Cold Hollow to Canada: Cold Hollow Woodlots

Climate Change Adaptation Strategies and Approaches

The climate change analyses that are compiled below were completed between 2017 and 2021. This means that landowners are in various stages of implementing recommendations and accomplishing strategies identified in these plans.

This compilation document draws on **45 analyses** that have been performed for Cold Hollow to Canada Woodlots Program participants. Because these are initially created by looking at individual management plans, not every strategy applies to each parcel or fits within each landowner's personal management goals. While some are relevant across a broad array of parcels, others are very specific.

In the compilation below, **strategies are color-coded based on our three town-based programs: Enosburgh**, **Montgomery**, and **Richford**. We've also given a coding system to individual landowners included in this summary, so as to protect their privacy. We've included the codes to show how we compile information from many landowners into a single understanding of the practices occurring in our region.

Strategy 1: Sustain Fundamental Ecological functions

1.1.-Maintain or restore soil quality and nutrient cycling

- Plan requires that Acceptable Management Practices for forest roads and trails are followed **(This is included in ALL Enosburgh, Montgomery & Richford analyses.)**
- Stream crossing upgrade is recommended (Ha) **1 of 45 analyses include this strategy.**
- Large Legacy trees are highlighted for retention which will eventually produce coarse woody material (ALL Enosburgh, E, Hi, H1, H2, H3, L, Li, Lo, M, P, R, St, Y, B, By, FS, G, M, GM, CP, DP, RTF) **37 of 45 analyses include this strategy.**
- Recommendation that basswood and be left in maple stands to assist in nutrient cycling. (C, DW, Hen, Hen2, M, PC, Cr, Hi, H2, H3, K, M, P, R, Y, B, By, CP, DP) **19 of 45 analyses**
- Recommendations to retain down woody material to provide nutrient cycling and build soil (ALL Enosburgh, E, Cr, Hi, H1, H2, H3, K, L, Li, Lo, M, P, R, S, Y, B, By, FSB, G, M, GM, CP, DP, RTF) **39 of 45 analyses**
- Rubus is present in the larger openings, providing nutrient cycling and limiting the establishment of hay-scented fern which limits regeneration from establishing (Hew, M, B) **3 of 45**
- Wetlands that support a fluctuating beaver population circulates nutrients (Li, Lo, Y**) 3 OF 45**

1.2 -Maintain or restore hydrology

- Plan requires that Acceptable Management Practices for forest roads and trails are followed. **(All Enosburgh, Montgomery & Richford)**
- Significant road improvement has been implemented under this ownership. (PC, Hi, H3, M, B, DP) **6 of 45**
- Seeps are identified and protected (Cr, H3, M, B, By, CP, DP) **7 of 45**
- Vernal pool identified with minimal harvest buffer (K, M, Y) **3 of 45**
- Potential seepage Forest (C, H3, M) **3 of 45**

- Operations will in some cases be limited to frozen ground conditions. This includes steep slopes and soils that are less well-drained or with a perched water table including Cabot soils. (DW, Cr) **2 of 45**

1.3- Maintain or restore riparian areas

- A no-cut buffer (Ecologically Significant Treatment Area) has been designated on both sides of all tributary streams (Hn2, PC, Cr, H3, Li, Lo, M, R, RTF) **9 of 45**
- A 75-100 foot minimal cut riparian buffer is recommended for permanent streams maintaining at least 70% crown cover. (C, DW, H, Hn, Hn2, M, S, R, Cr, E, Hi, H1, H2, H3, K, L, Li, Lo, M, P, R, S, Y, B, By, G, GM, CP) **28 of 45**
- The number and width of stream crossings in the buffers will be kept to a minimum (DW, A, C, Cr, E, H2, H3, K, L, Li, Lo, M, P, S, Y) **14 of 45**
- 25-foot buffer minimal cut on ephemeral streams (H, S, A, C, Hi, H1) **6 of 45**
- A 50-foot minimal cut buffer is recommended for all ephemeral streams, seeps, vernal pools and other wetlands (C, DW, Hn2, TF, M, P, W, Cr, By, G, CP, DP) **12 of 45**
- Maintain the integrity of the Beaver Impoundment and wetland complex. (DW) **1 of 45**

<u>Strategy 2: Reduce the impact of existing biological stressors</u>

2.1-Maintain or improve the ability of forest to resist pests and pathogens

- Species diversity is emphasized as a buffer to insect and disease (C, E, Hi, H1, H2, H3, K, L, Li, Lo, M, P, R, S, St, Y) **16 of 45**
- Recommendation to harvest poor quality red maple that has defects or multi-stemmed (S, Ha, B, M) **4 of 45**
- Remove trees with sugar maple borer damage, Eutypella canker. Cleaning disease trees will minimize further spread, even beech bark disease (C, DW, H, Hn, Hn2 Hew, M, PC, P, S, R, W, Cr, E, Hi, H1 ,H2, H3, K, L, Li, Lo, M, P, R, St, Y, B, By, G, M, GM, CP, DP) **34 of 45**
- A species diversity of at least 25% non-sugar maple is recommended in Stands which are managed for sap production to minimize impact from defoliators. (C, Hn, Hn2, Hew, T, Hi, H1, K, M, B, By, M, CP, DP) **13 of 45**
- Increase species diversity by releasing maple, birch, cherry, pine basswood, oak and spruce over time. (PC, S, B, By, G, M, GM) **7 of 45**
- Multi-aged management Is prescribed ensuring stand replacement (A, C, E, HA, H1, H2, H3, K, L, Li, Lo, M, P, S, St, Y, B, By, FS, FSB, G, M, GM, CP, DP) **25 of 45**
- Strategies to limit Armillaria root rot (uprooting susceptible root systems and stumps (H3) **2 of 45**
- The ash component will be managed to reduce the percent composition but to retain ash across all size classes to keep ash on the landscape and maintain a seed source over time. (Cr) **1 of 45**
- A release of sugar maple saplings is recommended, by reducing the ash component while retaining a portion of the ash to keep a future seed source (DW) **1 of 45**
- Tapping guidelines and biodiversity goals in the sugarbush will be followed to ensure the tapped area is managed as an ecosystem not a monoculture and that tapping coincides with growth rates and hole closure. (DW) **1 of 45**

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

- No invasive species were found in the forest. (DW, TF, Hn2, Hew, M, R, W, A, C, E, Ha, H1, H2, H3, S, St, Y, B, By, FS, FSB, M, GM, DP, RTF) **25 of 45**
- Low populations or individual plants Invasive species observed and to be removed: barberry to be removed (Hn, Cr, Hi, Lo, P, G), honeysuckle to be removed (PC, Cr, Hi, L, Li, Lo, R); Buckthorn to be removed (K), Knotweed to be removed (H, S, CP); spotted knapweed is in the fields and more frequent and early mowing is recommended to reduce the population (C, PC) **15 of 45**
- Invasive species monitoring is recommended; not annual (B, H, Hn, Hn2, PC, P, S, R, FS, RTF) **10 of 45**
- Annual monitoring is recommended (DW, PC, W, Cr, E, Hi, H1, H2, H3, K, L, Li, Lo, M, P, R, Y, B, By, G, M, GM, CP, DP) **23 of 45**
- Glossy buckthorn (?) identified during inspections, but not mentioned in the management plan (P) **1 of 45**

2.3- Manage herbivory to protect or promote regeneration

- Hunting is allowed and encouraged, including several hunters who return consistently. (C, DW, TF, H, Hen, Hen2, Hew, PC, P, S, R, W, **All Montgomery**, B, By, FS, FSB, G, M, GM, CP, DP, RTF) **41 of 45**
- Tops are NOT lopped when harvesting occurs, (PC, L, Li, G, GM, CP, DP) **7 of 45**
- All material left in wildlife patch cuts (Hi, G) **2 of 45**
- Deer wintering area, greater risk of browse. (C, E, Ha, H2, K, L, Li, M, P, Y) **10 of 45**
- Half of the property is being regenerated using a series of progressive clearcuts overwhelming the deer (P) **1 of 45**

<u>Strategy 3: Protect forests from severe fire and wind disturbance</u>

3.1-Alter forest structure or composition to reduce risk or severity of fire.

3.2 -Establish fuel breaks to slow catastrophic spread of fire

- Little to no fire risk at this time **(All Enosburgh, Montgomery & Richford)**

3.3-Alter forest structure to reduce severity or extent of wind and ice damage

- Crop tree release or other pre-commercial work recommended. The CTR will allow the best trees to expand crowns for a healthier more resistant tree. (ALL Enosburgh, Cr, E, Ha, Hi, H1, H2, H3, L, M, P, R, Y, B, By, G, GM, CP, DP) **31 of 45**
- Multi-stemmed red maple (weak branch architecture) recommended for removal (Ha) **1 of 45**
- Recent harvests have reduced the older overstory and released advance regeneration. More vigorous trees and advance regeneration can withstand wind and replace disturbance (E, H3, K, L, M, P, B, By, G) **9 of 45**
- Improvement cut recommended to reduce the poor quality overstory and release advance regeneration. More vigorous trees and advance regeneration can withstand wind and replace disturbance (C, TF, H, Hn, Hew, M, PC, S, T, R, W) **11 of 45**
- Patch or gap cuts allow for natural regeneration and create variable horizontal structure (DW, TF, Hn2, Hew, M, PC, P, S, R, W, E, Ha, H2, H3, L, Li, M, R, S, B, By, G) **21 of 45**

- Group selection recommended to add structure with understory development as replacement trees. (Cr) **1 of 45**
- Plantation conversion to native species recommended to enhance structure and advance regen to prevent potential blowdown. (DW, Cr, C, M) **4 of 45**
- Regeneration is diverse and abundant throughout the property providing resiliency to severe weather. (C, DW, H, Hn, Hn2 Hew, M, PC, P, W, Cr, E, H3, K, L, Li, Lo, M, P, Y, B, M, GM, CP, DP) **24 of 45**
- All red oaks are identified and released from competition (E, Hi, K) **3 of 45**
- ESH recommended (E, Ha, H2, Li, Lo, M, R, Y) **8 of 45**
- ESTA natural communities including Old Forest and Montane Forest are no cut areas (H3, Li) **2 of 45**
- Improvement cuts identify ash legacy trees to be retained. (DW) **1 of 45**

<u>Strategy 4: Maintain or create Refugia</u>

4.1-Prioritize and protect existing populations on unique sites

- The presence of high-quality soils (abundant indicator plants) on portions of the property does offer the potential for a *managed* refugia. Sugar maple and yellow birch are expected to be stressed by climate change but will be buffered from this stress in the better sites where nutrient availability is high. The silviculture addresses species and structure. (C, DW, Hn, Hn2, Hew, M, PC, T, R, Cr, H3, M, B, G, GM, CP, DP) **17 of 45**
- Large seeps and wetlands on the property provide unique habitat for a variety of species, protective buffers are established around these communities. (TF, H, Hn, PC, S, H3, Li, Lo, M, B, RTF) **11 of 45**
- Obligate species found in Vernal pools may be considered at-risk communities. Pool(s) have been identified and protective buffers placed around pools. (Hew, PC, R, K, M, Y) **6 of 45**
- Beech Mast stand has been prioritized for retention (W, H3, M) **5 of 45**
- Ridgeline and high elevation sites potential refugia for spruce and yellow birch, heartleaf birch (H3, M, RTF) **3 of 45**
- Old Forest identified and protected (Li) **1 of 45**
- Potential stands for old forest designation identified, as these stand have characteristics that reflect old forest conditions including diverse age classes, openings and older trees (Cr) **1 of 45**
- Montane Forest identified and protected (H3) **1 of 45**
- Red pine is used by black bear for communication and training, trees will be retained (E, M) **2 of 45**
- Cliff habitat provides den opportunities for bobcat (Hi, R) **2 of 45**
- American Woodcock (VT species of greatest conservation need) habitat highlighted in alder swamp (S) **1 of 45**
- Beaver impoundments and habitat enhancement by keystone species recognized (H, PC) **2 of 45**

4.2-Prioritize and protect at-risk species or communities

- Early successional habitat patches 2 acres in size have been or are planned which addresses Chestnut-sided Warbler and Ruffed Grouse habitat (both Vermont Medium

Priority Species of Greatest Conservation Need) (C, TF, PC, P, S, W, E, Hi, H2, Li, Lo, M, R, Y, B, By, G, GM, CP) **19 of 45**

- Large diameter legacy trees have been identified that could develop cavities for den or nesting habitat that addresses habitat needs for several species of concern (E, C Hi, H1, H2, H3, K, L, Li, Lo, M, P, R, S, St, Y, B, By, G, M, GM, CP) **22 of 45**
- Interior forest songbird habitat management recommended that address VT responsibility birds (C, H, Hen, Hen2, Hew, M, PC, P, S, R, E, Hi, H1, H2, H3, K, L, Li, Lo, M, P, R, S, Y, B, By, G, GM, CP) **29 of 45**
- Recognized Audubon VT Bird Friendly Maple Forest (B) **1 of 45**
- Between 1999 and 2011, 107 species of birds have been documented in the Enosburgh Town forest, including 28 of the 40 VT Responsibility birds. On Patch/Conneely forest 52 birds have been documented, including 14 of the 40 responsibility birds. 31 species of birds have been documented in the Richmond Town Forest, including 11 of the 40 VT Responsibility birds. In the Goyne forest, 33 birds have been documented, including 13 of the 40 responsibility birds. (TF, PC, RTF, G) **4 of 45**
- Species of concern found or observed include black bear (DW, PC, A, C, E, Ha, Hi, H2, K, Li, M, P, B, By, G, M, GM); fisher (DW, PC, E, H, Hi, H2, K, Li, M, P, B, By, G, M, GM); mink (E, H, Hi, H2, K, Li, M, P, B, By, G, M, GM); moose (DW, PC, A, C, Cr, E, H, Hi, H, H2, Li, M, P, B, By, G, M, GM); bobcat (DW, PC, A, C, Cr, E, H, Hi, H2, K, Li, M, P, B, By, G, M, GM); Lynx (A, C, E, H, Hi, H2, K, Li, M, P)**;** ruffed grouse (Cr)**;** otter (DW, PC, Cr); snowshoe hare (Cr); several responsibility birds (DW, PC, B, G, TF)**;** catamount (G); spotted salamander (PC) **29 of 42**
- Property is part of a network of parcels on a wildlife habitat monitoring transect that identifies sign for large-ranging mammals (E, Hi, M, B, GM) **5 of 45**
- Montane yellow birch-red spruce community identified and included in an ESTA (H3) **1 of 45**
- Old Forest along Black Falls Brook has been identified and designated as a no-cut ESTA (Li) **1 of 45**
- Plan provides information on Beaver as a keystone species when forming Impoundments (H, S, Pc, Li, Lo) **4 of 45**
- Beech mast stands identified (H3, M, Y) **3 of 45**
- Major streams are known for excellent native brook trout habitat (Cr) **1 of 45**
- Bird habitat data is reported in the management plan (PC) **1 of 45**

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

* Not applicable to private landowners

<u>Strategy 5: Maintain and enhance species diversity and structural diversity</u>

5.1- Promote age class diversity

- Plan promotes age class diversity across the property **(All Enosburgh, Montgomery & Richford)**
- Timing of treatments vary from stand to stand (ALL Enosburgh, A, C, Cr, E, Ha, Hi, H1, H2, H3, K, L, Li, Lo, M, P, R, S, St, Y, B, By, FS, FSB, G, M, GM, CP, DP) **43 of 45**
- Large trees are identified as permanent Legacy trees maintaining some old trees (C, TF, H, Hn, Hn2, Hew, M, PC, S, R, E, H1, H2, H3, K, L, Li, Lo, M, P, R, S, Y, B, By, G, M, GM, CP, DP) **30 of 45**

- Recent harvest featured small canopy gaps, 1/8 to ¼ acre in size creating structural diversity, abundant soft mast (rubus) (M, B) **2 of 45**
- Early Successional Habitat cuts implemented or planned (E, Ha, H2, Li, Lo, M, R, Y, B, By, G, GM, DP) **13 of 45**
- Reserve trees are planned through the property (Cr) **1 of 45**
- Extended rotations for harvesting are planned to grow larger and older trees (Cr) **1 of 45**

5.2-Maintain and restore diversity of native tree species

- Plan describes the maintenance of native species and emphasizes species diversity with a 20-25% quantifiable non-sugar maple. (C, H, Hn, Hn2, Hew, PC, S, R, H1, K, M, P, B, By, M, CP, DP) **17 of 45**
- Plan describes the maintenance of native species and emphasizes species diversity (DW, Cr) **2 of 45**
- Hard and soft mast species recommended for release from competition. (ALL Enosburgh, A, E, M, B, By, G, GM) **19 of 45**
- Regenerate or release red spruce (B, H, Hn2, PC, Li, Lo, M) **7 of 45**
- Coppice resprout aspen (B, PC, Y, G, GM) **5 of 45**
- It is recommended that red oak may be planted to provide a localized assisted migration (DW, Cr) **2 of 45**
- Recommendation to leave patches of conifer species along field edges. (C) **1 of 45**
- Recommendation that plantation be replaced by native species over time (TF) **1 of 45**

5.3- Retain biological legacies

- Snags, coarse woody material, wildlife trees, and large diameter stems are all identified as protected biological legacies (ALL Enosburgh, A, Cr, E, Ha, Hi, H1, H2, H3, K, L, Li, Lo, M, P, R, S, Y, B, By, G, FS, FSB, M, GM, CP, DP, RTF) **40 of 45**
- Targets include several species designated for Legacy Trees. (Cr) **1 of 45**
- Snags and cavity trees recommended for retention with an emphasis on large diameter stems. (Cr) **1 of 45**
- Down woody material numbers retention minimums identified. (Cr) **1 of 45**

5.4-Restore fire to fire-adapted ecosystems

- Not applicable as this forest is not a fire-adapted community

5.5-Establish reserves to protect ecosystem diversity

- Property is in the Use Value Appraisal Program **(**C, H, Hn, Hn2, Hew, M, PC, P, S, R, W, A, C, E, Ha, Hi, H1, H2, H3, K, L, Li, Lo, M, P, R, S, St, Y, B, By, FS, FSB, G, M, GM, CP, DP**) 39 of 45**
- Permanent conservation easements are in place (PC, R, W, M) **4 of 45**
- Potential for a future working lands conservation easement (C, TF, H, Hn, Hn2, Hew, M, P, S, T) **9 of 45**
- Riparian corridors have been designated as reserves to protect soils, water quality and wildlife movement (Cr) **1 of 45**
- The wetland complex is called out in the plan as an important attribute to species diversity and Beaver as a keystone species (DW) **1 of 45**

Strategy 6: Increase ecosystem redundancy across the landscape

6.1-Manage habitats over a range of sites and conditions

- Property is part of a Peer to peer Project for cross-boundary Landscape Level management in partnership with Cold Hollow to Canada Conservation Partnership **(All Enosburgh, Montgomery & Richford)**
- The property is part of a 45,000-acre forest block without any major road fragmentation. This area is at least doubled when including the forest block that extends into Canada with only one major intersecting road. Development is currently at a minimum along VT RT 105 as well as RT 242 with some sections permanently conserved. **(All Montgomery & Richford)**

6.2- Expand the boundaries of reserves to increase diversity

- Cold Hollow to Canada members with a vision to permanently conserve and/or steward the lands across the region **(All Enosburgh, Montgomery & Richford)**
- Permanent easements held by the Vermont Land Trust or Forest Legacy (PC, R, W, M) **4 of 45**
- Identified potential for conservation easement (B, C, TF, Hen, Hew, M, P, S, T) **9 of 45**

Strategy 7: Promote landscape connectivity

7.1-Use Landscape level planning and partnerships to reduce fragmentation and enhance connectivity

- Property is part of a peer to peer project for cross-boundary landscape level management in partnership with Cold Hollow to Canada Conservation Partnership **(All Enosburgh, Montgomery & Richford)**
- The wetlands on these properties are source waters for both Trout River and Beaver Meadow Brook which flows into the Tyler Branch. Tyler Branch and Trout River feed the Missisquoi River and are the upper reaches of the Missisquoi watershed. (All Enosburgh) The wetlands on these properties are source waters and include Pacific Brook (A) Wade Brook (C, H3, Y) Hannah Clark Brook (H2, M), Jay Brook trib (E, Ha), Tamarack Brook (Lo), Black Falls Brook (Li, S), South Branch (H1, L, Lo), West Hill Brook (R), Mt. Brook (B, FS, FSB, M, GM, RTF), Alder Brook (By, G) Trout River (K, P, R, St), which feed the Missisquoi River and are the upper reaches of the Missisquoi watershed. **42 of 45**
- Beaver Meadow Brook has buffer protection. (B, Hn, Hn2, PC, W) **5 of 45**
- Plan highlights the location of this property to be within a large unfragmented core habitat block forest (All Enosburgh, E, Hi, H1, H2, H3, K, L, Li, Lo, M, P, R, S, Y, B, By, FS, FSB, G, M, GM, CP, DP) **38 of 45**

7.2-Establish and expand reserves and reserve networks to link habitats and protect key communities

- Cold Hollow to Canada members with a vision to permanently conserve lands across the region **(All Enosburgh, Montgomery & Richford)**
- Permanent easements held by the Vermont Land Trust or Forest legacy (PC, R, W, M) **4 of 45**

- Property is scheduled to be permanently conserved in the near future with a Vermont Land Trust (Cr) **1 of 45**
- Potential for working lands conservation easement that connects with already conserved properties in this forest block. (C, TF, H, Hn, Hn2, Hew, M, P, S) **9 of 45**

7.3- Maintain and create habitat corridors through reforestation or restoration

- Riparian areas function as corridors for a variety of wide-ranging mammals, birds, and amphibians (B, DW, Hen, PC, W, C, Cr, E, H1, H2, H3, L, Li, Lo, M, R, S, Y, B, By, G, GM, CP) **22 of 45**
- Interior Forest Bird habitat and early successional habitat coordinated with a neighbor. (PC, M, P. B, By, FS, FSB, G, GM, DP) **10 of 45**
- Interior Songbird Habitat Assessment and Analysis by Audubon VT has been completed, or will soon be completed, with action items **(All)**
- Permanent conservation of this property connects with other lands designated for permanent conservation forming a linkage for animal movement. (Cr) **1 of 45**

<u>Strategy 8: Enhance genetic diversity</u>

8.1-Use seeds, and other genetic material from across a greater geographic area

8.2-Favor existing genotypes that are better adapted to future conditions

- Red oak is naturally present that can provide a local genotype in addition to a planted genotype (DW, Cr) **2 of 45**

8.3-Increase diversity of nursery stock to provide those species or genotypes likely to succeed

- Red oak is recommended to be planted to enhance local assisted migration (DW, Cr) **2 of 45**

<u>Strategy 9: Facilitate community adjustments through species transitions</u>

9.1-Anticipate and respond to species decline

- Coppice aspen to maintain this species (Y, G, GM, CP, RTF) **5 of 45**
- Red spruce favored providing seed source, habitat and potential replacement for hemlock (B, M) **2 of 45**
- Species diversity is a priority, keeping the maximum number of species present within a natural community allows for maximum options for natural self adaptation (Cr), **1 of 45**

9.2-Favor or restore native species that are expected to be better adapted to future conditions

- Rich soils on portions of these properties provide a buffering capacity against climate change. Sugar maple and yellow birch are both predicted to be stressed by climate change but the optimum conditions found on parts of this property provide an advantage to maintaining these species on this site for the long term. (C, DW, Hn, Hew, M, PC, R, Cr, H3, B, G, GM, RTF) **13 of 45**
- Spruce is found here and will be targeted for retention and release in the upper elevations and on the seep soils (H3, Lo, M, B, M, RTF) **6 of 45**
- High-quality red maple will be retained for tapping in sugar bushes (H1, K, P, B, By, M) **6 of 45**
- Red oak and quality red maple will be favored for retention (E, Hi, H2, K, P, R, CP, DP) **8 of 45**
- White pine favored for retention (E, M, P) **3 of 45**

- Climate adapted species (trees such as red oak and shrubs for wildlife) are planned to be planted (B, GM) **2 of 45**

9.3-Manage for species and genotypes with wide moisture and temperature tolerances

- Red maple, white pine, red oak, red spruce, beech all have the capacity to thrive in varied conditions. Healthy examples of these trees will be favored. (E, Hi, H2, K, M, P, R) **7 of 45**

9.4-Emphasize drought and heat tolerant species and populations

- Natural red oak regeneration has been released by removing the overstory (PC, E, Hi, K) **4 of 45**
- Red oak seedlings and/or acorns planted (PC, W, GM) **3 of 45**
- Red oak is a target species for retention (DW, Cr) **2 of 45**

9.5-Guide species composition at early stages of development

- Pre-commercial treatments that guide species are implemented in portions of these properties (C, DW, H, Hn, Hn2, M, PC, P, S, R, W, Cr, E, Ha, Hi, H1, H2, H3, K, L, Li, Lo, M, P, R, Y, B, By, G, M, CP, DP) **32 of 45**

9.6-Protect future adapted regeneration from herbivory

- Natural regeneration is encouraged through silviculture and protected from browse by leaving tops whole when harvesting, encouraging hunting and releasing advance regeneration (C, DW, TF, Hn, Hn2, M, PC, P, W, Cr, H1, H2, H3, K, L, Li, Lo, M, P, R, S, St, Y, B, By, FS, FSB, G, GM, CP, DP) **31 of 45**

9.7- Establish or encourage new mixes of native species

- Both natural regeneration and red oak plantings recommended (DW, Cr, E, Hi, K, L, B, G, CP, DP) **10 of 45**
- Both natural regeneration and red oak plantings have been implemented (PC, W) **2 of 45**

9.8- Identify and move species to sites that are likely to provide future habitat

- Red oak planted (PC, W, G, GM) **4 of 45**

<u>Strategy 10: Plan for and respond to disturbance</u>

10.1-Prepare for more frequent and more severe disturbances

- Emphasis on healthy crowns and root systems through crop tree release will give trees strength to withstand some wind and ice events. (All Enosburgh, Cr, E, Ha, Hi, H1, H2, H3, K, L, Li, Lo, M, P, R, Y, B, By, G, M, GM) **33 of 45**
- Establishing canopy gaps will release regeneration which will be the replacement stems if overstory trees are lost to disturbance. (DW, TF, H, Hn2, Hew, M, PC, S, Cr, E, Ha, Hi, H1, H2, H3, L, M, B, By, G, CP) **21 of 45**

- Patch cuts result in a more diverse regeneration mix (TF, PC, P, S, W, E, Ha, Hi, Li, Lo, M, B, G) **13 of 45**
- Natural disturbance has released advance regeneration and may encourage new establishment (DW, PC, S, B, By, G) **6 of 45**
- Sapling component availability identified (DW, Cr) **2 of 45**
- Distribution of regeneration identified (Cr) **1 of 45**

10.2-Prepare to realign management of significantly altered ecosystems to meet expected future environmental conditions
10.3-Promptly revegetate sites after disturbance
10.4-Allow for areas of natural regeneration after disturbance

- Sufficient regeneration currently is present. The recent implementation of Canopy gaps and partial removal of the poor quality overstory has released advance regeneration. (C, DW, TF, H, Hn, Hn2, Hew, M, PC, P, R, W, Cr, E, Ha, H2, H3, K, P, B, M, GM, CP, DP) **24 of 45**
- There is a healthy and abundant sapling component throughout the property that will be available to respond to any canopy disturbance. (C, TF, H, Hn, Hn2 Hew, PC, S, R, W, A, C, E, Hi, H2, H3, K, L, Li, Lo, M, P, R, St, Y, B, By, FS, FSB, GM, CP, DP) **32 of 45**
- Patch cuts improve species composition of regeneration and establish advance regeneration prior to potential natural disturbance. (TF, PC, P, S, W, E, Ha, Hi, H2, Li, Lo, M, R, Y, B, G, GM) **17 of 45**
- Natural regeneration is encouraged **(All Montgomery)**
- Canopy gaps recommended (Cr) **1 of 45**

10.5-Maintain seed or nursery stock of desired species for use following severe disturbance
10.6 Remove or prevent establishment of invasive plants and other competitors following disturbance

- No invasive plants in the woods have been identified on this property. (C, TF, Hn2, Hew, M, R, W, A, C, E, Ha, H1, H2, H3, Li, Y, B, By, FS, FSB, M, GM, DP, RTF) **24 of 45**
- Low populations or individual plants Invasive species observed and to be removed: barberry plants (Hen, H, S, Hi, Lo, P, G), honeysuckle to be removed (PC, H, S, T, Hi, L, Li, Lo, R); Buckthorn removal (P, T, K), Knotweed to be removed (PC, H, S, CP); spotted knapweed has been identified in the fields, managed (C, PC); **15 of 45**
- Annual monitoring is recommended (DW, PC, Cr, E, Hi, H1, H2, H3, K, L, Li, Lo, M, P, R, Y, B, By, G, M, GM, CP, DP) **23 of 45**
- Monitoring is recommended but not specified as annual (C, H, Hn, Hn2, Hew, R, FS, FSB, RTF) **9 of 45**

Additional Actions to Promote Adaptation

After the forest management plans were reviewed to identify current actions that support climate change adaptation, several natural resource professionals met to review the existing actions and identify additional activities that could increase the ability of the forest to adapt to change while meeting landowner objectives. Activities were assigned categories:

EMPHASIZE: These activities are currently being done, but they are even more important from a climate change perspective.

IMPROVE: These are activities currently being done, but where improvements have been identified to be more effective in a climate change context.

COMMUNICATE: These are activities already included in management plans but for which there is often a gap between plan language and implementation on the ground. For example, loggers, landowners, and ecologists may all perceive different end goals for a management strategy, and communication is needed to ensure that everyone is on the same page.

NEW: These activities are not currently being implemented and are novel responses to address climate change.

The following lists all the climate actions suggested by the analysis, with opportunities summarized for the full region. These strategies have also been summarized for Woodlots Program participants.

Strategy 1: Sustain Fundamental Ecological functions

1.1—Maintain or restore soil quality and nutrient cycling

1.2—Maintain or restore hydrology

1.3—Maintain or restore riparian areas

- ***IMPROVE:*** Little work is currently done to restore hydrology, and doing this can be labor-intensive and expensive. Excavators are generally needed to do grade work and are better at installing water bars. At some sites, it may be possible to do enhance activities related to water projection. For example, it may be possible to build roads on slant to help restore sheet flow and reduce erosion.
- ***NEW:*** New road and trail systems provide an opportunity to install these networks in the best way possible.
- ***COMMUNICATE:*** Plans emphasize the importance of large legacy trees and coarse woody debris, but there is sometimes a gap between the plan intention and actual implementation. For example, loggers may try to have greater utilization and remove more wood than was intended; likewise, landowners may perceive greater utilization as resulting in more money (which may not be true). More communication may be needed to engage landowners and loggers regarding the importance of leaving wood in the forest, and follow-through may need to be improved.
- ***IMPROVE:*** There may be opportunities to increase the use of cut or no-cut buffers around riparian areas or other features to further protect soils and water.
- ***NEW:*** The landowner group could build and maintain their own portable skidder bridge for use during harvests.
- ***IMPROVE:*** Use more cut-to-length systems to reduce soil/water impacts and increase window for harvest on some sites.
- ***COMMUNICATE:*** Communicate to landowner about the benefits of certain types of equipment.

Strategy 2: Reduce the impact of existing biological stressors

2.1—Maintain or improve the ability of forest to resist pests and pathogens

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

2.3—Manage herbivory to protect or promote regeneration

- ***EMPHASIZE:*** Silvicultural activities to maintain adequate stocking levels and remove defective growing stock help to increase forest vigor and health.
- ***EMPHASIZE:*** Monitoring and addressing the effects of invasive plants, forests pests and diseases, and other stressors remains critical.
- ***IMPROVE:*** Leaving tops and coarse woody debris scattered high can help to protect regeneration from deer browse. Tops are not lopped for aesthetics except along road—continue and expand this practice.
- ***NEW:*** Power wash logging equipment when it's coming from a location known to have invasives.

Other notes: The relationship between bird feeders and hemlock wooly adelgid was discussed, but an action (such as reducing birdfeeder use) was not suggested.

Strategy 3: Protect forests from severe fire and wind disturbance

3.1—Alter forest structure or composition to reduce risk or severity of fire.

3.2—Establish fuel breaks to slow catastrophic spread of fire

3.3—Alter forest structure to reduce severity or extent of wind and ice damage

- ***NEW:*** Recognize that disturbance will happen. If disturbances increase the amount of forest in early-successional habitat, evaluate forest structure at a landscape level and adjust silviculture accordingly. For example, a blowdown event that creates early-successional conditions may reduce the need for a harvest to create those conditions.
- ***EMPHASIZE:*** Regeneration is important to taking advantage of disturbances.
- ***COMMUNICATE:*** Anticipate more disturbances.

Strategy 4: Maintain or create refugia

4.1—Prioritize and protect existing populations on unique sites

4.2—Prioritize and protect at-risk species or communities

4.3—Establish artificial reserves for at risk and displaced species

- ***NEW:*** Work with landowners to identify frost pockets and areas that may serve as refugia for species like spruce and hemlock. For example, natural communities of boreal species like bunchberry may indicate colder conditions. Additionally, late spring aerial photographs could also help identify these areas.
- ***NEW:*** Consider ways that might be used to help identify the best quality sugar maple sites, which may serve as long-term refugia. For example, research and modeling on the site productivity of sugar maple based on soil, till mineralogy, or other conditions may help identify characteristics of best sites.
- ***EMPHASIZE:*** Test different silvicultural approaches to get hemlock regeneration. Currently, hemlock regeneration is rare in the forest for unknown reasons. A summer harvest with scarification is one activity that may be tried to create provide light and soil conditions for regeneration.
- ***NEW:*** Integrate information about the potential for bird habitats and refugia as it becomes available.

Other notes: There was also discussion about the use of the fragile areas registry to designate refugia, but the registry didn't ultimately appear to be suitable for this purpose.

Strategy 5: Maintain and enhance species diversity and structural diversity

5.1—Promote age class diversity

5.2—Maintain and restore diversity of native tree species

5.3—Retain biological legacies

5.4—Restore fire to fire adapted ecosystems

5.5—Establish reserves to protect ecosystem diversity

- ***EMPHASIZE:*** The vast majority of stewardship activities occurring in the forest is working to increase species and (especially) structural diversity.

Strategy 6: Increase ecosystem redundancy across the landscape

6.1—Manage habitats over a range of sites and conditions

6.2— Expand the boundaries of reserves to increase diversity

- ***NEW:*** The network aspect of these properties provides the opportunity replicate successful management. To the extent that existing or novel practices work for one landowner, they can be implemented elsewhere.

Strategy 7: Promote landscape connectivity

7.1—Use Landscape level planning and partnerships to reduce fragmentation and enhance connectivity

7.2—Establish and expand reserves and reserve networks to link habitats and protect key communities

7.3— Maintain and create habitat corridors through reforestation or restoration

- ***EMPHASIZE:*** The network aspect of these properties provides the opportunity to coordinate activities across ownerships. For example, a wider diversity of bird habitats can be created across the landscape. Each property is unique and contributes to the larger landscape.
- ***NEW:*** Work with the nearby agricultural community to establish forested riparian corridors. This will further increase connectivity, as well as reduce phosphorus and sediment loads.

Strategy 8: Enhance genetic diversity

8.1—Use seeds, and other genetic material from across a greater geographic area

8.2—Favor existing genotypes that are better adapted to future conditions

8.3—Increase diversity of nursery stock to provide those species or genotypes likely to succeed

- See comments related to future-adapted species under Strategy 9.

Strategy 9: Facilitate community adjustments through species transitions

9.1—Anticipate and respond to species decline

9.2—Favor or restore native species that are expected to be better adapted to future conditions

9.3—Manage for species and genotypes with wide moisture and temperature tolerances

9.4—Emphasize drought and heat tolerant species and populations

9.5—Guide species composition at early stages of development
9.6—Protect future adapted regeneration from herbivory
9.7— Establish or encourage new mixes of native species
9.8— Identify and move species to sites that are likely to provide future habitat

- ***EMPHASIZE:*** Do more work to take enhance the red oak component of forests where it is currently present or would be well-suited (such as old pine plantations).
- ***NEW:*** Plant future-adapted tree species as yard trees near residences. This provides an opportunity to identify trees that might be better-suited to local site conditions and able to persist in these locations in the northern Green Mountains. Planted trees will also provide a future seed source for out-planting into the forest in the future. Seeds and seedlings can be brought from lower elevations in the Champlain Valley or from elsewhere in the region (no strict emphasis on source).
- ***EMPHASIZE:*** Use shelters or other protection against browse to protect planted seedlings.
- ***EMPHASIZE:*** Ensure adequate regeneration of a diversity of species to provide future options.

Strategy 10: Plan for and respond to disturbance

10.1—Prepare for more frequent and more severe disturbances
10.2—Prepare to realign management of significantly altered ecosystems to meet expected future environmental conditions
10.3—Promptly revegetate sites after disturbance
10.4—Allow for areas of natural regeneration after disturbance
10.5—Maintain seed or nursery stock of desired species for use following severe disturbance
10.6—Remove or prevent establishment of invasive plants and other competitors following disturbance

- See comments related to disturbance under Strategy 3.