

# Climate Change Strategies and Approaches

## *Synthesis of the management plans of [Two towns in Franklin County, VT] Woodlots Group*

September 2022

Climate change is expected to have numerous impacts on natural resources, at every possible scale. For those who own and manage land, it can be challenging to sort through projections and research to understand how climate change might impact a single parcel—or, conversely, what role the management of that single parcel can play in aiding with climate change adaptation or mitigation.

The [Northern Institute of Applied Climate Sciences \(NIACS\)](#) has put together an [Adaptation Workbook](#) intended to bridge this gap. The workbook lays out a set of [10 strategies](#), each that provides a different lens through which to evaluate land management as it pertains to a changing climate. NIACS has also assigned a series of approaches to land management that accompany each strategy.

Cold Hollow to Canada works in conjunction with the Vermont Department of Forests, Parks, and Recreation to review management plans to help landowners identify strategies and approaches that are *already present in their management plans*. This gives landowners a starting point, allowing them to understand the role their land currently plays with regard to a changing climate. From there, each landowner can evaluate if or how inclusion of additional strategies or approaches might fit in with their management goals.

It is worth noting that the NIACS workbook was compiled for use at a national scale. Because climate change impacts different parts of the country in very different ways, some approaches are not relevant in our region. The list of strategies and approaches should therefore be used with careful consideration of regional climate change needs *and* of the particular traits of a single parcel or site, rather than as a prescription of activities that should occur in all locations.

To learn more about climate change and forest adaptation in Vermont, the Vermont Department of Forests, Parks, and Recreation has put together a comprehensive guide of research and recommendations: [Creating and Maintaining Resilient Forests In Vermont: Adapting Forests to Climate Change](#)

This is a synthesis of the analyses conducted for \_\_\_ individual management plans. All are part of the Cold Hollow to Canada Bakersfield and Fletcher Woodlots Group. The purpose of this synthesis is to allow each landowner to see what the group as a whole is accomplishing to help local forests stay resilient.

## **Strategy 1: Sustain Fundamental Ecological functions**

### **1.1. Reduce impacts to soils and nutrient cycling**

- Legacy trees are retained, which will become large coarse woody material and add to the soil organic layer. (Al, Be, Bu, C/D, Cr, He, Mac, Man, Mas, Re, Sa, Ti, Vr)
- Minimum targets for retention of snags and coarse woody material have been established. (He)
- A no-cut Riparian ESTA will minimize erosion and promote water quality in the brook. (Cr, He, Ti)
- Number of roads is kept to a minimum (F/O)
- Plan encourages repair of roads with erosion control measures. (Lep)
- Plan encourages that care be taken in areas with poorly drained soils, to avoid soil damage. (Be)
- The plan lists soil productivity as a principle of sustainable forest management that will be incorporated into all activities. (He)
- Plan recommends leaving scattered large, dead trees (snags) and downed logs. These will become coarse woody material that will add to the soil organic layer, build up soil richness, maintain moisture, and encourage nutrient cycling. (Be, Cr, He, Lep, Les, Mac, Ti, Vr)
- Plan requires that [Acceptable Management Practices](#) (AMPs) for roads and trails are followed. (Al, Be, Bu, C/D, Cr, F/O, He, Lep, Les, Mac, Man, Mas, Re, Sa, Ti, Vr)
- Plan states a goal to minimize soil impact. (Be)
- Plan states that erosion controls must be properly placed to last until at least the next cutting cycle. (He)
- Retain and add to coarse woody material during harvesting to build soil. (Al, Bu, C/D, Mac, Man, Mas, Re, Sa, Ti, Vr)
- Roads must be maintained to prevent soil erosion. (F/O, Lep)
- Some tops will remain in the woods after a harvest to provide coarse woody material. (Cr, Ti, Vr)
- Where erosion has been noted, it's recommended that shaping and grading be conducted followed by the installation of water bars to mitigate any future soil loss and potential sedimentation into water courses. (He)
- Whole tree removal is prohibited. Material smaller than 3 inches in diameter must be left in the woods, along with some crowns, branches, trees, and coarse woody debris. (F/O)

### **1.2 Maintain or restore hydrology**

- Acceptable Management Practices (AMP's) will be in place during any logging operation to prevent discharge into water bodies or sources. (Al, Be, Bu, C/D, Cr, F/O, He, Les, Mac, Man, Mas, Re, Sa, Ti, Vr)
- A no-cut riparian ESTA designated along the brook will protect flood resiliency and natural hydrology. (He)
- Protecting water quality in all wet areas and watercourses is stated as a primary goal for management. (Be)

- The protection of streams, seeps, vernal pools and other wetlands is identified as crucial for the maintenance and improvement of water quality and aquatic habitat, and careful management of all forestry activities in these areas is mandated. (He)
- Road improvement work has been conducted throughout the property. (C/D)
- Stream crossings are kept to a minimum number and width with protection during logging. (Al, Be, Bu, He, Man, Mas, Re)
- Road/trail improvements are recommended. (Al, Man)
- Wetlands are mapped and will have no active management. (Lep, Les)

### **1.3 Maintain or restore riparian areas.**

- A 50-foot buffer is placed on vernal pools, in which only very low-impact activities are allowed. (F/O)
- A 50 foot buffer with minimal cut is required to be placed on wetlands, streams, seeps, and wet areas, in excess of AMP requirements. (Be)
- A 50 foot minimal cut buffer has been placed on ephemeral streams, in excess of AMP requirements. (Bu, Cr, He, Mac, Man, Mas, Re, Ti, Vr)
- A 100 foot buffer has been placed on all perennial streams, with minimum limits on stocking levels and maximum limits on canopy openings. This is in excess of AMP requirements. (Her, Mac, Man, Re, Ti, Vr)
- A 100 foot Riparian ESTA has been placed on the property's brook frontage. (Cr, He, Ti)
- A buffer has been planted along the stream, with additional planting planned to extend the riparian buffer. (Al)
- The plan lists riparian buffers as a principle of sustainable forest management that will be incorporated into all activities. (He)

### **1.4 Reduce competition for moisture, nutrients, and light.**

- Both overstory and understory improvement cuts are prescribed, to reduce competition. (Lep, Les)
- Crop tree release is prescribed to reduce competition. (Cr, F/O, Lep, Les, Mac, Ti, Vr)
- During harvesting, the cutting of beech saplings is encouraged, to give other tree species a chance so they will not be outcompeted by the fast-growing beech. (Be, Ti, Vr)
- Group harvesting in areas of established hay-scented fern is discouraged. This fern can create a thick herbaceous layer that can prevent seed germination of other species. (Be)
- Thinning is prescribed where trees are tightly spaced. (Be, Cr, He, Mac, Sa, Ti, Vr)
- While this approach generally refers to trees, the plan outlines a strategy of reducing competition for songbirds by retaining small groups of trees during harvest to provide islands of micro-habitat, each with its own foraging and perching sites. (He)

## **1.5 Restore or maintain fire in fire-adapted ecosystems.**

(Not applicable.)

## **Strategy 2: Reduce the impact of existing biological stressors**

### **2.1 Maintain or improve the ability of forests to resist pests and pathogens**

- Adaptive management is recommended as a response to forest tent caterpillar outbreaks. (C/D)
- Ash will be retained at all size classes, to maintain a seed source over time. (Bu, Man, Mas)
- Crop tree release favors the trees least susceptible to pests and pathogens. (Lep, Les)
- A diversity of age classes is emphasized, which reduces species' vulnerability to pests and pathogens. (Be, Cr, He, Mac, Sa, Ti, Vr)
- Plan provides guidance for avoiding sun scald. (Lep)
- Plan requires that UVA tapping guidelines and Sugarbush Management Standards are followed, to ensure continued health of the stand. (Cr, F/O, Lep, Les, Ti, Vr)
- Removal of mature and over-mature trees (those no longer growing) not retained as legacies is encouraged, to minimize the population of insect and disease organisms (Cr, He, Sa, Ti, Vr)
- Species diversity is emphasized as a buffer to insects and disease. (Al, Be, Bu, C/D, He, Man, Mas, Re, Sa, Ti, Vr)
- Species diversity is emphasized in the sugarbush. (Cr, F/O, Lep, Les, Ti, Vr)
- Thinning is encouraged, to minimize the population of insect and disease organisms and increase vigor and crown development. (Mac)
- Thinning within the sugarbush is designed to look at overall forest health, as excessive thinning, no thinning, or poorly timed thinning may all contribute to decreased stand health. (Cr, Ti, Vr)
- Trees infected with sugar maple borer and eutypella canker, and necrotia canker are recommended to be removed during harvest. (Al, Bu, Croft, He, Mac, Man, Mas, Re, Sa, Ti, Vr)
- Trees resistant to beech bark disease will be retained through their biological life span. (Al, Be, Bu, C/D, Cr, He, Mac, Man, Mas, Re, Sa, Ti, Vr)

### **2.2 Prevent the introduction and establishment of invasive plant species & remove existing invasives**

- Early intervention is recommended if invasive species are found. (Cr, He, Mac, Sa, Ti, Vr)
- A list of the most common invasive species for the region is included in the plan. If land owners and managers learn to identify these species, they may be able to take action and prevent an infestation. (Be)

- Maintaining closed-canopy conditions along riparian areas will discourage some invasive species, many of which are light-loving and spread by water. (Cr, He, Mac, Sa, Ti, Vr)
- Monitoring for invasive species is recommended. This will allow for early detection and is particularly important along trails and roads where invasive species often first appear. (Al, Be, Bu, Cr, He, Mac, Man, Mas, Re, Sa, Ti, Vr)
- Plan encourages early control of scattered invasive plants (Al)
- The plan encourages the maintenance of crown cover during crop tree releases, to discourage the spread of hay-scented fern. While this is a native species, it forms dense mats that create conditions challenging to regeneration. (Mac)
- The plan lists control of invasive species as a principle of sustainable forest management that will be incorporated into all activities. (He).
- Planting/transplanting a shrub-dominated riparian/floodplain buffer is planned to prevent/improve invasion of reed canary grass. (Al)
- Removal and management of buckthorn is prioritized with future harvest (Al)
- Removal of small patches of identified invasives is recommended while populations are low. (Bu, Re)
- Watch list species recognized in plan, with resources (Ma)

### **2.3 Manage herbivory to protect or promote regeneration**

- Herbivory is identified as a potential/existing problem. (Al, Bu, He, Mas, Re)
- Hunting is allowed and/or encouraged. (Al, Bu, C/D, Man, Mas, Re)
- Planted red oak will include herbivory protection by using chemical deterrents (Mas)
- Projected harvests include larger openings that will promote early successional habitat with an abundance that has the potential to escape browse pressure. (Al)
- Tops will be left in the woods and slash maintained during harvest. This can protect regeneration from herbivory. (Al, Be, Bu, C/D, Cr, F/O, Man, Mas, Re, Ti)

## **Strategy 3: Reduce the risk and long-term impacts of severe disturbances.**

### **3.1 Alter forest structure or composition to reduce risk or severity of wildfire.**

(There is no fire risk at this time.)

### **3.2 Establish fuelbreaks to slow the spread of catastrophic fire.**

(There is no fire risk at this time.)

### **3.3 Alter forest structure to reduce severity or extent of wind and ice damage.**

- Canopy gaps are prescribed to remove plantations that have experienced loss to windthrow and allow native regeneration to become established. (Al, Bu, C/D, Mas, Re)

- Crop Tree release is prescribed. This enhances crown and root development for increased resistance to wind and ice. (Al, F/O, Bu, C/D, Cr, He, Mac, Man, Mas, Re, Sa, Ti, Vr)
- Development of regeneration through group selection will ensure forest continuity (Les)
- Encouragement of regeneration provides long-term forest resilience in response to storms. (Be, Bu)
- Group selection develops a forest structure that responds well to wind disturbance, maintaining the future forest. (Be, Bu, Cr, He, Mac, Man, Mas, Re, Sa, Ti)
- Multi-stemmed maples will be removed, because they are particularly susceptible to wind damage. (Lep)
- No single entry should reduce stocking by more than one third, to reduce impacts from windthrow or drought. (F/O)
- Overstory improvement cuts are prescribed, to enhance crown and root development for increased resistance to wind and ice. (Lep, Les)
- The plan emphasizes the risk of wind damage that could result from hemlock ring shake, maple eutypella canker, and beech bark disease and encourages landowner awareness. (Lep)
- Regeneration is emphasized, providing resilience to storms (C/D, Man, Mas, Re)
- Selection harvests are planned to release understory and pole components (C/D)
- Wind damage is a consideration of every prescription on the property. (Lep, Les)

### **3.4 Promptly revegetate sites after disturbance.**

- In group selection work, soil scarification is encouraged, to encourage establishment of sugar maple, birch, cherry, oak, or red spruce. (Ti)
- Natural regeneration is encouraged throughout the parcel, so that the forest would respond quickly after a disturbance. (Cr, F/O, Lep, Les, Mac, Re, Sa, Ti, Vr)

## **Strategy 4: Maintain or create Refugia**

### **4.1 Prioritize and maintain unique sites**

- Black bear sign have been noted, and the plan encourages that mature beech be retained during future treatments, especially where they occur in small groves in a stand, with nearby small patches implemented to promote berry production. (Ti)
- The cliffs and ledges in the northern portion of the parcel have been identified as potential den sites that could be habitat for black bear, bobcat, Lynx, coyote, porcupine, raccoon, and other small mammals. Consideration of these sites is encouraged during management. (Sa)
- Early successional habitat has been enhanced for neotropical songbirds. (Al)
- Edge habitat between forests and fields/roads have been identified as important areas for some wildlife, and management to enhance this soft edge is

encouraged, as is retention of softwood cover in these areas. (Cr, He, Mac, Sa, Ti, Vr)

- Hemlock swamp is a rare natural community in VT, and the plan states that it qualifies for additional protection in UVA. (Re)
- Maintenance and enhancement of wildlife habitat are identified as primary management goals. (Mac)
- Management will promote mature forest characteristics within 400 ft of a vernal pool. (Al)
- Meadows will be managed for grassland songbirds and other wildlife. (He, Lep, Les)
- Oak and larch will be retained because both are uncommon in this region. (Lep)
- One stand is managed specifically for wildlife. (Lep)
- The plan encourages that some areas of mature hardwoods with a fairly open understory be retained and released as wild turkey habitat, in mast stands of beech, oak, and hophornbeam. (Ti)
- Pollinator habitat has been identified and will be favored during management, with additional plantings of beneficial plants. (Al)
- Red Spruce-Northern Hardwood Natural community is being managed to maintain the species composition, with specific treatment to maintain red spruce on the landscape (Mas)
- Rich Northern Hardwood has been identified with abundant high quality regeneration, species diversity and a developed age class distribution (Man)
- The riparian area along the property's brook has been identified as important wildlife habitat, and management has been outlined accordingly including a no-cut ESTA. (He)
- Seeps and springs are identified, and considerations are encouraged during management. (Al, He, Sa, Ti)
- Softwood stands identified as winter wildlife habitat have been identified, with management techniques outlined. (Be, Cr, He, Mas, Ti, Vr)
- Special care should be taken in the rocky outcrops that provide winter denning sites for bear. (Ti)
- Stated management objectives include protection of ecologically significant features and wildlife habitat. (F/O)
- Uncommon plants have been identified and will be protected during harvest (Al)
- A vernal pool has been identified, though breeding wildlife populations had not been confirmed at the time of the plan's adoption. The plan encourages monitoring of the pool. If breeding populations are confirmed, enrollment of the pool and a 100-ft buffer as a Vernal Pool ESTA in VT's Use Value Appraisal program is suggested. Care should then also be taken in the "life zone" surrounding the pool. (Mac)
- Wetland buffers will be maintained (Al)
- Wetlands are identified, and management recommendations are outlined. (Be, He)

#### **4.2 Prioritize and maintain sensitive or at-risk species or communities**

- A buffer around the pond will protect the heron rookery. (Re)

- Aspen (at risk for seed viability success) was harvested to enhance coppice resprouting for vegetative reproduction (Les)
- During harvest, slash will be maintained to promote nesting habitat for birds. (Al)
- Forest management activities are designed to encourage wildlife, including the retention of nests, cavities, snags, soft edges, delayed mowing, mast-producing shrubs and trees, and more. (Be, Cr, F/O, He, Mac, Saylor, Titcomb, Vr)
- Interior forest songbird habitat management is recommended to address Vermont responsibility birds (Bu, Cr, He, Mac, Man, Mas, Re, Sa, Ti, Vr)
- A no-cut riparian ESTA has been designated along the brook that runs through the property. It is identified as providing a terrestrial wildlife corridor in addition to supporting riparian natural communities and protecting water quality. (He)
- Larch will be retained. (Le)
- Large-diameter legacy trees have been identified, which could develop cavities for den or nesting habitat that address habitat needs for several species of concern. (Al, Bu, C/D, He, Man, Mas, Re, Sa, Ti, Vr)
- Primary objectives for the property include enhancement of wildlife habitat. (He, Sa)
- Retention and release of mast species on the property is encouraged for wildlife. (Cr, Mac, Sa, Ti, Vr)
- Uncommon plants have been identified and will be protected during harvest. (Al)
- Vernal Pools have a 100 foot minimal cut buffer with an extended rotation around them and a 500 foot life zone where machinery will be limited and coarse woody material will be augmented (Re)

#### **4.3 Establish artificial reserves for at-risk and displaced species**

(Not applicable for private landowners.)

### **Strategy 5: Maintain and enhance species and structural diversity**

#### **5.1 Promote diverse age classes.**

- Canopy gap establishment and group selection in several stands encourages regeneration and structural diversity. (Cr, Mac, Vr)
- Crop tree release will encourage regeneration from a high-quality seed source. (F/O, Lep, Les)
- Entry cycles and rest periods are prescribed. (Al, Bu, C/D, Cr, F/O, He, Lep, Les, Mac, Man, Mas, Re, Sa, Ti, Vr)
- Individual/group selection treatments will establish areas for regeneration. (Lep, Les)
- The plan follows principles for sustainable forest management that include use of silvicultural techniques and prescriptions which use the structure (e.g. vertical structure and crown closure), function (e.g. age class distributions, special habitats or food sources, and riparian buffers), and dynamics (e.g. gap size, distribution and rates of formation) of the natural forest as a model for guidance. (He)



- The plan lists retention of appropriate numbers and size ranges of trees as a principle of sustainable forest management to be incorporated into all activities. (He)
- Specific management activities are prescribed with a goal of establishing and then releasing regeneration. (Cr, Mac, Sa, Ti, Vr)
- Stands are being converted from even-aged to uneven-aged. (Cr, Lep, Mac, Les, Sa, Ti, Vr)
- Structural diversity is highlighted (C/D)
- Structural diversity is highlighted through songbird habitat implementation. (Buxenbaum, Cr, He, Mac, Man, Mas, Re, Sa, Ti, Vr)
- Trees have been designated as legacies, ensuring the presence of a very old age cohort of trees to become established and maintained. (Al, Bu, C/D, Man, Mas, Re)
- Uneven-aged management is the goal throughout all or most of the property. (Al, Be, Bu, C/D, He, Man, Mas, Re)
- UVA Sugarbush management standards are followed, including recruitment/retention of multiple age classes in the sugarbush. (F/O)

## **5.2 Maintain and restore diversity of native tree species**

- Group management is encouraged to promote regeneration of native species. (Be)
- Larch, which is not common in the region, will be retained. (Lep)
- Mast trees have been identified and prioritized for management. (Al, Bu, Les, Man, Mas, Re)
- Oak, which is not common in the region, will be retained and/or released. (Lep, Les, Man)
- The plan lists native biodiversity and a mix of naturally occurring species as principles of sustainable management that will be incorporated into all management. (He)
- Restoration of native species is the focus of the next harvest through removal of plantations. (Al)
- Softwood cover is retained along edges for wildlife habitat (Mas)
- Species diversity is emphasized. (Cr, He, Mac, Sa, Ti, Vr)
- UVA sugarbush standards will be followed, including the retention of at least 25% of the basal area of trees in the sugarbush to be non-sugar maple species. (Frederick/Owens, Lep, Les)

## **5.3 Retain biological legacies**

- Cavity trees and coarse woody debris will be maintained and encouraged for habitat value for small mammals, herpetofauna, and invertebrates. (Al, Bu, Man, Mas, Re, Sa)
- Disease-free beech will be retained through their biological life span to provide a seed source and vegetative reproduction resistant to the disease. (Al, Be, Bu, C/D, Man, Mas, Re)

- Larger diameter trees have been identified for retention through their biological life span and then left as snags. (Al, Be, Bu, C/D, Cr, He, Ma, Man, Mas, Re, Ti, Vr)
- The plan lists retention of large diameter trees as a principle of sustainable forest management to be incorporated into all activities. (He)
- The plan sets targets for retention of snag trees. (Cr, Mas, Re, Sa, Ti, Vr)

#### **5.4 Establish reserves to protect ecosystem diversity**

- A long-term goal is to conserve the land in a forested condition. If this goal can be met, the land can act as a reserve within the greater landscape. (He, Sa)
- Property is included in the Use Value Appraisal program, keeping this as a working forest. (ALL)

### **Strategy 6: Increase ecosystem redundancy across the landscape**

#### **6.1 Manage habitats over a range of sites and conditions**

- Neotropical songbird habitat management is implemented to create conditions across the landscape for greater abundance. (Al, Bu, Cr, Hersey, Mac, Man, Mas, Re, Sa, Ti, Vr)
- Property is part of a cross boundary peer to peer management group (the Woodlots Program) designed to enhance redundancy. (ALL)

#### **6.2 Expand the boundaries of reserves to increase diversity**

- The Cold Hollow to Canada Woodlots group acts in some ways like a reserve. Members have a vision to steward and/or conserve forests across the region. While these lands are not all contiguous, they can act as stepping stones within the larger forested landscape. (ALL)
- Land is permanently conserved with Vermont Land Trust. (Re)

## **Strategy 7: Promote landscape connectivity**

### **7.1 Reduce landscape fragmentation.**

- This parcel is part of a large, unfragmented block, with minimal fragmentation between this block and neighboring blocks, creating a functional habitat block of over 85,000 acres. This area is identified by Vermont Conservation Design as highest priority for both interior forest and connectivity functions. If parcels within and between the blocks are maintained as forest, fragmentation can be kept to a minimum. (Not all are identified in plans, but this could apply to all!)

### **7.2 Maintain and create habitat corridors through reforestation or restoration**

- The block mentioned above likely functions currently as a habitat corridor. (ALL)
- Buffer restoration and management is helping to create habitat corridors. (AI)
- Consideration of the larger landscape and connectivity within and across forest blocks is encouraged in the plan. (Be, He)
- Maintain connectivity through cross border habitat management (Bux, Man)
- The Cold Hollow to Canada Woodlots group have a Landscape level songbird habitat assessment that addresses cross boundary management (ALL)

## **Strategy 8: Enhance genetic diversity**

### **8.1 Use seeds, germplasm, and other genetic material from across a greater geographic area**

- Resistant beech, elm and in the future ash can be identified to be free of disease. These individual trees or clusters will be retained as legacies to ensure a seed source with a potential for resistance (C/D, Re)

### **8.2 Favor existing genotypes that are better adapted to future conditions**

- Gap establishment targets removal of lower-quality growing stock. (Mac)
- Group selection targets removal of lower-quality growing stock. (Ti)
- Maintaining the largest diversity of species allows for self adaptation (C/D)
- Resistant beech can be identified to be free of disease. Individual trees or clusters can be retained as legacies to ensure a seed source with a potential for resistance. (AI, Be, Bu, Cr, He, Mac, Man, Mas, Saylor, Ti, Vr)
- Resistant elm and in the future ash can be identified to be free of disease. These individual trees or clusters will be retained as legacies to ensure a seed source with a potential for resistance. (AI, Bu, Man, Mas)

- Selected high-vigor stems are retained as a seed source. (Cr, He, Mac, Sa, Ti, Vr)

## **Strategy 9: Facilitate community adjustments through species transitions**

### **9.1 Favor or restore native species that are expected to be better adapted to future conditions**

- Basswood is favored. This tree is expected to do well in a changing climate. (Sa, Ti)
- Crop tree release favors sugar maple, yellow birch, and black cherry. (Lep, Mac, Les, Ti, Vr)
- Enhancing diversity through retention and planting is a primary focus of the management plan. (Al)
- Group selection will occur adjacent to mature red oak, to encourage regeneration of this future-adapted species. (Ti)
- Maintaining the largest diversity of species allows for self-adaptation. (Be, Cr, He, Mac, Sa, Ti, Vr)
- Oak is retained and released to allow for establishment of oak regeneration. Oak is expected to do well in a changing climate. (Al, Bu, C/D, F/O, He, Lep, Les, Mac, Man, Re, Sa, Ti, Vr)
- Red maple, white pine, red spruce, and beech all have capacity to thrive in varied conditions. Healthy examples of some or all of these trees will be favored. (Al, C/D, Cr, He, Lep, Mas, Re)
- Restore native species expected to be adapted to future conditions in the current Norway spruce plantation. (Bu, Mas)
- Red spruce in the understory may be released. This species has a long life span with many opportunities to regenerate. (Man)
- Retention of cherry is encouraged. Cherry is expected to do well in future conditions. (F/O, Les, Ti, Vr)
- Transition to more adapted species is considered (Man)

### **9.2 Establish or encourage new mixes of native species**

- Establishment of native mast trees is recommended. (He)
- Establishment of native shrubs for mast has been recommended (Cr, Mas)
- Red maple, white pine, red oak, beech all have capacity to thrive in varied conditions. Healthy examples of these trees will be favored. (Bu, Man, Mas, Re)
- Red oak is prescribed to be planted in openings to expand the existing natural range. (Bu, Man, Mas)

### **9.3 Guide changes in species composition at early stages of stand development.**

- Focus on advancing red oak as a more dominant species, red maple and yellow birch which are more adapted to climate change are favored (Man)

- Pre-commercial treatments that guide species transition are implemented (Al, Bu, C/D, Man, Mas, Re)
- Red oak is targeted for regeneration. (Ti, Vr)
- Red spruce is to be released during group selection. (Mas, Re)
- Regeneration is considered in all treatments (Al, Bu, C/D, Man, Mas, Re)

#### **9.4 Protect future-adapted seedlings and saplings.**

- Maintaining the largest diversity of species allows for self-adaptation. (Al, Man, Mas, Re)
- Planted red oak will include herbivory protection by using chemical or physical deterrents (Bu)
- Red oak and/or white pine are favored for retention. (Al, Re)
- Tops are left whole to discourage browse (Man)

#### **9.5 Disfavor species that are distinctly maladapted**

- Balsam fir plantation may be converted back to a native hardwood stand (the natural forest type of the area). (Lep)

#### **9.6 Manage for species and genotypes with wide moisture and temperature tolerances**

- Maintaining a large diversity of species allows for self-adaptation. (Al, Bu, Cr, F/O, He, Lep, Les, Mac, Man, Mas, Sa, Ti, Vr)

#### **9.7 Introduce species that are expected to be adapted to future conditions.**

- Red oak is being underplanted (Mas)
- A variety of mast tree and mast shrub species have been recommended to be planted that provide a food source for wildlife (Bu)

#### **9.8 Move at-risk species to locations that are expected to provide habitat**

- Aspen may be vegetatively regenerated to ensure persistence with potential loss of seed germination (Bu)
- A focus on connectivity with the surrounding forests will allow wildlife the greatest chance of moving themselves. (He, Mac, Sa, Ti)
- Red spruce regeneration highlighted for release to encourage its persistence in the landscape (Mas, Re)
- A variety of mast tree and mast shrub species have been recommended to be planted that provide a food source for wildlife (Mas)

## **Strategy 10: Realign ecosystems after disturbance**

### **10.1 Promptly revegetate sites after disturbance.**

- Crop tree release is prescribed, which will provide a seed source that will aid in revegetation in the case of a disturbance. (Al, Cr, F/O, He, Mac, Man, Ti, Vr)
- Encouragement of revegetation prior to a disturbance will allow regeneration to occur naturally. (Al, Be, Bu, Cr, F/O, Lep, Les, Mac, Sa, Ti, Vr)
- Establishing canopy gaps will release regeneration, which will be the replacement stems if overstory trees are lost to disturbance. (Al, Bu, Man, Mas)
- Individual/group selection is prescribed. This will provide a seed source that will aid in revegetation in the case of a disturbance. (Cr, Lep, Les, Sa)
- In group selection work, soil scarification is encouraged, to encourage establishment of sugar maple, birch, cherry, oak, or red spruce. (Ti)

### **10.2 Allow for areas of natural regeneration to test for future-adapted species.**

- In a stand with poor regeneration, individual/groups selection cuts are prescribed specifically to encourage regeneration. (Lep, Les)
- Natural regeneration is encouraged throughout the parcel. (Be, Bu, C/D, Cr, F/O, He, Lep, Les, Mac, Man, Mas, Re, Sa, Ti, Vr)

### **10.3 Realign significantly disrupted ecosystems to meet expected future conditions.**

(Not needed at this time.)

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**These strategies and approaches have been selected to accomplish three goals, all of which are needed as forests face changing climate conditions:**

***Resistance:*** Actions that improve the forest's defenses against anticipated changes or directly defend the forest against disturbance in order to maintain relatively unchanged conditions; effective in the short term. (Strategies 1, 2, 3, 4, 5)

***Resilience:*** Actions that accommodate some degree of change, but encourage a return to prior conditions after a disturbance, either naturally or through management. Appropriate for short term or for areas that are buffered from climate change impacts. (Strategies 1, 2, 3, 5, 6, 7, 8)

***Transition:*** Actions that intentionally accommodate change and enable ecosystems to adaptively respond to changing and new conditions. (Strategies 1, 2, 6, 7, 8, 9, 10)

