mortality from weather events including ice and windthrow. Advance regeneration of black birch, white pine, red spruce and black cherry has occurred in some of the harvest openings. Coarse woody debris is abundant in all the red spruce stands. The following tables illustrate the stand structure, composition, relative density, quadratic stand diameter, regeneration and understory vegetation.

Red Spruce Volume and Stocking

Volume

Species	Spp Code	Sawlog Bf/Acre	Pulp Cords/Acre	Sawtimber Mean Ht (logs)	Total Bf (Stand)	Total Cords (Stand)	Topwood Cords (Stand)
Spruce	5	11,173	16.84	2.9	122,903	185.3	17
Red Maple	7	1,352			14,873		
Black Cherry	10	996		1.5	10,951		6
			0		0		
Total		13,521	0		148,727	185.3	23

Stocking Diagnostics								
				%				
		Total	Total	BA/ac				
Spp	Spp Code	Trees/Acre	BA/Acre	by Spp	QMD	Rel Density	% AGS	
Spruce	5	258.7287	140	0.875	9.960569	58.70312151	0.642857	
Red maple	7	16.5267	10	0.0625	10.53293	0	1	
Black cherry	10	8.710997	10	0.0625	14.50803	7.947455715	1	
Total		283.9664	160	1	10.1641	66.65057722	0.6875	
		Median Stand Diameter ->>			11.2	71.09394904		
						<<- Estimated Relative Density		

Regeneration Information – Red spruce

Stand:	Plot#	RM	WA	BC	NS	BE	WP	RO	YB
Stems/Acre		600		100	300	500			100

Ground Cover Information

Ground Cover Species	Norway Spruce and Red Spruce		
Species:	Ferns	Duff	Rubus spp.
% Cover:	15	65	10

Coarse Woody Debris Amounts: 625 cubic feet / 7.3 cords per acre

C.) Stand Structure-White Pine Plantation (30 acres): The structure of the white pine plantation can be described as a single-storied even-aged forest established in 1923 or sometime shortly thereafter. It is dominated by large eastern white pine greater than 15" average diameter with a relative stand density of approximately 90 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. Regeneration is variable due to diffuse sunlight reaching the forest floor from adjacent stands and a lack of ground disturbance to scarify the soil. Understory species inventoried include American beech, red oak and red maple. Also represented in the understory are black birch, hemlock and striped maple. Coarse woody debris can be heavy due to the stand mortality incurred from dense stands of conifers competing for sunlight and nutrients. The following tables illustrate the stand structure, composition, relative density, quadratic stand diameter, regeneration and understory vegetation

White pine plantation volume and stocking

Volume	White Pine Plantation						
				Sawtimber	Total	Total	Topwood
		Sawlog	Pulp	Mean	Bf	Cords	Cords
Species(spp.)	Spp. Code	Bf/Acre	Cords/Acre	Ht (logs)	(Stand)	(Stand)	(Stand)
W. pine	1	30031.52	7.532881	3	240252.2	60.26304	30.14334
Hemlock	3	0	0.856591		0	6.852728	
Ash	8	484.9068		1.5	3879.254		2.124641
B. cherry	10	342.1644		1	2737.315		2.820565
B. birch	13	791.2459			6329.967		
Total		31649.84	8.389472		253198.7	67.11577	35.08855

Stocking Diagnostics			White pine plantation					
		Total	Total	% BA/ac				
Species	Spp Code	Trees/Acre	BA/Acre	by Spp	QMD	Rel Density	% AGS	
W. pine	1	203.5359	220	0.916667	14.07775	78.52586	0.863636	
Hemlock	3	11.48019	5	0.020833	8.9362	2.239789	1	
Ash	8	3.543269	5	0.020833	16.08516	3.868379	1	
B. cherry	10	5.85724	5	0.020833	12.51068	3.973728	1	
B. birch	13	6.011578	5	0.020833	12.34904	0	1	
Total		230.4281	240	1	13.81912	88.60775	0.875	
		Median Stand Diameter ->>			15.84489	90.49303	<<- Estimated Relative Density	

Regeneration Information – White pine plantations

Stand	Plot#	RM	WA	BC	HK	WP	RO	BE	WB
White Pine									
Stem Count		8					2	4	
Stems/Acre		600					150	300	

Ground Cover Information

Ground Cover Species	White pine plantations		
Species:	Ferns	Duff	Rubus spp.
% Cover:	5	85	10

Coarse Woody Debris Amounts: 1250 cubic feet / 15 cords/acre.

D.) Stand Structure: White Pine- Hardwood (10 acres): This stand is an even-aged white pine stand with associate species of red maple, sugar maple and hemlock. It developed earlier than the plantations and may have been young forest at the time planting operations were taking place on the forest. The overall tree stem form is fair to good with some multiple-stemmed white pine in the overstory. 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 moderately dense stands with a mostly closed canopy. It has been treated within the last 40 years. The following tables illustrate the stand structure, composition, relative density, quadratic stand diameter, regeneration and understory vegetation.

White pine - Hardwood volume and stocking

Volume	White pine hardwoods					
			Sawtimber	Total	Total	Topwood
	Sawlog	Pulp	Mean	Board feet	Cords	Cords
Spp	Bf/Acre	Cords/Acre	Ht (logs)	(Stand)	(Stand)	(Stand)
White pine	21,208		4.2	212,082		6
Hemlock	372	0.84	1.5	3,724	8.4	3
Sugar maple	725	1.62		7,249	16.2	
Red maple	2,767	4.42	2	27,672	44.2	8
White ash	0	1.34		0	13.4	
Black cherry	372		1.5	3,724		2
Black birch	269	1.79	1	2,694	17.9	3
Beech	0	0.96		0	9.6	
Red oak	382		1.5	3,818		2
	0			0		
Total	26,096	10.96		260,964	109.6	24

Stocking Diagnostics - White Pine-Hardwoods						
	Total	Total	% BA/ac			
Spp	Trees/Acre	BA/Acre	by Spp	QMD	Rel Density	% AGS
White pine	44	104	54%	20.8	33.5	92%
Hemlock	16.6	8	4%	9.4	3.6	100%
Sugar maple	14.2	8	4%	10.2	6.5	50%
Red maple	55.4	40	21%	11.5	31.9	60%
Whie ash	5.2	4	2%	11.9	3.2	0%
Black cherry	4	4	2%	13.6	3.1	100%
Black birch	25.9	16	8%	10.7	12.9	25%
Beech	16	4	2%	6.8	3.5	0%
Red Oak	3.2	4	2%	15.3	3.5	100%
Total	184.4	192	100%	13.8	102	75%
			Median Stand Diameter ->>	16.6	102	<<- Estimated Relative Density

Regeneration Information – White pine-hardwoods

Stand – White Pine - hardwoods	RM	WA	BC	HK	WP	RO	BE	WB
Stems/Acre	200		100	100	100	200	100	

Ground Cover Information – White pine - hardwoods

Ground Cover Species	White pine - hardwoods		
Species:	Ferns	Duff	Striped Maple
% Cover:	10	80	10

Coarse Woody Debris Amounts: 495 cubic feet/ 6 cords per acre.

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, Armillaria root rot on the 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. Wildfire is not a common occurrence on the forest but the potential does exist under favorable conditions. Other protection concerns are illegal dumping, unauthorized vehicle access, illegal tree cutting and non-permited campfires. Flooding and road washouts occurred during Tropical Storm Irene which have damaged some of the secondary roads. Native invasive species and non-native invasive species are present on the forest. Some of the non-native species include bittersweet (Celastrus orbiculatus), Japanese barberry (Berberis thunbergii) , common buckthorn (Rhamnus cathartica) and glossy buckthorn (Rhamnus frangula). Native invasives such as wild grape are the most prevalent issue on the forest. These woody vines grow into the forest canopy and will envelop and kill smaller trees.

3**Black Knot on cherry**

Recreational and Aesthetic Resources: The main access to the state forest is Cricket Hill Road in Conway. The forest is open to all legal passive recreation activities that are allowed on DCR properties including hunting, fishing, snowshoeing, hiking, animal tracking and birding. There is an official snowmobile trail on the some of the main forest roads that are maintained by the Conway Snowmobile Club. The project area has no designated hiking, biking or horseback riding trails present.

Wildlife Habitat Conditions: Most of the project area is in closed forest canopy with scattered openings from natural disturbances and prior harvests. The gradual transition of the monoculture plantations to a mixed hardwood and softwood stand will add to both the diversity of plant and wildlife species. 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 do not pose a danger to the operator will also be retained. These are important as nesting habitat to more than 60 cavity nesting birds and mammals. Current conditions show large quantities 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' are useful and there are currently large amounts of this material present. The planned treatments will add additional regeneration to maintain browse and cover providing 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 and implementing 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 and implement the irregular shelterwood silviculture system of managing white pine to provide additional space, light and water resources for remaining overstory trees and regeneration of native species. 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 (expanding gap variant) will be applied throughout this stand 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). 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 (gaps) of various sizes up to ½ acre to release existing regeneration and create favorable conditions for establishing new regeneration of desirable species. Retention trees of desirable species and form will be maintained in the openings when possible and red oak trees along the stand boundary will be utilized for a seed source. The final appearance of the stand will be irregular in terms of height and density. This system mimics naturally occurring random storm events which seldom are regular in terms of spacing and timing. Future entries into the stand will expand the openings (gaps) and create additional age classes.

- Forest management efforts will also be aimed at retaining wildlife trees and ensuring adequate course woody debris.

- **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 within 5 - 10 years post treatment 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 and Red Spruce Plantations: Silvicultural practices in these stands will demonstrate and implement the irregular shelterwood system method of regenerating Norway spruce to provide additional space, light and water resources for remaining overstory trees and regeneration of native species. 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.

4. **Irregular shelterwood in Europe**

The primary goal of treatment in these spruce plantations is to regenerate the plantations to native species and grow 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, create structural diversity and regenerate the forest.

- **Silviculture Methods:** The irregular shelterwood system (expanding gap variant) 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 stands. 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, creating openings (gaps) to release existing regeneration and creating favorable conditions for establishing new regeneration of desirable species. Openings up to 3 acres will be created in several locations in order to release existing regeneration in areas that have excessive mortality from both abiotic and biotic factors such as root rot. Retention trees of desirable species and form will be maintained in the openings when possible. Potential locations are located on the silvicultural prescription map.
- **Desired and Expected Results:** This harvest should lead to stands of high quality Norway spruce, northern hardwood species and northern red oak. The stand will be fully stocked with desirable regeneration and residual trees will have ample opportunity to grow. As the stand matures wildlife cavity 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 approximately 10 years after this current harvest and will continue the process of regenerating the stand.

White Pine-Hardwoods: Silvicultural practices in these stands will demonstrate and implement 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 (expanding gap variant) 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. Retention trees will be white pine, black cherry and red oak trees with well-formed crowns. 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 (gaps) up to ½ acre 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 competition. This would be in approximately 10 years but will be determined by future forest inventory work.

Logging System Requirements: These stands will be harvested with a cut-to-length harvester and an eight or six-wheel forwarder to ensure safety, lower ground pressure and efficiency. It will also permit the use of smaller landings and have less impact on the residual trees. This type of harvesting system will allow for adequate coarse woody debris retention as opposed to systems that remove the entire tree from the site.

Project Access and landings: Access to the proposed project area will be from Cricket Hill Road via Whately 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 be placed to block illegal access to the forwarder / skid trails.

- **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:** Existing snags (standing dead trees) will be retained; however operators have the right to remove any snag that poses a safety hazard to themselves or equipment. Live cavity trees will be retained to provide habitat for a variety of birds and mammals. 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 steel gates for access control, control of invasive species, gravel and road grading and drainage.

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 Northern Institute of Applied Climate Science Adaptation Workbook to 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 may accelerate the spread of Hemlock woolly adelgid, which will impact an important species in the riparian zones.
- Warmer temperatures or more open canopy conditions as a result of stress on the overstory trees may allow for present invasive and undesirable species to increase in the understory.
- Overall warmer temperatures will favor a different species composition. It is predicted that those species 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.

Area/Topic	Approach	Tactics
Reduce existing biological stressors	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.

Area/Topic	Approach	Tactics
Maintain/enhance species and structural diversity	5.1. Promote diverse age classes.	Use of uneven-aged silviculture to promote age and species diversity. Remove non-native plantations due to 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.
Facilitate community adjustments through species transition	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. 9.5. Disfavor species that are distinctly maladapted.	Use of uneven-aged silviculture to promote age and species diversity. Remove non-native plantations due to susceptibility to insect pests and encourage regeneration of a diversity of tree species.

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 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. Yellow paint final road layout. 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/Wildlife Tree	As needed	Red Horizontal Line
Cut Tree	Cut Saw Log	Individual tally DBH + height	Blue Horizontal Line plus butt mark
Cut Tree	Cut Pulp/Cord Wood	Individual tally DBH + height	Blue Dot/slash plus butt mark
Cut Tree	Cut Live Cull Tree	No tally	Blue X plus butt mark
Cut Tree	Dead Tree Warning	No tally	Blue X plus butt mark

Norway/Red spruce plantations: Irregular Shelterwood/group openings/patch cuts: Remove 50 to 70% of the basal area reducing the stand to approximately 100-140$^{sq/ft}$ by following the guide below. Remove no more than 50% of the basal area within the road buffer except for safety concerns.

1. Remove unacceptable \ understory Norway spruce
2. Remove any diseased spruce or diseased black cherry
3. Remove unacceptable red maple, American beech or birch
4. Remove unacceptable black cherry
5. Remove all trees infected by Armillaria root rot.
6. Retain high quality Norway and red spruce for residual stand.
7. Release advanced regeneration in low density red spruce area.
8. Center gaps created around healthy, mature native hardwoods such as red oak, black birch and black cherry when possible. It will be preferred to release advanced regeneration of these species when possible.

Retention of mature seed producing black cherry, red oak sugar maple, black and yellow birch within the stand is preferable. American beech that is healthy and free of beech bark disease is also a preferred residual tree. These species also occur in adjacent stands along the plantation edges and will be the best location for the larger groups and patches up to 2 to 3 acres.

White Pine Plantations: Irregular Shelterwood: Remove 50 to 70% of the basal area reducing the stand to approximately 80-130$^{sq/ft}$ by following the guide below. Remove no more than 50% of the basal area within the road buffer except for safety concerns.

1. Remove unacceptable white pine
2. Remove any diseased black cherry
3. Remove unacceptable red maple, American beech or birch
4. Remove unacceptable black cherry
5. Remove all trees infected by Armillaria root rot.
6. Retain high quality white pine for residual stand.
7. Retain several live and dead cavity trees per acre when possible.
8. Center gaps created around healthy, mature native hardwoods such as Red oak, Black birch and Black cherry when possible. It will be preferred to release advanced regeneration of these species when possible.

Retention of mature seed producing black cherry, red oak sugar maple, black and yellow birch within the stand is preferable. American beech that is healthy and free of beech bark disease is also a preferred residual tree. These species also occur in adjacent stands along the plantation edges.

White Pine – Hardwood: Irregular Shelterwood: Remove 30 to 50% of the basal area reducing the stand to approximately 80 to 90$^{sq/ft}$ by following the guide below. Remove no more than 50% of the basal area within the road buffer.

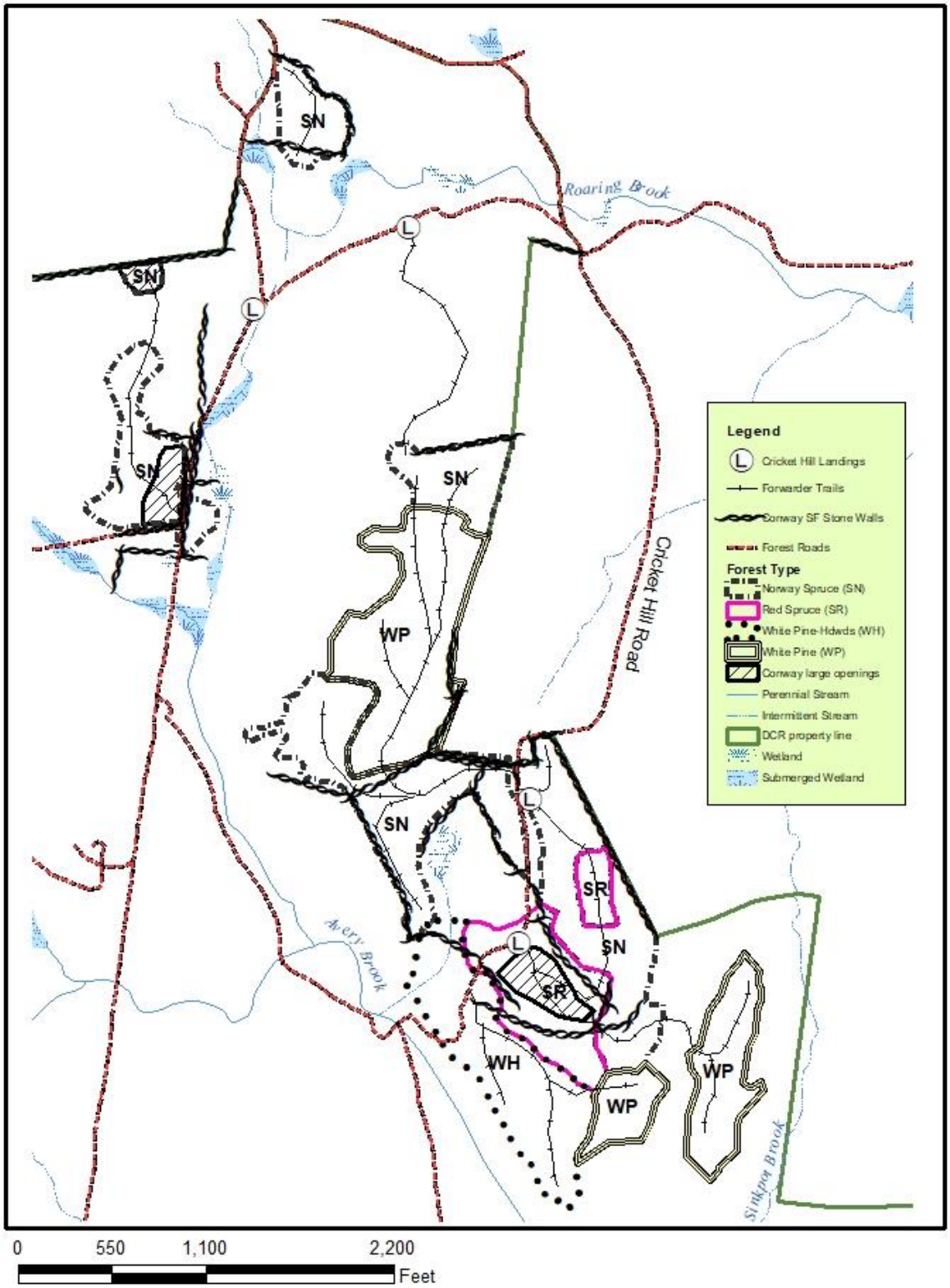
1. Remove unacceptable white pine.
2. Remove poorly formed red maple and white pine.
3. Retain high quality white pine, cherry, red oak, sugar maple, yellow birch, black birch and beech for residual stand.
4. Retain several dead and live cavity trees per acre when possible.
5. Remove black cherry with black knot disease.

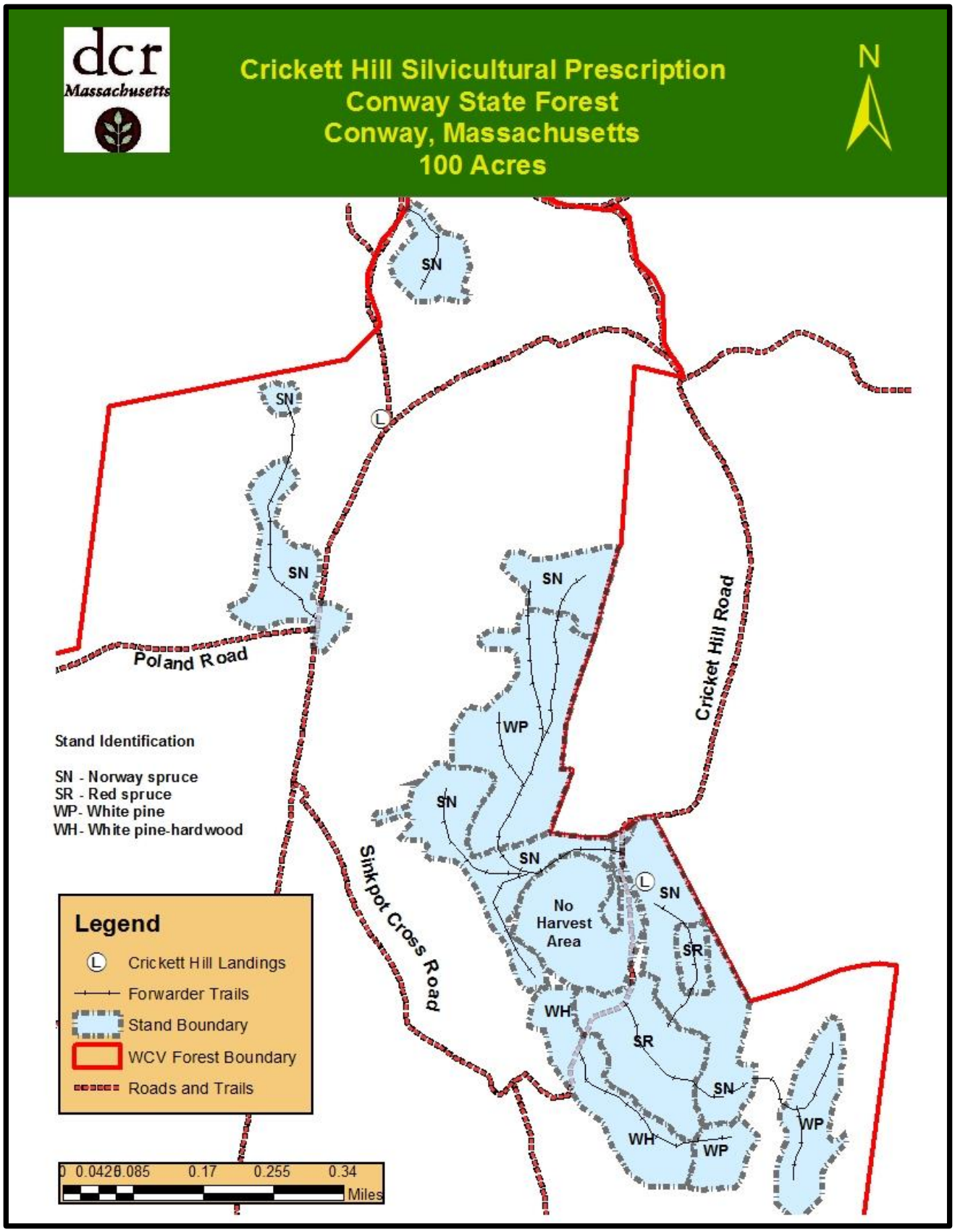
6. Release any groups of preferred advanced regeneration.
7. Center gaps created around healthy, mature native hardwoods such as red oak, black birch and black cherry when possible. It will be preferred to release advanced regeneration of these species when possible.

Cricket Hill Silvicultural Prescription

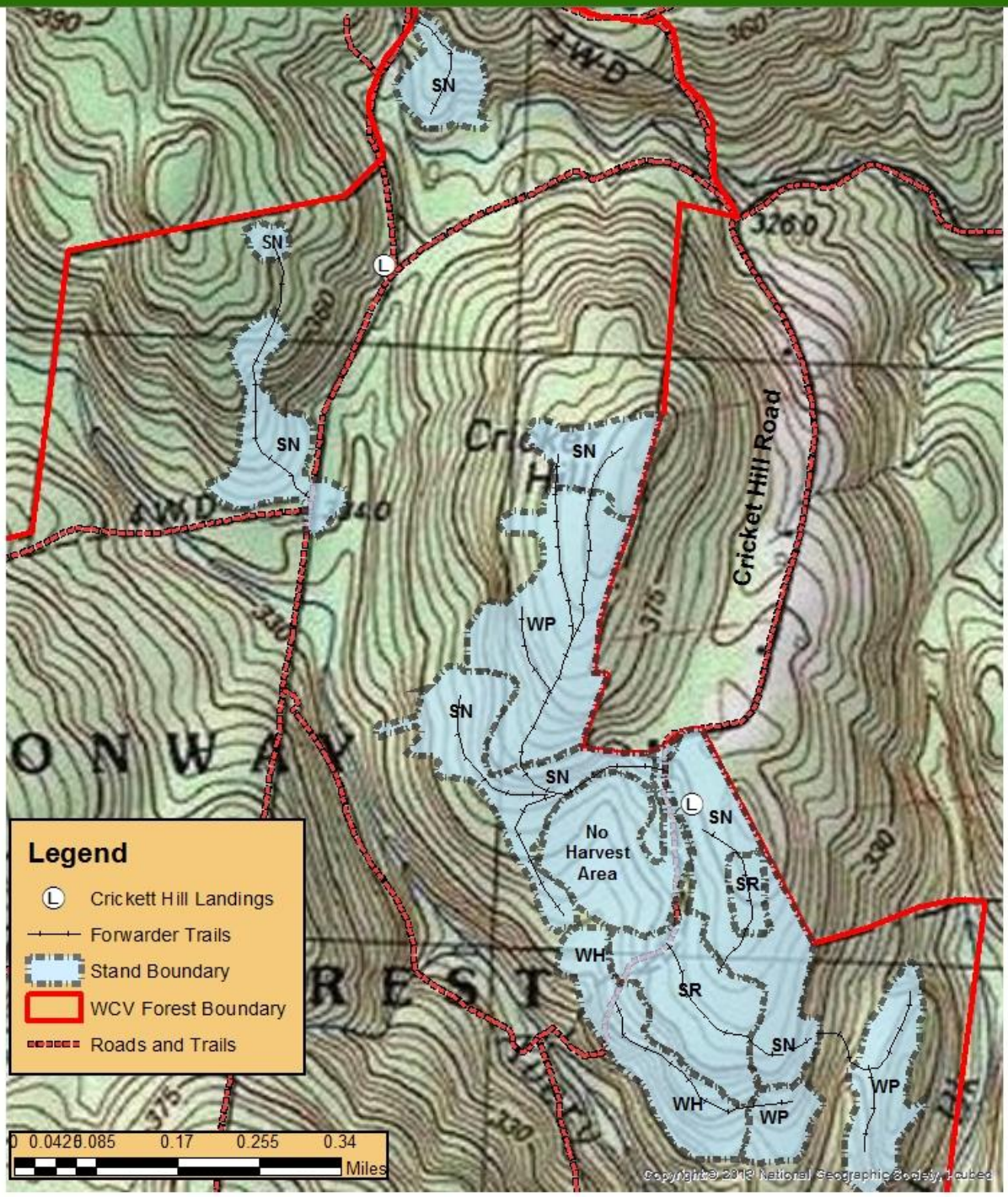
Conway State Forest 100 Acres

Conway, Massachusetts



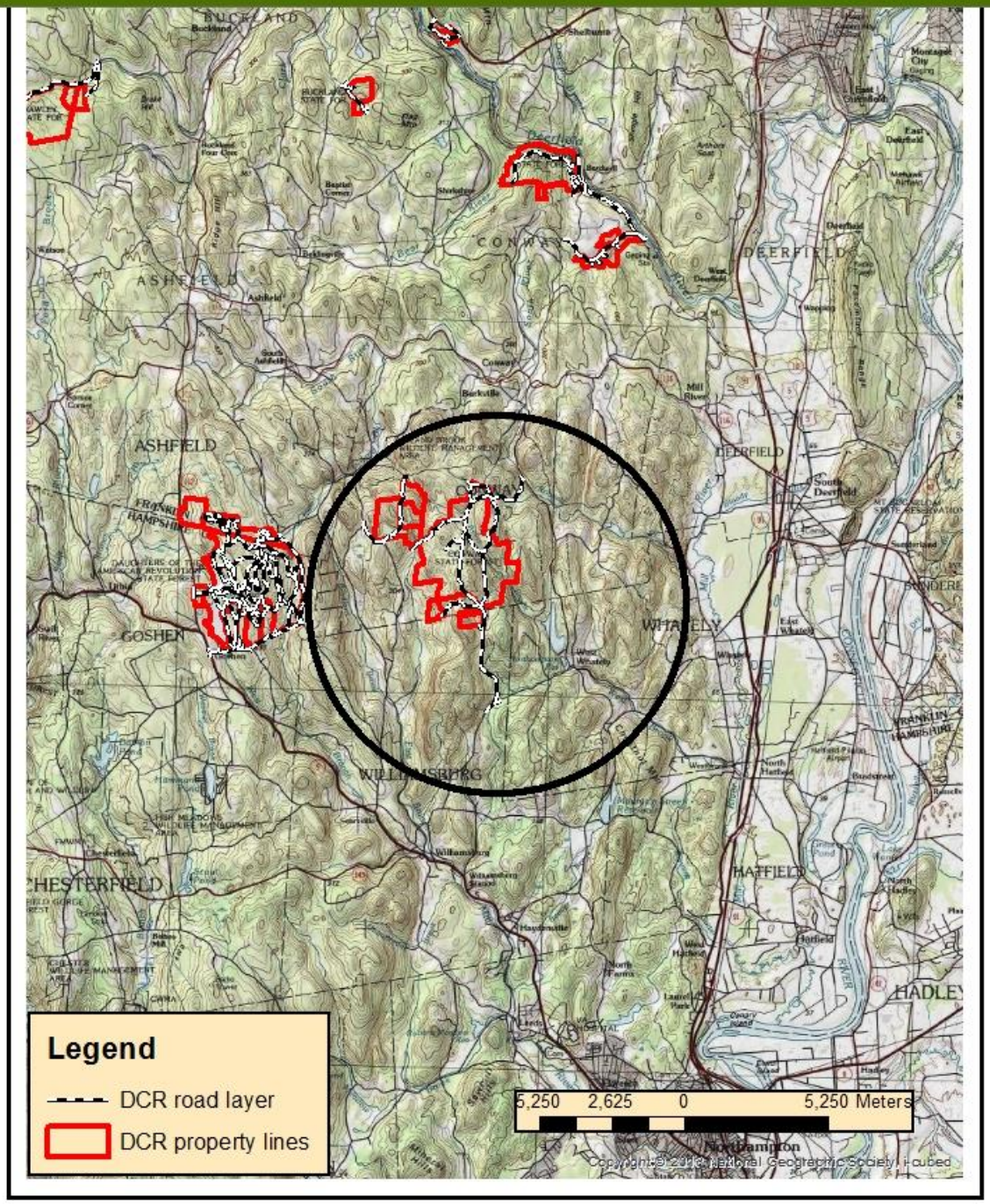

dcr
Massachusetts
Crickett Hill Silvicultural Prescription
Conway State Forest
Conway, Massachusetts
100 Acres
N
SN
SN
SN
SN
WP
SN
SN
SN
SR
WH
SR
SN
WH
WP
WP
Poland Road
Cricket Hill Road
Sinkpot Cross Road
No Harvest Area
Stand Identification
SN - Norway spruce
SR - Red spruce
WP- White pine
WH- White pine-hardwood
Legend
Crickett Hill Landings
Forwarder Trails
Stand Boundary
WCV Forest Boundary
Roads and Trails
0 0.042 0.085 0.17 0.255 0.34
Miles

Crickett Hill Silvicultural Prescription
Conway State Forest
Conway, Massachusetts
100 Acres



dcr
Massachusetts

Conway State Forest
Locus Map



Appendix 1. Common Abbreviations.

Tree species:

White ash – WA
Basswood – BA
Beech - BE
Black birch – BB
Yellow birch – YB
White birch – WB
Balsam fir – BF
Hemlock - HK
Pignut hickory – PH
Shagbark hickory - SH
Red maple – RM
Sugar maple – SM
White pine – WP
Red pine – RP
Black oak - BO
Red oak – RO
White oak - WO
Norway spruce – SN
Red spruce – SR

Forest types (may also be same as species code):

BB – Beech/birch/maple also known as northern hardwoods.
HH – Hemlock/hardwoods
MH – Mixed hardwoods
OH – Oak/hardwoods
WH – White pine/hardwoods

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