Audubon
VERMONT

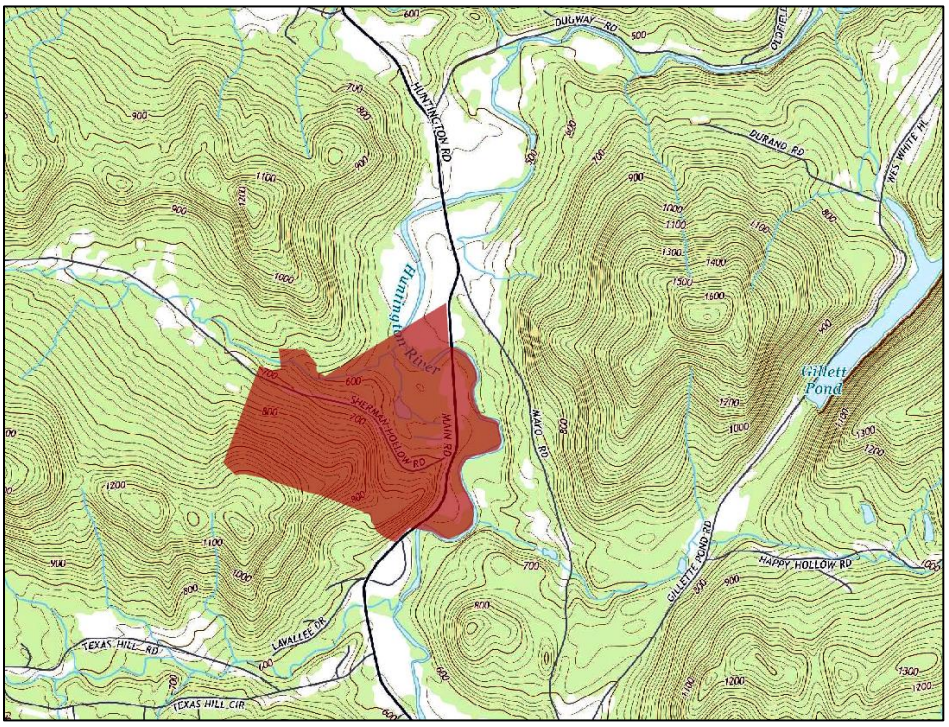
Forest Ecosystem Management Plan

for the forested lands of

The Green Mountain Audubon Center

SPAN: 303-096-10319

235 GIS Acres



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Plan Start / End Dates
10/1/2023 – 10/1/2033

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Property Data Summary

Landowner: Green Mountain Audubon Society, c/o National Audubon Society (Audubon Vermont)
Address: 255 Sherman Hollow Rd, Huntington, VT, 05462
Property location: North and South side of Sherman Hollow Road- extending to West and East of Huntington Road in Huntington, VT
SPAN: 303-096-10319
Acreage of Focus Area: 235 total acres with 183.5 acres productive forestland based on GIS analysis.

Introduction

The following forest management plan (FMP) was developed for the Green Mountain Audubon Center (GMAC) in Huntington, Vermont. This plan is intended to guide the management of the property for 10 years beginning in 2023 and concluding in 2033- in accordance with Audubon Vermont's mission to *protect birds and the places they need, today and tomorrow.*

Management of the GMAC is principally focused on ecological values of the resource. The primary goal in managing these lands is to maintain and/or enhance a diversity of habitat types for wildlife, with a focus on Audubon Vermont's Silviculture with Birds in Mind principles (Hagenbuch et al. 2011). Furthermore, these goals exist in light of existential threats of climate change, alongside the need for, and emerging science considering, carbon sequestration and storage while managing forest ecosystems. Concurrently, management of the GMAC seeks to maintain and create opportunities for scientific research, environmental education, nature exploration/recreation, demonstration of ecological and climate/carbon-smart land management practices- as well as the sustainable production of agricultural and forest products where compatible with the aforementioned objectives and values.

The overarching management strategy, at this time, is to *maintain and increase the resiliency of the forest* by capitalizing on opportunities to *maintain and increase the structural and species diversity of the forest ecosystem at multiple scales*; and we will do so in full consideration of current and anticipated threats and vulnerabilities of the forest.

Here we follow the frameworks and resources available from the Northern Institute of Applied Climate Science (NIACS)- Climate Adaptation Response Framework- as well as the Securing Northeast Forest Carbon Program guidance to forest management for forest carbon and climate resiliency.

As you will see, we consider the forest ecosystem and overall environment affecting that ecosystem on multiple scales- from landscape, to property-wide, to stand by stand, or even a group of trees in a stand; it is vital to recognize that the forest ecosystem is comprised of, and affected by, processes across all of these levels.

Temporally, it is necessary that this plan account for, and consider, the effects of climate change upon the GMAC forest extending out to the end of the century. Yet, this plan is framed in the traditional 10-year management planning cycle that is standard for Vermont forests. Our approach to forest management must be iterative, pro-active, anticipatory, and adaptable. With this in mind, the approach captured here aims to establish a model by which the forest can be assessed every ten years as a means to monitor the status of ecosystem health- and from those findings, re-evaluate and apply the ever-evolving science of climate change, so that the forest can continue to withstand, and as necessary, adapt, to ongoing, emerging, and anticipated biotic and abiotic environmental changes to come.

Executive Summary

The GMAC is situated in a highly forested landscape offering core breeding and wintering habitat for birds as well as vital wildlife connectivity corridors connected to intact highest priority forest blocks; overall the landscape around and including the GMAC is predicted to be highly resilient to climate change, supporting the strategy of *maintaining and increasing the resiliency of the forest*.

The forest of the GMAC, of which are principally northern hardwoods and mixedwood forests, are quite variable across stands in terms of species and structural diversity, overall offering a diversity of habitat conditions for birds; however, one common element is that the stands tend to have somewhat lower presence of understory and midstory structure, and, for some stands, to be understocked. In several stands, deer herbivory at the GMAC seems to be an impediment to regeneration. Recent natural disturbances (windthrow) in the forests (for example within stand C-1) have been diversifying conditions in lieu of management intervention. In many areas, the presence of large-diameter senescing pioneer species, such as Eastern white pine, are poised to increase recruitment of standing large-diameter snags and cavity trees, and in time, add desirable coarse and fine woody debris to the forest floor as they fall.

Using resources from the Northern Institute of Applied Climate Science, we have identified a suite of climate and carbon adaptation tactics for the GMAC that will guide our management approach this cycle (see section: Climate and Carbon Adaptation Tactics for the GMAC, below). Based on our findings, opportunities for management intervention via application of Silviculture with Birds in Mind prescriptions do exist, while many stands should be allowed to naturally develop this cycle as we monitor for biotic and abiotic change, prevent and manage invasive plants and pathogens, and continue to evaluate the development and application of the science of forest ecosystem management as we progress towards the next 10 year management planning process.

Both forest inventory and remotely modeled data indicate that the forest has lower carbon *stores* than is potential for these forest types; in other words, these forests have not reached their carbon storage capacity. Rather, based on relevant silvicultural guides, there is literal room to grow- and thus to *sequester* more carbon. Indeed, predicted sequestration rates for the GMAC property indicate the above ground biomass in the

forest is on a trajectory to increase stores by up to 7.5% by 2050. In future planning cycles, there is an opportunity to consider the application of alternate forest management strategies (see section: Climate and Carbon Adaptation Tactics for the GMAC, below) that may serve to advance sequestration rates.

The species comprising major stocking of the GMAC forest have variable predictions regarding their prospects of vulnerability to climate change by the end of the century. Overall, risk is ultimately spread across the diversity of species that exist- with some stands having less diversity (thus greater risk) and other stands having greater diversity (and thus less risk). Generally speaking, the persistence of the majority stocking species of the GMAC is likely to continue into the end of the century despite mixed predictions of how species may fare in terms of habitat suitability; however, continuing to plan for the potential for change in the health of individual species, especially those that comprise substantial stocking and those considered to have increased vulnerability to climate change, will be of paramount importance in staying adaptable in management approach going forward, each decade, through the century.

Environmental characteristics of the GMAC property that confer particular vulnerability to climate change largely center upon risk of flooding, ice damage, and erosion from extreme hydric events given proximity to the Huntington River, Sherman Hollow Brook, and the existence of class 2 wetlands, including a beaver complex, on property. These waterways also increase the risk of the spread of invasive plants on property.

The soils underlying the property are important to consider in light of climate change. The vast majority of the property has highly erodible soils, much of the area south of Sherman Hollow Road has high windthrow potential, and much of the area north of Sherman Hollow Road has high drought vulnerability. These vulnerabilities must be considered when planning any management on the GMAC.

Stand-specific Silvicultural Prescriptions

Stand 1: Consider crop tree release.
Stand 2: Manage as reserve area and monitor for change in forest ecosystem health.
Stand 3: Manage as reserve area and monitor for change in forest ecosystem health.
Stand 4: Manage as reserve area and monitor for change in forest ecosystem health.
Stand 5: Group selection targeting Eastern white pine within the plantation just north of Sherman Hollow Road.
Stand A: Manage as reserve area and monitor for change in forest ecosystem health.
Stand B: Consider crop tree release with canopy gap formation.
Stand C-1: Manage as reserve area and monitor for change in forest ecosystem health.
Stand C-2: Consider expanding existing gaps through chop and drop of trees along the immediate perimeter of select gaps.
Stand C-3: Consider crop tree release with canopy gap formation.
Stand D: Manage as reserve area and monitor for change in forest ecosystem health.

Below, please find in-depth details informing and supporting these findings- for the property as a whole, and for each individual forest stands comprising it.

Property Description

Location
The Green Mountain Audubon Center (GMAC) is located in the township of Huntington, further located within Chittenden County of Vermont.

Topography
The elevation of the GMAC ranges from ~540 feet elevation to ~1000 feet of elevation. The terrain of the GMAC ranges from relatively flat in most areas to very steep slopes in a minority of locations. The aspect is variable from north, to east, to south with a gradual downhill slope to the north-northeast.

Landscape context
The GMAC is located in the Northern Green Mountains biophysical region of Vermont.

The 2500 acre landscape immediate surrounding and including the 207 acre property of the GMAC is comprised of approximately 1769 acres of forest cover (~71% of area), 273 acres of agricultural open areas (~11%) and approximately 5 acres of shrubland (0.2%); the remaining 426 acres (~18%) are a mixture of developed areas, waterways, and wetland areas (Image 1).(Image 1

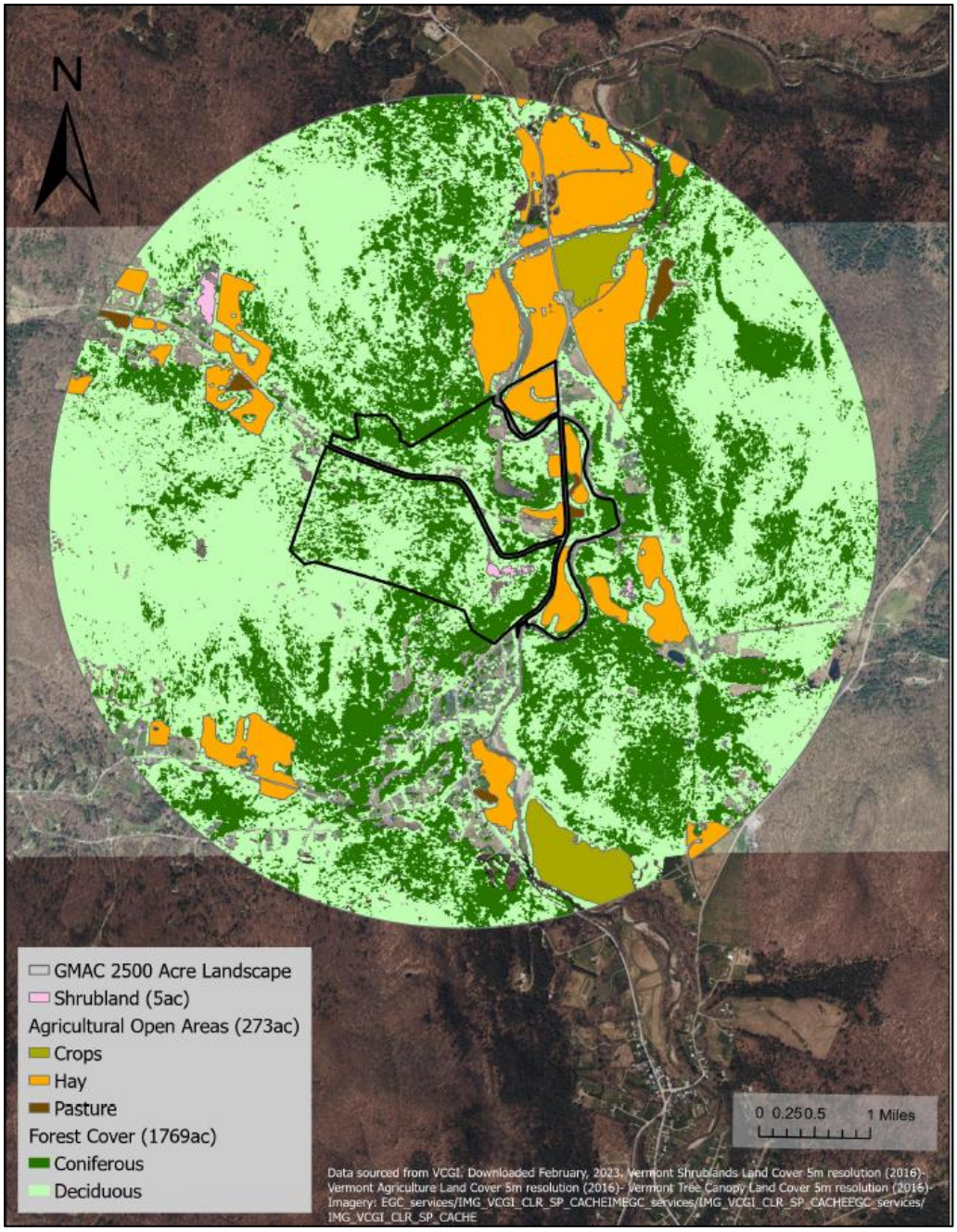


Image 1) 2500 acre landscape surrounding and including the GMAC property.

The GMAC falls within the Battell Forest Block, an Important Bird Area of continental significance as identified by National Audubon Society's Important Bird Area Analysis (National Audubon Society, 2023). The block consists of approximately 127,000 acres of contiguous forest land bounded by the Winooski River in the north, Mt. Horrid to the south, VT Rt. 100 in the east, and VT Rt. 116 to the west. This block is approximately 91% forested and contains significant amounts of mature forest that provide important habitat to a diversity of birds and other wildlife species. Additionally, the easternmost boundary of the GMAC property is located approximately 1600 meters from a Highest

Priority Interior Forest and Highest Priority Connectivity Block identified by Vermont Conservation Design (VCD; Sorenson and Zaino, 2018; Image 2)

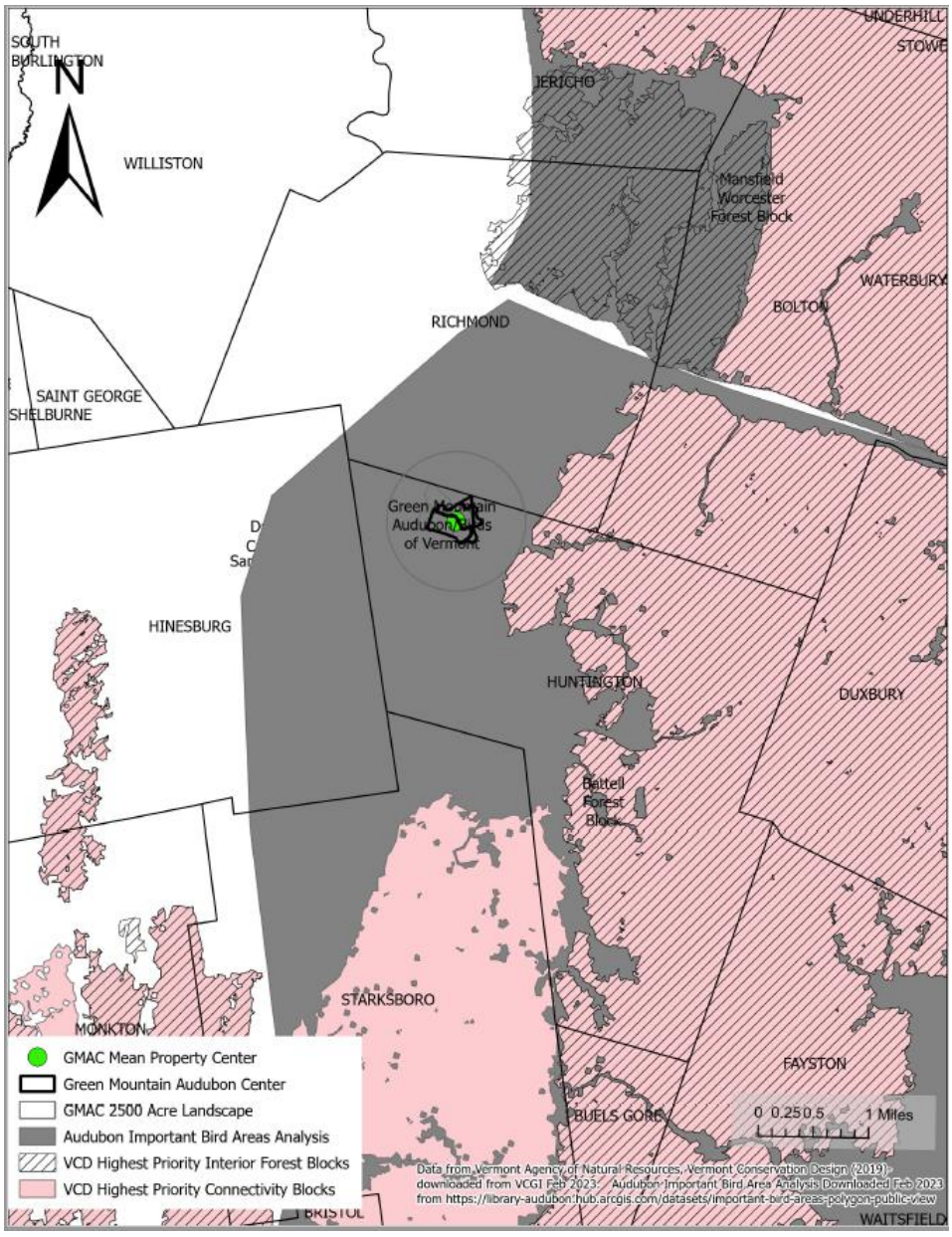


Image 2) Important Bird Area analysis and Vermont Conservation Design forest blocks relative to the GMAC property.

Soils

The area is underlain by Graywacke sandstone, a sedimentary rock. The vast majority of the area is composed of till-derived soil, deposited from glaciers which existed in the past. There is a small stretch of the project area along Sherman Hollow Road where the soils are primarily water-derived, as alluvial deposits from Sherman Hollow Brook and other streams. There are many areas of shallow soils in the project area, which manifest as areas of high amounts of blown down trees, resulting in a pit-and-mound topography in many areas of the property. Additionally, much of the soil types at the GMAC are vulnerable to drought and erosion.

Watershed, Rivers, Streams, Wetlands, and Vernal Pools
The GMAC is within the Sherman Hollow Brook watershed within the Lake Champlain basin- with multiple small streams, seeps, and wet muddy soils that drain into the Huntington River. The Huntington River borders and cuts through the property.

Sherman Hollow Brook runs through the northern part of the property and joins the Huntington River. Both the Huntington River and Sherman Hollow Brook are identified by VCD as highest priority aquatic habitats for conservation (Image 3).

A small pond and surrounding wetland historically frequented by beavers sits in the GMAC with an outlet into the Huntington River. This wetland and two others on property have been mapped as class 2 wetlands by the State of Vermont- all of which are identified by VCD as highest priority for conservation (Image 3).

There are no vernal pools currently identified on the GMAC property based on best available mapping data and field observations.

Rare and Uncommon Species
The only documented instance of rare or uncommon species on the GMAC property is an S1 (very rare in Vermont) nonvascular plant located in one of the wetlands on property. VCD has identified this plant as a species of highest priority for conservation (Image 3).

Terrestrial and Riparian Wildlife Crossings
The GMAC property is bisected by Sherman Hollow road- the entire section of which has been identified as a highest priority terrestrial wildlife crossing area according to VCD. The property is also bisected by Huntington Road- the entirety of which, as it co-occurs with the GMAC property, is either a priority or highest priority riparian wildlife crossing (Image 3).

Highest Priority and Priority Natural Communities
There are no highest priority or priority natural communities mapped by VCD on the GMAC property.

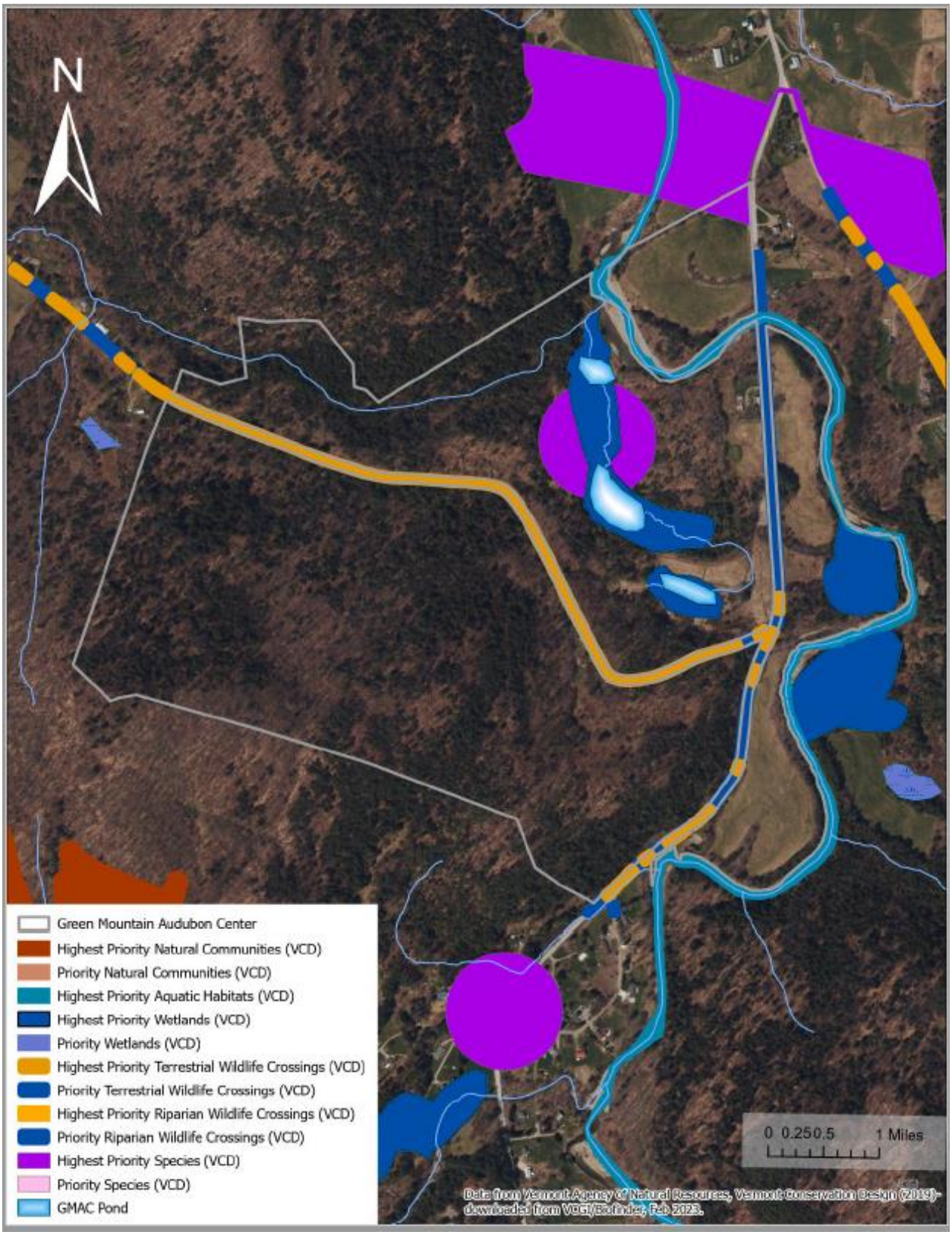


Image 3) VCD Species and Community Scale priority and highest priority elements relative to GMAC property.

Invasive Species
Non-native invasive plant species threaten biodiversity, alter natural processes, and can seriously degrade habitat quality. Non-native invasive plant species exist in isolated patches across the GMAC. Honeysuckle (*Lonicera spp.*), buckthorn (*Rhamnus spp.*), wall lettuce (*Lactuca muralis*), barberry (*Berberis spp.*), Japanese knotweed (*Reynoutria japonica*), and oriental bittersweet (*Celastrus orbiculatus*) are the invasive species documented at the GMAC. Areas of the property also contain the rustic jumping worm (*Amynthas agrestis*).

Non-native insects and diseases are a concern for our trees. Emerald ash borer (EAB; *Agrilus planipennis*), an insect resulting in mortality of most all ash (*Fraxinus sp.)* it encounters, has been documented in nearby Richmond in 2020; the GMAC property exists within a zone of likely infestation, and it can be anticipated that the insect will kill ash trees on property in coming decades. Multiple caterpillar species including Fall webworm (*Hyphantria cunea*), Forest Tent Caterpillar (*Malacosoma disstria*), and Gypsy Moth (*Lymantria dispar*) can cause defoliation, mostly to Vermont's hardwood tree species. Hemlock woolly adelgid (HWA, *Adelges tsugae*) impacts hemlocks and is currently present only in southern Vermont, far from the GMAC. Spruce budworm (*Choristoneura fumiferana*) had a large impact on Vermont's softwoods historically with low current presence and impacts. Beech Bark Disease (BBD) is a scale insect (*Cryptococcus fagisuga)* and fungus relationship that damage and infect American Beech trees. BBD results in dead spots on the tree bark, fungal cankers, and tree girdling. Beech trees with BBD can experience crown thinning, immature leaves, and dead limbs; infected trees are also more vulnerable to other environmental factors like drought and wind events.

Biodiversity
In addition to aforementioned Rare and Uncommon Species occurrences on property, the GMAC hosts a wide array of flora and fauna. The species documented across various monitoring efforts for the property represent a rich array of habitats and features thereof that indicate a robust habitat diversity across the property at large, including those of the forested areas. Some highlights include:

- To date, 775 species of various flora and fauna have been identified for the property on iNaturalist (on iNaturalist.org search "Green Mountain Audubon Nature Center"; see Appendix Item A for full list of species documented to date on iNaturalist).

- To date, 154 species of birds have been documented for the property on eBird (on eBird.org search hotspots: "Green Mountain Audubon Nature Center"; see Appendix Item B for list of species documented on property to date from eBird).

Regarding forest birds, Audubon Senior Biologist, Mark LaBarr, has been monitoring populations at long-term point-count stations for the Vermont Center for Ecostudies' Forest Bird Monitoring (FBMons) Program since 1997 in Stand C-2, documenting the

occurrence of the following 48 species, including 11 of the 12 species of Audubon Vermont's Birder's Dozen (Audubon Vermont, 2013).

Breeding bird species documented at FBMons point count locations, 1997-2022

American Crow	Brown-headed Cowbird	Red-breasted Nuthatch
American Goldfinch	Canada Goose	Red-eyed Vireo
American Redstart	Canada Warbler*	Rose-breasted Grosbeak
American Robin	Chestnut-sided Warbler*	Ruby-throated Hummingbird
Barred Owl	Common Raven	Scarlet Tanager*
Black-and-white Warbler	Downy Woodpecker	Slate-colored Junco
Black-billed Cuckoo	Eastern Wood-Pewee*	Solitary Vireo
Blackburnian Warbler	Great Crested Flycatcher	Tufted Titmouse
Black-capped Chickadee	Hairy Woodpecker	Veery*
Blackpoll Warbler	Hermit Thrush	White-breasted Nuthatch
Black-tailed Gnatcatcher	Least Flycatcher	White-throated Sparrow*
Black-throated Blue Warbler*	Mourning Dove	Wild Turkey
Black-throated Green Warbler*	Myrtle Warbler	Winter Wren
Blue Jay	Northern Cardinal	Wood Thrush*
Blue-headed Vireo*	Northern Parula	Yellow-bellied Sapsucker*
Brown Creeper	Ovenbird	
	Pileated Woodpecker	

*Audubon Vermont's Birder Dozen Species

Notably, signs of white-tailed deer are abundant, including tracks, browse, beds, and scat observable throughout the forest; most all of the stand areas of the GMAC property have been mapped by the State of Vermont as potential deer wintering areas.

Forest

Based on the latest inventory, at least seventeen tree species comprise the stocking across the eleven stands delineating the forested portions of the property (Image 4). The five most prevalent species, by volume, are: Eastern hemlock (24% stocking), sugar maple (21% stocking), white pine (13% stocking), red maple (13% stocking), and yellow birch (7% stocking). Overall forest types consist of both northern hardwood and mixedwood stands, further comprising predominate natural communities of northern hardwood, hemlock-northern hardwood, and hemlock-white pine-northern hardwood. See individual stand-by-stand summaries, below, for more detailed information.

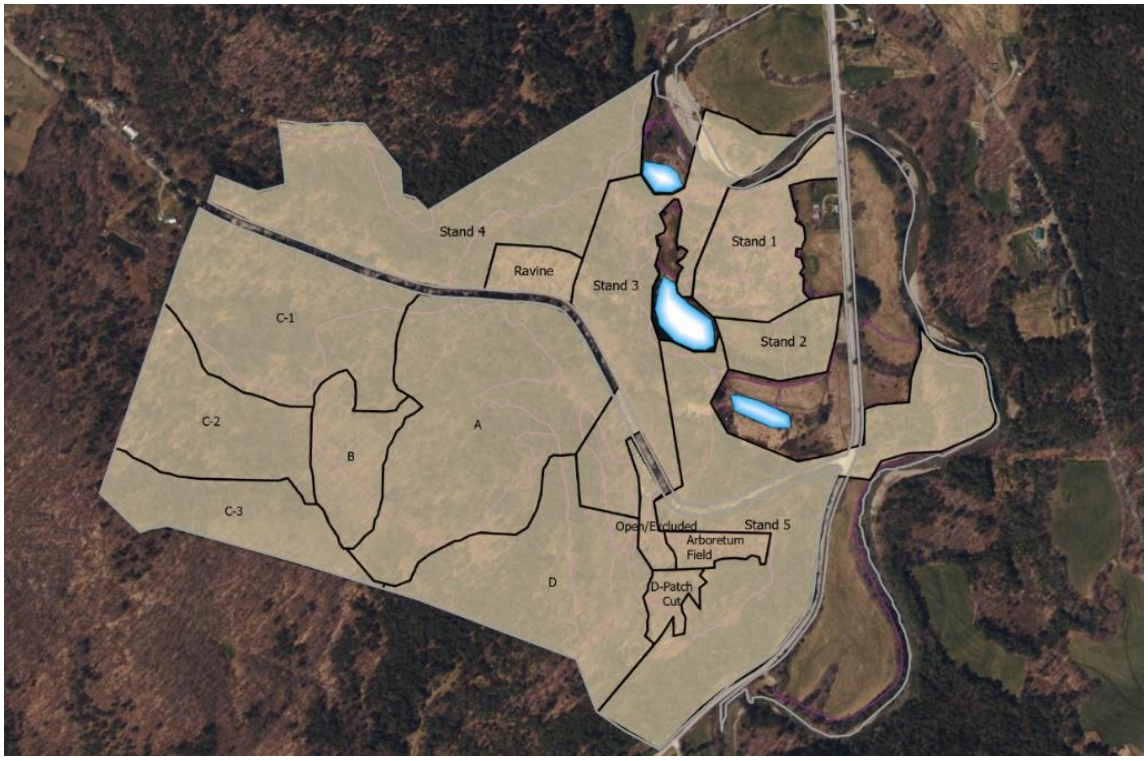


Image 4: Stand map for GMAC property.

Climate Change Considerations

Central to this plan is the consideration of climate change vulnerability for the GMAC property- and from that, applying tactics that will allow the forest to be resilient and adaptable to the changes to come.

Ongoing and Predicted Impacts for the Region

Given the extreme importance of the climate upon ecosystem health, including forest dynamics, it is vital to consider the observed and expected changes in climate in the region, as well as understand and consider the role that climate has upon the forest ecosystem.

Relevant to the GMAC property, the following are selected excerpts from the 2021 Vermont Climate Assessment (Galford et al. 2021) summarizing the ongoing and predicted impacts of climate change on Vermont and Vermont's forests.

Climate Change in Vermont

- Vermont's annual average temperature has increased by almost 2°F (1.11°C) since 1900. Winter temperatures have increased 2.5 times faster than annual temperatures over the past sixty years, and the number of very cold nights has decreased by over seven days in the same time period.
- Average annual precipitation in Vermont has increased by 21% since 1900 and has become more variable in the last decade. Annual snowfall has been

decreasing since the 1960s, yet winter precipitation has increased, suggesting that more winter precipitation is falling as rain.
- Vermont's freeze-free period has lengthened by three weeks since 1960; the trend has accelerated to an increase of nine days per decade since 1991.
- Extreme weather events such as droughts and floods are expected to continue to increase with climate change. Vermont experiences 2.4 more days of heavy precipitation than in the 1960s, most often in summer.

Climate change in Vermont Forests:

- Climate change is beginning to shift growing conditions for forests in Vermont, with greater changes expected to become more favorable for southern-adapted tree species and less favorable for currently adapted tree species. Species that will benefit from this change include northern red oak, shagbark hickory, and black cherry, while species including sugar maple, balsam fir, yellow birch, and black ash will be negatively impacted. While growing conditions will be significantly different by 2100, actual changes in forest makeup will follow a delay as older trees die and are replaced by young ones.
- Forest productivity, an important indicator of forest health and carbon storage, is amplified by a longer growing season and greater atmospheric carbon dioxide (CO2) and is expected to increase in Vermont in the next 50–100 years. However, productivity will be highly variable by species and will likely begin to decrease by the end of the century as high summer temperatures, drought, and soil nutrient loss outweigh benefits.
- Climate change is expected to continue exacerbating the threats that invasive plants, insects, and diseases already pose to the health of Vermont's forests. These threats are compounded by other climate-related factors, such as worsening storms and increasingly irregular precipitation.
- Warmer winters and wetter summers already limit active forest management by shortening the time frames that forest operations can take place. These negative climate impacts are projected to strengthen in the future, potentially leading to cascading negative effects on rural economies, forest product markets, and management for forest health and climate adaptation.
- As climate change impacts forest ecosystem function, there is a need for management to increase forest adaptive capacity. Current methods to achieve increased adaptive capacity at the ecosystem level (retaining ecosystem function despite threats to individual tree species or forest types) include increasing forest structural complexity and enhancing compositional and functional diversity and redundancy.

The following is a summary of the climate model based predictions for the GMAC region of Vermont summarized at a resolution of a 1x1 lat/long degree grid (S44_E72) available through the USFS Climate Change Tree Atlas database (Iverson et al. 2019). These results inform the tree species vulnerability assessment model results reported in the stand summaries below. For a full summary of these model results see Appendix Item C.

- Annual average temperature predictions range from an increase of 4.53 °F (9.78%) to 13.42 °F (24.3%) by the end of century.

- Growing season, May to September, average temperature predictions range from an increase of 4.40 °F (6.81%) to 14.24 °F (19.15%) by the end of century.

- Coldest month average temperature predictions range from an increase of 4.31 °F (25.23%) to 10.88 °F (46.0%) by the end of century.

- Warmest month average temperature predictions range from an increase of 3.67 °F (5.25%) to 10.05 °F (13.19%) by the end of century.

- Annual total precipitation predictions range from an increase of 1.92 inches (4.01%) to 7.52 inches (14.05%) by the end of century.

- Growing season, May to September, average precipitation predictions range from an increase of 0.14 inches (.64%) to 2.09 inches (8.72%) by the end of century.

Predicted Climate Change Resilience for GMAC

The Nature Conservancy's Resilient Site Analysis (Anderson et al. 2016), which produces site-specific scores representing an estimation of the potential capacity to maintain species diversity and ecological function amidst a changing climate, suggests that the lands of the GMAC have potential to be quite resilient to the effects of climate change (Image 5). In fact, the lands of the GMAC property score above average in terms of resilience values compared to the surrounding ecoregion (Image 6). These scores were determined by evaluating and quantifying physical characteristics of the site that foster resilience, principally landscape diversity and local connectedness.

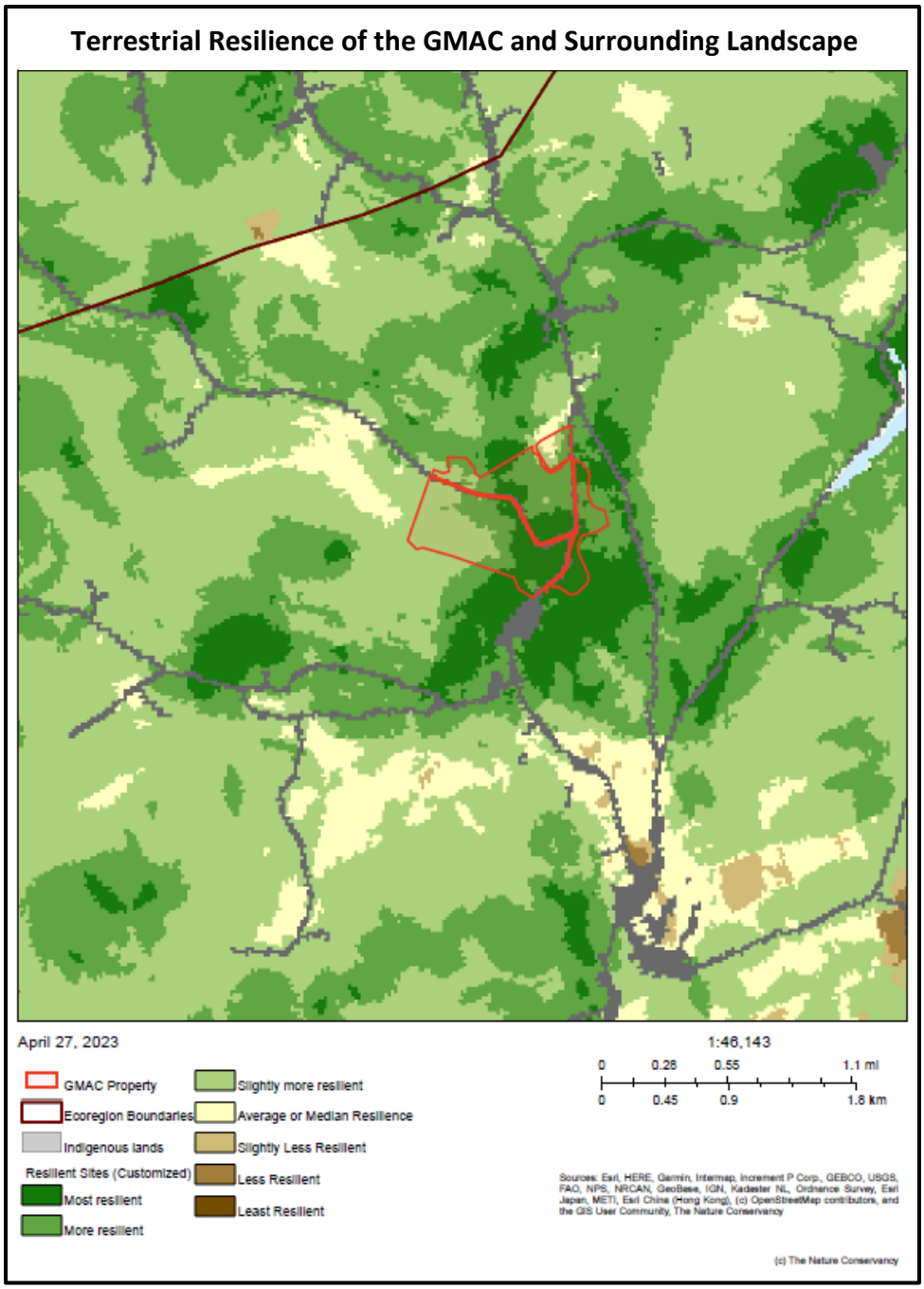


Image 5) results of TNC's climate change resiliency analysis for the GMAC and surrounding area (Anderson et al. 2016).

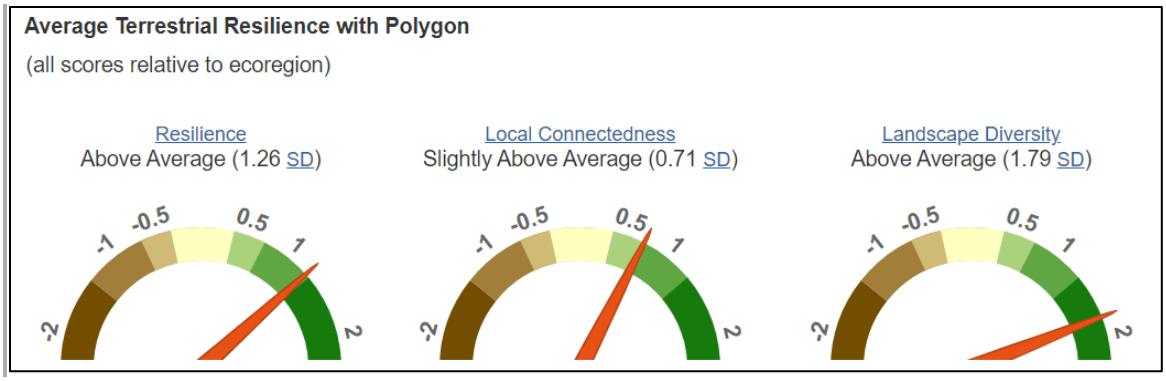


Image 6) Average Terrestrial Resilience scores of GMAC property relative to surrounding ecoregion (Anderson et al. 2016)

Forest Carbon

Model Based Estimated Carbon Sequestration and Storage

Queried from The Nature Conservancy Resilient Land Tool (https://www.maps.tnc.org/resilientland/; Anderson et al. 2016, 2023), the following (Image 7) are 30-30 meter grid model-based estimates of forest carbon sequestration potential for the GMAC over 40 years between 2010 and 2050 from the work of Williams et al. (2021b) and Gu et al. (2019). The model considers above-ground biomass, coarse woody material, soil carbon and other pools. It is important to note that these estimates come with an assumption that no significant changes to the forest from harvest or disturbance have happened since 2010- yet, the GMAC has indeed conducted harvests in Stands C-1, C-2, B, and A- thus these estimates have decreased accuracy for those stand areas. Regardless, an overarching level of inference can be made regarding the rate of potential sequestration across the property out to 2050. For stand-specific carbon store estimates, a different methodology was used to derive estimates from inventory data specifically; those estimates are provided in each stand description.

The results of the potential carbon sequestration predictions for the GMAC property (Figure 1) indicate that the forests of the GMAC, on current trajectory, have the potential to sequester up to 485 metric tons of above-ground carbon by 2050- a 7.5% increase in carbon stores. However, as noted above, this estimate assumes 1) that no disturbance has occurred to the forest, which is not the case given that a harvest occurred in 2012 and 2) that no alterations/disturbances will occur (natural or through management) between now and 2050.

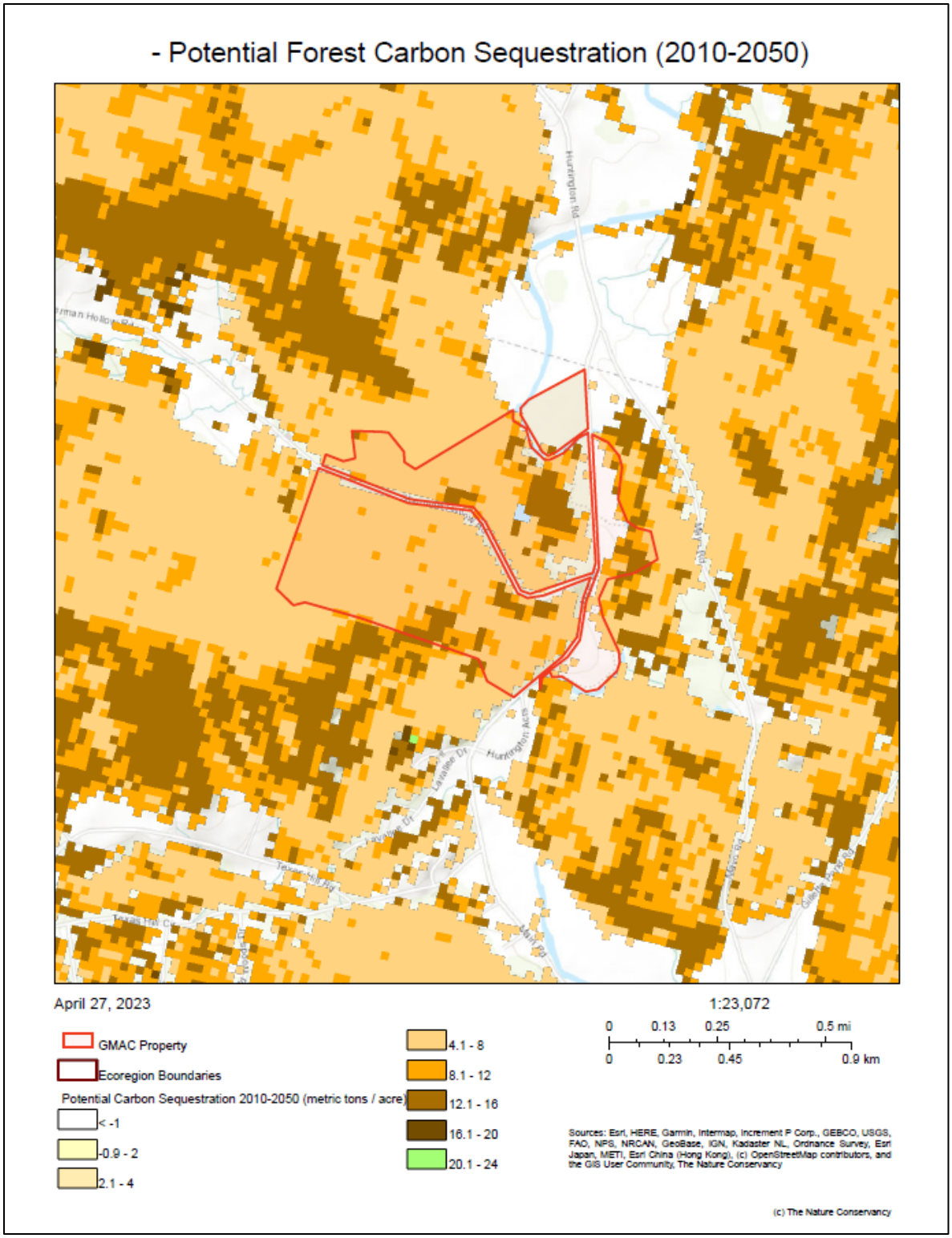


Image 7: Estimates of forest carbon sequestration potential for the GMAC property, 2010-2050

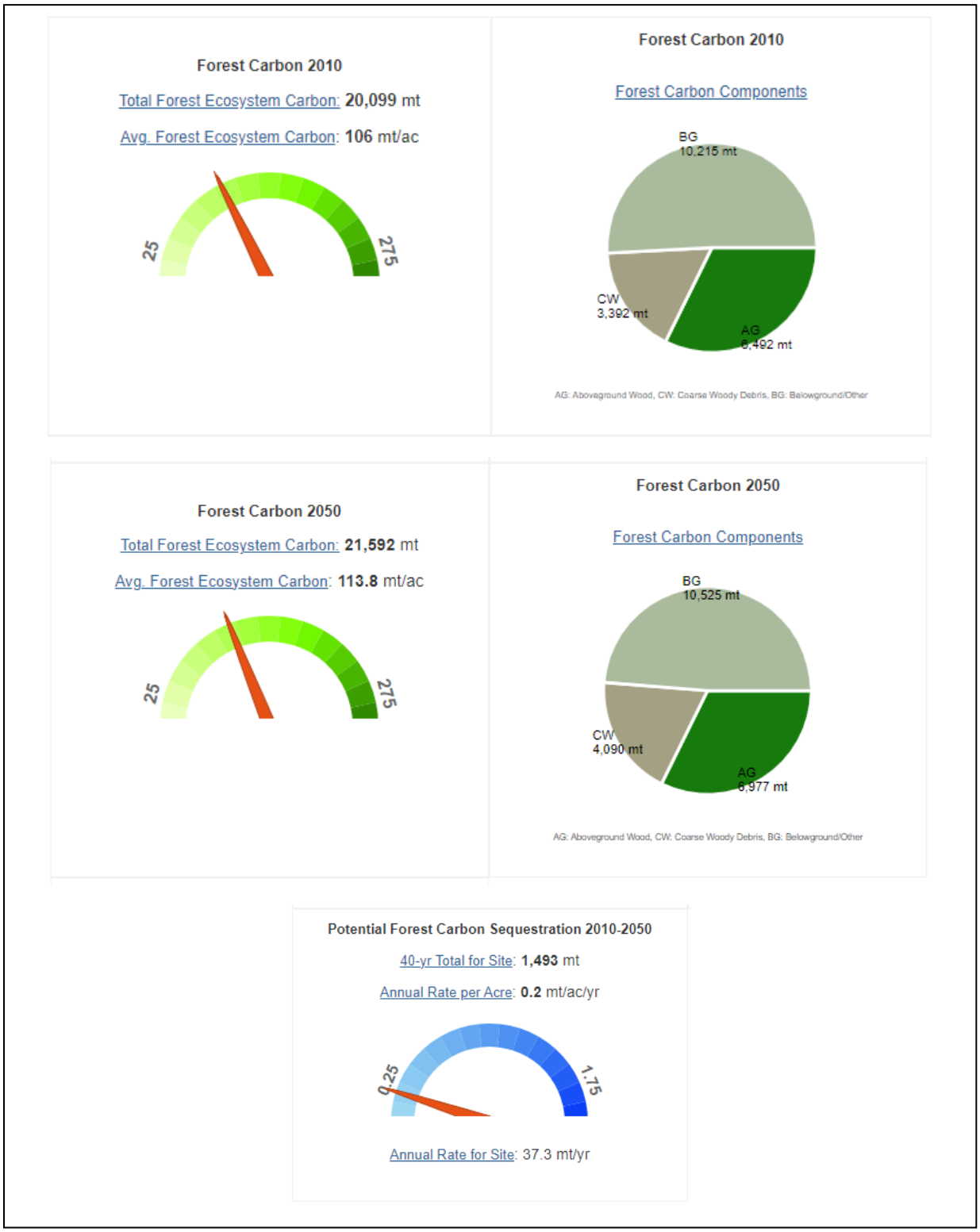


Figure 1: Summaries of potential carbon storage and sequestration in various forest carbon pools for the GMAC, 2010-2050

Inventory Based Carbon Storage Estimates

See stand by stand summaries of carbon and CO^2 storage, per acre, based on inventory measures within stand descriptions below.

Climate and Carbon Adaptation Tactics for the GMAC

In consideration of management goals of the GMAC, we used the NIACS Climate Change Response Framework (forestadaptation.org) to identify the following candidate climate and carbon adaptation strategies for managing the GMAC forest. Depending on site-specific conditions identified during inventory, some modifications to tactics exist in silvicultural prescriptions, while still honoring the approach and co-benefits associated with these tactics.

Tactic	Approach	Anticipated co-benefits
Maintain current extent of forested area, including early successional and mature forest	1.1 Avoid forest conversion to non-forest land uses	**Forest bird habitat:** Maintains extent and quality of bird habitat **Climate adaptation:** Maintains existing tree species diversity **Carbon mitigation:** Maintains existing carbon sequestration capacity
Using forwarder during harvest operations and position landing sites adjacent to the road (rather than within forest)	2.1 Reduce impacts to soils and nutrient cycling	**Forest bird habitat:** Maintains interior forest bird habitat **Climate adaptation:** Minimizes non-climate stressors; reduces risk of erosion during extreme rain events **Carbon mitigation:** Protects soil carbon stocks
Control of non-native invasive plant populations using mechanical removal (preferred), herbicides, or targeted goat grazing	2.3 Prevent the introduction and establishment of invasive plant species and remove existing invasives 2.5 Reduce competition for moisture, nutrients, and light	**Forest bird habitat:** Native plant populations support greater insect food resources and higher-quality cover **Climate adaptation:** Maintains native plant diversity, which enhances forest resistance and resilience **Carbon mitigation:** Maintains carbon sequestration capacity of forest lands and natural ecosystems
If EAB impacts occur, use insecticide on a small number of ash trees to preserve ash component on landscape	2.4 Maintain or improve the ability of forest to resist pests and pathogens	**Forest bird habitat:** Increases tree species diversity and potential food resources for birds **Climate adaptation:** Increases opportunities for species diversity recovery in the future **Carbon mitigation:** Reduces carbon losses, potentially enhances future carbon gains
Maintain no-harvest reserve area where forest is allowed to succeed to larger size classes	4.2 Establish reserves on sites with high carbon density	**Forest bird habitat:** Provides old-forest interior bird habitat **Climate adaptation:** Maintains landscape diversity; potential refugia **Carbon mitigation:** Maintains carbon in high carbon density stands
Implement forest harvest (such as group selection and expanding gap harvests) in northern hardwood stands and in sugarbush to maintain or increase tree species diversity and improve tree growth	2.4 Maintain or improve the ability of forest to resist pests and pathogens 3.5 Alter forest structure to reduce severity or extent of wind and ice damage 6.6 Promote species and structural diversity to enhance carbon capture and storage efficiency	**Forest bird habitat:** Increases vertical structure, providing more cover and nesting sites. **Climate adaptation:** Improves tree health and vigor to enhance forest resistance and resilience to a variety of climate-related stressors **Carbon mitigation:** Improves tree health and vigor of the residual stand to maintain long-term carbon stocks and maintain/enhance sequestration rates
In actively-managed stands, use silvicultural practices (single-tree selection, crop-tree release, and thinnings) that promote the quality of red maple, white pine, black cherry, and other native species for sawtimber	5.1 Prioritize sites with low vulnerability to carbon loss for maintaining high carbon density 7.1 Favor existing species or genotypes that are better adapted to future conditions	**Forest bird habitat:** Increases habitat quality and complexity through enhanced species and structural diversity **Climate adaptation:** Promotes native species that are expected to be better-adapted to future conditions **Carbon mitigation:** Reduces risk of long-term carbon losses by favoring lower-risk species; may increase provision of long-lived wood products

In actively managed stands, increase stocking levels by allowing trees to get to larger size classes	6.2 Increase stocking on well-stocked or under-stocked forest lands	**Forest bird habitat:** Maintains interior forest bird habitat **Climate adaptation:** Maintain structural diversity **Carbon mitigation:** Increases carbon stocks within managed stands
Promote northern red oak component in areas where the species is present	6.6 Promote species and structural diversity to enhance carbon capture and storage efficiency	**Forest bird habitat:** Increases tree species diversity and potential food resources for birds **Climate adaptation:** Promotes native species that are expected to be better-adapted to future conditions **Carbon mitigation:** Reduces risk of long-term carbon losses by favoring lower-risk species

View online at: forestadaptation.org/Green-Mt-Audubon

Stand Inventory and Assessment Methods

Forest Inventory and Bird Habitat Assessment

Inventory plots were systematically selected along a 5 chain by 5 chain grid using ArcGIS's fishnet tool. Each plot falling within a forested area was inventoried according to standard variable radius sampling, using a 10BAF prism. Forest bird habitat was measured at each inventory location according to Silviculture with Birds in Mind habitat assessment methods. Inventory data was analyzed in Excel.

Climate Change and Carbon Considerations

We used the *Securing Northeast Forest Carbon Program's Guide for a Forest Management/Stewardship Plan Addendum for Forest Carbon and Climate Resiliency* (https://www.northeastforestcarbon.org/; Appendix Item D) to develop this assessment and management plan. According to the guide, we use the following resources to inform this plan:

1. Tree Species Changes/Silviculture: we used the Vulnerability Assessment for Northern Forest Region Analysis (Janowiak et al. 2018) to report climate change vulnerabilities of the major forest types comprising the GMAC property. To report species-specific climate change projections scaled to the GMAC region, we used the most up-to-date model results summarized at a 1x1 lat/long degree grid (S44_E72; Iverson et al. 2019), available through the USFS Climate Change Tree Atlas database (https://www.fs.usda.gov/nrs/atlas/tree/). A regional summary is also available as a handout (see Appendix Item E).
    a. Using these findings, we report for each stand the climate change projections for individual tree species alongside their stand-specific stocking percentages.
    b. Using these findings, we report for each stand the climate change projections for the overall forest type comprising the stand.
2. Geophysical: Used TNC's climate resiliency tool to identify resiliency values for the GMAC property.
3. Soils: Used Soil Data for VT, downloaded from the Web Soil Survey (https://websoilsurvey.nrcs.usda.gov/) into GIS, to identify soils for each stand,

and from there summarized the unique characteristics of each soil as it relates to vulnerability to climate change.

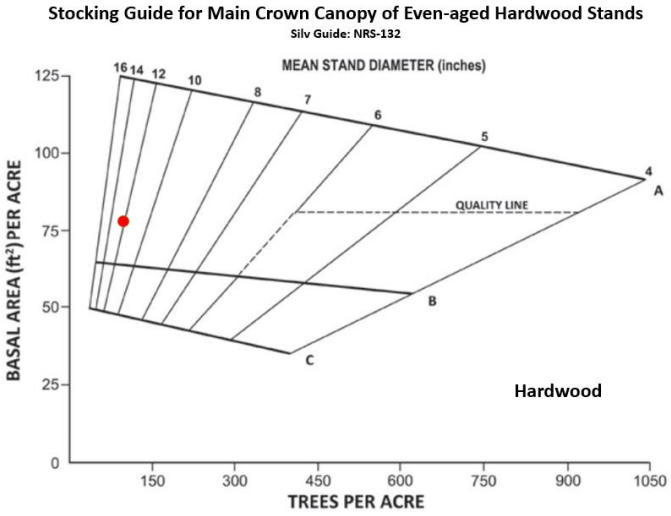
   a. Soil characteristics affecting forest vulnerability to climate change:
      i. Erodibility: Used 2012 index of erodibility of soils in Chittenden County (see Appendix Item F) to identify erodibility of soils identified within each stand based on Web Soil Survey soils data.
      ii. Drought Vulnerability and Windthrow Potential: Used Web Soil Survey database to identify the drought vulnerability of each soil type identified for the property.

4. Hydrological: Used geospatial data downloaded from Vermont Center for Geographic Information to identify rivers, streams, and wetland features within each stand.
5. Climate:
   a. Property wide: we report the climate model results that informed the tree species/silvicultural vulnerability findings- using the most up-to-date model results summarized at a 1x1 lat/long degree grid (S44_E72) (Iverson et al. 2019), available through the USFS Climate Change Tree Atlas database.
6. Carbon:
   a. For model based estimated carbon sequestration and storage we used The Nature Conservancy Resilient Land Tool, to extract 30-30 meter grid model-based estimates of forest carbon sequestration potential for the GMAC over 40 years between 2010 and 2050.
   b. For estimates of current stores in each stand from inventory data- we used Securing Northeast Forest Carbon Program's new (2023) Forest Carbon Calculator (https://www.northeastforestcarbon.org/forest-carbon-estimators-and-calculators/) to calculate metric tons of carbon (Co) per acre stored in above and below-ground biomass and the metric tons of carbon dioxide (Co2) equivalent in above and below ground live tree biomass based on inventory derived stand BA. Note that this estimate is produced for the ecoregion subsection (M211Ca) that surrounds and includes the GMAC property. These estimates are provided at the same resolution and from models parameterized by the same FIA data that fed into the Iverson et al. 2019 analysis- as such the use of these data are consistent with the species-specific vulnerability estimates reported here.

Current Stand Conditions

Stand: **1**
Stand Size: **9 acres**
Descriptor: **Sugarbush** (maple-hemlock-birch)
Natural Community Type: Hemlock-Northern Hardwood
Forest Cover Type: Northern Hardwood
Silv Guide: NRS-132

Stand Summary: 4 plots, 10 BAF	
Total Basal Area/Acre	78 sq.ft.
Total Trees/Acre	98
Trees/Acre >24”	2
Quadratic Mean Diameter	12.06 in.
Snags/Acre	8
Snags/Acre >12 in	1
Snags/Acre >18 in	1
Avg Dia. Snags	17 in.
Cavity Trees/Acre	1
Cavity Trees/Acre >12 in	1
Avg Dia. Cavity	30 in.



Interpretation: Values (red dot) residing below B line indicate understocked condition; the further below, the more understocked. Values from B to A line indicate full stocking; the closer the values fall towards the A line the more saturated the stocking is towards full stocking. Values above A line indicate overstocked condition.

BA by tree species*

Species	**BA**	**% of Total BA**
SM	35	45%
RM	20	26%
EH	8	10%
YB	5	6%
WA	5	6%
WP	3	3%
BC	3	3%

*See Table 1 for glossary of species names and abbreviations.

Average BA/Acre by Diameter Class (Diameter Distribution)

Size Class (DBH)	**Total BA**
Sap (<5")	0
Pol (5"-11")	25
Saw (11"-24")	45
Lg.saw (>24”)	8
TOTAL	78

Carbon Estimates Based on Stand BA	
Co Metric Tons/Acre	22.20
Co2 Metric Tons/Acre	81.47

Songbird Habitat Assessment

Overstory	
Cover	73%
Distribution	Uniform
Midstory	
Cover	76-100%
Distribution	Patchy

Dominant species	EH, AB, SM, RM
Understory	
Cover	26-50%
Distribution	Patchy
Dominant species	EH, AB, SM, RM
Soft mast	None observed
Invasives	Light
Species	Buckthorn, Honeysuckle, Japanese Knotweed
Downed Dead Wood	
FWM/Acre	2 pile/acre
CWM/Acre	2 piece/acre

Notes: Significant SM seedlings present in plot 82

Stand History: According to the *2007 GMAC/BOVM Important Bird Area Land Mgt. Plan* (Appendix Item G), this stand was described as "Unit 6". This stand has been used for maple sap production since at least 2007. There is no record of forest management activities being completed within this stand to date, although a stand-wide crown thinning, and a small 1.5 acre early successional treatment were prescribed for the northern portion of the stand.

Access/Operability: Abundant access via established trails/woods roads used by small tractor during sugaring operations.

Silvicultural Attributes:
This small northern hardwood stand is adequately stocked, albeit on the lower end of the volume range. The stand is dominated by sugar maple, red maple, and Eastern hemlock with a minority composition of early seral species of yellow birch, white ash, white pine and black cherry. Accordingly, regeneration noted in understory is largely comprised of the same as above: Eastern hemlock, American beech, sugar maple, and red maple. The species diversity is moderate to low relative to that of other stands north of Sherman Hollow Road. Much of the stock is in the pole and saw size-classes, with the majority being saw-sized. Acceptable growing stock (AGS) and unacceptable growing stock (UGS) ratios suggest 65% AGS and 35% UGS for this stand. Large-diameter trees are present, but not in great numbers.

Wildlife Structural Attributes:
The overstory within this stand is largely and uniformly closed, overtop a midstory comprised of dense patches of Eastern hemlock, American beech, sugar maple and red maple. The understory is the most underdeveloped layer of the forest within the stand, with a patchy distribution of the same species comprising the midstory and those otherwise dominating the stand stocking. There are invasive plants noted within the

understory. Down dead wood volumes, both coarse and fine woody material, are relatively low for this stand.

The snag density is robust- exceeding the minimum of 6/acre recommended according to Silviculture with Birds in Mind, however inventory data suggests that few are over the 12" threshold prescribed- indicating that larger diameter snags are lacking. Cavity tree numbers are low for this stand.

The habitat conditions within this stand are conducive to birder dozen species that focus upon closed canopy mixed forests, including those with abundant snags, such as: YBSA, BTNW, SCTA, BHVI*, but likely lacks many of the species that associate with dense understory and abundant down woody debris.

*See Table 2 for glossary of bird species abbreviations.

Climate Change Vulnerability:

Tree Species Changes

Northern hardwood forests, like that which comprise this stand, are considered to have low-moderate vulnerability to climate change based on medium evidence and model agreement. Key drivers underpinning this vulnerability of this forest type are drier summers, changes in soil temp and moisture, and altered nutrient availability. Common species to this forest type associate with a broad range of predicted habitat suitability changes under different climate scenarios, suggesting a high degree of variability in changes to this forest going forwards.

Specific to the major species comprising this stand identified during inventory, the following predictions are available from the Climate Change Tree Atlas (Iverson et al. 2019) for the region of the GMAC regarding how tree species may fare under both low and high climate change scenarios by the year 2100.

Stand Species-Specific Climate Change Projections for GMAC Region of Vermont			**Low Climate Change (RCP 4.5)**		**High Climate Change (RCP 8.5)**	
Species[1]	**Stocking %**	**Adaptability***	**Habitat Change+**	**Persistence Capability^**	**Habitat Change+**	**Persistence Capability^**
SM	45%	High	Sm. dec.	Good	Sm. dec.	Good
RM	26%	High	Sm. inc.	Very Good	Sm. inc.	Very Good
EH	10%	Low	No change	Fair	Sm. dec.	Fair
YB	6%	Medium	Sm. dec.	Fair	Sm. dec.	Fair
WA	6%	Low	Sm. inc.	Fair	Sm. inc.	Fair
WP	3%	Low	Sm. inc.	Good	No change	Fair
BC	3%	Low	Sm. inc.	Fair	Lg. inc.	Good

[1] See Table 1 for glossary of species abbreviations
* Species ability to respond favorably to disturbance based on life history factors.

+ Projected change in species suitable habitat in GMAC region by 2100 under associated climate change scenarios based on modeling results.
^ Overall rating describing species expected ability of cope or persist amidst projected change in suitable habitat in GMAC region by 2100 based on model results and expert opinion.

These results indicate that the persistence of the majority stocking species of this stand is likely to continue into the end of the century despite mixed predictions of how these species may fare in terms of habitat suitability. Overall species composition is likely to persist given mixed vulnerabilities across species relative to one another.

Introduction of Non-Native Invasive Pests and Species
Amidst these changes, the growth rate of non-native invasive species noted during inventory are expected to increase with climate change further modifying the condition of the forest and impacting native vegetation. Proliferation of non-native invasive pests specific to this stand, such as hemlock woolly adelgid threaten to impact hemlock and emerald ash borer is a threat to ash.

Hydrology
The northern area of this stand borders the Huntington River, making this area susceptible to extreme weather events and disturbances from high flows within the river which include erosion of banks, spillover of banks, ice damage in winter, etc.

The south-southwestern borders a class two wetland that buffers the beaver pond making this part of the stand vulnerable to extreme hydrological events.

Soils
Erodibility of the soils underlying the stand is important to consider when evaluating how vulnerable the area is to extreme rain events; the more erodible the soil, the more vulnerable the stand is to extreme weather posed by climate change; any events, including management activities, that expose soil and/or disturb the soil poses risk of exacerbating this vulnerability.

The soil characteristics underlying this stand, alongside the stand's proximity to the Huntington River and the class two wetland, make it vulnerable to erosion from extreme rain events- vulnerability which could be exacerbated by management activities that increases soil exposure.

Soil Type (slopes)	Est. Prop	Erodibility Potential	Drought Potential	Windthrow Potential
Adams and Windsor loamy sands (5-12%)	80%	High	Vulnerable	Low
Hadley Very Fine Sandy Loam	20%	Not Highly Erodible	Somewhat Vulnerable	Low

Carbon Stocking:
Given that current stand stocking is at the lower end of the stocking chart, this suggests that stocking (and thus carbon sequestration and subsequent storage) is likely to continue

as the stand develops; this is further supported by the fact that much of the aboveground carbon in this stand is stored in trees that are predicted to persist amidst possible changes in climate. The remainder of the carbon stores are in trees that have at least a fair chance of persistence. Taken together, this indicates that the stand is positioned to likely continue to store and sequester carbon at reasonable rates given overall persistence and growth of species currently comprising the stocking.

Desired Future Stand Conditions and Management Strategies

Management Goals: Sustained maple sap production, long-term production of softwood and hardwood sawtimber, resiliency to climate change, increased carbon sequestration and storage, and sustained breeding and wintering habitat for both resident and non-resident birds.

Management Objectives:
Additional management strategies based upon inventory findings, climate change vulnerability and carbon considerations, include:

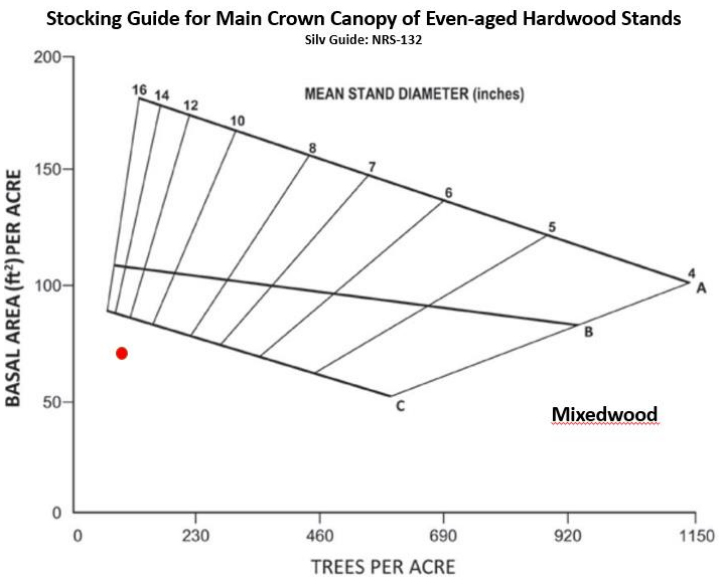
- Targeted release of sugar maple and red maple
- Adding coarse woody and fine woody material to the forest floor
- Increasing recruitment of larger-diameter snags
- Increase recruitment of cavity trees
- Manage non-native invasive species
- Efforts to maintain soil stability near hydric features
- Monitoring for introduction of HWE and EAB

Management prescription: Consider a crop tree release to increase the growth rate of desirable sugar and red maple species (modification of Silviculture with Birds in Mind Option 1A). Trees may be girdled to create snags and cavity trees and/or may be felled and left as down woody material. Map and manually remove invasive plants.

Current Stand Conditions

Stand: **2**
Stand Size: **4.5 acres**
Descriptor: **Hemlock Swamp** (hemlock-yellow birch)
Natural Community Type: Hemlock
Forest Cover Type: Mixedwood
Silv Guide: NRS-132

Stand Summary: 2 plots, 10 BAF	
Total Basal Area/Acre	65 sq.ft.
Total Trees/Acre	99
Trees/Acre >24 in	1
Quadratic Mean Diameter	10.98 in.
Snags/Acre	24
Snags/Acre >12 in	5
Snags/Acre >18 in	2
Avg Dia. Snags	15 in.
Cavity Trees/Acre	2
Cavity Trees/Acre >12 in	2
Avg Dia. Cavity	24 in.



BA by tree species

Species	BA	% of Total BA
EH	40	62%
YB	10	15%
QA	5	8%
RM	5	8%
WP	5	8%

Songbird Habitat Assessment	
Overstory	
Cover	35%
Distribution	Patchy
Midstory	
Cover	51-75%
Distribution	Patchy
Dominant species	EH, AB, YB
Understory	
Cover	51-75%
Distribution	Patchy

Average BA/Acre by Diameter Class (Diameter Distribution)

Size Class (DBH)	Total BA
Sap (<5")	0
Pol (5"-11")	35
Saw (11"-24")	25
Lg.saw (>24")	5
TOTAL	65

Carbon Estimates Based on Stand BA	
Co Metric Tons/Acre	18.62
Co2 Metric Tons/Acre	68.34

Dominant species	EH, Herbaceous wetland spp.
Soft mast	None observed
Invasives	None observed
Downed Dead Wood	
FWM/Acre	5 piles/acre
CWM/Acre	35 pieces/acre

Notes: Wetland and pond make up portion of stand.

Stand History: This stand was previously described as Unit 10 according to the *2007 GMAC/BOVM Important Bird Area Land Mgt. Plan.* This area has no record of receiving any management intervention to date.

Access/Operability: Limited access given prevalence of wet soils within and surrounding the stand.

Silvicultural Attributes:
This small Eastern hemlock-dominated mixedwood stand has fairly low volumes of timber, largely in small-saw to saw size classes with a few large trees mixed in. The species diversity is low relative to that of other stands North of Sherman Hollow Road- with the overstory being dominated by Eastern hemlock, midstory comprised of hemlock, yellow birch and American beech, and understory of hemlock alongside wetland-associate herbaceous species. Quaking aspen and red maple also comprise a small amount of the stocking.

Wildlife Structural Attributes
The overstory is largely open with patchy distributions of canopy trees, overtop a patchy and denser midstory comprised of hemlock, American beech, and yellow birch and similarly structured understory of hemlock and herbaceous wetland associate species. Snag number and size meet and exceed SWBiM recommendations (Hagenbuch 2011). Cavity trees are present, albeit in relatively low numbers, yet of quality size for wildlife. Down dead wood volumes, both coarse and fine woody material, are moderate to high, respectively, for this stand. Soft mast is lacking in this stand.

The habitat conditions within this stand are conducive to birder dozen species that focus upon moist mixedwood stands dominated by hemlock with moderately open canopies, and/or abundant snags such as: YBSA, CAWA, BTNW, WTSP, and SCTA; VEER could be present in areas with more deciduous cover.

Climate Change Vulnerability

Silviculture

Northern hardwood forests, of which this stand is a variant, are considered to have low to moderate vulnerability to climate change based on medium evidence and model agreement. Key drivers underpinning this vulnerability of this forest type are drier summers, changes in soil temp and moisture, and altered nutrient availability. Common species to this forest type associate with a broad range of predicted habitat suitability changes under different climate scenarios, suggesting a high degree of variability in changes to this forest going forwards.

Specific to the major species comprising this stand identified during inventory, the following predictions are available from the Climate Change Tree Atlas for the region of the GMAC regarding how tree species may fare under both low and high climate change scenarios by the year 2100.

Stand Species-Specific Climate Change Projections for GMAC Region of Vermont			**Low Climate Change (RCP 4.5)**		**High Climate Change (RCP 8.5)**	
Species	**Stocking %**	**Adaptability***	**Habitat Change+**	**Persistence Capability^**	**Habitat Change+**	**Persistence Capability^**
EH	62%	Low	No change	Fair	Sm. dec.	Fair
YB	15%	Medium	Sm. dec.	Fair	Sm. dec.	Fair
QA	8%	Medium	Sm. inc.	Good	Sm. inc.	Good
RM	8%	High	Sm. inc.	Very Good	Sm. inc.	Very Good
WP	8%	Low	Sm. inc.	Good	No change	Fair

* Species ability to respond favorably to disturbance based on life history factors.
+ Projected change in species suitable habitat in GMAC region by 2100 under associated climate change scenarios based on modeling results.
^ Overall rating describing species expected ability of cope or persist amidst projected change in suitable habitat in GMAC region by 2100 based on model results and expert opinion.

Low species diversity alongside the majority stocking of Eastern hemlock which has low adaptability to disturbance and only fair prospects of persistence, makes this stand more vulnerable to climate change than others on property. It is likely that a possible decline of hemlock will be compensated for, in time, with the continued growth of some of the other species that are predicted to fare better, such as red maple.

Hydrology
The western portion of this stand borders a class 2 wetland- so called the “Beaver Pond”. Wet soils underly much of the stand.

Soils
Erodibility of the soils underlying the stand is important to consider when evaluating how vulnerable the area is to extreme rain events; the more erodible the soil, the more vulnerable the stand is to extreme weather posed by climate change; any alterations, including management activities, that expose soil and/or disturb the soil poses risk of exacerbating this vulnerability.

The soil characteristics comprising much of this stand contribute substantial vulnerability to extreme rain events expected with climate change; this vulnerability is heightened by proximity of class 2 wetlands/beaver complex as well as areas of wet soil throughout.

Soil Type (slopes)	Est. Prop	Erodibility Potential	Drought Potential	Windthrow Potential
Duane and Deerfield (5-12%)	25%	High	Vulnerable	Low
Adams and Windsor loamy Sands (5-12%)	25%	High	Vulnerable	Low
Adams and Windsor loamy Sands (0-5%)	25%	Not Highly Erodible	Moderately Vulnerable	Low
Groton Gravelly Fine Sandy Loam (30-60%)	25%	High	Vulnerable	Low

Carbon Stocking:
This stand has the lowest carbon stores per acre of any stand on the GMAC property. Given that current stand stocking is low, this suggests that there is large capacity for increased carbon sequestration and storage as the stand develops naturally; however, the majority species comprising the stocking has less than ideal prospects of continued productivity in future climate scenarios, suggesting that carbon sequestration and storage rates may remain low on its current trajectory.

Desired Future Stand Conditions and Management Strategies

Management Goals: Manage as a reserve area for aesthetics, softwood songbird habitat, and as a buffer between wetland/riparian area and walking paths. Resiliency to climate change, increased carbon sequestration and storage.

Management Objectives:
Management strategies based upon inventory findings, climate change vulnerability and carbon considerations, include:

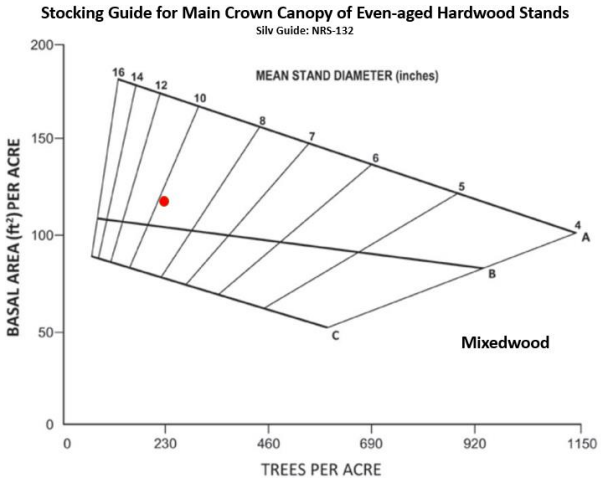
- Monitoring for introduction of HWE
- Minimize disturbance to forest and soils
- Increase recruitment of large-diameter snags

Management prescription: Manage as reserve area and monitor for change in forest ecosystem health.

Current Stand Conditions

Stand: **3**
Stand Size: **19 acres**
Descriptor: **Center of property, intersected by Sherman Hollow Rd.** (hemlock-maple-birch)
Natural Community Type: Hemlock-Northern Hardwood
Forest Cover Type: Mixedwood
Silv Guide: NRS-132

Stand Summary: 8 plots, 10 BAF	
Total Basal Area/Acre	113 sq.ft.
Total Trees/Acre	229
Trees/Acre >24 in	2
Quadratic Mean Diameter	9.49 in.
Snags/Acre	12
Snags/Acre >12 in	8
Snags/Acre >18 in	1
Avg Dia. Snags	16 in.
Cavity Trees/Acre	4
Cavity Trees/Acre >12 in	4
Avg Dia. Cavity	21 in.



BA by tree species

Species	BA	% of Total BA
EH	45	40%
SM	18	16%
YB	18	16%
RM	16	14%
AB	5	4%
WA	4	3%
WP	3	2%
RO	3	2%
A. Basswood	1	1%
HH	1	1%

Average BA/Acre by Diameter Class (Diameter Distribution)

Size Class (DBH)	Total BA
Sap (<5")	0
Pol (5"-11")	39
Saw (11"-24")	68
Lg.saw (>24")	6
TOTAL	113

Carbon Estimates Based on Stand BA	
Co Metric Tons/Acre	32.23
Co2 Metric Tons/Acre	118.28

Songbird Habitat Assessment

Overstory	
Cover	83%
Distribution	Uniform
Midstory	
Cover	76-100%
Distribution	Patchy
Dominant species	EH, AB, SM, RM, YB

Understory	
Cover	26-50%
Distribution	Patchy
Dominant species	AB, YB, EH, SM, RM
Soft mast	Present
Invasives	None
Species	
Downed Dead Wood	
FWM/Acre	10 piles/acre
CWM/Acre	17 pieces/acre

Notes: Honeysuckle noted in plot 90.

Stand History: This newly and thusly defined stand is comprised of previously described units 2, 8 and a portion of 17 under the *2007 GMAC/BOVM Important Bird Area Land Mgt. Plan.* Management activities prescribed for these stands under that plan include invasive species removal, beaver activity control, and alder thicket development (unit 2), crown thinning in northern portion of unit 8, and various efforts to control invasive plants and release mast-producing trees in unit 17; there is no record of completion of these activities. A utility ROW that exists along the border of this stand and Sherman Hollow Road is maintained as an open area by the utility.

Access/Operability: Areas of limited access along Sherman Hollow Road with much of the stand on and beyond areas of steep slopes.

Silvicultural Attributes:
This moderately sized, moderately stocked, mixedwood stand is dominated by Eastern hemlock alongside sugar maple, yellow birch, and red maple; additional northern hardwood associated species exist in smaller proportions. In total, species diversity is moderate relative to that of other stands North of Sherman Hollow Road. Stocking trends towards larger-size class trees with the majority being in the saw-size and notable amounts of larger-diameter trees (>24" DBH).

Wildlife Structural Attributes:
The uniform mixedwood overstory and patchy midstory are both fairly dense; the midstory is comprised of the species dominating the stand. The understory contains patches of American beech, yellow birch, Eastern hemlock, sugar maple and red maple and is of low to intermediate density. Additionally, the snag and cavity tree density is robust and trends towards larger sizes; coarse and fine woody material are well-represented within the stand; there is a lack of soft mast, yet northern red oak grows in this stand, a hard mast producing species.

These characteristics are likely to provide suitable habitat for a range of bird species, including most of the Birders Dozen.

Climate Change Vulnerability

Silviculture

Northern hardwood forests, of which this stand is a variant, are considered to have low to moderate vulnerability to climate change based on medium evidence and model agreement. Key drivers underpinning this vulnerability of this forest type are drier summers, changes in soil temp and moisture, and altered nutrient availability. Common species to this forest type associate with a broad range of predicted habitat suitability changes under different climate scenarios, suggesting a high degree of variability in changes to this forest going forwards.

Specific to the major species comprising this stand identified during inventory, the following predictions are available from the Climate Change Tree Atlas for the region of the GMAC regarding how tree species may fare under both low and high climate change scenarios by the year 2100.

Stand Species-Specific Climate Change Projections for GMAC Region of Vermont			**Low Climate Change (RCP 4.5)**		**High Climate Change (RCP 8.5)**	
Species	**Stocking %**	**Adaptability***	**Habitat Change+**	**Persistence Capability^**	**Habitat Change+**	**Persistence Capability^**
EH	40%	Low	No change	Fair	Sm. dec.	Fair
SM	16%	High	Sm. dec.	Good	Sm. dec.	Good
YB	16%	Medium	Sm. dec.	Fair	Sm. dec.	Fair
RM	14%	High	Sm. inc.	Very Good	Sm. inc.	Very Good
AB	4%	Medium	No change	Good	No change	Good
WA	3%	Low	Sm. inc.	Fair	Sm. inc.	Fair
WP	2%	Low	Sm. inc.	Good	No change	Fair
RO	2%	High	Lg. inc.	Very Good	Lg. inc.	Very Good
A. Basswood	1%	Medium	Lg. inc.	Good	Lg. inc.	Good
HH	1%	High	Sm. inc.	Very Good	Sm. inc.	Very Good

* Species ability to respond favorably to disturbance based on life history factors.
+ Projected change in species suitable habitat in GMAC region by 2100 under associated climate change scenarios based on modeling results.
^ Overall rating describing species expected ability of cope or persist amidst projected change in suitable habitat in GMAC region by 2100 based on model results and expert opinion.

The diversity of species within this stand increases its prospects of resiliency to climate change. That said, Eastern hemlock, the dominant species comprising the stocking, has less than ideal prospects regarding productivity in future climate scenarios. However, the next three most prevalent species, sugar maple, yellow birch, and red maple, have overall positive prospects for continued productivity amidst potential climate change scenarios.

Hydrology

The northernmost portion of this stand is bisected by the Huntington River and also straddles wetlands and a beaver pond. Increases in frequency and magnitude of extreme

rain events will make this stand susceptible to erosion, flooding, and possible ice damage. Conversely, drought may reduce and otherwise change the size and overall character of wetlands and the pond associated with the stand.

Soils

Erodibility of the soils underlying the stand is important to consider when evaluating how vulnerable the area is to extreme rain events; the more erodible the soil, the more vulnerable the stand is to extreme weather posed by climate change; any events, including management activities, that expose soil and/or disturb the soil poses risk of exacerbating this vulnerability.

The soil characteristics comprising much of this stand contribute substantial vulnerability to extreme rain events expected with climate change; this vulnerability is exacerbated by co-occurrence of the Huntington River and the abutting class 2 wetlands/beaver complex. A small proportion of the soils underlying the stand also have moderate drought potential.

Soil Type (slopes)	Est. Prop	Erodibility Potential	Drought Potential	Windthrow Potential
Stetson Gravelly Find Sandy Loam (0-5%)	5%	Not Highly Erodible	Moderately Vulnerable	Low
Groton Gravelly Fine Sandy Loam (30-60%)	60%	High	Vulnerable	Low
Adams and Windsor loamy Sands (0-5%)	5%	Not Highly Erodible	Moderately Vulnerable	Low
Colton and Stetson Soils (20-30%)	25%	High	Vulnerable	Low
Hadley Very Fine Sandy Loam	5%	Not Highly Erodible	Somewhat Vulnerable	Low

Carbon Stocking:

Current stand stocking levels suggests there is room for increased carbon sequestration and capacity to store that carbon as the stand develops; however, potential impacts of climate change on Eastern hemlock may result in decreased productivity of this species and thus carbon sequestration and storage potential. However, this may be offset by persistence and growth of the diversity of other species also comprising the stand and prospects for their unique, more favorable, response to future changes.

Desired Future Stand Conditions and Management Strategies

Management Goals: Manage for the long-term production of softwood and hardwood sawtimber, resiliency to climate change, increased carbon sequestration and storage, and sustained breeding and wintering habitat for both resident and non-resident birds.

Management Objectives: Increase sawtimber quality and quantity, protect interior forest conditions, increase understory density/horizontal and vertical heterogeneity, increase

species diversity beyond Eastern hemlock, maintain abundance of large-diameter snags/cavity trees/downed woody material. Additionally:

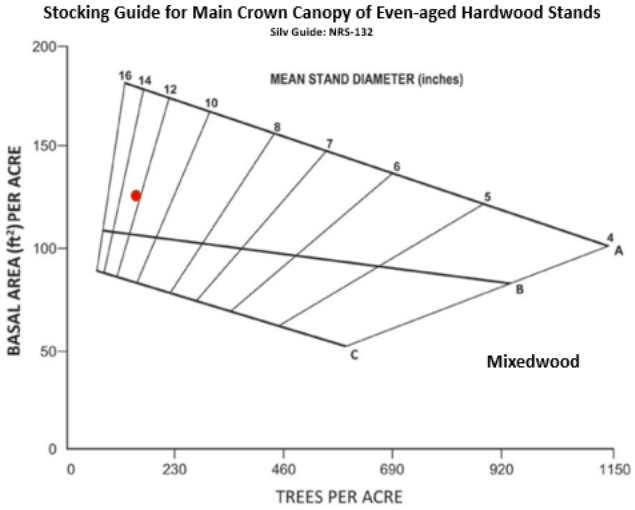
- Monitoring for introduction of HWE and invasive species
- Minimize disturbance to forest and soils

Management Prescription: Manage as reserve area and monitor for change in forest ecosystem health.

Current Stand Conditions

Stand: **4**
Stand Size: **25 acres**
Descriptor: **Northwest corner, bisected by Sherman Hollow Brook** (hemlock-pine-maple)
Natural Community Type: Hemlock-White Pine-Northern Hardwood
Forest Cover Type: Mixedwood
Silv Guide: NRS-132

Stand Summary: 11 plots, 10 BAF	
Total Basal Area/Acre	125 sq.ft.
Total Trees/Acre	144
Trees/Acre >24"	3
Quadratic Mean Diameter	12.63 in.
Snags/Acre	16
Snags/Acre >12 in	10
Snags/Acre >18 in	2
Avg Dia. Snags	19 in.
Cavity Trees/Acre	2
Cavity Trees/Acre >12 in	2
Avg Dia. Cavity	24 in.



BA by tree species

Species	BA	% of Total BA
EH	40	32%
WP	33	26%
SM	18	14%
YB	17	14%
RM	6	5%
WA	3	2%
RO	2	1%
Striped M.	2	1%
BC	1	1%
A. Basswood	1	1%
AB	1	1%
PB	1	1%
QA	1	1%

Average BA/Acre by Diameter Class (Diameter Distribution)

Size Class (DBH)	Total BA
Sap (<5")	0
Pol (5"-11")	37
Saw (11"-24")	77
Lg.saw (>24")	11
TOTAL	125

Carbon Estimates Based on Stand BA	
Co Metric Tons/Acre	35.81
Co2 Metric Tons/Acre	131.42

Songbird Habitat Assessment	
Overstory	
Cover	75%
Distribution	Patchy
Midstory	
Cover	76-100%
Distribution	Patchy
Dominant species	EH, AB, SM, Striped M., YB
Understory	
Cover	26-50%
Distribution	Patchy
Dominant species	AB, Striped M., RM, YB, EH, Hobblebush
Soft mast	Present
Invasives	Present
Species	Honeysuckle, Buckthorn, Barberry
Downed Dead Wood	
FWM/Acre	25 piles
CWM/Acre	49 pieces

Notes: Honeysuckle, Buckthorn observed (plots 74, 85, 88). Plot 76 had significant blowdown indicative of wind event. Stand bisected by Sherman Hollow Brook.

Stand History: This newly and thusly defined stand is comprised of the northern portion of Unit 17 and southwestern portion of Unit 22 under the *2007 GMAC/BOVM Important Bird Area Land Mgt. Plan.* Other than the utility ROW, which is frequently mowed by the utility, this area has no management history.

Access/Operability: Access from Sherman Hollow Road, however limited access given power line corridor and steep and inoperable slopes north of power line corridor.

Silvicultural Attributes:
This moderately sized mixedwood stand has moderate stocking, comprised predominantly of Eastern hemlock, white pine, sugar maple, and yellow birch. Species diversity is high relative to that of other stands North of Sherman Hollow Road with a variety of additional northern hardwood species present within the stand, many of which are early seral species. Much of the stocking is in the saw size class, less in the pole size class, and a minority component is of larger-saw sized stock. A variety of invasive plants are established in this stand.

Wildlife Structural Attributes:
The overstory presents as largely closed canopy in patchy form overtop a denser midstory of likewise patchy form. The midstory is comprised of Eastern hemlock, American beech, yellow birch, sugar maple, red maple, and striped maple. The understory is the most open layer of the forest with similar stocking as the midstory and overstory; notably there is hobblebush in the understory of this stand. Soft mast is present within the stand. Both snag and cavity tree density are robust in number and form within the stand; down woody debris, both coarse and fine are also robust. Large-diameter trees exist in this stand.

The characteristics of the stand are favorable for a diversity of interior bird species, including many among the Birders Dozen.

Climate Change Vulnerability:

Silviculture
Northern hardwood forests, of which this stand is a variant, are considered to have low to moderate vulnerability to climate change based on medium evidence and model agreement. Key drivers underpinning this vulnerability of this forest type are drier summers, changes in soil temp and moisture, and altered nutrient availability. Common species to this forest type associate with a broad range of predicted habitat suitability changes under different climate scenarios, suggesting a high degree of variability in changes to this forest going forwards.

Specific to the major species comprising this stand identified during inventory, the following predictions are available from the Climate Change Tree Atlas for the region of the GMAC regarding how tree species may fare under both low and high climate change scenarios by the year 2100.

Stand Species-Specific Climate Change Projections for GMAC Region of Vermont			Low Climate Change (RCP 4.5)		High Climate Change (RCP 8.5)	
Species	**Stocking %**	**Adaptability***	**Habitat Change+**	**Persistence Capability^**	**Habitat Change+**	**Persistence Capability^**
EH	32%	Low	No change	Fair	Sm. dec.	Fair
WP	26%	Low	Sm. inc.	Good	No change	Fair
SM	14%	High	Sm. dec.	Good	Sm. dec.	Good
YB	14%	Medium	Sm. dec.	Fair	Sm. dec.	Fair
RM	5%	High	Sm. inc.	Very Good	Sm. inc.	Very Good
WA	2%	Low	Sm. inc.	Fair	Sm. inc.	Fair
RO	1%	High	Lg. inc.	Very Good	Lg. inc.	Very Good
Striped M.	1%	Medium	Sm. dec.	Poor	Lg. dec.	Poor
BC	1%	Low	Sm. inc.	Fair	Lg. inc.	Good
A. Basswood	1%	Medium	Lg. inc.	Good	Lg. inc.	Good
AB	1%	Medium	No change	Good	No change	Good
PB	1%	Medium	No change	Fair	No change	Fair
QA	1%	Medium	Sm. inc.	Good	Sm. inc.	Good

* Species ability to respond favorably to disturbance based on life history factors.
+ Projected change in species suitable habitat in GMAC region by 2100 under associated climate change scenarios based on modeling results.
^ Overall rating describing species expected ability of cope or persist amidst projected change in suitable habitat in GMAC region by 2100 based on model results and expert opinion.

Hydrology

The northernmost portion of this stand abuts the Huntington River, and Sherman Hollow Brook runs through this stand, both of which are vulnerable to extreme hydrological events and also bring the potential for introduction if non-native invasive plants such as Japanese knotweed.

Soils

Erodibility of the soils underlying the stand is important to consider when evaluating how vulnerable the area is to extreme rain events; the more erodible the soil, the more vulnerable the stand is to extreme weather posed by climate change; any events, including management activities, that expose soil and/or disturb the soil poses risk of exacerbating this vulnerability.

The soil characteristics of this stand are overall highly vulnerable to extreme rain events expected with climate change- this vulnerability is exacerbated by the co-occurrence of Sherman Hollow Brook as well as areas if steep slopes in close proximity to the brook.

Soil Type (slopes)	Est. Prop	Erodibility Potential	Drought Potential	Windthrow Potential
Colton and Stetson Soils (20-30%)	55%	High	Vulnerable	Low
Colton and Stetson Soils (30-60%)	35%	High	Vulnerable	Low
Stetson Gravelly Fine Sandy Loam (0-5%)	5%	Not Highly Erodible	Moderately Vulnerable	Low

Colton Gravely Loamy Sand (0-5%)	5%	Not Highly Erodible	Vulnerable	Low

Carbon Stocking: Current stand stocking levels suggests there is room for increased carbon sequestration and capacity to store that carbon as the stand develops; however, potential impacts of climate change on the dominant species, Eastern hemlock, may result in decreased productivity of this species and thus reduce carbon sequestration and storage potential of that species. However, this is likely to be offset by persistence and growth of the diversity of other species also comprising the stand given prospects among their collective, potentially more favorable, response to future changes in climate conditions.

Desired Future Stand Conditions and Management Recommendations

Management Goals: Manage long-term production of softwood and hardwood sawtimber, breeding habitat for neo-tropical migratory songbirds, climate change resiliency and carbon sequestration and carbon potential.

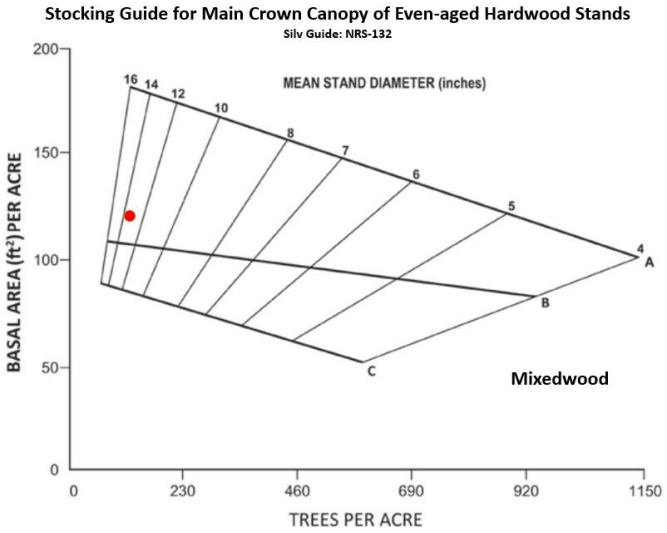
Management Objectives: Increase sawtimber quality and quantity, protect interior forest conditions, promote understory density/horizontal and vertical heterogeneity, maintain species diversity, increase abundance of large-diameter snags/cavity trees/downed woody material.

Management Prescription: Treat and monitor invasive plants within this stand. Otherwise, manage as reserve area and monitor for change in forest ecosystem health.

Current Stand Conditions

Stand: **5**
Stand Size: **31 acres**
Descriptor: **South-eastern edge, intersected by Sherman Hollow Rd.** (pine-hemlock-maple)
Natural Community Type: Hemlock-White Pine-Northern Hardwood
Forest Cover Type: Mixedwood
Silv Guide: NRS-132

Stand Summary: 11 plots, 10 BAF	
Total Basal Area/Acre	109 sq.ft.
Total Trees/Acre	116
Trees/Acre >24 in	3
Quadratic Mean Diameter	13.12 in.
Snags/Acre	36
Snags/Acre >12 in	14
Snags/Acre >18 in	5
Avg Dia. Snags	16 in.
Cavity Trees/Acre	2
Cavity Trees/Acre >12 in	1
Avg Dia. Cavity	15 in.



BA by tree species

Species	BA	% of Total BA
WP	41	38%
EH	20	18%
RM	11	10%
QA	8	8%
SM	6	6%
YB	5	5%
BC	5	5%
RO	4	3%
WA	4	3%
HH	2	2%
PB	2	2%
BL	1	1%

Average BA/Acre by Diameter Class (Diameter Distribution)

Size Class (DBH)	Total BA
Sap (<5")	0
Pol (5"-11")	28
Saw (11"-24")	67
Lg.saw (>24")	14
TOTAL	109

Carbon Estimates Based on Stand BA	
Co Metric Tons/Acre	31.52
Co2 Metric Tons/Acre	115.68

Songbird Habitat Assessment	
Overstory	
Cover	64%
Distribution	Patchy
Midstory	
Cover	51-75%
Distribution	Patchy
Dominant species	EH, AB, SM, RM, HH, Striped M., YB, Dogwood, WA
Understory	
Cover	26-50%
Distribution	Patchy
Dominant species	AB, Striped M., RM, EH, SM, Dogwood, WA
Soft mast	Present
Invasives	Light
Invasive species	Honeysuckle, Buckthorn, Barberry
Downed Dead Wood	
FWM/Acre	7 piles/acre
CWM/Acre	29 pieces/acre

Notes: Some areas of stand have quite steep terrain; portion of plot bordered by field; signs of deer herbivory observed. Honeysuckle and buckthorn noted in plot 46.

Stand History: This is a newly described stand, comprised of previously described Units 11 (a pine plantation) and the westernmost section of Unit 3, according to *2007 GMAC/BOVM Important Bird Area Land Mgt. Plan.* No management activities have occurred in the area of this stand to date.

Access/Operability: Good access to parts of stand via Sherman Hollow Road. Areas of inoperable steep slopes.

Silvicultural Attributes:
Stand stocking is moderate and is comprised of fewer but larger trees overall; much of the stock is in the saw size class with a notable amount extending to the large size class. The stand is dominated by Eastern white pine, of which there is a plantation just north of Sherman Hollow Road; these pine are at peak growth and many are beginning to decline. Other dominant species across the stand include Eastern hemlock and red maple. A variety of other northern hardwood species also grow in this stand in smaller proportions; together, species diversity is high relative to that of other areas on the GMAC property.

Notably, a unique patch of black locust grows near the Audubon Center office- the only such occurrence of the species in large numbers on the property.

Wildlife Structural Attributes:
The overstory is patchy and intermediately open/closed. The midstory is of similar form as the overstory and is comprised of Eastern hemlock, American Beech, sugar maple, red maple, hophornbeam, striped maple, yellow birch, white ash and alternate-leaf dogwood. The understory is comprised of the same species as the midstory yet is the most open of the three forest layers. While soft mast is present in the understory, so are a handful of invasive plants. Other habitat features such as large-diameter trees, snags, cavity trees, coarse and fine woody material are in robust numbers and form.

The characteristics of this stand are suitable for a range of bird species that depend upon mature mixedwood forest cover with diversity of structure across the strata, including many of the Birders Dozen. Areas of the forest lacking understory structure are likely to maintain less diversity than those with more structure; these areas likely underserve such species as WOTH, VEER, and BTBW.

Climate Change Vulnerability:

Silviculture
Northern hardwood forests, of which this stand is a variant, are considered to have low to moderate vulnerability to climate change based on medium evidence and model agreement. Key drivers underpinning this vulnerability of this forest type are drier summers, changes in soil temp and moisture, and altered nutrient availability. Common species to this forest type associate with a broad range of predicted habitat suitability changes under different climate scenarios, suggesting a high degree of variability in changes to this forest going forwards.

Specific to the major species comprising this stand identified during inventory, the following predictions are available from the Climate Change Tree Atlas for the region of the GMAC regarding how tree species may fare under both low and high climate change scenarios by the year 2100.

Stand Species-Specific Climate Change Projections for GMAC Region of Vermont			Low Climate Change (RCP 4.5)		High Climate Change (RCP 8.5)	
Species	**Stocking %**	**Adaptability***	**Habitat Change+**	**Persistence Capability^**	**Habitat Change+**	**Persistence Capability^**
WP	38%	Low	Sm. inc.	Good	No change	Fair
EH	18%	Low	No change	Fair	Sm. dec.	Fair
RM	10%	High	Sm. inc.	Very Good	Sm. inc.	Very Good
QA	8%	Medium	Sm. inc.	Good	Sm. inc.	Good
SM	6%	High	Sm. dec.	Good	Sm. dec.	Good
YB	5%	Medium	Sm. dec.	Fair	Sm. dec.	Fair
BC	5%	Low	Sm. inc.	Fair	Lg. inc.	Good
RO	3%	High	Lg. inc.	Very Good	Lg. inc.	Very Good
WA	3%	Low	Sm. inc.	Fair	Sm. inc.	Fair
HH	2%	High	Sm. inc.	Very Good	Sm. inc.	Very Good
PB	2%	Medium	No change	Fair	No change	Fair
BL	1%	Medium	New Habitat	New Habitat	New Habitat	New Habitat

* Species ability to respond favorably to disturbance based on life history factors.
+ Projected change in species suitable habitat in GMAC region by 2100 under associated climate change scenarios based on modeling results.
^ Overall rating describing species expected ability of cope or persist amidst projected change in suitable habitat in GMAC region by 2100 based on model results and expert opinion.

The diversity of species occupying this stand bodes well in terms of long-term climate change resiliency. The second most dominant species, Eastern hemlock, may be more susceptible to decline with changing climate, however any impacts upon this species is likely to be offset by the varied response of the diversity of other species that, considered together, are likely to persist and fare reasonably well under various climate scenarios.

Hydrology

The Northeastern portion of the stand borders the Huntington River- thus areas are susceptible to extreme weather events and disturbances from high flows within the river. Erosion of banks, spillover of banks, ice damage in winter, are a concern- as are the introduction of non-native invasive plants via the waterway. The northern portion of the stand also abuts two class-2 wetlands with hydric soils around- making these areas vulnerable to extreme weather events.

Soils

Erodibility of the soils underlying the stand is important to consider when evaluating how vulnerable the area is to extreme rain events; the more erodible the soil, the more vulnerable the stand is to extreme weather posed by climate change; any events, including management activities, that expose soil and/or disturb the soil poses risk of exacerbating this vulnerability.

This stand is comprised of a relatively large variety of soil types- the majority of which have moderate to high erodibility potential. Areas of steep slopes exist throughout the stand- particularly the southwestern portion overlooking Huntington Road- such steep slopes, where they do exist, exacerbates the vulnerability of this stand to extreme events.

Soil Type (slopes)	Est. Prop	Erodibility Potential	Drought Potential	Windthrow Potential
Colton And Stetson Soils, (30-60%)	55%	High	Vulnerable	Low
Hadley Very Fine Sandy Loam, Frequently Flooded	6%	Not Highly Erodible	Somewhat Vulnerable	Low
Colton And Stetson Soils (20-30%)	3%	High	Vulnerable	Low
Agwam Fine Sandy Loam (12-30%)	3%	High	Moderately Vulnerable	Low
Hinesburg Fine Sandy Loam, (25-60%)	6%	High	Somewhat Vulnerable	Low
Stetson Gravelly Fine Sandy Loam (0-5%)	6%	Not Highly Erodible	Moderately Vulnerable	Low
Munson and Raynham Silt Loams (6-12%)	7%	Potentially Highly Erodible	Somewhat Vulnerable	High
Duane and Deerfield Soils (5-12%)	3%	Potentially Highly Erodible	Vulnerable	Low
Adams and Windsor Loamy Sands (0-5%)	4%	Not Highly Erodible	Moderately Vulnerable	Low
Groton Gravelly Fine Sandy Loam (30-60%)	7%	High	Vulnerable	Low

Carbon Stocking: Much of the stock, and thus the carbon stores, exist in fewer, but larger diameter trees. Current stocking levels suggest that there is room for increased stocking (sequestration and storage); however, to increase carbon sequestration potential- this will need to come in the form of increased growth rate of smaller diameter stock amidst the existing large-diameter trees. Forest management efforts that promote the growth of these smaller diameter stock will stand to increase the carbon sequestered in this stand.

Desired Future Stand Conditions and Management Recommendations

Management Goals: Promote long-term production of softwood and hardwood sawtimber, maintain and/or increase climate change resiliency, increase carbon sequestration and storage, and promote breeding habitat for neo-tropical migratory songbirds.

Management Objectives: Increase understory development, stimulate increased growth rate of woody vegetation. Treat and monitor invasive species.

Management Prescription: The pine plantation area of this stand could benefit from removal of groups of the declining overstory of Eastern white pine from the plantation just north of Sherman Hollow Road, giving way for diversification of species and structure, below the current overstory (modification of Silviculture with Birds in Mind

Option 3B). Below are inventory summaries of the volume of live white pine within the plantation itself.

An additional inventory consisting of 4 points, focused just within the Eastern white pine plantation indicate the following stocking levels of live Eastern white pine:

Average BA/Acre by Diameter Class (Diameter Distribution) of living White Pine ONLY

Size Class (DBH)	Total	AGS	UGS
Sap (<5")	*0*	*0*	*0*
Pol (5"-11")	*10*	*5*	*5*
Saw (11"-24")	*93*	*75*	*18*
Lg.saw (>24")	*5*	*5*	*0*
TOTAL	*108*	*85*	*23*

Applying a shortcut formula to calculate board feet (BF) and cordwood volume, per acre, from this inventory of the pine plantation indicate the following potential volumes of sawtimber and pulpwood, per acre, of live white pine:

Volume Calculations of living White Pine Only

Quality	Cords/Acre	BF/Acre
AGS (Sawtimber)	19.65	9825
UGS (Pulpwood)	4.35	2175

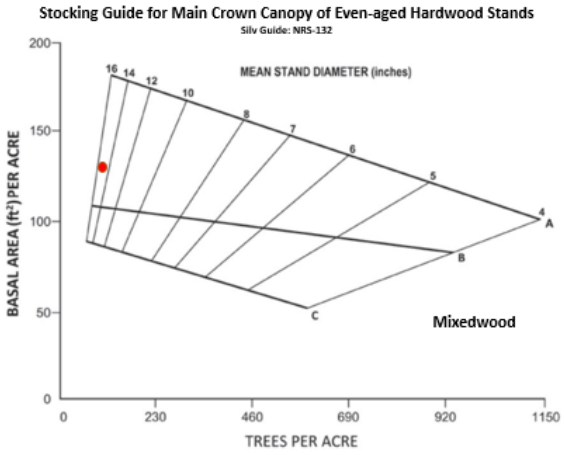
The flush of growth following pine removal will result in increased carbon sequestration, while much of the carbon will continue to be stored in the remaining stocking across greater areas of the stand. Prior to any harvest, all invasive species in the project area must be removed. Access to pine plantation is possible from Sherman Hollow Road. All efforts must be made to minimize the potential for soil disturbance- which include winter harvest and minimal use of mechanized equipment, if possible.

Current Stand Conditions

Stand: **A**
Stand Size: **28 acres**
Descriptor: **2012 No-Treatment Demo Site** (hemlock-red oak- red maple)
Natural Community Type: Hemlock-Northern Hardwood
Forest Cover Type: Mixedwood
Silv Guide: NRS-132

Stand Summary: 8 plots, 10 BAF	
Total Basal Area/Acre	134 sq.ft.
Total Trees/Acre	103
Trees/Acre >24 in	2
Quadratic Mean Diameter	15.46 in.
Snags/Acre	11
Snags/Acre >12 in	1
Snags/Acre >18 in	1
Avg Dia. Snags	14 in.
Cavity Trees/Acre	na
Cavity Trees/Acre >12 in	na
Avg Dia. Cavity	na

Note that cavity trees were not distinguished during the inventory of stands south of Sherman Hollow Road.



BA by tree species

Species	BA	% of Total BA
EH	43	32%
RM	26	20%
SM	18	13%
RO	16	12%
YB	11	8%
WA	9	7%
WP	5	4%
QA	4	3%
BC	1	1%
PB	1	1%

Average BA/Acre by Diameter Class (Diameter Distribution)

Size Class (DBH)	Total	AGS	UGS
Sap (<5")	0	0	0
Pol (5"-11")	49	28	21
Saw (11"-24")	71	35	36
Lg.saw (>24")	14	3	11
TOTAL	134	65	69

Carbon Estimates Based on Stand BA	
Co Metric Tons/Acre	38.68
Co2 Metric Tons/Acre	141.96

Songbird Habitat Assessment	
Overstory	
Cover	70%
Distribution	NA
Midstory	
Cover	25-50%
Distribution	na
Dominant species	SM, EH, HH, AB, STMA, YB
Understory	
Cover	1-25%
Distribution	na
Dominant species	SM, WA, AB, STMA, RO, HH, Rubus, Fern, BC
Soft mast	na
Invasives	na
Invasive species	na
Downed Dead Wood	
FWM/Acre	11.25 piles/acre
CWM/Acre	40 pieces/acre

Notes: Some areas of the stand are recovering from natural disturbance resulting in gaps of ESH. Other areas inoperable due to steep slopes, WA and RO seedlings, with areas of advanced YB regen in gaps. Two cedar stems noted in midstory at one plot. EAWP, REVI, BTNW, BCCH, SCTA* noted at one plot.

Stand History: This stand was designated as Stand A, and a reserve area for the last management cycle, according to the 2011 FMP Amendment (see *Harvest Plan Excerpt 2011*). Previous to that, this stand was comprised of parts of then described Units 9 and 3, and received no treatment according to the *2007 GMAC/BOVM Important Bird Area Land Mgt. Plan* (see Appendix Item H). Otherwise, this stand has naturally regenerated post agricultural abandonment 110 or so years ago.

Access/Operability: Access is limited due to the steep, wet terrain; however, the northeastern area adjacent to the road has excellent access.

Silvicultural Attributes:
This Eastern hemlock-dominated mixedwood stand has a modest amount of timber volume contained in fewer but larger trees; stocking is between the A and B line. Much of the stocking is in the saw size class, among which is an equal mix of AGS to UGS stock. The species diversity is fairly high.

Wildlife Structural Attributes:

The overstory canopy, comprised of softwoods and hardwoods is largely closed, beneath which is an intermediately open midstory mixedwood canopy containing non-merchantable hardwood species such as hophornbeam and striped maple. The understory is open and contains the same species as in the midstory and overstory, with the addition of soft mast species like Rubus sp. and black cherry. The density of CWM and FWM are robust. There is an ideal number of snags per acre, however the overall size of these snags tends to be smaller than is ideal for wildlife habitat- missing the target size and number recommended for quality bird habitat.

Red oak grows in this stand- offering hard mast for wildlife. Black cherry growing in the stand also offers some soft mast as well.

Climate Change Vulnerability:

Silviculture

Northern hardwood forests, of which this stand is a variant, are considered to have low to moderate vulnerability to climate change based on medium evidence and model agreement. Key drivers underpinning this vulnerability of this forest type are drier summers, changes in soil temp and moisture, and altered nutrient availability. Common species to this forest type associate with a broad range of predicted habitat suitability changes under different climate scenarios, suggesting a high degree of variability in changes to this forest going forwards.

Specific to the major species comprising this stand identified during inventory, the following predictions are available from the Climate Change Tree Atlas (Iverson et al. 2019) for the region of the GMAC regarding how tree species may fare under both low and high climate change scenarios by the year 2100.

Stand Species-Specific Climate Change Projections for GMAC Region of Vermont			**Low Climate Change (RCP 4.5)**		**High Climate Change (RCP 8.5)**	
Species	**Stocking %**	**Adaptability***	**Habitat Change+**	**Persistence Capability^**	**Habitat Change+**	**Persistence Capability^**
EH	32%	Low	No change	Fair	Sm. dec.	Fair
RM	20%	High	Sm. inc.	Very Good	Sm. inc.	Very Good
SM	13%	High	Sm. dec.	Good	Sm. dec.	Good
RO	12%	High	Lg. inc.	Very Good	Lg. inc.	Very Good
YB	8%	Medium	Sm. dec.	Fair	Sm. dec.	Fair
WA	7%	Low	Sm. inc.	Fair	Sm. inc.	Fair
WP	4%	Low	Sm. inc.	Good	No change	Fair
QA	3%	Medium	Sm. inc.	Good	Sm. inc.	Good
BC	1%	Low	Sm. inc.	Fair	Lg. inc.	Good
PB	1%	Medium	No change	Fair	No change	Fair

* Species ability to respond favorably to disturbance based on life history factors.
+ Projected change in species suitable habitat in GMAC region by 2100 under associated climate change scenarios based on modeling results.

^ Overall rating describing species expected ability of cope or persist amidst projected change in suitable habitat in GMAC region by 2100 based on model results and expert opinion.

The diversity of species occupying this stand bodes well in terms of long-term climate change resiliency. The most dominant species, Eastern hemlock, may be more susceptible to decline with changing climate, however any impacts upon this species is likely to be offset by potential increased growth rate of the second most dominant species, red maple, alongside the varied response of the diversity of other species that, considered together, are likely to persist and fare reasonably well under various climate scenarios.

Hydrology

There are seepy areas of this stand.

Soils

Erodibility of the soils underlying the stand is important to consider when evaluating how vulnerable the area is to extreme rain events; the more erodible the soil, the more vulnerable the stand is to extreme weather posed by climate change; any events, including management activities, that expose soil and/or disturb the soil poses risk of exacerbating this vulnerability.

The soil characteristics of this stand contribute substantial vulnerability to extreme weather events expected with climate change. Relative to other stands on the GMAC property, this stand has multifaceted vulnerability; extreme rain events have increased potential to impact the soils through erosion, conversely, lack of rain resulting in drought poses a threat, as does extreme winds resulting in windthrow. Steep areas of this stand exacerbate this vulnerability. Together, this suggests that any activity that increases exposure of soils to rain and sun, and trees to wind, are likely to result in undue disturbance and impact to the stand health.

Soil Type (slopes)	Est. Prop	Erodibility Potential	Drought Potential	Windthrow Potential
Lyman-Marlow Very Rocky Loams, (30- 60%)	65%	High	Somewhat Vulnerable	High
Peru Extremely Stony Loam, (20-60%)	10%	High	Slightly Vulnerable	Moderate
Cabot Extremely Stony Silt Loam, (3-25%)	10%	Potentially Highly Erodible	Slightly Vulnerable	High
Colton And Stetson Soils, (20-30%)	15%	High	Vulnerable	Low

Carbon Stocking: This stand has the largest carbon stores per acre of any on the GMAC property. Much of the stock, and thus the carbon stores, exist in fewer, yet larger trees of saw and pole-sized stock, with the greatest volume being contained in saw-sized trees. Current stocking levels suggest that there is room for increased stocking (sequestration leading to storage); however, to increase carbon sequestration potential- this will need to

come in the form of increased growth rate of smaller diameter stock amidst the existing larger-diameter trees. Forest management efforts that promote the growth of these smaller diameter stock will increase the carbon sequestered in this stand.

Desired Future Stand Conditions and Management Recommendations

Management Goals: Promote long-term production of softwood and hardwood sawtimber, maintain and/or increase climate change resiliency, increase carbon sequestration and storage, and promote breeding habitat for neo-tropical migratory songbirds.

Management Objectives: Increase understory development, stimulate increased growth rate of woody vegetation. Treat and monitor invasive species.

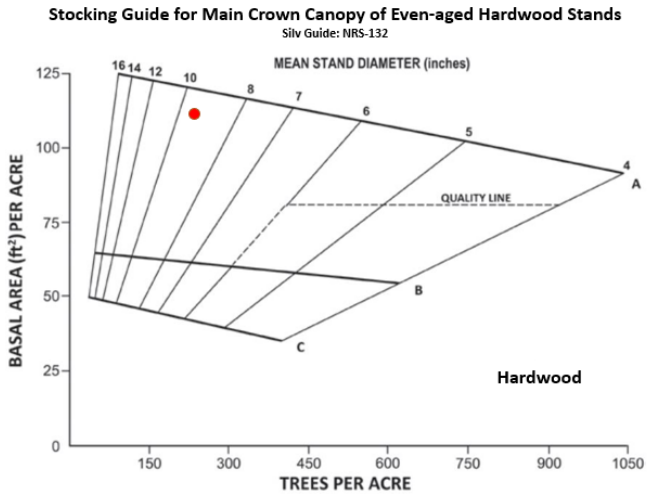
Management Strategy: Manage as reserve area this cycle.

Note: given the heightened vulnerability of this stand to extreme weather events posed by climate change, any activities, including harvests, occurring in this stand, now and into the future, must, to the greatest degree possible, avoid exposing large areas of soil to sun and rain, and individual trees to wind loading. It can be expected that natural disturbances are likely to naturally create canopy gaps that will stimulate increased growth rate in the understory and smaller diameter stock, as the largest trees are likely succumb to windthrow over time.

Current Stand Conditions

Stand: **B**
Stand Size: **6.5 acres**
Descriptor: **2012 Demo CTR W/CGF** (sugar maple-white ash- red maple)
Natural Community Type: Northern Hardwood
Forest Cover Type: Northern Hardwood
Silv Guide: NRS-132

Stand Summary: 2 plots, 10 BAF	
Total Basal Area/Acre	110 sq.ft.
Total Trees/Acre	234
Trees/Acre >24 in	0
Quadratic Mean Diameter	9.29 in.
Snags/Acre	6
Snags/Acre >12 in	6
Snags/Acre >18 in	3
Avg Dia. Snags	18 in.
Cavity Trees/Acre	na
Cavity Trees/Acre >12 in	na
Avg Dia. Cavity	na



BA by tree species

Species	BA	% of Total BA
SM	45	41%
WA	30	27%
RM	25	23%
YB	5	5%
BH	5	5%

Average BA/Acre by Diameter Class (Diameter Distribution)

Size Class (DBH)	Total	AGS	UGS
Sap (<5")	0	0	0
Pol (5"-11")	50	20	30
Saw (11"-24")	60	35	25
Lg.saw (>24")	0	0	0
TOTAL	110	55	55

Carbon Estimates Based on Stand BA	
Co Metric Tons/Acre	31.52
Co2 Metric Tons/Acre	115.68

Songbird Habitat Assessment

Overstory	
Cover	70%
Distribution	na
Midstory	
Cover	50-75%
Distribution	na
Dominant species	SM, AB, WA

Understory	
Cover	1-25%
Distribution	na
Dominant species	HH, STMA, AB, WA
Soft mast	Present
Invasives	na
Invasive species	na
Downed Dead Wood	
FWM/Acre	0 piles/acre
CWM/Acre	40 pieces/acre

Notes: BH, RO and BC seedlings noted for some plots. Elderberry on tip-up mount with some Rubus noted for one plot.

Stand History: This stand was newly designated as Stand B and received a crop tree release and canopy gap formation treatment in winter of 2012/2013 according to the 2011 FMP Amendment (see *Harvest Plan Excerpt 2011*). Previously, this stand was comprised of parts of then described Units 3 and received no treatment according to the *2007 GMAC/BOVM Important Bird Area Land Mgt. Plan*. Previously, this stand had naturally regenerated post agricultural abandonment 110 or so years ago**.**

Access/Operability: Access is possible via an established forwarder/skid trail that enters the northwest corner of this stand from C-1, ultimately leading to a road-side landing on Sherman Hollow Road in the northwest corner of stand C-1.

Silvicultural Attributes:
This small northern hardwood sugar maple dominated stand is fully stocked- approaching the A line, comprised of a nearly equal mix of pole and saw sized trees, of which nearly equal are AGS/UGS. The species diversity is relatively low with five species comprising the stocking. Areas of canopy gap formation have resulted in desirable regeneration response.

Wildlife Structural Attributes:
The overstory tends to be fairly closed, under which the midstory is moderately closed and the understory is fairly open. In areas where canopy gaps were created through management this last cycle, regeneration/structural response is desirable- adding diversity to the understory conditions in these areas. Species diversity in midstory and understory are low, comprised of northern hardwood species, including non-merchantable timber like hophornbeam and striped maple. Bitternut hickory offers hard mast forage for species. Notably, while there are many trees approaching the large-diameter size class, overall trees exceeding this size threshold are lacking. While the CWM density is robust, FWM is absent based on inventory measures. Snag presence in terms of both density and size are robust; past girdling efforts were moderately successful, resulting in desirable snag recruitment, despite a proportion of girdled trees having survived the treatment.

Climate Change Vulnerability:

Silviculture

Northern hardwood forests, like that which comprise this stand, are considered to have low-moderate vulnerability to climate change based on medium evidence and model agreement. Key drivers underpinning this vulnerability of this forest type are drier summers, changes in soil temp and moisture, and altered nutrient availability. Common species to this forest type associate with a broad range of predicted habitat suitability changes under different climate scenarios, suggesting a high degree of variability in changes to this forest going forwards. Regarding the major species comprising this stand identified during inventory,

Specific to the major species comprising this stand identified during inventory, the following predictions are available from the Climate Change Tree Atlas (Iverson et al. 2019) for the region of the GMAC regarding how tree species may fare under both low and high climate change scenarios by the year 2100.

Stand Species-Specific Climate Change Projections for GMAC Region of Vermont			**Low Climate Change (RCP 4.5)**		**High Climate Change (RCP 8.5)**	
Species	**Stocking %**	**Adaptability***	**Habitat Change+**	**Persistence Capability^**	**Habitat Change+**	**Persistence Capability^**
SM	41%	High	Sm. dec.	Good	Sm. dec.	Good
WA	27%	Low	Sm. inc.	Fair	Sm. inc.	Fair
RM	23%	High	Sm. inc.	Very Good	Sm. inc.	Very Good
YB	5%	Medium	Sm. dec.	Fair	Sm. dec.	Fair
BH	5%	High	New Habitat	New Habitat	New Habitat	New Habitat

* Species ability to respond favorably to disturbance based on life history factors.
+ Projected change in species suitable habitat in GMAC region by 2100 under associated climate change scenarios based on modeling results.
^ Overall rating describing species expected ability of cope or persist amidst projected change in suitable habitat in GMAC region by 2100 based on model results and expert opinion.

The relatively low species diversity of this stand, in theory, reduces its resiliency to climate change relative to other stands on the GMAC property. Thankfully, however, the prospect for resilience among the species comprising the stocking based on species-specific climate change predictions, and the fact that three of the most well-stocked species are all in relatively high proportion, is favorable. Unfortunately, expected establishment of emerald ash borer is expected to severely impact ash, the second most stocked species in this stand. If ash were to decline, other species currently growing in the stand would be expected to backfill this loss.

Hydrology

There are seepy areas of this stand.

Soils

Erodibility of the soils underlying the stand is important to consider when evaluating how vulnerable the area is to extreme rain events; the more erodible the soil, the more vulnerable the stand is to extreme weather posed by climate change; any events, including management activities, that expose soil and/or disturb the soil poses risk of exacerbating this vulnerability.

The soil characteristics of this stand contribute substantial vulnerability to extreme weather events expected with climate change. Relative to other stands on the GMAC property, this stand has multifaceted vulnerability; extreme rain events have increased potential to impact the soils through erosion, conversely, lack of rain resulting in drought poses a threat, as does extreme winds resulting in windthrow. Steep areas of this stand exacerbate this vulnerability. Together, this suggests that any activity that increases exposure of soil to rain and sun, and trees to wind, are likely to result in undue disturbance and impact to the stand health.

Soil Type (slopes)	Est. Prop	Erodibility Potential	Drought Potential	Windthrow Potential
Peru Extremely Stony Loam, (20-60%)	55%	High	Slightly Vulnerable	Moderate
Lyman-Marlow Very Rocky Loams, (30- 60%)	45%	High	Somewhat Vulnerable	High

Carbon Stocking: Carbon stores per acre in this stand are high relative to others on the GMAC property; this carbon is stored in a robust composition of pole and saw sized trees within the stand, that, based on stocking charts suggest are nearing capacity (A line) to maintain growth of trees- indicating that sequestration rates are declining in its current condition.

Desired Future Stand Conditions and Management Recommendations

Management Goals: Promote long-term production of softwood and hardwood sawtimber, maintain and/or increase climate change resiliency, increase carbon sequestration and storage, and promote breeding habitat for neo-tropical migratory songbirds.

Management Objectives: Increase understory development, stimulate increased growth rate of woody vegetation. Treat and monitor invasive species. Increase species diversity, increase abundance of large-diameter snags/cavity trees/downed woody material.

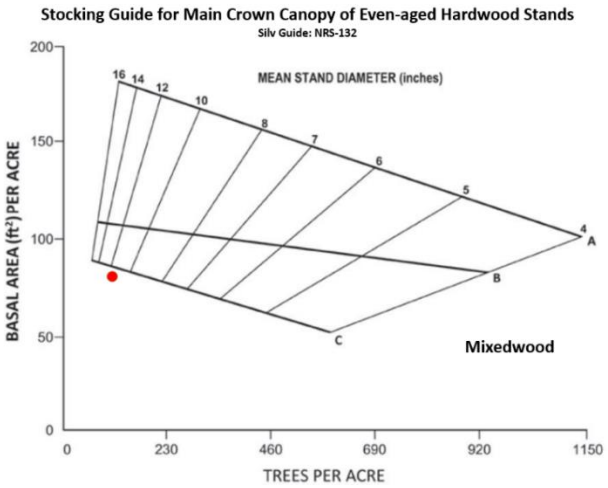
Management Strategy: Possible crop tree release with canopy gap formation (Silviculture with Birds in Mind Option 1A). Management objectives could be met through a reduction in stocking that results in increased understory development and favoring the release (and thus increased growth rate) of desirable species such as sugar maple, red maple, yellow birch, and bitternut hickory. Specifically, efforts to promote bitternut hickory, from a climate adaptive perspective, would add greater value.

However, the expected introduction of EAB, and consequently, the loss of ash, the second most stocked species in this stand, could very well result in such thinning, naturally, while concurrently adding standing snags, as well as fine and coarse woody material; this material would retain carbon stored, adding to carbon stores in non-living pools in the forest.

Current Stand Conditions

Stand: **C-1**
Stand Size: **19 acres**
Descriptor: **2012 Demo Expanding Gap Group Shelterwood** (white pine-sugar maple-Eastern Hemlock)
Natural Community Type: Hemlock-Northern Hardwood
Forest Cover Type: Mixedwood
Silv Guide: NRS-132

Stand Summary: 7 plots, 10 BAF	
Total Basal Area/Acre	81 sq.ft.
Total Trees/Acre	110
Trees/Acre >24 in	2
Quadratic Mean Diameter	11.65 in.
Snags/Acre	20
Snags/Acre >12 in	13
Snags/Acre >18 in	4
Avg Dia. Snags	18 in.
Cavity Trees/Acre	na
Cavity Trees/Acre >12 in	na
Avg Dia. Cavity	na



BA by tree species

Species	BA	% of Total BA
WP	23	28%
EH	19	23%
SM	17	21%
RM	10	12%
PB	6	7%
BC	3	4%
YB	3	4%
RO	1	2%

Average BA/Acre by Diameter Class (Diameter Distribution)

Size Class (DBH)	Total	AGS	UGS
Sap (<5")	0	0	0
Pol (5"-11")	24	14	10
Saw (11"-24")	49	26	23
Lg.saw (>24")	9	3	6
TOTAL	81	43	39

Carbon Estimates Based on Stand BA	
Co Metric Tons/Acre	22.92
Co2 Metric Tons/Acre	84.12

Songbird Habitat Assessment

Overstory	
Cover	51.43%
Distribution	na
Midstory	
Cover	25-50%
Distribution	na
Dominant species	SM, EH, AB, STMA, WA, HH
Understory	

Cover	25-50%
Distribution	na
Dominant species	STMA, WA, Rubus, fern, AB, HH, YB, SM, EH, WP
Soft mast	Present
Invasives	Present
Invasive species	Honeysuckle
Downed Dead Wood	
FWM/Acre	14.29 piles/acre
CWM/Acre	50 pieces/acre

Notes: Areas of harvested canopy gap, elderberry, WA, BC seedlings present. RBNU, WIWR, HETH, REVI noted. Rubus sp. and honeysuckle present in other gaps resulting from 2012 harvest. Notable that for most gaps resulting from 2012 harvest- greatest regen is along edge of the gaps- possibly due to aspect and sun exposure. Deer browse is heavy in areas- and has impacted regen in many of the gaps.

Stand History: This stand was designated stand C-1 and received an expanding-gap group shelterwood treatment conducted winter of 2012/2013 according to the 2011 FMP Amendment (see *Harvest Plan Excerpt 2011*). Previous to that, this stand was comprised of parts of then described Units 9 and 3 and went without intervention according to the *2007 GMAC/BOVM Important Bird Area Land Mgt. Plan*. Previously, a minor salvage of windblown pine sawn on site occurred in the late '90s. Otherwise, there is no evidence of management since conversion from agriculture +/- 110 years ago.

Access/Operability: Access is easy via an established forwarder/skid trail entering the northwestern portion of the stand along Sherman Hollow Road. Wet conditions in this stand make a winter harvest necessary to avoid significant rutting and reduce erosion risks.

Silvicultural Attributes:
This mixedwood stand has relatively low stocking in terms of volume, falling below the c-line. The stocking is largely in the saw-sized class with nearly equal proportions of AGS and UGS stock. There is a component of large-diameter legacy trees. The stand is dominated by Eastern white pine and Eastern hemlock with lower proportions of sugar maple, red maple and associated northern hardwood species. Overall, species diversity is moderate relative to other stands. The larger gaps created during the 2012 harvest have resulted in desirable regeneration- while the smaller gaps have not responded as well, exhibiting dense fern growth coupled with impacts of heavy deer browse. Notably, many large-diameter Eastern white pine and Eastern hemlock have blown down during wind events this past cycle; some in association with gaps established through management, effectively expanding those gaps further.

Wildlife Structural Attributes:

The overstory is intermediately open overall (51%) with a midstory and understory that are also largely open. Large-diameter legacy trees are present in the overstory. Both midstory and understory contain a mix of hardwood and softwood species representative of the overall stocking. Notably, the understory contains areas of striped maple, hophornbeam, and yellow birch, alongside soft mast producing species including elderberry, Rubus sp. and the non-native invasive species of honeysuckle; these species grow in and near gaps resulting from previous management and natural disturbance. Understory development/regeneration of small-diameter stems within larger gaps have added a desirable diversity of wildlife habitat conditions to the stand. However, smaller gap treatments evidence less of such success, suggesting that larger gaps are necessary in any future management efforts to achieve the desired response. Otherwise, snag size and density, alongside FWM and CWM, are all robust, with large-diameter legacy trees having blown down in recent storms adding more to these components.

Climate Change Vulnerability:

Silviculture

Northern hardwood forests, of which this stand is a variant, are considered to have low to moderate vulnerability to climate change based on medium evidence and model agreement. Key drivers underpinning this vulnerability of this forest type are drier summers, changes in soil temp and moisture, and altered nutrient availability. Common species to this forest type associate with a broad range of predicted habitat suitability changes under different climate scenarios, suggesting a high degree of variability in changes to this forest going forwards.

Specific to the major species comprising this stand identified during inventory, the following predictions are available from the Climate Change Tree Atlas (Iverson et al. 2019) for the region of the GMAC regarding how tree species may fare under both low and high climate change scenarios by the year 2100.

Stand Species-Specific Climate Change Projections for GMAC Region of Vermont			**Low Climate Change (RCP 4.5)**		**High Climate Change (RCP 8.5)**	
Species	**Stocking %**	**Adaptability***	**Habitat Change+**	**Persistence Capability^**	**Habitat Change+**	**Persistence Capability^**
WP	28%	Low	Sm. inc.	Good	No change	Fair
EH	23%	Low	No change	Fair	Sm. dec.	Fair
SM	21%	High	Sm. dec.	Good	Sm. dec.	Good
RM	12%	High	Sm. inc.	Very Good	Sm. inc.	Very Good
PB	7%	Medium	No change	Fair	No change	Fair
BC	4%	Low	Sm. inc.	Fair	Lg. inc.	Good
YB	4%	Medium	Sm. dec.	Fair	Sm. dec.	Fair
RO	2%	High	Lg. inc.	Very Good	Lg. inc.	Very Good

* Species ability to respond favorably to disturbance based on life history factors.
+ Projected change in species suitable habitat in GMAC region by 2100 under associated climate change scenarios based on modeling results.
^ Overall rating describing species expected ability of cope or persist amidst projected change in suitable habitat in GMAC region by 2100 based on model results and expert opinion.

The diversity of species within this stand increases its prospects of resiliency to climate change. The mature white pine in this stand are likely to naturally senesce and decline before the worst of expected climate change effects; Eastern hemlock, vulnerable to disturbance, exacerbated by the potential for (and observed) windthrow, given soil characteristics, may also decline relative to other species. It may be expected that any such loss of these dominant species results in an increased growth rate of the remaining species with relatively higher prospects for resilience to changes in climate to come.

Hydrology
Areas of this stand are seepy in nature.

Soils
Erodibility of the soils underlying the stand is important to consider when evaluating how vulnerable the area is to extreme rain events; the more erodible the soil, the more vulnerable the stand is to extreme weather posed by climate change; any events, including management activities, that expose soil and/or disturb the soil poses risk of exacerbating this vulnerability.

The soil characteristics of this stand contribute substantial vulnerability to extreme weather events expected with climate change. Overall, soils have a high erodibility potential, increased drought potential, and high windthrow potential. Together, this suggests that any activity that increases exposure of soil to rain and sun, and trees to wind, are likely to result in undue disturbance and impact to the stand health.

Soil Type (slopes)	Est. Prop	Erodibility Potential	Drought Potential	Windthrow Potential
Peru Extremely Stony Loam, (20-60%)	20%	High	Slightly Vulnerable	Moderate
Lyman-Marlow Very Rocky Loams, (30- 60%)	20%	High	Somewhat Vulnerable	High
Cabot Extremely Stony Silt Loam, (3-25%)	50%	Potentially Highly Erodible	Slightly Vulnerable	High
Colton And Stetson Soils, (20-30%)	10%	High	Drought Vulnerable	Low

Carbon Stocking: Stores are moderate per acre in this stand, being predominantly contained in fewer, larger trees, most notably, the large Eastern white pine and Eastern hemlock. Given the understocked condition of this stand, in theory, there is great potential for increased growth (sequestration) of stock, if conditions allow. The current canopy gaps, and recent expansion and addition of gaps from windthrow of large pine and hemlock, are likely to result in increased sequestration rates as the understory and midstory responds to these disturbances. Concurrently, the stock blown down in these past (and potential future) disturbance events adds carbon to other pools within the forest.

Desired Future Stand Conditions and Management Recommendations

Management Goals: Promote long-term production of softwood and hardwood sawtimber, maintain and/or increase climate change resiliency, increase carbon sequestration and storage, and promote breeding habitat for neo-tropical migratory songbirds.

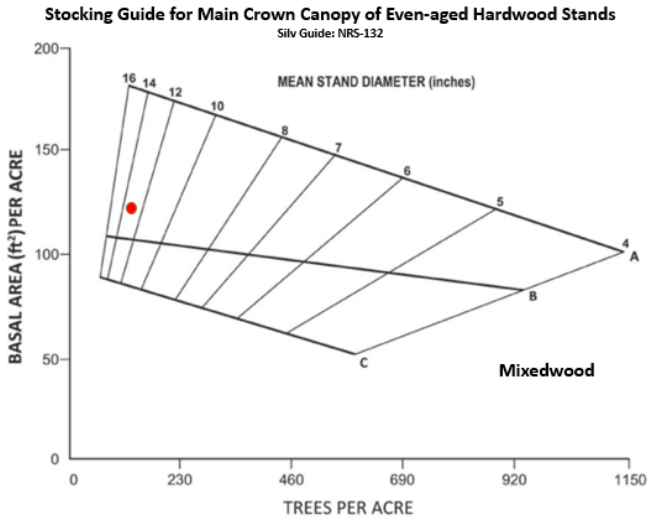
Management Objectives: Increase understory development, stimulate increased growth rate of woody vegetation. Treat and monitor invasive species.

Management Strategy: Recent windthrow of large diameter stock have resulted in natural expansion of gaps created through harvest in the last cycle. This stand should be allowed to naturally develop and experience natural mortality of large diameter stock (pine and hemlock) from post-maturation senescence and from natural disturbances resulting from windthrow given soil characteristics. Efforts to monitor and control non-native and invasive species in these gaps is increasingly important.

Current Stand Conditions

Stand: **C-2**
Stand Size: **12 acres**
Descriptor: **2012 Demo-Single Tree and Group** (hemlock-sugar maple- red maple)
Natural Community Type: Hemlock-Northern Hardwood
Forest Cover Type: Mixedwood
Silv Guide: NRS-132

Stand Summary: 4 plots, 10 BAF	
Total Basal Area/Acre	115 sq.ft.
Total Trees/Acre	136
Trees/Acre >24 in	1
Quadratic Mean Diameter	11.03 in.
Snags/Acre	18
Snags/Acre >12 in	11
Snags/Acre >18 in	5
Avg Dia. Snags	18 in.
Cavity Trees/Acre	na
Cavity Trees/Acre >12 in	na
Avg Dia. Cavity	na



BA by tree species

Species	BA	% of Total BA
EH	40	44%
RM	18	19%
SM	10	11%
HH	10	11%
WP	5	6%
WA	3	3%
BC	3	3%
PB	3	3%

Average BA/Acre by Diameter Class (Diameter Distribution)

Size Class (DBH)	Total	AGS	UGS
Sap (<5")	0	0	0
Pol (5"-11")	18	10	8
Saw (11"-24")	68	35	33
Lg.saw (>24")	5	3	3
TOTAL	90	48	43

Carbon Estimates Based on Stand BA	
Co Metric Tons/Acre	32.95
Co2 Metric Tons/Acre	120.93

Songbird Habitat Assessment	
Overstory	
Cover	57.5%
Distribution	na
Midstory	
Cover	50-75%
Distribution	na
Dominant species	SM, EH, HH, STMA, AB
Understory	
Cover	1-25%
Distribution	na
Dominant species	SM, fern, STMA, AB, Rubus
Soft mast	Present
Invasives	na
Invasive species	na
Downed Dead Wood	
FWM/Acre	10 piles/acre
CWM/Acre	62 pieces/acre

Notes: Areas of blowdown 1/10 ac in size. Areas where 2/3rd of trees that were previously girdled have become snags. WA seedlings abundant in areas.

Stand History: This area was designated Stand C-2 and received a single tree and small group selection harvest in winter of 2012/2013 according to the 2011 FMP Amendment (see *Harvest Plan Excerpt 2011*). Previously, this stand was described as part of Unit 3 and received no treatment according to the *2007 GMAC/BOVM Important Bird Area Land Mgt. Plan*. Otherwise, aside from some very old remnant skid or agricultural trails, there is no evidence of management since conversion from agriculture +/- 110 years ago.

Access/Operability: Access is via an established forwarder/skid trail entering the stand from the southwest corner of stand C-1, originating from a road-side landing located in the northwest corner of the stand C-1 along Sherman Hollow Road. Wet conditions in this stand make a winter harvest necessary to avoid significant rutting and reduce erosion risks. Also, some areas exhibit shallow bedrock and small outcrops which should be avoided by skidders.

Silvicultural Attributes:

This Eastern hemlock dominated mixedwood stand is intermediately stocked (between A and B line), comprised of fewer but larger trees. The majority of the volume is in saw-sized class, with nearly equal proportions of AGS/UGS trees. There is a component of large-diameter trees as well. Red maple, sugar maple, and hophornbeam are the sub-dominant species after hemlock in this stand. Areas of group selection this past management cycle have resulted variable response- with some areas exhibiting desirable understory regeneration and other areas exhibiting dense fern growth coupled with heavy

deer browse. This phenomena suggests that larger groups are necessary to achieve desirable regeneration.

Wildlife Structural Attributes:
This stand is characterized by an intermediately dense canopy (57.5%) overtop a denser midstory and a fairly open understory. A mixture of hardwood and softwood species comprise the midstory. The understory contains some soft mast producing species (rubus sp.) as well as robust volumes of CWM and FWM. Snag numbers and size thereof are robust. In areas where canopy gaps were created through management, regeneration and concurrent structural complexity of the response in the understory layer is variable. Past girdling efforts were moderately successful, resulting in desirable snag recruitment, despite a proportion of girdled trees having survived.

Climate Change Vulnerability:
Silviculture
Northern hardwood forests, of which this stand is a variant, are considered to have low to moderate vulnerability to climate change based on medium evidence and model agreement. Key drivers underpinning this vulnerability of this forest type are drier summers, changes in soil temp and moisture, and altered nutrient availability. Common species to this forest type associate with a broad range of predicted habitat suitability changes under different climate scenarios, suggesting a high degree of variability in changes to this forest going forwards.

Specific to the major species comprising this stand identified during inventory, the following predictions are available from the Climate Change Tree Atlas (Iverson et al. 2019) for the region of the GMAC regarding how tree species may fare under both low and high climate change scenarios by the year 2100.

Stand Species-Specific Climate Change Projections for GMAC Region of Vermont			**Low Climate Change (RCP 4.5)**		**High Climate Change (RCP 8.5)**	
Species	**Stocking %**	**Adaptability***	**Habitat Change+**	**Persistence Capability^**	**Habitat Change+**	**Persistence Capability^**
EH	44%	Low	No change	Fair	Sm. dec.	Fair
RM	19%	High	Sm. inc.	Very Good	Sm. inc.	Very Good
SM	11%	High	Sm. dec.	Good	Sm. dec.	Good
HH	11%	High	Sm. inc.	Very Good	Sm. inc.	Very Good
WP	6%	Low	Sm. inc.	Good	No change	Fair
WA	3%	Low	Sm. inc.	Fair	Sm. inc.	Fair
BC	3%	Low	Sm. inc.	Fair	Lg. inc.	Good
PB	3%	Medium	No change	Fair	No change	Fair

* Species ability to respond favorably to disturbance based on life history factors.
+ Projected change in species suitable habitat in GMAC region by 2100 under associated climate change scenarios based on modeling results.
^ Overall rating describing species expected ability of cope or persist amidst projected change in suitable habitat in GMAC region by 2100 based on model results and expert opinion.

The moderate species diversity among current stocking increases the prospects of overall resilience to climate change for this stand. It is likely that any decline in hemlock, resulting from climate change and/or natural senescence, will be compensated for, in time, with increased growth rate of the next two dominate species, red maple and sugar maple, which have more favorable prospects regarding resiliency in the face of climate change.

Hydrology
Parts of this stand have seepy soils.

Soils
Erodibility of the soils underlying the stand is important to consider when evaluating how vulnerable the area is to extreme rain events; the more erodible the soil, the more vulnerable the stand is to extreme weather posed by climate change; any events, including management activities, that expose soil and/or disturb the soil poses risk of exacerbating this vulnerability.

The soil characteristics of this stand contribute substantial vulnerability to extreme weather events expected with climate change. These soils have a high erodibility potential, increased drought potential, and high windthrow potential. Together, this suggests that any activity that substantially increases exposure of soil to rain and sun, and trees to wind, are likely to result in undue disturbance and impact to the stand health.

Soil Type (slopes)	Est. Prop	Erodibility Potential	Drought Potential	Windthrow Potential
Lyman-Marlow Very Rocky Loams, (30- 60%)	95%	High	Somewhat Vulnerable	High
Peru Extremely Stony Loam, (20-60%)	5%	High	Slightly Vulnerable	Moderate

Carbon Stocking: The carbon storage per acre in this stand is on the higher end compared to other stands on the GMAC property; much of this stock is stored in fewer and larger-diameter hemlock and white pine. According to the stocking chart, the stand has space to increase stocking (i.e. sequester more carbon through growth); given the mature state of the dominant species that comprise the majority stocking, the greatest potential for increased sequestration rates is in the recruitment and promotion of smaller diameter stock contained in the midstory. Natural senescence of mature stock, alongside any loss of stock to windthrow will serve to transfer stored carbon into other forest pools, as well as make room for increased recruitment of smaller diameter size classes, and in doing so, increase carbon sequestration rates for the stand. Otherwise, any conditions, natural or artificially induced, that result in increased growth of smaller dimeter stock will contribute to greater sequestration rates.

Desired Future Stand Conditions and Management Recommendations

Management Goals: Promote long-term production of softwood and hardwood sawtimber, maintain and/or increase climate change resiliency, increase carbon sequestration and storage, and promote breeding habitat for neo-tropical migratory songbirds.

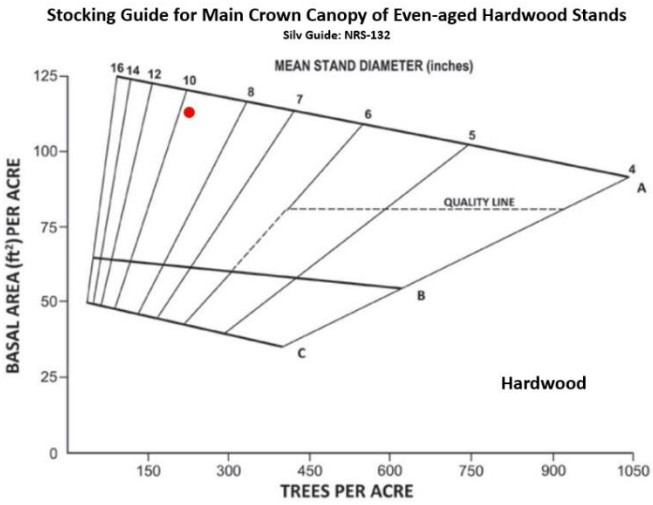
Management Objectives: Increase understory development, stimulate increased growth rate of woody vegetation. Treat and monitor invasive species.

Management Strategy: One option is for this stand to be allowed to naturally develop and experience natural mortality of large diameter stock (pine and hemlock) from post-maturation senescence and from natural disturbances resulting from windthrow given soil characteristics. However, in light of the observation that regeneration is limited in small gaps created in the last entry, another option is to consider expanding these existing gaps through chop and drop of trees along the immediate perimeter of select gaps (modification of Silviculture with Birds in Mind Option 2A). Regardless, efforts to monitor and control non-native and invasive species in these gaps will be increasingly important.

Current Stand Conditions

Stand: **C-3**
Stand Size: 9.5 acres
Descriptor: sugar maple- white ash- paper birch
Natural Community Type: Northern Hardwood
Forest Cover Type: Northern Hardwood
Silv Guide: NRS-132

Stand Summary: 2 plots, 10 BAF	
Total Basal Area/Acre	120 sq.ft.
Total Trees/Acre	225
Trees/Acre >24 in	0
Quadratic Mean Diameter	9.90 in.
Snags/Acre	25
Snags/Acre >12 in	0
Snags/Acre >18 in	0
Avg Dia. Snags	6 in.
Cavity Trees/Acre	na
Cavity Trees/Acre >12 in	na
Avg Dia. Cavity	na



BA by tree species

Species	BA	% of Total BA
SM	55	46%
WA	15	13%
PB	10	8%
HH	10	8%
BH	10	8%
EH	5	4%
YB	5	4%
WO	5	4%
BU	5	4%

Average BA/Acre by Diameter Class (Diameter Distribution)

Size Class (DBH)	Total	AGS	UGS
Sap (<5")	0	0	0
Pol (5"-11")	60	50	10
Saw (11"-24")	60	30	30
Lg.saw (>24")	0	0	0
TOTAL	102	80	40

Songbird Habitat Assessment

Overstory	
Cover	75%
Distribution	na
Midstory	
Cover	25-50%
Distribution	na
Dominant species	SM, EH
Understory	
Cover	1-25%

Carbon Estimates Based on Stand BA	
Co Metric Tons/Acre	34.38
Co2 Metric Tons/Acre	126.17

Distribution	na
Dominant species	SM
Soft mast	Present
Invasives	Light
Invasive species	Honeysuckle, Buckthorn, Barberry
Downed Dead Wood	
FWM/Acre	5 piles/acre
CWM/Acre	40 pieces/acre

Notes: Areas of rich northern hardwood conditions with cohosh, leak, as well as WA, SM, and HH seedlings. Parts of this stand lack leaf litter- possibly due to invasive earth worms. HETH, BCCH, and REVI noted.

Stand History:
This is a newly defined and thusly described stand unit this cycle. Previously, this stand was described as part of Unit 3 and was allowed to develop naturally according to the *2007 GMAC/BOVM Important Bird Area Land Mgt. Plan.* Otherwise, there is no evidence of management since conversion from agriculture +/- 110 years ago.

Access/Operability:
Access would be via an established skid trail through C-1 and C-2 originating from a landing on Sherman Hollow Road. Areas of this stand have wet soil and rock outcroppings.

Silvicultural Attributes:
This sugar maple dominated hardwood stand is fully stocked (approaching the A line), comprised of near equal proportions of pole and saw-sized stock. The overall quality of trees is good, with pole-sized stock trending towards AGS, and the saw sized stock in equal proportions AGS/UGS. Many small-diameter snags exist within the stand as remnants of stem exclusion among poles during stand development. Lidar-derived cover-type data show a component of tall conifer in the western portion of this stand, which were not captured during inventory.

Wildlife Structural Attributes:
The stand overstory is fairly closed (75%), overtop a moderate to low density midstory of sugar maple and hemlock and even less dense understory of sugar maple below. The understory does contain soft mast, growing in rich northern hardwood conditions, but also has a number of invasive species as well. The density and size of snags are lacking, with adequate amounts of CWM and relatively low amounts of FWM. Leaf litter is noted to be lacking in parts of the stand. These conditions are conducive to Birders Dozen species that occupy the mature canopy mixed forest interior habitats such as BHVI and BTNW. However, species that require snags and cavity trees such as woodpeckers and

cavity nesting songbirds, as well as those requiring midstory and understory structure, such as HETH and WOTH, are likely to be lacking.

Climate Change Vulnerability:

Silviculture

Northern hardwood forests, like that which comprise this stand, are considered to have low-moderate vulnerability to climate change based on medium evidence and model agreement. Key drivers underpinning this vulnerability of this forest type are drier summers, changes in soil temp and moisture, and altered nutrient availability. Common species to this forest type associate with a broad range of predicted habitat suitability changes under different climate scenarios, suggesting a high degree of variability in changes to this forest going forwards. Regarding the major species comprising this stand identified during inventory,

Specific to the major species comprising this stand identified during inventory, the following predictions are available from the Climate Change Tree Atlas (Iverson et al. 2019) for the region of the GMAC regarding how tree species may fare under both low and high climate change scenarios by the year 2100.

Stand Species-Specific Climate Change Projections for GMAC Region of Vermont			**Low Climate Change (RCP 4.5)**		**High Climate Change (RCP 8.5)**	
Species	**Stocking %**	**Adaptability***	**Habitat Change+**	**Persistence Capability^**	**Habitat Change+**	**Persistence Capability^**
SM	46%	High	Sm. dec.	Good	Sm. dec.	Good
WA	13%	Low	Sm. inc.	Fair	Sm. inc.	Fair
PB	8%	Medium	No change	Fair	No change	Fair
HH	8%	High	Sm. inc.	Very Good	Sm. inc.	Very Good
BH	8%	High	New Habitat	New Habitat	New Habitat	New Habitat
EH	4%	High	Sm. inc.	Very Good	Sm. inc.	Very Good
YB	4%	Medium	Sm. dec.	Fair	Sm. dec.	Fair
WO	4%	High	Lg. inc.	Good	Lg. inc.	Good
BU	4%	Low	Unknown	FIA Only	Unknown	FIA Only

* Species ability to respond favorably to disturbance based on life history factors.
+ Projected change in species suitable habitat in GMAC region by 2100 under associated climate change scenarios based on modeling results.
^ Overall rating describing species expected ability of cope or persist amidst projected change in suitable habitat in GMAC region by 2100 based on model results and expert opinion.

The diversity of species comprising this stand increases its prospect of resilience to climate change. The most dominant species recorded in inventory, sugar maple, has promising prospects for withstanding the predicted changes to come in the region. However, the second most stocked species, white ash, is likely to decline due to the expected introduction of EAB. Any reduction in stocking of ash is likely to be compensated for by increase in other species established in the stand. Notably, bitternut hickory has notably high stocking in this stand compared to others, and is a species expected to benefit from climate change; this species has high value as a hard mast

producing species. Similarly, white oak, also growing in this stand, is predicted to experience a notable increase in regional habitat suitability and is also a mast producing species of benefit to wildlife.

Hydrology
This stand has areas of seepy soils.

Soils
Erodibility of the soils underlying the stand is important to consider when evaluating how vulnerable the area is to extreme rain events; the more erodible the soil, the more vulnerable the stand is to extreme weather posed by climate change; any events, including management activities, that expose soil and/or disturb the soil poses risk of exacerbating this vulnerability.

The soil characteristics of this stand contribute substantial vulnerability to extreme weather events expected with climate change. These soils have a high erodibility potential, increased drought potential, and high windthrow potential. Together, this suggests that any activity that substantially increases exposure of soil to rain and sun, and trees to wind, are likely to result in undue disturbance and impact to the stand health.

Soil Type (slopes)	Est. Prop	Erodibility Potential	Drought Potential	Windthrow Potential
Lyman-Marlow Very Rocky Loams, (30- 60%)	100%	High	Somewhat Vulnerable	High

Carbon Stocking: Based on inventory measures, this stand has high carbon stores per acre relative to other stands on property, with equal proportions of this carbon contained in pole and saw-sized trees. Accordingly, the stocking chart indicates the stand is near overstocked conditions, suggesting that, on its current trajectory, the sequestration rate can be expected to rapidly decrease as the stand reaches its carrying capacity and the concurrent carbon storage potential in the live trees is effectively reached.

Desired Future Stand Conditions and Management Recommendations

Management Goals: Promote long-term production of softwood and hardwood sawtimber, maintain and/or increase climate change resiliency, increase carbon sequestration and storage, and promote breeding habitat for neo-tropical migratory songbirds.

Management Objectives: Stimulate increased growth rate of all woody vegetation, specifically increasing understory and midstory development. Treat and monitor invasive species.

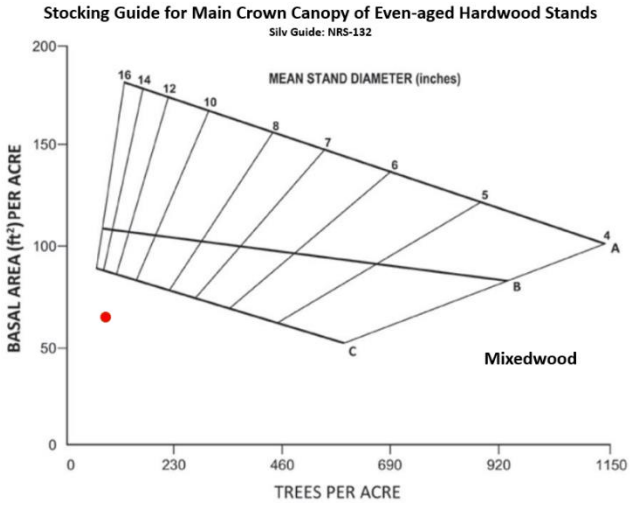
Management Strategy: There is an opportunity to apply a crop tree release with canopy gap formation (Silviculture with Birds in Mind Option 1A), utilizing chop, drop, and

leave methods in conjunction with girdling to concurrently release desirable stock, create canopy gaps, stimulate regeneration in the understory as well as midstory development, create snags, and add CWD and FWD to the forest floor. By leaving material in the woods, carbon will be transferred into other forest carbon pools; such methods will also minimize disturbance to the soil given that no heavy equipment will be required. Specifically target mature maple, oak, and hickory for crop trees. Focus canopy gaps atop desirable advanced regeneration. Notably, without intervention, and in addition to any outcome of management, EAB is likely to result in some thinning and recruitment of snags, and in time, CWD and FWD.

Current Stand Conditions

Stand: **D**
Stand Size: 20 acres
Descriptor: white pine, Northern red oak, Eastern hemlock
Natural Community Type: Northern Hardwood
Forest Cover Type: Mixedwood
Silv Guide: NRS-132

Stand Summary: 6 plots, 10 BAF	
Total Basal Area/Acre	60 sq.ft.
Total Trees/Acre	78
Trees/Acre >24 in	1
Quadratic Mean Diameter	15.46 in.
Snags/Acre	11
Snags/Acre >12 in	1
Snags/Acre >18 in	1
Avg Dia. Snags	14 in.
Cavity Trees/Acre	na
Cavity Trees/Acre >12 in	na
Avg Dia. Cavity	na



BA by tree species

Species	BA	% of Total BA
WP	23	39%
RO	18	31%
EH	7	11%
SM	5	8%
WA	3	6%
RM	2	3%
WO	2	3%

Average BA/Acre by Diameter Class (Diameter Distribution)

Size Class (DBH)	Total	AGS	UGS
Sap (<5")	0	0	0
Pol (5"-11")	18	8	10
Saw (11"-24")	38	12	27
Lg.saw (>24")	3	0	3
TOTAL	60	20	40

Carbon Estimates Based on Stand BA	
Co Metric Tons/Acre	17.19
Co2 Metric Tons/Acre	63.09

Songbird Habitat Assessment

Overstory	
Cover	48.33%
Distribution	na
Midstory	
Cover	50-75%
Distribution	na

Dominant species	EH, AB, SM, RM, HH, WP, STMA, PB, RO, YB, Dogwood, WA
Understory	
Cover	1-25%
Distribution	na
Dominant species	AB, STMA, RO, HH, RM, EH, SM, WA
Soft mast	Present
Invasives	Light
Invasive species	Honeysuckle, A. Bittersweet
Downed Dead Wood	
FWM/Acre	6.7 piles/acre
CWM/Acre	26.67 pieces/acre

Notes: Stand includes area of 2009 patch cut- which resulted in much CWM as well as substantial patches of rubus sp. alongside some honeysuckle and bittersweet. Potential to create more ESH in this stand when patch cut area matures. Areas of this stand include steep and inoperable slopes. Areas of serviceberry and witch hazel.

Stand History: This is a newly defined and thus described stand unit. Previously this area was part of Unit 3 and was allowed to develop naturally. Included in this new stand delineation is an approximately 2-acre patch cut completed in 2009, targeting an Eastern pine/Douglas fir plantation, previously described as Unit 12, according to the *2007 GMAC/BOVM Important Bird Area Land Mgt. Plan.* Otherwise, there is no evidence of management since conversion from agriculture +/- 110 years ago.

Access/Operability: Areas of this stand include steep and inoperable slopes. Access, if possible, would be from the north, near the visitor center along Sherman Hollow Road.

Silvicultural Attributes: This mixedwood stand is dominated by Eastern white pine and Northern red oak alongside smaller proportions of Eastern hemlock, sugar maple and associated northern hardwood species. The stocking overall is low, below the C-line, comprised of few, but largely saw and large-saw sized trees. The quality of these trees trends towards UGS. Particular to the patch cut area, some large white pine remain as the only existing overstory trees, below which is a thick layer of pole-sized yellow birch, ash, and striped maple that have grown in response to the treatment and are nearing the stem-exclusion phase.

Wildlife Structural Attributes: The canopy of this stand is fairly open (48%)- more so than most other stands on property. The midstory is the most developed, with a diversity of softwood and hardwood species comprising the structure. The understory is largely open, containing the same species as above. Red oak growing in this stand offers desirable hard mast, and areas of dogwood, Rubus sp., and serviceberry also offer soft mast. Pockets of invasive honeysuckle, wall lettuce, and bittersweet grow in areas of the understory- including in the 2009 patch cut. The patch cut area in particular can be characterized as young forest, being dominated by pole-sized yellow birch, paper birch, ash, and striped maple. Within the patch cut, CWM and larger-diameter snags exist in moderate to robust numbers. Across the remainder of the stand, snag density is decent, but large snags are lacking; volume of CWM exists in moderate amounts, yet FWM is relatively low.

Climate Change Vulnerability:

Silviculture

Northern hardwood forests, of which this stand is a variant, are considered to have low to moderate vulnerability to climate change based on medium evidence and model agreement. Key drivers underpinning this vulnerability of this forest type are drier summers, changes in soil temp and moisture, and altered nutrient availability. Common species to this forest type associate with a broad range of predicted habitat suitability changes under different climate scenarios, suggesting a high degree of variability in changes to this forest going forwards.

Specific to the major species comprising this stand identified during inventory, the following predictions are available from the Climate Change Tree Atlas (Iverson et al. 2019) for the region of the GMAC regarding how tree species may fare under both low and high climate change scenarios by the year 2100.

Stand Species-Specific Climate Change Projections for GMAC Region of Vermont			**Low Climate Change (RCP 4.5)**		**High Climate Change (RCP 8.5)**	
Species	**Stocking %**	**Adaptability***	**Habitat Change+**	**Persistence Capability^**	**Habitat Change+**	**Persistence Capability^**
WP	39%	Low	Sm. inc.	Good	No change	Fair
RO	31%	High	Lg. inc.	Very Good	Lg. inc.	Very Good
EH	11%	Low	No change	Fair	Sm. dec.	Fair
SM	8%	High	Sm. dec.	Good	Sm. dec.	Good
WA	6%	Low	Sm. inc.	Fair	Sm. inc.	Fair
RM	3%	High	Sm. inc.	Very Good	Sm. inc.	Very Good
WO	3%	High	Lg. inc.	Good	Lg. inc.	Good

* Species ability to respond favorably to disturbance based on life history factors.
+ Projected change in species suitable habitat in GMAC region by 2100 under associated climate change scenarios based on modeling results.
^ Overall rating describing species expected ability of cope or persist amidst projected change in suitable habitat in GMAC region by 2100 based on model results and expert opinion.

The large, mature, white pine dominating many areas of this stand are likely to naturally senesce in the coming decades - although stress from extreme weather events may be expected to accelerate this decline. Decline in overstory pine would effectively release sub-dominant species, among which their predicted climate vulnerability is reasonably spread. Most promising (and unique to this stand in particular), is the potential for the well-established Northern red oak to flourish given its current dominance in areas of the stand, as well as its superior prospects of continued productivity under potential future climate scenarios.

Hydrology
Part of this stand have seepy soils.

Soils
Erodibility of the soils underlying the stand is important to consider when evaluating how vulnerable the area is to extreme rain events; the more erodible the soil, the more vulnerable the stand is to extreme weather posed by climate change; any events, including management activities, that expose soil and/or disturb the soil poses risk of exacerbating this vulnerability.

The soil characteristics underlying this stand contribute substantial vulnerability to extreme weather events expected with climate change- specifically with regard to erodibility from extreme rain, drought from lack of rain, and windthrow from extreme winds. Notably, this stand has areas of very steep slopes, exacerbating erodibility potential of the stand. Together, this suggests that any activity that substantially increases exposure of soil to rain and sun, and trees to wind, are likely to result in undue disturbance and impact to the stand health.

Soil Type (slopes)	Est. Prop	Erodibility Potential	Drought Potential	Windthrow Potential
Lyman-Marlow Very Rocky Loams, (30- 60%)	75%	High	Somewhat Vulnerable	High
Colton And Stetson Soils, (20-30%)	10%	High	Drought Vulnerable	Low
Colton And Stetson Soils, (30-60%)	5%	High	Drought Vulnerable	Low
Agawam Fine Sandy Loam, (12-30)	5%	High	Moderately Vulnerable	Low

Carbon Stocking: Carbon stores per acre are low for this stand- accordingly, the stocking chart indicates that the stand is understocked, suggesting that there is much room for growth of trees across the stand.

Desired Future Stand Conditions and Management Recommendations

Management Goals: Promote long-term production of softwood and hardwood sawtimber, maintain and/or increase climate change resiliency, increase carbon sequestration and storage, and promote breeding habitat for neo-tropical migratory songbirds.

Management Objectives: Promote growth of all woody vegetation, specifically seeking to increase understory development and recruitment of larger diameter trees into overstory. Treat and monitor invasive species.

Management Strategy: Allow the stand to naturally develop, allow for senescence of white pine, which will eventually result in large-diameter snags. Windthrow of mature white pine will also create openings that will stand to stimulate understory regeneration. Monitor and treat invasive species, particularly in the patch cut area. In coming cycles, it will be likely that management should involve promotion of red and white oak through crop tree release as a climate adaptive strategy.

Table 1: Glossary of Tree Species Abbreviations

Abbreviation	**Common Name**	**Scientific Name**
A. Basswood	American Basswood	*Tilia americana*
AB	American Beech	*Fagus grandifolia*
BC	Black Cherry	*Prunus serotina*
BH/BN/BU	Bitternut Hickory	*Carya cordiformis*
BL	Black Locust	*Robinia pseudoacacia*
EH	Eastern Hemlock	*Tsuga canadensis*
HH	Eastern Hophornbeam	*Ostrya virginiana*
PB	Paper Birch	*Betula papyrifera*
QA	Quaking Aspen	*Populus tremuloides*
RM	Red Maple	*Acer rubrum*
RO	Northern Red Oak	*Quercus rubra*
SM	Sugar Maple	*Acer saccharum*
Snag	Standing Dead Tree	-
Striped M.	Striped Maple	*Acer pensylvanicum*
WA	White Ash	*Fraxinus americana*
WO	White Oak	*Quercus alba*
WP	Eastern White Pine	*Pinus strobus*
YB	Yellow Birch	*Betula alleghaniensis*

Table 2: Glossary of Bird Species Abbreviations

Abbreviation	**Common Name**	**Scientific Name**
BCCH	Black-capped Chickadee	*Poecile atricapillus*
BHVI	Blue-headed Vireo	*Vireo solitarius*
BTBW	Black-throated Blue Warbler	*Etophaga caerulescens*
BTNW	Black-throated Green Warbler	*Setophaga virens*
CAWA	Canada Warbler	*Cardellina canadensis*
EAWP	Eastern Wood Pewee	*Contopus virens*
HETH	Hermit Thrush	*Catharus guttatus*
RBNU	Red-breasted Nuthatch	*Sitta canadensis*
REVI	Red-eyed Vireo	*Vireo olivaceus*
SCTA	Scarlet Tanager	*Piranga olivacea*
VEER	Veery	*Catharus fuscescens*
WIWR	Winter Wren	*Troglodytes hiemalis*
WOTH	Wood Thrush	*Hylocichla mustelina*
WTSP	White-throated Sparrow	*Zonotrichia albicollis*
YBSA	Yellow-bellied Sapsucker	*Sphyrapicus varius*

Literature Cited

- Anderson, M.G., A. Barnett, M. Clark, C. Ferree, A. Olivero Sheldon, J. Prince. (2016). Resilient Sites for Terrestrial Conservation in Eastern North America. The Nature Conservancy, Eastern Conservation Science.
- Anderson, M.G., Clark, M., Olivero A.P., Barnett, A.R., Hall, K.R., Cornett, M.W., Ahlering, M., Schindel, M., Unnasch, B., Schloss, C., Cameron, D.R., (2023), A resilient and connected network of sties to sustain biodiversity under a changing climate. Ecology. https://doi.org/10.1073/pnas.2204434119
- Audubon Vermont, The Birders Dozen, (2013)
- Galford, G.L., Faulkner, J., Dupigny-Giroux, L.-A., Posner, S. and Edling, L. (eds.) (2021). The Vermont Climate Assessment 2020. Gund Institute of Environment, University of Vermont, Burlington, VT. DOI: 10.18125/kowgvg. Accessed online at vtclimate.org
- Gu, H., Williams, C. A., Hasler, N., & Zhou, Y. (2019). The carbon balance of the southeastern U.S. forest sector as driven by recent disturbance trends. Journal of Geophysical Research: Biogeosciences, 124, 2786– 2803. https://doi.org/10.1029/2018JG004841
- Hagenbuch, S., Manaras, K., Shallow, J., Sharpless, K., Snyder, M., (2011). *Silviculture with Birds in Mind*, Audubon Vermont and Vermont Department of Forest, Parks, and Rec.
- Iverson, L.R.; Prasad, A.M.; Peters, M.P.; Matthews, S.N. (2019). Facilitating Adaptive Forest Management under Climate Change: A Spatially Specific Synthesis of 125 Species for Habitat Changes and Assisted Migration over the Eastern United States. Forests. 10(11): 989. https://doi.org/10.3390/f10110989.
- Janowiak, Maria K.; D'Amato, Anthony W.; Swanston, Christopher W.; Iverson, Louis; Thompson, Frank R., III; Dijak, William D.; Matthews, Stephen; Peters, Matthew P.; Prasad, Anantha; Fraser, Jacob S.; Brandt, Leslie A.; Butler-Leopold, Patricia; Handler, Stephen D.; Shannon, P. Danielle; Burbank, Diane; Campbell, John; Cogbill, Charles; Duveneck, Matthew J.; Emery, Marla R.; Fisichelli, Nicholas; Foster, Jane; Hushaw, Jennifer; Kenefic, Laura; Mahaffey, Amanda; Morelli, Toni Lyn; Reo, Nicholas J.; Schaberg, Paul G.; Simmons, K. Rogers; Weiskittel, Aaron; Wilmot, Sandy; Hollinger, David; Lane, Erin; Rustad, Lindsey; Templer, Pamela H. (2018). New England and northern New York forest ecosystem vulnerability assessment and synthesis: a report from the New England Climate Change Response Framework project. Gen. Tech. Rep. NRS-173. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 234 p. https://doi.org/10.2737/NRS-GTR-173
- Leak, W., Yamasaki, M., Holleran, R., Silvicultural Guide for Northern Hardwoods in the Northeast, NRS-GTR-132, (2014)
- National Audubon Society, Important Bird Areas Database (2023)

- Sorenson, E., Zaino, R., Vermont Conservation Design- Summary Report for Landscapes, Natural Communities, Habitats, and Species (2018), Vermont Department of Fish and Wildlife, Vermont Agency of Natural Resources.
- Williams, C. A., N. Hasler, H. Gu, and Y. Zhou. (2021b). Forest Carbon Stocks and Fluxes from the NFCMS, Conterminous USA, 1990-2010. ORNL Distributed Active Archive Center

Appendix Items

- Appendix Item A: iNat_observations_GMAC_8_16_23.csv
- Appendix Item B “eBird Checklist for Green Mountain Audubon Nature Center 8_16_23.pdf
- Appendix Item C: S44_E72_GMAC_Region_Tree_Climate_Vuln_Results
- Appendix Item D: FMP-forest-carbon-addendum.11.2022.FINAL_.pdf
- Appendix Item E: Climate Change Projections for Individual Tree Species in the Northern Forest
- Appendix Item F: Chittenden_Co_VT_Highly_Erodable_Soils_2012.pdf
- Appendix Item G: 2007 GMAC/BOVM Important Bird Area Land Mgt. Plan
- Appendix Item H: Harvest Plan Excerpt 2011