State of Vermont
Agency of Natural Resources
Department of Forests, Parks and Recreation
Department of Fish & Wildlife

WORCESTER RANGE MANAGEMENT UNIT LONG-RANGE MANAGEMENT PLAN

LONG-RANGE MANAGEMENT PLAN

Elmore, Vermont
Middlesex, Vermont
Stowe, Vermont
Waterbury, Vermont
Worcester, Vermont

18,772 acres

FORESTS, PARKS & RECREATION
VERMONT
AGENCY OF NATURAL RESOURCES

Prepared by: Barre District Stewardship Team

VERMONT
FISH & WILDLIFE

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MISSION STATEMENTS

Vermont Agency of Natural Resources

The mission of the Agency of Natural Resources is “to protect, sustain, and enhance Vermont’s natural resources, for the benefit of this and future generations.”

Four agency goals address the following:

- To promote the sustainable use of Vermont’s natural resources;
- To protect and improve the health of Vermont’s people and ecosystems;
- To promote sustainable outdoor recreation; and
- To operate efficiently and effectively to fulfill our mission.

Departments

Vermont Department of Environmental Conservation
Mission Statement

To preserve, enhance, restore, and conserve Vermont’s natural resources, and protect human health, for the benefit of this and future generations.

Vermont Fish & Wildlife Department
Mission Statement

The mission of the Vermont Fish & Wildlife Department is the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont. To accomplish this mission, the integrity, diversity, and vitality of their natural systems must be protected.

Vermont Department of Forests, Parks and Recreation
Mission Statement

The mission of the Department of Forests, Parks and Recreation is to practice and encourage high quality stewardship of Vermont’s environment by monitoring and maintaining the health, integrity, and diversity of important species, natural communities, and ecological processes; managing forests for sustainable use; providing and promoting opportunities for compatible outdoor recreation; and furnishing related information, education, and services.

EXECUTIVE SUMMARY

Long-Range Management Plan (LRMP) Development

The Worcester Range Management Unit (WRMU) is an important place – valued by many, for many reasons. These lands provide beautiful scenery, recreation, hunting, landscape connectivity, wildlife and wildlife habitat, carbon storage and sequestration, climate mitigation, clean water, flood resiliency, forest products, and more. Management is purposefully balanced to achieve these multiple goals to the best of our ability.

The Vermont Agency of Natural Resources (ANR) plans for the management of state-owned lands through the development of parcel or unit-specific Long-Range Management Plans (LRMP) developed by the Agency's District Stewardship Teams (DST). These teams are inter-disciplinary groups of natural resource professionals from the Departments of Forests, Parks and Recreation, Fish and Wildlife, and Environmental Conservation. The development of LRMPs follows a robust process that includes resource inventories and assessments, goal setting, public involvement, and development of implementation strategies and actions.

Public Involvement in LRMP Development

Public input is an important part of the development of a robust LRMP and the ANR is committed to a planning process which offers the opportunity for citizens and stakeholders to participate. The public input process for this LMRP was purposefully varied and included open-house style meetings, a widely shared digital story map and public input surveys, and conversations with partner organizations, neighbors, and interested public to encourage meaningful dialogue of value and context. All public comments were received, reviewed, and summarized by the DST and considered in the development of the LRMP. More information on the public process for the WRMU LRMP can be found on page 10. We believe in involving the public to create a collaborative approach to managing public lands. While we don't simply go by majority rule, we do welcome suggestions that align with the missions and goals of our agency and department, as well as the principles guiding the management of ANR lands. We also take into consideration what's financially feasible. Your input matters, and we're eager to work together towards solutions that benefit everyone. A summary document of public comment received and ANR response can be found in Appendix 6.

How Are Long-Range Management Plans Developed?

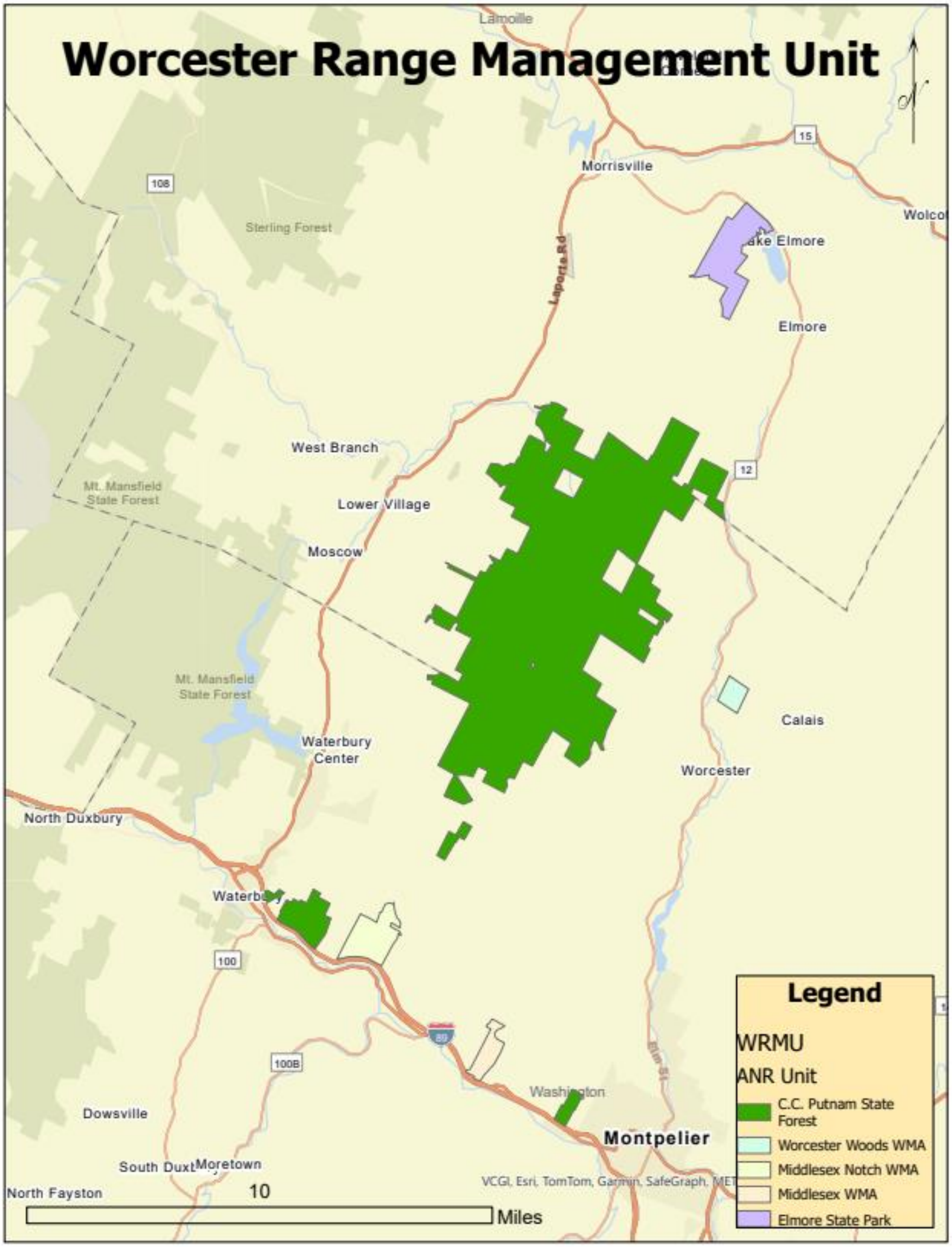
Development of long-range management plans represents an important step in providing responsible stewardship and shared understanding of management for valued public assets. The development of this long-range plan for the WRMU was initiated by the expiration of the separate parcels previous plans. Developing a long-range management plan includes the following steps:

Long-Range Management Planning Process:

Worcester Range Management Unit

The WRMU is located in north-central Vermont in the towns of Elmore, Worcester, Middlesex, Waterbury, and Stowe. It is made up of approximately 18,772 acres and includes five separate parcels: C.C. Putnam State Forest (SF), Elmore State Park (SP), Middlesex Notch Wildlife Management Area (WMA), Middlesex WMA, and Worcester Woods WMA.

Map 1: Worcester Range Management Unit



The WRMU is a diverse landscape. It encompasses the majority of high elevation lands along the spine of the Worcester Mountain Range. It additionally contains large areas of mid-elevation lands, and some low elevation lands along the Winooski River Valley/Interstate-89 Corridor. The highest elevation within the management unit is an unnamed peak, elevation 3,642 ft (the highest named peak is Mt. Hunger, 3,539 ft); the WRMU's lowest elevation is along the southern boundary of the Perry Hill Block in Waterbury (elevation 480 ft).

Management Goals and Objectives

The unit-wide management goals for the WRMU include:

- Protect the ecologically functional landscape and natural and cultural resources of the Worcester Range Management Unit.
- Provide diverse recreational opportunities and trail systems where appropriate and compatible with other goals.
- Promote climate adaptability and carbon resilience on the landscape to address climate change impacts.
- Use a variety of management strategies to support healthy and resilient forest ecosystems; where it is appropriate, support the production of a diverse array of sustainably harvested forest products.
- Provide high-quality habitat for target and general plant and wildlife species.

Priority Strategies and Focus Areas for the Worcester Range Management Unit

	Strategies	Focus Areas
Natural Communities	• Protect sensitive high-quality state significant natural communities and rare, threatened, and endangered species unit-wide. • Allow natural processes and disturbance regimes to prevail and old forest conditions to develop in designated areas. • Achieve increased ecological function through the restoration of old forest characteristics using active vegetation management in designated areas. • Restore natural community habitat features, structure, and species composition through targeted silviculture practices where designated. • Control or limit invasive species populations to the extent possible.	Unit-wide where these occur LMC 1.0 LMC 2.0, LMC 3.0 Unit-wide, and targeted in RTE habitat
Wildlife Habitat	• Enhance habitat through management of all vegetative stages. • Create young forests where feasible in concert with other proposed harvests. Use passive & active management to develop old &structurally complex forests. • Enhance hard and soft mast components and deer wintering habitat. • Protect and promote habitat for rare, threatened & endangered species where they are likely or known to occur. • Leave tops intact when harvesting trees to protect regeneration and create brush pile habitat.	Deer wintering habitat – softwood & hardwood, young forest & old forest habitat, old fields, mast stands

Water Quality	• Enhance forest cover in riparian areas & wetland buffers to maintain natural stream temperatures, wildlife corridors, & to mitigate flooding impacts. • Follow riparian guidance to protect all wetlands, seeps, streams, & amphibian breeding pools. • Design roads, trails, & other infrastructure for aquatic organism passage & flood resiliency. Improve exiting road and trail infrastructure to minimize erosion.	Roads and trails, amphibian breeding pools, small wetlands, seeps, riparian zones
Climate Adaptation	• Promote & protect areas with diverse tree species, sizes, ages, & spacing for forest structural complexity to moderate impacts of severe disturbance & to aid in maintaining forest processes & ensure carbon resilience through both active & passive management. • Protect soil quality, nutrient cycling & hydrology. • Reduce the number of trees that serve as host species for invasive insects & pathogens in a manner that considers the overall health & function of the forest (considering regeneration and understory plant communities). • Promote the establishment of well-adapted species and consider future-adapted species. • Maintain forest corridors to promote movement and dispersal of species over time. • Develop & maintain a resilient forest that fosters natural communities with a range of tree densities, gap sizes, plant species, and tree ages. • Develop silvicultural prescriptions that consider likely climate change scenarios and focus on building resiliency and complexity.	Throughout WRMU
Forest Management	• Develop & maintain a resilient forest that fosters natural communities with a range of tree densities, gap sizes, plant species, and tree ages. • Provide sustainable, periodic timber harvesting to promote forests that are structurally and compositionally diverse. • Utilize diverse types of forest management to create age and structural complexity. • Develop silvicultural prescriptions that consider likely climate change scenarios and focus on building resiliency and complexity.	LMC 2.0, LMC 3.0
Historic Resource	• Document, interpret and protect historic resources. • Consult with Division of Historic Preservation on ground-disturbing activities.	Throughout WRMU
Recreation	• Work closely with all partner groups to provide enjoyable & safe trail user experience & ecologically sound trail systems. • Support opportunities for dispersed, sustainable, fish and wildlife-based recreation per easements, funding requirements, and department mission. • Provide landscape for remote, dispersed recreation. • Ensure proper planning for and implementation of new trails where appropriate.	Throughout WRMU
Public Access	• Maintain existing parking areas, kiosks, & signage to support public access. • Continue to seek opportunities for public access to the WRMU. • Develop public access opportunities where lacking, needed, and appropriate.	Throughout WRMU

Roads & Trails	• Maintain roads & infrastructure responsive to likely climate change scenarios. • Promote resiliency, water quality, and erosion control. • Plan water crossings on roads and trails to withstand increasing frequency and intensity of storm events, enhancing flood resilience and mitigating downstream impacts.	Throughout WRMU

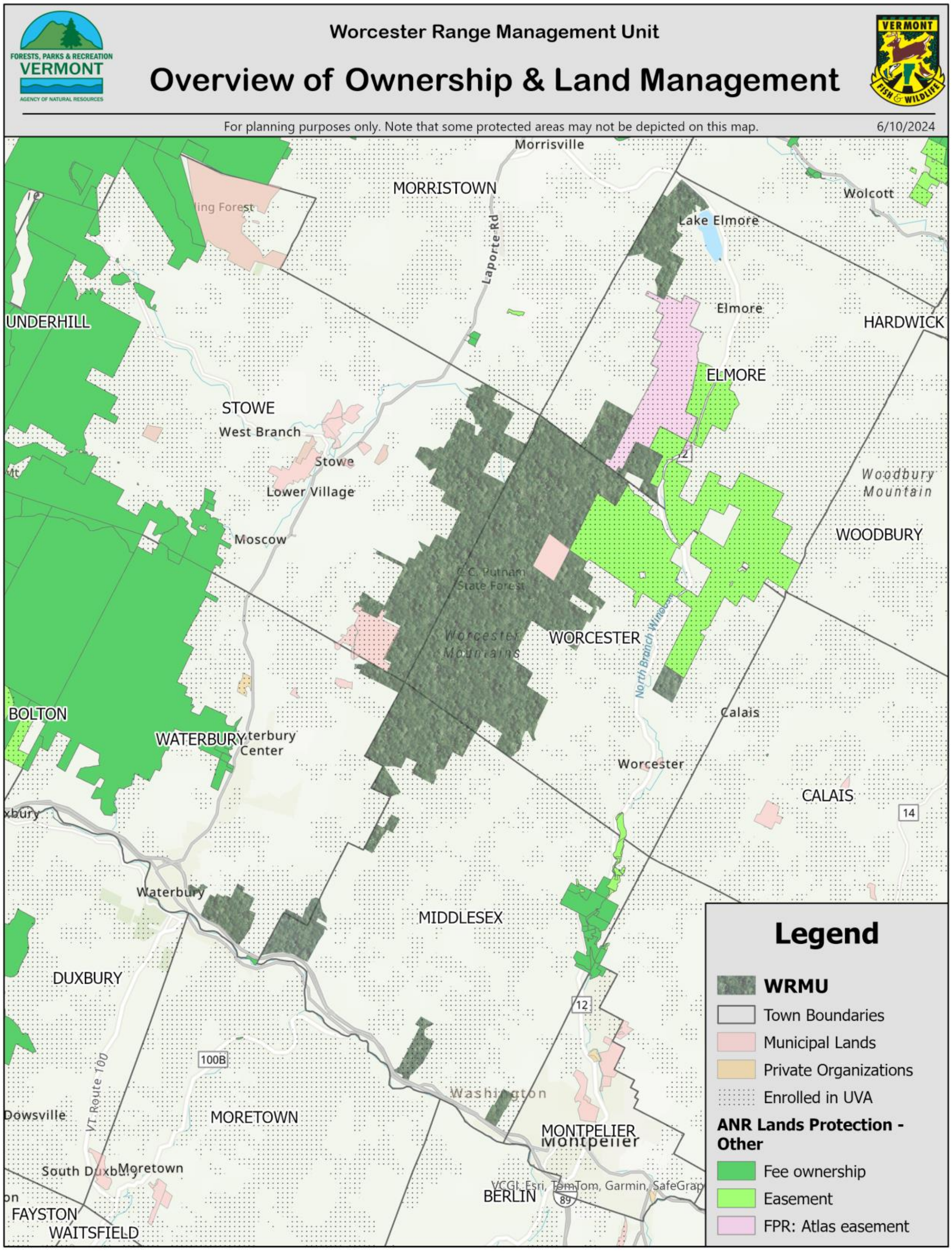
Vermont Conservation Design

Vermont Conservation Design (VCD) is a scientific vision for maintaining the state's ecologically functional landscape, which includes forest blocks, riparian areas, natural communities, and habitats that are the highest priority for sustaining Vermont's biodiversity now and into the future. State lands are critical to achieving the vision in VCD, which serves as a key tool for informing the parcel- and unit-specific strategies included in the Management Strategies and Actions section of the WRMU LRMP.

The Long-Range Management Plan aligns with VCD, proposing multiple objectives that support and contribute to its vision. One specific example is the strategy to promote wildlife movement and ecological connectivity through the Shutesville Hill Wildlife Corridor and the "Worcester Range to Northeast Kingdom" connection east across Route 12. Another specific example is that roughly half of the management unit will be managed to promote the development of structurally complex old forest conditions that contribute to meeting the old forest targets in Vermont Conservation Design. The inclusion of these and many other strategies ensures that the Worcester Range Management Unit contributes to maintaining the ecologically functional landscape envisioned by Vermont Conservation Design.

This unit is situated adjacent to and in the vicinity of several conserved lands that contribute to its landscape context and ecological function. These include, but are not limited to, the 6,500-acre privately-owned Worcester Woods forestland conservation easement, the 6,598-acre Woodbury Mountain Wilderness Preserve and Eagle Ledge Addition owned by the Northeast Wilderness Trust, the 2,281-acre Atlas Forest Legacy parcel, the 506-acre Waterbury Village Waterworks, the 262-acre Worcester Town Forest, and thousands of acres of land in the Current Use Program helping to protect Vermont's working landscape of conservation land, forest land, and agricultural land, from land conversion.

Map 2: Protected Lands and Lands Enrolled in the Current Use Program (UVA) Adjacent to and in the Vicinity of the WRMU.



Natural Communities

The WRMU is of exceptional ecological importance at local, statewide, and regional scales. It supports a notable diversity of species and natural communities. Fifteen rare or uncommon plant species have been located within the unit. Four of these species are particularly vulnerable to trampling by hikers and dogs on the summits of Mount Hunger and Elmore Mountain. Natural communities in the unit range from oak forests along the Winooski River Valley to montane and boreal communities at the highest elevations. In the WRMU, 27 natural community types were identified and mapped. Seventeen of the 27 natural communities are considered state-significant, including 367 acres of wetland and 17,000 acres of upland. The elevational gradient of the unit, most of which is found within intact forest blocks, allows for relatively unhindered movement of species. Locally, this facilitates climate resilience by allowing species to move and adjust ranges in response to climate change.

The LRMP identifies several management actions to support healthy ecosystem function of natural communities, including allowing natural processes and disturbance regimes to prevail when appropriate and ensuring that forest management, wildlife habitat creation, and recreation strategies do not lower the quality rank of significant natural communities.

Wildlife Habitat

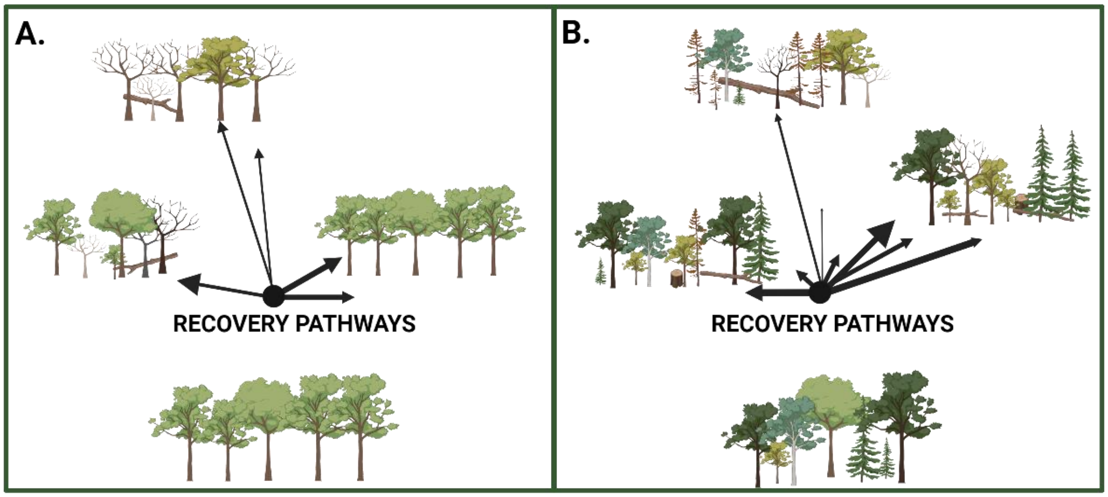
The WRMU comprises a portion of one of the largest habitat blocks in the State. It supports a diverse range of habitats for many species and is a critical ecological and wildlife connection from the main spine of the Northern Green Mountains to the large forest blocks of Vermont's Northeastern Highlands. This corridor is ecologically significant far beyond Vermont's borders. The Worcester Range is a key connection for species movement between the Adirondacks and western Massachusetts all the way north and east to Maine, New Brunswick, and the Gaspé Peninsula.

In addition to the extensive matrix forest community, there are numerous special wildlife habitat features including wetlands, cliffs, forest openings, and soft- and hard-mast stands. Managing for habitat diversity and healthy ecosystems encourages robust populations of large and small mammals, birds, reptiles, amphibians, and insects.

Climate Change and Adaptation

Vermont forests have undergone significant changes over the past century due to land use and the introduction of invasive plants, insects, and pathogens. Compounding these impacts, climate change poses a significant threat to forest ecosystem function, including those found in WRMU, through changes in temperature, precipitation patterns, growing season length, ranges of insect pests and pathogens, and frequency of natural disturbances. To adequately account for the uncertainty and adaptability to future climate change, forests should be managed as complex adaptive systems to maintain or enhance stand structural and compositional diversity and functional redundancy across multiple temporal and spatial scales. Greater ecosystem diversity provides increased recovery and resilience pathways to maintain forest function under future climate conditions (Figure 1). This can be achieved through both active and passive management to create a resilient landscape that improves and maintains an array of ecosystem services and addresses social and ecological needs.

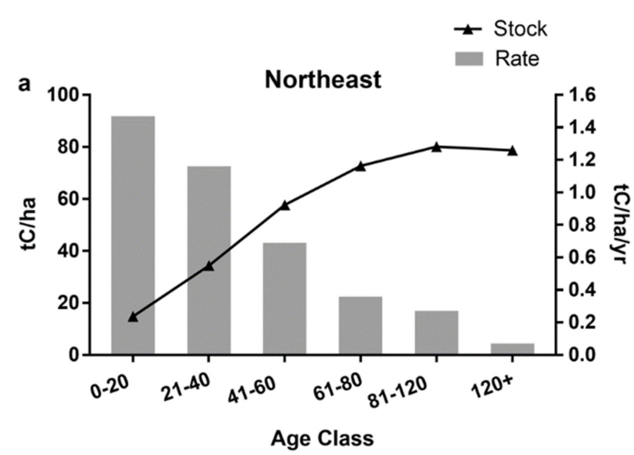
Figure 1: Forest Recovery Pathways in Response to Climate Change



Forests adapt to changes in conditions (e.g., drought and extreme precipitation, mortality due to pests and pathogens) through altered stand structure and composition. Recovery pathways in response to climate change are depicted as arrows for a homogenous forest with minimal species diversity (Panel A) and an heterogenous forest with greater species diversity (Panel B). Arrow length is an indicator of the amount of change while arrow thickness is the likelihood of that pathway (adapted from (Puettmann & Messier, 2020).

Forest Carbon

Vermont forests accumulate carbon from the atmosphere and store it in aboveground biomass and soil and confer landscape and community resilience, even while being vulnerable to climate change impacts themselves. The ability of a forest to store carbon and the rate at which forests accumulate carbon peak at different stages of forest development. Young forests accumulate carbon at a higher rate but have less storage, while old forests have a lower rate of accumulation but can store greater amounts carbon.



Average stocks (tC/ha, line, e.g., carbon storage) and annual net change (tC/ha/yr, bars, e.g., rate of accumulation) in live aboveground tree carbon stocks by age class in the Northeast (from Hoover & Smith, 2023).

Both the rate of accumulation and storage of carbon are critical pieces of the equation for carbon mitigation and resiliency, emphasizing the importance of having a range of forest structural and compositional diversity across the landscape. Forests are more than their carbon content or the timber products they provide; they are complex systems that provide an array of ecosystem services and should be managed holistically without single-objective goals. The WRMU LRMP utilizes sustainable forest management/muti-objective forestry to enhance or maintain forest and carbon resilience through diversifying both species and structural composition while addressing social and ecological needs (e.g., wildlife habitat, forest products, carbon storage and accumulation, recreation, etc.).

Carbon resilience is an important aspect of managing the forests in the WRMU. Carbon stocks and rates may be measured through permanent FIA plots that occur on state lands.[1]

Forest Management

The WRMU is predominately forested and managed to achieve a variety of goals and objectives. Forest management strategies focus on maintaining and enhancing habitat, biodiversity, forest health, and vigor to maximize the benefits and services of healthy forests. A range of harvest techniques will be used to provide wildlife habitat, biodiversity, healthy and vigorous forests, protection of water resources, opportunities for research, high-quality forest products, and the demonstration of forest management. Management activities will enhance both hard and soft mast species. Young forest conditions will be created by establishing groups and patches in suitable locations to support the 1–20-year forest age class across the WRMU,, which is important to many wildlife species, and to meet the VCD target for that habitat component within the management unit.

Careful and thoughtful forest management provides many benefits, including improved wildlife habitats, forest health, diversity, climate resilience, recreational access, and economic benefits. Forest management has been and will continue to be an important aspect of the overall management of the WRMU. While more than 6,000 acres of the WRMU allow for active forest management (timber harvests), during the 20-year period covered in this plan, twelve areas, totaling 1,928 acres, will be further analyzed and considered for active management treatments. If, at that time, the District Stewardship Team determines that a treatment is beneficial to the resource, ANR staff will carefully plan a harvest. The maximum number of acres considered for treatment equals approximately 0.5% of the WRMU per year. One of the primary goals of this plan is to increase forest stand diversity (both structure and species diversity); therefore, the planned treatments will be designed to shift all forest stands toward an uneven-age structure.

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[1] The Forest Inventory and Analysis (FIA) program of the USDA Forest Service collects, processes, analyzes, and reports on data necessary for assessing the extent and condition of forest resources in the United States.

Fisheries and Water Resources

Waters within WRMU are mostly small, high gradient, cold-water streams that support wild, self-sustaining populations of brook trout. Other species found within these waters include Rainbow trout, brown trout, two species of suckers, eight species of minnow, one darter species, and one species of sculpin.

These waters eventually flow into two major Vermont rivers that contribute to Lake Champlain – the Winooski and the Lamoille. Lake Elmore, the only sizeable lake in the area, lies adjacent to the WRMU.

The proper management of the WRMUs water resources provides value downstream of its boundaries in the form of drinkable, swimmable, fishable, and boatable waters in Lamoille, Washington, Franklin, and Chittenden counties.

Forest Health

The extensive areas of interior forest within the WRMU, particularly the higher elevation natural communities, host few, if any, invasive plant species. However, the lower elevations abutting Interstate-89 host a variety of non-native invasive plants that threaten natural plant communities. The Perry Hill, Middlesex Notch WMA, Middlesex WMA, and Middlesex blocks largely consist of abandoned agricultural land, and have experienced more recent human disturbance than the contiguous, mountainous block of CC Putnam State Forest. Ongoing efforts to monitor and control invasive species are critical in managing healthy forest ecosystems. The major expected threats from forest pests and pathogens in the WRMU include the arrival of emerald ash borer and beech leaf disease within the unit and continued red pine decline.

Historic and Scenic Values

The forested ridgeline of the Worcester Range can be seen throughout the central part of the state and is an invaluable scenic resource. These lands have been culturally significant for many generations. Although there are no known pre-contact (pre-CE 1600) archaeological sites within the WRMU, some sections of the unit were home to early European settlers, as is evidenced by stone foundations and walls scattered across the landscape. Careful consideration will be given to all activities on the WRMU to ensure that historic, cultural, and scenic values are protected.

Recreation

The WRMU is a four-season multi-use area offering a wide variety of recreation-based opportunities. Recreational opportunities in these areas are extensive, including popular hiking trails, remote recreation experiences, camping at Elmore State Park, and opportunities to hunt, fish and view wildlife. There are nearly 43 miles of trails on the WRMU, with fourteen parking area access points. Thousands of people visit this area every year, and their experiences range from busy trails and crowded summits to solitary experiences in vast woods. The LRMP identifies several opportunities to improve the recreation experience and expand recreation opportunities on state land by re-routing trails and, with the appropriate partnerships, adding new trails and managing backcountry skiing zones.

Land Management Classification

After completion of inventories and assessments, the lands, resources, and facilities held by the Vermont Agency of Natural Resources (ANR) are evaluated and assigned to appropriate Agency Land Management Classification (LMC) categories based on knowledge and understanding of resources and appropriate levels of management. The four categories applied to the WRMU are Highly Sensitive Management (9,961 acres; 53.8%), Special Management (4,186 acres; 22.6%), General Management (4,302 acres; 23.3%), and Intensive Management (49 acres; 0.3%). This enables land managers to allocate use and management by area, minimizing conflicts between competing objectives and facilitating a common understanding of the overall use or type of management in specific WRMU areas.

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A. Purpose of Ownership

The Agency of Natural Resources (ANR) and its Department of Forests, Parks and Recreation (FPR), and Fish and Wildlife Department (FWD) have been legislatively authorized to acquire lands, hold interests in lands, and conduct land management activities for the public benefit, and to manage those lands for a variety of public purposes, ranging from the protection of important natural resources to public uses of the land in appropriate places.

Planning and management of ANR lands is conducted by the local District Stewardship Team (DST). The DST is an inter-disciplinary group of natural resource professionals from the Department of Forests, Parks & Recreation, Fish and Wildlife Department, and the Department of Environmental Conservation (DEC). It includes wildlife and fisheries biologists, foresters, recreation managers, the state land ecologist, and a watershed planner. This group commonly seeks input from other ANR professionals. The DST has broad expertise and considers a wide array of resource concerns and public uses when writing and implementing Long-Range Management Plans.

Natural resources include, but are not limited to biodiversity, wildlife habitat, natural communities, water bodies, wetlands, undeveloped land, scenery, and aesthetic values.

Public uses include, but are not limited to recreation, access to state lands or waters, environment related businesses, education, research, and sustainable use of renewable resources such as forest management, hunting, fishing, and trapping.

State Forests and Parks are managed by the Vermont Department of Forests, Parks and Recreation to meet a variety of conservation and management goals.

Use and Management of C.C. Putnam State Forest and Elmore State Park is designed to:

- Conserve biological diversity on the parcel and contribute to the diversity of the larger landscape.
- Maintain and enhance forest ecosystem health.
- Maintain and enhance the parcel’s ability to provide ecosystem services such as providing wood products, protecting soil and water resources, and providing recreational opportunities.
- Promote an ethic of respect for the land, sustainable use, and exemplary management.
- Protect and improve the condition and resiliency of important biological and natural resources.
- Conform to all deed restrictions, conservation easements, and legal agreements.
- Maintain or enhance the quality rank of significant natural communities and protect habitat of rare, threatened, and endangered species.

- Enhance wildlife habitat through creation of a variety of vegetative stages (age classes), protection and enhancement of critical wildlife habitat such as deer wintering areas, and protection of unique habitat.
- Produce a diversity of wood products through sustainable management and harvest practices.
- Maintain or enhance water quality and fisheries habitat.
- Control or limit to the extent feasible invasive plant populations.
- Document, interpret, and protect historic resources.
- Provide dispersed recreational opportunities and trail systems where appropriate and compatible with other goals.
- Evaluate new recreational use requests in the context of total recreational use of parcel (degree of use, numbers of trails), the Recreational Opportunity Spectrum (ROS), and other management goals for the parcel.
- Provide safe and enjoyable access for public uses while protecting the resource and forest access infrastructure.

WMAs are managed by the Vermont Fish & Wildlife Department to meet a variety of goals. Wildlife management objectives include game species such as white-tailed deer, turkey, grouse, and beaver as well as non-game species such as songbirds, small mammals, amphibians, and birds of prey. Multiple objectives are accomplished by a combination of commercial and non-commercial vegetative management practices and strategies applied over time in a manner that protects and enhances unique habitats.

Use and management of Middlesex Notch WMA, Middlesex WMA and Worcester Woods WMA is designed to:

- Protect and improve the condition and resiliency of important biological and natural resources.
- Protect and enhance wetland function.
- Protect and enhance rare, threatened, and endangered species and their habitat.
- Maintain or enhance the condition of natural communities.
- Protect and enhance wildlife habitat through management of all vegetative stages; creation of early successional growth; improvement of deer wintering areas; and protection of unique habitat.
- Demonstrate exemplary wildlife management practices so that practices applied here may find broader application on private lands.
- Provide sustainable, periodic timber harvesting in appropriate areas to promote wildlife habitat and improve forest productivity.
- Enhance opportunities for wildlife-based recreation, particularly hunting, trapping, and wildlife viewing.
- Protect and improve public access.

B. Location Information

The 18,772-acre WRMU comprised of five separate properties: C.C. Putnam SF (16,685 acres), Elmore SP (995 acres), Middlesex Notch WMA (625 acres), Middlesex WMA (281 acres), and Worcester Woods WMA (186 acres). These separate properties span five different towns: Worcester (9,234 acres), Stowe (4,088 acres), Middlesex (2,807 acres), Elmore (1,831 acres), and Waterbury (812 acres).

The WRMU is accessed from many locations. Some of the most highly used access points include the trailheads at Perry Hill, Stowe Pinnacle, Pinnacle Meadows, Moss Glen Falls and Elmore State Park. Trailheads are maintained for the public to access the WRMU at these locations, and at other locations. Refer to Maps 1–4 for a better understanding of the location of the Management Unit, and the administrative units within the WRMU.

C. History of Acquisition

State acquisition of land within the present limits of the WRMU began in 1914 when about one thousand acres of burned mountain land was given to the state by C. C. Putnam and his son, Ralph. In pursuit of a state policy to acquire high elevation, mountainous land for "scenic preservation and control of stream flows,"[2] the State has over the intervening years increased the size of the C. C. Putnam State Forest to include about 16,685 acres of mostly contiguous land.

Non-contiguous parcels of the C.C. Putnam State Forest were acquired beginning in 1973, with the transfer of 506 acres from the Vermont State Hospital (later known as the Perry Hill Block). Notable additions to the main body of the forest include: the 670-acre Meyers Block; the 870-acre parcel containing Stowe Pinnacle; the 758-acre Brownsville Forest parcel; and the 1,800-acre Hunger Mountain Headwaters parcel. Non-C.C. Putnam State Forest parcels include Elmore State Park (995 acres), Worcester Woods WMA (186 acres), Middlesex Notch WMA (625 acres), Middlesex WMA (281 acres) and one separate part, the Middlesex Block (127 acres). These parcels together with the C. C. Putnam State Forest and its additions comprise the WRMU, an area encompassing approximately 18,772 acres.

D. Land Use History

Historic use of the major portion of the WRMU prior to state ownership was logging and *lumbering*.[3] At different times there were steam operated sawmills within and in the general vicinity of the WRMU, which represent late nineteenth-early twentieth century technological advances in the industry. Some of these mills organized logging camps to maintain production (e.g., the Worcester Block logging camp).

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[2] VANR. (1999). *Lands Conservation Plan: A Land Acquisition Strategy for the Agency of Natural Resources.* Montpelier: State of Vermont.

[3] Lumbering is a historic term for the wood products industry—it includes logging, log driving, manufacturing and transport.

While most of the WRMU was considered too rough for agricultural pursuits, there were exceptions. Some of the gentler ground at lower elevations was cleared and used for pasture by local farmers (e.g., parts of Perry Hill Block and Middlesex Block). And some of the more easily accessible sugar maple stands were utilized for sugaring (e.g., Burt Hollow Block).

Depletion of timber reserves due to natural causes such as forest fire, hurricane, insect infestation and disease, and human causes related to the intensification and industrialization of the logging and lumbering industry contributed to the formation of state policy regarding the purchase/acquisition of private land for public use. Notable among the antecedents of this policy were the private enterprises of Theron Bailey on Mt. Hunger and the development of recreational resources at Moss Glen Falls and the Lake Elmore area. In 1933, the Town of Elmore deeded 30 acres to the State. This parcel was later expanded to become Elmore State Park. The Civilian Conservation Corps (CCC) were responsible for the design, layout and construction of the original park.

E. Resource Highlights

The WRMU is a large nearly completely forested land unit. The dominant forest component is northern hardwood, comprised mostly of the sugar maple-beech-yellow birch community. Even though the northern hardwood type covers much of the WRMU, the variety of flora and fauna found here is impressive. The WRMU is located in the Northern Green Mountains biophysical region, which encompasses the mountains in the north-central portion of Vermont. This region is part of the Appalachian Mountain system that stretches across much of the eastern side of North America. As a result of the relatively high elevations, this region has higher levels of precipitation, lower temperatures, and a short growing season.

The metamorphic bedrock is acidic and lacks the limey, nutrient rich soils found in neighboring lowlands. Glacial till covers much of the region. While soil types vary across the WRMU, Lyman-Marlow very rocky loams are dominant. Other soil types found here include the very rocky Hogback-Rawsonville complex, Peru extremely stony loam, and the very rocky Ricker-Londonderry-Stratton complex.

Precipitation amounts over the landscape of the WRMU range from around 60 inches per year in the upper elevations to half that in the lowest elevations. Rain, snow, and cloud intercept all contribute to the precipitation amounts. Within the WRMU there are few open bodies of water; beaver ponds make up this component. The WRMU is within the greater Lake Champlain basin, and as such run-off from this land unit eventually drains into the lake. Main tributaries include the Winooski River, Moss Glen Brook, Shady Rill, Gold Brook, and Patterson Brook. The landscape diversity found on the WRMU results in a wide variety of natural community types, from Alpine Meadow at the summit, to floodplain forest at lower elevations on the Perry Hill block.

The WRMU is within a large unfragmented habitat block that has an abundance of wildlife, including black bear, white-tailed deer, moose, ruffed grouse, bobcat, beaver, a wide variety of songbirds and raptors, brook trout, fox, snowshoe hares, and amphibians and reptiles. Critical wildlife habitats have been identified for many of these species on the WRMU.

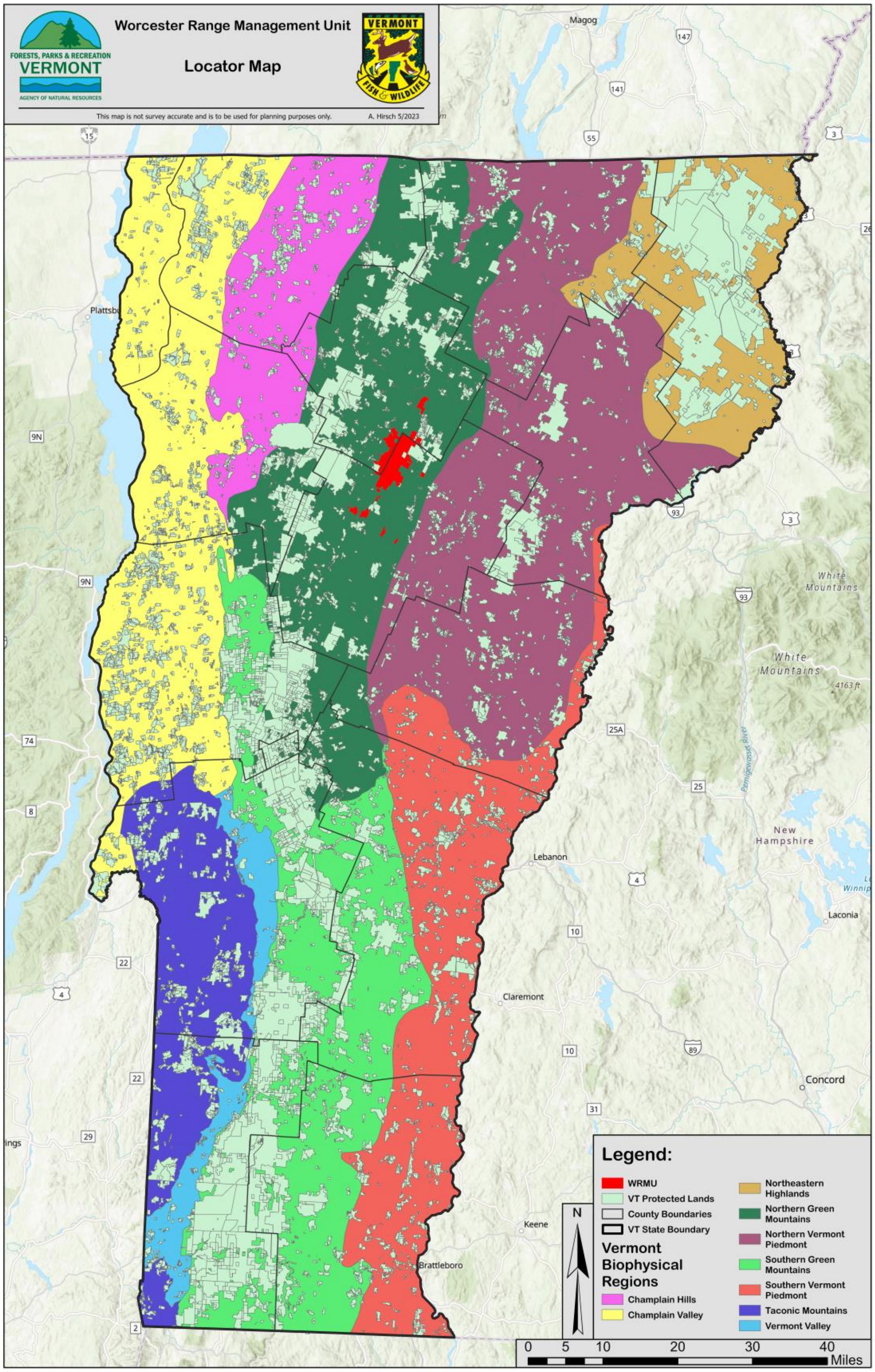
At lower elevations with more gradual terrain, one can find remnants of past human habitation. Much of this occurred in the mid to late 1800's and early to mid-1900's. Former logging and hunting campsites are also found here. Recreational use has long been a tradition within the WRMU. Trails began to be established in the mid-1800's for tourism. In 1939, a trail and fire tower were constructed by the Vermont Division of Forestry as part of a federal initiative to rehabilitate forests in New England after the destruction brought by the hurricane of 1938.

The land base of the WRMU is within a day's drive of several major metropolitan areas in both the United States and Canada. As such, the WRMU attracts many thousands of visitors each year. Hiking, hunting, mountain biking, primitive camping, as well as, campground camping at Elmore State Park, snowmobiling, fishing, and wildlife observation are all popular pursuits. Even though it does have popular trails, there are still many places within the WRMU that are quite remote and rarely visited by humans.

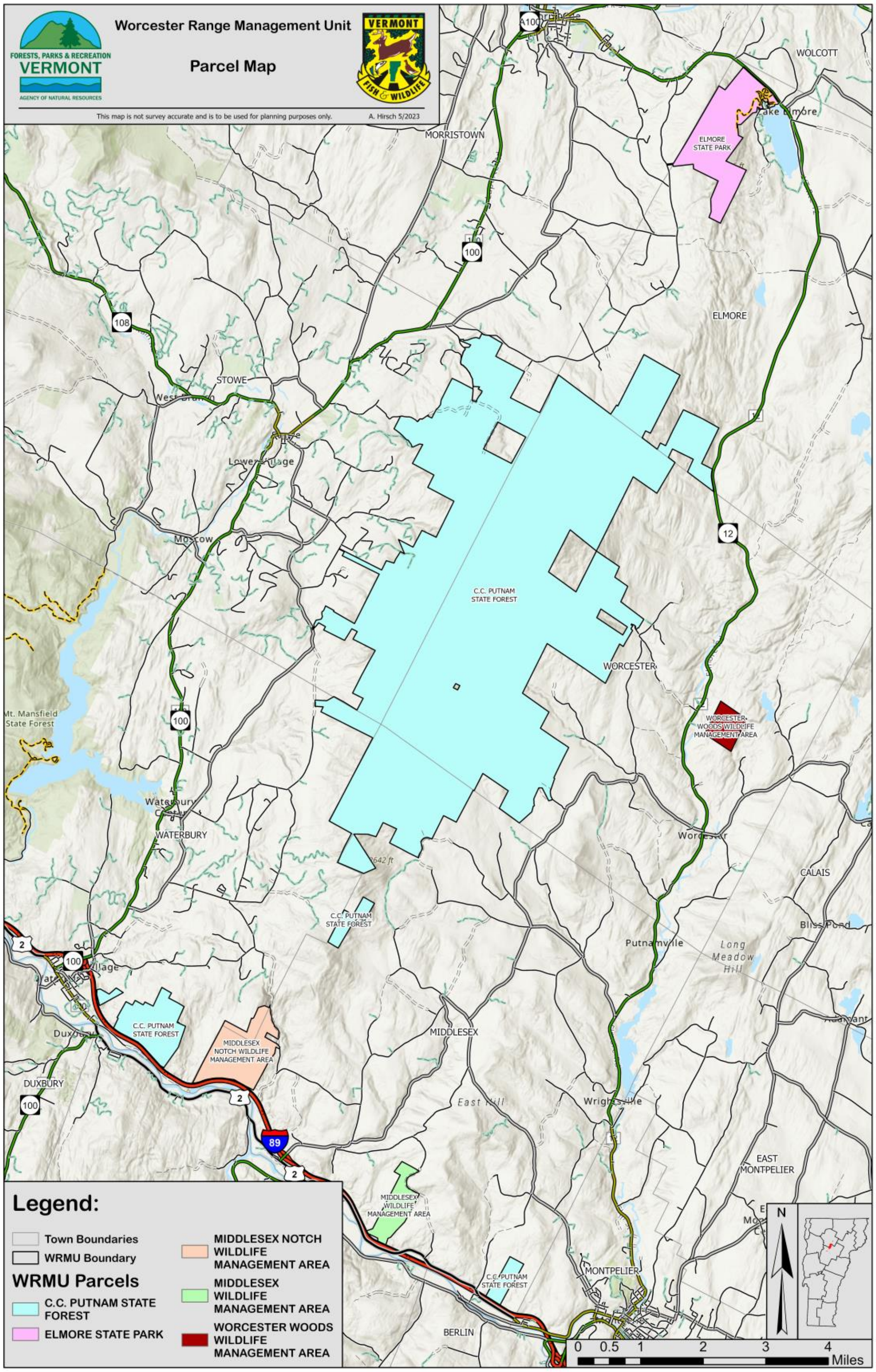
F. Relationship to Town, Regional, and Other Pertinent Planning Efforts

The WRMU stretches across five towns and two counties. The regional plans and town plans for the area within which the WRMU is located are pertinent to the context of the long-range plan for the WRMU and have been considered in the development of this plan. Each of the regional and town plans recognize the importance of resource protection, wildlife populations and habitat, hazard mitigation, working landscapes, recreational opportunities and the scenic character of each community. The planning and management of the WRMU will play an important role in helping each of these towns achieve the goals outlined in their regional and town plans.

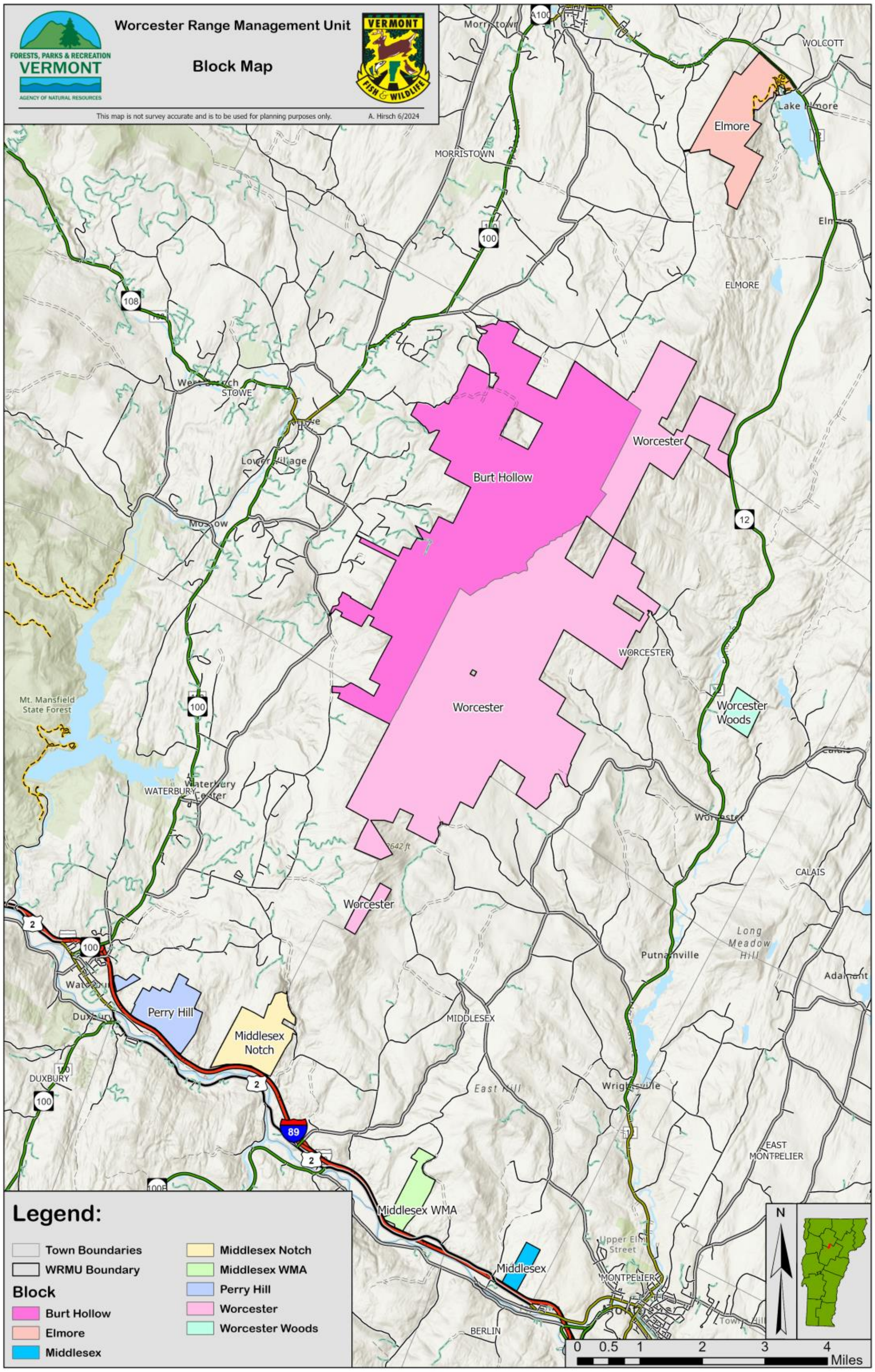
Map 3: Locator and Biophysical Region Map



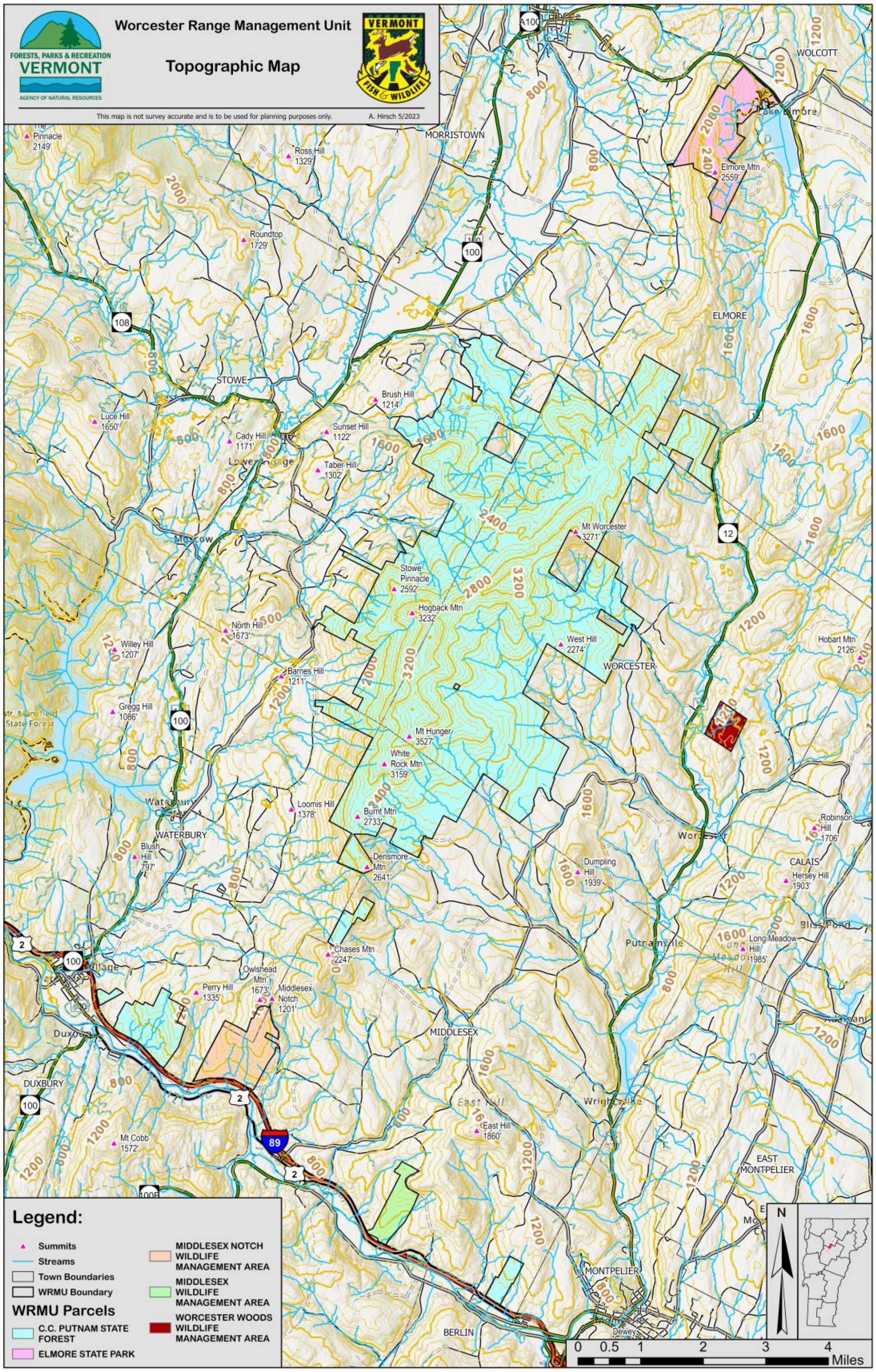
Map 4: Parcel Base Map



Map 5: WRMU Block Map



Map 6: Worcester Range Management Unit Topographic Map



II. PUBLIC INPUT

The public engagement process for the WRMU Long-Range Management Plan was conducted with a variety of methods to allow the opportunity for all interested parties to participate. All public input received has been considered in the preparation of this plan.

A. Public Involvement Process

Public involvement in the WRMU Long-Range Management Plan process will be conducted in accordance with Agency of Natural Resources policies, procedures, and guidelines. Public involvement or citizen participation is a broad term for a variety of methods through which the general public has input into public land management decisions. The Agency of Natural Resources, including the Departments of Forests, Parks and Recreation and Fish & Wildlife, is committed to a planning process which offers the opportunity for all citizens and stakeholders to participate. These include letters, surveys, personal comments, telephone calls, e-mails, and more formal methods such as public meetings and workshops. All public input received concerning the future stewardship of the WRMU has been considered in the preparation of this plan.

B. Public Needs Assessment ("Scoping")

The goal of the public needs assessment is to develop an understanding of public opinion about current and future management of the WRMU. Scoping was conducted between June 5 and August 3, 2020. With the onset of the COVID-19 pandemic, the Barre District Stewardship Team (DST) shared information and solicited comments about the WRMU through an online tool called a StoryMap. Through this interactive platform, the team shared written and map-based information about the natural resources on the property and invited public comments through an online survey. In addition to the survey, comments were also collected through an email account set up for this specific purpose. ANR encouraged participation by reaching out to partner groups and the public in a variety of ways, including phone calls, emails, a press release, website notifications, and Front Porch Forum postings. 723 individuals provided comments. A summary of public scoping feedback is available in APPENDIX 5: Public Scoping Summary; public scoping comments are available upon request.

C. Draft Plan Release and Public Comment

Following the release of the Draft Long-Range Management Plan on November 13, 2023, public informational meetings were held on December 13 and 19, 2023 in Worcester and Stowe, respectively. District staff presented the management goals, strategies and actions recommended for the WRMU and answered questions from the public. Public comments were accepted on the plan between December 13, 2023, and February 2, 2024. Comments were accepted at the public meetings, by email, by online comment form, by mail, and by phone. 669 comments were received on the plan. A summary of the comments received during the public involvement process along with a summary of the Agency's response to comments can be found in APPENDIX 6: Public Responsiveness Summary.

III. RESOURCE ANALYSIS

A. Legal Constraints Assessment

The lands of the WRMU were acquired through numerous land transactions since the State's first acquisition of the Unit's land in 1914. Because of this acquisition history, there are several constraints that affect the ongoing management of the land. Below is a summary of major constraints that impact the management of the land.

Summary of Major Legal Constraints:

Conservation Easements

- The Stowe Land Trust (SLT) and the Vermont Housing and Conservation Board (VHCB) co-hold a Grant of Development Rights, Conservation Restrictions, and Public Access Easement on C.C. Putnam State Forest's 126.3-acre Pinnacle Property, located at the end of Upper Pinnacle Road in Stowe. The easement was executed in June 2002.
- The SLT and the VHCB co-hold a Grant of Development Rights, Conservation Restrictions, and Public Access Easement on C.C. Putnam State Forest's 758-acre Brownsville Forest Property, located off the Brownsville Road in Stowe. The easement was executed in July 2019.
- The Department of Forests, Parks and Recreation entered a Conservation Agreement with the VHCB for C.C. Putnam State Forest's 69-acre North Branch Headwaters Property, located off Route 12 in Elmore. The agreement was executed in April 2007.
- Middlesex Wildlife Management Area (WMA) was obtained in June 1990 because of Act 250 Land Use Permit 5W0933. Middlesex WMA serves as mitigation land for deer wintering habitat that was lost to residential development in Berlin, VT. The State of VT, via its Fish & Wildlife Department, does not own the land in fee but owns the exclusive land development rights on the property except for four, two-acre parcels whose location is to be determined. The locations of these four parcels must front along and within 150 feet of Town Highway # 37 (Upper Barnet Hill Road) and be limited to the development of one residential dwelling for each parcel. To-date, these lots have not been developed. The State also holds the recreational rights, to include hunting, fishing and trapping, on all the land outside of the four, two-acre house sites. The State also holds the timber management rights.

Deed Restrictions or Obligations

- The Nature Conservancy (TNC), in its 1986 deed conveying 100 acres in Middlesex to the State as an addition to C.C. Putnam State Forest, requires the State to erect and maintain a plaque stating, "This area was acquired with the assistance of The Nature Conservancy."
- TNC, in its 1986 deed conveying a parcel of 21.4 acres in Worcester and 216 acres in Middlesex, a parcel of 114 acres in Middlesex and a parcel of 124.4 acres in Worcester to the State as additions to C.C. Putnam State Forest, requires the State to erect and maintain a plaque stating, "This area was acquired with the assistance of The Nature Conservancy."

- In a 1992 deed conveying 100 acres to the State, as an addition to C.C. Putnam State Forest in Stowe, the former owners limited the use of the property to public conservation purposes, restricted the State's ability to transfer or lease the property, and conveyed a Reversionary Interest in the property to The Nature Conservancy.
- The State benefits from a Right of Way to access Elmore State Park from the "Elmore-Morrisville highway" in Elmore, which it acquired as part of a land acquisition project in 1956.
- The State benefits from a Right of Way over private land that connects the two tracts of the Perry Hill block of C.C. Putnam State Forest in Waterbury, which it acquired in 1982.
- The State benefits from a Right of Way to access Elmore State Park from Elmore Mountain Road in Morristown, which it acquired as part of a land acquisition project in 1983.
- The State benefits from a Right of Way to access C.C. Putnam State Forest from Town Highway 39 in Middlesex, which it acquired in 1988.
- The State benefits from a Right of Way to access C.C. Putnam State Forest from Route 12 in Elmore, which it acquired as part of a land acquisition project in 1996.
- The State benefits from a Right of Way to access the Pinnacle Property of C.C. Putnam State Forest from the terminus of Town Highway 67 in Stowe, which it acquired as part of a land acquisition project in 2002.
- The State benefits from a Right of Way to access the Moss Glen Falls block of C.C. Putnam State Forest from Town Highway 16 in Stowe, which it acquired as part of a land acquisition project in 2008.
- The State benefits from a Right of Way adjacent to the Upper Hollow tract of C.C. Putnam State Forest in Stowe, which it acquired as part of a land acquisition project in 2019.

Funding Conditions or Restrictions

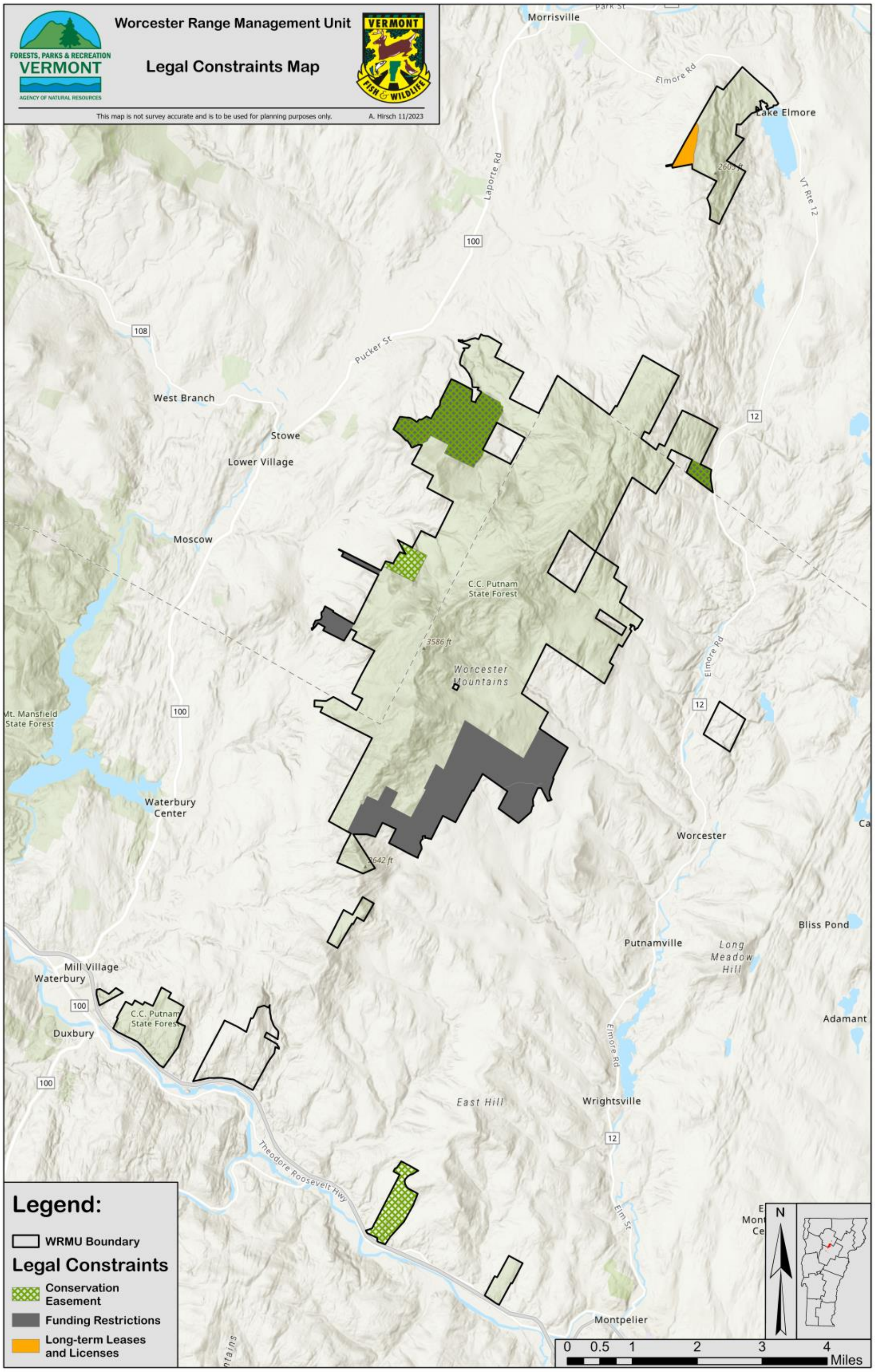
- The following parcels in C.C. Putnam State Forest were acquired through grants from the federal Land and Water Conservation Fund (LWCF) and therefore have certain restrictions imposed upon them through the LWCF program. LWCF funds are used to conserve properties with important outdoor recreational value.
    - 800 acres in Worcester acquired in 1967
    - 1,583 acres in Worcester acquired in 1973
    - 800 acres in Stowe and 160 acres in Waterbury acquired in 1975
    - 216 acres in Middlesex acquired in 1976
    - 100 acres in Worcester acquired in 1978
    - 3,791 acres in Stowe and Worcester acquired in 1979
    - 32 acres in Stowe acquired in 1980
    - 474 acres in Middlesex and Worcester acquired in 1986
- The following parcels in Elmore State Park were acquired through or developed with grants from the federal LWCF and therefore have certain restrictions imposed upon them through the LWCF program. LWCF funds are used to conserve properties with important outdoor recreational value in perpetuity.
    - 1.9 acres in Elmore acquired in 1984

    - The land surrounding the Elmore State Park bath house
- The following parcels in C.C. Putnam State Forest were acquired through grants from the federal Forest Legacy Program (FLP), or to serve as matching funds for the FLP, and therefore have certain restrictions imposed upon them through the FLP program.
    - 69 acres in Elmore acquired in 2007 as a match for the Orange County Headwaters FLP project.
    - 758 acres in Stowe acquired in 2019, known as the Brownsville Forest tract, which served as match for multiple FLP projects, including the Hunger Mountain Headwaters project.
    - 109 acres in Stowe acquired in 2019, known as the Upper Hollow Tract of the Hunger Mountain Headwaters FLP project.
    - 1,768 acres in Middlesex and Worcester acquired in 2018, known as the Patterson Brook Headwaters Tract of the Hunger Mountain Headwaters FLP project.

Long-term Leases and Licenses

- The State of Vermont entered a license with *Shannon Sugar Shack*, allowing *Shannon Sugar Shack* to tap maple trees on and extract maple sap from Elmore State Park. The license runs from January 1, 2023, until December 31, 2027.

Map 7: Legal Constraints on the Worcester Range Management Unit



B. Ecological Assessment of Natural Communities

The Agency of Natural Resources uses a "coarse filter/fine filter" approach to the ecological inventory and assessment of state lands.[4] Widely employed as a management tool on state, federal, and private lands (it is an aid to land managers who seek to protect most or all the species that naturally occur on their lands, but who lack the resources to make exhaustive inventories of all taxonomic groups.[5] Because many groups of organisms are cryptic or poorly understood (for example, fungi and soil invertebrates), it is not practical to make lists of all of them.[6] Even if we could assemble such lists of species, it would be impossible to manage the land with all of them in mind. Instead, natural communities are treated as a proxy for the biological organisms of which they are composed. It is thought that if examples of all of Vermont's natural communities are conserved at the scale at which they naturally occur, most of the species they contain, from the largest trees and mammals to the smallest insects, will also be conserved.[7] Natural communities are thus a coarse filter for "catching" most of an area's native organisms. Because the conservation of habitats (in the form of natural communities) will not protect all species, we also employ a "fine filter" to catch the remaining species that are known to require very specific conditions for their growth, reproduction, wintering, etc. Examples of organisms benefiting from the fine filter inventories described below include breeding birds, deer on their wintering areas, and rare plants.

Ecological Overview

The WRMU is of exceptional ecological importance at local, statewide, and regional scales. It supports a notable diversity of species and natural communities. Fifteen rare or uncommon plant species have been located within the WRMU. Four of these species are particularly vulnerable to trampling by hikers and dogs on the summits of Mount Hunger and Elmore Mountain. Natural communities in the unit range from oak forests along the Winooski River Valley to montane and boreal communities at the highest elevations. The elevational gradient of the unit, most of which is found within intact forest blocks, allows for relatively unhindered movement of species. Locally, this facilitates climate resilience by allowing species to move and adjust ranges in response to climate change. The WRMU supports critical ecological connection from the main spine of the Northern Green Mountains to the large forest blocks of Vermont's Northeastern Highlands. This corridor is ecologically significant far beyond Vermont's borders. The Worcester Range is a key connection for species movement between

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[4] Jenkins, R. E. (1985). The indentification, acquisition, and preservation of land as a species conservation strategy. In *R. J. Hoage ed. Animal extinctions* (pp. 129-145). Washington, D.C.: Smithsonian Institution Press.
[5] See for example: Leslie, M., Meffe, G. K., Hardesty, J. L., & Adams, D. L. (1996). *Conserving biodiversity on militaryl lands: A handbook for natural resources managers.* Arlington, VA: The Nature Conservancy; Stein, B. A., Kutner, L. S., & Adams, J. S. (2000). *Precious heritage: the status of biodiversity in the United States. The Nature Conservancy and the Association for Biodiversity Information*. New York: Oxford University Press.
[6] Anderson, M., Grossman, D., Groves, C., Poiani, K., Reid, M., Schneider, R.,Weakley, A. (1999). *Guidelines for representing ecological communities in ecoregional conservation plans.* Arlington, VA: The Nature Conservancy.
[7] National Council for Air and Stream Improvement, Inc. (NCASI). (2004). *Managing elements of biodiversity in sustainable forestry programs: Status and utility of NatureServe's information resources to forest managers*. Retrieved March 26, 2007, from http://www.natureserve.org/library/ncasi_report.pdf

the Adirondacks and western Massachusetts all the way north and east to Maine, New Brunswick, and the Gaspé Peninsula.

Broad patterns emerged while mapping the natural communities. First, the WRMU is characterized by the large matrix forest community types: Northern Hardwood Forest at lower elevations, and then Red Spruce-Northern Hardwood Forest, Montane Yellow Birch-Red Spruce Forest, and Montane Spruce-Fir Forest as elevation increases. Small patch wetlands are abundant, occurring in both closed basins and because of groundwater seepage. Outcrops and small cliffs are also common in the mountainous terrain. The high mountain summits, including White Rock Mountain, Mount Hunger, and Mount Worcester are characterized by Boreal Outcrop and Red Spruce-Heath Rocky Ridge natural communities. Finally, the warm and dry slopes of the Winooski Valley support communities characterized by red oak. The topography, soils, vegetation, and wildlife associations of each natural community in the WRMU are described below.

Coarse Filter Assessment

Biophysical Region and Climate

The WRMU is in the Northern Green Mountains biophysical region. This region is part of the Appalachian Mountain system that stretches across much of the eastern side of North America. As a result of the high elevations, the region has high levels of precipitation, low temperatures, and a short growing season. The terrain is rugged. The metamorphic bedrock is generally acidic, and the region lacks the limey, nutrient-rich soils found in the neighboring lowlands. Glacial till covers much of the region, but glacial and river sediments are present in the valleys.

Bedrock Geology, Surficial Geology, and Soils

The bedrock underlying the WRMU is mostly metamorphic sedimentary rock dating to the Cambrian-Ordovician era (about 500 million years ago). Most of the unit is underlain by phyllite and schist—generally acidic rocks that contribute little nutrient enrichment, unless topography or hydrology concentrate nutrients. Bands of amphibolite and greenstone in the Worcester Range mountains, however, contain minor dispersed calcium and likely contribute to enrichment. Middlesex WMA is underlain by quartzite, an acidic, erosion resistant rock.

Glacial till, deposited at the end of the last glaciation, some 15,000-12,000 years ago, is the predominant surficial deposit in the unit. This layer of till can be many feet deep. Some of the higher summits in the Worcester Range have large expanses of exposed bedrock; these may never have had a thick layer of till deposited or post-glacial disturbances and erosion may have removed the original till deposits. Glacial till is also present in the valleys, but subsequent depositions of sediments and organic matter have buried much of the till. In particular, the Winooski Valley was initially flooded after the continental glacier retreated, and this lake left deep sand and silt deposits along the valley wall. These deposits are readily visible at Perry Hill in CC Putnam SF, and on the lower slopes of Middlesex Notch WMA. Similar deposits can also be found in the Stowe Valley, including the area around Moss Glen Falls. Finally, many of the wetlands in the WRMU have post-glacial accumulations of muck and peat.

The soils of the WRMU are primarily the products of these surficial deposits. The most widespread soil types are the Tunbridge and Lyman series, which together cover over 6,000 acres of the WRMU, followed by the Rawsonville and Hogback series, which together cover roughly another 3,000 acres. Valleys feature sands, sandy loams, and silty loams, and some widespread soil types include the Adams, Marlow, and Peru series. Wetlands feature organic soils such as Peacham muck.

Hydrology

The Northern Green Mountains receive more precipitation than any other region in Vermont, but the amount any particular place receives depends on elevation and aspect. The high peaks of the Worcester Range receive around 60 inches of precipitation per year, while sites in the Winooski Valley receive substantially less: Middlesex WMA receives only around 38 inches of precipitation per year. With the exception of a very small stretch of the North Branch of the Winooski, no major rivers are found within the boundary of WRMU lands, though there are numerous small streams. Most of the water drains into the Winooski Basin, either by flowing directly into the Winooski River main stem, into the Little River in the Stowe Valley, or into the North Branch of the Winooski in the Worcester Valley. The northern-most portions of the WRMU drain into the Lamoille River. Groundwater is abundant in the mountains, resulting in frequent seepage at the surface. The larger flowages result in a characteristic seep-adapted wetland flora; smaller flows produce mesic (and productive) forest soil conditions. Surface water also collects in depressions to form vernal pools. Overall, wetlands cover just a small percentage of the WRMU by acreage, but small pocket wetlands are widespread and provide important landscape diversity that supports many species of plants and animals.

Landscape-Scale Ecological Context

The WRMU is a critical part of an international network of connected forested habitats in the northeastern US and adjacent Canada. The Worcester Range mountains and their flanks are a critical part of a species corridor connecting the main spine of the Northern Green Mountains to the large forest blocks of Vermont's Northeastern Highlands. This corridor provides an ecologically significant connection far beyond Vermont's borders.

Corridors of connected forest and riparian habitat are critical for conservation of biological diversity. They not only allow individual animals (such as young individuals searching for new habitat) to move throughout the landscape, but also allow for the transfer of genetic information across the region. Even the occasional travel of a few individual animals between otherwise isolated populations can substantially increase the long-term viability of each, because the genetic diversity within each group is effectively increased. In addition, these corridors provide long-term opportunities for species to shift ranges in response to climate change and other stressors.

The majority of the WRMU—including Elmore SP, Middlesex Notch WMA, and nearly all of CC Putnam SF—is within a single forest block comprising more than 45,000 acres. This block provides abundant opportunities for local wildlife movement. It is connected to other forest blocks by several notable pathways. One is west across Route 100 at Shutesville Hill, where a patchwork of small forest blocks and riparian areas provides a route for species movement between the large forest block surrounding Bolton Mountain and Mount Mansfield. This area is a conservation focus for local communities. A second pathway is east across Route 12, to another almost equally large forest block. Worcester Woods WMA is located within this block. The lands along Route 12 have also been a conservation focus, and a substantial area is permanently conserved by private ownership and easements. The third pathway is south across Route 2 and Interstate 89. These roads, along with associated development and a parallel rail line, present significant barriers to species movement. Nonetheless, there is evidence of wildlife movement using culverts and traveling under bridges in this vicinity.

Two outlying parcels, Middlesex WMA and the Middlesex Block of CC Putnam SF, are located within much smaller forest blocks. These areas contribute locally to wildlife habitat and other ecological functions.

Natural Communities

A natural community is an assemblage of biological organisms, their physical environment (e.g., geology, hydrology, climate, natural disturbance regime, etc.), and the interactions between them.[8] The 97 natural community types described in Vermont repeat across the landscape in patches (or "polygons") of various sizes. These patches (or groups of patches in close proximity to each other) are referred to as natural community occurrences and are to be distinguished from broad descriptions of community types.

174 occurrences of 27 natural community types were identified and mapped in the WRMU (see Table 1: Natural Communities of the Worcester Range Management Unit). A total of 460 natural community polygons were mapped. This section includes a summary of the Natural Community Ecological Assessment for the WRMU. See a complete assessment with natural community descriptions inAPPENDICES

APPENDIX 1.

Natural communities in the WRMU were identified through aerial photograph interpretation and field surveys. Natural communities of the Brownsville Forest acquisition were inventoried and described by Matt Peters in a 2019 report "Brownsville Forest Rapid Ecological Assessment; Stowe, VT." Portions of that report have been incorporated into this document and noted as such.

Because some natural communities occur at very small scales (e.g., less than ¼ acre), this mapping effort is probably incomplete. Natural community mapping is an iterative process, and our knowledge improves with each mapping effort. Thus, the map presented here should not be viewed as a final statement on community distribution in the WRMU; instead, it should be treated as a first attempt at describing natural communities in this area. Land managers

[8] Thompson, E., Sorenson, E., & Zaino, R. (2019). *Wetland, woodland, wildland: a guide to the natural communities of Vermont.* Vermont Fish and Wildlife Department, Vermont Land Trust, and The Nature Conservancy. Distributed by Chelsea Green Publishing, Inc: White River Junction, VT.

and members of the public should be aware that additional examples of small patch natural communities (e.g., vernal pools and seeps) probably occur on the management unit. As subsequent inventories and site visits are conducted, this map will be improved.

Natural community occurrences are assigned a quality rank, a statement of their overall ecological value which helps guide management. An "A"-ranked occurrence is of high quality relative to others of its type in the state, while a D-ranked example is of comparatively low quality. Quality ranks are objectively assigned on the basis of three factors: occurrence size, current condition, and landscape context. The three factors vary in the degree to which they influence overall quality in different communities. For example, size and landscape quality are more important factors than current condition in the quality ranking of Northern Hardwood Forests, while current condition and landscape context receive greater attention in the ranking of Rich Northern Hardwood Forests. It is important to recognize that assignment of low-quality ranks may be due to small size rather than poor current condition. When community occurrences are either rare or of high quality (or a combination of these factors), they may be designated as being of "statewide significance." This designation is applied according to objective guidelines established by the Vermont Fish and Wildlife Department, and which are available upon request. It is recommended that state-significant natural communities be afforded a higher level of protection than other areas of the management unit.

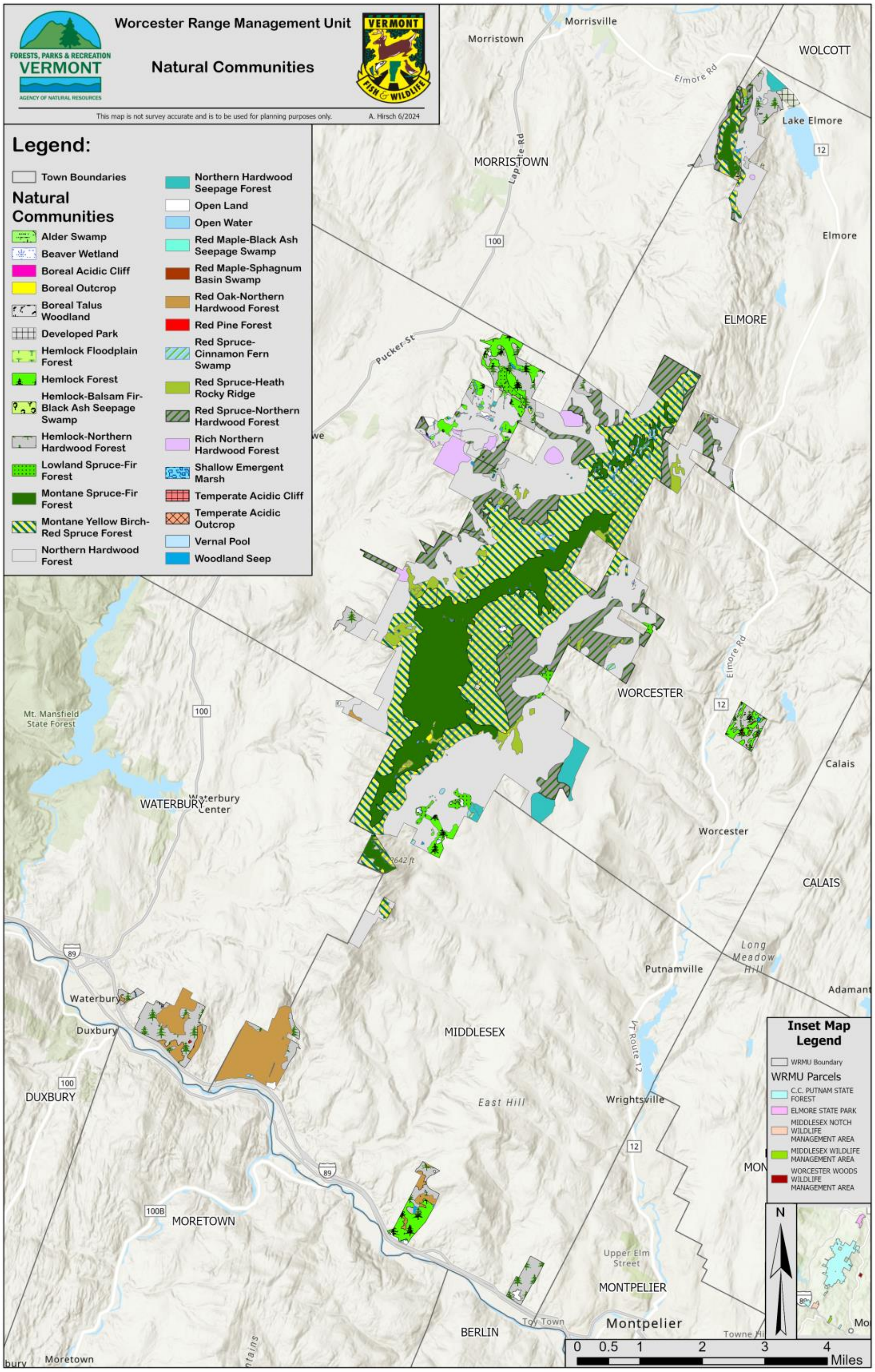
Some broad patterns emerged from this mapping effort. First, the WRMU is characterized by the large matrix forest community types: Northern Hardwood Forest at lower elevations, and then Red Spruce-Northern Hardwood Forest, Montane Yellow Birch-Red Spruce Forest, and Montane Spruce-Fir Forest as elevation increases. Small patch wetlands are abundant, occurring in both closed basins and because of groundwater seepage. Outcrops and small cliffs are also common in the mountainous terrain. The high mountain summits, including White Rock Mountain, Mount Hunger, and Mount Worcester are characterized by Boreal Outcrop and Red Spruce-Heath Rocky Ridge natural communities. Finally, the warm and dry slopes of the Winooski Valley support communities characterized by red oak. The topography, soils, vegetation, and wildlife associations of each natural community in the WRMU are described below.

Table 1: Natural Communities of the Worcester Range Management Unit[9]

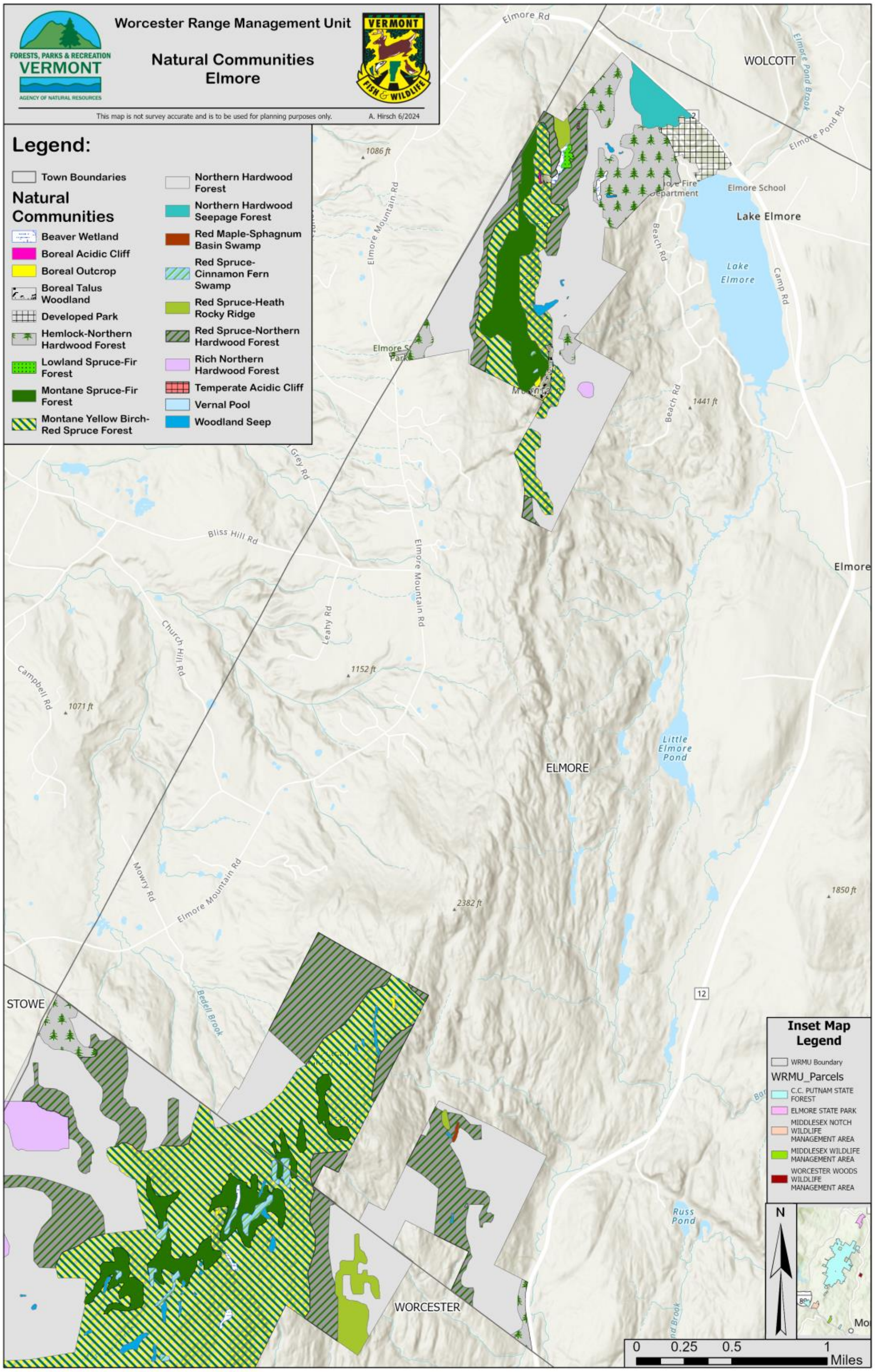
Natural Community		Acres	Vermont Distribution	Example of Statewide Significance?
Wetlands	Alder Swamp	2	very common	
	Beaver Wetland	46	very common	n/a
	Hemlock Floodplain Forest	1.6	*unknown*	
	Hemlock-Balsam Fir-Black Ash Seepage Swamp	5	uncommon	yes
	Northern Hardwood Seepage Forest	287	uncommon	yes
	Red Maple-Black Ash Seepage Swamp	0.3	common	
	Red Maple-Sphagnum Basin Swamp	5.5	uncommon	yes
	Red Spruce-Cinnamon Fern Swamp	60	uncommon	
	Shallow Emergent Marsh	1.5	common	
	Vernal Pool	2.4	uncommon	unknown
	Woodland Seep	51		
Uplands	Boreal Acidic Cliff	0.5	common	yes
	Boreal Outcrop	13	common	yes
	Boreal Talus Woodland	10	uncommon	yes
	Hemlock Forest	565	common	yes
	Hemlock-Northern Hardwood Forest	1191	very common	
	Lowland Spruce-Fir Forest	143	uncommon	yes
	Montane Spruce-Fir Forest	2378	uncommon	yes
	Montane Yellow Birch-Red Spruce Forest	4386	uncommon	yes
	Northern Hardwood Forest	6089	very common	yes
	Red Oak-Northern Hardwood Forest	831	common	yes
	Red Pine Forest	1	rare	yes
	Red Spruce-Heath Rocky Ridge	312	uncommon	yes
	Red Spruce-Northern Hardwood Forest	2029	very common	yes
	Rich Northern Hardwood Forest	272	common	yes
	Temperate Acidic Cliff	0.3	common	
	Temperate Acidic Outcrop	2	common	Yes

[9] For more information on these and other natural communities, see Thompson, E., Sorenson, E., & Zaino, R. (2019). *Wetland, woodland, wildland: a guide to the natural communities of Vermont.* Vermont Fish and Wildlife Department, Vermont Land Trust, and The Nature Conservancy. Distributed by Chelsea Green Publishing, Inc: White River Junction, VT.

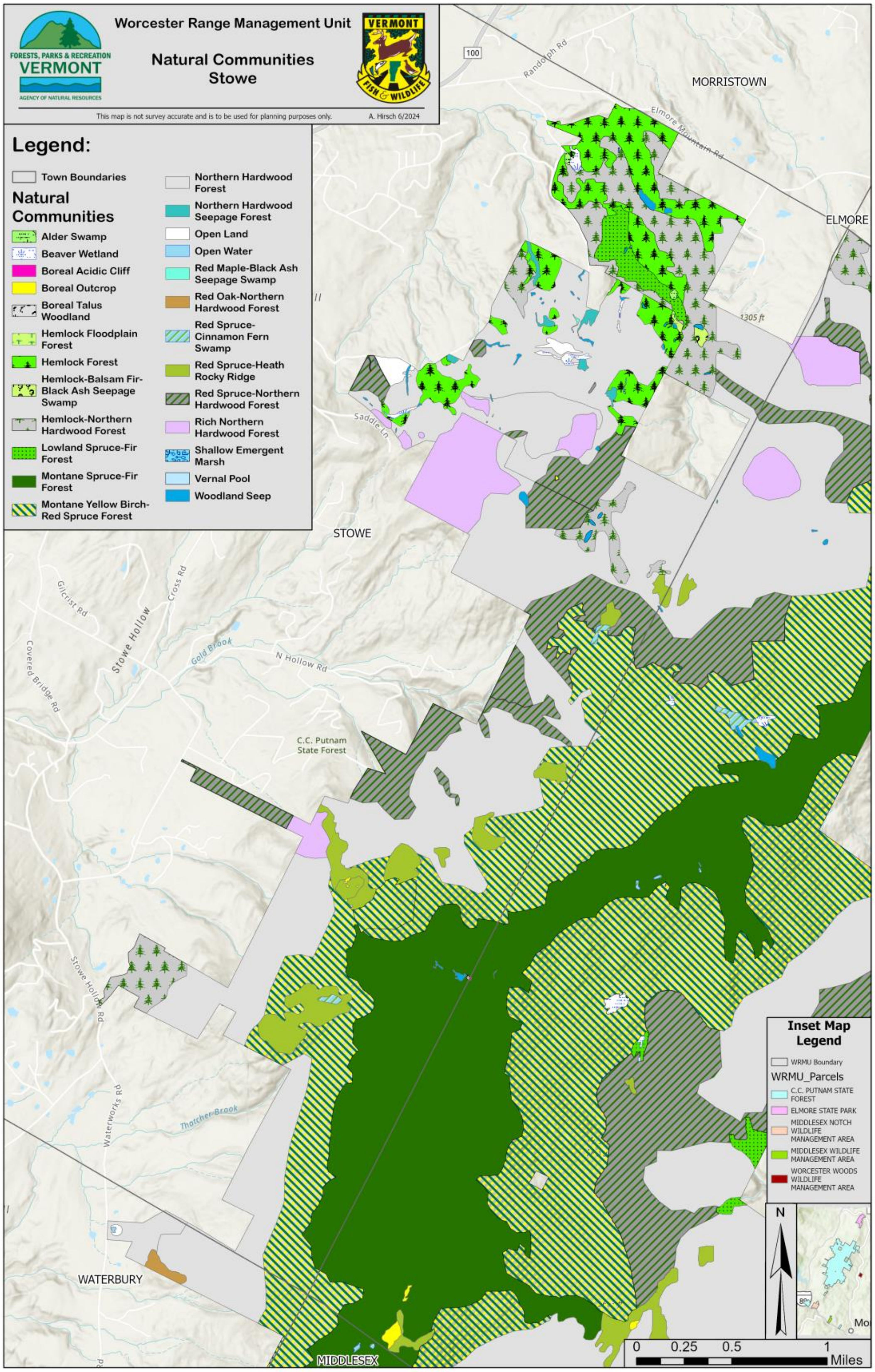
Map 8: Natural Community Map



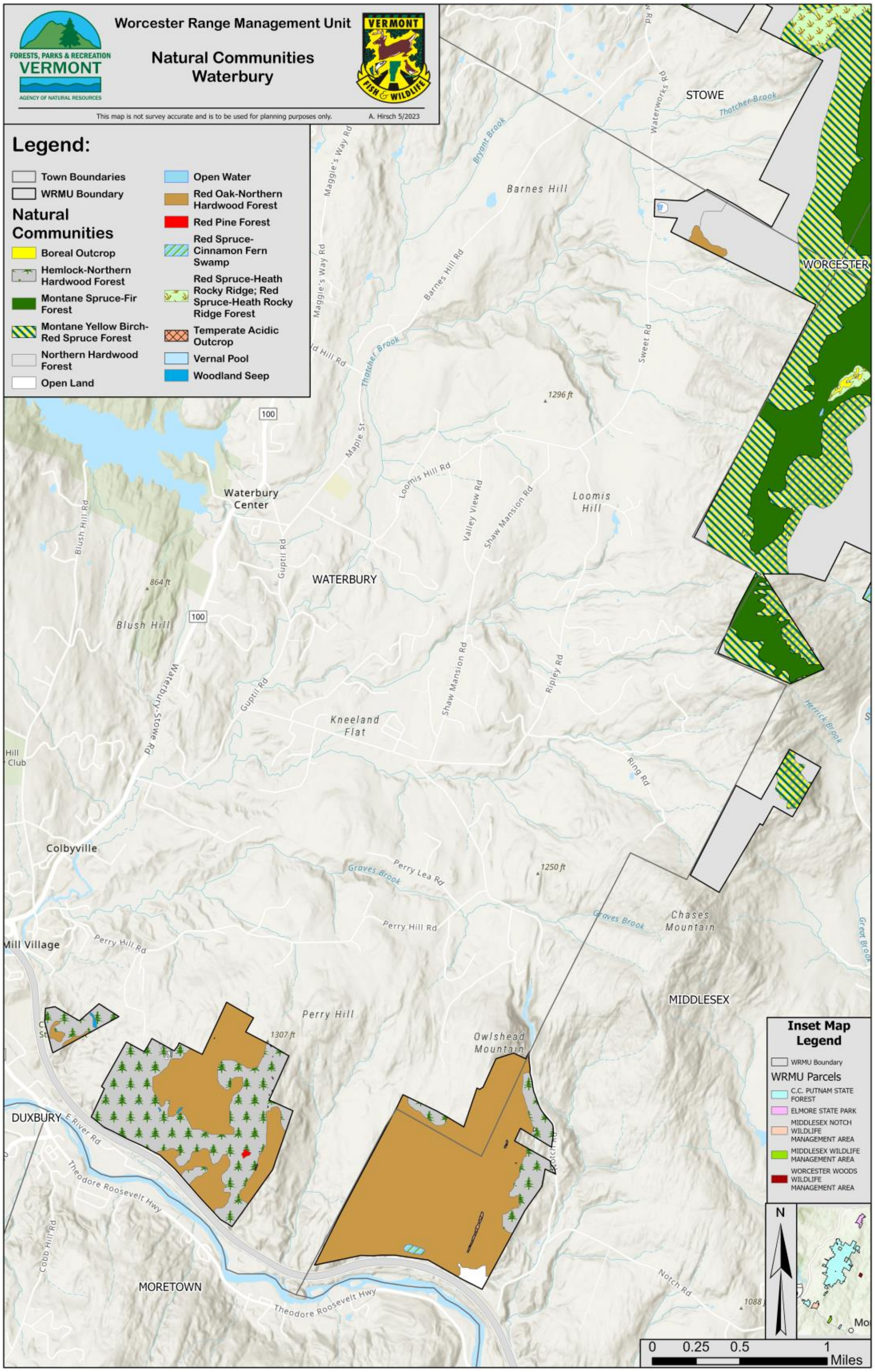
Map 9: Natural Community Map - Elmore



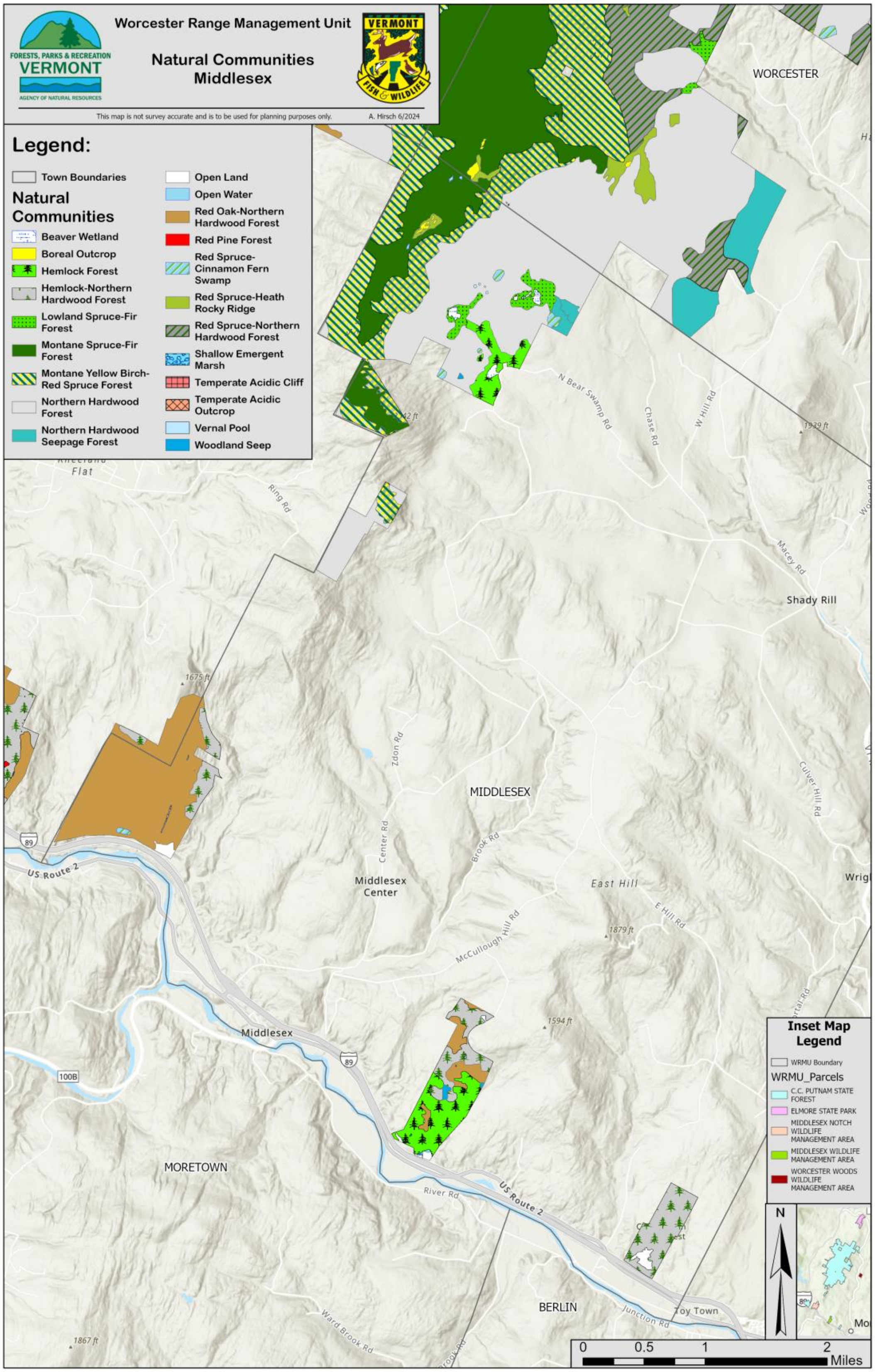
Map 10: Natural Community Map - Stowe



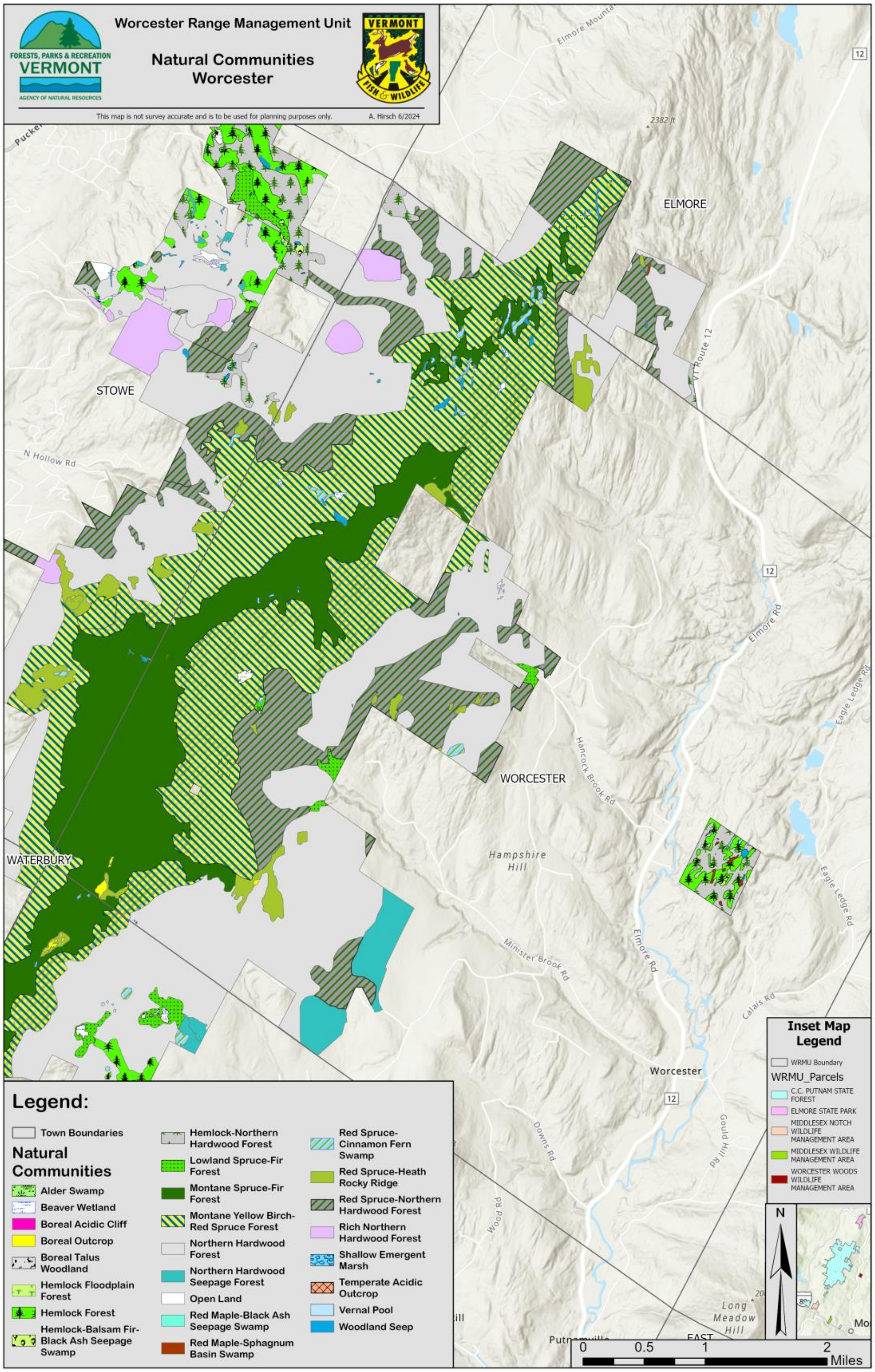
Map 11: Natural Community Map - Waterbury



Map 12: Natural Community Map - Middlesex



Map 13: Natural Community Map - Worcester



Fine Filter Assessment

Rare, Threatened, and Endangered Species
The WRMU is home to a number of rare and uncommon species of animals and plants. These species and their management needs are summarized in the Table 2 below.

Plants
Eight species of rare or very rare plants have been located within the WRMU, as well as seven species of uncommon plants. No legally protected plant species are known to occur within the WRMU.

Table 2: Rare, Threatened, and Endangered Plants of the Worcester Range Management Unit

Species Name	Common Name	Sites Where Found	State Rarity Rank[10]	Rarity*
Agrostis mertensii	Boreal Bentgrass	Mount Hunger	S1	Very Rare
Carex bigelowii	Bigelow's Sedge	Mount Hunger	S1	Very Rare
Ephemerum sp. (*crassinervium* or *spinulosum*)	A moss	Beaver Wetlands	S1-S3	Very Rare to Uncommon
Arceuthobium pusillum	Dwarf Mistletoe	Spruce-Fir Swamps	S2	Rare
Calystegia sylvatica ssp. *fraterniflora*	Twin-Flower Hedge Bindweed	Shrubby Roadside	S2	Rare
Vaccinium uliginosum	Alpine Bilberry	Mount Hunger	S2	Rare
Vaccinium vitis-idaea	Mountain Cranberry	Mount Elmore	S2	Rare
Luzula parviflora	Small-Flowered Rush	Montane Spruce-Fir Forest	S2-S3	Rare to uncommon
Asclepias exaltata	Poke Milkweed	Oak Forests	S3	Uncommon
Cardamine concatenate	Cut-Leaved Toothwort	Rich Forest	S3	Uncommon
Carex formosa	Handsome Sedge	Hunger Mountain trailhead	S3	Uncommon
Conopholis americana	Oak-Drops	Oak Forests	S3	Uncommon
Galium kamtschaticum	Boreal Bedstraw	Seeps	S3	Uncommon
Galium trifidum	Small Bedstraw	Red Maple Swamp	S3	Uncommon
Galium trifidum	Showy Mountain Ash	Montane Forests	S3	Uncommon

*There are no known legally protected plants in the WRMU

[10] For a full explanation of these rarity ranks, visit: https://vtfishandwildlife.com/conserve/conservation-planning/natural-heritage-inventory

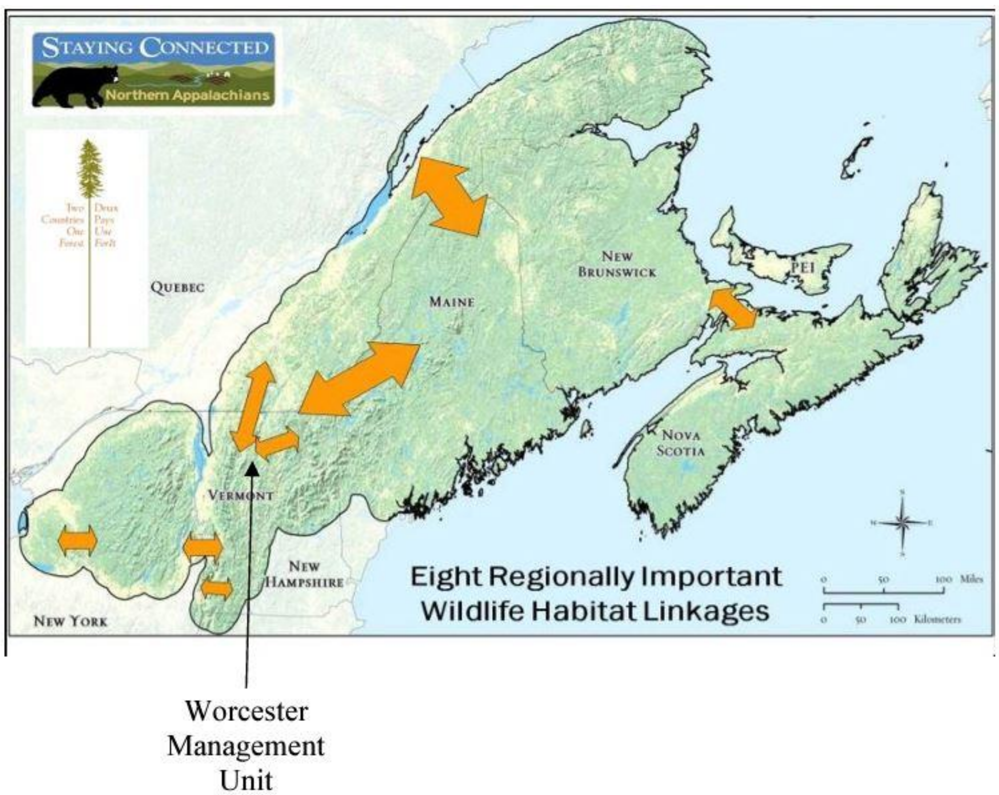
C. Wildlife and Habitat Assessment

Bird and Mammal Overview

Natural Communities and Wildlife Habitat

The WRMU (WRMU) encompasses one of the largest contiguous forest blocks in the state. This feature and its proximity to the Northern Green Mountain Forest make the WRMU an important part of the habitat linkage permitting critical north-south and east-west travel by wildlife possible. So important is this area to wildlife, it was identified by the Staying Connected Initiative as two of eight such critical linkages in Vermont.

Figure 2: Northern Appalachian Wildlife Habitat Linkages identified by the Staying Connected Initiative.[11]



General Habitat Condition

The WRMU is predominately forested with wetlands, vernal pools, herbaceous openings, and talus comprising less than 2% of the management unit. When assessing the forest block for measures of diversity beyond the landscape level it is necessary to view them at a finer scale of diversity that is measured by age rather than forested versus unforested acres. Although having been logged extensively by early European settlers and subsequently farmed by their descendants (1700-1900), much of the WRMU since then has experienced only limited, light

[11] Adapted from https://stayingconnectedinitiative.org/wp-content/uploads/2022/08/SCILinkageBoundaries_May_2015.pdf

timber harvesting. The extensive acreage and few access points of the ownership limit the ability of forestry staff to measure current forest stand characteristics. However, based on partial inventories conducted in 1990, mean stand diameters were determined to range between 9 and 14 inches. As these means were measured over 30 years ago, and no removal by harvest has occurred since, it is reasonable to estimate the dominant trees range in age between 90-120 years old. These figures would indicate a dominant forest cover of relatively old and large trees. Aside from small groups of trees being thrown from a weather event, sapling and pole-sized stands do not occur in any measure of abundance.

The understory vegetation has not been systematically measured but the natural community analysis reports varying levels of understory diversity depending on past land use and growing site nuances such as aspect and soil depth. Lower elevations have the most recent human uses and have the greatest amount of uniformity of age class distribution. Within the management unit generalist species of wildlife such as deer, blue jays, raccoons, and red squirrels are considered abundant and widely distributed. Whereas the upper elevations have experienced mostly natural disturbance and have a corresponding greater amount of heterogeneity among its stand structure. describes the general forest conditions influenced by seral stage and soil moisture that are found on the WRMU.

Table 3. Descriptive terms of general forest condition resulting from its seral stage and soil moisture.

Term	Definition
Mixed	A combination of deciduous and coniferous trees that are also mixed in aged but have a developed canopy of at least 30 feet.
Mature	Deciduous, coniferous, or mixed species characterized by a predominance of trees 80– 100 years old or older with some downed stems and heavy influence of shade from the canopy.
Early Succession	Coniferous, deciduous, or mixed species characterized by pin cherry, aspen, white pine 1-50 years old.
Open/Edge	A condition in any forest type where a vegetative seam is created by the merging of two or more cover types or a ‘hole’ in the canopy occurs due to wind, beavers, or humans.
Wetland	Vegetation closely associated with the influence of a consistent presence of water during part or all the growing season. Some species closely associated with this type are alders, willows, red maple, and sedges.

Given the expansiveness of the major forest types comprising the WRMU, the property supports the range of bird and mammal species that depend and even thrive on the interior forest that can’t easily be found elsewhere in the state. Examples of these include Scarlet Tanager, Northern Goshawk, and perhaps even Pine Marten.

Common bird and mammal species observed within the WRMU include moose (*Alces alces*), white-tailed deer (*Odocoileus virginiana*), black bear (*Ursus Americana*), bobcat (*Lynx rufus*), river otter (*Lutra Canadensis*), fisher (*Martes pennanti*), mink (*Mustela vison*), striped skunk (*Mephitis mephitis*), snowshoe hare (*Lepus americanus*), eastern coyote (*Canis latrans*), raccoon (*Procyon lotor*), beaver (*Castor Canadensis*), many species of birds ranging from warblers to thrushes, woodpeckers to sparrows, to owls and hawks, and numerous small mammals associated with this type of ecosystem (e.g. red and gray squirrels, porcupine, weasels, and deer mice).

Birds

The variety of natural communities, range of elevations, and soils support a corresponding array of bird life in the WRMU. Perhaps the single most important asset of the ownership for birds is the large contiguous nature of the forestland. Although bounded by paved highway, the 15,600 acres of uninterrupted forest represents a significant ecological entity of interior forest to which many bird species depend on. Examples of species benefiting from this increasingly rare habitat are Northern Goshawk (*Accipiter gentilis*), Swainson's Thrush (*Catharis ustulatus*), Wood Thrush (*Hylocichla mustelina*), Hermit Thrush (*Catharis guttatus*), Scarlet Tanager (*Piranga olivacea*), and Ruby-crowned Kinglet (*Regulus calendula*). The few but well-distributed wetland pockets formed by beaver dams create open sedge and edge habitat suitable for Northern Waterthrush (*Parkesia noveboracensis*), American Redstart (*Setophaga ruticilla*), Chestnut-sided Warbler (*Setophaga pensylvanica*) and three flycatchers, Alder (*Empidonax alnorum*), Willow (*Empimodax trailii*), and the Great-crested (*Myairchus crinitus*). Due to the high suitability and dominance of forested habitats, grassland habitat is conversely rare to non-existent (save for that associated with beaver flowages) and therefore associated grassland species such as Bobolink (*Dolichonyx oryzivoris*) and Vesper Sparrow (*Pooecetes gramineus*) are also rare or nonexistent. Three game bird species related to forested habitats are commonly found on the WRMU. Ruffed Grouse (*Bonasa umbellus*) are the most common of the three due to their frequency among the northern hardwood community. Grouse can be found throughout the WRMU as they utilize different feeding and ground-nesting habitats depending on the time of year. American Woodcock (*Scolopax minor*) make use of moist soils and forest openings associated with beaver dams for feeding, courtship, and nesting habitat. The Wild Turkey (*Meleagris gallopavo*) ranges throughout the lower and mid-elevations of the WRMU in search of food and roosting cover. The nesting habitat for turkeys is widely, but likely sparsely, distributed which is most often associated with the forest edges and fallen trees.

Mammals

The forested habitats of the WRMU support a variety of mammal species common to the deciduous and coniferous forests of Vermont. The largest mammals, moose (*Alces alces*), black bear (*Ursus americanus*), and white-tailed deer (*Odecoileus virginianus*) can be found throughout the WRMU but also concentrated in their respective feeding and wintering areas at seasonal times. Mid-sized mammals such as bobcat (*Lynx rufus*), fisher (*Pekania pennanti*), grey fox (*Urocyon cinereoargenteus*), and raccoon (*Procyon lotor*) are dispersed throughout the forest but like their larger counterparts also seek specific habitat features to take cover from the weather and to rear young. The smaller mammals such as snowshoe hare (*Lepus Americana*), red squirrel (*Tamiasciurus hudsonicus*), grey squirrel (*Sciurus carolinensis*), northern flying squirrel (*Glaucomys sabrinus*), and short-tailed weasel (*Mustela erminea*) are common residents of the WRMU. The smallest mammals include the short-tailed shrew (*Blarina brevicauda*), masked shrew (*Sorex cinereus*), woodland jumping mouse (*Napaeozapus *insignis*), white-footed deer mouse (*Peromyscus leucopus*), and red-backed vole (*Myodes gapperi*) and are also common on the unit. Collectively, they can be found throughout the WRMU where fallen limbs, trees and accumulated leaf litter provide protective cover and food sources like seeds and invertebrates.

Listed Bird and Mammal Species (T&E) and Species of Greatest Conservation Need (SGCN)

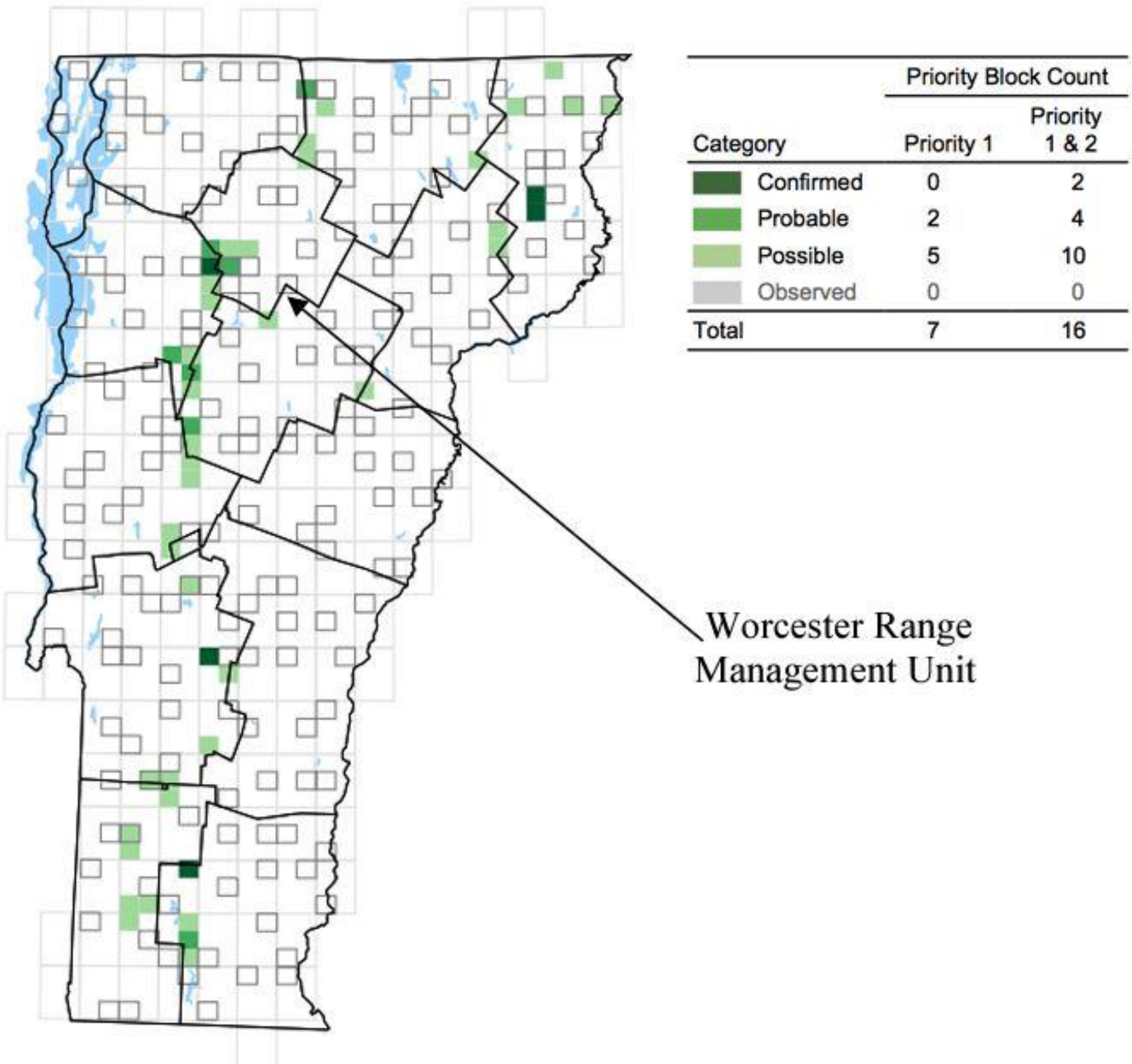
Birds

Thirteen species of birds are listed as endangered or threatened in Vermont. However, only three of them occupy forest habitat at some time during their lives. Of those the Whip-poor-will (*Antrostomus vociferous)* requires extensive grassland intermixed with forest to nest and feed which makes it a very unlikely resident of the WRMU. Spruce Grouse (*Falcipennis Canadensis)* require intermediate aged boreal forests of black spruce and balsam fir interspersed with grassy openings to meet their life requirements. Sufficient acreage habitat of this type does not exist on the management unit to support Spruce Grouse. The Rusty Blackbird (*Euphagus carolinus)* shares similar boreal forest features with the Spruce Grouse. Extensive poorly drained surfaces from which to forage for invertebrates and their eggs is an essential habitat component for the blackbird. The WRMU does not have sufficient areas of this habitat to support nesting Rusty Blackbirds.

Two montane forest bird species categorized as SGCN inhabit the management unit. They are the Blackpoll Warbler (*Setophaga striata*) and Bicknell's Thrush (*Catharus bicknelli*). Bicknell's Thrush (abbreviated as BITH) has been the subject of much study over the last 20 years and its' population is thought to be in one of the most precarious situations of any North American bird population. An obligate occupant of the limited distribution of the southern Quebec and Maritime spruce-fir forest and the montane spruce-fir forest of northern New England and the Adirondacks of New York state, it spends its winter months largely on the island of Hispaniola and neighboring islands where agricultural uses of the island are replacing the forest cover critical to the Thrush's survival. The population of Bicknell's Thrush (BITH) is estimated to be less than 100,000 individuals.

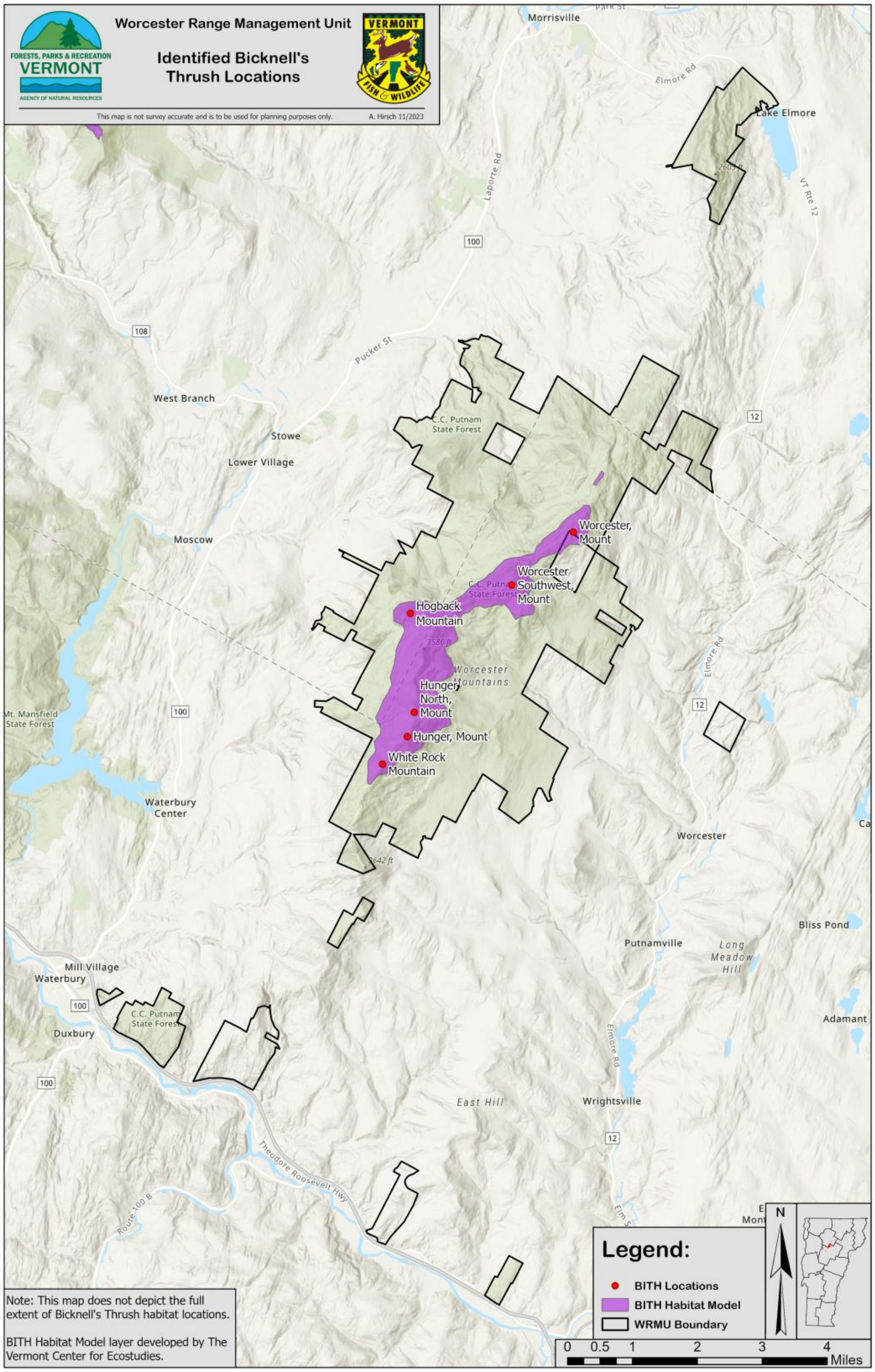
WRMU's montane spruce-fir forest has documented observations of singing male BITH. Although few points with singing males have been identified it is possible more sites exist. This is because the habitat is extremely difficult to survey due to its remote location and lack of clear pathways for observers to navigate the area. This natural community makes up 1561 acres (19%) of the management unit which is significant not only in its size but its contiguous and relatively free of human impacts. That highlights the important role the WRMU serves in Bicknell's Thrush conservation. Map 14 illustrates the few priority blocks where BITH were identified during data collection for the Second Vermont Breeding Bird Atlas published in 2013. Map 14 illustrates the limited locations where BITH have been identified on the management unit.

Map 14: Bicknell's Thrush priority block breeding bird locations from the Second Vermont Breeding Bird Atlas (2013).



Category	Priority Block Count: Priority 1	Priority Block Count: Priority 1 & 2
Confirmed	0	2
Probable	2	4
Possible	5	10
Observed	0	0
Total	7	16

Map 15: Identified locations of singing male Bicknell's Thrush during recent Mountain Bird Watch breeding bird surveys and Bicknell's Thrush habitat model developed by the Vermont Center for Ecostudies.



Mammals

The devastating effects of White Nose Syndrome has reduced Vermont cave-dwelling bat populations to near extinction levels and has led to the state listing of four species as endangered. The northern long-eared bat is also federally listed. Those species not listed are considered to be SGCN. Acoustic survey work has not yet been conducted on the WRMU, but surveys conducted by FWD wildlife biologists during the summer of 2015 in the neighboring towns of Bolton and Duxbury recorded the presence five bat species identified in Table 4.

Table 4: Bat species recorded during acoustic surveys in Duxbury and Bolton, Vermont 2015

Species	Scientific Name
Big brown bat	*Eptesicus fuscus*
Little brown bat	*Myotis lucifugus*
Hoary bat	*Lasiurus cinereus*
Eastern red bat	*Lasiurus borealis*
Silver-haired bat	*Lasionycteris noctivigans*

These species have been found at many of the locations around the state where acoustic surveys have been conducted. Given the habitat similarities between the survey towns and WRMU the presence of these species is very likely. However, presence is not synonymous with abundance so acoustic surveys must be conducted prior to any significant forest management work on the unit.

Data from the survey indicates evidence of the state endangered tri-colored bat, *Perimyotis subflavus*, activity in acoustic data from along the Winooski River in Duxbury on a single night. Not much is known about this species' summer behavior, so they could potentially be present, but are rare on the landscape overall. Indiana bats, *Myotis sodalis*, are not expected to occur on the management unit as it is higher elevation and well east of their known Vermont range. Northern long-eared bats could potentially be living on the management unit as they were once widespread throughout Vermont forests. They were not detected in Bolton or Duxbury in 2015 but they can be difficult to positively identify in acoustic data because they are "whispering bats." The State threatened eastern small-footed bat, *Myotis leibii*, tends to dwell in cliffs and other talus in the summer. One individual was detected in Bolton so there is reason to believe occurrence in the talus natural communities of the WRMU is very possible. These survey results reiterate the need for acoustic monitoring of the management unit to determine the presence of this and other state and federally listed bat species.

In summary, the WRMU plays a very important role in the conservation of many Vermont listed bird (Table 5) and mammal (Table 6) species.

Table 5: Vermont T&E and SGCN Birds of the WRMU

Taxa	Species	Scientific Name	Listing Status
Birds	Bicknell's Thrush	*Catharis Bicknelli*	SGCN
	Wood Thrush	*Hylocichla mustelina*	SGCN
	Blackpoll Warbler	*Setophaga striata*	SGCN
	Black-throated Blue Warbler	*Setophaga caerulescens*	SGCN
	Chestnut-sided Warbler	*Setophaga pensylvanica*	SGCN
	American Black Duck	*Anas rubripes*	SGCN
	Common Loon	*Gavia immer*	SGCN
	Great Blue Heron	*Ardea herodias*	SGCN
	American Bittern	*Botaurus lentinginosus*	SGCN
	Cooper's Hawk	*Accipter cooperii*	SGCN
	Northern Goshawk	*Acipter gentilis*	SGCN
	Red-shouldered Hawk	*Buteo lineatus*	SGCN

Table 6: Vermont T&E and SGCN Mammals of the WRMU

Taxa	Species	Scientific Name	Listing Status
Mammals	Eastern Small-footed Bat	*Myotis leibe*	State Threatened
	Little Brown Bat	*Myotis lucifigus*	State Endangered
	Northern Long-Eared Bat	*Myotis septentrionalis*	State Endangered/FT
	Tri-Colored Bat	*Perimyotis subflavus*	State Endangered
	Silver-Haired Bat	*Laisionycteris noctivagans*	SGCN
	Hoary Bat	*Lasiurus cinereus*	SGCN
	Rock Vole	*Microtus chrotorrhinus*	SGCN
	Woodland Vole	*Microtus pinetorum*	SGCN
	Rock Shrew	*Sorex dispar*	SGCN
	American Pygmy Shrew	*Sorex hoyi*	SGCN

It is important to note that systematic surveys of the WRMU for listed species and SGCN have not been conducted. It is possible for additional species to be added to these lists following coordinated surveys for them are implemented.

Necessary Wildlife Habitat

Deer Wintering Areas

White-tailed deer are perhaps the state's most well-known species. Hunters and non-hunters alike spend a considerable amount of time and money watching, photographing, and hunting this species. Vermont statute even mandates the deer herd to be managed at a 'healthy and abundant' level. To meet Vermonter's expectations, wintering habitat is essential (i.e., 'necessary') for deer to survive winters in this mountainous and snowy part of Vermont. Mature coniferous species (e.g., balsam fir, red spruce, and Canada hemlock) comprise the majority of the shelter value of this habitat. Other species providing cover value include eastern white pine, white spruce, and northern cedar. Interspersed among the conifers are deciduous species common to these forest types such as sugar maple, yellow birch, red oak, American beech, and white ash. Owing to its essential nature, wintering area habitat is uncommon and not distributed evenly throughout the state. It is estimated that only 13% of the state's deer habitat can support wintering deer. A total of 956 acres of the WRMU is classified as deer wintering area. The acreage is separated into three distinct units and is located in three separate towns (Table 7).

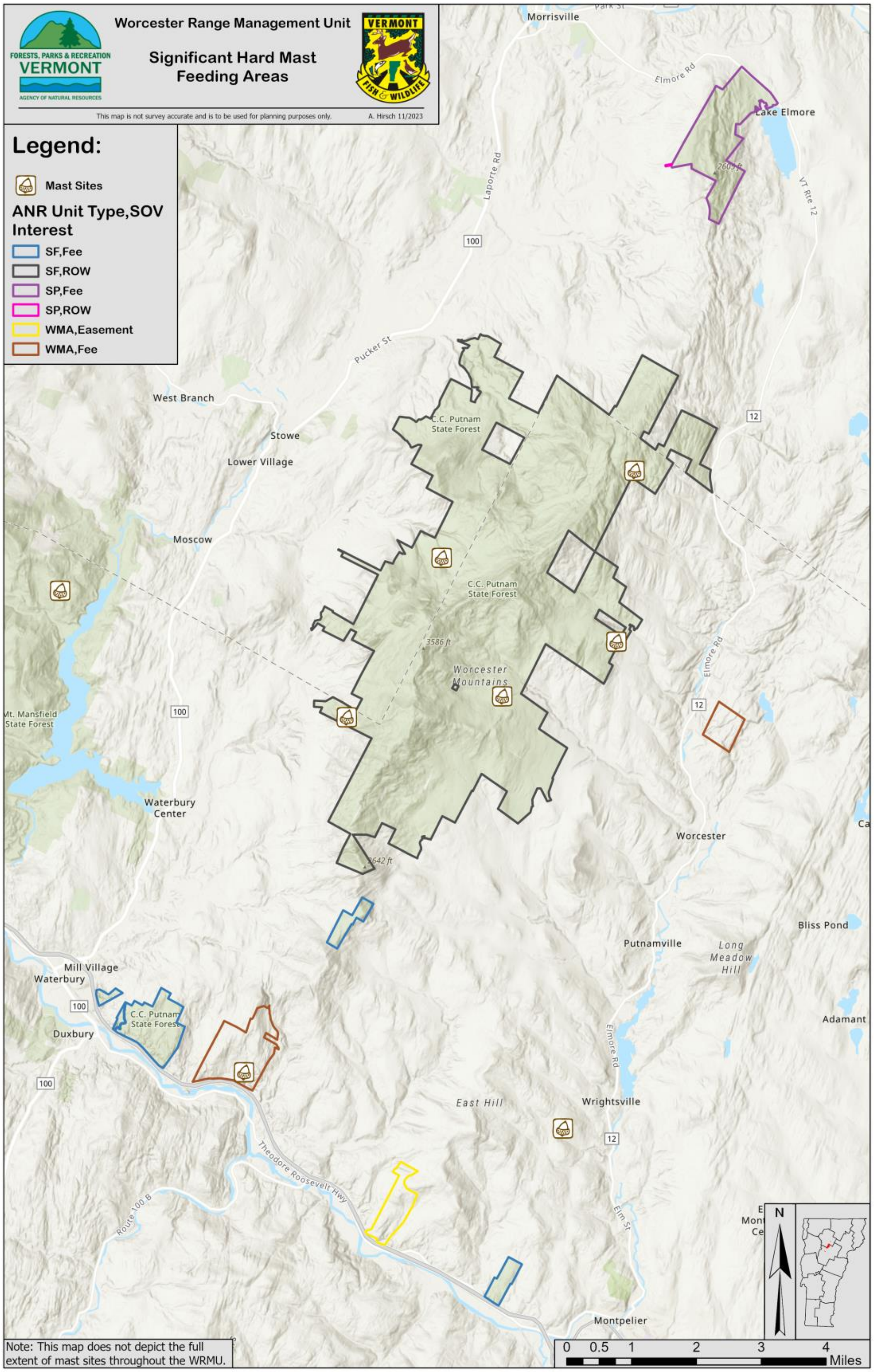
Table 7: WRMU Deer Wintering Area Distribution by Town and Acreage

Town	Acres
Waterbury	510
Morristown	243
Worcester	185 (Worcester Woods Wildlife Management Area)
TOTAL	938 acres

The sum acreage of these wintering areas comprises approximately 5% of the approximate 18,772 acres. Although the quality of these acres is very good, the lower-than-average percent of wintering area habitat correlates with the low pre-hunt deer population estimate of 16.1 deer/ mi^2 (Statewide = 20.5) reported in the *2010-20 Deer Management Plan*.[12] Timber harvests in these habitats should be focused on maintaining or enhancing the overhead cover values of the respective stands while promoting regeneration of the dominant forest type. Adherence to the *Management Guide for Deer Wintering Areas in Vermont* co-authored by the Fish and Wildlife Department (FWD) and the Department of Forests, Parks, and Recreation (FPR) in 1990 will assure these goals are met.[13] Map 16 illustrates the juxtaposition of the wintering area habitat on the WRMU.

[12] Vermont Department of Fish and Wildlife. (2010). *Big Game Management Plan, 2020-2030.* Montpelier: State of Vermont.
[13] VANR. (1999). *Lands Conservation Plan: A Land Acquisition Strategy for the Agency of Natural Resources.* Montpelier: State of Vermont.

Map 16: Deer wintering habitat locations on the WRMU



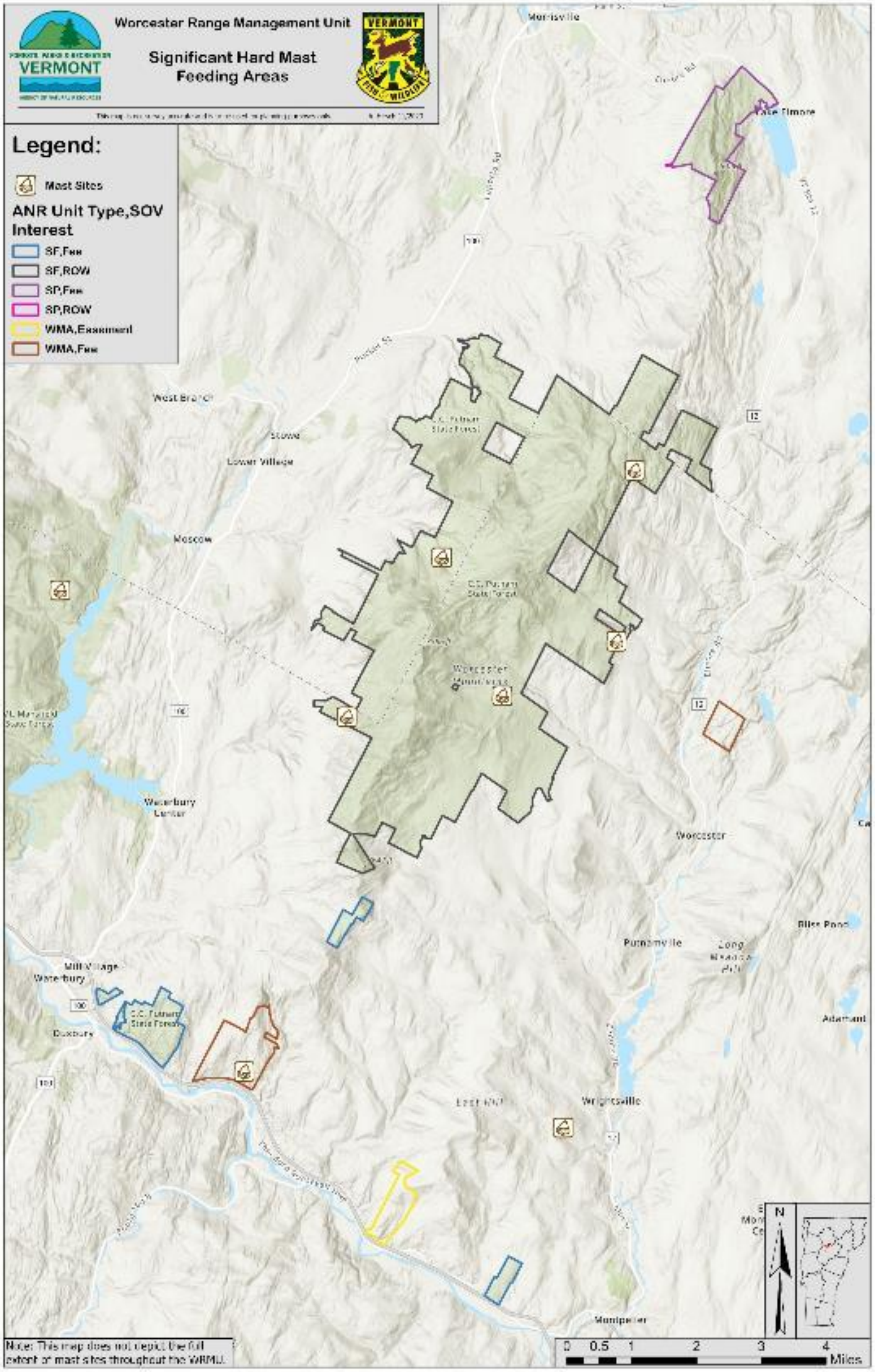
Hard Mast Feeding Areas

Hard mast (i.e., nuts) feeding areas are significantly important for the many wildlife species that rely on this high-fat and protein food source for winter survival. Nuts from oak, beech, hickory, are some of the most common and obvious forms of hard mast but other sources not commonly thought of are equally important because of their common and wide distribution across Vermont. Those would include seeds from yellow and white birch, hophornbeam, ash, and maple. Although these species are found and utilized by wildlife throughout the northern hardwood distribution on the management unit, of particular significance are the concentrations of red oak and American beech. The above average stocking level in these unique growing sites create abundant forage opportunities for wildlife without a large expenditure of energy traveling between trees to obtain the nuts. Because of these unique qualities hard mast areas are uncommon, which further highlights their importance. Of the estimated 18,772 acres in the MU, only 600 acres (3.2%) is classified as a hard mast feeding area. These critical habitats found on the WRMU are either pure stands of oak encompassing modest acreage or higher than average stocking rate of mast producing trees over a large acreage (200+ acres). The WRMU supports six known concentrated feeding areas in 4 different towns (Table 8). Map 17 illustrates the locations of these important feeding sites.

Table 8. Hard mast feeding areas by type, acreage, and town.

Hard Mast Type	Estimated Acreage	Town
Red Oak	10	Waterbury
Red Oak	20	Middlesex
Northern Hardwood (beech >30%)	250	Worcester
Northern Hardwood (beech >30%)	200	Worcester
Northern Hardwood (beech >30%)	100	Worcester
American Beech (significant Black Cherry)	20	Stowe

Map 17: Significant hard mast feeding areas, WRMU



Reptiles

The WRMU provides habitat for a number of common and widespread snake and turtle species, and likely supports at least one uncommon species. The Vermont Reptile and Amphibian Atlas was consulted in the development of this list, along with incidental records of observations. Common garter snake (*Thamnophis sirtalis*) is probably the most abundant reptile species in the unit, as they are found in a wide variety of habitats and elevations, but red-bellied snake (*Storeria occipitomaculata*) and ring-necked snake (*Diadophis punctatus*) are likely also abundant on the management unit. Another common species, milksnake (*Lampropeltis triangulum*), is likely found in some of the lower-elevation openings. While there are no records of its occurrence on the WRMU, it is possible that the uncommon species smooth green snake (*Opheodrys vernalis*) occurs in grassy openings such as beaver meadows. It is likely that most snake species in the WMU use natural rock outcrops and talus for basking and cover. Because there are few large waterbodies within the management unit, turtle habitat is likely limited. Painted turtles (*Chrysemys picta*) and snapping turtles (*Chelrydra serpentina*) are expected to occur in Lake Elmore and might also be present in some of the larger beaver wetlands. Wood turtle (*Glyptemys insculpta*), an uncommon species, has been documented along several streams in the vicinity of the WMU, and may travel upstream into the management unit. Wood turtle is listed as a Species of Concern in Vermont and identified as a Species of Greatest Conservation Need in the Wildlife Action Plan. Maintaining and enhancing water quality and natural riparian zones in the headwaters of these streams will help protect this species.

In the absence of focused surveys for reptiles on the WRMU, it is recommended that site specific surveys be completed prior to future land management actions to provide a more detailed record of presence and distribution on the WRMU.

Invertebrates

Very little is known about the innumerable species of invertebrates found within the Worcester Management Unit. Native invertebrates can play critical roles in plant pollination, seed dispersal, and nutrient cycling.[14] Among many other species, these include bees, wasps and ants (Order *Hymenoptera*), butterflies and moths (Order *Lepidoptera*), dragonflies and damselflies (Order *Odonata*), beetles (Order *Coleoptera*). The Natural Heritage Inventory of the Vermont Department of Fish and Wildlife has recently begun efforts to track the conservation status of some species from these four invertebrate orders. Thus, it is possible that future inventories of the management unit may identify rare or uncommon invertebrate species that could benefit from particular management actions.

Two unusual habitats within the WRMU that might harbor rare invertebrate species include the high-elevation exposed summits, and the sandy soils of the Perry Hill Block of CC Putnam

[14] Didham, R. K., Ghazoul, J., Stork, N. E., & Davis., A. J. (1996). Insects in fragmented forests: a functional approach. *Trends in Ecology and Evolution, 11*(6), 255-260; Losey, J. E., & Vaughan, M. (2006). The economic value of ecological services provided by insects. *Bioscience*, 56(4): 311-323; Potts, S. G., Biesmeijer, J. C., Neumann, C. K., Schweigerm, O., & Kunin, W. E. (2010). Global pollinator declines: trends, impacts and drivers. *Trends in Ecology and Evolution*, 25(6): 345-353.

SF. Several insect species endemic to the alpine zone have been found on Mount Washington in New Hampshire, and in Vermont there is a beetle that is restricted to a small area of the alpine zone on Mount Mansfield.[15] Although not as high in elevation as Mount Mansfield, the summits of the Worcester Range are alpine in character and may provide suitable habitat for specialist species. In contrast, the sandy soils of Perry Hill are on a low-elevation, south-facing slope, and likely one of the warmest habitats in the management unit. Openings in the forest canopy have resulted in about a half-acre area of exposed sand where species of ground-nesting bees have been observed. If opportunities arise for invertebrate inventory, these sites would be a high priority.

Amphibians

The WRMU provides excellent habitat for a variety of amphibian species. In general, the amphibian habitat in the WRMU includes four types: vernal pools, streams, beaver ponds, and uplands. These habitats and their associated amphibian species are discussed below.

Vernal Pools

Vernal pools are essential habitat for three species found in the WRMU: spotted salamander, Jefferson salamander, and wood frog. All three species use vernal pools in the spring as breeding habitat. During the rest of the year, they disperse into the surrounding upland forest. These species are sensitive to negative impacts both to the vernal pool itself and the surrounding upland. Research shows that some wood frogs can travel over 1,000 feet from the pool.[16] Large pools may be used by other amphibian species as well, including eastern newt, spring peeper, green frog, and American toad.

Natural community inventory in the WRMU identified 29 distinct vernal pools within the WRMU. Many of these pools occur in clusters with multiple vernal pools in close proximity, increasing the overall habitat value. Important concentrations of pools are found in the Perry Hill Block of CC Putnam SF, Middlesex Notch WMA, and Worcester Woods WMA. Other vernal pools are scattered around the management unit. In addition, it is likely that additional pools are present but were not found during inventory. Many pools have not been fully assessed to determine their suitability for amphibian breeding; it is important to conduct additional survey work if management activities are planned near any of these pools. Amphibians may also in congregate marginal habitats such as water-filled skidder ruts or other human-caused ground disturbances. In general, these anthropogenic pools are unlikely to provide suitable habitat and end up functioning as the population sinks.

Streams

Three species of salamanders in the WRMU rely on streams and associated riparian habitat: northern two-lined salamander, northern dusky salamander, and spring salamander. These

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[15] Johnson, C. (1998). The Nature of Vermont: Introduction and Guide to New England Environment. *Hanover, NH: University Press of New England*.

[16] Baldwin, R. F., Calhoun, A., & deMaynadier, P. G. (2006). Conservation planning for amphibian species with complex habitat requirements: a case study using movements and habitat selection of the wood frog Rana sylvatica. *Journal of Herpetology, 40*(4), 442-453.

species are generally found very close to or within small, rocky streams, but some may travel up to several hundred feet away when the ground is wet. Because these species are generally common in undisturbed habitats but can be negatively impacted by disturbances to water quality, canopy cover, or ground cover, they are considered good indicators of habitat quality and ecosystem integrity.[17]

The many miles of streams in the WRMU are mostly within undisturbed forest habitat and would be expected to provide excellent habitat for stream salamanders. Occasional disturbance from timber harvesting may result in localized negative impacts. Additionally, streams in the Perry Hill Block of CC Putnam SF may experience negative impacts from trail erosion. Preventing soil erosion and maintaining canopy cover in riparian zones can reduce or prevent these potential negative impacts.

Beaver Ponds

The mountainous terrain of the WRMU provides little lake or pond habitat. Small beaver ponds can be found throughout the WRMU, but because of the terrain these are usually small and may be short-lived as beavers use up food resources in an area. These beaver ponds can support eastern newt, American toad, gray treefrog, green frog, pickerel frog, and spring peeper. Two species that use lake and pond habitat, American bullfrog and northern leopard frog, are known to occur in the area around the WRMU but may not be present on the state lands due to a lack of large waterbodies (the WRMU does include a small length of developed beach frontage on Lake Elmore, but this is likely of limited habitat value.) Beaver ponds are ephemeral, thus the species that use them need to move as habitat conditions change. Maintaining forest cover and riparian connectivity will provide opportunities for movement and dispersal for these amphibian species in the WRMU.

Uplands

The forested habitat of the WRMU provides habitat for the eastern red-backed salamander, the only entirely terrestrial salamander in Vermont. This common species needs leaf litter and downed woody debris which both trap moisture in the soil and provide cover. Since this species is sensitive to changes in soil moisture and chemistry, it can be a good indicator of habitat conditions and ecosystem integrity.[18] The eastern newt is another species that depends on upland forests. While adults are aquatic, the “red eft” stage is terrestrial, and the bright orange or red salamanders are a familiar sight on rainy days. Like the eastern red-backed salamander, the red eft needs moist soil and cover.

To enumerate all the species found on the Worcester Range would require extensive inventory work and good luck that they were present when the observers were there. Table 9 lists

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[17] Crawford, J. A., & Semlitsch, R. D. (2007). Estimation of core terrestrial habitat for stream-breeding salamanders and delineation of riparian buffers for protection of biodiversity. *Conservation Biology, 21*(1), 152-158.
[18] *Google Maps*. (2020, February). Retrieved from https://www.google.com/maps/@44.2630144,-72.5740712,14z.
Hartwell, H. W., & Droege, S. (2001). A case for using Plethodontid salamanders for monitoring biodiversity and ecosystem integridy of North American forests. *Conservation Biology*, 558-569.

species likely to be found or observed on the WRMU and the principal habitat setting they would be found in. They are grouped into five general categories as discussed below. Because many of the species use multiple habitats and age types this should not be construed as a definitive list of species or description of habitat. References are provided at the end of this technical appendix to direct readers to more authoritative sources.

Table 9. Birds, Mammals, Reptiles, and Amphibians Likely to Inhabit the Worcester Range Forest Block

Class	Mixed	Mature	Early Succession	Open/Edge	Wetland
Birds	Great-Horned Owl	Swainson's Thrush	Alder Flycatcher	Mourning Dove	Common Loon
	Barred Owl	Scarlet Tanager	Least Flycatcher	Chimney Swift	Belted
Kingfisher					
	Saw-Whet Owl	Bicknell's Thrush	Chestnut-sided Warbler	Song Sparrow	Swamp
Sparrow					
	Yellow-Bellied Sapsucker	Blackpoll Warbler	American Redstart	Northern Flicker	Osprey
	Downy Woodpecker			Eastern Kingbird	Bald Eagle
	Pileated Woodpecker			Tree Swallow	Great Blue
Heron					
	Hairy Woodpecker			Bank Swallow	Wood Duck
	Eastern Wood-Pewee			Barn Swallow	American Black
Duck					
	Eastern Phoebe			House Wren	Mallard
	Great Crested Flycatcher			Gray Catbird	Blue-winged
Teal					
	Blue-Headed Vireo			Cedar Waxwing	Common
Merganser					
	Red-Eyed Vireo			Yellow Warbler	Osprey
	Blue Jay			Chipping Sparrow	
	American Crow			Red-Tailed Hawk	
	Common Raven			Indigo Bunting	

	Black-Capped Chickadee			Northern Cardinal	
	Red-Breasted Nuthatch			Red-Winged Blackbird	
	White-Breasted Nuthatch			Common Grackle	
	Brown Creeper			Brown-Headed Cowbird	
	Winter Wren			Baltimore Oriole	
	Golden-Crowned Kinglet			American Goldfinch	
	Ruby-Crowned Kinglet			Turkey Vulture	
	Veery			Ruby-Throated Hummingbird	
	Hermit Thrush				
	Wood Thrush				
	American Robin				
	Northern Parula				
	Magnolia Warbler				
	Black-Throated Blue Warbler				
	Yellow-Rumped Warbler				
	Black-Throated Green Warbler				
	Blackburnian Warbler				
	Black-and-White Warbler				
	Ovenbird				
	Common Yellowthroat				
	Canada Warbler				
	Dark-Eyed Junco				

	Rose-Breasted Grosbeak				
	White-Throated Sparrow				
	Purple Finch				
	Sharp-Shinned Hawk				
	Cooper's Hawk				
	Northern Goshawk				
	Red-Shouldered Hawk				
	Broad-Winged Hawk				
	Ruffed Grouse				
Mammals	Big Brown Bat	Black Bear	Meadow Jumping Mouse	Deer Mouse	Beaver
	Bobcat	Gray Fox	Long-tailed Weasel	Red Fox	Mink
	Coyote	Meadow Vole		Striped Skunk	Muskrat
	Eastern Chipmunk				Pygmy Shrew
	Ermine				River Otter
	Fisher				Star-Nosed
	Snowshoe Hare				
	White-Tailed Deer				
	Woodland Jumping Mouse				
	Woodland Vole				
	White-Footed Mouse				
Mole					
	Grey Squirrel				
	Hairy-Tailed Mole				
	Long-Tailed Shrew				
	Masked Shrew				
	Moose				

	Northern Flying Squirrel				
	Porcupine				
	Raccoon				
	Red Squirrel				
	Red-Backed Vole				
	Short-Tailed Shrew				
	Smoky Shrew				
Reptiles	Eastern Milk Snake			Eastern Garter Snake	Midland-Painted Turtle
	Northern Ringneck Snake			Eastern Garter Snake	Snapping Turtle
	Northern Brown Snake				Wood Turtle
	Northern Redbelly Snake				
Amphibians	American Toad				Bullfrog
	Gray Treefrog				Green Frog
	Jefferson Salamander				Northern Dusky Salamander
	Northern Spring Salamander				Northern Leopard Frog
	Redback Salamander				Northern Spring Frog
Peeper					
	Red-Spotted Newt				Northern Two-Lined Salamander
	Spotted Salamander				Pickerel Frog

D. Climate Change Assessment & Anticipated Impacts

There are many sources of evidence to show that both globally and locally, the climate is changing because of increasing amounts of heat-trapping greenhouse gases in the atmosphere. Because the climate of a location affects nearly all aspects of ecosystem processes (Janowiak et al., 2018), climate change has the potential to negatively impact Vermont's forests and natural ecosystems, including those found in the Worcester Range Management Unit. Changes in the climate at WRMU could alter water availability, decomposition rates and nutrient cycling, tree growth, prevalence and severity of insect and pathogen outbreaks, abundance of invasive plants, food availability for wildlife, and the timing of seasonal events. Increases in extreme weather events also pose a threat to road and trail networks and recreational opportunities. Because of these potential impacts, it is critical to include climate change in the planning and management of the WRMU. By understanding how the climate has changed and how it is projected to change in the future, we can anticipate the possible impacts and manage accordingly.

Climate Change in Vermont

Vermont has experienced substantial increases in both temperature and precipitation over the last 100 years, with the most dramatic changes occurring in the last few decades. While there is considerable variability in weather from year to year, long-term records from weather stations around Vermont show that all regions within the state are experiencing higher temperatures and changing precipitation patterns.[19]

According to the Vermont Climate Assessment, the following changes have been observed:[20]

- Vermont's average annual temperature has increased by 1.5°F since 1960.
- Winter temperature has warmed more than the other seasons (+3.1°F since 1960).
- The freeze-free period (temp. >28°F) is over three weeks longer than it was in the 1960s.
- Vermont has about 10 fewer cold winter nights (temp. <0°F) now compared to the 1960s.
- Annual precipitation has increased nearly 7 inches since 1960, with the largest increases occurring in the summer.
- Heavy rainfall events (> 1 inch) are becoming more common, especially in the summer months.

[19] Galford, G. L., Faulkner, J., Dupigny-Giroux, L. A., Posner, S., & Edling, L. (2021). The Vermont Climate Assessment 2020. *Gund Institute of Environment, University of Vermont, Burlington, VT*. doi:10.18125/kowgyg. Accessed online at vtclimate.org

[20] Galford, G. L., Faulkner, J., Dupigny-Giroux, L. A., Posner, S., & Edling, L. (2021). The Vermont Climate Assessment 2020. *Gund Institute of Environment, University of Vermont, Burlington, VT*. doi:10.18125/kowgyg. Accessed online at vtclimate.org

The effects of climate change are a developing management issue within the WRMU.

Historical data have shown changes across Vermont over the past 50 years, including:

- Summer temperatures increased 0.4°F per decade
- Winter temperature increased 0.9°F per decade
- Spring thaw arrives 2.3 days earlier per decade
- Precipitation increased 15-20%, with 67% from "heavy precipitation" events

Climate Change in the Worcester Range Management Unit

Because mountainous terrain affects weather patterns and long-term climatic trends, the observations noted above have not been uniform throughout the state. Therefore, looking at weather data specific to the WRMU is helpful.[21]

The average annual temperature of the WRMU is nearly two degrees cooler than the statewide average. This difference is about the same for the coldest (January) and warmest (July) months. The WRMU experiences nearly 6 inches more annual rainfall compared to the statewide average, and this difference is more pronounced in the summer.

Table 10: Historic Climate Data. Mean temperature (degrees Fahrenheit) and precipitation (inches) for the entire state of Vermont (VT) and the WRMU (30-year normal [1990-2020], 800 m resolution, source: PRISM Climate Group). The difference between the statewide values and WRMU are shown in the last column.

Climate variable	VT			WRMU			WMRU vs. VT
	Mean ± SD			*Mean ± SD*			*Difference*
Annual mean temperature (°F)	42.6	±	1.1	40.8	±	1.4	-1.8
January mean temperature (°F)	16.0	±	1.0	14.4	±	1.2	-1.6
July mean temperature (°F)	66.9	±	1.2	64.9	±	1.6	-1.9
Annual precipitation (in)	47.8	±	4.2	53.6	±	4.2	+5.7
Spring precipitation (in)	11.3	±	1.1	12.6	±	1.0	+1.3
Summer precipitation (in)	14.5	±	1.2	16.5	±	1.4	+1.9
Fall precipitation (in)	12.0	±	1.1	13.4	±	1.1	+1.5
Winter precipitation (in)	10.0	±	0.9	11.0	±	0.9	+1.0

Like the statewide trends, the WRMU has experienced a significant increase in mean annual temperature. This increase equates to an average increase in mean annual temperature of 0.6°F per decade. Unlike the statewide average, the data does not show an increasing trend in annual precipitation for the WRMU. Within the WRMU, there is spatial variability in both temperature and precipitation. The higher elevation areas of the Worcester Range experience

[21] These data are modeled across Vermont from weather station data and do not reflect actual observations at the management unit.

lower temperature and greater amounts of precipitation (Figure 3). Some of the higher elevation areas receive, on average, more than 60 inches of rainfall in a year – almost 50% more rain than the statewide average.

Figure 3: Mean annual temperature (degrees Fahrenheit) and total annual precipitation (inches) at WRMU for year 1981-2021 (4 Km resolution, source: PRISM Climate). The horizonal blue line depicts the linear trend, and the gray shading the variability around that trend.

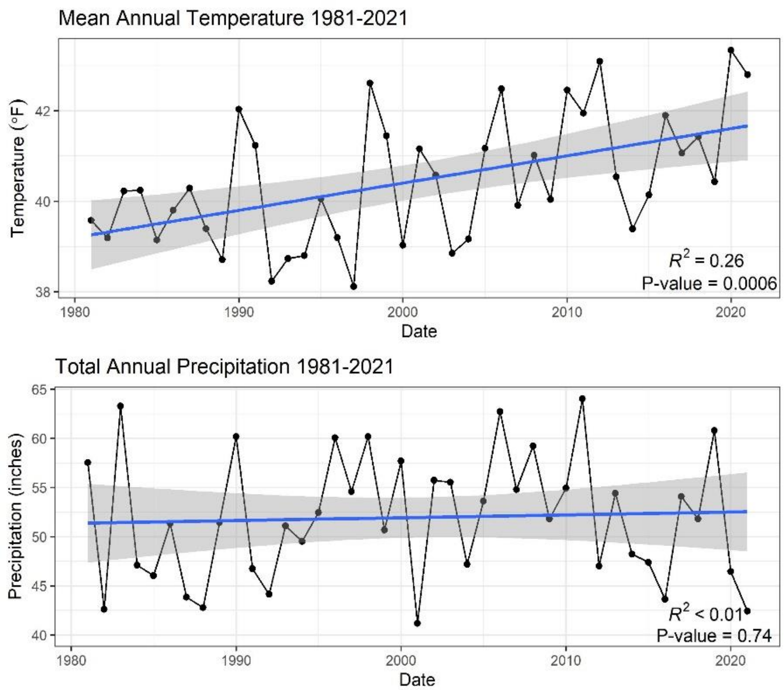
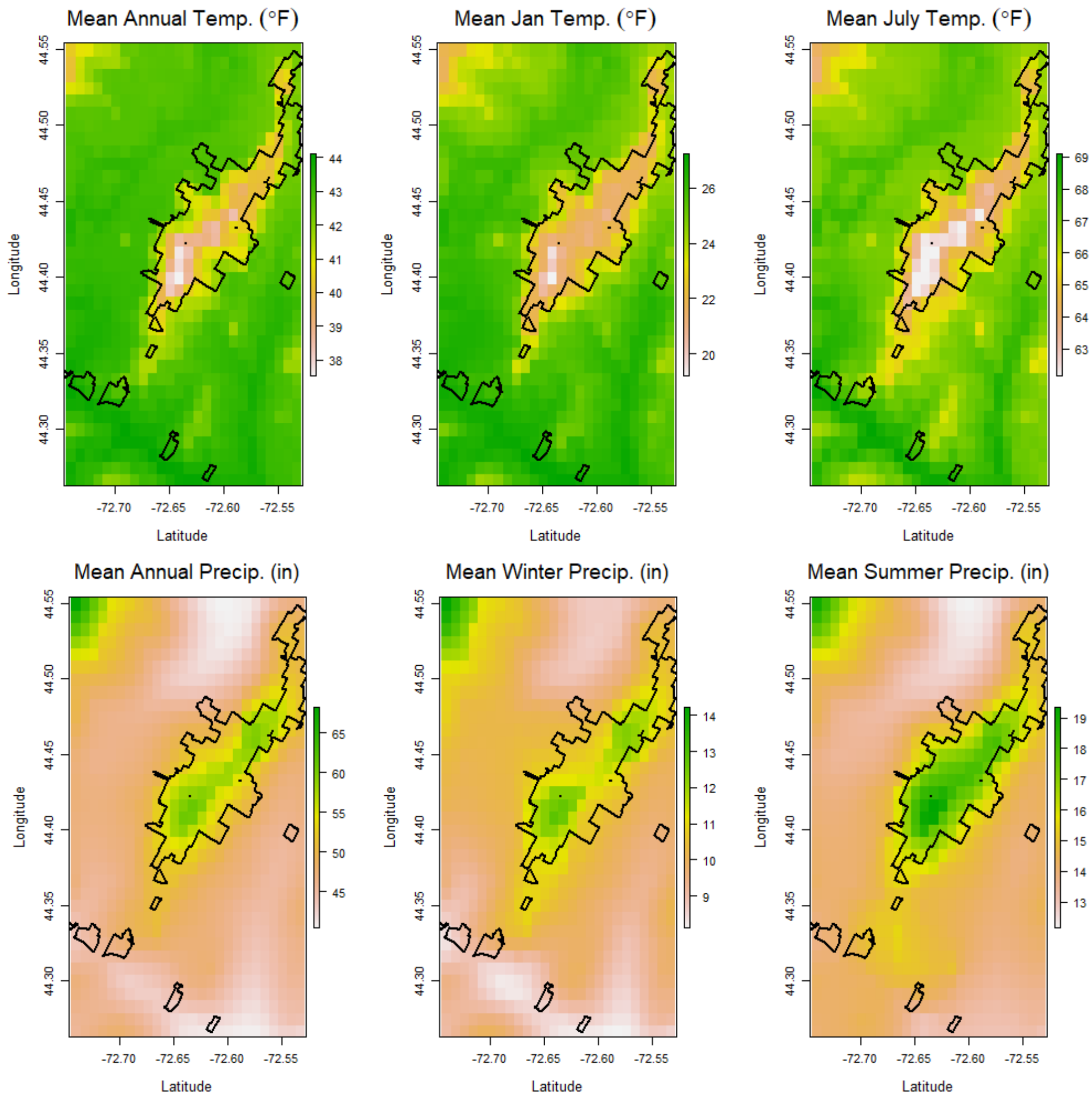


Figure 4: Mean temperature (degrees Fahrenheit) and precipitation (inches) for the WRMU (30-year normals [1990-2020], 800 m resolution, source: PRISM Climate Group). Note that scales are unique to each graph



Anticipated Impacts of Climate Change on Forest Ecosystems

Climate change is already altering the growing conditions for forests in Vermont, with greater changes expected. According to multiple sources, these changes may impact forests in the following ways:[22]

- Increased temperatures, especially in winter
- Increased precipitation, especially rain in winter
- Increased extreme weather events, including floods, windstorms, drought, and fires
- Longer growing seasons, shorter winters
- Changing biological interactions

These potential changes are expected to have a range of effects on the forested ecosystems of the WRMU, as with forests across the State. Table 11 lists examples of anticipated effects and time frames of many key climate factors on upland forests of Vermont.

Table 11: Expected Climate Change Effects and Timeframes.[23]

Key Climate Change Factors	Expected Effects	Timeframe
Warming temperatures and variable precipitation	Compositional changes associated with changes in thermally suitable habitat (loss of cold-adapted species and increase in warm-adapted species) • More favorable for southern-adapted tree species (e.g., northern red oak, shagbark and bitternut hickory, and black cherry) • Less suitable for northern and boreal tree species (e.g., balsam fir and black spruce)	• In the absence of major disturbance, shifts in forest composition will take at least several decades to occur • Localized effects could occur on a shorter timescale
	Variable tree regeneration, recruitment, and germination success given seedling sensitivity to changes in moisture and temperature	Long-term, but localized effects could occur on a shorter timescale
	Increase in overwinter survival of pests, such as balsam and hemlock woolly adelgid	Immediate
	Increased physiological stress, resulting in increased susceptibility to pests and pathogens, decreased productivity and increased tree mortality	Immediate

[22] Janowiak, et al. 2018; Wikle, et al. 2021.

[23] Adapted from Janowiak et al. (2018). *New England and northern New York forest ecosystem vulnerability assessment and synthesis: a report from the New England Climate Change Response Framework project.* Department of Agriculture, Forest Service, Northern Research Station. 234p. Newtown Square, PA: Gen. Tech. Rep. NRS-173.; Wikle, J., Higgins, H., Clark, P., Cook, D., Garton, J., Kosiba, A., & Schadler, E. (2021). Climate Change in Forests. In Galford, G.L., Faulkner, J. et al. (Eds), The Vermont Climate Assessment 2021. *Burlington, VT: Gund Institute for Environment at the University of Vermont*; Clarke, P. W., & D'Amato, A. W. (2022). Seedbed not rescue effect buffer the role of extreme precipitation on temperate forest regeneration. *Ecology*, 104(3); TetraTech. (2013). Climate change adaptation frameword. Prepared for Vermont Agency of Natural Resources.

	Increased evapotranspiration, resulting in a decrease in soil moisture; moisture limitation/stress negatively impacts productivity and survival in many species	Immediate
	Increased decomposition rate of organic material may enrich soils and make them more suitable for competitors	Long-term, but localized effects could occur on a shorter timescale
	Decrease in winter snowpack, leading to change in deer browsing patterns, which affects regeneration	Immediate
	Warmer winters and wetter summers will continue to limit active forest management by shortening the window in which forest operations can take place.	Long-term
	Lengthening of growing season resulting in changes in species competitiveness, especially favoring non-native invasive plants	Immediate
Increase in extreme weather events	Increased physical damage and disturbance, leading to gap formation, which could facilitate the spread of invasive plants	Immediate
	Declines in forest productivity and tree survival associated with increased drought events	Long-term
	Heavy precipitation events will continue to increase, contributing to potential flooding and soil erosion	Long-term
Phenology (timing)	Longer growing season	Immediate
	Early spring thaws/late frosts can damage buds, blossoms and roots, which affects regeneration	Immediate
	Change in freeze/thaw cycles could disrupt regular periodicity of cone cycles	Immediate
	Asynchronous changes in phenology may negatively impact some migratory species and pollinators	Immediate
Increase in fire risk	Loss of fire intolerant species and increase in fire tolerant species, such as red and pitch pines	Long-term, but localized effects could occur on a shorter timescale
	Earlier and warmer springs and smaller snowpacks, and hotter drier summers conducive to increased fire risk	Immediate

Understanding the diverse factors of forest ecosystem vulnerability is crucial to enhancing their resilience and designing effective adaptation strategies. As climate change impacts forest ecosystem function, forest management can be a tool to minimize stressors and increase the resilience of the forest to respond and adapt to change. Current methods to achieve increased resilience include reducing vulnerabilities and increasing forest structural complexity, diversity, and redundancy.[24] See page 149 for greater details about climate adaptive strategies for the WRMU.

[24] Todd A Ontl, M. K. (2020). Forest Management for Carbon Sequestration and Climate Adaptation. *Journal of Forestry*, 86-101; Swanston et al. (2016). *Forest Adaptation Resources: climate change tools and approaches for land managers, 2nd edition.* Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 161 p. http://dx.doi.org/10.2737/NRS-GTR-87-2: Gen. Tech. Rep. NRS-GTR-87-2.

E. Forest and Timber Resource Assessment

History of Forest Management on the WRMU:

General
The historic land use history of the upland forests in the Worcester Range is a story common to most forestland in Vermont. The lower elevation, moderately sloping terrain, was cut and cleared for agriculture and settlement. These lands were kept open for generations, then eventually abandoned and allowed to grow back to forest. Today, less than 1% of the formerly cleared lands that now make up the WRMU are maintained in an open field condition.

Further up the slope, the more marginal land was sometimes used for agriculture - clearing and grazing, but also for timber extraction to supply mills in the area and for maple sugaring. The most marginal of these areas (excessively steep slopes, high elevation, greater distances to settlements) were still used, mainly for timber extraction, but largely remained forested during this time.

Today's forest of the WRMU is a product of this history. The places that were kept open the longest, and have reverted to forests most recently, have common traits. They have more early and mid-successional tree species in the canopy (e.g., paper birch, aspen, balsam fir, and red maple). These stands also tend to have simple stand structures (e.g., fewer very large trees, fewer standing dead trees, etc.). With early successional tree species and simple stand structures, these relatively young forests are easily identifiable.

Older 'mature forests' in the WRMU vary considerably. Just like with young forests, this variability has a lot to do with land use history, but it also depends on modern forest management practices, soil types, site qualities, hydrology, aspect, deer, and moose populations (browse pressure), and the influence of natural disturbances (wind events, ice storms, pests and disease outbreaks). These forests have developed over time and will have greater complexity – both in species diversity and structural complexity – than nearby young forest stands.

Over the last 200 years, the use of timber resources within the WRMU has evolved from specific species extraction to the current multi-faceted, science-based silvicultural approach utilized today to manage the forests for various objectives.

Recent Forest Management History
The following is a brief forest history of the four blocks of CC Putnam State Forest and tracts of land that comprise the WRMU and have been actively managed. A total of 15 harvests covering 720 acres have occurred in the Unit from 1980 through 2013, as well as a seven-acre harvest that took place in 1961. (See page 133 for a description of management classification system used on the WRMU.)

Perry Hill Block:

The Perry Hill block is a non-contiguous parcel located in Waterbury, VT. The 547-acre block was transferred to FPR from the Waterbury State Hospital in 1973. The Washington County Foresters Cooperator's woodland record for the State Hospital's land documents extensive forest management since the early 1950's. Approximately 30 acres of red and white pine seedlings were planted from 1947 through 1965, and numerous thinning and harvest cuts have occurred over the years.

The Perry Hill Block has evidence of past agricultural use and there are stands in various stages of development. Nearly the entire block is mapped as a deer wintering area, and evidence of winter use is clearly visible.

This block has extremely challenging access for forest management. Past timber sales have had to skid through the tunnel that runs under I-89, and over the adjacent railroad tracks, before reaching what was then a landing along the town road. This main access is no longer feasible.

Worcester and Middlesex Blocks:
In 1828 and again in 1903, severe forest fires burned over a large swath of high elevation forest in what is now the Worcester Block. In 1914, Christopher Columbus Putnam and his son, Ralph, who were both in the lumber business, donated a burnt-over 1,095-acre lot to the State. This was the beginning of a state policy to purchase high elevation and mountainous land for scenic preservation and to control stream flows. Over the years, FPR has acquired several parcels within this block to meet this objective. The most recent acquisition occurred in 2020 with the addition of the 1,760-acre Patterson Brook Tract.

Today, the Worcester Block is 9051 acres in size, and the Middlesex Block is 129 acres. Most of the acreage not burned in the two large fires was owned and managed for timber production before state acquisition. Historically, forest management access was severely limited resulting in very little management occurring under FPR management. During the last planning period eight harvests occurred, treating 311 acres. Before the FPR acquisition, the former Patterson Brook Tract was extensively managed by the previous owner for forest products.

Burt Hollow Block:
The Burt Hollow Block shares a similar history (1800-1975) to that of the Worcester and Middlesex Blocks. The majority of the Burt Hollow Block was acquired between 1975-1979. This included the 950-acre Stowacre Incorporate parcel, the 1,300-acre Burt Forests property, and a 2,457-acre parcel along the height of the Worcester Range, purchased through The Nature Conservancy. In 2019, the Brownsville Forest Parcel (previously the 'Storey parcel') was acquired and added to the Burt Hollow Block.

Under FPR ownership, only three harvests have occurred to date within the Burt Hollow Block, covering 201 acres. The former Storey parcel was a working forest and managed by the previous owner for forest products.

Elmore State Park:

Elmore State Park is approximately 995 acres and is noncontiguous with the other WRMU tracts. The Park was acquired in 1936 when the town of Elmore gifted the State 30 acres of land on Lake Elmore. The terrain ranges from 1,160' in elevation to 2,680' at the peak of Elmore Mountain. The park is primarily managed for recreation, with active management of undeveloped forestland where appropriate. The most recent harvest occurred in 2013, treating 55 acres of northern hardwood forest.

Table 12: WRMU Past Timber Sales (1980-present)

Block	Timber Sale Name	Acres	MBF	Cords	Year
Worcester Block	Worcester comp 7 fuelwood sale	36	6	163	1998
Worcester Block	Comp 8 salvage sale	5	10	36	1992
Worcester Block	Intersect Sale	15		133	1987
Worcester Block	Worcester white birch sale	200	600	416	1987
Worcester Block	Fuelwood sale	5		40	1985
Worcester Block	Worcester comp 5 bid-fuelwood sale	20		123	1984
Worcester Block	Fuelwood sale	5		20	1982
Worcester Block	Bonazzi 79 trailhead	25	60	112	1980
Burt Hollow Block	North Hollow Sale	190	250	500	1996
Burt Hollow Block	1995 Taber Hill Rd Negotiated Sale	6	13.2	28	1995
Burt Hollow Block	1993 North Hollow Rd Negotiated Sale	5	10.08	26	1993
Elmore Block	Wooden Well Sale	55	23.5	552	2013
Perry Hill Block	Perry Hill Sale	73	242		1983
Perry Hill Block	Perry Hill Plantation Sale	30	39	87	1985
Perry Hill Block	Perry Hill Plantation Sale	50	85	129	1986

Non-Commercial Vegetation Management:

Where opportunities and funding exist, FPR has conducted non-commercial vegetation management throughout the WRMU. Management practices completed during the previous planning period include apple tree release and pruning, and invasive plant management. Currently, opportunities exist for young forest management, timber stand improvement, invasive plant management, mast tree release, stream loading, ecosystem restoration, apple tree pruning and release, and open land management.

Non-Timber Forest Products:

In 2012, FPR entered into a lease agreement with a sugar maker to tap maple trees within Elmore State Park along its western boundary line. The lease is currently active until 2027. This activity occurs on 83 acres and contains approximately 2,000 taps.

Soils and Site Productivity:

Soil characteristics such as structure, texture, porosity, depth, as well as chemical and biological properties are a major factor in determining the potential productivity of any site.

This potential site quality is often expressed in terms of site class. The various soils found on this parcel have been grouped into four different site classes and are depicted on the soils map (Map 20 and Map 21). Site Class I represents the most productive and Site Class IV is the least productive. Table 14 shows the productivity of each site class expressed in terms of capacity to produce wood and the site index for different species. Site Index is defined as the height of dominant trees in even-aged stands at a certain age. In addition to estimating potential productivity, Site Classes have also been used to project appropriate management entry intervals. Because Site Class I lands grow trees more rapidly, the interval between management entry is reduced as compared with that on Site Class IV lands. For example, the recommended management entry interval for northern hardwoods on Site Class I soils is 15 years, and on Site Class III soils it is 25-35 years. Soil survey mapping units are useful for generalized thinking about productivity, but more detailed site-specific investigations are important to determine what management activities are ultimately appropriate. There are 87 different mapped soil types found on the WRMU. The soil series and complexes found in most of the area are described further below.

The soils information used in this assessment is based on the Washington County and Lamoille County Soils Survey conducted by the Natural Resource Conservation Service (NRCS). Due to the size and elevation gradient of the Worcester Range, many different soil types exist throughout the management unit. In total, the MU has 87 different soil types. Table 13 below shows the relative proportion of the total area covered by each soil type.

Table 13: Main Soil Series and Complexes by Acre

Soil Series or Complex	Acres
Tunbridge-Lyman Complex	3,807
Hogback-Rawsonville Complex	3,791
Lyman-Tunbridge Complex	2,707
Ricker-Londonderry-Rock Outcrop Complex	2,477
Stratton-Glebe Complex	1,856
Peru Series	1,056
Other	939
Berkshire Series	741
Mundal Series	675
Londonderry-Stratton Complex	611
Adams Series	577
Marlow Series	496
Ricker-Londonderry-Stratton Complex	353
Ricker Peat Series	352
Salmon Series	311

Table 14: Site Class Management Potential

Site Class	Potential Productivity (cubic feet of wood/acre/year)	Site Index (height at age 50)		Acres
Site Class I	>85 cubic feet	White Pine	70’	0

		Northern Hardwoods	60’	
Site Class II	50 to 84 cubic feet	White Pine Northern Hardwoods	60-69’ 53-59’	5,680
Site Class III	20 to 49 cubic feet	White Pine Northern Hardwoods	50-59’ 45-52’	9,331
Site Class IV	<20 cubic feet	White Pine Northern Hardwoods	50’ 45’	3,768

Existing Conditions and Dominant Forest Types:

Forest resource assessments are conducted periodically using the FOREX inventory (forest examination) method developed by the Vermont Department of Forests, Parks, and Recreation to inventory and evaluate state lands for long-range management planning. The forest resource assessment or forest inventory for this plan was completed in multiple stages. The first inventory surveyed the entire Management Unit and took place between 1988-2002. A more recent inventory (2018-2020) was designed with a targeted approach. This recent inventory focused on stands that are accessible and appropriate for sustainable forest management. A subset of the Barre District Stewardship Team formed a timber management working group that visited all thirteen proposed vegetation management areas to verify that these areas were suitable for timber harvests. Also, within the past few years, ANR has acquired three new parcels to the WRMU (Brownsville Forest, Upper Hollow, and Patterson Brook Headwaters acquisitions). To include these parcels in this LRMP, the most recent forest inventory data, collected by private consulting foresters and utilized in developing Use Value Appraisal Forest Management Plans that the respective County Forester had approved, was used.

Data collected using FOREX provides detailed information on the forest at regular intervals, allowing long-term monitoring. Data are systematically collected at a series of plots distributed throughout the WRMU. Information collected throughout the inventory process provides ANR land managers with the necessary data to make informed and science-based decisions to best manage the natural resources.

Dominant Forest Types

A cover type is a point-in-time identification of the main forest canopy; in other words, it is a snapshot of the current conditions found within the forest. They are discrete, predictable associations of tree species that occur within a set of conditions. Natural communities are, by definition, a description of late successional condition and consider many elements in addition to canopy vegetation. In many instances, the cover type and natural community are the same. At other times, particularly when the cover type reflects early successional tree species or a plantation, the two may be different. What follows is a general overview of the timber resources on lands of WRMU based upon information derived from ANR FOREX inventories, management records, and interpretation of aerial photography.

Northern Hardwoods (Sugar Maple-Beech-Yellow Birch):

The Northern Hardwood Forest type is found on approximately 27% of the WRMU. This cover type is found on the more productive soils, usually on upland sites or elevated areas that tend to have moderate to well-drained soils. Dominant canopy trees within this cover type include sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), yellow birch (*Betula alleghaniensis*) and red spruce (*Picea rubra*). Lesser components are black cherry (*Prunus serotina*), red maple (*Acer rubrum*), and white ash (*Fraxinus americana*). The quality of timber within this forest type varies significantly and is impacted by several factors, the most significant being historic land uses, past forest management, and site quality. Soils at higher elevations (above 2,000 feet) tend to be more poor-quality sites for northern hardwood species.

Regeneration within this forest type varies throughout the management unit and is correlated to recent forest management history and the presence (or absence) of diseased American beech in the overstory (See ‘Beech Bark Disease Complex’ discussion in Forest Health Assessment section).

Red spruce-northern hardwood (red spruce-sugar maple-beech):
The mixed forest type is found on 28% of the WRMU. This cover type is strongly correlated to soil type and elevation. Dominant canopy trees within this cover type include intolerant hardwood species such as trembling aspen (*Populus tremuloides*), bigtooth aspen (*Populus grandidentata*), paper birch (*Betula papyrifera*), and red maple (*Acer rubrum*) and softwood species such as red spruce (*Picea rubra*) and balsam fir (*Abies balsamea*). Lesser components include a variety of species often reflecting the dominant canopy species prior to harvesting activities.

Health/Vigor of Timber [Forest] Resource
see Forest Health Section on page 76.

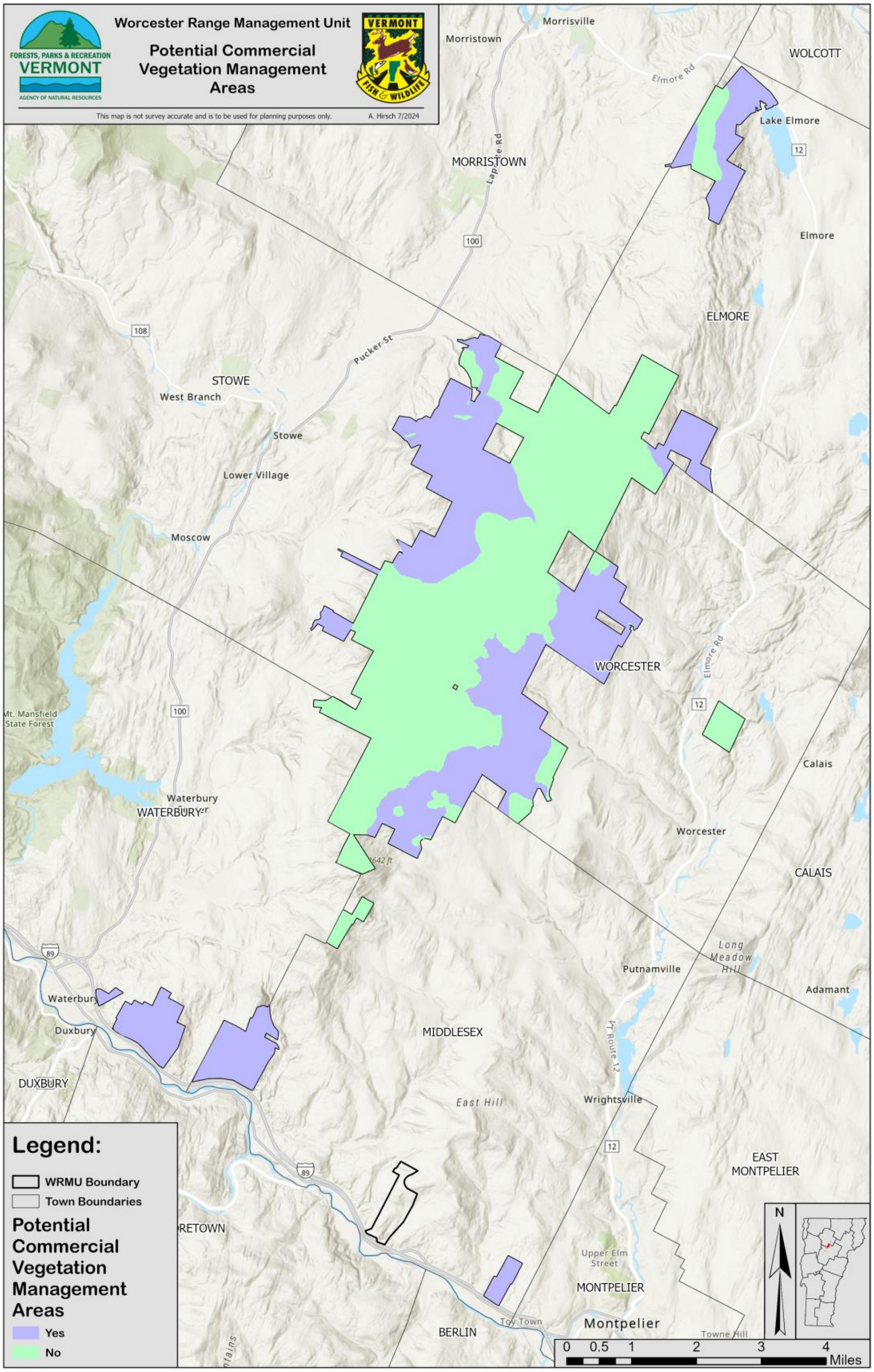
Access/Operability
Of the 18,772 acres of the WRMU, approximately 8,641 acres were evaluated for potential commercial vegetation management. This number is calculated by subtracting the following from the total land base acreage: 1. Natural Areas, 2. Easement restrictions, 3. Deed restrictions, 4. Mapped Class I & II wetlands, 5. Parking areas, and 6. Fields and agricultural areas (Map 17: Significant hard mast feeding areas, WRMU). Of the remaining acres, more will be determined to be inaccessible and/or unsuitable for commercial vegetation management during the pre-sale inventory and initial sale layout and reconnaissance phase of the process. During this on-site planning phase, ANR staff remove areas that are either too steep, too fragile, or too far away from access points to reasonably allow for management. If that occurs, these areas will be delineated on the ground and excluded from the proposed harvest area.

Table 15: Dominant Forest Types

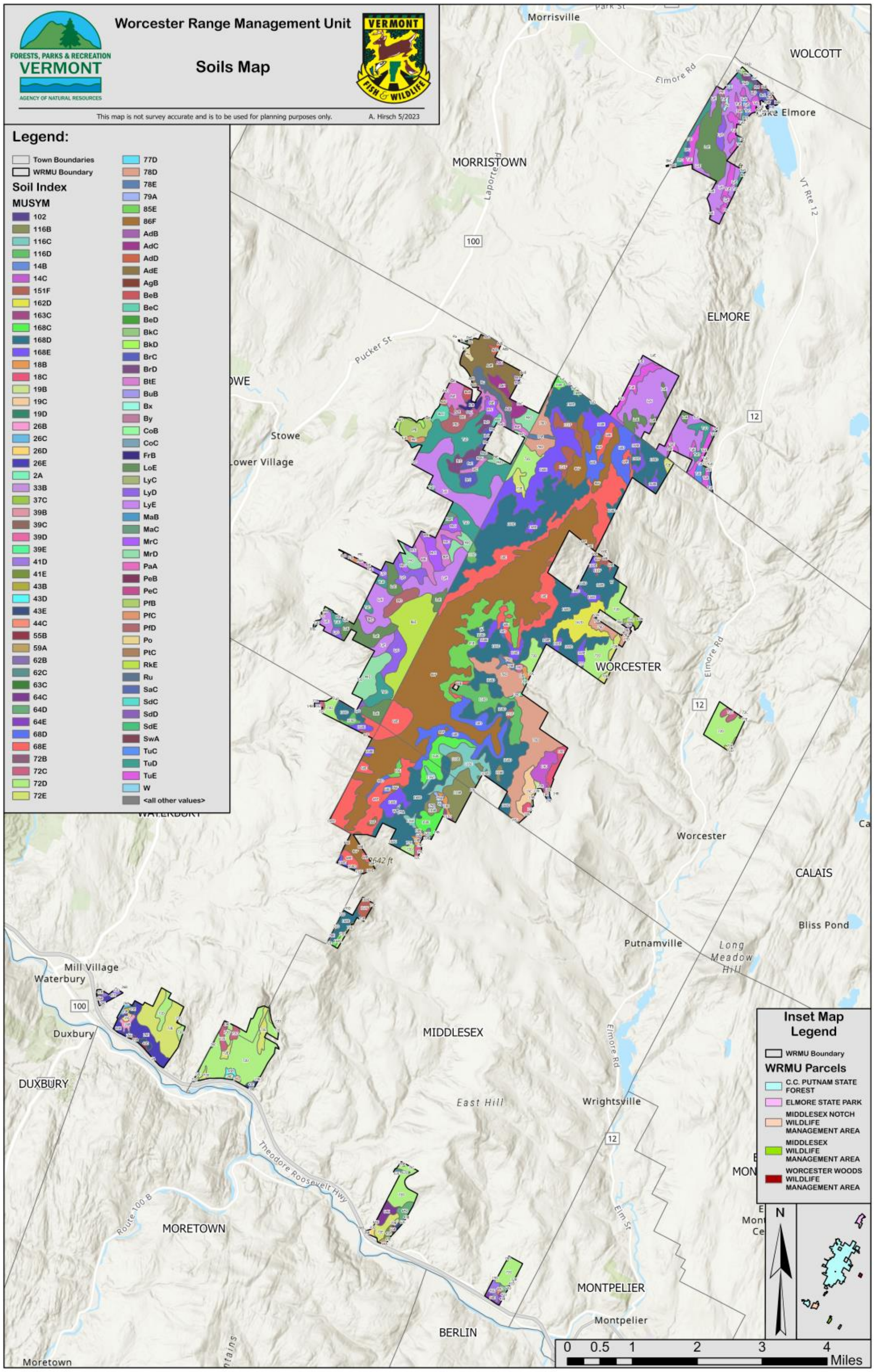
Type (SAF)	**Major Species**	**Acres**
31	Red Spruce, Sugar Maple, Beech	5,233
25	Sugar Maple, Beech, Yellow Birch	5,037
33	Red Spruce, Balsam Fir	3,542
24	Hemlock, Yellow Birch	1,355

18	Paper Birch	1,077
108	Red Maple	709
20	White Pine, Red Oak, Red Maple	558
27	Sugar Maple	535
30	Red Spruce, Yellow Birch	298
22	White Pine, Hemlock	277
-	Other	140

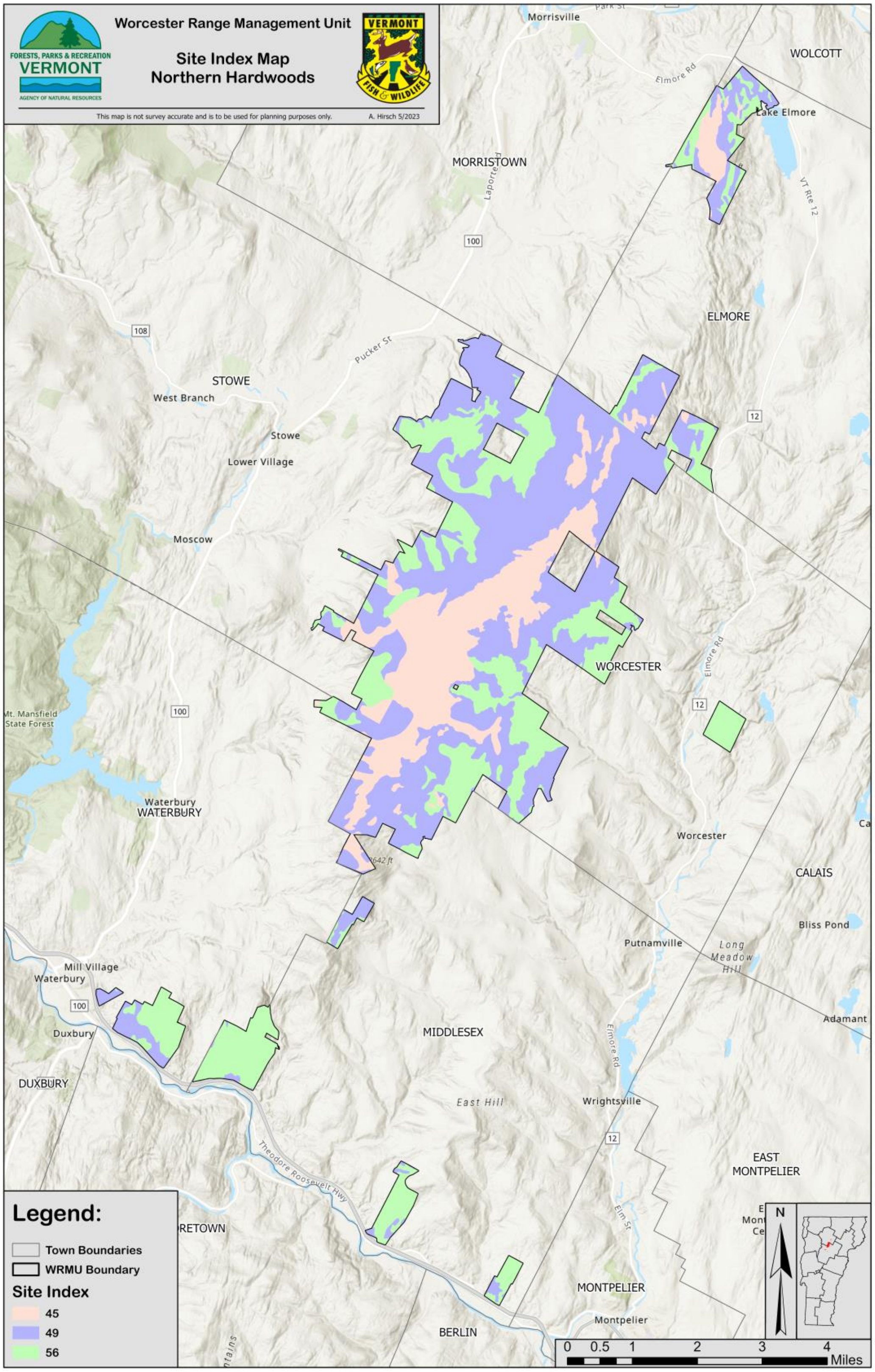
Map 18: Potential Vegetation Management Areas



Map 19: Cover Types

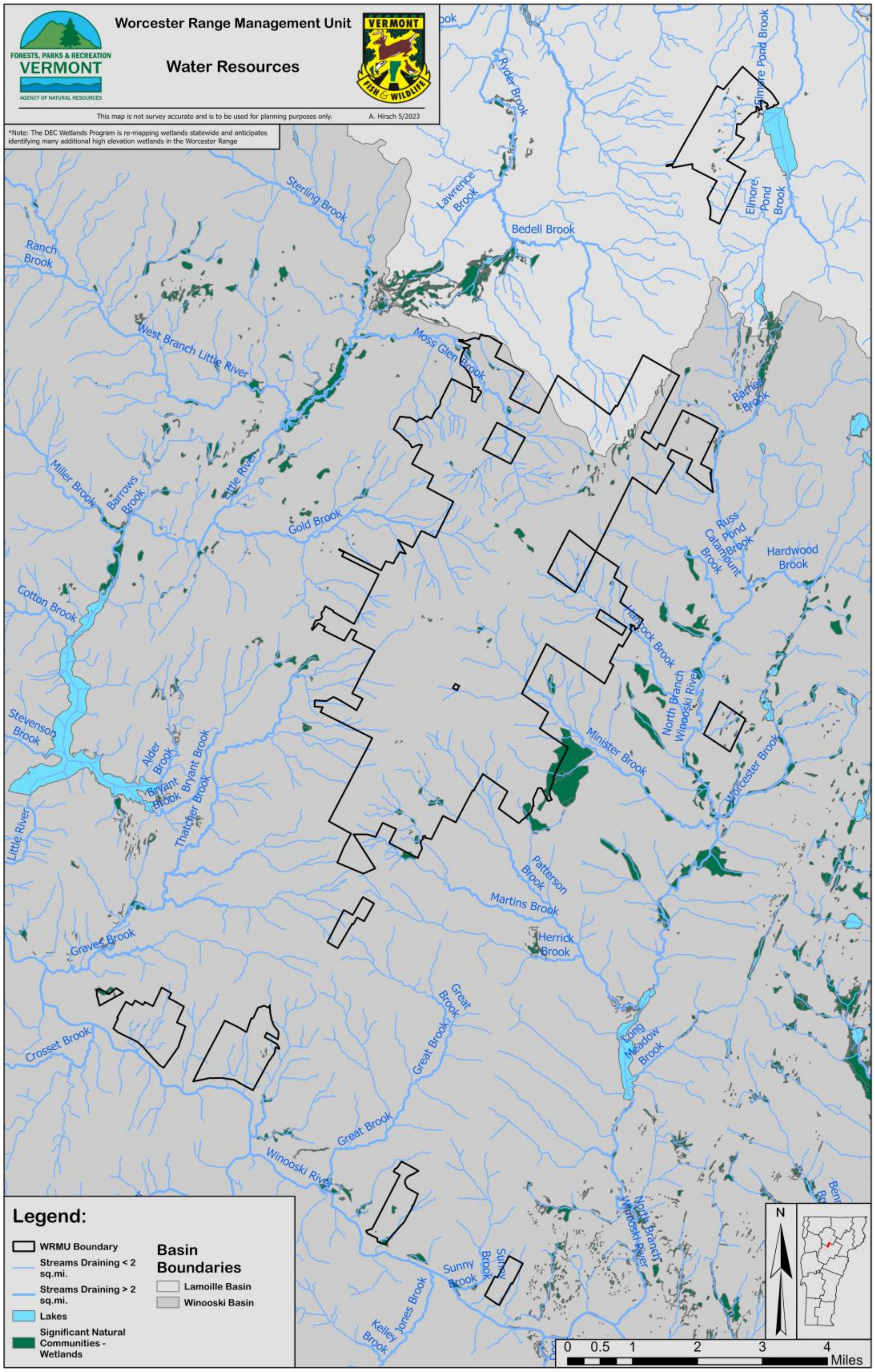


Map 20: Soils



FORESTS, PARKS & RECREATION
VERMONT
AGENCY OF NATURAL RESOURCES
Worcester Range Management Unit
Site Index Map
Northern Hardwoods
VERMONT
FISH & WILDLIFE
This map is not survey accurate and is to be used for planning purposes only.
A. Hirsch 5/2023
Morrisville
WOLCOTT
Lake Elmore
MORRISTOWN
ELMORE
STOWE
West Branch
Stowe
Lower Village
Moscow
WORCESTER
Mt. Mansfield State Forest
Waterbury
WATERBURY
Worcester
CALAIS
Bliss Pond
Putnamville
Long Meadow Hill
Adamant
Mill Village
Waterbury
Duxbury
DUXBURY
MIDDLESEX
East Hill
Wrightsville
EAST MONTPELIER
MONTPELIER
Montpelier
BERLIN
Theodore Roosevelt Hwy
Legend:
Town Boundaries
WRMU Boundary
Site Index
45
49
56
N
0 0.5 1 2 3 4
Miles

Map 21: Site Index



F. Water Resource Assessment and Flood Resiliency

Overview

The WRMU consists of numerous geographically scattered high elevation seeps and small streams that drain less than two square miles of area (Map 21). These high elevation headwaters eventually flow into two major Vermont rivers that contribute to Lake Champlain – the Winooski and the Lamoille– via several sub-watersheds (Map 22). The waters of the WRMU that contribute to the Lamoille basin are found in Elmore State Park and a small northern section of C.C. Putnam State Forest. The management unit does not fully include any sizable lakes; however, Lake Elmore is located adjacent to a portion of Elmore State Park. The contributing waters to the Winooski basin flow through most of the C.C. Putnam State Forest and the entirety of the Middlesex Notch and Worcester Woods WMAs. Headwaters contribute profoundly to downstream water quantity and water quality, making up about 55% of the water volume in fourth - and higher order streams, such as the Lamoille and Winooski Rivers.[25] The forest and wetland plants and soils within the unit provide filtering and temperature moderating functions to keep waters clean and cool as they flow downstream and slow and retain waters during rain events.[26] The proper management of the WRMU's water resources provides value downstream of its boundaries in the form of drinkable, swimmable, fishable, and boatable waters in Lamoille, Washington, Franklin, and Chittenden counties.

Improper water resource management can have a significant impact to the local community in Vermont. For example, a study conducted by the Gund Institute for Ecological Economics estimated that a decrease in water clarity of one meter in Lake Champlain during July and August could lead to the loss of "195 full-time equivalent jobs, a $12.6 million reduction in tourism expenditure, and a total economic reduction of nearly $16.8 million."[27] The value of properly managed headwaters in the WRMU extends not only to Lake Champlain, but to the communities surrounding the Unit like Stowe and Elmore where the Moss Glen Falls Natural Area and Elmore State Park receive thousands of visitors each year who enjoy the quality and aesthetics provided by clean, clear water. Likewise, the towns of Worcester, Montpelier, Middlesex, Stowe, and Waterbury have developed river corridors vulnerable to fluvial erosion and inundation flooding, as exemplified in the July 2023 floods. While much of Waterbury's water supply, managed by the Edward Farrar Utility District, lies within the WRMU, lands maintaining intact headwater riparian zones and river corridors can reduce overland runoff and increase floodplain storage and infiltration, lessening downstream peak flows and sediment and nutrient export that threaten downstream built infrastructure, water supply, and recreational uses.

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[25] Alex Alexander, R. B., Boyer, E. W., Smith, R. A., Schwarz, G. E., & Moore, R. B. (2007). The Role of Headwater Streams in Downstream Water Quality. *Jornal of the American Water Resources Association*, 41-59.

[26] USEPA. (2015). *Connectivity of Streams & Wetlands to Downstream Waters: A Review & Synthesis of the Scientific Evidence.* Washington DC: Office of Research and Development, United States Environmental Protection Agency (USEPA).

[27] Voigt, B., Lees, J., & Erickson, J. (2015). *An Assessment of Economic Value of Clean Water in Lake Champlain.* Burlington: Lake Champlain Basin Program.

With the prediction that population growth in the surrounded communities is likely, the development and implementation of well-planned management strategies for the headwaters, wetlands, ponds and lakes throughout the WRMU will ensure that the water quality benefits of this valuable state resource will extend well into the future.[28] However, historic land uses can also have legacy impacts on water resource conditions that should be considered when managing WRMU's water resources. Except for the steepest areas of the unit, most forests were logged or cleared for grazing livestock where conditions allowed. Sawmills were located within and outside of the WRMU on lower elevation sections of Elmore Pond Brook, Moss Glenn Brook, Hancock Brook, and Gold Brook. In the 19th century, gold was mined from Gold and Minister Brooks where sluiceways and mining infrastructure was installed. Although some of these uses happened over 100 years ago, human activities on the land have caused some alteration of stream channels and the flow of water through these channels. Because the streams in this unit are fairly small, it is highly unlikely they were used for log runs. Therefore, the majority of historical impacts, prior to state ownership, stem from the erosion of unmanaged skid roads, forest roads, undersized stream crossing structures, and the compaction of soil. Water resource assessments provide an understanding of baseline conditions in the State's waters and an ability to detect potential change in future conditions.

Available Water Resource Assessments

The Vermont Water Quality Standards (VWQS) provide the basis used by the Vermont Department of Environmental Conservation (DEC) in determining the condition of surface waters including whether the water meets or does not meet certain criteria. The assessment of a water's condition within the context of the VWQS requires consideration of the water's classification, designated and existing uses, and the corresponding narrative and numeric water quality criteria. This assessment categorizes Vermont's surface waters as either "full support, altered, or impaired." DEC uses a five-year rotational monitoring approach, where each of Vermont's 15 tactical basins are typically monitored once every five years to support the development of tactical basin plans that guide Vermont's surface water quality management. Water quality monitoring and assessment work is summarized in the two tactical basin plans relevant to the WRMU (2023 Winooski Tactical Basin Plan; 2021 Lamoille Tactical Basin Plan) and detailed in the Water Quality Monitoring Program Strategy.

Most surface water monitoring is led by programs in DEC's Watershed Management Division, including the Rivers Program. Within the Rivers Program, the Biomonitoring and Aquatic Studies Section focuses on biological monitoring of aquatic macroinvertebrate and fish communities, plus targeted water chemistry and temperature monitoring. Biomonitoring staff also support the LaRosa Partnership Program, a community-based nutrient and chloride monitoring program. The Rivers Program also supports stream geomorphic assessments that evaluate geomorphic and physical habitat conditions of rivers. Here we provide an overview of biomonitoring and geomorphic condition data for the major streams draining the WRMU.

Stream Geomorphic Assessments (SGAs)

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[28] Jones, K., & Schwarz, L. (2013). *Vermont Population Projections - 2010 - 2030.* Montpelier: State of Vermont.

Degraded geomorphic condition in Vermont's streams may impact:

- wildlife and fish habitat (e.g., riparian buffer removal increases water temperature, reduces shading and habitat for insects that feed fish, and channel alteration destroys aquatic habitat).
- public safety (e.g., loss of floodplains that store floodwaters, accelerated streambank erosion which results in infrastructure damage, and channel straightening that increases flow velocity during rain events).
- water quality (e.g., higher phosphorus loading from bank soil erosion stormwater runoff from encroachment of impervious surfaces and agricultural land).

The Rivers Program conducts a three-phase stream geomorphic assessment approach to assess the physical condition of rivers in Vermont. Phase 1 is a watershed assessment, Phase 2 is a rapid field stream assessment, and Phase 3 is a field survey assessment.[29] SGAs often inform comprehensive River Corridor Plans that identify causes of channel instability and make recommendations for restoration and protection projects. Phase 1 SGAs have been performed on the mainstems of most major streams draining the WRMU (Map 22). Phase 2 SGAs were completed on a subset of these brooks mainly downstream of the WRMU boundary. Results of all assessments are reported in the following documents:

- Phase 1 Stream Geomorphic Assessment: Upper Winooski River Watershed, North Branch, and Lower Stevens Branch Sub-Watershed and North Branch Winooski River Corridor Plan
    - Covering Martins, Herrick, Patterson, Minister Brook, Hanock, and Catamount Brooks
- Little River Corridor Plan
    - Covering Moss Glen and Gold Brooks
- Middle Winooski River Corridor Plan
    - Covering Thatcher Brook

In general, available SGAs found that stream reaches in these watersheds are often in "Reference" (best) to "Good" physical condition within the WRMU, whereas reaches on the same stream downstream of the WRMU range from "Good" to "Poor," with most considered in "Fair Condition" (Map 21). The above reports further detail the physical conditions of and potential stressors modifying individual stream reaches. Such stressors may include floodplain and river corridor encroachments, channel straightening, flow regulation, berming, poor riparian buffers, stormwater inputs, undersized bridges and culverts, and other impacts from contemporary or historic development and land use. The River Corridor Plans also identify both general actions and specific projects that can move stream reaches closer to their dynamic equilibrium condition, restoring habitat integrity and improving flood resilience.

[29] VANR, DFPR. (2019). *Vermont Water Quality Acceptable Management Practices Manual for Logging Professionals.* Montpelier: State of Vermont.

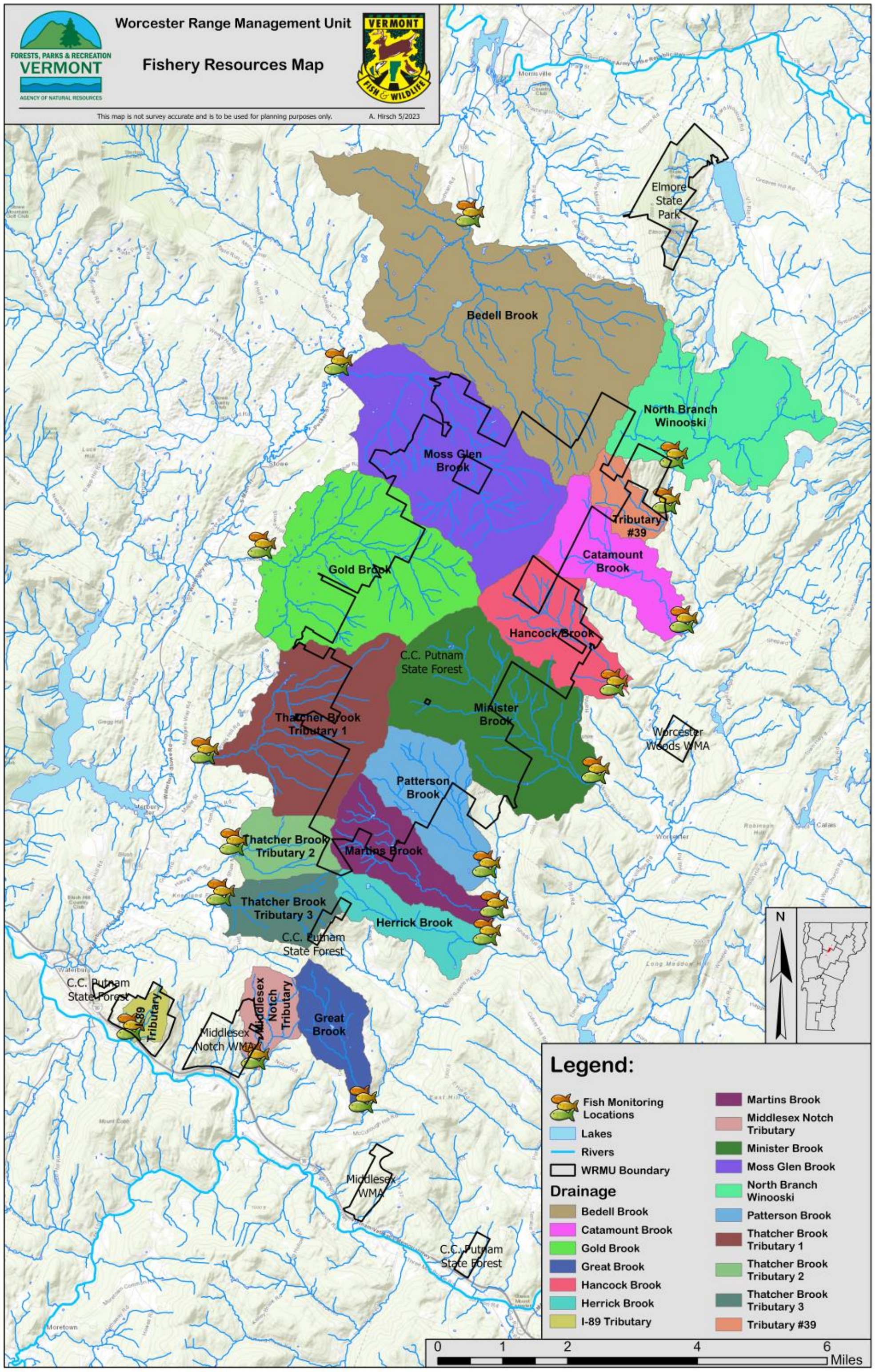
Biological Assessment

Biological communities reflect overall ecological integrity (i.e., chemical, physical, and biological condition). Therefore, biomonitoring results can directly assess the status of a waterbody relative to the primary goal of the federal Clean Water Act. These communities integrate the effects of different stressors and thus provide a broad measure of the stressors' aggregate impact. Because they integrate stressors over time, they can provide an ecological measure of fluctuating environmental conditions. The Rivers Program uses biological monitoring (i.e., biomonitoring) to detect aquatic biota impairments in wadeable streams, as well as the type and severity of potential stressors causing the impairment. Biomonitoring is also important for identifying streams at or near a reference level condition. Each community of macroinvertebrates and fish is rated from Poor (severely degraded and not meeting VWQS) to Excellent (similar to the natural condition and exceeding the Vermont Water Quality Standards). If a stream repeatedly fails to meet minimum aquatic biota expectations, it is a candidate for the Vermont Priority Waters List. If a stream has macroinvertebrate and fish communities consistently at or near a reference level condition, it is a candidate for increased protection through upward reclassification. Macroinvertebrate and fish monitoring is conducted following procedures outlined in the Watershed Management Division's Field Methods Manual. Applying biocriteria and determining assessments for both communities is outlined in the Vermont Water Quality Standards.

Biomonitoring assessments are available for five of the major tributaries draining the WRMU (Map 21). Gold Brook attained "Excellent" ratings for both fish and macroinvertebrate communities; Hancock Brook attained a "Very Good" rating based on its fish community; Martins Brook (encompassing the upstream Patterson and Herrick Brooks) attained a "Very Good – Excellent" rating based on its macroinvertebrate community; Bedell Brook attained a "Very Good" rating for its fish community and a "Very Good – Excellent" rating for its macroinvertebrate community; and Thatcher Brook attained a "Good" rating for its macroinvertebrate community and a "Poor" rating for its fish community. The Thatcher Brook sampling site is well downstream of the WRMU boundary and incorporates significant upstream developed and agricultural riparian area that is not representative of the forested riparian corridor of its headwaters in the WRMU.

To support the five-year reassessment cycle of Vermont's surface water conditions, Tactical Basin Plans include a table of possible water resource monitoring needs identified by various state staff and water resource partners. ANR staff also meet before each assessment cycle to prioritize these and other identified monitoring needs. The Winooski basin's next assessment is slated for 2025, with subsequent monitoring periods every five years. The 2023 Winooski Tactical Basin Plan identifies additional sampling needs on Moss Glen, Hancock, and Thatcher Brooks. This LRMP also recommends sampling on Minister Brook to assess its baseline biological condition.

Map 22: Water Resources



G. Fisheries Resource Assessment

Watershed Background

The WRMU contains 18,772 acres and is located almost entirely within the Winooski River watershed. Several tributaries of the Little River and North Branch of the Winooski River originate within the unit's four pieces, C.C Putnam State Forest (16,685 acres), Middlesex WMA (290 acres), Middlesex Notch WMA (627 acres), and Worcester Woods WMA (184 Acres). The remaining parcel, Elmore State Park (995 acres) is located at the edge of the Lamoille and Winooski River drainages and borders 219-acre Lake Elmore. Apart from the occasional beaver flowage, the 219-acreface waters are entirely riverine including several headwater streams that originate above 2,500 ft. All waters flowing from WRMU eventually enter Lake Champlain.

Fisheries Assessment Procedure

In 2015, 18 fisheries surveys were conducted within the Winooski River watershed surrounding WRMU (Table 16). Surveys consisted of single or multiple run electrofishing with a 500-volt DC stream side generator. Captured brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*), and rainbow trout (*Onchorhynchus mykiss*) were measured to the nearest millimeter (total length), weighed to the nearest gram, and released. All other species were identified and released.

Trout population estimates are presented using the maximum weighted likelihood method developed by Carl and Strub for multiple run surveys and for single run surveys (2 of 18 surveys) a minimum estimate is used.[30] Trout population estimates are separated into three size classes: young-of-year (YOY); <6 inches; and 6-10 inches. Stocked trout were distinguished by fin clips or physical appearance and are not included in population estimates. Species presence within each waterbody is based on historic sampling records from the Vermont Department of Environmental Conservation (DEC) and the Vermont Department of Fish and Wildlife (DFW). Further information regarding all common fish names listed in this document can be found in *Fishes of Vermont*.[31]

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[30] Carle, F., & Strub, M. (1978). A new method for estimating population size from removal data. *Biometrics, 34*, 621-630.
[31] Langdon, R. W., Ferguson, M. T., & Cox, K. M. (2006). *Fishes of Vermont.* Waterbury, VT.

Table 16: Fisheries sampling site information (2015)

1st Tributary (2nd order stream)	2nd Tributary (3rd order stream)	3rd Tributary (4th order stream)	Sampling Date	Elevation	Station Length (Ft)	Station Mean Width (Ft)	Lat. Coords	Lon. Coords
Little River	Gold Brook		10/6/2015	820	310	19.6	44.4424	-72.6875
Little River	Gold Brook		10/6/2015	680	290	19.1	44.4427	-72.7026
Little River	Gold Brook	Rodgers Brook	10/6/2015	885	219	9.0	44.4399	-72.6790
Thatcher Brook			9/4/2015	415	495	24.2	44.3410	-72.7512
Little River	Moss Glen Brook		8/6/2015	840	260	14.3	44.4828	-72.6253
Little River	Moss Glen Brook		8/6/2015	730	358	17.1	44.4880	-72.6612
Thatcher Brook	Unnamed Tributary		8/4/2015	770	269	8.4	44.3560	-72.7015
Thatcher Brook	Unnamed Tributary		8/4/2015	850	279	7.3	44.3686	-72.6970
Middlesex Notch Brook			8/3/2015	750	269	7.5	44.3159	-72.6888
Unnamed Highway Trib.			8/3/2015	430	5	5.0	44.3225	-72.7326
North Branch	Tributary #39		7/6/2015	1180	268	12.0	44.4536	-72.5469
North Branch	Martins Brook	Herrick Brook	7/17/2015	1110	250	10.2	44.3462	-72.6091
North Branch	Catamount Brook		7/17/2015	870	318	10.8	44.4240	-72.5409
North Branch	Hancock Brook		7/16/2015	1265	229	14.7	44.4191	-72.5713
North Branch	Minister Brook		7/14/2015	1190	265	20.0	44.3954	-72.5891
North Branch	Martins Brook	Patterson Brook	7/14/2015	1110	228	11.7	44.3631	-72.6093
North Branch	Martins Brook		7/13/2015	660	340	27.9	44.3349	-72.5793
North Branch	Martins Brook		7/13/2015	1090	228	11.7	44.3531	-72.6067

Findings

Waters within WRMU are mostly small, high gradient, cold-water streams. While the upper elevational extent of fish presence within WRMU is unknown, surveys at lower elevations primarily downstream of WRMU (2 of 18 surveys were within WRMU) documented abundant wild self-sustaining populations of brook trout (confirmed by the presence of young-of-year as evidence of natural reproduction). In addition, 13 other fish species were observed. Four of 12 streams surveyed contained salmonid species other than brook trout. Rainbow trout were observed in Gold Brook and Thatcher Brook and brown trout in Patterson Brook, Martin Brook, Gold Brook and Thatcher Brook. Other fish sampled included two species of sucker, eight species of minnow, one darter species, and one sculpin species (Table 17).

Table 17: Stream information and species occurrence

Stream	Gold Brook	Rogers Brook	Thatcher Brook	Moss Glen Brook	Middlesex Notch Brook	Unnamed Highway Tributary
Sub-watershed	**Littler River**	**Littler River**	**Little River**	**Little River**	**Winooski**	**Winooski**
Drainage area (acres)	5,790	5,189	12,364	5,562	1,193	161
Drainage area (square miles)	9.0	8.1	19.3	8.7	1.6	0.3
Survey Elevation	820 / 680	885	415/770 /850	840 / 730	750	430
Species						
Longnose Sucker	x		x			
White Sucker	x		x	x		
Slimy Sculpin	x		x			
Blacknose Dace	x	x	x	x	X	
Bluntnose Minnow						
Common Shiner			x	x		
Creek Chub	x		x			
Longnose Dace	x		x	x		
Northern Redbelly Dace				x		
Fathead Minnow	x		x	x		
Central Mudminnow				x		
Tessellated Darter			x			
Brook Trout	x (yoy)[32]	x (yoy)	x (yoy)	X(yoy)	x (yoy)	x
Brown Trout	x (yoy)		x (yoy)			
Rainbow Trout	x (yoy)	x	x (yoy)			

[32] Observation of young-of-the-year trout (yoy) indicates natural reproduction.

Stream	Tributary 39	Hancock Brook	Catamount Brook	Minister Brook	Patterson Brook	Martins Brook
Sub-watershed	**Winooski North Branch**	**Winooski North Branch**	**Winooski North Branch**	**Winooski North Branch**	**Winooski North Branch**	**Winooski North Branch**
Drainage area (acres)	752	2,428	1,863	5,565	3,255	8,197
Drainage area (square miles)	1.2	3.8	2.9	8.7	5.0	12.8
Survey Elevation	1180	1265	870	1190	1110	1090
Parcel Border Elevation	1180	1310	2180	1620	1960	1800
Species						
Longnose Sucker						
White Sucker						x
Slimy Sculpin				X		
Blacknose Dace	x	x	x	X	x	x
Bluntnose Minnow						
Common Shiner						
Creek Chub						
Longnose Dace			x			x
Northern Redbelly Dace						
Fathead Minnow						
Central Mudminnow						
Tessellated Darter						
Brook Trout	x (yoy)	x (yoy)	x (yoy)	x (yoy)	x (yoy)	x (yoy)
Brown Trout					x (yoy)	x
Rainbow Trout						

Yearling trout have been historically stocked by VDFW within lower elevation reaches of Thatcher Brook, Gold Brook, Martins Brook, and Moss Glen Brook, but no authorized stocking has occurred since 2008 in Thatcher Brook or since 1975 in Gold Brook, Martins Brook, or Moss Glen Brook. The absence of recent stocking and the presence of young-of-the-year rainbow trout in Gold Brook and Thatcher Book and young-of-the-year brown trout in Gold Brook, Thatcher Brook, and Patterson Brook indicate self-sustained naturalized populations within these streams.

According to *The Vermont Management Plan for Brook, Brown and Rainbow Trout*, streams containing dense populations (≥20lbs/acre and ≥1000 trout/mile) of brook trout are considered to have “populations near their maximum potential and may represent Vermont’s only native trout resource which has not been significantly altered by past management practice.”[33] Eight of 12 streams surveyed in 2015 contained brook trout population estimates greater than 1000 trout/mile (5 of these 8 streams also contained more than 20 lbs/acre of brook trout).

[33] VDFW. (1993). *The Vermont Management Plan for Brook, Brown and Rainbow Trout.* Federal Aid in Fish and Wildlife Restoration, Waterbury, VT.

Water temperature, especially during warm summer months can have an adverse effect on the distribution and health of fish populations. If given the ability to move, fish will often seek refugia from warm temperatures. Waters within WRMU exhibit characteristics (high elevation, steep gradient, heavily vegetated) common to many of Vermont's cold-water streams. While no streams flowing directly from WRMU have been monitored for temperature, abundant brook trout populations indicate cold temperatures as brook trout prefer temperatures less than 68°F and will experience heat-shock at temperatures over 72°F.[34] Notably elevated summer temperatures have been observed in downstream waters of the North Branch, the Little River, and the Winooski River (Table 18).

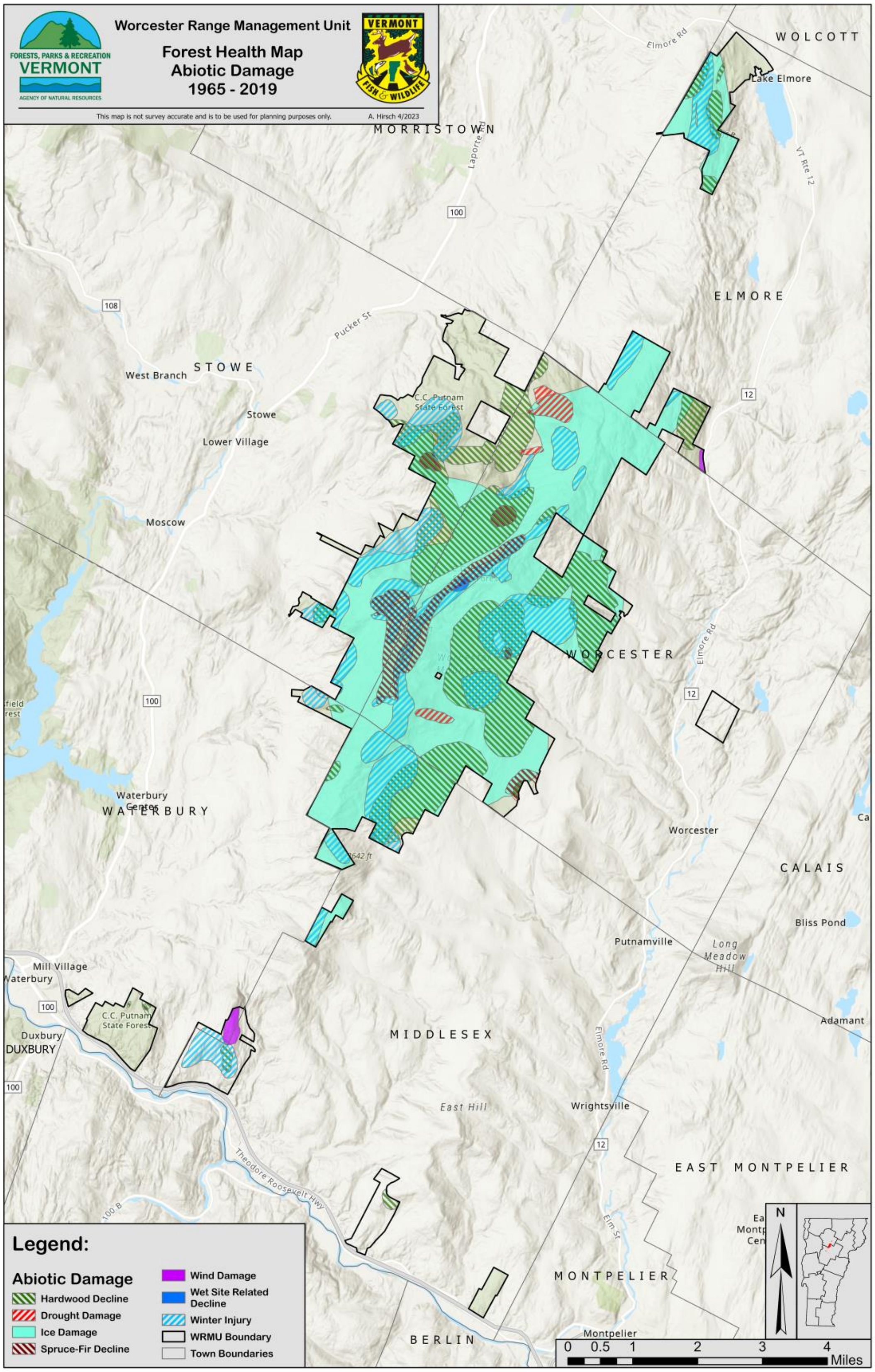
Table 18: Continuous temperature metrics recorded in rivers downstream of the WRMU (June-September

Stream	Year	Elevation	Max Temp (°F)	Max 7-Day Temp (°F)[35]	Number of Hours >72 (°F) June-Sept	Latitude Coordinates	Longitude Coordinates
Little River	2003	390	75.5	72.3	30	44.3536	-72.7773
North Branch	2003	800	80.5	76.8	270	44.4025	-72.5510
North Branch	2003	730	79.0	79.0	508	44.3773	-72.5459
North Branch	2003	660	82.5	78.8	462	44.3426	-72.5659
North Branch	2012	660	84.0	79.5	812	44.3426	-72.5659
Winooski	2015	420	79.3	1,461	464	44.3139	-72.7030

The WRMU provides excellent angling opportunity to some of Vermont's most picturesque waters. With its proximity to population centers (Montpelier, Waterbury, Morrisville, and Stowe), abundant wild trout populations, and several access points to large tracts of undeveloped public land, angling opportunity is widespread. Management goals of currently owned riparian lands should follow *The Riparian Management Guidelines for Agency of Natural Resources Lands*.[36] The future acquisition and preservation of additional riparian lands surrounding WRMU should also be considered to conserve habit, maintain connectivity and cold-water temperatures, and help protect water quality.

[34] Kratzer, J., & Warren, D. (2013). Factors Limiting Brook Trout Biomass in Northeastern Vermont Streams. *North American Journal of Fisheries Management, 33*, 130-139.
[35] Max 7-Day Temp is the maximum temperature from a 7-day rolling average of daily maximum temperatures.
[36] VANR. (2015). *Riparian Management Guidelines for Agency of Natural Resources Lands.* Montpelier: State of Vermont.

Map 23: Fisheries Resources



H. Forest Health and Resiliency Assessment

Recent History of Forest Health Issues

While it has avoided exposure to many statewide forest health outbreaks, the Worcester Range Management Unit has incurred abiotic and biological stresses in recent decades. A forest tent caterpillar (FTC) outbreak from 1976 to 1982 resulted in approximately 3,300 acres of hardwood defoliation within the WRMU. These repeated years of FTC-caused defoliation resulted in 650,000 acres of mapped damage and approximately 33,500 acres of moderate to heavy mortality being mapped across Vermont. Sugar maple and ash species were most heavily defoliated by FTC during this infestation. Aerial surveys from 1983 to 1986 identified approximately 130 acres of hardwood mortality following FTC defoliation in the WRMU. By the mid-1980s, previously declining sugar maple populations in the WRMU began to recover.

In 1971, *Scleroderris* canker was positively identified in Lamoille County, and by 1984 had been discovered in Stowe and Elmore. *Scleroderris* is caused by the European strain of *Gremmeniella abietina*, harming all pine and a variety of spruce, fir, larch, and hemlock species. In Vermont and New York, the pathogen has caused greater than 90% mortality in 20-30-year-old red and scots pine stands. The towns encompassing the WRMU have remained under quarantine since the early 1980s, resulting in limited spread of *Scleroderris* since 1986.

From the 1960s to mid-1980s, pollution-induced acid deposition caused decline and mortality in red spruce populations across the northeastern United States. At the peak of this decline, red spruce mortality exceeded fifty percent in some stands. The Worcester Range was not spared from red spruce damage in this period. In 1974, 1982, and 1983, aerial surveys detected spruce death and decline across more than 650 acres of the WRMU. Environmental regulation since the mid-1980s reversed the decline in red spruce populations, and the tree's health has improved statewide.

A 1990 pear thrips (*Taeniothrips inconsequens*) outbreak caused sugar maple defoliation across a significant portion of the WRMU. Periodical infestations of the non-native European insect are common in Vermont, with foliar damage occurring across 5,500 acres of the WRMU in 1993. Pear thrips feed on plant tissue, resulting in dwarfed, discolored foliage that resembles late frost damage. While pear thrips prevent normal leaf formation during bud break, trees are typically able to recover within the same growing season. Since 1993, no pear thrips damage has been observed in the WRMU.

From 1993 to 2015, fungal pathogens and insects defoliated large swaths of birch across the majority of the WRMU. Birch defoliator complex was most prevalent in the WRMU in 2005, 2009, and 2013. Non-native birch leafmining sawflies (*Fenusa pusilla, Fenusella nana*, others) and the native birch skeletonizer (*Bucculatrix canadensisella*) created the greatest insect damage to birch over this period. Larvae of these insects feed on birch leaves, depleting trees of stored nutrients and reducing their photosynthetic capacity. A prominent pathogen in this birch defoliating complex is the native Septoria leaf spot (*Septoria betulae*). Septoria causes brown spots and occasional premature leaf drop, adding stress to birch trees already fighting insect pressure. During this 20-year period, birch trees across 11,000 acres of the WRMU experienced foliar damage.

In January 1998, a severe ice storm damaged trees across nearly the entire state of Vermont. The Worcester Range was no exception, with over 13,000 acres of the management unit experiencing some form of ice damage. Across the state, hardwood species experienced the greatest damage, particularly in pole-sized trees and branches less than 8 inches in diameter. Smaller paper birch trees were heavily bent, and regeneration was flattened in some areas. As the spring progressed, much of the affected regeneration and smaller birch straightened to previous form. Additionally, widespread frost damage occurred in May 2010, impacting sugar maple, birch, beech, poplar, and red maple species across over 4,000 acres of the WRMU. Most trees in the WRMU were able to refoliate soon after the freeze event.

Current Forest Health Issues

Although it has experienced its share of forest health issues, the Worcester Range has not been as severely affected by recent health stressors as other Vermont Forests. While high populations of forest tent caterpillar and maple leaf cutter have defoliated hardwood species statewide, the WRMU has largely been unscathed by these outbreaks. Statewide trends in the white pine needle damage (WPND) complex have not heavily affected white pine in the WRMU. Since recovering from acid deposition damage in the 1980s, large components of spruce and balsam fir have experienced little to no forest health issues across the management unit. Beech bark disease, a complex of native fungal pathogens (*Neonectria* spp.) and the non-native beech scale insect (*Cryptococcus fagisuga*), have been attacking American beech trees across Vermont. As an important food source to wildlife and major forest component, American beech is an essential tree species in the Worcester Range. While beech bark disease is present in the WRMU, foliar damage and beech decline have been limited. Since 2010, only 640 acres of foliar discoloration or beech decline associated with beech bark disease has been detected via aerial survey in the WRMU.

While the Worcester Range has been resilient to many pests, some current and future threats to its health include:

Emerald Ash Borer (EAB)

The most significant future forest health threat to the WRMU is the invasive Emerald Ash Borer (*Agrilus planipennis*). Native to Eastern Asia, the wood boring beetle was first identified in the United States in 2002 and has decimated ash tree populations across the central and eastern United States ever since. EAB larvae feed on the conductive tissue of ash trees, effectively girdling and killing them within 1-4 years of feeding. EAB was first identified in Vermont in February 2018 and has now been detected in seven counties within the state. As of February 2020, 4845 acres of the WRMU fall within the emerald ash borer infested area. While EAB has not been detected across the entire infested area, ash trees present in the infested area are within a 10-mile radius of a confirmed detection, and thus are at a higher risk for infestation and mortality. Neither EAB nor associated ash mortality have been positively detected yet in the WRMU.

Beech Leaf Disease (BLD)

An emerging threat to American beech (*Fagus grandifolia*) was confirmed in Windham County in Vermont in 2023. Beech Leaf Disease is associated with an invasive nematode (*Litylenchus crenatae mccannii)* and has been known to cause mortality of beech saplings in two years, or larger beech trees in several years. While BLD is not yet present in the WRMU, its rapid spread in neighboring states leads us to believe it will be widespread within the state, likely in the next several years.

Red Pine Decline

Mortality of red pine (*Pinus resinosa*) has steadily increased across Vermont since 2014. Mature red pine plantations in the Perry Hill block of the WRMU have experienced heavy and rapid mortality during this statewide decline. While common insects and diseases, such as pine gall weevil and Diplodia and Sirococcus shoot blights have been detected, the cause of this extensive decline and mortality has not been identified yet. The invasive insect, red pine scale (*Matsucoccus matsumurae*) has not been detected within the WRMU but is present in other Vermont red pine stands. Surveys to detect the pine wood nematode (*Bursaphelenchus xylophilus*) are currently underway in Perry Hill. Carried by native pine sawyer beetles (*Monochamus* spp.), the pine wood nematode embolizes xylem tissue in pines, preventing water flow up the stem. In summer 2020, a statewide study was established to monitor red pine health and decline, with a research plot being established at the Perry Hill Block. Identifying the cause of this mortality will help protect red pine across the state and WRMU that has yet to experience red pine decline.

Table 19: Invasive Exotic Pests of Worcester Range Management Unit

Species Name	Common Name	Distribution Across Vermont	Sites Where Found	Present Threat to Native Plant Communities
Neonectria spp.	Beech Bark Disease	Widespread	Northern hardwood stands	Significant impact on mature beech
Lecanosticta acicola, Lophophacidium dooksii, Bifusella linearis, Septorioides strobe	White Pine Needle Damage	Widespread	Stands containing eastern white pine (*Pinus strobus*)	Mortality and significant decline of white pine
Cronartium ribicola	White Pine Blister Rust	Isolated patches	Localized impact where *ribes* present	Impact on young white pine trees and new growth
Fenusa pusilla, Messa nana, Others	Birch Leaf Miners	Varies, but can be widespread	Red spruce, northern hardwood	Decline or mortality of white birch from defoliation
Taeniothrips inconsequens	Pear Thrips	Varies	Northern hardwood	Persistent outbreaks can

				cause crown dieback
Agrilus planipennisi	Emerald Ash Borer	Isolated patches, but spreading	Ash (*Fraxinus* spp.) stands	Infestations lead to heavy mortality within 4 years

Nonnative Invasive Plant Species:

The extensive areas of interior forest within the WRMU, particularly the higher elevation natural communities, host few if any invasive plant species. However, the lower elevation areas host a variety of nonnative invasive plants that threaten natural plant communities. The Perry Hill and Middlesex Blocks, as well as the Middlesex Notch and Middlesex WMAs, that Interstate-89 largely consist of abandoned agricultural land, and have experienced more recent human disturbance than the contiguous, mountainous block of CC Putnam State Forest. These contain open fields, early successional forest, and a greater proportion of exposed forest edge, allowing for the introduction of nonnative invasive pests. Invasives present in these blocks include Asiatic bittersweet, common and Japanese barberry, common and glossy buckthorn, honeysuckle, and multiflora rose. Elmore State Park has a growing population of honeysuckle, concentrated in and around the camping sites.

A highly competitive vine, Asiatic bittersweet constricts and girdles trees, eventually killing them. Buckthorn, autumn olive, honeysuckle, multiflora rose, and barberry behave in similar manners. Once established, eradication of these invasive plants becomes extremely difficult. These shrubs create dense thickets in fields, forest edges, disturbed sites, and forest understories, outcompeting native plants and tree regeneration. Species of buckthorn can grow beyond shrubs into small trees as tall as 25 feet. Many of these shrubs exhibit allelopathic behavior, creating optimized growing conditions for themselves while diminishing growing conditions for native competition. These invasive plants reproduce vigorously via heavy seed production, vegetative reproduction, and seed dispersal by wildlife.

Wall lettuce is a non-native herb that is notable for its ability to invade undisturbed, mature forests. This species is found on the Brownsville parcel, where it is established in patches of Rich Northern Hardwood Forest. Because this spreads even in the absence of disturbance, it can be very difficult to eradicate.

Two non-native invasive plants threaten floodplains and riparian areas in the WRMU. Goutweed is established along Moss Glen Brook. A patch of Japanese knotweed was found along Brownsville Road in disturbed soil; it has not yet been detected in riparian areas of the WRMU but can spread rapidly. Both species form dense patches that displace native riparian vegetation. The resulting loss of shade, bank stability, and plant diversity has negative impacts on water quality and fish and wildlife habitat.

In addition to the threat posed to native plant communities, invasive plants within the WRMU threaten wildlife and human health. Dense thickets of barberry create the ideal habitat for white footed mice and black legged ticks, two vectors of Lyme disease. Research suggests that the density of ticks carrying the Lyme disease bacteria is greater in areas where barberry is present, posing a clear human health risk.[37] The fruit of nonnative honeysuckle species contains a laxative which allows for rapid seedling dispersal by feeding birds and limits nutrient uptake when they feed.

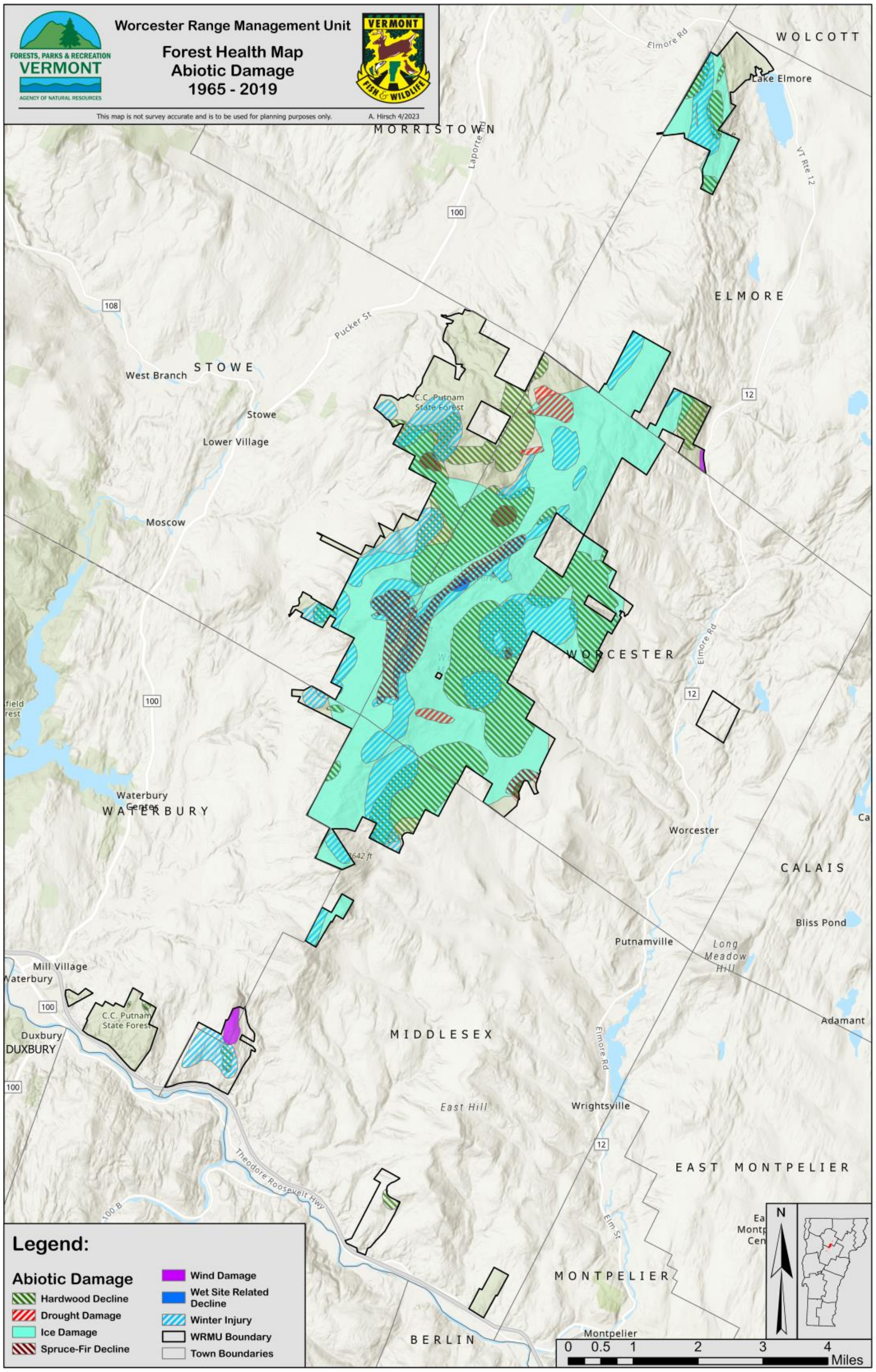
Table 20: Non-native Invasive Plants of the Worcester Range Management Unit

Species Name	Common Name	Sites Where Found	Present Threat to Native Communities
Elleagnus umbellata	Autumn olive	Open Woodlands Fields Forest Edges	Creates dense thickets outcompeting native vegetation.
Celastrus orbiculatus	Asiatic bittersweet	Fields Forests Forest Edges Disturbed Sites	Vines girdle and slowly kill trees. Can cover and block sunlight to native vegetation.
Rosa multiflora	Multiflora rose	Man-made or Disturbed Sites Fields/Meadows Riparian Areas Shrublands/Thickets	Creates dense thickets outcompeting native vegetation.
Lonicera spp.	Honeysuckle	Forest Edges Fields Hardwood Understories	Creates dense thickets outcompeting native vegetation. Increased songbird predation.
Berberis thunbergii	Japanese barberry	Disturbed Areas Forests Edges Fields/Meadows	Creates dense thickets outcompeting native vegetation. Creates sustainable habitat for invasive earthworms/vectors of Lyme disease.
Berberis vulgaris	Common barberry	Floodplains Hardwood Understories	Creates dense thickets outcompeting native vegetation. Creates sustainable habitat for invasive earthworms/vectors of Lyme disease.
Rhamnus cathartica	Common buckthorn	Disturbed Areas Fields/Meadows	Creates dense thickets outcompeting native vegetation.

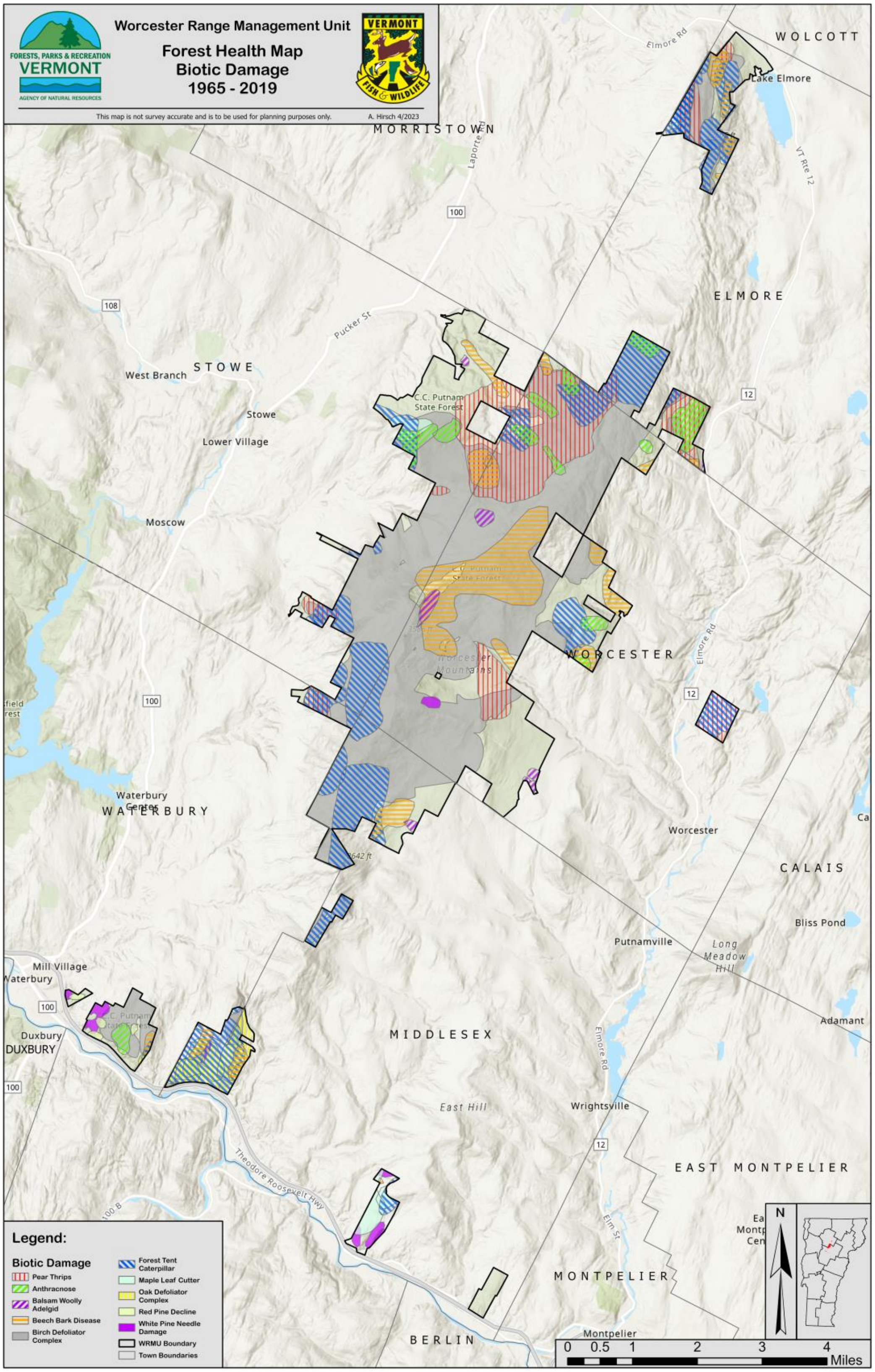
[37] Williams, S. C., & Ward, J. S. (n.d.). Effects of Japanese barberry (Ranunculales: Berberidaceae) removal and resulting microclimatic changes on Ixodes scapularis (Acari: Ixodidae) abundances in Connecticut, USA. *Envrion. Entomol.*, 39, 1911-1921.

			Laxative quality of fruit limits nutrient uptake in birds/readily disperses seed.
Frangula alnus	Glossy buckthorn	Forests Edges Forests Wetlands	Creates dense thickets outcompeting native vegetation. Laxative quality of fruit limits nutrient uptake in birds/readily disperses seed.
Mycelis muralis	Wall lettuce	Northern Hardwood Forests, Rich Northern Hardwood Forest	Capable of invading mature natural communities.
Fallopia japonica (Polygonum cuspidatum)	Japanese knotweed	A small colony establishing at pullout along Brownsville Rd; can spread to riparian areas	Creates dense patches that displace native vegetation; results in loss of riparian functions.
Aegopodium podagraria	Goutweed	Floodplains and riparian areas	Dense patches displace native vegetation.

Map 23: Forest Health – Abiotic Damage



Map 24: Forest Health – Biotic Damage



I. Historic Resource Assessment

Introduction

This historic resource assessment (HRA) for the WRMU is divided into six sections including Elmore State Park, the Atlas Forest Legacy parcel, C.C. Putnam State Forest, and the three WMAs located within the WRMU (Middlesex Notch, Middlesex, and Worcester Woods WMAs). The discussion of C.C. Putnam State Forest is further subdivided into five sections (Map 58) labeled as the Stowe Northeast (Moss Glen Falls/Brownsville), Stowe Southeast (the Burt Hollow/Gold Brook and Upper Hollow), Worcester Mountain, Middlesex Northwest, and the Waterbury-Perry Hill Sections. This structure for the discussion of C.C. Putnam State Forest follows the organization of Stephen Scharoun and Ellen Cowie's report *The Cultural Landscape of the Worcester Range Management Unit*, adding a discussion of acquisitions that have been made since 2007. The goal of this review is to not provide the cultural background and history of the WRMU, but rather to review, locate, and map the items listed below for each management unit:[38]

- All previously conducted HRAs reviews including those conducted for the Recreational Trails Program (RTP);
- The identification of Map Documented Structures (MDSs) and roads within or directly adjacent to the WRMU as illustrated in historic maps including Walling, Beers and historical USGS maps (Table 35);
- A review of LIDAR mapping to identify features that might represent historical structures such as stone walls and cellar holes;
- The known archaeological sites as listed by the DHP; and
- Historical sites including State and National Register listed properties.

The report outlines all MDSs and roads that were found within or directly adjacent to the boundaries of the WRMU, as illustrated on Walling, Beers, and historic USGS maps.[39] Road intersections are typically effective when georeferencing historical maps although inconsistencies and differences can occur. Given the potential for variability in georeferencing as well as the technology available to surveyors in the 19th century, it is important to take each location as a rough estimate as to where the MDS might have stood. In addition, the historic roads also do not always match exactly with the locations of the present-day roads that they are presumably the ancestors of. In comparing the different historical maps, it is not always clear if an MDS mapped on one map is the same as one mapped on the other, or if there are two different structures that were located near each other. In general, if a structure on a Walling map appeared to be located within about 200 hundred feet of structures identified on

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[38] Scharoun, S., & Cowie, E. (2007). *The Cultural Landscape of the WRMU, in the Towns of Elmore and Stowe, Lamoille County and Worcester, Middlesex and Waterbury, Washington County, Vermont.* Historic Resource Summary, Historic Context and Development and Prioritization of Known and Expected Historic Resources. Archaeology Research Center, University of Maine, Farmington. On file with the Vermont Department of Forests, Parks and Recreation.

[39] Walling, H. F. (1858). Map of Washington County, Vermont. New York; Walling, H. F. (1859). Map of the Counties of Orleans, Lamoille, and Essex, Vermont. Loomis & Way, New York.

a Beers map, then it was assumed that both maps were mapping the same structure. In some cases, two structures on the Walling and Beers maps may not appear in the exact same location, however the Beers map will list what was likely the widow of the person listed on the earlier Walling map. It can therefore be assumed that the two locations are mapping the same structure. (e.g., E. Johnson on the Walling map is followed by Mrs. Johnson on the Beers map 20 years later).
* All listed RTP projects were conducted before 2019

Table 37lists all MDSs, providing the citation or citations for each entry, as well as the name ascribed to the MDS (if available). Finally, for all MDSs, an identification number is assigned. The first number is the management unit number for that unit and the second number is the number for that MDS within that management unit (e.g., 10-26 is the 26th structure identified within C.C. Putnam State Forest). These numbers correspond with numbers in the attribute list.

After reviewing all MDSs, LIDAR mapping for each section was reviewed, using 0.7-meter LIDAR at a scale of 1:1000 to 1:2500, to identify potential structural remains. Finally, all previously conducted CRM projects within each section of the WRMU were reviewed and mapped, to illustrate the locations of each Archaeological Resource Assessment (ARA) or architectural review, conducted within the management unit, as well as where any sensitive areas were identified. There have been no excavations (Phase I, II, or III projects) within the WRMU.

Elmore State Park

The first colonial settlement of Elmore was located at Grout Hill by 1790, about a mile south of Elmore State Park.[40] Settlement moved north in the early 1800s to the northeast shore of the Elmore Lake, just east of the Park, to take advantage of Elmore Pond Brook. However, the construction of the railroad through Morrisville and Wolcott in the middle of the 19th century caused further development in the second half of the 19th century to move to the north of Elmore and elsewhere.[41] Route 12 on the northeast edge of the Park can be found on the Walling (1859) and Beers (1878) maps of Elmore. Route 12 is clearly delineated on historical maps with a location that closely matches the location of the present-day Route 12. Both Walling (1859) and Beers (1878) also map a road that runs around the north and west sides of the lake, located a couple hundred feet to the north and west of the present-day Beach Road. Beach Road today takes a sharper turn to the south after exiting the Park and it is unclear if the two roads are the same road, although the road's location is restricted by the steep topography of Elmore Mountain. Nothing visible on LIDAR appeared to match the location of the road as mapped by Walling (1859) and Beers (1878) and it is possible that the location of the 19th century road as illustrated in Map 59 is the result of inaccuracies in georeferencing, although the location of the intersecting Route 12 is very close. Sarah MacCallum describes the

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[40] MacCallum, S. (1999). *National Register of Historic Places Registration Form - Elmore State Park, Elmore, Vermont.* . Report submitted May 11, 1999. Report on file with the VD FPR, Montpelier.
[41] Scharoun and Cowie 2007:17.

road leading from Route 12 to the Bath House as a Civilian Conservation Corps (CCC) construction.[42] However, given the road's representation on 19th century maps, it appears likely that the CCC utilized the existing Beach Road. In addition, this road can also be seen in the USGS 1927 map.

Although logging was the dominant industry in Elmore during the 19th century, Elmore Mountain was likely too steep for the available technology at the time and in addition, the mountain lacked white pine and spruce. Logging was likely restricted to the lower slopes between the lake and the mountain, particularly in the northern portions of the Park. Logging infrastructure including logging camps and landings, may have been located along what is today Beach Road. Loggers brought the timber to the shores of the lake and then transported it across the lake to the sawmill located on Elmore Pond Brook to the east of the Park.[43]

The Walling (1859) and Beers (1878) maps illustrate several structures within or adjacent to the Park (
* All listed RTP projects were conducted before 2019

Table 37and Map 59). The Walling (1859) map illustrates the I. Darling farm (Structure 730-11) on the west side of Route 12, near the present-day intersection with Beach Road. The map also shows a blacksmith shop (Structure 730-12) located to the southwest of the Beach Road and Route 12 intersection, just outside the boundary line of the Park. There are two structures on the Beers (1878) map with no name, located where the Walling (1859) map places the blacksmith shop. The Beers (1878) map also locates the Post Office (Structure 730-9) to the north of Beach Road where the road turns to the south, approximately at the Park boundary. According to USGS, two structures in 1927 were located one on either side of the Beach Road/Route 12 intersection, indicating that Structures 730-11 (the I. Darling farm) as well as either 730-12 (the Blacksmith Shop) or 730-8 remained standing into the 20th century. The Post Office was gone by 1953 according to the USGS (1953) map and the two structures to the southwest of the intersection continue through the 1986 Morrisville map (USGS 1986).

The earliest documented recreational use of present-day Elmore State Park dates to the 1870s with the establishment of Camp Bacon, also known as Mt. Lookout Farm, for hunting, boating, and camping. However, the camp was located to the east of the Park on Beach Road along the west side of Lake Elmore. There is no evidence of anything related to Mt. Lookout Farm within Elmore State Park.[44] The State of Vermont acquired Elmore State Park in the early 1930s and the CCC then transformed the location into a recreation place accessible by car. As discussed in

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[42] MacCallum, S. (1999). *National Register of Historic Places Registration Form - Elmore State Park, Elmore, Vermont.* . Report submitted May 11, 1999. Report on file with the VD FPR, Montpelier.
[43] Scharoun, S., & Cowie, E. (2007). *The Cultural Landscape of the WRMU, in the Towns of Elmore and Stowe, Lamoille County and Worcester, Middlesex and Waterbury, Washington County, Vermont.* Historic Resource Summary, Historic Context and Development and Prioritization of Known and Expected Historic Resources. Archaeology Research Center, University of Maine, Farmington. On file with the Vermont Department of Forests, Parks and Recreation.
[44] Scharoun and Cowie 2007: 18.

greater detail below, the CCC built several structures at the Park including a bathhouse, picnic area, lookout tower and caretaker's cabin, as well as the road leading up to the mountain trailhead (see Map 59 and Table 35). Sarah MacCallum completed a National Historic Register Nomination form for the property and nominated the property as an Historic Park Landscape, citing that it meets the state parks requirements, as well as recognizing its importance to the history of the CCC in Vermont.[45] MacCallum also writes that the CCC structures exhibit the distinctive characteristics of architecture, landscape architecture, and recreation areas constructed by the CCC in the 1930s. Of the 30 buildings, camp sites, and structures that MacCallum identifies, she lists five as contributing properties, built by the CCC between 1934 and 1936. These properties are listed below.

1. The Bath House (Structure 730-1) was built by the CCC in 1936. MacCallum describes the Bath House as constructed in an H-shape with a gabled-roof with shallow gables covered in wood shingle. She defines the Bath House as an excellent example of the rustic architecture found at other CCC sites across Vermont and the country citing the split-log siding, the massive chimney, and the dark brown stain.
2. The CCC built the Beach Access Road in 1934 (Structure 730-5) and MacCallum writes that the road was constructed to connect Route 12 to the Bath House. She believes that the road has not changed significantly since it was constructed, retaining a gravel surface and maintaining the same level as seen in photos, although she writes that the road has been extended to provide access to private homes adjacent to the park. As discussed above, it appears from historic maps that the CCC built the road over the existing 19th century road and that the road was extant in the years preceding the work of the CCC.
3. The Beach (730-3) was built in 1934. The CCC removed large rocks from the beach and brought in sand, demarcating the area with timbers. MacCallum states that the Beach maintains its integrity, with little change since its original construction. However, it is unclear if she accounts for work done to the retaining wall in 1988 (see Project 299 below).
4. Access Routes (730-4) constructed by the CCC include an existing unpaved path that runs to the CCC camp located at the top of the access road, where the trail to the Fire Tower starts. According to MacCallum, the CCC camped at the north end of the access road, on the south side of the road. Although the area is now overgrown, she writes that cellar holes and metal pipes are visible, comprising the remains of 20 or so structures in total that were either removed or fell into disrepair after the CCC left the Park. MacCallum cites the area's archaeological potential. Although the actual location is not mapped, MacCallum writes that the camp sat along the south side of the road. However, in looking at the LIDAR mapping of the area that she indicates as the location for the camp, it appears more sloped and undulating. On the north side, however, is a roughly rectangular area that is more level and that contains faint shapes at right angles that appear to be cultural and not natural. The other access route MacCallum

[45] MacCallum, S. (1999). *National Register of Historic Places Registration Form - Elmore State Park, Elmore, Vermont. .* Report submitted May 11, 1999. Report on file with the VD FPR, Montpelier.

describes is today the hiking trail leading up to the Fire Tower. She writes that the present-day hiking trail was likely put in-place to create access to the summit for the construction and occupation of the Fire Tower in 1939. MacCallum writes that "the path to the summit still maintains its integrity and its relationship to the landscape while the modern access road maintains only its historic relationship with the landscape."[46]

5. The Fire Tower (730-2) was built in 1939 not by the CCC but by the Vermont Division of Forestry as part of a Federal initiative to rehabilitate forests in New England after the destruction brought by the hurricane of 1938. A cabin once stood at the site for use by the occupant of the tower, but it burned down in 1983 and today is marked by the foundation and remaining bed frames. The lookout remained active until 1974.

MacCallum lists other structures found at Elmore State Park but not as contributing to the NRHP listing. These structures included the toll booth and gate, campsites, bathroom facilities, and a woodshed, all built in 1963. More recent structures include lean-to shelters, picnic shelters, garage and Ranger Quarters, all built between 1979 and 1984. According to MacCallum, these structures are in keeping with the historical character of the Park. Her nomination was written in 1999 when the 1963 structures were 36 years old. They are now more than 50 years old and therefore potentially eligible. Although not discussed by MacCallum, the remains of the former Ranger's cabin (730-10) are located about 1,200 feet north of the trail leading to the Fire Tower (Sue Bulmer, personal communication).

In reviewing LIDAR mapping for Elmore State Park, the location of a possible cellar hole was identified (Structure 730-7) consisting of a square depression roughly 25 by 25 feet. However, given its relatively remote location up the east-facing slope of Elmore Mountain, it appears unlikely to have been a structure and may be an anomaly that shows up as a square.

The Online Research Center (ORC) database provided by the DHP does not list any archaeological sites located within Elmore State Park.

C.C. Putnam State Forest

Given the size of C.C. Putnam State Forest, this discussion breaks up the management unit into five sections, following the organization of the Scharoun and Cowie report. However, since 2007, FPR has acquired three additional parcels including the Upper Hollow North (Berry), Brownsville, and Patterson Brook parcels. The discussion below adds each of these three parcels to the five sections as outlined in Scharoun and Cowie (see Map 58). The HRA projects conducted within the C.C. Putnam State Forest are discussed within a single section.

Stowe Northeast - Moss Glen Falls/Brownsville

[46] MacCallum, S. (1999). *National Register of Historic Places Registration Form - Elmore State Park, Elmore, Vermont.* . Report submitted May 11, 1999. Report on file with the VD FPR, Montpelier.

Moss Glen Brook flows southeast to northwest through the Stowe Northeast section. Settlement in the 19th century developed along the Brook, focusing around Moss Glen Falls to take advantage of the waterway's potential for waterpower. The 19th century settlement included the construction of a sawmill and a starch factory as well as tourism. A small village grew up around the Falls along Brownsville Road that took on the name Brownsville, consisting of several farms, a blacksmith shop, and a schoolhouse. According to Hamilton Child, at least seven farms were located along Brownsville Road.[47] At the beginning of the 1890s, the C.E. and F.O. Burt Lumber Company purchased the mill and the surrounding timberland, but then closed the Moss Glen Brook mill, moving its operations to the Stowe village mill. Despite the closure of the mill, it appears from early 20th century USGS maps that the farms and the school remained in Brownsville, not disappearing until after the middle of the century. The schoolhouse was moved in 1954 to become part of the nearby Stan Marc Wright Summer School of Art at the corner of Randolph Road.[48]

No National or State register properties are located within the Stowe Northeast section of the C.C. Putnam State Forest. Present-day roads running through or along the boundaries of State lands include the Brownsville Road, a Class 3 road that runs southeast-to-northwest through the section, roughly parallel to Moss Glen Brook. The Brownsville Road then splits, becoming a Class 4 road that continues to the south/southwest and another Class 4 road to east/southeast, becoming McCall Pasture Road. Following Walling and Beers, the routes of the present-day roads have changed little since the 19th century with the exception of a single road that is no longer mapped today, cutting off from Brownsville Road and leading up to Moss Glenn Falls (see Map 60).

Taken together, Walling and Beers map a total of 19 structures that are within, along the boundaries of, or just outside of C.C. Putnam State Forest. Of these 19, three lie just outside the State Forest boundaries (Structures 10-13, 10-14, and 10-15) and three appear to lie directly on the boundaries (Structures 10-9, 10-16, and 10-33). Four of the 19 structures include the Blacksmith Shop (Structure 10-33), the Sawmill (10-4), the School (10-6), and the Starch Factory (10-5). Seven structures are likely the farms numbered by Child, including Structures 10-2, -3, -9, -11, -12, -14, and -40 and are spread throughout the village although all except for two are in close association with either Brownsville Road or McCall Pasture Road. The other two (Structures 10-2 and 10-3) were located along the small road mapped by Walling, Beers, and the United States Geological Ssurvey (1919) that led to the Falls. The identification of eight structures are unclear or not provided by either Walling or Beers, although "F.J.B" (Structure 10-7) and "Fuller & Boyington" (Structure 10-39) were likely places of business. Structure 10-7 sat at the end of the road that is no longer mapped whereas

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[47] Child, H. (1883). Gazetteer and Business Directory of Lamoille and Orleans Counties, Vermont for 1883-1884. *Jounal Office, Syracuse*.

[48] Scharoun, S., & Cowie, E. (2007). *The Cultural Landscape of the WRMU, in the Towns of Elmore and Stowe, Lamoille County and Worcester, Middlesex and Waterbury, Washington County, Vermont.* Historic Resource Summary, Historic Context and Development and Prioritization of Known and Expected Historic Resources. Archaeology Research Center, University of Maine, Farmington. On file with the Vermont Department of Forests, Parks and Recreation.

Structure 10-39 does not appear to have been placed in association with any mapped road. The Sawmill (10-4) and the Starch Factory (10-5) were both located along Moss Glenn Brook, perhaps reachable by the road listed above that is no longer mapped. The Blacksmith Shop (10-33) was located to the northwest along the boundary of the State Forest, at the intersection of Moss Glenn Falls Road and Brownsville Road, likely taking advantage of a well-crossed intersection. The School (10-6) stood to the south along Brownsville Road. As outlined above, the Sawmill was removed in the 1890s. However, much of the village appears to have remained well into the 20th century except for the Blacksmith Shop and the Starch Factory.[49] By 1968, the roads were still mapped, but none of the structures on State land remained.[50]

Scharoun and Cowie discuss the development of the Moss Glen Falls area for tourism during the 19th century.[51] According to Walling, a sulfur spring was located just to the northwest of the Stowe Northeast Section along Moss Glen Falls Road that may have attracted visitors. The spring is not mapped by Beers. Also, visitors from the Mt. Mansfield Hotel in Stowe village came to see Moss Glen Falls as early as 1871 if not earlier, and it is possible that there are structural remains associated with tourism at the Falls that are still extant.

In reviewing the Stowe Northeast Section with LIDAR, numerous probable roads and paths can be seen. However, despite the high number of MDSs associated with this section of C.C. Putnam State Forest, relatively few structural remains are apparent. A possible pen is located about 800 feet south of the intersection of Brownsville Road and McCall Pasture Road. Possible cellar holes include Structure 10-43, located in possible association with Structure 10-10 identified on both the Walling and Beers' maps. A possible pen (Structure 10-44) can also be seen about 400 feet to the north of Structure 10-43, also in association with the MDS-labeled Structure 10-10. Another cellar hole is located in possible association with Structure 10-13 as mapped by Beers, adjacent to an additional possible structure.

There are no listed archaeological sites within the Stowe Northeast section according to the DHP's Online Resource Center as well as no listed National or State Register properties.

Stowe Southeast - Burt Hollow Block/Gold Brook Area

The Stowe Southeast section includes Gold Brook and its tributaries in the northern half, and the beginnings of Thatcher Brook in the southern half, both flowing west into the Little River. Settlement in the 19th century in this portion of Stowe focused on the lower stretches of the Gold Brook drainage, to the west/northwest of C.C. Putnam State Forest and so not within the

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[49] United States Geological Survey. (1919). Montpelier, Vermont Quadrangle, 1:62500. United States Geological Survey, Washington, DC.
[50] United States Geological Survey. (1968a). Stowe, Vermont Quadrangle, 1:24000. United States Geological Survey, Washington, DC.
[51] Scharoun, S., & Cowie, E. (2007). *The Cultural Landscape of the WRMU, in the Towns of Elmore and Stowe, Lamoille County and Worcester, Middlesex and Waterbury, Washington County, Vermont.* Historic Resource Summary, Historic Context and Development and Prioritization of Known and Expected Historic Resources. Archaeology Research Center, University of Maine, Farmington. On file with the Vermont Department of Forests, Parks and Recreation.

WRMU. According to Scharoun and Cowie, the sawmill that lay along Gold Brook to the west of WRMU likely cut lumber that came down logging roads within the Stowe Southeast Section. The Walling and Beers maps do not illustrate any farms or other structures within the WRMU, however outlying features associated with the farms located to the west/northwest might lie within the State Forest boundaries, including stone walls, sugaring infrastructure, and orchards.[52] A unique feature of the Gold Brook drainage with possible archaeological remains is the region's history of gold mining during the 19th century (Hill 1949:166). According to Ralph Nading Hill (1949), an old man known as "Indian Joe," camped on Gold Brook in the 1800s and would come into town, paying for things with gold nuggets. Locals tried to track him back into the mountains, but Indian Joe always lost them. In the 1850s, Abial H. Slayton bought a farm on Gold Brook and mined for gold along the brook for the next 50 years, constructing a sluice box and other mining infrastructure. Slayton found small amounts of gold and Scharoun and Cowie suggest that remains of the infrastructure Slayton built might still be found along Gold Brook within the WRMU.

The Vermont State Geologist (1987) and USGS (2020) lists two quarry/mine sites within the Stowe Southeast Section, both are no longer producing although the date of their use is unclear. An amphibolite and schist mine (Structure 10-51) is located near the trailhead for the Waterbury Trail up Mount Hunger. A copper mine (Structure 10-52) is located on the steep west-facing slope of the mountain, to the southeast of Thatcher Brook (Map 61).

A review of LIDAR mapping for the Stowe Southeast section produced several possible cellar holes and other features. Structures 47 and 48 are apparent cellar holes located along a probable road on either side of a tributary of Moss Glen Brook. Structure 49 is a possible cellar hole located on the west side of a tributary of Gold Brook, sitting to the north of what appears to be the end of a road. Structure 10-50 is a possible cellar hole located to the west of Pinnacle Meadow Road. In addition to the possible cellar holes, a very long possible stone wall was identified coming down the west side of Hogback Mountain. However, the line produced by this feature lacks the right angles and straight lines typical of stone walls.

Worcester Mountain Section

The Worcester Mountain Section of C.C. Putnam State Forest encompasses the east-facing slopes of the Worcester Mountain Range with the west-facing slopes of Hampshire Hill running along the east/southeast side of the State Forest. The earliest recorded settlements in Worcester from the late 18th and early 19th centuries grew up around Hampshire Hill feeding into "Smuggler's Road," the earliest known road through the town and what is likely today's Hampshire Hill Road about half a mile to the east of the C.C. Putnam boundary. By the middle of the 19th century, residents of Worcester had largely abandoned the Hampshire Hill

[52] Scharoun, S., & Cowie, E. (2007). *The Cultural Landscape of the WRMU, in the Towns of Elmore and Stowe, Lamoille County and Worcester, Middlesex and Waterbury, Washington County, Vermont.* Historic Resource Summary, Historic Context and Development and Prioritization of Known and Expected Historic Resources. Archaeology Research Center, University of Maine, Farmington. On file with the Vermont Department of Forests, Parks and Recreation.

settlements as the population center shifted to the North Branch of the Winooski River where the current village center sits. The earliest farms and the core settlement area located along Hampshire Hill lay outside the boundaries of C.C. Putnam State Forest. However, it is possible that outlying features from these homesteads may lie within the WRMU including features such as stonewalls, fence lines, sugaring arches and others. There is also a history of logging and milling within the Worcester Mountain Section of C.C. Putnam State Forest and Ron Wells, now retired Forestry Specialist for FPR, located several logging camps as well as the remains of a sawmill along Hancock Brook (see Map 62). As with Gold Brook on the west side of the Worcester Mountains, the latter half of the 19th century saw gold mining operations along Minister Brook and its tributaries. Although the exact locations of these operations remain unclear, structural remains associated with gold mining up the Minister Brook might include the remains of sluice boxes, timber dams and deposits associated within possible mining camps.[53]

A review of historical maps for Worcester resulted in the identification of a small cluster of buildings along what is today called Mountain Road, a Class 3 Road that runs east into Hampshire Hill Road. Hancock Brook flows to the southeast along Mountain Road in close association with the mapped structures. The structures included a school (Structure 10-26) and two homesteads (Structures 10-27 and 10-28), and in addition there are several neighboring structures mapped along Hampshire Hill Road but outside of the WRMU. It is not known how these structures relate to the early settlement of Worcester as outlined above. The exact location of the structures listed above in relation to the boundaries of the WRMU are unclear and although Mountain Road itself is not within the WRMU, it is possible that the structures or other features salient to them, were. A review of 20th century USGS maps indicates that "Hampshire Hill School" remained listed as a school into the 1940s (USGS 1944) but is mapped closer to the intersection between Mountain Road and Hampshire Hill Road, and therefore not within C.C. Putnam State Forest.[54] Houses remain located along Mountain Road today and it is possible that at least two of these are the 19th century homes mapped by Walling and Beers.

As discussed above, Ron Wells identified several logging camps and a mill foundation along the eastern slopes of the Worcester Range (see Map 62), mapped as Structures 10-55 through 10-60, as well as 10-30 and 10-31, with 10-57 for the mill foundation located on Hancock Brook. Scharoun and Cowie provide a map of the locations, and Structures 10-55 through 10-60, as well as 10-30 and 10-31, are drawn georeferencing that map. However, the Scharoun and Cowie map is at a scale of 1:45,000 so the locations are only approximate. For example, the mill (Structure 10-57) is mapped about 360 feet east of Hancock Brook. A review of LIDAR mapping for the Worcester Section of C.C. Putnam State Forest did not indicate the location of any possible cellar holes or stone walls. A single large area measuring 375 by 150 feet was identified to the northwest of Mountain Road, about 400 feet north of Structure 10-27, with a road leading to it that may have been mined for sand and gravel. There are no listed

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[53] Hemenway, A. M. (1891). The Vermont Historical Gazetteer 1868-1891. Burlington, Vermont.
[54] United States Geological Survey. (1944). Montpelier, Vermont Quadrangle, 1:62500. United States Geological Survey, Washington, DC.

archaeological sites within the Worcester Section of C.C. Putnam State Forest, as well as no National or State Registered properties.

Middlesex Northwest Section

The Middlesex Northwest Section is located along the east-facing slopes of Mount Hunger and White Rock Mountain, drained by Patterson and Martins Brook and their tributaries. The general area has been traditionally known as "Bear Swamp," after the swamp that lies between Martins Brook and Herrick Brook to the east and southeast of the WRMU. The earliest settlements dating to the late 18th and early 19th centuries began in the Bear Swamp area and the upper reaches of Martins Brook, near the road that ran north/northeast to the Hampshire Hill settlement in Worcester. However, settlement moved east by the mid-19th century along Martins Brook in the Shady Rill area where mills, a church, schools and farms were built. Tourism developed in the Bear Swamp area in the 1870s and a carriage road was constructed leading to a trail that went up to the Mt. Hunger summit. The structures included stairs, ladders, and bridges to reach the summit. The carriage road remains today as North Bear Swamp Road, a Class 4 Road that, towards the end of the 19th century, led to the farm of Alonzo R. Leonard located just east of the WRMU boundary. Leonard developed accommodations and a stable for the guests that came to make the trip to the summit. His place was known as "Leonard's Bear Swamp Motel," and included a dance hall on the third floor of his farmhouse. By the end of the 19th century, the trail fell into disrepair and the trail infrastructure was finally destroyed by the great fire of 1903.[55]

MDSs within the Middlesex Northwest Section as mapped by Walling and Beers include two homesteads (Structures 10-18 and 10-19) located at the southeastern edge of the WRMU, to the northwest of North Bear Swamp Road and about a half mile west of the Alonzo Leonard farm (Map 63). The trailhead for the Middlesex Trail runs between the two locations. A third farmstead was located west of Herrick Brook and North Bear Swamp Road. Both structures were gone by the early 20th century.[56]

A cluster of six MDSs (Structures 10-20 through 24; and 32) lay on the east/southeast-facing slopes of Hunger Mountain in association with Hults Road and two trails. Hults Road is a small road that runs northwest off West Hill Road, possibly dating to the late 18th and early 19th century settlement of the town and north to the Hampshire Hill settlement in Worcester. The structures are mapped by Walling and Beers and include five homesteads and a school (Structure 10-24). A review of LIDAR mapping located features that are likely cellar holes in association with the five homesteads and the schoolhouse as mapped in the 19th century, with each potential hole lying within 100 and 200 feet of the historic map locations (see Map 63). An additional possible cellar hole was identified using LIDAR (Structure 10-61), located at the end of an apparent road that leads south to the cluster of MDSs discussed above, and from there to Hults Road. Structure 10-61 includes a single cellar hole as well as at least two possible structures located about 100 feet to north and two additional possible structures about 700 feet to the west/northwest. It is also possible that the outline of a former field can

[55] Hemenway, A. M. (1891). The Vermont Historical Gazetteer 1868-1891. Burlington, Vermont; Seidman, S., & Wiley, P. (2006). *Middlesex in the Making.* Barre, Vermont: Middlesex Historical Society.
[56] United States Geological Survey. (1919). Montpelier, Vermont Quadrangle, 1:62500. United States Geological Survey, Washington, DC.

be detected about 500 feet to the north/northwest. By 1919, two of the structures located along Hults Road remained, but were gone by 1968.[57]

The Hoyt and Renasco parcels are two portions of the Worcester Section of C.C. Putnam State Forest that run along the ridge of the Worcester Mountain Range to the west of South Bear Swamp Road and east of the border between Middlesex and Waterbury. A single MDS is in the northeast corner of the Hoyt parcel (Structure 10-17) and a single possible cellar hole was identified using LIDAR in the northeast corner of the Renasco parcel (Structure 10-62). Structure 10-62 lies about 150 feet upslope to the north of an apparent road running east-to-west. Structure 10-17 was gone by 1919. According to Seidman and Wiley, a carriage road once connected the town centers of Middlesex and Waterbury, crossing the mountain range via a saddle through the Renasco parcel, located just north of Chases Mountain.[58] It is possible to map a possible road that meets the description running north-to-south between the two towns (see Map 63).

There are no listed archaeological sites within the Worcester Section and no properties listed on the National or State Registers.

Perry Hill Block

The Perry Hill Block Section encompasses the southernmost extent of the Worcester Mountain Range, running down to the Winooski River. The block is bounded to the east by a steep valley that separates the Perry Hill Block from Middlesex Notch WMA, and to the west a small section of the block lies about 850 feet to west/northwest of the larger portion of the Perry Hill Block. To the north, beyond the northern boundary of the block, the north-facing slopes of the mountain roll down to Graves Brook. As discussed in greater detail by Scharoun and Cowie, settlement in the 19th century focused to the north of the Perry Hill Block along Perry Hill Road. According to Child, the farms kept dairy herds and sugaring operations.[59] Excessive slope likely limited the growing of crops. The farms were probably sheep farms throughout at least the first half of the 19th century. Scharoun and Cowie cite the possibility of farm-related features lying along the north-facing slopes that separate Perry Hill Road and the Perry Hill Block including stone walls, fence lines, and sugar arches. Farms also developed along the southern boundary of the Perry Hill Block, facing the Winooski River although the steep slopes likely prevented the growth of these farms north into the block. There are no listed archaeological sites or National and State Register listed properties within the Perry Hill Block.

According to the Walling and Beers maps, a road ran along the southern boundary of the Perry Hill Block, paralleling the river, the railroad, as well as present-day River Road and I-89 (Map 64). It is possible that I-89 today runs over the road as mapped in the 19th century. If it is

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[57] United States Geological Survey. (1968b). Mount Worcester, Vermont Quadrangle, 1:24000. United States Geological Survey, Washington, DC.
[58] Seidman, S., & Wiley, P. (2006). *Middlesex in the Making.* Barre, Vermont: Middlesex Historical Society.
[59] Child, H. (1889). Gazetteer of Washington County, Vermont 1783-1889. *Syracuse Journal Company,* Syracuse, New York.

assumed that the position of the railroad has remained constant since it was first built in the middle of the 19th century, then it is also likely that the river has moved significantly over the last 180 years when comparing modern and historic maps. An old railroad bed is evident in the smaller portion of the Perry Hill Block that are the remains of an electric railroad run by the Mt. Mansfield Railroad Company. The railroad ran between Waterbury Village and Stowe Village between 1897 and 1932.[60]

The Walling and Beers maps illustrate a total of five structures within the Perry Hill Block including a cemetery (10-25) and a School (10-29), as well as three farms, one of which (10-34) is found on both Walling and Beers maps and was identified by an archaeological survey (Structure 10-1). Knight conducted an ARA in preparation for construction along the Small Axe Trail (formerly known as the Rastaman Trail), writing that the trail bisected the remains of what he identified as the E. Johnson/Mrs. Johnson house (Structure 10-34).[61] However as can be seen in Map 64, the cellar hole that Knight (2014) identified (Structure 10-1) sits about 800 feet to southwest of where the Beers map (as georeferenced for this review) places it. As with georeferencing the road, inconsistencies were encountered in mapping the location of these structures when comparing the Walling and Beers maps. Also, given the massive construction effort cited above that took place along the base of the mountain to lay down I-89, it is also quite possible that the structural remains of the homesteads mapped on Walling and Beers maps were removed and/or buried beneath the highway.

A cemetery (Structure 10-25) dating to the 19th and early 20th century sits within the southwest portion of the Perry Hill Block, about 100 feet to the east of the Perry Hill Main Trail. Although the cemetery is found on the Beers map, it is not evident on the Walling map and so likely dates to no earlier than the 1860s.The Vermont State Hospital used the cemetery between 1892 and 1912 and it contains the burial sites of about 30 people, with graves formerly marked by wooden crosses. Since the cemetery is identified on the Beers map in 1873, it can be assumed that local people used the spot for 25 or more years before the State Hospital began to bury people there. The cemetery is not illustrated on any USGS maps. The location mapped in Map 64 is from a hand-marked map of the Perry Hill Block in the ANR Lands Records, presumably from the consultation with the DHP discussed in Scharoun and Cowie. However, that location is likely very approximate given that as mapped, it sits on a steep south-facing slope.

A review of LIDAR mapping for the Perry Hill Block identified two unknown features. Structure 10-53 consists of a large rectangular raised shape located near Structure 10-29 and measuring

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[60] Scharoun, S., & Cowie, E. (2007). *The Cultural Landscape of the WRMU, in the Towns of Elmore and Stowe, Lamoille County and Worcester, Middlesex and Waterbury, Washington County, Vermont.* Historic Resource Summary, Historic Context and Development and Prioritization of Known and Expected Historic Resources. Archaeology Research Center, University of Maine, Farmington. On file with the Vermont Department of Forests, Parks and Recreation.

[61] night, C. (2014). Archaeological Desk Review and Field Inspection for the Proposed Rastaman Trail VT15-D4-7 Project, Waterbury, Washington County, Vermont. End of Field Letter on file with the Vermont Department of Forests, Parks and Recreation.

about 80 by50 feet. Structure 10-54 is also an unknown feature consisting of a large depression forming a right angle and measuring about 40x40 feet.

A small section of C.C. Putnam State Forest lies at the southeastern corner of Middlesex along the north edge of I-89 (Map 65). A steep south/southwest-facing slope encompasses the entire section, leading down to the intervale between the southern edge of the mountain and the Winooski River. Two first-order streams flank the parcel, one on the southeast boundary and the other on the northwest boundary. There are no listed archaeological sites as well as no National or State Register listed properties within this parcel. In addition, there are no structures mapped within the parcel on 19th century or USGS maps from the 20th century. A review of LIDAR mapping for the parcel indicated several apparent trails as well as three possible sections of stone walls running roughly parallel to the boundaries of the parcel.

Middlesex Notch WMA

Middlesex Notch WMA lies at the southern-most extent of the Worcester Mountain Range and is characterized by the steep east-facing slopes of Owls Head Mountain that run down to Notch Brook, and south-facing slopes that run down to the Winooski River. Several first-order and second-order streams flow south and east through the WMA and into Notch Brook and the Winooski. There are no listed archaeological sites within the WMA and the steep terrain allowed few locations for historical settlement except along Notch Brook. Notch Road runs roughly south-to-north and forms the northeastern boundary of the WMA. The road is found on both the Walling and Beers maps of Middlesex and according to Scharoun and Cowie, Notch Road was an early road that ran between Middlesex and Waterbury in the 19th century through Middlesex Notch but became less used as the population centers of both towns shifted to locations focused on the Winooski River. Today the road is a Class 3 Road up until approximately the point at which the road becomes the northeastern boundary of the WMA, where it turns to a Class 4 Road. The Walling and Beers maps identify three MDSs (557-1, -2, and -3) along Notch Road that appear to have stood on the west side of the road and therefore within, or along the boundary of, Middlesex Notch WMA (
* All listed RTP projects were conducted before 2019

Table 37and Map 66). An additional possible cellar hole (557-4) was identified using LIDAR, located about 150 yards south of 557-3. It is possible that 557-4 is the LIDAR-mapped location of 557-3 such that both MDSs refer to the same structure. Structure 557-1 can be found on 20th century USGS maps up to 1944 but the structure is not present on the next USGS map in 1968.[62] Although there are no present-day structures located along the Class 4 portion of Notch Road, the southern most of the four structures (Structure No. 557-1) is located roughly

[62] United States Geological Survey. (1968b). Mount Worcester, Vermont Quadrangle, 1:24000. United States Geological Survey, Washington, DC.

at the juncture of the Class 3 and Class 4 Roads, where according to an aerial present-day structures are located.[63]

The road as mapped by Beers and Walling runs about 175 feet to the west of the present-day Notch Road. Although the discrepancy may appear to be an error in 19th century mapping and/or georeferencing, LIDAR mapping illustrates a road in roughly the same location of the road as mapped by Beers and Walling. A couple cellar holes, and other features can also be identified using LIDAR. As discussed above, a substantial cellar hole (Structure 557-4) can be seen about 150 yards south of Structure 557-3. An additional possible cellar hole can be seen using LIDAR about 70 feet to the west of Structure 557-4, possibly representing a salient structure to 557-4. There are also several straight lines and right angles visible with LIDAR that might be the remains of stonewalls from animal pens associated with 557-4. Another cellar hole along Notch Road is visible with LIDAR about 100 feet northwest of Structure 557-1 but is not mapped as a separate structure since it is likely the remains of Structure 557-1. Structure 557-5 is a possible cellar hole visible with LIDAR located along a stream and what appears to be a road running east-to-west towards Notch Road. Structure 557-6 is not a structure but rather appears to be a large area visible using LIDAR that covers about 500 by 200 feet, with a ramp running down towards I-89. It is possible that Structure 557-6 is the remains of a mining operation conducted in support of the construction of the highway. It is also possible to see push-piles located along the eastern boundary of the feature. As of 2020, no cultural resource management reviews have been conducted within Middlesex Notch WMA and there are no listed archaeological sites or National and State Register properties.

Middlesex WMA

The Middlesex WMA lies along the north side of I-89 and the Winooski River, with Upper Barnet Hill Road forming the northeastern boundary of the property. The WMA consists largely of a south-facing slope running down to the Winooski with a second-order tributary flowing south along the WMA's east boundary. According to Scharoun and Cowie, Upper Barnet Hill Road dates to before the Walling map and the farms mapped by Walling along this road date to the early settlement of Middlesex. Today the portion of the Upper Barnet Hill Road that runs along the northeast side of the Middlesex WMA is a Class 4 Road that is listed as "Impassable or Untraveled." Of the several farms located along this road in the 19th century, only Structure 556-1 sits within the WMA (Map 67). The structure was gone by the early 20th century.[64] No CRM projects have been conducted within the WMA and no listed archaeological sites or Nation and State Register properties have been identified. In addition, LIDAR for the Middlesex WMA did not produce any evidence for potential structural remains.

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[63] *Google Maps*. (2020, February). Retrieved from https://www.google.com/maps/@44.2630144,-72.5740712,14z.
Hartwell, H. W., & Droege, S. (2001). A case for using Plethodontid salamanders for monitoring biodiversity and ecosystem integridy of North American forests. *Conservation Biology*, 558-569.
[64] United States Geological Survey. (1919). Montpelier, Vermont Quadrangle, 1:62500. United States Geological Survey, Washington, DC.

Worcester Woods WMA

Worcester Woods WMA is a small WMA located to the east of the North Branch of the Winooski River. There are no listed archaeological sites or National or State Register listed properties within the unit. In addition, no HRA projects have been conducted within the unit and no structures are visible when reviewing historical maps and a LIDAR map of the area.

J. Recreation Resource Assessment

Introduction

The WRMU offers a wide variety of recreational opportunities. There are five separate geographic areas within the WRMU where recreation plays a significant role: Elmore State Park, the Worcester Range, Perry Hill, Moss Glen Falls, and Brownsville. Dispersed pedestrian recreation can also be found on three Wildlife Management Areas (WMAs) within the management unit: Middlesex Notch, Middlesex, and Worcester Woods. The WMAs will be covered in more detail in the Wildlife Assessment section of the LRMP. This recreation assessment will be organized by these distinct geographic areas. Recreational opportunities in these areas are extensive, including popular hiking trails, remote recreation experiences, opportunities to hunt and view wildlife, and the ability to access developed facilities and take part in organized activities. Trails that are formally managed by FPR and its partners, such as the Catamount Trail Association (CTA), the Vermont Association of Snow Travelers (VAST), and the Waterbury Area Trails Alliance (WATA) collectively see upwards of 150,000 visits per year.[65]

Recreational uses in the WRMU include but are not limited to hiking, sightseeing, leaf peeping, mountain biking, horseback riding, snowmobiling, cross-country skiing, snowshoeing, backcountry skiing, fishing, hunting, trapping, rock climbing, winter camping, primitive camping, metal detector use, and geocaching.

Wildlife-based recreation can be found throughout the unit. The forest is home to many species of wildlife including bear, deer, grouse, beaver, mink, coyote, fisher, brook trout, and many other game and non-game species. Moose are also known to frequent stretches of this large intact forest.

Summary of Recreational Assets

Many recreation activities occur through trailheads managed by the Department of Forests, Parks, and Recreation. In recent years FPR has observed increased pressure at certain times of the year at established and managed trailhead access areas within the WRMU. There are nine managed access areas within the WRMU, and one managed access area on town land directly associated with State Land trails. At the time of this assessment, five of them are known to see use occurring beyond their capacity during peak usage periods. FPR has been in the process of

[65] This data was developed by averaging the infrared sensor data collected at Elmore, Worcester, Middlesex, Stowe Pinnacle, Perry Hill, Waterbury, Brownsville, and Moss Glen between 2014 and 2020 (133, 347) and rounding up to include use on CT and VAST. See “Recreation Methods” attachment for more details.

implementing and developing plans to expand parking opportunities to address overflow issues.

There are 42.5 miles of recreational trails in the WRMU. Overall, within the WRMU there are 687 recreation trail structures with 65% in good, 22% in fair, and 13% in poor condition as of a 2019 assessment. There are also 338 locations noted which need, and currently lack, recreation infrastructure to combat impacts from high use, fix erosion issues, or harden a tread surface.

Trail usage in the WRMU has been monitored historically using sign-in sheets at select trailheads and, more recently, with infrared trail sensors. The trail sensors have added a higher degree of accuracy, and average daily totals have ranged from a low of 9 (Middlesex Trail) to a high of 124 (Moss Glen Falls Trail).

Regional and State Context

The WRMU is between 30 minutes (Perry Hill) to just over an hour's drive (Elmore State Park) of Chittenden County, the most densely populated area in the state, less than three hours from the Montreal metropolitan area and within a day's drive for more than 30 million people in southern New England and the Mid-Atlantic states. Because of its size and rugged terrain, C.C. Putnam State Forest retains its sense of remoteness even with its proximity to populated areas. It is a unique recreational resource in the state and is vitally integrated into the economic and environmental well-being of the nearby towns.

Recreation Opportunity Spectrum

The Recreation Opportunity Spectrum (ROS) is an inventory and assessment process designed to focus on the character of experiences a recreational user can expect to find on a parcel of land. Developed by the US Forest Service for use mainly in the western United States, this system has been adapted for use in the eastern United States and is more finely tuned for use in Vermont and New England.[66]

Three ROS classifications were determined for the WRMU. The remoteness and size of the Worcester Range itself and its ridgeline area make this a good example of the Semi-Primitive Non-motorized setting in Vermont. Other parcels were found to be more developed due to their proximity to town roads, logging roads, private camps, and year-round homes, as well as the evidence of humans around and within the land area. The developed state park and facilities are classified as Developed Natural, while the remaining land base is Semi-Developed Natural and Semi-Primitive Nonmotorized (see Map 25).

Boating and Fishing

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[66] More, T. A., Bulmer, S., Henzel, L., & Mates, A. E. (2003). *Extending the Recreation Opportunity Spectrum to nonfederal lands in teh Northeast: an implementation guide.* Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station. doi:https://doi.org/10.2737/NE-GTR-309.

There are many stream fishing opportunities in the unit, including the headwaters of Moss Glen Brook, Gold Brook, Thatcher Brook, Minister Brook, Hancock Brook, and Bedell Brook, but there is only one lake, Lake Elmore. Lake Elmore is 224 acres with a maximum depth of 18 feet. The lake drains into the Lamoille River through Elmore Pond Brook at the northern end. Lake Elmore provides recreational fishing opportunities for northern pike, largemouth bass, smallmouth bass, yellow perch, and bullhead.

Motorboats and personal watercraft are allowed and can be launched at the Vaughn M. Douglass Fish and Wildlife Access Area on the lake's south end. This access area has a concrete ramp, no public restrooms, and is plowed in the winter.

The water quality trend in the lake is “good” according to the DEC Scorecard.[67] The lake is considered to have “poor conditions” for Invasive Species: Eurasian watermilfoil is currently found there. A local group has formed to support removal and mitigation efforts associated with the Eurasian watermilfoil infestation. There are “reduced conditions” for Shoreland and Lake Habitat as well. The lake rates as “fair” for shoreland condition and mercury levels.

The statewide 1990 Vermont Lakes and Ponds Recreation Management Study was completed to assist with establishing management objectives for the public waters in Vermont.

Under the Typology of Vermont’s Lakes and Ponds, Lake Elmore is classified as a **Medium Use, High-Speed Motorized Recreation Uses and Compatible Low-Speed Recreation Uses.** The recreational experience objectives provide equal opportunities for affiliation and solitude. Moderate concentrations of humans can be found and experiencing nature is secondary to recreation activity. There is a wide range and mix of recreation activities limited by carrying capacity and safety considerations; all types of watercraft are in evidence. Substantial modifications have occurred to the natural environment; hardening of sites may have occurred for protection of soils; fishery values are of secondary importance. Access sites are developed and maintained for launching of larger watercraft; single ownership of surrounding land may exist. There may be shore land development. On-site management controls are highly visible; occasional law enforcement personnel are evident on-site. Lake size is medium to large.

Lake Elmore is designated as warm water fish habitat for purposes of the Vermont Water Quality Standards. While the shallow parts allow for growth of aquatic plants, the vegetation is very patchy. These scattered weed beds provide the main cover for Lake Elmore’s fish species.

Existing Recreational Resources

Overview

[67] VANR. Vermont Lake Score Card: Lake Elmore. https://anrweb.vt.gov/PubDocs/DEC/WSMD/Lakes/Lake_Score_Cards/ELMORE.HTML

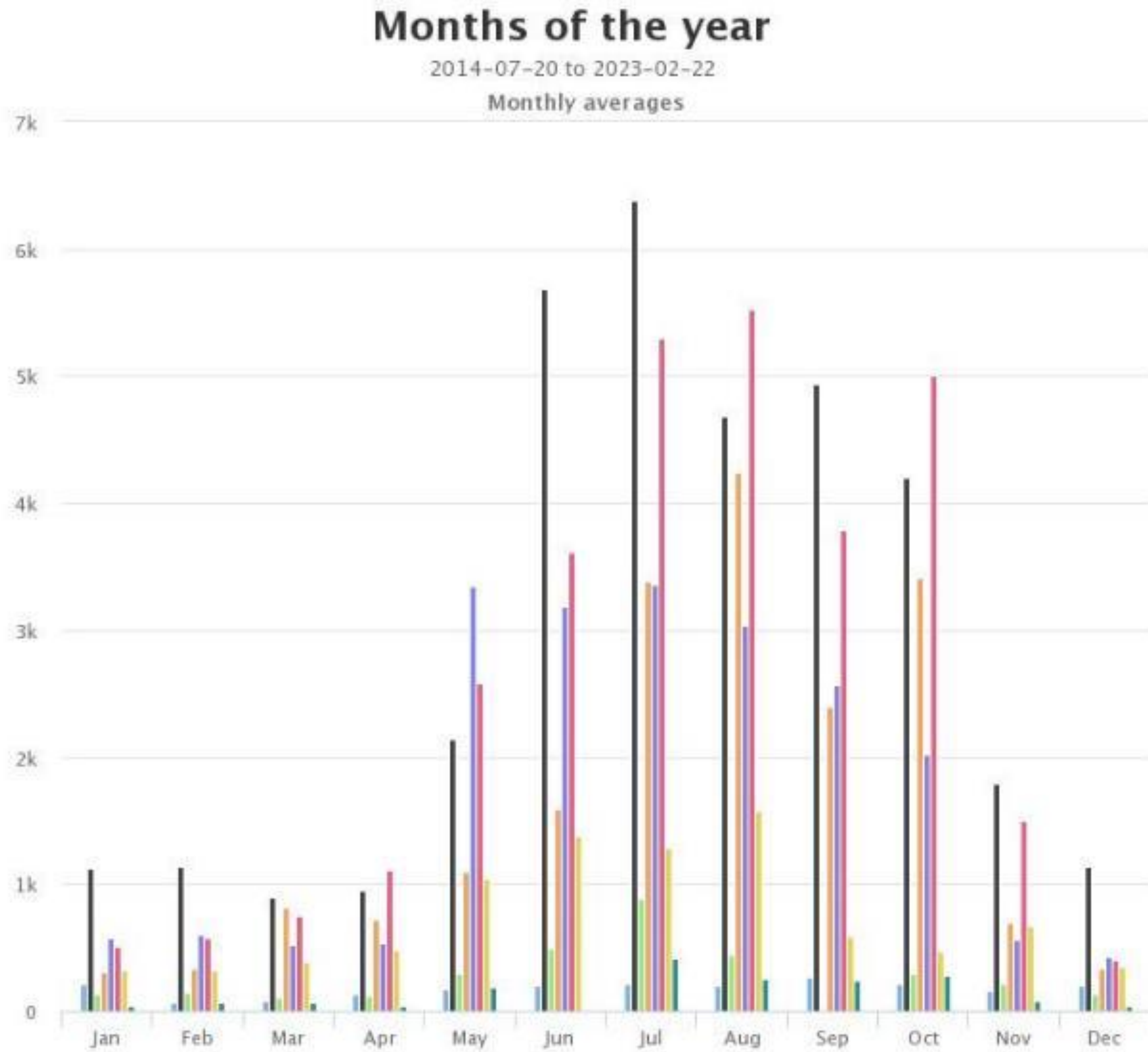
The existing recreational resources found within the WRMU will be described by parcels of similar recreational and geographic characteristics. This section will focus on parcels containing managed recreation trail corridor.

The recreation resources within the WRMU see a wide range of use. Since 2014 FPR has been utilizing the following strategies to better understand the degree of use on managed trail corridors:

- Strategically located infrared sensors
- Sign-in box data
- Direct observation
- User surveys

All the strategies listed above have proven important in understanding use patterns and determining how to allocate management resources. The infrared sensor data allows for a quick snapshot of use. In the bar graph below, you can see estimates of the gradient of use associated with trails within the management unit. Snapshots of this data can be found in the attachment “WRMU Trail Data” arranged by geographic location. Summaries of procedures for data capture and more details about the accuracy of the data can be found in the attachment entitled “WRMU Recreation Data Collection Methods.”

Figure 5: Monthly Average of Visitation by Recreation Area



Site Name	Average	Median	STDV	Min	Max
Brownsville1	177.3	197.0	55.3	73.0	270.0
Elmore (AD)	2,922.6	1,966.2	1,997.5	896.5	6,380.1
Middlesex (AD)	271.3	178.6	229.3	1.0	879.0
Moss Glenn (D)	1,611.8	955.3	1,337.9	305.0	4,247.3
Perry Hill IR (AD)	1,730.0	1,310.7	1,238.9	428.1	3,358.9
Stowe Pinnacle (AD)	2,554.7	2,040.2	1,921.2	398.8	5,530.8
Waterbury (D)	741.2	538.5	437.0	320.8	1,576.6
Worcester (D)	158.0	81.0	122.1	39.0	418.5

(A) = adjustment applied (D) = divide by 2 applied

Parcels with Managed Trail Corridors

Elmore State Park

i. Overview

As the only developed state park in the management unit, Elmore State Park provides a large, family-friendly campground and several day use areas, ranging from a sandy beach and CCC-constructed Beach House with a picnic area to a moderate but rewarding trail system to the top of Mount Elmore. The Elmore State Park parcel includes the summit of Elmore Mountain where a 55-foot fire tower is located, still in usable condition to support public recreation offering a 360-degree view of the surrounding landscape. The park is open daily to the public and is staffed from May through October.

Quiet lake paddling can also be found on Lake Elmore, known as the "Beauty Spot of Vermont." Elmore State Park offers 616 feet of lake frontage. Paddlers can bring their own non-motorized craft to launch from the beach, or rent a canoe, kayak, or paddleboat from the Beach House. Motorboats are allowed on the lake and can be launched from the Fish and Wildlife boat ramp at the south end of the lake.

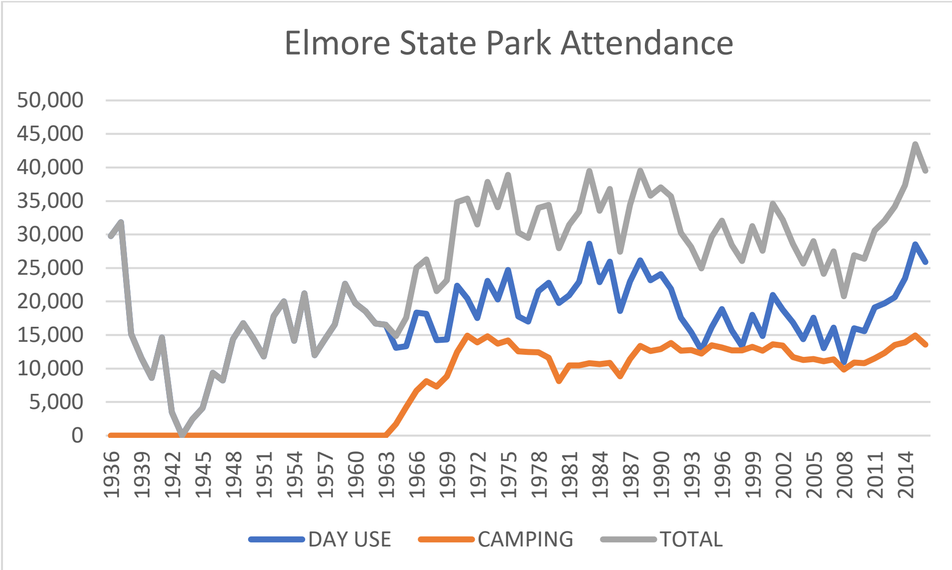
ii. Recreation Facilities

Elmore State Park has the following amenities:

- A campground with 44 tent/RV sites and 15 lean-to sites.
- 2 campground bathrooms with flush toilets, hot and cold running water and coin-operated showers.
- A hiking trail leading to the top of Elmore Mountain and the fire tower, a hiking trail following the northern ridgeline creating a loop with the Fire Tower Trail and a Nature Trail.
- A large, sandy beach great for swimming (boat rentals available) providing access to fishing on Lake Elmore.
- A CCC-built beach house with bathrooms and changing rooms and a concession stand selling park merchandise and light fare.
- Picnic shelters, one available within the campground and one available at the trailhead to the hiking trails.
- Playground.

Vermont State Parks maintains records on attendance and revenues generated at every state park in the system (see Figure 6). Fees have been adjusted throughout the years to reflect the increase in the cost of operating the parks; therefore, there is the corresponding increase in revenues. Attendance has fluctuated throughout the years but has been relatively unchanged since the mid-1970s.

Figure 6: Elmore State Park Attendance



iii. Recreation Trails

There are three developed hiking trails at Elmore. The trails are limited to foot traffic. No motorized vehicles or mountain bikes are allowed on these trails.

- Elmore Mountain Trail: leads the hiker on a 1.7-mile journey through forest and alpine terrain, emerging at the summit of Elmore Mountain, the northernmost peak in the Worcester Range. The fire tower at the summit offers a breath-taking view of the Lamoille Valley, the Southern Worcester Range, Mount Mansfield, and the Northern Green Mountains. The first mile is a moderate hike and will bring you to the remnants of an old lookout cabin, once the home of the fire ranger. The last leg up to the historic tower is somewhat difficult, but the visual rewards that await the hiker make the trek worthwhile. The trail is marked with blue blazes and is well worn with rocky sections and a steep scramble near the summit. From the summit you can create a loop using the Ridge Trail or hike back down the Elmore Mountain Trail.
- Ridge Trail: This 2.3-mile trail follows the ridgeline north from the tower taking you past the Balancing Rock, a boulder (most likely a glacial erratic) perched at a precarious but immovable angle. This trail gives the hiker many opportunities to sprawl out on the boulders along the way and enjoy the magnificent views and cool breezes. The trail continuing past balancing rock was constructed in 2012 and makes a loop back to the Fire Tower Trail.
- Mountain Brook Nature Trail: This easy, ½ mile self-guided trail starts from the left side of the trailhead parking lot. The trail crosses a woodland stream twice and offers views of several waterfalls.

Worcester Range

i. Overview

The C.C. Putnam State Forest is the fifth largest State Forest in Vermont totaling 16,685 acres. C.C. Putnam State Forest is primarily mountainous terrain extending over nine miles along the Worcester Mountains. The forest spreads into the towns of Elmore and Stowe in Lamoille County, and the towns of Middlesex, Waterbury, and Worcester in Washington County. Elevations range from 500 to 3,642 feet above sea level creating a diversity of cover types including northern hardwoods, paper birch, spruce/fir, and a variety of sub-alpine conditions on five major peaks. The range encompasses White Rock, Mount Hunger, Hogback, Worcester and Stowe Pinnacle Mountains, the peaks are the so-called third range of the Green Mountains.

ii. Unique Features

A total of 4,138.9 acres of C.C. Putnam State Forest are a designated Natural Area (Title 10 V.S.A., Chapter 83, S2607). Of this area, 3,391 acres are above 2,500 feet in elevation; the remaining 80.7 acres surround Moss Glenn Falls in the town of Stowe. Most of the Worcester Range is identified as Semi-primitive non-motorized within the ROS.

iii. Recreation Facilities

The Worcester Range has six primary trailhead parking areas. All the parking areas are gravel surfaces, none of them have human waste management systems although FPR has been providing port-a-potties during the busiest months in recent years as funding permits. Through survey and assessment efforts in recent years FPR has a better understanding of the pressure exerted on most of the parking areas.

Table 21: Estimated percentage of time that parking areas are over capacity

Trailhead Location	Managed Vehicle Capacity	Surface Type	Observation Period	Estimated Percentage of Time Over Capacity
Pinnacle Meadows/Stowe Pinnacle	22	Gravel	July 2, 2014-September 22, 2018	30%
Waterbury	14	Gravel	November 12, 2015-April 27, 2018	10.75%
Middlesex	11	Gravel	July 30, 2017-February 27, 2018	Insufficient Data
Middlesex Overflow	9	Gravel	No data	No data
Worcester	12	Gravel	October 17, 2017-August 17, 2017	4%

iv. Recreation Trails

The Worcester Range contains the following recreation trails:

- Waterbury Trail (Mount Hunger): On the west side of the forest, the Waterbury Trail in Waterbury leads to the summit of Mount Hunger. Its bald summit affords spectacular views to the east, south and west, with views of Whiteface, Camel's Hump, Killington and Mt. Mansfield. Beyond this range one may catch a glimpse of Lake Champlain and the Adirondacks. Many peaks of the White Mountains are visible on the horizon to the east.
- Middlesex Trail (Mount Hunger), White Rock Trail, and Bob Kemp Trail: the trailhead in Middlesex will take you to the summit of White Rock and Mount Hunger. The Middlesex trail to Mount Hunger is 2.4 miles to the summit with 1800 ft. elev. gain. Optionally, the Bob Kemp Trail will take you to a lower scenic summit at White Rock Mtn. (approx. 2 miles total, 1500 ft. elev. gain).
- Stowe Pinnacle and Pinnacle Meadow Trails: the two trailheads for the Pinnacle Trail in Stowe lead to the summit of the Stowe Pinnacle. Most people hike out and back on the 2.9-mile trail which begins on Upper Hollow Road in Stowe. The Pinnacle Meadows Trail is located off Pinnacle Meadow Road. Here a .5-mile hike on a graveled road brings you to a vista of the Mansfield range and an open field that is managed by FPR. From this vista a woods trail follows a contour for 0.52-miles to the Stowe Pinnacle Trail.
- Hogback Trail: a 1.1-mile trail connecting Stowe Pinnacle to the Skyline Trail. The use on the Hogback Trail is drastically lower than that of the Pinnacle Meadow and Stowe Pinnacle Trails and is typically used by hikers wanting to perform a point-to-point trip in the Worcester Range connecting different trailheads via the Skyline Trail.
- Worcester Trail: On the east side, the Worcester Trail takes you up on the west side to the summit of Mount Worcester. This trail is 2.5 mi. to the summit with 1900 ft. elevation gain.
- Skyline Trail: The summits of Mount Hunger, Stowe Pinnacle, and Mount Worcester are connected by the Skyline Trail, making this a very popular spot for hiking, snowshoeing, and backcountry skiing.

Moss Glen Falls

i. Overview

Moss Glen Falls Natural Area is in Stowe and is comprised of 80 acres (includes the falls and a buffer zone). This is one of the highest waterfalls in the state, with a total drop of over 100-feet. It is also considered one of the most beautiful, as the water courses through a gorge, into pools, and over sloping vertical walls in a deep forest dominated by hemlock. Moss Glen Falls is defined by the bedrock geology that creates the cascading falls and the lower wetlands that serves as beaver habitat. Prior to becoming part of the C. C. Putnam State Forest, the waters of Moss Glen Falls were harnessed to run a sawmill stationed in a level area below the falls. There is a history of access to the view of the falls, as noted from the degree of impact to the soils along the slope adjacent to the falls, visitors have used numerous social trails.

ii. Recreation Facilities

The trailhead parking area providing access to the falls is located at a bend in Moss Glen Falls Road at the location where the road crosses Moss Glen Brook. During peak times parking pressure is well beyond the capacity of the 14-vehicle trailhead parking area. Upwards of sixty vehicles have been observed parking along the roadside of Moss Glen Road on high-use days. To reduce the chance that roadside parking would create issues with emergency vehicle access FPR worked with the town of Stowe to develop a parking ban on the roadside furthest from the trailhead parking area. In 2020 the trailhead parking area was expanded to the maximum extent possible, and options are being explored for an additional trailhead parking area to serve the location.

iii. Recreation Trails

Historically FPR has managed a 0.25-mile trail to the base of the falls. This short trail has required regular maintenance as it travels through a wetland that is heavily used by beavers. In 2020 the trail was more clearly defined and managed to support access to the first overlook of the falls. Beyond this point there is no formal management and signage has been installed to mark the end of the established trail. A large degree of social trail activity and user impact is occurring along the slope leading to the top of the falls.

Perry Hill

i. Overview

Perry Hill has become a major Vermont mountain biking destination promoted by the Waterbury Area Trails Alliance (WATA), the town of Waterbury, and area businesses. WATA, a chapter of the Vermont Mountain Bike Association, also maintains and manages the network through a cooperative agreement with the State. The network contains approximately 10-miles of trail corridor. The trails are designed and maintained for mountain biking although runners, hikers, and dog walkers utilize the corridors as well. Based on the average daily totals for all trail sensor data collected between 7/28/2014 and 1/26/2019 mountain biking accounts for 89% of the use of the network and hiking, running, dog walking, snowshoeing, cross-country skiing account for the remaining 11%. This ratio was determined by evaluating data collected from onsite trail traffic sensors.

ii. Recreation Facilities

The parking area and trailhead associated with Perry Hill is on Town of Waterbury property. To access the parcel that contains the 10-mile trail network the public needs to cross a set of railroad tracks and go through a tunnel beneath Interstate 89.

There is a trailhead kiosk where visitors can view a map of the trail system and where WATA posts the trails open, caution or closed using green, yellow, and red placards.

iii. Recreation Trails

The following trails can be found on the Perry Hill network.

Table 22: Perry Hill Trails

Name	Length Ft	Length Mi	Trail Type

Burning Spear Trail	5,633	1.07	Mountain Bike/Pedestrian
Campfire Trail	9,516	1.80	Mountain Bike/Pedestrian
Disneyland Trail	3,270	0.62	Mountain Bike/Pedestrian
Joe’s Trail	4,836	0.92	Mountain Bike/Pedestrian
Permission Trail	4,336	0.82	Mountain Bike/Pedestrian
Main Climb Trail	2,979	.56	Mountain Bike/Pedestrian
Red Tape Trail	5,348	1.01	Mountain Bike/Pedestrian
S'Mores Trail	2,374	0.45	Mountain Bike/Pedestrian
Small Axe Trail	10,683	2.02	Mountain Bike/Pedestrian
Scotch Tape Trail	1,563	0.30	Mountain Bike/Pedestrian
Six Flags Trail	2,919	0.55	Mountain Bike/Pedestrian

From a mountain bike perspective, the trail network is divided into the following levels of difficulty:

Table 23: Perry Hill Trail Difficulty Levels

Trail Type	Length (ft)	Length (Mi)
Beginner	7,800	3.58
Intermediate	15,177	2.38
Expert	17,712	4.26

Brownsville

i. Overview

In 2019 the Vermont Department of Forests, Parks, and Recreation’s (FPR) acquisition of the Brownsville Forest property added 758 acres to the northwest portion of C.C. Putnam State Forest. Located along Brownsville Road and McCall Pasture Roads in the Town of Stowe, the land supports a host of ecological, forest, hydrological, scenic, and recreational resources. Prior to becoming State Land, the property had a history of supporting local recreation. Recreators such as hunters, walkers and trappers have utilized the property for its rugged features, while a trail network historically attracted users such as hikers, trail runners, skiers, and mountain bikers. The property and surrounding State Land are popular hunting areas. The property contains the “Inberno” trail, recognized by locals as one of the first mountain bike trails in Stowe. Built in the mid-1990s, the Inberno trail and the other mountain bike trails have received various levels of use over the years.

The Department, with the help of Stowe Trails Partnership (STP) and Stowe Land Trust (SLT), conducted a rapid recreation and trail assessment in July 2019. As part of this assessment, the partners documented trail conditions, features, and layout to help inform interim recreation management decisions.

The town roads that border the Brownsville parcel receive a good deal of recreational use. Recreational use increases in the winter when the town only plows the Class III portions, leaving the Class IV sections unplowed and open to snowshoeing, cross-country skiing, and short-distance snowmobiling routes. The trails and Class IV Roads are also used for hiking and dog walking year-round.

ii. Recreation Facilities

In 2020 FPR installed a three-season parking area capable of containing seven vehicles within the Class IV section of Brownsville Road. This section of Brownsville Road is not plowed in the wintertime. To support full year recreational access a four-season parking area is planned.

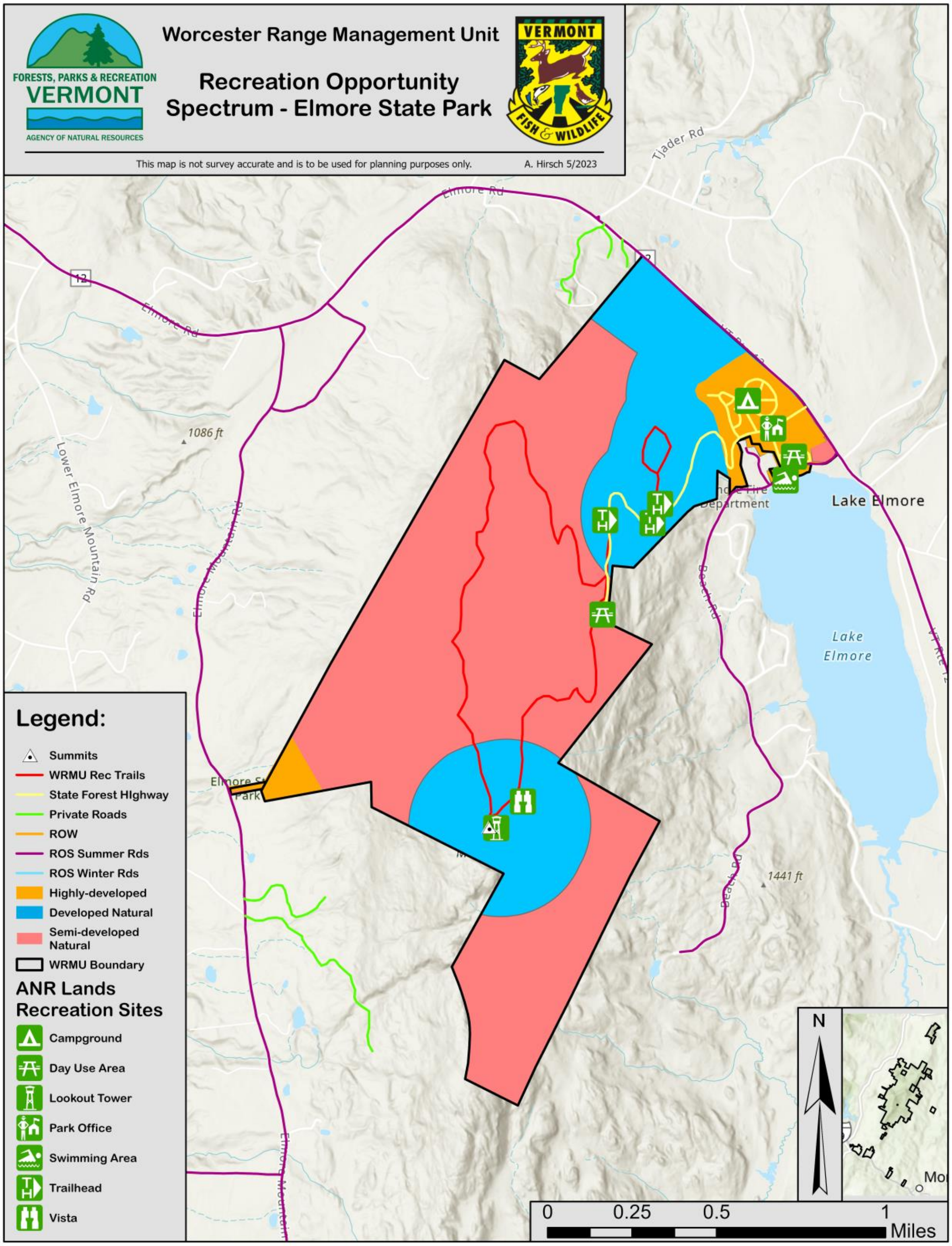
iii. Recreation Trails

When FPR acquired the parcel an inventory of existing trail corridor was performed. FPR found 2.5 miles of trail built to sustainable standards and endorsed for pedestrian use. It was also determined that another 2.5 miles of pre-existing trail had the potential for endorsement pending additional trailwork. To balance wildlife and forestry management goals with recreation objectives FPR plans to limit the amount of trail on this parcel to 5 miles. Given the history of use and that the layout and design of the pre-existing trail network is most aligned with mountain bike trail specifications, mechanized endorsement of the all or part of the network will be considered pending FPR's ability to develop local management partnerships and the improvement of trail infrastructure to meet best practices for sustainable mountain bike trails.

Primitive Camping

Primitive camping is allowed in C.C. Putnam State Forest per the FPR and FWD Primitive Camping Guidelines. Off-season camping (winter camping) is allowed at all state parks with the permission of the parks regional manager (state park rules). No reservations are needed but groups of ten or more require a special use permit (SUP) and the process and application can be found on the Vermont State Parks website.

Map 25: Recreation Opportunity Spectrum – Elmore State Park



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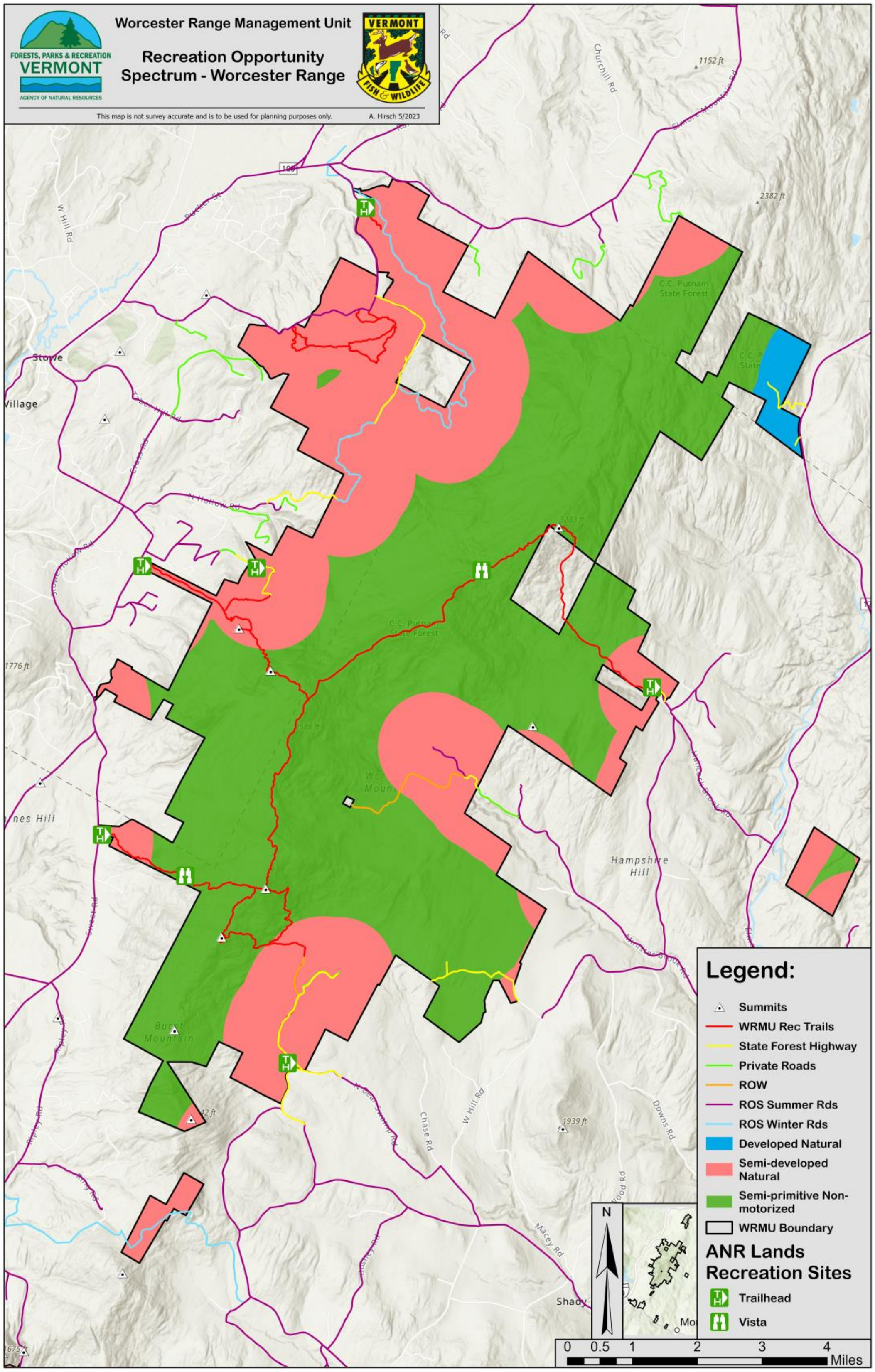
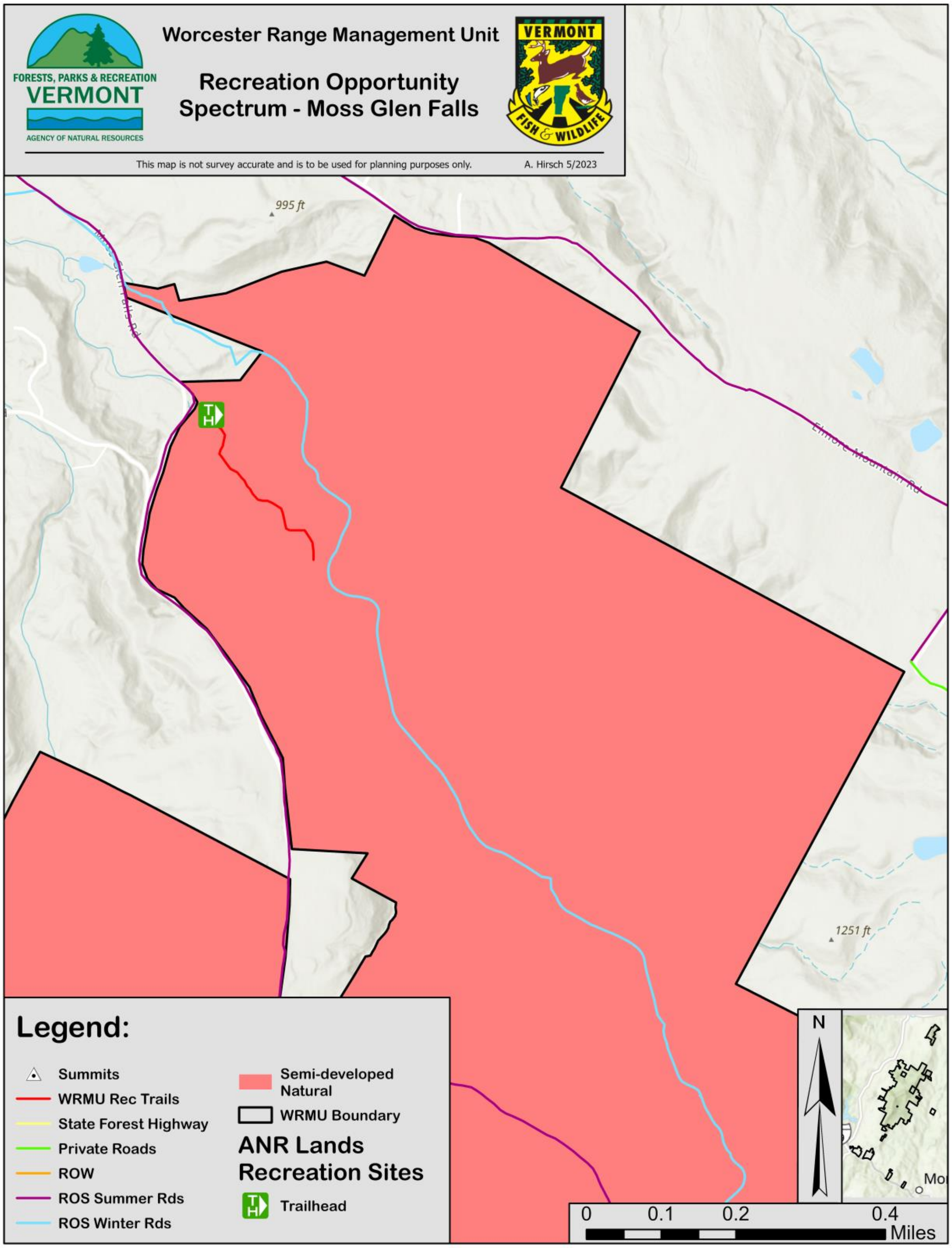
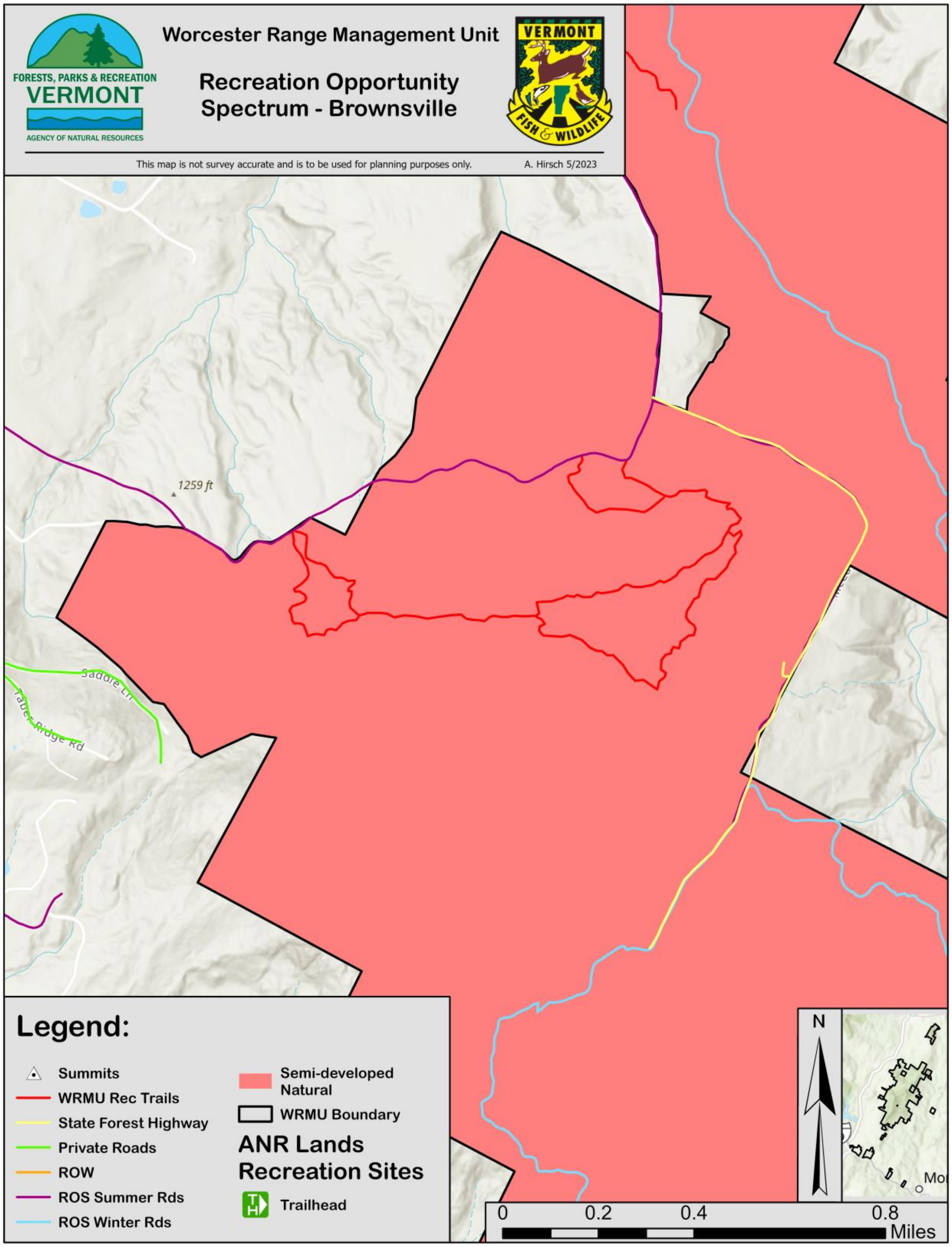
Map 26: Recreation Opportunity Spectrum – Worcester Range



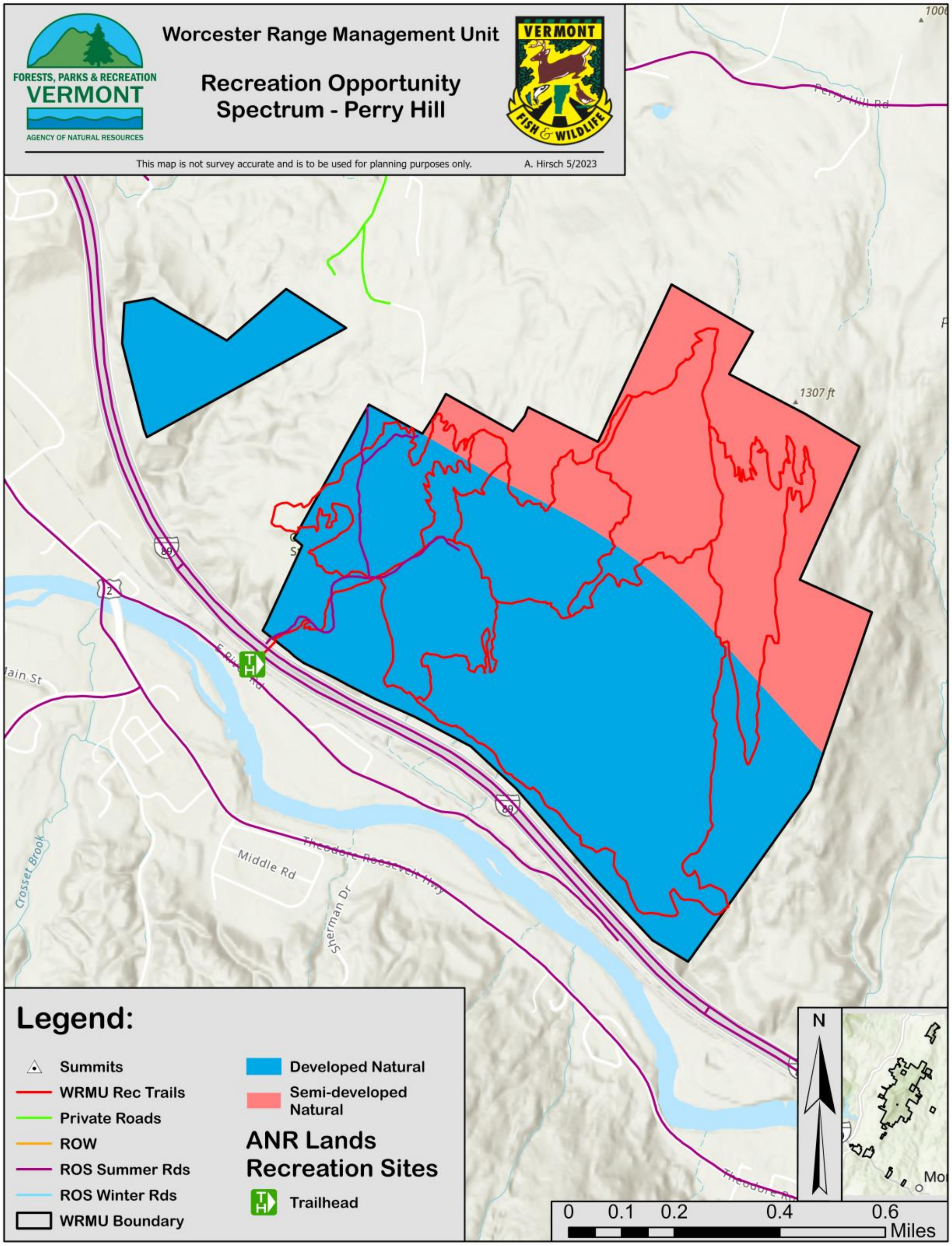
Map 27: Recreation Opportunity Spectrum – Moss Glen Falls



Map 28: Recreation Opportunity Spectrum – Brownsville



Map 29: Recreation Opportunity Spectrum – Perry Hill



K. Infrastructure and Public Access

Description

Public access and management access within the Worcester Range Management Unit is supported by public highways, private roads, and by the State Forest Highway (SFH) system. Many of these roads were constructed as farm roads in the nineteenth century or were established during the height of timber extraction in the first half of the twentieth century. Although constructed for farming and large-scale logging purposes, today the network is managed to a standard that maintains water quality and aquatic habitat, while allowing for management and public access, emergency egress.

Existing Conditions

Public Highways
There are several town-owned and maintained public highways that serve the WRMU. Town highways (within Vermont) are classified as either 1, 2, 3 or 4, and the Agency of Transportation maintains design, construction, and maintenance standards for each class. Under these standards Class 2 is a town maintained paved road; Class 3 is a town-maintained gravel road. Both road classes are supported with State funding. Class 4 roads are public rights-of-way, but they receive minimal state aid, and towns are only obligated to maintain bridges and stream culverts. Some roads that, in fact or appearance, serve only State land are town roads. As such, they are not subject to the Department's classification system, and use of these roads may not be regulated by ANR. When State land is clearly the principal beneficiary of these roads, or when use of the roads by the State generates the greatest maintenance burden, there is often a high degree of cooperation between the State and town officials. When the State, in its capacity as a landowner, desires to have a Class 4 Road maintained or improved, approval of the local selectboard is needed.

State Forest Highways
Forest roads that exist on State land, and that are owned and managed by the Agency of Natural Resources are designated as "State Forest Highways" (SFH). Classification of state forest highways is done in accordance with FPR Policy #13, adopted on May 15, 1991. This policy states that "...classification of roads identifies appropriate uses (at appropriate times), insures proper resource management and protection, and informs the public about which roads may be used under what conditions." The policy goes on to state that State Forest Highways do not meet the definition of a public highway (19 VSA, 1, (12)), and that they exist solely to meet the purposes of the Department (10 VSA, 2601).

Class A Roads
Paved or unpaved roads open for year-round public vehicle use. There are no Class A state forest highways on WRMU.

Class B Roads
Paved or unpaved roads that are generally open for public vehicle use but may be closed at certain times of the year to restrict such access.

Class C Roads
Unpaved roads not generally open for public vehicle use. The majority of state forest highway roads on the WRMU fit into this category. These roads are usually gated or barricaded because they were not constructed to a standard that can withstand frequent motorized use by the public. They were built for infrequent timber harvesting access and not general recreational access. The opening of gates to accommodate snowmobile use or timber harvesting operations does not change the road classification.

Truck Road Designs
Truck roads within the WRMU can be categorized as having one of the following designs: *graveled and drained* road, *drained* road, or *undrained* road. Graveled and drained truck roads are the highest quality roads in the SFH system; they have a gravel surface and a mix of drainage features—road crown, waterbars, broad-based dips, ditches, cross-drain culverts, and stream culverts or bridges. These roads generally can accommodate summer and winter truck use.

The next category, drained truck roads, have significant drainage structures, such as ditches and cross-drain culverts, but have a base and surface constructed with on-site material (usually mineral soil). Problem sections of these roads are typically spot graveled as is necessary over time. These roads will accommodate winter truck use, and may accommodate light summer use (small timber harvests) if weather conditions are just right (e.g., warm and dry). Undrained roads are simple roads made of native mineral soil and stabilized only with waterbars (no ditches or culverts). These roads are only used during winter months when the ground is sufficiently frozen.

Skid Roads
Truck roads end at log landings. From landings, access into the forest occurs on roads designed to accommodate temporary use by large harvesting equipment (e.g., skidders, bunchers). The larger, main skid roads that connect the landing to the forest are called “main skid roads” or “primary skid roads.” Main skid roads branch into smaller, less traveled skid roads called “skid trails” or “secondary skid roads” or “spur roads.”

Both types of roads are designed and used in places with favorable soil conditions and are stabilized with waterbars during and after the completion of each logging operation. Primary skid roads are considered a permanent part of the state forest highway system; however, they are not suitable for regular use and receive no maintenance between harvest operations. Secondary skid roads are considered temporary infrastructure and are often reclaimed by forest regeneration.

Culverts and Bridges
Culverts and bridges exist throughout the WRMU along SFHs and trails to assist with creating resilient access for vehicles and improve water quality. Within the WRMU culverts and bridges are generally installed along SFHs and VAST trails to assist with stream crossings and manage runoff associated with roadside ditching. There are numerous culverts along these roads and

trails; there are five snowmobile bridges on the WRMU, all located along the Moss Glen VAST trail in the Burt Hollow Block.

Pertinent Issues:

- Undersized infrastructure
- Inadequate number of culverts installed
- Existing infrastructure does not meet Vermont's Acceptable Management Practices for managing water quality.
- Inconsistent funding for annual maintenance

Access Road and Multi-use Trail Maintenance

Forest access roads need regular maintenance and repair. Two factors influence the amount of maintenance that a particular section of road requires—road design and level of use. Roads that receive only light traffic, and that are designed with appropriately sized and located drainage structures, will require the least maintenance over time. But even the best roads require maintenance. FPR performs routine maintenance during the spring, after snowmelt, and after heavy rain events, when waterbars are repaired and culverts are cleared of debris using hand tools. During this time, roads, ditches, culverts, and bridges are inspected for greater levels of damage that requires excavation. Some of the most common excavation projects include replacing old or damaged culverts, cleaning ditches, smoothing and crowning road surfaces, and repairing waterbars, broad-based dips and turnouts.

During this LRMP planning period FPR has been able to leverage federal funds from the Clean Water Initiative Program (CWIP) administered through a partnership with FPR & DEC. Funding is designed to restore Vermont's waters and meet water quality restoration targets outlined in the *2016 Lake Champlain Phosphorus Total Maximum Daily Load (TMDL)* to meet Vermont's Water Quality Standards. The *2023 Winooski Tactical Basin Plan* serves as the Phase 3 Implementation Plan of the Lake Champlain TMDL and describes the Agency's current perspective on activities intended to achieve the forestlands sector TMDL phosphorus reduction goals. In short, full achievement is anticipated from compliance with the *Acceptable Management Practices for Logging Jobs* on private, municipal, and state lands.

Within the district all SFH's, multiuse trails and primary skid trails are evaluated using a modified Road Erosion Inventory (REI) to determine existing conditions and needs required to bring roads into compliance with Vermont's AMPs. The REI segments SFHs into 300 ft. sections to determine their proximity to surface water as funding can only be spent on segments that are hydrologically connected. This funding will be spent to make many needed upgrades and repairs to our access network and infrastructure. Examples of work include upgrading undersized stream crossings with larger culverts or bridges, installing new cross drain and ditch relief culverts, resurfacing roads to re-establish crown, installing waterbars and broad-based dips, and armoring ditches with stone.

Roads and multi-use trails within the WRMU were surveyed in 2021 for this Clean Water Initiative Program. Maintenance and improvement projects will begin in 2023.

Assessment of Need:

1. Need consistent and adequate funding source for annual maintenance
2. Need a complete inventory of drainage structures and bridges within the WRMU
3. Need to design and implement maintenance projects to raise roads and multi-use trails to current water quality standards (VT AMPs).

Infrastructure Summary

Table 24: WRMU Access Road Information: Class, Design, Type, Use

Parcel	Town	Road Name	Class	Design	Type	Use
Elmore SP	Elmore	Elmore Access Road	B	Paved	Park Road	Public Access, Management
Elmore SP	Elmore	Elmore Park Access Road	B	Graveled, Drained	SFH	Public Access, Management
Elmore SP	Elmore	Elmore Park Roads	C	Graveled, Drained	Park Road	Public Access, Management
Elmore SP	Elmore	Fire Tower Road	C	Drained	SFH	Public Access, Management
C.C. Putnam SF	Elmore	Green Crow Parcel Access	C	Graveled, Drained	SFH	Public Access, Management
C.C. Putnam SF	Elmore	Former Green Crow Row		Undeveloped	FPR ROW	Management
C.C. Putnam SF	Elmore	Green Crow Access Road	C	Drained	SFH	
Middlesex WMA	Middlesex	Upper Barnett Hill Road	A	Drained	Town Highway	Public Access, Town Highway
M. Notch WMA	Middlesex	Notch Road	A	Drained	Town Highway	Public Access, Town Highway
C.C. Putnam SF	Middlesex	Bear Swamp Road	A	Drained	Town Highway	Public Access, Management
C.C. Putnam SF	Middlesex	Middlesex Trail Road	C	Graveled, Drained	SFH	Public Access, Management
C.C. Putnam SF	Middlesex	Langlois Row		Undeveloped	FPR ROW	Management
C.C. Putnam SF	Middlesex	Middlesex Trail Road Exit	C	Drained	SFH	Management
C.C. Putnam SF	Stowe	Upper Pinnacle Road, Private	A	Graveled, Drained	Private Road	Private Use, Public Access, Management
C.C. Putnam SF	Stowe	Upper Pinnacle, SFH	A	Drained	SFH	Public Access, Management
C.C. Putnam SF	Stowe	McCall Pasture Road	B	Drained	Town Highway	Public Access, Management

C.C. Putnam SF	Stowe	Brownsville Road	B	Graveled, Drained	Town Highway	Public Access, Town Highway
C.C. Putnam SF	Stowe	McCall Pasture Road Exit	C	Drained	SFH	Public Access, Management, VAST
C.C. Putnam SF	Stowe	Pinnacle Meadow Road	C	Drained	SFH	Public Access, Management
C.C. Putnam SF	Stowe	Lancaster Row	C	Drained	SFH	Management, VAST
C.C. Putnam SF	Stowe	Brownsville Landing Road	C	Drained	SFH	Management
C.C. Putnam SF	Waterbury	Main Climb (Private Row)	C	Graveled, Drained	Trail	Recreation Trail, Public Access, Private Row
C.C. Putnam SF	Waterbury	Perry Hill Row	C	Undrained	SFH	Public Access, Management
C.C. Putnam SF	Worcester	Worcester Trail Access Road	B	Graveled, Drained	SFH	Public Access, Management
C.C. Putnam SF	Worcester	Hults Road	B	Graveled, Drained	Town Highway	Public Access, Town Highway, Private Access
C.C. Putnam SF	Worcester	Patterson Brook Road	C	Graveled, Drained	SFH	Public Access, Management
C.C. Putnam SF	Worcester	Worcester Block Access Road	C	Graveled, Drained	SFH	SFH Use, Public Access, Management
C.C. Putnam SF	Worcester	Patterson Brook Road	C	Graveled, Drained	SFH	Public Access, Management
C.C. Putnam SF	Worcester	Patterson Camp Road	C	Undrained	SFH/Private ROW	Private Use, Management
C.C. Putnam SF	Worcester	Patterson Landing Road	C	Undrained	SFH	Public Access, Management
Worcester Woods WMA	Worcester	Worcester Woods Row	C	Undeveloped	DFW ROW	Undeveloped

Table 25: WRMU Access Road Information: Maintainer, Length, Needs

Road Name	Primary Maintainer(s)	Length (ft)	Needs/Repairs
Elmore Access Road	Parks Division	2,923	Update/maintain through DEC water quality program
Elmore Park Access Road	Parks Division	1,163	Update/maintain through DEC water quality program
Elmore Park Roads	Parks Division	6,570	Update/maintain through DEC water quality program
Fire Tower Road	Forests Division	3,019	Update/maintain through DEC water quality program
Green Crow Parcel Access	Forests Division	471	Update/maintain through DEC water quality program
Former Green Crow Row	Forests Division	1,744	None
Green Crow Access Road	Forests Division	1,651	Update/maintain through DEC water quality program
Upper Barnett Hill Road	Town		Update/maintain through DEC water quality program
Notch Road	Town	3,884	Update/maintain through DEC water quality program
Bear Swamp Road	Town	5,949	Update/maintain through DEC water quality program
Middlesex Trail Road	Forests Division	4,429	Update/maintain through DEC water quality program
Langlois Row	Forests Division	1,611	Consider development
Middlesex Trail Road Exit	Forests Division	2,641	Update/maintain through DEC water quality program
Upper Pinnacle Road, Private	Private/ Forests Division	773	Update/maintain through DEC water quality program
Upper Pinnacle, SFH	Forests Division	395	Update/maintain through DEC water quality program
McCall Pasture Road	Town/ Forests Division	5,940	Update/maintain through DEC water quality program
Brownsville Road	Town	4,396	Update/maintain through DEC water quality program
McCall Pasture Road Exit	Town/ Forests Division	2,225	Update/maintain through DEC water quality program
Pinnacle Meadow Road	Forests Division	2,664	Update/maintain through DEC water quality program
Lancaster Row	Forests Division	3,828	Update/maintain through DEC water quality program
Brownsville Landing Road	Forests Division	231	Update/maintain through DEC water quality program
Main Climb (Private Row)	Forests Division	1,749	Maintain as trail
Perry Hill Row	Forests Division	1,538	Consider development

Worcester Trail Access Road	Forests Division	923	Update/maintain through DEC water quality program
Hults Road	Town	2,632	Work with Town to plan/repair/maintenance options
Patterson Brook Road	Forests Division	2,266	Update/maintain through DEC water quality program
Worcester Block Access Road	Forests Division	1,114	Update/maintain through DEC water quality program
Patterson Brook Road	Forests Division	2,816	Update/maintain through DEC water quality program
Patterson Camp Road	Private/Forests Division	817	
Patterson Landing Road	Forests Division	586	Update/maintain through DEC water quality program
Worcester Woods Row	Department of Fish & Wildlife	1,534	Consider development

Table 26: Gates

Location	Condition	Status	Needs
McCall Pasture Road (entrance)	Good	Farm gate installed by Town of Stowe 2020.	None
McCall Pasture SFH	Fair	Steel Swing gate	Paint, grease
McCall Pasture-Moss Glen VAST	Fair	Steel Swing gate	Paint, grease
Moss Glen VAST (off Moss Glen Road)	Fair	Farm Gate	
Lancaster ROW	Fair	Steel swing gate	Paint, grease
Brownsville Road Field Gate	Poor	Farm gate	Replace
Brownsville Road Field #2 Gate	Poor	Chain link fence gate	Replace
Pinnacle Meadow	Good	Steel swing gate	Paint, grease
Perry Hill	Good	Steel swing gate	Paint, grease
Carriage Road	Fair	Steel swing gate	Paint, grease
Patterson Brook Road (Hults Rd)	Fair	Steel swing gate	Paint, grease
Elmore SP Main gate	Good	Parks style steel swing gate	None
Elmore SP Beach Road side gate	Good	Parks style steel swing gate	None

Table 27: Kiosks

Location	Condition	Status	Needs
Pinnacle Meadows	Good	New in 2020	Maintained as needed
Stowe Pinnacle	Good	New in 2020	Maintained as needed
Moss Glen	Good	New in 2020	Maintained as needed
Worcester Trailhead	Good	New in 2020	Maintained as needed
Middlesex Trailhead	Good	New in 2020	Maintained as needed
Waterbury trailhead	Good	New in 2020	Maintained as needed
Brownsville 3 Season Trailhead	Good	New in 2020	Maintained as needed
Perry Hill Trailhead	Good	New in 2020	Maintained as needed

Table 28: Parking Areas

Location	Condition	Status	Needs
Elmore State Park (Day Use)	Gravel	Satisfactory	Maintained Annually
Elmore State Park (Fire Tower Rd)	Gravel	Satisfactory	Maintained Annually
Green Crow Landing	Grass/ Gravel	Satisfactory	Maintained as needed/ Mowed as needed
Worcester Trailhead	Gravel	Satisfactory	Maintained as needed
Middlesex Trailhead	Gravel	Satisfactory	Maintained as needed
Middlesex Notch	Gravel	Satisfactory	Maintained as needed
Perry Hill	Gravel	On Town Land (do not maintain)	Monitored for use
Waterbury Trailhead	Gravel	Satisfactory	Needs to be expanded to match use.
Berry Stowe Hollow Road	Native	Needs Improvement	Needs resurfacing
Pinnacle Parking	Gravel	Satisfactory	Maintained as needed
Pinnacle Meadow	Gravel	Satisfactory	Maintained as needed
Brownsville 3 Season	Gravel	Satisfactory	Maintained as needed
*Brownsville	Gravel	To be Developed	Planned 2023
Moss Glen	Gravel	Satisfactory	Maintained as needed
Middlesex WMA Parking Lot	Gravel		Maintained by Town as it is also a plow turn-around.

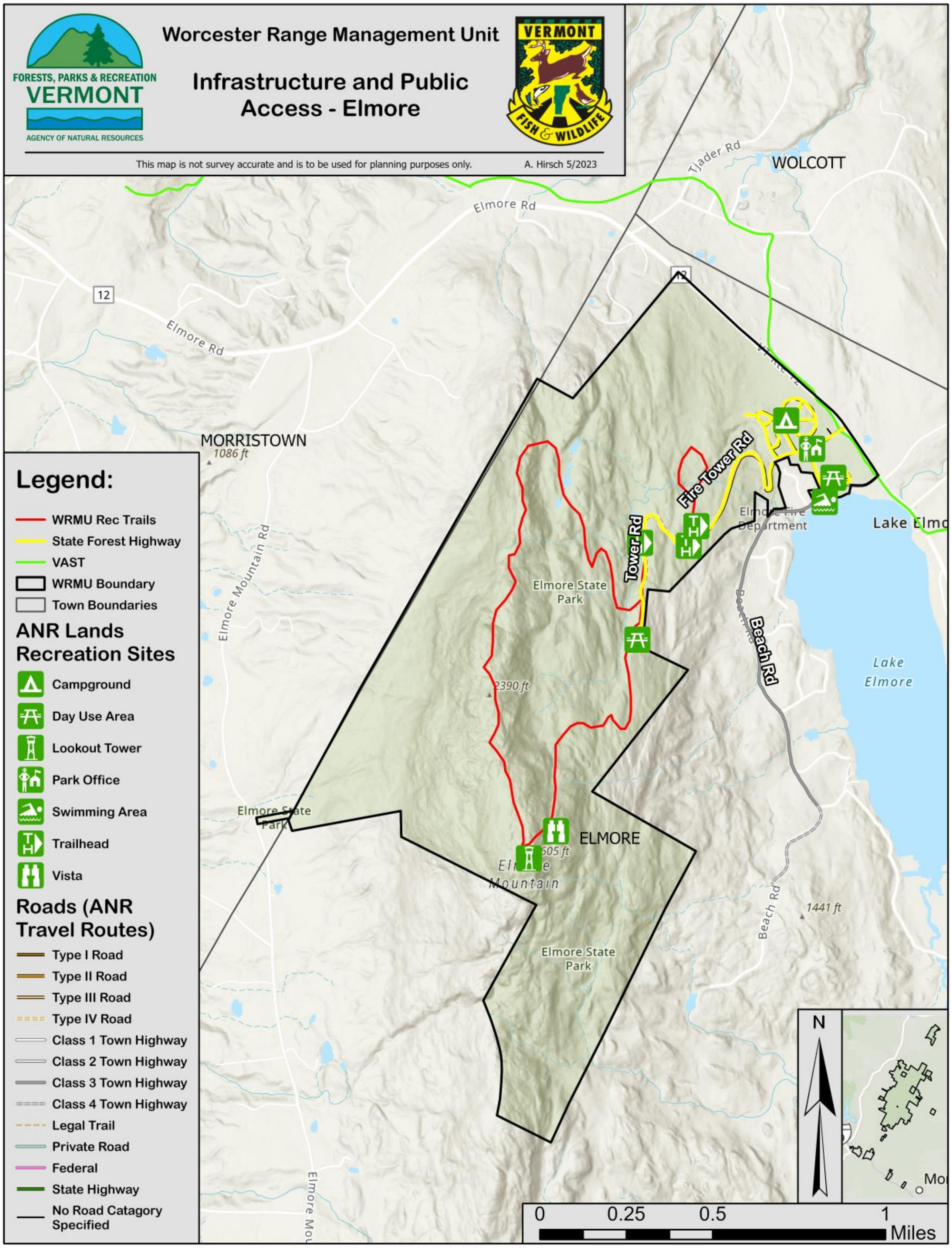
Table 29: Signs

Location	Condition	Status	Needs
Stowe Pinnacle	Good		Nothing
Pinnacle Meadows	Good		Nothing
Brownsville	Good		Nothing
Moss Glen Falls	Okay	Should be improved	Small chip on lower left corner should be painted
Waterbury Trail	Good		Lichen could be scrubbed off when on site
Perry Hill	Good		Nothing
Middlesex Trail	Good		Nothing
Worcester Block NE	Okay	Should be improved	Should apply a fresh coat of paint and glue where boards are separating
Worcester Trail	Good		Nothing
Middlesex Notch WMA	Good		Nothing
Middlesex WMA	Good		Nothing

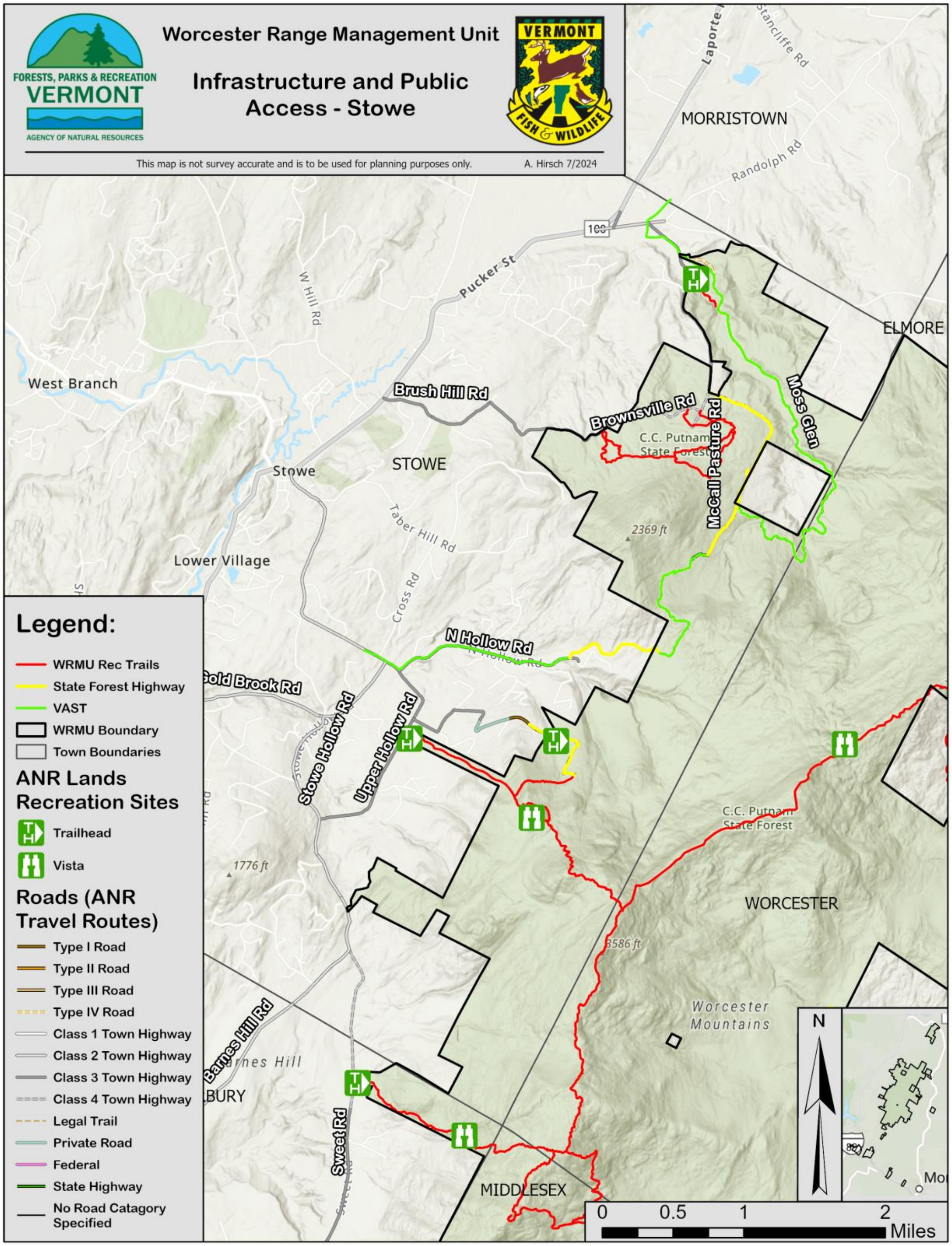
Table 30: Elmore State Park Buildings/Structures Inventory

Building Name	Year Built	Condition	Notes
Ranger's quarters	1984	Good	Renovated winter 2020-2021
Staff Quarters	1984	Good	Renovated winter 2021-2022
Garage	1984	Fair	Needs electrical work
Contact Station	1995	Good	
Woodshed	1990	Fair to Good	
Picnic Shelter	1983	Good	Recent electrical upgrades
Toilet #1	1964	Poor	Needs full renovation
Lean-tos (5)	1970	Good	
Lean-tos (4)	1990	Good	
Pumphouse	1964		
Storage Building			
Toilet #3	1970	Good	Recent renovations
Solar Shower Addition	1993	Fair to Good	Recent renovations but epoxy floor failed
Sanitary Dump Station	1970	Fair	Over 50 years old, probably needs complete renovation
Lean-tos (6)	1990	Good	
Campsites (45)		Good	
Toilet #4	1936	Collapsed in the woods	
Nature Center	1980	Gone	Torn down
Fire tower	1940	Good	Recent money allocated for upgrades
Beach House CCC	1936	Good	Renovated in 2010; needs painting
Playground (Campground)	1994	New	New in 2022
Playground (Picnic Area)	1995	Removed	Will be relocated next to beach house

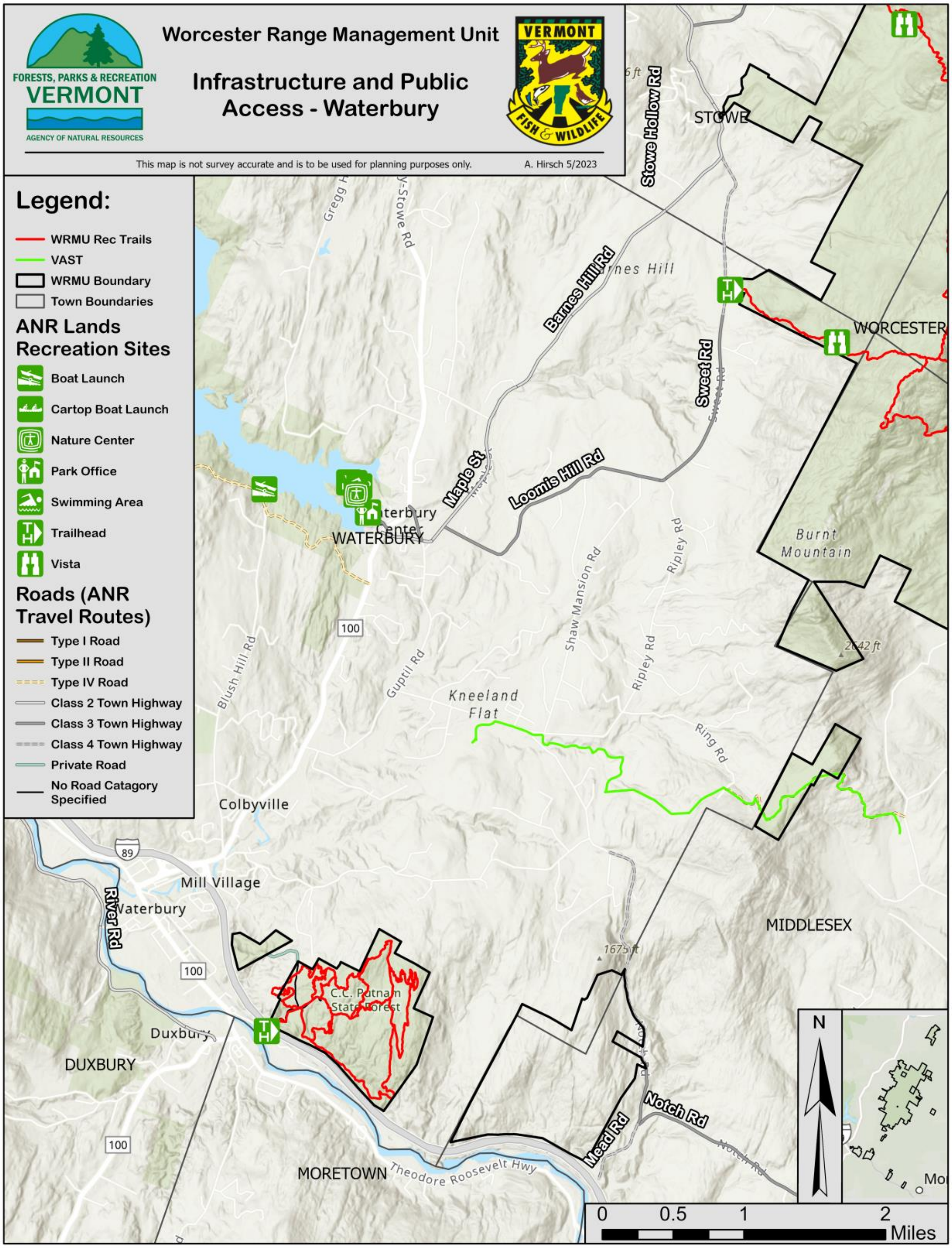
Map 30: Infrastructure and Public Access - Elmore



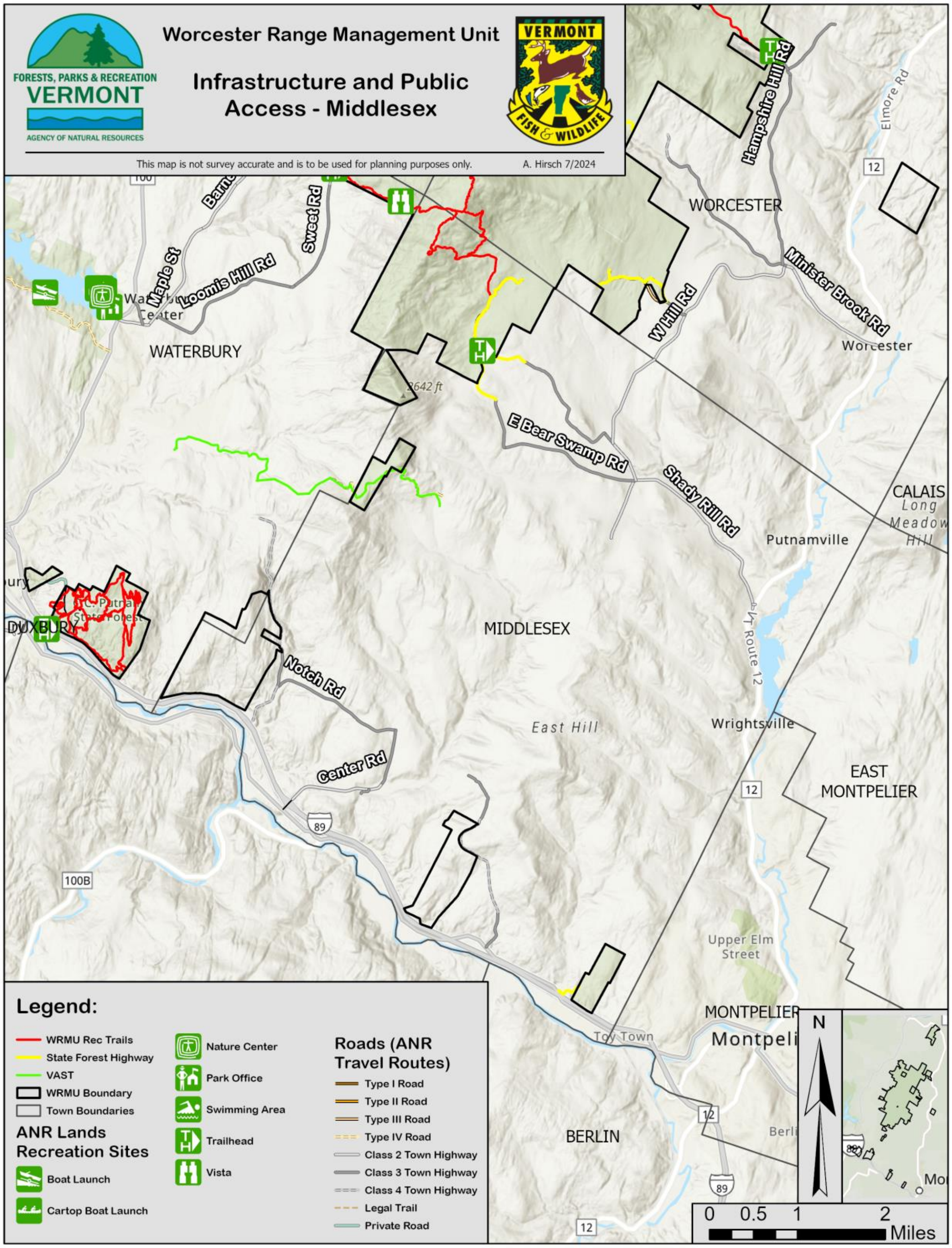
Map 31: Infrastructure and Public Access - Stowe



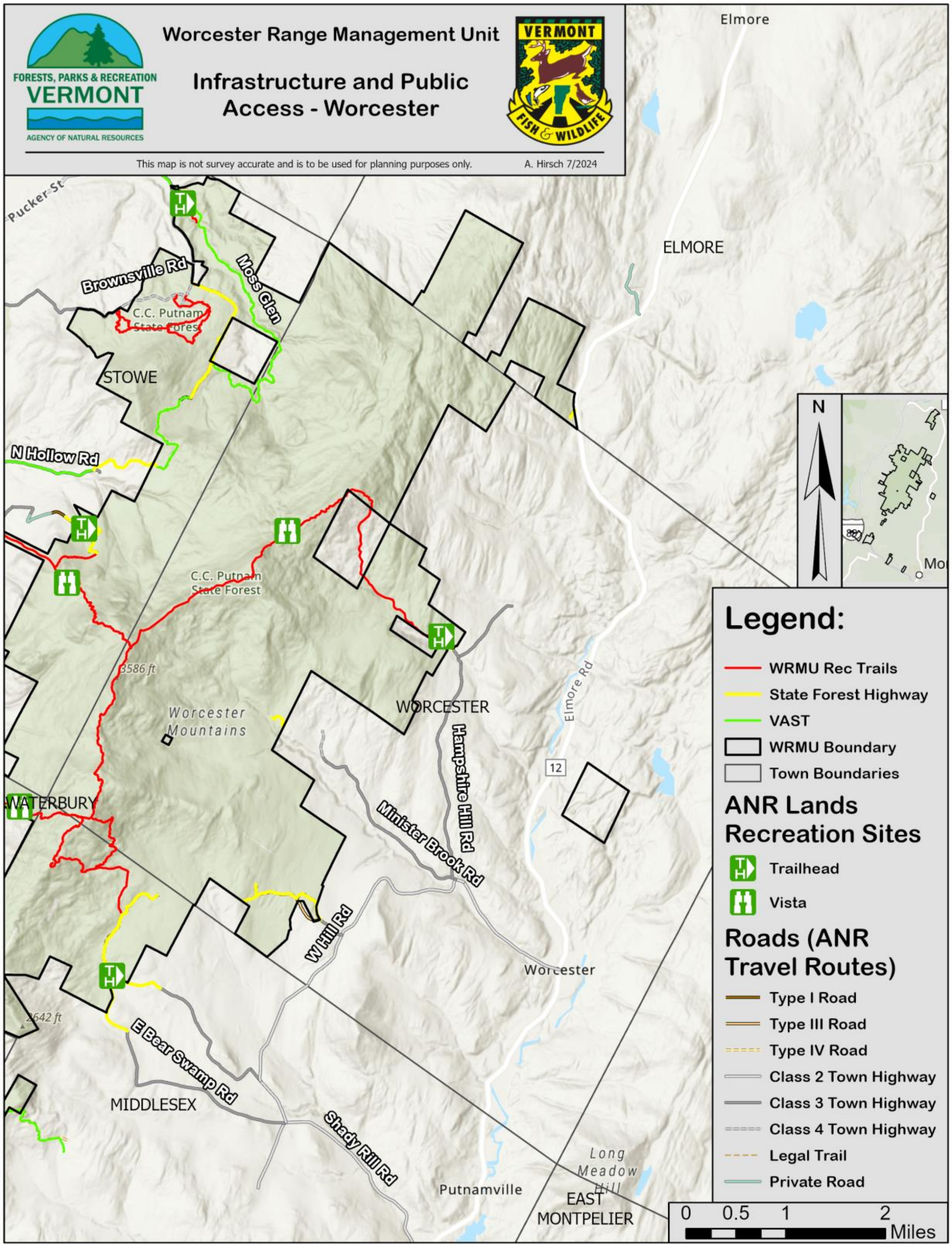
Map 32: Infrastructure and Public Access - Waterbury



Map 33: Infrastructure and Public Access - Middlesex



Map 34: Infrastructure and Public Access - Worcester



L. Scenic Resource Assessment

Description

Natural-appearing landscapes with high scenic diversity enhance people's well-being while creating a sense of place (USFS 1995).[68] The WRMU offers a wide range of scenic resources including 360° views of mountainous terrain from five major peaks, secluded waterfalls, and lowland meadows. The span of Worcester Range is a major scenic feature to surrounding areas such as Waterbury Reservoir, Mt. Mansfield, Rte. 12, Rte. 15, Rte. 100, I-89, and neighboring towns. The Worcester Range parallels Mt. Mansfield to the east, providing an excellent vantage point of the highest peaks in Vermont. Areas of high-quality scenic value correspond with popular recreation destinations such as Moss Glen Falls, the Elmore Fire Tower, Worcester peaks, and Stowe Pinnacle.

Existing Conditions

Scenic resources of the Worcester Range occur on C. C. Putnam State Forest, Elmore SP, Middlesex WMAs, and Worcester Woods WMA. Features are categorized based on the level of visual significance (regional, local, and parcel):

Regional: A significant scenic resource known and appreciated at a broad geographic scale (often geologic landform), typically unique, prominent and visible by numerous people.
Local: A scenic resource visible from off site that may be geologic but can also be subjectively attractive rural and/or forest vistas.
Parcel: A scenic resource visible from only within or just adjacent to the parcel such as maintained meadows, historic sites, and unique geological features.

Table 31: Visually Significant Resources of the Worcester Range

Feature	Level of Significance	Location	Vantage Point	Description
Worcester Mtn.	Regional	C.C. Putnam SF	The five peaks in the Worcester Range can be seen from surrounding towns, major roads (Rt. 12, Rt.100, I-89), and other recreation centers (Waterbury Reservoir, Mt. Mansfield).	Bald summit (elev. 3293') surrounded by sub-alpine forest. Unique quartz slabs near the peak.
Hogback Mtn.	Regional	C.C. Putnam SF		Forested summit (elev. 3505') slightly off trail.
Stowe Pinnacle	Regional	C.C. Putnam SF		Exposed rocky summit (elev. 2651') with popular views of Waterbury Reservoir, Mt. Mansfield, and Camels Hump.

[68] USFS. (1995). *Landscape Aesthetics: A Handbook for Scenery Management.* US Department of Agriculture. Retrieved from https://handle.nal.usda.gov/10113/CAT11132970

Mt. Hunger	Regional	C.C. Putnam SF		Broad, flat-rock summit (elev. 3539') with views of the Green Mtns and Adirondacks to the West and the White Mountains to the East.
White Rock Mtn.	Regional	C.C. Putnam SF		Exposed summit (elev. 3194') with excellent views of Mt. Hunger.
Elmore Fire Tower	Local	Elmore State Park	Summit of Elmore Mtn. with access via the Ridge Trail or Fire Tower Trail.	The top of the fire tower offers views of the Green Mountains to the west and the Presidential Range of NH to the east.
Vista	Local	Elmore State Park	Fire Tower Trail	Ranger cabin foundation with a view of Elmore Pond and surrounding mountains.
Vista	Local	C.C. Putnam SF	Stowe Pinnacle Trail	Rocky outcrop with views of Mt. Mansfield.
Hunger Mtn. Waterfall	Parcel	C.C. Putnam SF	Waterbury trail vista	
Moss Glen Falls	Parcel	Moss Glen Falls (Stowe) Natural Area	Rocky outcrop on hiking trail	Cascading waterfall with a drop of over 100 feet surrounded by a hemlock dominated forest.
Beaver Pond and Trail	Parcel	Moss Glen Falls (Stowe) Natural Area	Hiking trail	Boardwalk trail through beaver habitat that showcases gnawed trees, dams, and lodges.
Meadows	Parcel	C.C. Putnam SF: (Pinnacle meadows, Brownsville, McCall Pasture)	Hiking trail	Mowed meadows that offer scenic diversity to the viewshed

Pertinent Issues

General landscape maintenance is an integral part of scenery management. However, trail maintenance of vistas and mowing of meadows require ongoing attention. The combination of limited time and funds constrain the management of these scenic features.

The Elmore Fire Tower is a historic landmark that often requires general upkeep. A statewide project to improve the quality and safety of fire towers while maintaining historic value is underway. Although the safety needs of Elmore Fire Tower are being addressed, the maintenance still needs to be considered long term.

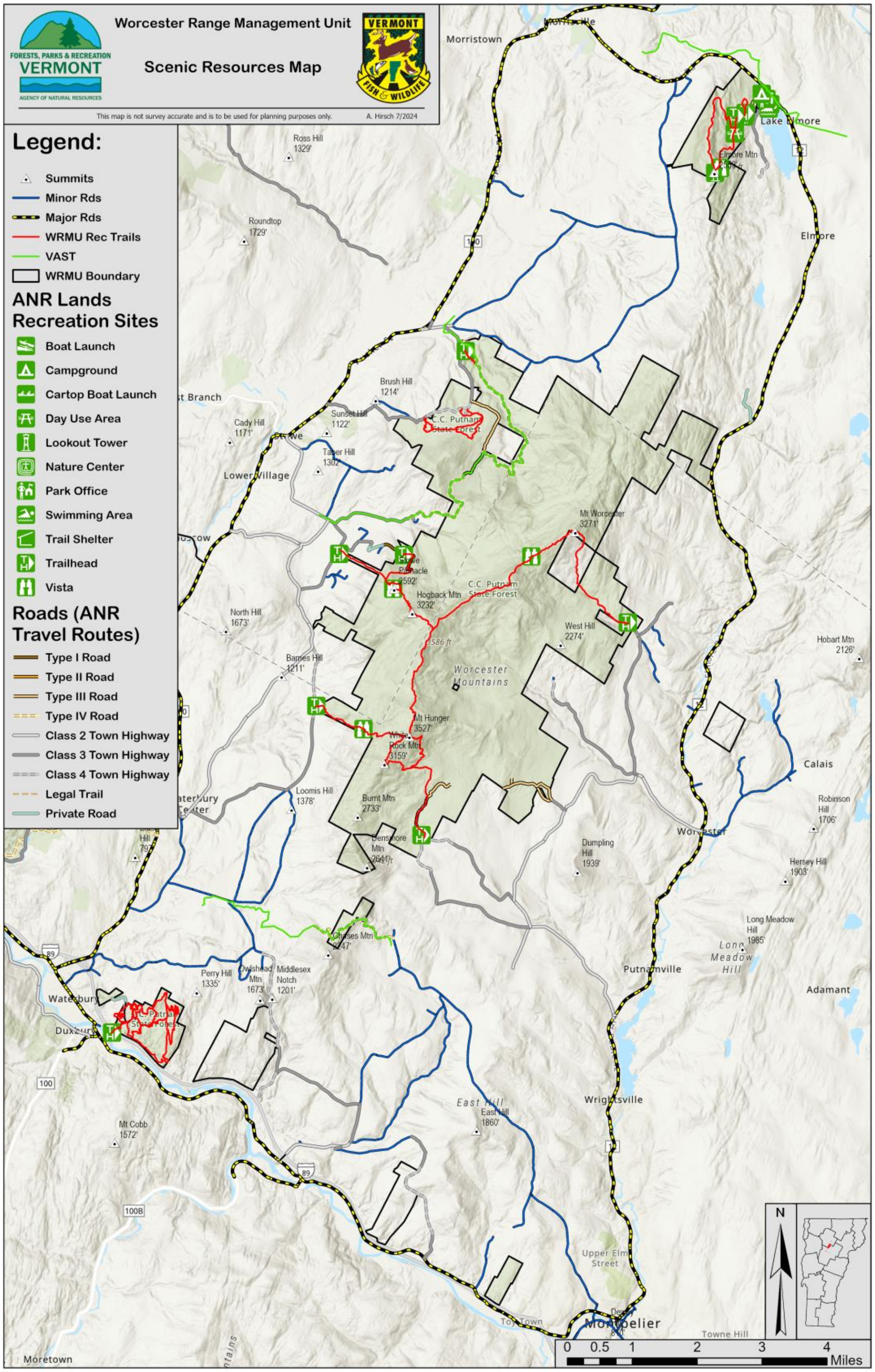
As development in surrounding villages of Stowe, Waterbury, and Elmore continues, the scenic integrity of the landscape should be considered long term. Development within a natural landscape can disrupt the intactness of the viewshed, thus altering the visual impression of the scenic resource.[69] Forest management can have a similar effect on the landscape but can be mitigated by strategic planning and design.

Assessment of Need

- Additional funding for trail maintenance of vistas and mowing of meadows.
- Collaboration with surrounding villages on major development projects.

[69] USFS. (1995). *Landscape Aesthetics: A Handbook for Scenery Management.* US Department of Agriculture. Retrieved from https://handle.nal.usda.gov/10113/CAT11132970.

Map 35: Scenic Resources Map



IV. MANAGEMENT STRATEGIES AND ACTIONS

The following includes seven sections:

- Section A identifies broad goals for the entire WRMU.
- Section B describes general strategies and actions that will be used to achieve these broad goals.
- Section C describes Climate Change Adaptation strategies.
- Section D (Land Management Classification (LMC) Section) describes the site-specific management actions that will occur throughout the WRMU.
- Section E describes Vegetation Management Activities.
- Section F describes the Recreation Management Actions.
- Section G describes Road Infrastructure Management Actions.

A. Management Goals for the Worcester Range Management Unit

Utilizing the "multiple use" concept, management of the WRMU embraces several priorities in achieving the goals set forth for this land base. The top priorities of management for the WRMU are to protect and conserve the natural, cultural, and scenic resources present, to provide a range of recreational opportunities, to continue to harvest forest products sustainably, and to maintain and enhance diverse plant and wildlife habitats. The relative importance of these goals will vary based on several factors, including the area's official State designation (State Forest, State Park, Natural Area, or Wildlife Management Area), and the area's Land Management Classification, which is described later in this section.

Unit-Wide Goals

1) **Protect the ecologically functional landscape and natural and cultural resources of WRMU.** Protecting the ecology of the WRMU and its natural resources is our highest priority. Management goals for the WRMU are developed at multiple scales (including both landscape and fine scale), allowing for the protection of its natural resources while meeting Vermont Conservation Design's vision to sustain the state's ecologically functional landscape. The natural resources found here must be maintained and enhanced to protect and conserve aesthetic and ecological values, recreational opportunities, watershed values, timber, wildlife, and rare, threatened, and endangered species for present and future generations. Proper consideration will also be given to protect important cultural and historic resources.
2) **Provide diverse recreational opportunities and trail systems where appropriate and compatible with other goals.** Recreation is a primary use of certain areas within the WRMU (e.g., Perry Hill & Elmore State Park) and management activities will maintain and enhance recreational opportunities. Most of the recreational pursuits on the WRMU are pedestrian based activities, primarily concentrated on hiking trails but with increases in dispersed, non-trail recreation. Recreation management strategies are designed to provide an outstanding user experience while minimizing negative ecological effects.

3) **Promote climate adaptability and carbon resilience on the landscape to address climate change impacts.** One of the primary goals of the WRMU is to assess the potential impacts of climate change on forested areas and subsequently devise strategies to mitigate risks and enhance resilience to future climatic conditions. Through both active and passive forest management, strategies will aim to encourage multi-aged/size structure, increase tree species and functional diversity, maintain hydrological cycle and erosion control, increase biological legacies and dead wood, and create stable carbon pools while balancing carbon storage and accumulation for carbon resilience.
4) **Use a variety of management strategies to support healthy and resilient forest ecosystems; where it is appropriate, support the production of a diverse array of sustainably harvested forest products.** A range of forest management strategies will be implemented on appropriate lands within the management unit to increase the diversity of tree ages, species, and structure to bolster ecosystem resilience. Further, these strategies are designed to produce high-quality forest products and to provide and enhance plant and wildlife habitat and biodiversity. Additionally, the WRMU will implement research experiments in partnership with the University of Vermont focused on climate adaptive strategies to add resilience to the landscape and provide demonstration sites for landowners, forest managers, and other stakeholders.
5) **Provide high-quality habitat for target and general plant and wildlife species.** Utilizing a combination of commercial and non-commercial forest management practices, the WRMU will continue to provide high value wildlife habitat. Management operations will promote retention and enhancement of special wildlife related features. Old field openings will be maintained; large contiguous blocks of forest will remain intact; streams and wetlands will be protected; softwood cover will be preserved and enhanced; mast-producing trees will be retained and released from competition from other trees; and critical habitats will be conserved. Within areas prescribed for active management, areas of late successional forest, which provide special wildlife habitats such as large snags, coarse woody debris, large tip-up mounds, and other related features will be managed to conserve, promote, and expand those features. Outside of areas prescribed for management, natural disturbance regimes will continue to be the dominant force shaping wildlife habitat.

B. General Management Strategies and Actions

Resource Protection

Goal: Protect the ecologically functional landscape and natural and cultural resources of the Worcester Range Management Unit

Resource protection is inherent in nearly every management action conducted on the WRMU. The goal of resource protection is in the forefront of our minds when considering any new or existing activity on the WRMU. When one considers a management action, what typically comes to mind is a discrete activity - building a trail, ditching a road, etc. But there are management “actions” conducted that further the goal of protection. Some of these actions are listed below, along with general strategies that serve to further resource protection efforts. Site-specific management strategies can be found in Section C.

General Management Strategies

- Protect the WRMU's contributions to Vermont's ecologically functional landscape:
    - Maintain and enhance the WRMUs intact and unfragmented interior forest.
    - Increase, maintain, and enhance both young and old forest representation on the WRMU and adjacent to the WRMU where opportunities exist.
    - Promote wildlife movement and ecological connectivity through the Shutesville Hill Wildlife Corridor and the "Worcester Range to Northeast Kingdom" connection east across Route 12.
    - Document, maintain, and enhance known and suspected travel corridors to enable wildlife movement across the broader landscape.
    - Conserve physical landscape diversity on the parcel and contribute to the diversity of the larger landscape.
    - Pursue opportunities to work with adjacent landowners and municipalities to promote an ecologically functional landscape.
- Maintain or enhance the ecological quality of significant natural communities:
    - Promote the natural diversity of native species.
    - Protect the soils, landforms, and water resources that support significant natural communities.
    - Monitor impacts from other human activities, including recreation and forest management.
    - When appropriate, allow natural processes and disturbance regimes to prevail.
    - Ensure that timber management, wildlife habitat, and recreation strategies do not lower the quality rank of significant natural communities.
- Protect rare, threatened, and endangered species and their habitats:
    - Maintain or enhance habitat for uncommon and rare species.
    - Manage and monitor impacts from other uses, including recreation and forest management activities.
    - Support survey efforts to identify and map the extent of any rare, threatened, and endangered species and their habitats on the WRMU.
    - Prioritize management of invasive species that pose a threat to native rare, threatened, or endangered species.
- Protect, restore, and enhance water quality, fisheries habitat, flood resilience, and wetland function:
    - Follow the *Riparian Management Guidelines for Agency of Natural Resources Lands* (VANR, 2015) to protect water quality and control soil erosion.
    - Follow state and federal permit requirements and conditions related to water resources (e.g., wetlands, rivers, streams, lakes, and ponds).
    - Minimize and mitigate negative impacts to water resources and their functions and values by:

        - Improving existing developed lands, roads, and trail infrastructure to minimize impacts to riparian areas and aquatic habitat, and to prevent erosion.
        - Retaining and enhancing the amount and distribution of coarse woody material for fish habitat, connectivity, flood resiliency, and nutrient cycling.
        - When appropriate, installing new stream crossing structures that allow for aquatic organism passage.
        - Restoring native vegetation to previously managed riparian habitat.
        - Planning water crossings on roads and trails to withstand increasing frequency and intensity of storm events, thereby enhancing flood resilience and mitigating downstream impacts.
        - Avoiding the use of fertilizers or pesticides near any wetland, river, stream, pond, or lake habitat when practicable.
        - Maintaining and creating pervious (permeable) conditions within the WRMU where possible and practicable.
        - Implementing priority clean water projects identified in assessments and Tactical Basin Plans where appropriate.
- Promote resilience and adaptation to address climate change:
    - Through a combination of active and passive management, promote an intact, connected, and biologically and physically diverse landscape.
    - Retain and enhance the amount and distribution of coarse woody material for nutrient cycling and soil protection.
    - Manage tree age diversity and forest structural complexity across the landscape with particular attention to landscape-level management, to moderate impacts of severe disturbances.
    - Promote forest cover in riparian areas and adjacent upland forests and wetland buffers to maintain natural stream temperatures, wildlife corridors, and to mitigate flooding impacts.
    - Maintain and enhance forest species diversity including trees, shrubs, herbaceous plants, and bryophytes to aid in maintaining forest processes.
    - Maintain rare and sensitive natural communities as potential refugia.
    - Promote landscape connectivity by considering management actions on nearby properties when enacting management on the WRMU.
    - Create a more resilient State Forest Highway and trail system. This will be achieved by stabilizing and increasing the size and number of water diversion structures (bridges, stream culverts, ditch relief culverts, broad based dips and waterbars).
- Promote an ethic of respect for the land, sustainable use, and exemplary management:
    - Continue to improve public outreach and education efforts aimed at educating users about appropriate uses of state land. Utilize a variety of information outlets including internet, social media, mailings, trailhead signs and others.
    - Conform to all deed restrictions, conservation easements, and other legal agreements.

- Ensure proper waste management at all facilities including trail shelters and parking areas.
- Limit special use permits and licenses to appropriate activities and locations.

- Maintain and enhance forest ecosystem health:
  - Conduct periodic forest health surveys.
  - Consider current insect and disease conditions when determining the timing of management activities.
  - Prevent the introduction of additional non-native invasive plants.
  - Monitor the WRMU for the introduction of non-native species.
  - Control or eradicate known non-native invasive plant populations.
  - Identify, monitor, and manage native forest health threats in collaboration with FPR Forest Health staff.
- Document, interpret, and protect historic resources:
  - Identify and buffer known and discovered cultural and historic sites.
  - Work with the Division of Historic Preservation (DHP) to identify and correctly buffer historic sites during management activities.
  - When appropriate, install interpretive signage about historic resources along roads and trails.

Wildlife Habitat Management Strategies

Goal: Provide high-quality habitat for specific and general wildlife species.

High priorities of management on the WRMU are special wildlife habitat projects and the incorporation of wildlife-related management into other activities. Several of the important wildlife habitats found in the WRMU are classified in this plan as *critical plant and wildlife* habitat. These areas include deer wintering areas, bobcat denning habitat, early successional forests, fields, hard (beech and red oak, etc.) and soft (apple, mountain ash, cherry trees, berries) mast production areas. Specific management actions aimed at maintaining and enhancing these resources are listed in the Land Management Classification section (below).

There are also many other important habitat features found throughout the WRMU. Examples include vernal pools, small wetlands, seeps, riparian zones, aspen and birch stands, raptor nesting trees, snags, and cavity trees and late successional (old) forests. Many of these features are found at a scale too small to be mapped or are of an ephemeral nature. Management activities will be designed to maintain and improve these features wherever possible, using a combination of active and passive management.

Listed below are **general** strategies and tactics that will be employed on a **broad-scale** throughout the WRMU to meet the goal of providing high-quality habitat for target and general wildlife species.

- Protect and enhance unique wildlife habitats and features for both specific and general wildlife species:
  - Before conducting management activities, monitor for the presence of important wildlife habitat, such as known occurrences of rare, threatened, or

endangered species, significant natural communities, stream and wetland riparian zones, bobcat denning sites, raptor nest trees, etc., and provide a buffer adequate to prevent disturbance to these features.

- Adhere to management guidelines for threatened and endangered bats in Vermont prepared by the Vermont Fish and Wildlife Department, particularly *Forest Management Guidance for State Lands – Northern Long-eared Bats.*
    - Review all timber harvests that are proposed within the WRMU for potential effects on bat species and adjust prescriptions and timing of operations accordingly.
- Avoid impacts to Bicknell's Thrush and its high elevation habitat.
- Maintain and improve important mast trees and shrubs.
    - Management within bear-scarred beech stands will follow the *VT ANR Management Guidelines for Optimizing Mast Yields in Beech Mast Production Areas*.
    - Maintain and enhance soft mast species where they occur.
    - Natural soft mast areas will be maintained by appropriate means, as determined by site-specific conditions.
    - Maintenance of permanent upland openings and creation of temporary silvicultural openings will contribute additional soft mast.
    - Fruit bearing trees will be retained, released, and pruned in appropriate locations, to provide mast for wildlife.
    - Promote adequate numbers of snags, cavity trees, and dead and downed wood, in accordance with modern scientific guidelines.
    - Protect individual trees of special wildlife significance.
- Deer wintering areas (DWA) will be maintained and improved.
    - DWAs will be promoted by maintaining at least 50% of the area in functional shelter (softwood cover >35 feet in height and with >70% average canopy cover) when conducting vegetation management within the wintering habitat.
    - When possible, maintain softwood connectivity throughout the winter area during management activities.
    - Browse enhancement strategies will be developed by the FWD Biologists for harvests within or adjacent to Deer Wintering Areas. These strategies will be integrated into silvicultural prescriptions.
- Where appropriate, trees will be retained in travel lanes for deer (>200ft wide) and hare (15-45ft wide) within softwood areas and to adjacent hardwood stands.
- Where possible, aspen stands will be targeted for harvest to produce dense aspen regeneration for its value to wildlife.
- Existing fields will be mowed or burned approximately every three years to maintain open, herbaceous conditions.
    - Mowing will occur after August 1 to allow fledging of ground nesting birds. In areas where wood turtles are likely to occur, mowing will take place after October 1st to prevent direct mortality.

        - New openings may be developed to replace current openings by mowing or burning log landings.
        - New acreage may be converted from forest into shrub upland opening. This would likely occur adjacent to existing shrubland habitat.
    - When identified, active heron rookeries and nests of raptors, such as bald eagles, peregrine falcons, and other rare species will be protected with appropriate buffers, in accordance with FWD guidance. Disturbance will be limited within buffer zones and any timber harvesting will not occur during the active nesting period.
    - Artificial nesting structures such as osprey and eagle platforms, bat boxes, and wood duck boxes may be installed in suitable locations to enhance limiting habitat elements.
    - Protect and enhance wildlife habitat through management of early successional habitat and by increasing young forest representation on the landscape.
    - Follow guidance from the Vermont Conservation Design effort (Sorenson & Zaino, 2018) to increase the percentage of forest land in this area in a young forest age class (1-15 years old). The current vegetation management strategies and actions section (below) does not identify specific large-scale areas for the creation of new young forest stands on the WRMU. However, ANR will work to opportunistically identify places on the WRMU where young forest creation can be incorporated in planned uneven-aged management treatments provided it meets management objectives and silvicultural guides.
    - Maintain existing openings (fields and landings) by mowing or burning.
    - If appropriate and practical, locate new young forest openings in previously disturbed sites (e.g., old homesteads, pastures, or previously burned sites).
- Promote the development of old forest (late successional forest) and structurally complex forest habitats in the WRMU:
    - Follow guidance from the Vermont Conservation Design effort (Sorenson & Zaino, 2018) related to creating and maintaining both late successional and structurally complex forests.
    - Use passive management to achieve this goal in a mosaic of forested natural community types in low to high elevations (Highly Sensitive Management Areas).
    - Use a combination of passive and active management to achieve this goal in mid- to lower elevations. This will include taking advantage of opportunities to promote development of old forest characteristics as part of other planned active management activities.
- Maintain and enhance surface water quality within the WRMU to protect aquatic and terrestrial habitat:
    - Identify appropriate Riparian Management Zones in accordance with the *Riparian Management Guidelines for Agency of Natural Resources Lands* to protect riparian function around all wetlands, seeps, streams, and vernal pools. Activities that might result in disturbance or displacement of wildlife from these features will be avoided or minimized.

- Design roads, trails, and other infrastructure to allow for aquatic organism passage and riparian connectivity.
- For all vernal pools, no ground disturbance or vegetation management will be allowed within 100 feet of the pool edge, except for restorative purposes as described in the Guidelines. Within a secondary buffer zone, extending 500 feet past the primary buffer zone, at least 60% of the canopy will remain intact within this zone, composed of trees at least 25 feet tall. Landings, skid roads, and truck roads will not be located inside the secondary buffer zone whenever possible. Operations will avoid disturbing fallen logs; limbs and tops will be left where they are felled; and large trees may be cut and left in place to create downed woody material.
- Canopy cover and downed woody material between pool, wetland, and riparian habitats will be maintained whenever possible.

Wildlife Habitat Project Implementation:
Wildlife habitat projects are initiated on an opportunistic timeline. When and where opportunities are identified, management activities shall incorporate specific actions to protect or improve habitat. Typically, old field mowing is done on an annual to three-year schedule. Mast tree release is accomplished as time and resources allow.

Forest Management Strategies

Goal: Produce a diverse array of traditional and non-timber forest products through sustainable management and harvest practices while achieving forest resilience, ecological function, and wildlife habitat goals.

ANR will employ a range of tools from passive to active forest management to meet management goals for forests, wildlife, water quality, natural community integrity, and recreation. Passive management allows natural processes to dominate. Active forest management encompasses numerous activities that manipulate trees, shrubs, and other plants. Active forest management includes:

- Invasive plant treatments to reduce or eliminate invasive plants that can compete with native vegetation and degrade ecological function and natural community integrity.
- Mast tree release that opens light and space for certain trees, such as oaks, hickories, and beech, to provide valuable food sources for a range of wildlife species, allowing more vigorous growth and mast production.
- Forest stand improvement that removes certain trees to give healthy trees more space to grow and supports a more resilient stand structure.
- Forest management timber harvests that support the structure, diversity, resilience, and/or health of forest stands. When justified by the conditions on the ground and the latest science, timber harvests are a tool that can be combined with other techniques to achieve many land management goals and maintain the benefits and services of healthy forests.

The WRMU LRMP mixes active and passive management approaches that are tailored to conditions on the ground that will be used to achieve a range of goals. Active forest management on the WRMU contributes to the sustainable production of forest products, improvement of forest health conditions, management of quality wildlife habitat, control of invasive species, and contributes to forest resiliency and climate adaptation. Vermont is home to a vital forest products industry, of which ANR lands are a small yet important component. Revenue generation is never the primary reason to conduct forest harvesting activities; nevertheless, commercial timber sale revenue is an important source of funding that is reinvested in ANR public lands and facilities (including road maintenance, trails, parking areas, and habitat enhancements) and they support the operation of Vermont State Parks. Furthermore, commercial timber harvests are often the only affordable way to accomplish certain types of wildlife habitat management and to achieve management objectives related to landscape diversity and resilience.

Listed below are various strategies and tactics that are employed on a broad scale within the WRMU to meet the goal of sustainable production of forest products and ecosystem services.

General Strategies and Tactics:

- Develop and maintain a resilient forest that fosters natural communities with a range of tree densities, gap sizes, plant species, structure, and tree ages distributed over a variety of sites and conditions.
- Consider likely climate change scenarios when designing silvicultural prescriptions:
    - Plan silvicultural activities that will increase forest resilience, structure, and complexity.
    - Ensure that advance regeneration is abundant prior to overstory removal when conducting even-age management.
    - Monitor harvests and temporarily halt operations as needed to protect soil, water, and access infrastructure.
- Consider forest ecosystem function and opportunities for improvement:
    - Monitor for early detection and removal of invasive plant species.
    - Where invasive plant populations are already established, aggressive control as a component of any silvicultural system.
    - Follow *Riparian Management Guidelines for Agency of Natural Resources Lands* as they relate to forest management.
    - Plan management that will increase forest resilience, complexity, and structure.
    - Follow the *Procedure for the Management of Ash on ANR Lands in Response to Emerald Ash Borer* when designing silvicultural prescriptions.
    - Consider opportunities for rehabilitation and restoration of degraded forest conditions.
- Utilize a range of suitable silvicultural techniques:
    - Consider a broad range of peer-reviewed silvicultural guides.
    - All treatment areas in this plan are to be shifted to uneven-aged structures. ANR will determine the most appropriate silvicultural system to start this process on a site-specific basis.

  - Treatment areas that already include multiple age classes will be managed with uneven-aged and 2-aged systems (including but not limited to: selection and irregular shelterwood)
  - Some treatment areas may require the use of techniques more commonly associated with even-aged silvicultural systems, as a first step in moving these areas toward become more complex multi-aged forests. Even-aged treatments include (but are not limited to): regular shelterwood, seed tree, patch cutting, and crown thinning.
  - Consider the timing of silvicultural treatments (winter vs. summer) regarding soil and water protection, desired regeneration, and reducing conflict with recreation.
  - Match the harvest layout with the location and site conditions of a given timber management project.
  - Determine which types of harvest equipment will produce the best results on a specific timber harvest. Consider restricting the types of equipment allowed on site to achieve desirable outcomes.
  - Rotate vegetation management projects around the WRMU to enable a sustainable harvest in all forest blocks.
  - Conduct periodic forest inventories to help guide future plans and in developing silvicultural prescriptions.
  - Improve public outreach regarding the purposes, outcomes, and importance of timber management:
    - Install educational signage in the vicinity of harvest areas describing the goals of the harvest and expected impacts to wildlife habitat.
    - Utilize press releases and outreach to communities to inform the public about the goals of each harvest and expected impacts to wildlife habitat.
    - Host in-person tours of active timber and wildlife management projects.
    - Collaborate with high school and college level forestry and natural resource management programs.
- Enhance the resilience of the WRMU's road access system:
  - Survey the entire road system through the ANR's Forest Road Erosion Inventory (REI) Survey.
  - Increase the size and capacity of structures (i.e., culverts, bridges, ditches) to prepare for more frequent and intense storm events.
  - Replace and enlarge inadequate culverts and stream crossing structures to enhance stability and flood resilience.
  - Minimize the number of skid roads in a harvest area.
  - Close or relocate unsustainable road segments.
  - Stabilize historic skid roads that are within or close to an operating timber sale.

Water Resource Management Strategies

Goal: To keep waters clean and cool as it flows downstream and slow and retain water during rain events (USEPA, 2015).

ANR manages Vermont's surface waters to protect public health and safety and to ensure public use and enjoyment of Vermont waters and their ecological health as set forward in the *Vermont Surface Water Management Strategy* and Vermont Water Quality Standards. To this end, Vermont's *DEC's Tactical Basin Plans* provide a strategic guidebook to protect and restore Vermont's surface waters.

In the Lake Champlain basin, significant phosphorus loading from land use activity has impaired aquatic life and reduced recreational use due to cyanobacterial blooms, unpleasant odors, and low dissolved oxygen concentrations in the lake. The United States Environmental Protection Agency established total maximum daily loads (*TMDLs*) for the 12 Vermont segments of Lake Champlain to ensure that phosphorus reductions are achieved. Thus, a major surface water quality management goal in the Winooski and Lamoille basins is to reduce sediment and phosphorus export from the headwaters to Lake Champlain and, in doing so, achieve concomitant benefits of aquatic and riparian habitat improvement, flood resilience, and improved public use of local waters.

Two documents guide management activities on state lands to achieve these water quality goals: *VTANR's Riparian Management Guidelines (RMGs)* and the *Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in Vermont (AMPs).* The RMGs establish various riparian management zones for different types of surface water features, the criteria for delineating each zone type, their protective buffer widths, and the allowed activities within each zone. These RMGs provide state land managers consistent guidance on riparian and river corridor zone management to maintain the functions and values of these ecologically, hydrologically, and economically important zones in all settings, not just active harvest areas. Likewise, the AMPs were revised in 2018 to meet the intent of Vermont's Clean Water Act (Act 64) and to minimize water quality impacts from forest land management and silvicultural activity. AMPs set standards for the maintenance of forested buffer zones around water features; planning harvests near wetlands; the development, maintenance, and closeout of new forest roads, trails, and log landings; and the handling and storage of hazardous wastes. AMP compliance reduces sediment and phosphorus runoff from forestry activity by approximately 80% relative to unregulated land clearing activity. The Environmental Protection Agency's Lake Champlain TMDL anticipates that the phosphorus reduction target set for the forestlands sector in the Winooski and Lamoille basins (a reduction of 5% of the 2016 baseline phosphorus load from forestlands) will be fully achieved by eventual state, town, and private landowner compliance with the AMPs.

Because the RMGs and AMPs identify various strategies for foresters to slow, spread, and store stormwater runoff, they confer not just water quality but also flood resilience benefits. Flood resilience-relevant strategies from the RMGs and AMPs include disconnecting or reducing runoff from hydrologically connected roads and trails; maintaining or restoring intact, forested buffers of 50-100+ feet, depending on local slopes; restoring channelized streams, ditched wetlands, or rip-rapped shores; maintaining forest floor cover especially within riparian zones and river corridors, and increasing in-stream complexity through wood additions to improve floodplain connection and in-stream roughness.

To support AMP implementation on smaller roads and adherence to *Municipal Roads General Permit* guidelines on larger roads, FPR regularly inventories and maintains State Forest Highways and trails to both protect infrastructure and to maintain high water quality standards. Road Erosion Inventories (REIs) have been completed on most hydrologically connected segments of the WRMU road network, and trail assessment work has been completed for a significant number of WRMU's trails. These assessments guide the prioritization and implementation of water quality-related construction projects. Implementation projects on roads range from handwork to clear culverts, to larger excavation projects that upsize culverts, replace culverts with bridges, stabilize ditches, and better distribute water run-off into forest buffers. Likewise, trail restoration projects on the Waterbury Trail, Stowe Pinnacle Trail, Middlesex and Worcester Trails, and the Perry Hill Mountain Bike Trails have been implemented to address erosion from the heavy use of steep trails through the construction of water diversions, removal of berms, building or repair of water bars, and the construction of stable rock staircases. Road and trail assessment and maintenance activities are further described in the infrastructure sections of this LRMP.

Finally, local surface water management plans can provide additional guidance for surface water protection and restoration activities on state lands. As previously mentioned, three River Corridor Plans have been completed for the lower sections of streams draining both the east and west slopes of the WRMU. A *Lake Watershed Action Plan* was completed for Lake Elmore in 2020. Like River Corridor Plans, the Lake Watershed Action Plan identified recommended best management practices for roads, streams, and shorelines in the Lake Elmore watershed. Some of these recommended practices were located on state managed lands. Potential projects stemming from these local plans are included in *DEC's Watershed Projects Database* and mapped in the *Clean Water Projects Explorer.* These resources are regularly reviewed by DEC staff and watershed partners and, where appropriate, proposed projects can be developed on state lands in consultation with the District Stewardship Team.

The District Stewardship Team provides an avenue for ANR staff with water resource expertise to support FPR's foresters in state lands management. The Department of Fish & Wildlife's State Lands Ecologist reviews all treatment plans in part to ensure that the plans sufficiently protect aquatic habitats, which has co-benefits for flood resilience and water quality functions. The Department of Environmental Conservation's Watershed Planner and the Department of Fish & Wildlife's Fish Biologist play similar roles in reviewing treatment plans for water resource considerations as members of the Barre District Stewardship team that oversees decisions on the WRMU.

Recreation Management Strategies

Goal: Provide diverse recreational opportunities and trail systems where appropriate and compatible with other goals.

The intent of recreation management on the WRMU is to provide a variety of experiences for the visiting public within the capabilities of the resource. While there are many different recreational opportunities to enjoy on the WRMU, this land base cannot provide everything, and certain recreational activities are not compatible anywhere on the unit. Listed below are various strategies and tactics that are employed on a broad scale within the WRMU to meet the goal of providing diverse recreational opportunities.

General Strategies and Tactics:

- Maintain and improve public access:
  - Provide special use permits (SUPs) and licenses for activities that are compatible with the goals of the property and ANR policies.
  - Evaluate the capacity of parking areas and identify and implement management strategies to address parking challenges.
  - Enhance opportunities for wildlife-based recreation, particularly hunting, trapping, and wildlife viewing.
  - Support the development of increased accessibility through integration of standards to existing opportunities or development of new opportunities when the trail can be connected to an accessible trailhead parking area and the integration of universally accessible trail standards will not drastically alter the experience or create excessive ecological impacts.
- Maintain existing trail system:
  - Continue ongoing maintenance to trails and associated facilities utilizing trail crews, contractors, staff, volunteers and continuing to work with established recreation partners.
  - Continue to allow primitive camping, in portions of the WRMU in accordance with the *FPR's Primitive Camping Guidelines.*
  - Partner with organizations including Vermont Association of Snow Travelers (VAST), Catamount Trail Association (CTA) the Stowe Trails Partnership (STP), Waterbury Area Trail Alliance (WATA) and the Vermont Mountain Bike Association (VMBA) to provide enjoyable and safe trail user experiences, and an ecologically sound trail system.
  - Continue to monitor trail usage using trailhead registers, electronic counters, and other appropriate means.
  - Explore options to expand funding for recreation management.
- Explore opportunities to expand recreation where appropriate and compatible with other goals:
  - Evaluate new recreational use requests in the context of total recreational use of the parcel (degree of use, numbers of trails), the Recreational Opportunity Spectrum (ROS), and other management goals for the parcel.
  - Partner with organizations including the VAST, CTA, STP, WATA and VMBA to plan additional recreation opportunities.
  - Recreation planning should include expected changes because of climate change including extended hiking seasons, increased cost of maintenance, and the need for more robust infrastructure related to water crossings.
  - Work with partnering organizations to ensure sustainable accommodation of emerging recreational pursuits.
  - Engage in proactive education campaigns to inform users of the importance of strong backcountry ethics on public land.

- New areas for managed backcountry glade zones will be considered through the project proposal process. Dispersed backcountry skiing is allowed on State Lands unless specifically noted otherwise. Cutting trees on State Land without permission for any reason including for improving unauthorized glades is illegal.

Discussion:
ANR works with partnering organizations to better serve the public with recreation related projects and activities on the WRMU. Occasionally, these organizations propose changes or refinements to their respective trail systems. The Agency has Cooperative Agreements with Vermont Association of Snow Travelers (VAST), Stowe Trails Partnership (STP), Vermont Mountain Bike Association (VMBA), the Catamount Trail Association (CTA), and a Memorandum of Agreement with the Green Mountain Club (GMC). The Agency also receives ideas and formal proposals from individuals and small groups and develops proposals within the Agency as well.

This plan does not include a specific implementation schedule for recreation projects. The "Recreation Management Actions" section below discusses planned site-specific recreation projects. Maintenance projects are conducted as needed and are impacted by use levels, weather conditions, and other factors. New projects typically include collaboration with partnering organizations, and the timing of these projects often depends on factors external to ANR.

C. Climate Change Adaptation Strategies through Forest Management

Forests face a myriad of challenges, from permanent land conversion, invasive plants, pests and pathogens, deer browse, and climate change. While our forests possess resilience, they also exhibit characteristics that render them susceptible to these stressors to differing extents. Maintaining and managing our forests to bolster their resilience will enable them to persist in their crucial role as not only carbon sinks, but also as adaptive landscapes that provide social and ecological needs. To promote resilience and adaptability, the WRMU aims to both protect and promote high forest complexity through management techniques (Table 32). Forest complexity is generally based on the following characteristics: trees species diversity, tree size and age, tree functional traits, tree arrangement, and deadwood accumulation at both the stand and landscape scale. Forests with high complexity have greater recovery pathways and the ability to respond to current and future stressors.

Table 32: Framework for addressing climate change through identifying goals and developing forest management actions and strategies to address these goals.[70]

Goals	Actions	Strategies
Keep forest forested and connected	Protect resilient forests and the connections between them.	Minimize trails in areas identified for protection.
Minimize forest stress	Minimizing levels of invasive plants.	Identify areas that are at risk. Clean operational equipment before entering.
	Prevent the introduction of invasive insects and diseases and limit the impact of existing ones.	Increase representation of non-host species.
	Ensure water resources have forested buffers.	Identify buffers.
	Reduce deer browse to protect tree regeneration.	Leave treetops whole to shelter regeneration from deer. Continuation of hunting access on state lands.
	Maintain or restore soil and water health.	Minimize impacts by: • Plan skid roads and trails. • Operate only during stable conditions. • Follow AMPs. • Leave tops and limbs for stabilization.
	Ensure soil is abundant in organic matter and not compacted or eroding.	Use scarification techniques where appropriate. Operate only during stable conditions.
Reduce Vulnerability	Promote diverse species, sizes, ages, and spatial arrangement.	Establish or maintain a minimum of two age classes. Diversify aggregation of species arrangements. Utilize treatments that account for species silvics (e.g., gaps for shade-intolerant species, single-tree selection for shade-tolerant species).
	Promote the establishment of well-adapted species.	Identify species that are expected to be resilient to future conditions and implement

[70] Adapted from Catanzaro, D'Amato, & Huff, 2016, NIACS Adaptation Workbook, 2023.

		appropriate strategies for their establishment.
	Reduce the proportion of trees that host invasive insects and diseases.	Reduce the number of trees that serve as host species for invasive insects and diseases in a manner that considers the overall health and function of the forest (considering regeneration and understory plant communities).
	Reduce stem crowding to increase forest vigor.	Thinning decreases resource competition and increases tree vigor. Varied thinning across the forest creates a range of spatial and environmental conditions.
	Increase the amount of large snags and logs to reach appropriate levels of deadwood.	Passive approach to allow for natural accumulation. Active approach to create standing deadwood and down woody material by felling low-quality, unhealthy trees. Protect deadwood during timber harvests.
	Restore and protect riparian areas.	Protect riparian areas and create buffers. Incorporate plantings where appropriate.
Provide Refugia	Protect threatened, endangered, and at-risk species.	Identify areas and place protections.
	Harbor species that are at risk of being lost from the landscape.	Identify microclimates and diverse topography that may be potential refugia for species and other natural communities at risk of being lost from the landscape. Reserve or promote through appropriate management strategy; active or passive.

Taken together, these strategies will help the full range of native fish, wildlife, and plant species; natural communities; and ecological processes face a changing climate.

Infrastructure and Public Use Climate Change Adaptation Strategies

In addition to the far-reaching effects on ecological systems described above, climate change may also affect the infrastructure and public uses of the WRMU.

Potential effects could include:

- Floods damaging roads, trails, and camp structures.
- Fires endangering users, campground properties, and neighboring properties.
- Increased precipitation leading to more temporary/seasonal road closures and increased road maintenance.
- Shorter winters reducing snowmobile use seasons.
- Windstorms increasing maintenance needs to keep roads clear of trees.

Such effects will be dealt with on a case-by-case basis. It is anticipated that the systems in place to manage many of these uses will readily handle these issues. Others will require more comprehensive considerations, for example, increased precipitation and flooding – maintaining the WRMU as extensively forested, with significant riparian areas and intact wetlands is a key strategy to reduce and mitigate flooding in the management unit and downstream to Little River and the North Branch of the Winooski. In addition, however, ANR has and will continue to replace undersized culverts (which can fail in flood events) with larger and better positioned structures, and – long term – may need to consider some roads away from streams.

Future assessments of landscape and species vulnerability to climate change effects may be conducted to help management decision-making by identifying locations vulnerable to weather extremes and species vulnerable based on factors such as temperature extremes and habitat conditions.

D. Site Specific Management Strategies and Actions

This section describes the site-specific management actions that will occur throughout the WRMU.

Land Management Classification

Vermont ANR lands are managed using four categories of use or types of management to be emphasized on the land. In this section of the plan, the recommended levels of use or types of management will be shown for all the land area in this parcel. This section also describes generally how the land will be managed so that the activities occurring on the land are compatible with the category assigned. The four categories are: (1) *Highly Sensitive Management*; (2) *Special Management*; (3) *General Management*; and (4) *Intensive Management*.

As part of the planning process, the lands, resources, and facilities held by the ANR are evaluated and assigned to the appropriate land management category. Assignment of management categories for the WRMU is based on a thorough understanding of the resources identified and the application of over-arching lands management standards. The resources include natural communities, plants, and wildlife as well as recreation, historic, timber, and water resources.

1.0) **Highly Sensitive Management** – Areas designated as Highly Sensitive Management are described as **"areas with uncommon or outstanding biological, ecological, geological, scenic, cultural, or historical significance…".** Acres managed under this category will have no timber management, salvage harvest, or active wildlife habitat management. However, trees and other vegetation may be cut to restore natural community species composition and structure in limited locations; manage specific habitat conditions for rare, threatened, and endangered species; and to maintain safe and enjoyable recreational conditions.

2.0) **Special Management** – Areas designated as Special Management include areas **"…where protection and/or enhancement of those resources is an important consideration for management."** Timber harvesting and wildlife habitat management as well as recreation are considered to be complementary uses within this classification to the extent that they do not impact special features.

3.0) **General Management** – The General Management category includes areas where **"dominant uses include vegetation management for timber and wildlife habitat, concentrated trail networks, and dispersed recreation…"** A primary consideration for management is minimizing conflict between activities. Sensitive resources that occur within these areas may require special attention.

4.0) **Intensive Management** – The Intensive Management category is characterized by a **"high level of human activity and high intensity development on/or adjacent to State land."** Aesthetics and safety are the primary management considerations in these areas. However, more sensitive resources that occur within these areas may require special attention.

Highly Sensitive Management (HSM) — 9,961 acres

This is defined as an area with uncommon or outstanding biological, ecological, geological, scenic, cultural, or historic significance where protection of those values is the primary consideration for management. Human activities and uses should not compromise the exceptional feature or features identified. In general, these areas will develop under natural processes and natural disturbance regimes and will not be subject to active forest or habitat management. In some limited cases vegetation may be manipulated for natural community restoration; management or specific habitats for rare, threatened, and endangered species; and to maintain safe and enjoyable recreation access.

Within the WRMU there are 9,961 acres classified as Highly Sensitive Management. This makes up 53.8% of the total 18,498 classified acres. These areas will help to achieve Vermont Conservation Design old forest targets in the Northern Green Mountain biophysical region. These include:

HSM 1.8 - Natural Areas (4,139 acres)
These are highly sensitive areas designated by the Commissioner of FPR under ***10 V.S.A., 83 s 2607. Natural areas; designation.***

HSM 1.8A - Worcester Range Natural Area (4,058 acres)
In 1983, Vermont Governor Richard Snelling designated this portion of the Worcester Range as a State Natural Area. This designation means these areas will be managed and maintained for the preservation of their natural condition.

Eight hiking trails are located within (or partially within) the boundaries of HSM 1.8A—The Skyline Trail, Ridge Trail, Stowe Pinnacle Trail, Hunger Mountain Trail, Worcester Trail, Middlesex Trail, White Rock Trail, and the Bob Kemp Trail. The following is a list of management strategies and actions that will be generally implemented throughout HSM 1.8A. Planned actions for specific trails are outlined in the Recreation Plan section (below).

Management Strategies and Actions:
- Maintain species and ecological functions throughout the Natural Area.
- Allow the majority of this area to develop passively.
- The importance of concentrating impact to established trails will be more clearly relayed to the public through onsite signage. Within the sensitive high elevation areas in the Natural Area passive strategies for delineating hiking trail tread to protect nearby sensitive vegetation will be established and maintained.
- Maintain the existing recreation infrastructure so that it has a minimal impact on natural resources.
- Evaluate social trails and determine strategies for closure or formal management.
- Continue to prohibit primitive camping.
- Strengthen protection and education efforts focused on maintaining the health of the alpine zone.
- Monitor for unauthorized cutting of trees and shrubs for the purpose of backcountry skiing.
- Evaluate new recreation developments for consistency with FPR Natural Area policy.

HSM 1.8B - Moss Glen Falls Natural Area (81 acres)
Moss Glen Falls is a spectacular natural landmark in Stowe. According to a state-commissioned study, the falls are the “highest undammed cascade in the state of Vermont.” Because of these exceptional qualities, on May 27, 1983, Moss Glen Falls were declared a State Natural Area by Governor Richard Snelling. This approval was for the statutory purposes set out in **10 V.S.A. ss2607. Natural areas; designation**. The primary purpose of the designation is to protect the waterfall and adjacent lands; its secondary purpose is to allow public enjoyment of the Falls through compatible recreational activities.

The following is a list of management strategies and actions that will be generally implemented throughout HSM 1.8B. Specific plans for recreation trails are outlined in the Recreation Plan section (below).

Management Strategies and Actions:
- Protect the Moss Glen waterfalls and the adjacent lands.
- Maintain species and ecological functions.
- Allow public access to Moss Glen Falls.
- Maintain the existing recreation infrastructure so that it has a minimal impact on natural resources.
- Monitor for unauthorized uses of the area.
- Continue to prohibit primitive camping.
- Strengthen protection efforts focused on maintaining this area's ecological values.
- Strengthen educational efforts focused on maintaining this area's recreational and ecological values.
- Evaluate management strategies and actions for consistency with FPR Natural Areas policy.

HSM 1.11 - District Designation Highly Sensitive Management Areas (5,822 acres)
These are highly sensitive areas protected because of steep slopes or high elevation (especially 2500+feet), wet soils, other physical limitations, or other "uncommon or outstanding biological, ecological, geological, scenic, cultural, or historic significance where protection of those values is the primary consideration for management."

HSM 1.11A - High Elevation Worcester Range-West (2,302 acres)
This designated area includes the upper slopes along the western side of the WRMU, in the towns of Waterbury, Stowe and a portion in Elmore. Most of this highly sensitive area has very steep slopes, thin soils, and is easily damaged if not carefully protected. HSM 1.11A includes portions of three major hiking trail systems: Hunger Mountain Trail (Waterbury), Stowe Pinnacle Trail (Stowe) and Pinnacle Meadows Trail, also in Stowe.

A small portion (20 acres) of this classification area is under conservation easement with the Stowe Land Trust. This area is labeled as HSA1.11A (CE) on the Land Management Classification Map (Map 38).

HSM 1.11B - High Elevation Worcester Range-East (1,823 acres)
This designated area mainly includes the upper slopes along the eastern side of the WRMU, in the towns of Middlesex, Worcester and a portion in Elmore. Most of this highly sensitive area has very steep slopes, thin soils, and is easily damaged if not carefully protected. HSM 1.11B includes portions of the Middlesex Trail and White Rock Trail, both in Middlesex.

HSM 1.11C - Elmore Mountain High Elevation (304 acres)

This designated area is located entirely in the town of Elmore and includes Elmore Mtn. summit and its high elevation slopes. Most of this highly sensitive area has very steep slopes, thin soils, and is easily damaged if not carefully protected. HSM 1.11C includes portions of the Elmore Fire Tower Trail and the Catamount Trail.

HSM 1.11D – Moss Glen Headwaters (1,207 acres)
All the water features throughout the WRMU are important natural resources and are managed as such. The primary management goal for Moss Glen NA is to protect and preserve the natural features, and the development of old forest in mid to lower elevation areas. Therefore, any management maintaining a healthy watershed and the development of old forest upstream of the Natural Area will be the top priority in this Moss Glen Headwaters area.

Specific plans for recreation trails are outlined in the Recreation Plan section (below).

Management Strategies and Actions:
- Collaborate with SLT and VHCB to meet the requirements of the easement.

HSM 1.11E - Worcester Woods WMA (186 acres)
The entire Worcester Woods WMA functions as a critical wildlife corridor. The wildlife management goals of this parcel are compatible with a goal to increase the development of old forest in mid to lower elevations in the Northern Green Mountains biophysical region. Therefore, the development of old forest will be a top priority in the Worcester Woods WMA.

The following is a list of management strategies and actions that will be generally implemented throughout HSM 1.11A, B, C, D, E. Specific plans for recreation trails are outlined in the Recreation Plan section (below).

Management Strategies and Actions:
- Maintain species and ecological functions.
- Allow for passive old forest development to support VCD targets in the Northern Green Mountain biophysical region.
- Maintain the existing recreation infrastructure so that it has a minimal impact on natural resources.
- Promote the development of a formal trail maintainer program for the Worcester Range.
- Evaluate social trails and determine strategies for closure or formal management.
- Continue to prohibit primitive camping.
- Strengthen protection and education efforts focused on maintaining the health and integrity of the area’s natural communities.
- Monitor for unauthorized cutting of trees and shrubs for the purpose of backcountry skiing.

Special Management (SM)— 4,186 acres

These are areas with unique or special resources where protection and/or enhancement of those resources is an important consideration for management. These areas do not require the same level of protection given to highly sensitive areas and may be intensively managed for specific purposes. Recreation, timber harvesting, and wildlife habitat management are considered complementary uses within this classification to the extent that they do not negatively impact special features.

Special Management Areas represent approximately 4,186 acres or 22.6% of the 18,498 classified acres. Special Management Areas are located throughout the WRMU and are described below.

SM 2.1 Biological (including aquatic), cultural, and geological resources (1,267 acres)
These are areas with biological, cultural, and/or geological resources that are important but not exemplary as determined by the Nongame and natural heritage program, the State Archaeologist, and the State Geologist.

SM 2.1A - Moss Glen Headwaters (1,263 acres)
All the water features throughout the WRMU are important natural resources and are managed as such. The Moss Glen Headwaters Area is classified as a Special Management area because it drains into Moss Glen Brook, which flows through, and creates the Moss Glen Falls Natural Area (see HS1.8B). The primary management goal for Moss Glen Natural Area is to protect and preserve the natural features and encourage old forest development. Therefore, any management maintaining a healthy watershed upstream of the Natural Area will be the top priority in the Moss Glen Headwaters area.

A portion (246.9 acres) of this classification area is under a conservation easement held by the Stowe Land Trust (SLT) and the Vermont Housing and Conservation Board (VHCB) These areas are labeled as SM2.1A (CE) on the Land Management Classification Map (Map 38).

Specific plans for recreation trails are outlined in the Recreation Plan section (below).

Management Strategies and Actions:

- Collaborate with SLT and VHCB to meet the requirements of the easement.
- Incorporate active and passive management for old forest characteristics in mid-elevation areas of Red Spruce-Northern Hardwood Forest, Rich Northern Hardwood Forest, Hemlock Forest, and Lowland-Spruce-Fir Forest natural communities.
- Implement Timber Harvest #3 as outlined in Timber Management Goals section.

SM 2.1B - Elmore CCC Camp (4 acres)

This area delineates the location of the 1930's and 1940's work camp that housed Civilian Conservation Corps Company #1209 that worked on infrastructure projects in the Park. They constructed a bathhouse, picnic area, the Elmore Mountain fire tower and caretaker's cabin.

Management Strategies and Actions:

- Collaborate with the Department of Historic Preservation (DHP) to protect the historic and cultural resources at this location.

SM 2.1C - Elmore Fire Tower (<0.1 acres)

This structure was built by the Civilian Conservation Corps Company in the 1940s.

Management Strategies and Actions:

- Collaborate with the Department of Historic Preservation to protect this resource.
- Restore the structure through the upcoming State Lands fire Tower Safety Improvements and Repairs Project.
- Continue on-going maintenance as needed.

SM 2.2 Critical plant and wildlife habitat (2,044 acres)

These are areas with critical plant and wildlife habitat. These include important bear feeding and foraging areas, wildlife travel corridors for black bears, bobcat, herps, deer wintering areas, migratory bird habitat, wetlands, fisheries, presence of edge of range species, and mast stands.

SM 2.2A - Wetlands (367 acres)

A portion (13.3 acres) of this classification area is under a conservation easement held by the Stowe Land Trust and the Vermont Housing and Conservation Board. These areas are labeled as SM2.2A (CE) on the Land Management Classification Maps (Map 36).

Management Strategies and Actions:

- Protect wetland function and value, including wetland habitat, hydrologic regimes, and soil development, through the application of *VTANR's Riparian Management Guidelines* and passive management.
- Control invasive species spread and introduction where feasible.
- Collaborate with SLT and VHCB to meet the requirements of the easement in SM2.2A (CE).

SM 2.2B - Deer Wintering Areas (511 acres)

A portion (23.6 acres) of this classification area is under a conservation easement held by the Stowe Land Trust and the Vermont Housing and Conservation Board. These areas are labeled as SM2.2B (CE) on the Land Management Classification Maps.

Management Strategies and Actions:

- Discourage new trail development that would lead to increased use during the winter unless new trail reduces impact from existing or unregulated use.
- Explore opportunities to relocate existing winter trails to avoid deer wintering areas.
- Implement Timber Harvest #2 as outlined in Vegetation Management Goals section.
- Within deer wintering areas (DWA) that are scheduled for treatment, comply with *Management Guide for Deer Wintering Areas in Vermont*.

SM 2.2C - Wildlife corridors (510 acres)

The WRMU is a critical landscape-scale habitat linkage, connecting large regional forest blocks. Two identified corridors within the management unit are the Shutesville wildlife corridor and the Rte. 12 corridor.

Management Strategies and Actions:

- Ensure that management actions promote these areas wildlife corridor functions.
- Explore opportunities and collaborative efforts to further protect these resources.
- Collaborate with VHCB to meet all the requirements of this conservation easement (Rt 12 corridor).
- Maintain the short access road on the Rt 12 corridor side to DFPR standards. This includes ditching, grading and gravelling, mowing, hazard tree removal, and regular maintenance and improvement of drainage structures.
- This short road provides access to the parcel and to a landing/parking area. See discussion of this landing/parking area in section 4.4A.

SM 2.2D- Fields (31 acres)

Old fields and maintained openings provide valuable landscape diversity and critical habitats for certain early successional wildlife species. These are predominantly located near existing roads and at lower elevations. There are five separate fields located within the WRMU: Middlesex Block Field, Worcester Orchard, Brownsville Field #1 and #2, and Pinnacle Meadows field.

A portion (19.1 acres) of this classification area have conservation easements. The SLT and the VHCB hold easements on 16.9 of these acres (Brownsville Field #1 and #2). SLT holds an additional easement on the 2.2-acre Pinnacle Meadows field. All of these field areas are labeled as SM2.2A (CE) on the Land Management Classification Maps.

Management Actions:

- Maintain fields by mowing on approximately a 3-year cycle. The Pinnacle Meadows field is a designated emergency helicopter landing site and may need to be mowed more frequently.
- Delay mowing of maintained fields until after August 15th to provide habitat for birds, as well as wildflowers that support bees and other pollinator species.

- Release and prune apple trees, in and around fields, to increase health, vigor and overall soft mast production.
- Cut trees, as necessary, to maintain field edges.
- Maintain and improve access to each field for management purposes.

SM 2.2E - Mast areas and bobcat habitat (625 acres)
This LMC classification makes up the Middlesex Notch Wildlife Management Area.

Management Actions:
- Maintain and enhance the oak component, and the component of other mast trees, through on-going crop tree release treatments as time and resources allow.
- Discourage new trail development in these sensitive habitats.
- Explore opportunities to gain additional access to the property for future wildlife habitat management projects.
- Evaluate potential for vegetation management to achieve increased ecological function through the restoration of old forest characteristics where best suited.

SM 2.5 -Special Protection Areas (575 acres)
These are areas that are designated for protection by deed restrictions or conservation easements.

SM 2.5A - Pinnacle Meadows Property Conservation Easement Area (117 acres)
This LMC classification is made up of the area encumbered under the Pinnacle Meadows Conservation Easement. Additional acreage is encumbered under this conservation easement and is classified and described elsewhere in this section.

Management Actions:
- Collaborate with the Stowe Land Trust to meet the requirements of the conservation easement.
- Pinnacle Meadows Road (private)
  - Collaborate with neighboring landowners and with the Town of Stowe in maintaining the Pinnacle Meadows Private Road. Explore the possibility of turning the private section of the Pinnacle Meadows Road into a Class 3 Town Road.
- Pinnacle Meadow Road-State Forest Highway (portion of the road above gate)
  - Maintain the short access road to FPR standards. This includes ditching, grading and gravelling, mowing, hazard tree removal, and regular maintenance and improvement of drainage structures.
  - Maintain the gate in a working condition.
  - Communicate with Stowe Rescue if this road is ever closed or made impassable from significant road maintenance projects.
- See *Recreation Section* for trail plans.

SM 2.5B - Brownsville Forest Property Conservation Easement Area (458 acres)

This recent acquisition supports a host of ecological, forest, hydrological, scenic and recreational resources. These lands are encumbered by an easement co-held by the SLT and the VHCB.

Additional acreage is encumbered under this Conservation Easement and is classified and described in other Land management Classification sections. (See LMC Sections: HS2.1A (CE), HS2.2A (CE), HS2.2B (CE), HS2.2D (CE), IM4.4B)

Management Actions:

- Collaborate with SLT and VHCB to meet the requirements of the conservation easement.
- Collaborate with the Town of Stowe in maintaining McCall Pasture Road to accommodate management and public access.
  Implement Timber Harvests #3 and #6.

SM 2.8 - Agricultural Land (88 acres)

The Elmore Sugaring License Area is located on the west side of Elmore SP; this area has been tapped for maple syrup production through a sugaring license (Shannon Sugaring License).

Management Strategies and Actions:

- Arrange license with qualified sugarmakers for use of these lands and in accordance with current Guidelines and Licensing Requirements for Tapping and Collecting Sap from Maple Trees on Department of Forests, Parks and Recreation lands, July 2010 (or equivalent updated standard).

SM 2.9 - Special Recreation Areas (212 acres)

SM2.9A - Perry Hill Special Recreation Area (179 acres)

Located in the western half of the main portion of the Perry Hill Block, this area is managed primarily for its recreational value as a mountain bike trail network during the summer, and for fat biking and snowshoeing during winter months.

SM2.9B - Stowe Pinnacle Special Recreation area (33 acres)

See the *Recreation Plan Section* for details on this location.

General Management (GM) — 4,302 acres

These are areas where the dominant uses are sustainable timber harvesting, wildlife habitat management, concentrated trail networks, dispersed recreation, and other general uses. In these areas, a primary management consideration is minimizing conflict between the activities, as well as with lands categorized as more sensitive where they are adjacent to a general use area. In addition, more sensitive resources that occur within these areas may require special attention.

General Management areas represent approximately 4,302 acres or 23.2% of the 18,498 classified acres.

GM 3.0- General Management (4,302 acres)

The majority of General Management acres within the WRMU are located at lower elevations in the towns of Middlesex and Worcester. This large continuous block makes up 3,220 acres of the total general management classified lands. 557 additional GM acres are located on the west side of the Worcester Range, and approximately 525 acres are located at lower elevation on the east side of Elmore SP.

These areas are not defined by their ecologically sensitive features or important wildlife habitat. However, ecologically significant features and critical wildlife habitat undoubtedly exist in these areas, but at smaller scales. These important, smaller scale features will be identified during management operations (forest, recreation, and wildlife habitat management), and will be appropriately protected.

Management Strategies and Actions:

- Utilize strategies described in the *Vegetation Management section* to increase forest resilience, forest diversity and complexity, while producing sustainable forest products.
- Utilize strategies described in the *Wildlife Habitats Management section* to optimize habitat for a variety of general and specific wildlife species.
- Utilize strategies described in the *Recreation Plan section* to optimize recreation opportunities and to minimize conflicts.
- Restore old forest characteristics using active management techniques where suitable.
- Implement Timber Harvests #'s 1,3,4,5,6,7,9,11 & 12 as outlined in the *Timber Management Goals section*.

Intensive Management (IM) — 49 acres

The Intensive Management areas are those places that are easily accessible and characterized by a high level of human activity and high intensity development on or adjacent to state land. Aesthetics and safety are the primary management considerations in these areas. However, more sensitive resources that occur within these areas may require special attention.

Within the WRMU there are approximately 49 acres in the Intensive Management classification. This area represents 0.3% of the 18,498 classified acres.

IM 4.2 – Elmore State Park (41 acres)

Management Goals:

- Protect the natural and historic resources while providing high quality recreational opportunities and experiences, including both terrestrial and aquatic resources.
- Provide safe recreational facilities.
- Provide recreational facilities to meet current and future needs.
- Provide educational facilities and opportunities.

Elmore State Park had its beginning in 1936 when the town of Elmore and local citizens made a gift of 30 acres on Lake Elmore to the state of Vermont. Construction of Elmore State Park was started by the Civilian Conservation Corps (CCC) in 1933 and was mostly completed by 1936. The main attraction of the park is Lake Elmore, a 219-acre waterbody which park activities are centered on. Access to the park is gained from VT Route 12 and is located approximately 5 miles southeast of Morrisville. The parcel is almost completely forested except for areas in and around the park itself.

Park Amenities include 45 campsites and 15 lean-tos. Full restroom facilities with showers are available. There is a swimming beach with beach house, concessions, changing rooms and boat rentals. A picnic shelter is available for large day use gatherings. On the southern end of the lake, outside of the managed area, is a Fish and Wildlife Department boat launch, which is open to the public. There is no fee for use of this boat launch, and it is open for use even if the park is closed.

Management Strategies and Actions:

- Improve and update existing facilities to meet current regulatory codes and public demands.
- Convert some sites into cabins or lean-tos if demand warrants it.
- Protect historical and cultural features within the park.
- Maintain the existing park roads and trails.
- Develop additional educational and interpretative materials and information on the natural and cultural history of the area.
    - Monitor and control invasive plant species while promoting native plant cover.
    - Stabilize shoreline as feasible.

IM 4.4 – Trailhead Parking Areas (8 acres)

There are ten trailhead parking areas spread across the WRMU. Management actions for each individual site are described below.

Management Strategies and Actions (across all trailheads):

- Continue to maintain and upgrade parking areas. Such maintenance will include periodic shaping, grading and graveling the parking area. Maintenance will also include managing the surrounding vegetation through pruning, brushing and hazard tree removal.
- Evaluate the capacity of parking areas and respond accordingly to growing need. ANR is committed to providing public access to the WRMU and recognizes that decisions to expand or limit parking are driven not only by the carrying capacity of a parking area or associated infrastructure, but also the social and ecological carrying capacity of the trail network, and by the nearby community.
- Consider options for improved human and pet waste management at all trailheads.
- Continue to maintain trailhead kiosk structures and their outreach materials.

- Consider installing additional kiosks as is deemed appropriate.
- Evaluate the capacity of trailheads and parking areas and respond accordingly to growing need. Full parking areas can lead to unsafe parking situations or to general resource congestion. ANR is exploring solutions to alleviate these problems and will continue to engage with town officials to identify possibilities. ANR is committed to providing public access to the WRMU.

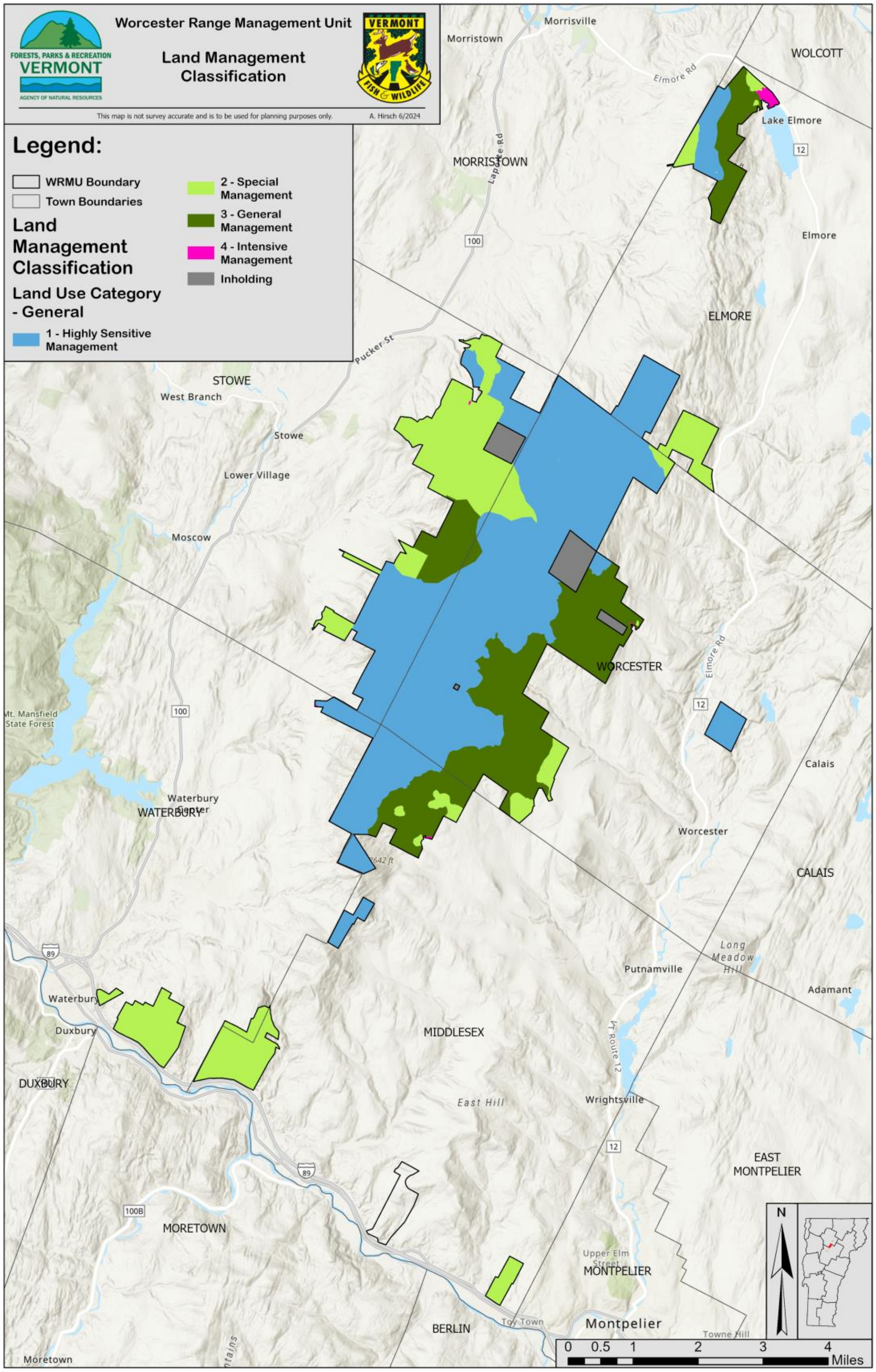
IM 4.4A—Trailheads and Parking Areas (existing) (7 acres)
Management Strategies and Actions:

- Maintain and regularly improve existing trailheads and parking areas. Periodically, ANR will brush out around parking lots, remove hazard trees, or hire contractors to carry out basic maintenance projects, such as grading, graveling, and ditching.
- Pinnacle Meadows Trailhead -Develop additional parking at to eliminate overflow parking on public roadsides. This should be completed this field season.
- Hunger Mountain Trailhead - Develop additional parking at to eliminate overflow parking on public roadsides.
- Middlesex Trailhead - Develop a more sustainable solution for winter parking that will accommodate increased use.
- Moss Glen Falls—Explore options to increase parking capacity in order to eliminate overflow parking on public roadsides.
- Perry Hill—Collaborate with the Town of Waterbury to ensure that the Perry Hill parking area (located on Town land) is maintained and continues to provide public access.

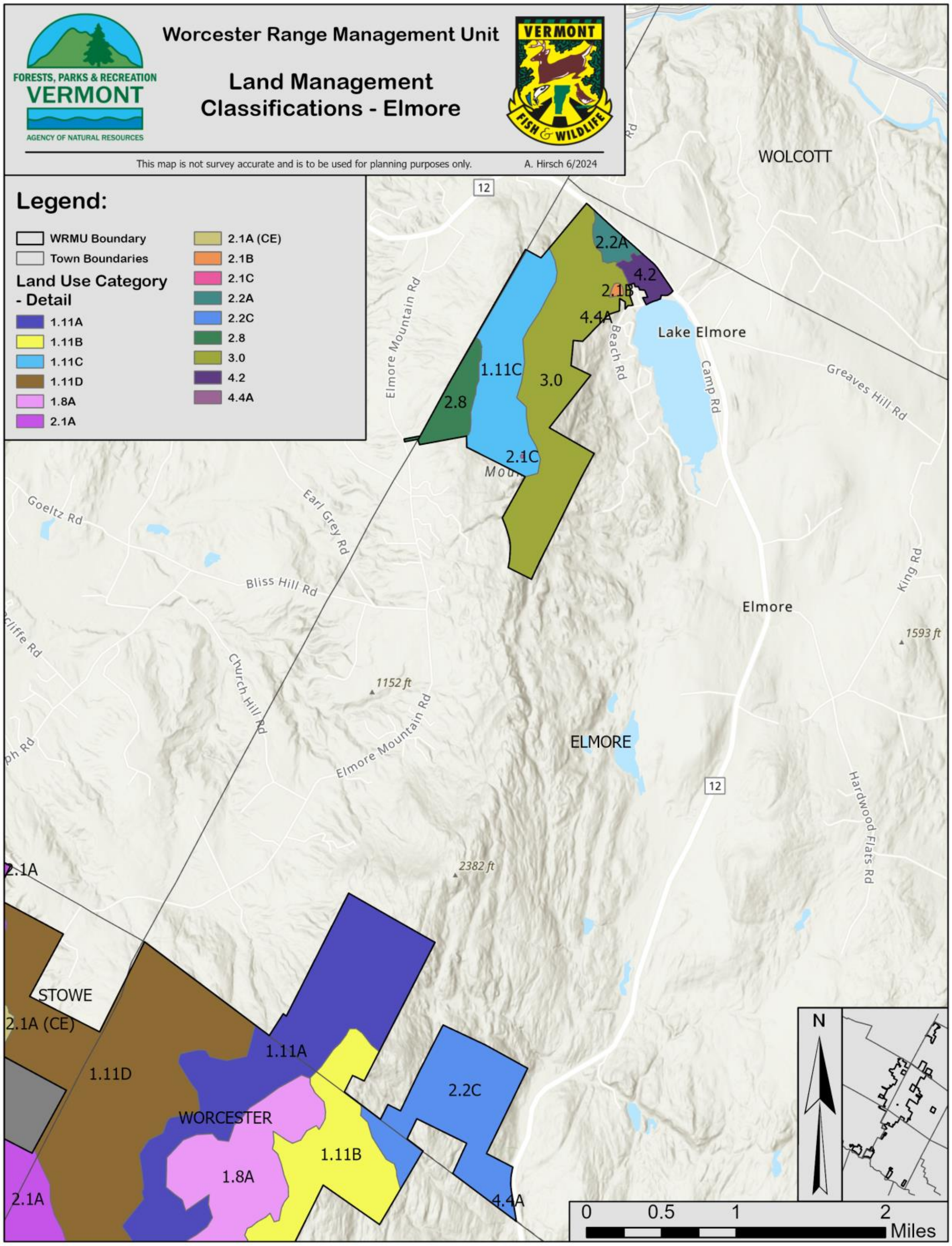
IM 4.4B—Trailheads and Parking Areas (new, planned) (1 acres)
Management Strategies and Actions:

- Brownsville—Install a four-season trailhead parking area that is located near the junction of Brownsville Road and McCall Pasture Road.
- Hults Road—Install a small parking area near the existing gate to improve access.

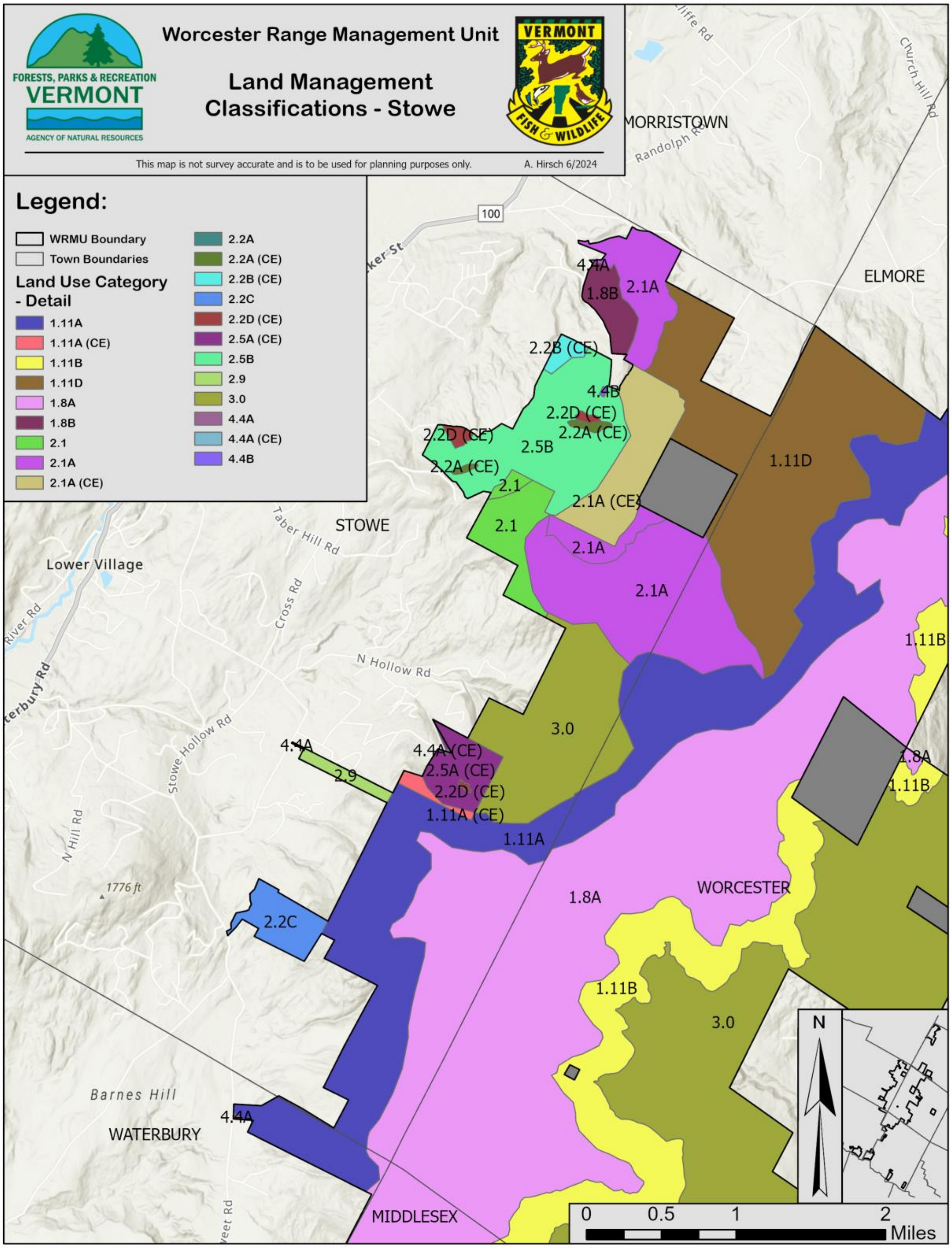
Map 36: Land Management Classification – General overview of the LMC's of WRMU



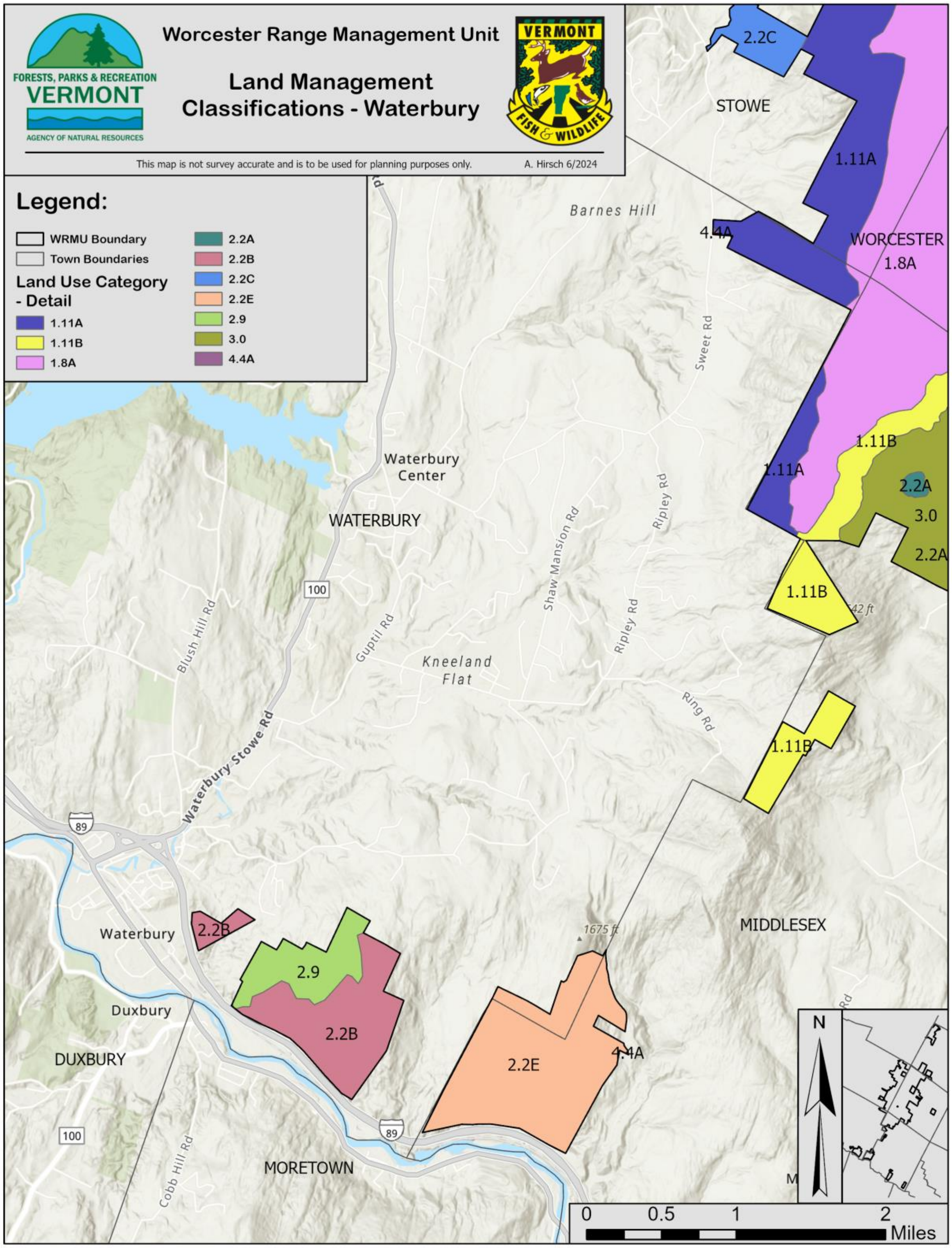
Map 37: Land Management Classification – Elmore



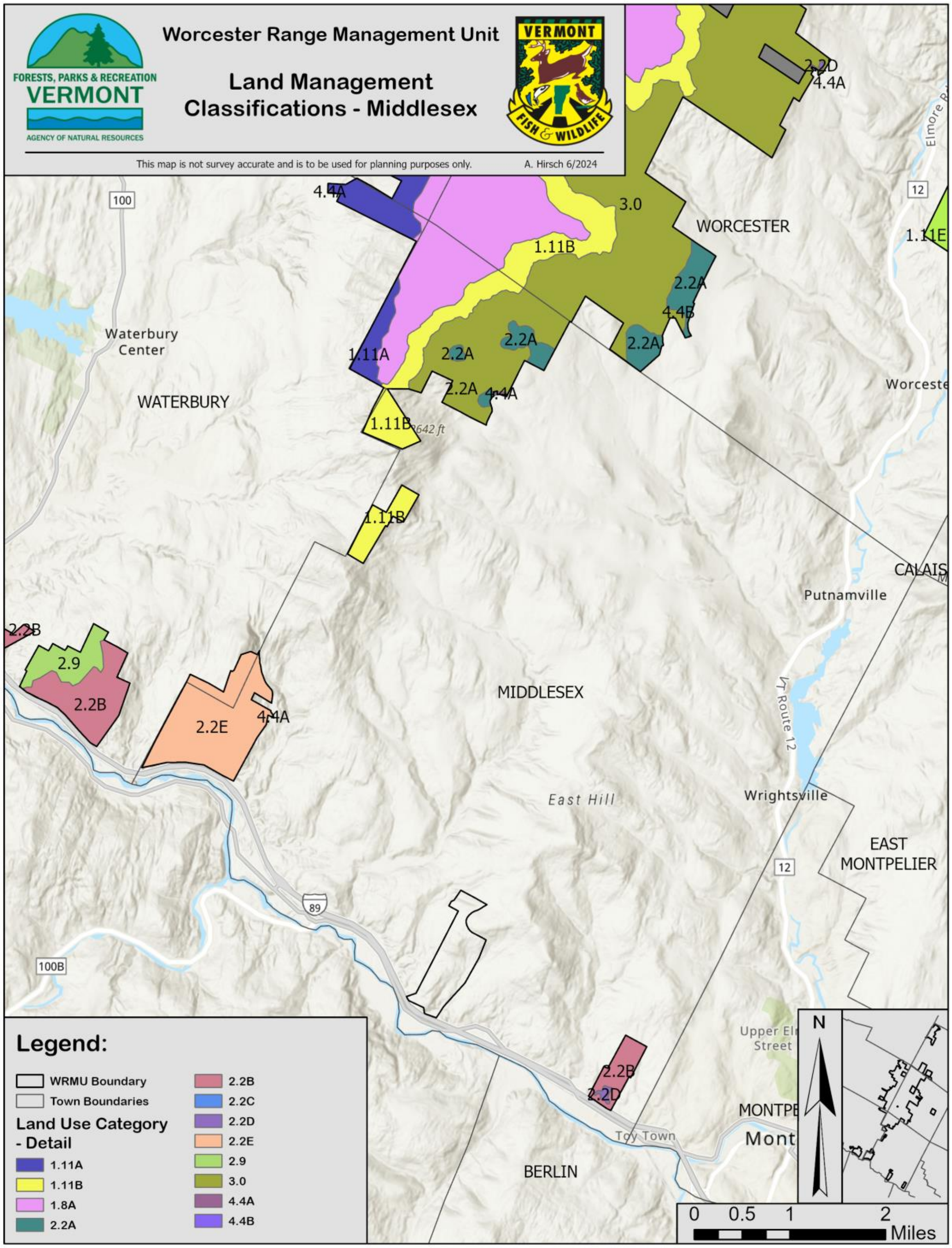
Map 38: Land Management Classification – Stowe



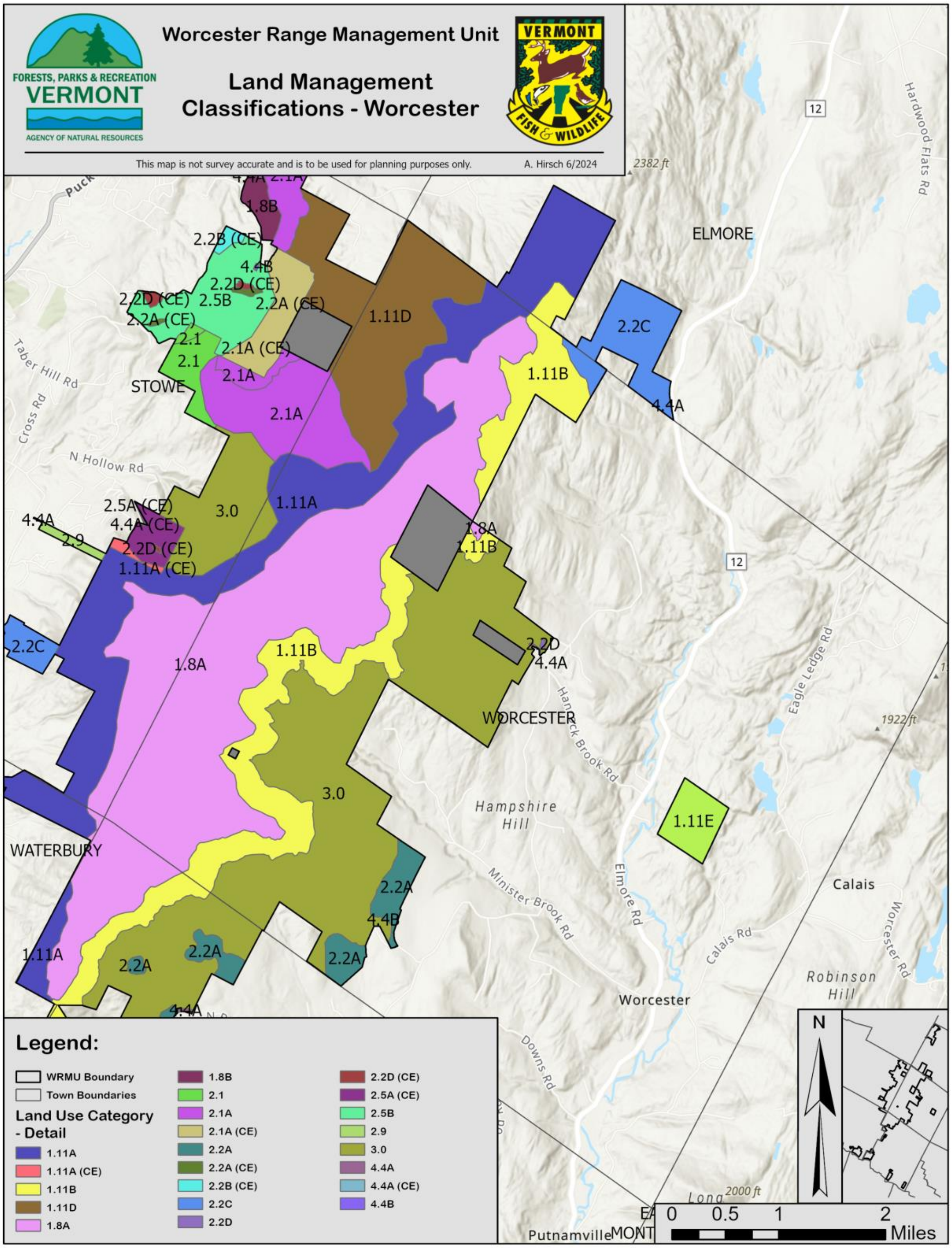
Map 39: Land Management Classification – Waterbury



Map 40: Land Management Classification – Middlesex



Map 41: Land Management Classification – Worcester



E. Site-Specific Forest Management Activities

Forest vegetation management activities occur in two main forms - commercial timber sales, and non-commercial vegetation management activities (e.g., invasive plant control, open land management, apple tree pruning and release, and timber stand improvement). Within the WRMU there are roughly 8,641 acres available, accessible, and appropriate for commercial vegetation management activities. Approximately 2,250 of these acres were unavailable to the state to conduct forest management activities prior to the acquisitions of the Brownsville Forest Property in 2019 (758 acres) and the Patterson Brook Headwaters Tract in 2020 (1877 acres), due to being inaccessible or in non-state ownership. With these two acquisitions, a total of 875 acres of existing state land that had previously been inaccessible for timber management became accessible. Of these 875 acres, 440 acres are scheduled for forest management activities in this LRMP.

The majority of the planned timber management actions in this LRMP are commercial vegetation management activities. Over the next twenty years, 12 commercial timber harvests are scheduled to occur throughout the WRMU. In total, treatments will occur across a total of 1,928 acres, or approximately 10.3% of the total forested area within the WRMU. These treatments range in size from 74 acres to 298 acres, with the average treatment size of 161 acres. Many of the larger timber harvests will take two seasons to complete. Most of the timber harvests on the WRMU will be conducted in the winter months to reduce impacts to the site and protect existing regeneration. However, summer logging may be suitable in some instances when ground conditions allow, or soil scarification is required to meet harvest objectives.

Areas identified for treatment in this LRMP will receive additional review and inventory. A detailed review of special wildlife habitat (e.g., habitat for rare, threatened, or endangered species), significant natural communities, important historic or cultural sites, and sensitive natural features (e.g., streams, steep slopes, wetlands, etc.) will be conducted on each treatment area. A more detailed pre-sale inventory will also be conducted on each treatment area to gather data and information related to forest health, species composition, stand age, forest structure, soil characteristics, wildlife habitat, and information on forest product quality, value, and distribution.

These reviews and inventories will be used to develop silvicultural prescriptions for each treatment area consistent with the management goals for the WRMU. Silvicultural prescriptions are written by State Lands Foresters with input and collaboration from other District Stewardship Team members, and then reviewed by Stewardship Foresters. Current silvicultural guides are referenced to formulate appropriate strategies for treatment. A variety of silvicultural treatments will be utilized depending on the results of the information gathered and an evaluation of opportunities for demonstration projects.

See Table 33 for an implementation schedule of vegetative management on the WRMU. The “Management” column represents a preliminary determination of the type of silvicultural treatment that will be utilized on a given sale. The treatment type will be further refined after completing the pre-sale forest inventory referenced above. Treatment schedules need to be flexible to account for unforeseen circumstances. Examples of this include extreme weather, road washouts, disease or insect infestations, and poor conditions for logging such as extended wet periods or lack of cold weather and/or inadequate snow cover or frozen ground.

Table 33: Commercial Vegetation Management Schedule (2025-2045)

Treatment #	Schedule	Acres	ANR Unit	Forest Type	Management	Primary Management Objective(s)	Secondary Management Objective(s)
#1	2025	298	C.C. Putnam State Forest	Sugar Maple-Beech-Yellow Birch Red Spruce-Sugar Maple-Beech	Uneven-Aged	Begin conversion from even aged stand condition to multi aged stand condition.	Release established desirable regeneration. Retain and recruit standing and down woody debris. Improve species composition. Increase tree vigor. Improve vertical and horizontal structure within existing stands. Improve species composition of both hardwood and softwood species.
#2	2027	117	C.C. Putnam State Forest	Hemlock-Yellow Birch	Uneven-Aged	Maintain, enhance and improve Deer Wintering Habitat	Improve vertical and horizontal structure within existing stands. Create young forest habitat by softening existing field edge. Manage against non-native plants. Retain and recruit standing and down wood debris. Promote intermediate species like yellow birch.
#10	2041	138	C.C. Putnam State Forest	Sugar Maple-Beech-Yellow Birch;	Uneven-Aged	Improve old forest characteristics using active	Improve vertical and horizontal structure within existing stands. Manage against non-native plants.

				Hemlock-Yellow Birch		management techniques	Retain and recruit standing and down woody debris. Consider ROS when designing timber sales to protect the target recreational experience on the Brownsville trails.
#4	2031	160	C.C. Putnam State Forest	Sugar Maple-Beech-Yellow Birch	Uneven-Aged	Begin conversion from even aged stand condition to multi aged stand condition.	Improve vertical and horizontal structure within existing stands. Improve songbird habitat using Foresters for the Birds techniques. Improve tree quality. Retain and recruit standing and down woody debris. Improve species composition of both hardwood and softwood species.
#8	2038	157	C.C. Putnam State Forest	Sugar Maple-Beech-Yellow Birch	Uneven-Aged	Begin conversion from even aged stand condition to multi aged stand condition.	Improve vertical and horizontal structure within existing stands. Improve songbird habitat using Foresters for the Birds techniques. Improve tree quality. Retain and recruit standing and down woody debris. Improve species composition of both hardwood and softwood species.

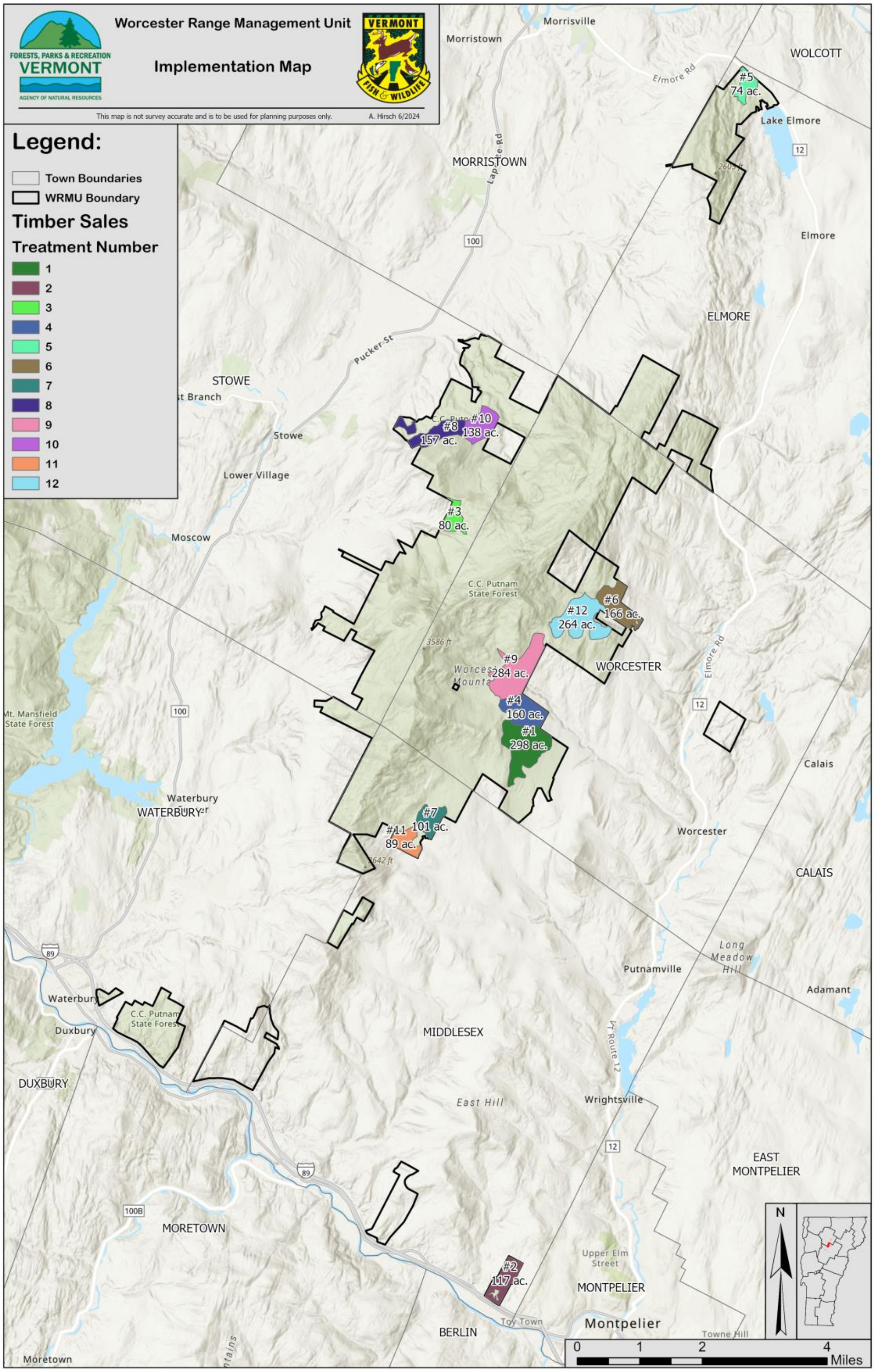
							Provide forest management outreach and education. Consider ROS when designing timber sales to protect the target recreational experience on the Brownsville trails.
#6	2035	166	C.C. Putnam State Forest	Red Spruce-Sugar Maple-Beech	Uneven-Aged	Begin conversion from even aged stand condition to multi aged stand condition.	Demonstrate exemplary forest management to the public. Improve vertical and horizontal structure within existing stands. Improve songbird habitat using Foresters for the Birds techniques. Retain and recruit standing and down woody debris. Improve species composition of both hardwood and softwood species. Improve old forest characteristics using active management techniques. Provide forest management outreach and education. Consider ROS when designing timber sales to protect the target recreational experience on the Worcester Mountain Trail.
#5	2033	74	Elmore SP	Paper Birch	Uneven-Aged	Continue conversion from even aged stand condition	Improve vertical and horizontal structure within existing stands.

						to multi aged stand condition within stand 730-1-1-4 and continue to manage for early successional habitat in stand 730-1-1-1.	Retain and recruit standing and down woody debris. Improve tree quality. Improve species composition of both hardwood and softwood species.
#12	2045	264	C.C. Putnam State Forest	Sugar Maple-Beech-Yellow Birch	Uneven-Aged	Begin conversion from even aged stand condition to multi aged stand condition.	Improve vertical and horizontal structure within existing stands. Retain and recruit standing and down woody debris. Improve tree quality. Improve species composition of both hardwood and softwood species. Improve old forest characteristics using active management techniques. Consider ROS when designing timber sales to protect the target recreational experience on the Elmore Mountain Trail.
#9	2039	284	C.C. Putnam State Forest	Sugar Maple-Beech-Yellow Birch	Uneven-Aged	TBD	Improve vertical and horizontal structure within existing stands.

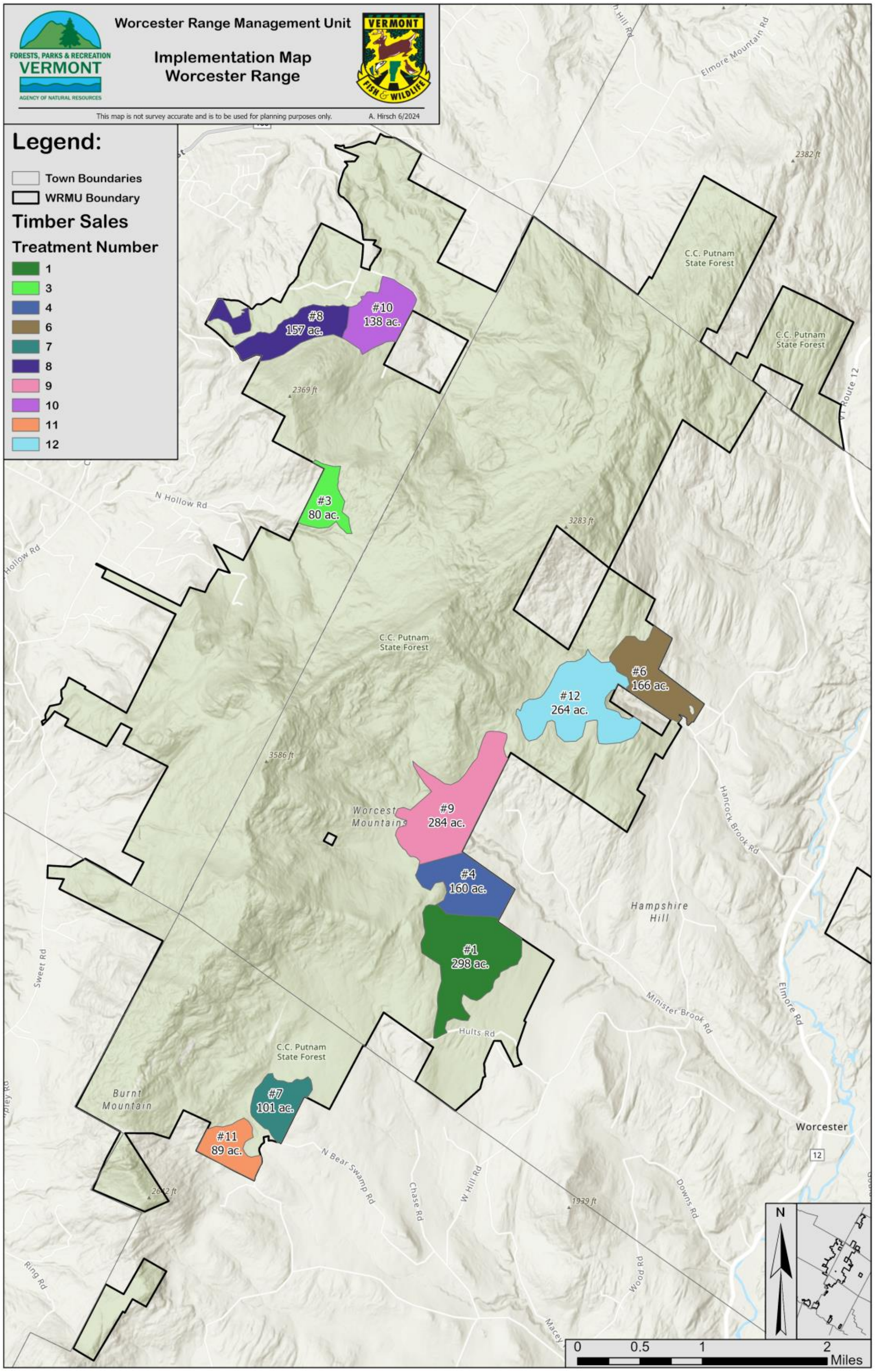
							Retain and recruit standing and down woody debris. Improve tree quality and vigor. Improve species composition of both hardwood and softwood species. Improve old forest characteristics using active management techniques.
#3	2029	80	C.C. Putnam State Forest	Sugar Maple-Beech-Yellow Birch	Uneven-Aged	Continue uneven-aged management	Improve vertical and horizontal structure within existing stands. Retain and recruit standing and down woody debris. Improve tree quality. Improve species composition of both hardwood and softwood species. Improve old forest characteristics using active management techniques. Consider ROS when designing timber sales to protect the target recreational experience on the VAST trail.
#7	2035	101	C.C. Putnam State Forest	Sugar Maple-Beech-Yellow Birch	Uneven-Aged	Begin conversion from even aged stand condition to multi aged	Promote exemplary forest management to the public. Improve vertical and horizontal structure within existing stands.

						stand condition.	Retain and recruit standing and down woody debris. Improve tree quality. Improve species composition of both hardwood and softwood species. Improve old forest characteristics using active management techniques. Provide forest management outreach and education. Consider ROS when designing timber sales to protect the target recreational experience on the Middlesex Trail.
#11	2043	89	C.C. Putnam State Forest	Sugar Maple-Beech-Yellow Birch; Red Spruce, Sugar Maple, Beech	Uneven-Aged	Continue uneven-aged management	Release softwood regeneration. Improve vertical and horizontal structure within existing stands. Retain and recruit standing and down woody debris. Improve tree quality. Improve old forest characteristics using active management techniques. Consider ROS when designing timber sales to protect the target recreational experience on the Middlesex Trail.

Map 42: Timber Harvest Implementation

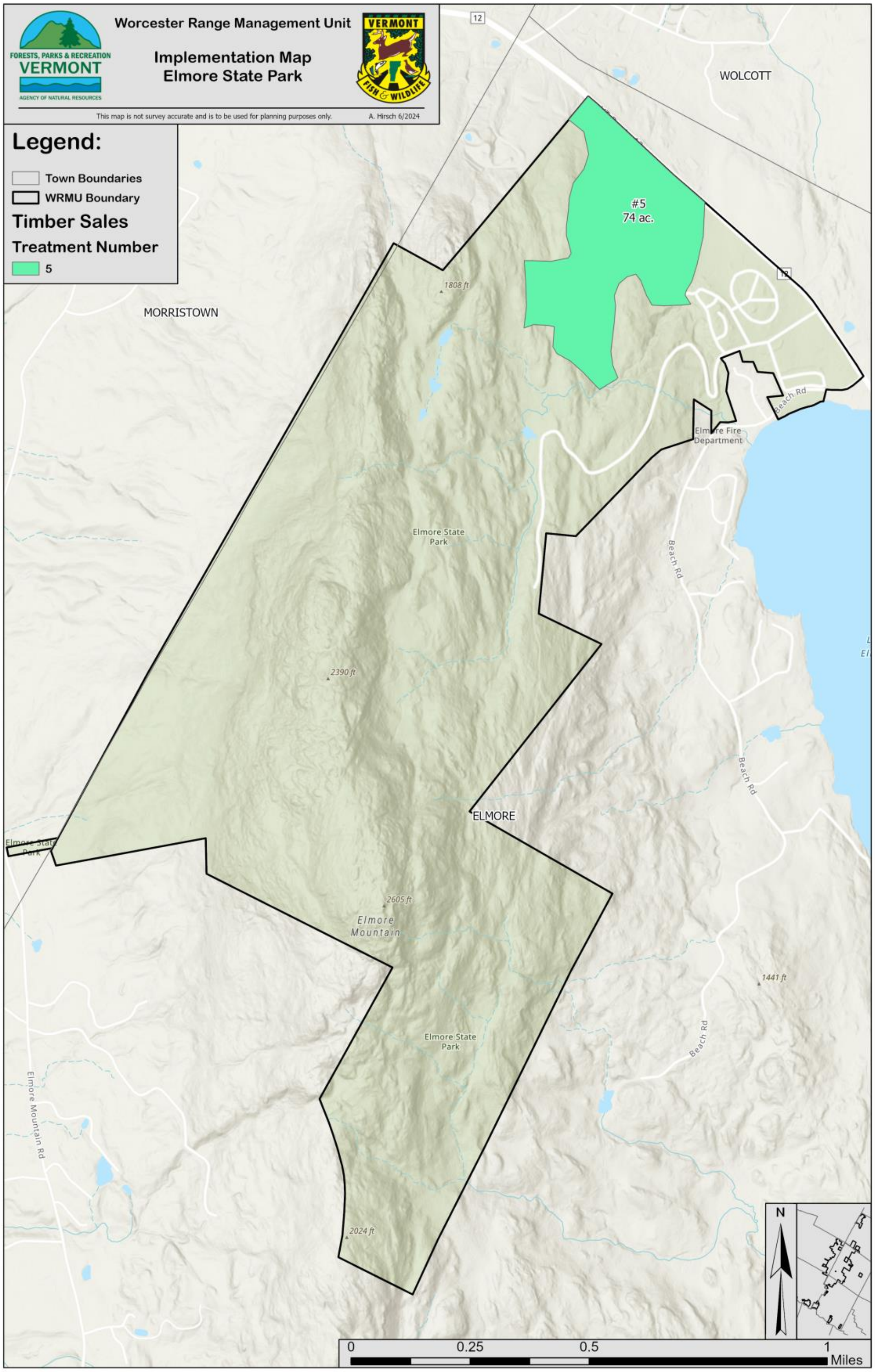


Map 43: Timber Harvest Implementation – Worcester Range



Map 44: Timber Harvest Implementation – Middlesex Block

Map 45: Timber Harvest Implementation – Elmore State Park



F. Site-Specific Recreation Management Actions

This section divides the WRMU into six Recreation Areas and lists the associated management actions for each site. Because recreation infrastructure is generally linear, it often spans multiple Land Management Classifications (LMCs). The LMCs associated with each feature are listed parenthetically. Unless otherwise noted the following goals apply:

- There are no plans for additional trails within the Recreation Areas, but additional trails can be considered by interested partners submitting proposals to the Barre District Stewardship Team. Proposals will be evaluated for compatibility with the management goals of the property. If endorsed proposals are not consistent with the management goals, it could trigger the need for an amendment to the WRMU LRMP.
- A balanced approach will be taken with recreation management and ecological and wildlife resources.
- FPR plans to continue to maintain the current recreation infrastructure.
- FPR is open to working with partners and volunteer trail maintainers to support management goals.

Recreation Area 1: Elmore State Park

Elmore State Park offers many recreational pursuits to visitors, including camping, swimming, and easy access to hiking trails. Trails can be accessed directly from the State Park, or from a trailhead further up Elmore Mountain Road. The trail network consists of the Elmore Fire Tower Trail (LMCs: GM3.0, HSM1.11C), Ridgeline Trail (GM3.0, HSM1.11C), and the Mountain Brook Nature Trail (GM3.0). A popular hike seeing upwards of 8,000 visits during peak use months brings people to the Fire Tower at elevation 2,615 ft. The Catamount Trail (GM3.0, HSM1.11C) utilizes the Fire Tower Access Road, and the Vermont Association of Snow Travelers (VAST) Trail skirts the eastern part of the parcel adjacent to Rte. 12 (GM3.0).

Management Actions:

- Continue to support the management and maintenance of the VAST and Catamount Trails by working collaboratively with the partner groups. There are no plans to expand the trail network during this management cycle.
- A mat will be added at Elmore Beach which will allow for accessible access to the water during the periods of the year when the park is managed for public use (LMC: 4.2).

Recreation Area 2: Worcester Range (West)

The western side of the Worcester Range sees higher use than the eastern side and suffers from a commensurate user impact, most visible as widening trail tread, erosion, and overflowing trailhead parking areas. Usage data collected in 2017 shows an average daily total at Stowe Pinnacle of 69 users. During the same period the Middlesex Trail saw an average daily total of 9 users. The drastic difference in use can be attributed to proximity to population centers and the differences in the degree of promotion that occurs from area businesses and on-line resources.

On the north end of the west side of the range, the Stowe Pinnacle Trail (LMCs: IM4.4A, SM2.9, HS1.11A, HS1.8A) and Pinnacle Meadows Trail (SM2.5A(CE), HS1.11A(CE), HS1.11A) provide access to Stowe Pinnacle and the Hogback Trail (HS1.8A) which leads to the Skyline Trail (HS1.8A). To the south the Waterbury Trail (HS1.11A, HS1.8A) climbs to the top of Hunger Mountain and provides access to the Skyline Trail.

Stowe Pinnacle Mountain

Two trailheads service Stowe Pinnacle Mountain, one located on Upper Hollow Road called the Stowe Pinnacle Trailhead and the other located at the end of Pinnacle Meadows Road called the Pinnacle Meadows Trailhead. Combined these two trailhead parking areas provide parking for 23 vehicles. Based on usage observations made between 2014-2018 it is estimated that on peak-use days the demand for parking can exceed what is available by over 60 vehicles. Most of the overflow parking occurs at the Stowe Pinnacle Trailhead and leads to trail users parking along Upper Hollow Road once the managed parking area is filled. It has been observed that most trail users accessing Stowe Pinnacle use the Stowe Pinnacle Trailhead. The Stowe Pinnacle Trail is primarily a fall-line trail, unable to attain sustainable grades through contoured switchbacks due to the tight confines of the State Lands boundary that connects the trailhead to the more sprawling body of the CC Putnam State Forest. The combination of steep grades and high use had led to a large degree of trail impacts along this trail.

The Pinnacle Meadows parcel was secured by the SLT and transferred to FPR in 2002. One of the goals of the acquisition was to provide additional parking and an alternative access route to Stowe Pinnacle. The Pinnacle Meadows Trail follows a forestry road to a meadow with a vista of the Mt. Mansfield Range, then follows a contour and joins the Stowe Pinnacle Trail. The high degree of use has caused significant social trails to develop causing concerns of both resource development and user safety.

Management Actions:

- Create a sustainable loop trail system incorporating access to Stowe Pinnacle Mountain emanating from the Pinnacle Meadows Trailhead to dissipate use (LMCs: HS1.8A, HS1.11A, HS1.11A(CE), SM2.5A(CE), SM2.9, IM4.4A).
- Develop additional parking to eliminate overflow parking on public roadsides (LMCs: IM4.4A).

Mount Hunger

On the west side of the Worcester Range, access to the ridgeline from the southern extent is managed by the Waterbury Trail which leads to the top of Mount Hunger. The trailhead is located off Sweet Road and has a capacity of 14 vehicles. Based on observations made between 2015-2018 it is estimated that during periods of peak use there can be over 30 additional vehicles parking along the shoulder of Sweet Road. The average daily total for trail users at this location is 24 based on usage data acquired in 2016.

Management Actions:

- Develop additional parking to eliminate overflow parking on public roadsides (LMC: HM4.4A).

Concerns and Unauthorized Uses

On the west side of the Worcester Range FPR has documented a growing network of social trails, some very substantial in their extent. Backcountry skiing has also been growing in popularity in this section of the CC Putnam State Forest. There has been an observed increase in illegal cutting in this section of the forest. Most social trails emanate from the Pinnacle Meadows and Water Works areas. The Water Works parcel is owned and managed by the Edward Farrar Utility District (EFUD) for its public water supply values and is available for dispersed pedestrian recreation. The trail system that has developed on this parcel over the years is currently not authorized at the time of the development of this document.

Management Actions:

- Evaluate social trails and determine strategies for closure or formal management. (LMCs: 1.8A, 1.11A, 1.11B)
- Evaluate the impacts of the unauthorized cutting associated with backcountry skiing. (LMCs: 1.8A, 1.11A, 1.11B)
- If backcountry skiing is found to be compatible with management goals, seek to develop a partnership with the CTA or similar partner group to consider formal management of backcountry skiing. (LMCs: 1.8A, 1.11A, 1.11B)

Recreation Area 3: Worcester Range (East)

There are two primary accesses to the Worcester Range ridgeline from the east side of the range. To the north there is the Worcester Trail located off Mountain Road in the town of Worcester and to the south the Middlesex Trail located off Bear Swamp Road in the town of Middlesex. The Skyline Trail, which follows the ridge of the range connecting Mount Hunger and Worcester Mountain, and the White Rock and Bob Kemp Trails, which form a loop associated with the peak of Hunger Mountain, will be included in the eastern side of the range because use levels closest resemble those associated with the Worcester and Middlesex Trails.

Middlesex, White Rock, and Bob Kemp Trails

With the recently acquired Patterson Brook parcel FPR now has full ownership and management responsibilities for the forestry road that serves as the first section of the Middlesex Trail. There are currently two trailhead parking areas associated with this access. The historic parking area can hold 11 vehicles and the recently installed overflow parking area at the entrance to the forestry road can accommodate 10 additional vehicles. In the winter the section of North Bear Swamp Road where the trailhead parking areas are located does not get plowed and has been blocked from use during the winter months through the end of mud season to reduce road impacts. During this period the town of Middlesex and the adjoining landowner keep an area available for winter use parking. Increased pressure for access during this period will likely require a plan to be developed for managed winter parking on State Land.

Management Actions:

- Develop a more sustainable solution for winter parking to accommodate increased use during this season. (LMCs: 4.4A, 1.11A)

Worcester and Skyline Trails

The Worcester Trailhead parking area was improved in 2020 to accommodate parking for 12 vehicles. Based on increased winter demand for access, FPR has begun having this access and parking area plowed in the winter.

The Skyline Trail was designed and installed in the late 1980's to early 1990's and provides a unique remote ridgeline experience. Work has been done along this trail to install puncheon in wet and muddy locations using lumber milled on site.

Management Actions:

- Continue to manage wet and muddy locations on the Skyline Trail using milled lumber to keep the trail from widening and reducing the development of social trails. (LMC: 1.11B)

Recreation Area 4: Moss Glen Falls

Moss Glen Falls is a popular attraction located in a managed Natural Area. The .25-mile trail travels through a wetland that sees a high amount of beaver activity then ascends a slope to a vista of the falls. This location can see upwards of 8,000 user visits during peak use months. The parking area was improved and slightly expanded in 2020 and has a maximum capacity of 14 vehicles. During times of peak use the location can see overflow parking along the roadside in excess of 30 vehicles. Due to property boundary and wetland constraints the trailhead parking area cannot be further expanded. The site restrictions and demand for access require further planning to determine the feasibility of additional trail and parking.

In 2020 the Vermont Youth Conservation Corps (VYCC) replaced approximately 600 feet of degraded boardwalk and installed metal treadway grating to improve the section of trail that bisects the wetland. Improvements were also made to the tread that climbs the slope to the vista although continued work needs to occur to create a more accessible and sustainable treadway. There are also social trails along the slope leading to the top of the falls. There is an opportunity to explore the installation of a loop trail as well as more sustainable trail alignments.

Management Actions:

- Explore the opportunity to develop a trail realignment for the section of trail that parallels Moss Glen Stream, removing the treadway from the wetland area to higher ground. (LMC: 1.8B)
- Explore the possibility of a loop trail to disperse use. (LMC: 1.8B)
- Consider the future installation of a raised and accessible boardwalk replacing the puncheon as the primary route through the wetland area. (LMC: 1.8B)

- Improve the vista trail by adding stone steps, retainer walls, and railing. (LMC: 1.8B)
- Evaluate social trails and determine strategies for closure or formal management. (LMC: 1.8B)
- Continue to support current partner group, VAST, and any groups or organizations we may form partnerships within the future in managing trail corridors within the Natural Area. (LMC: 1.8B)
- Explore options for additional parking.

Recreation Area 5: Brownsville

In 2019 the Stowe Land Trust acquired the Brownsville parcel and transferred it to the Department of Forests, Parks, and Recreation. Five miles of historic trail were identified for consideration as managed trails available for public use pending our ability to improve them to sustainable standards. In 2020, FPR endorsed 2.5 miles of trail for pedestrian use noting the need to provide trailhead parking area to support public access. In 2020, a three-season parking area was improved on Brownsville Road to support access to the trail network although the location of this trailhead parking area is on a stretch of Brownsville Road that is not maintained in the wintertime. Currently winter parking occurs at the junction of Brownsville Road and McCall Pasture Road and at a snowplow turnaround on the southern end of the unplowed section of Brownsville Road. A four-season parking area is planned for future installation to support access to the trail network. FPR is currently working with the Stowe Trail Partnership (STP) to develop a management agreement that would allow the organization to operate as corridor managers on the parcel. FPR would like to work with STP to improve the remaining 2.5 miles of trail on the Brownsville parcel to sustainable standards and eventually perform the work needed to have the entire network reach mechanized standards.

Management Actions:

- Improve the remaining 2.5 miles of identified recreation corridor to sustainable standards to expand the amount of pedestrian trail on the parcel, bringing the total trail mileage to five miles. (LMCs: 2.1A (CE), 2.2A (CE), 2.2D (CE), 2.5B)
- Install a four-season trailhead parking area to be located near the junction of Brownsville Road and McCall Pasture. (LMCs: 4.4B)
- Achieve mechanized endorsement of the trail network to allow for the use of mountain bikes. Mechanized endorsement will be contingent upon upgrading trails to International Mountain Bike Association standards and by following FPR Policy 4. (LMCs: 2.1A (CE), 2.2A (CE), 2.2D (CE), 2.5B)
- Consider grooming trails within the network to support winter recreation for snowshoeing, cross-country skiing, and potentially fat biking if trails receive mechanized endorsement per FPR Policy 4. It has been determined through an evaluation of previous use, terrain, character of parcel, and parcel objectives, that the trail network on the Brownsville parcel will be limited to 5 miles. Refinements to the network to improve sustainability and reduce impacts will be considered by the Barre District Stewardship Team through the recreation project proposal process. (LMCs: 2.1A (CE), 2.2A (CE), 2.2D (CE), 2.5B)

- The feasibility of a universally accessible trail connecting the three-season parking area on Brownsville Road to the northern meadow and beaver pond overlook will be explored (LMCs: 2.5B).
- As work occurs to achieve mechanized designation every effort will be made to attain accessible mountain bike standards (LMCs: 2.1A (CE), 2.2A (CE), 2.2D (CE), 2.5B).

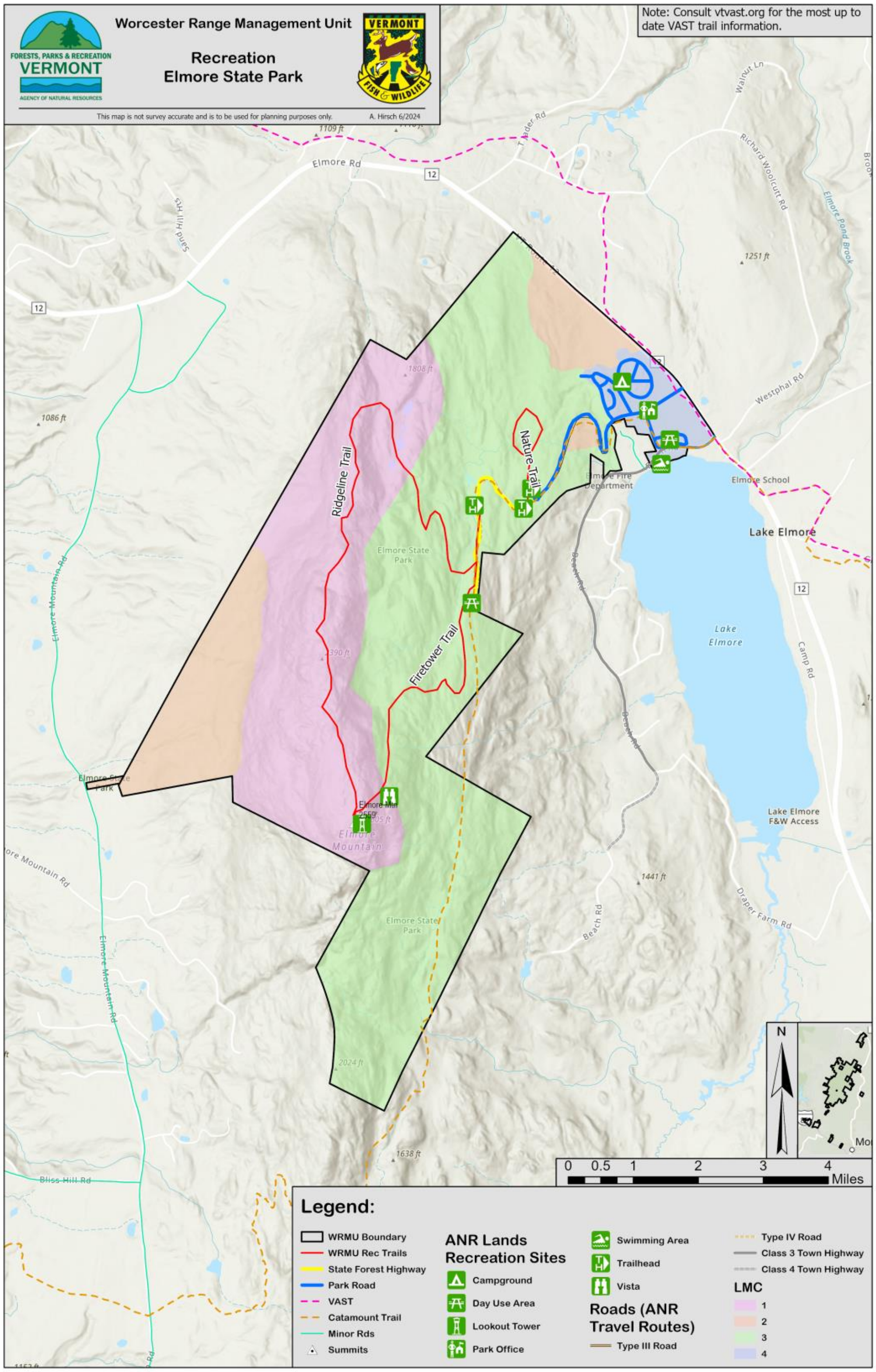
Recreation Area 6: Perry Hill

Perry Hill is a regionally renowned 10-mile network of mountain bike trails that also support pedestrian uses. The network can see over 3,000 user visits during peak use months. The Waterbury Area Trails Alliance (WATA) operates as a corridor manager on the parcel under a cooperative agreement FPR has with the Vermont Mountain Bike Association. A trailhead parking area supporting access to the network is located on Town of Waterbury land. A pilot winter recreation management program was developed and implemented in 2021 and continued in the winter of 2022 with the goal of providing the public with groomed trails while limiting recreation user impacts to the deer wintering area found on the parcel.

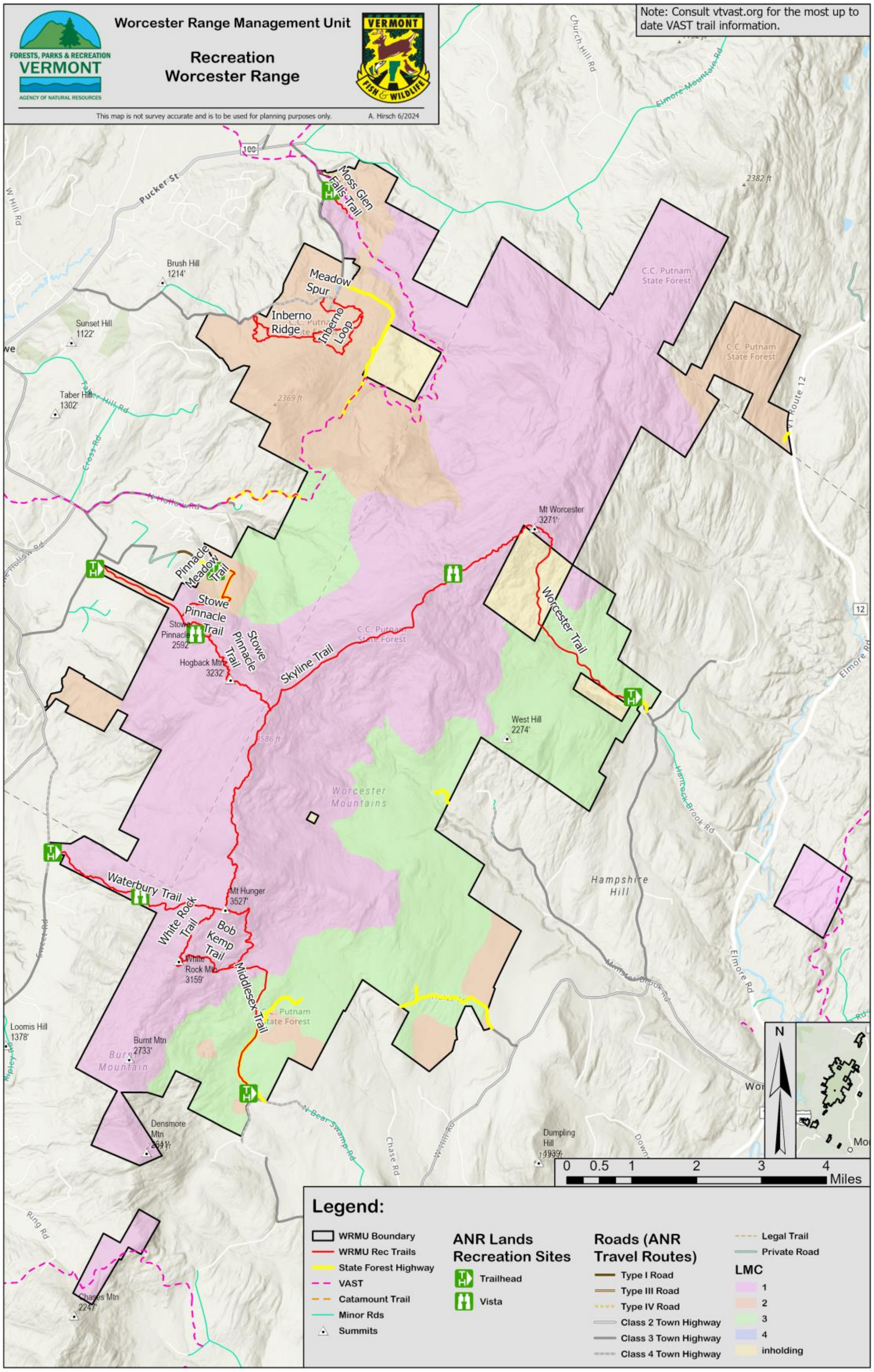
Management Actions:

- Support WATA's efforts as corridor managers through on the ground planning support and supporting grant applications that support endorsed trail network improvements.
- Integrate the pilot winter recreation management plan into standard operating procedures to mitigate impacts to deer wintering area and provide a winter recreation resource to the public (LMCs: 2.9, 2.2B).
- Consider additional trails to the network under the following conditions:
    - Additional trails will provide connectivity to adjoining parcels pending ecological assessments of potential corridors of connectivity and DST review and approval.
    - Additional trail will solve documented issues with user dispersion and/or correct impacts or add to trail network sustainability.
    - Additional trail will be designed to avoid significant ecological impact to sensitive features identified in the ecological assessment.
    - Additional trail will be limited to the section of the parcel that is not mapped by the FWD as deer wintering area or, if it is within the mapped deer wintering area, it is specified as a "summer-season use only trail".
- Support the concept of a multi-use trail to connect Perry Hill trail network to Little River State Park.
- FPR will collaborate with VMBA to assess the Perry Hill network to determine actions that would need to be implemented to attain accessible mountain bike standards. Based on the outcome of the assessment FPR will work with the WATA to determine a strategy to make logical trail modifications to provide accessible mountain biking where possible.

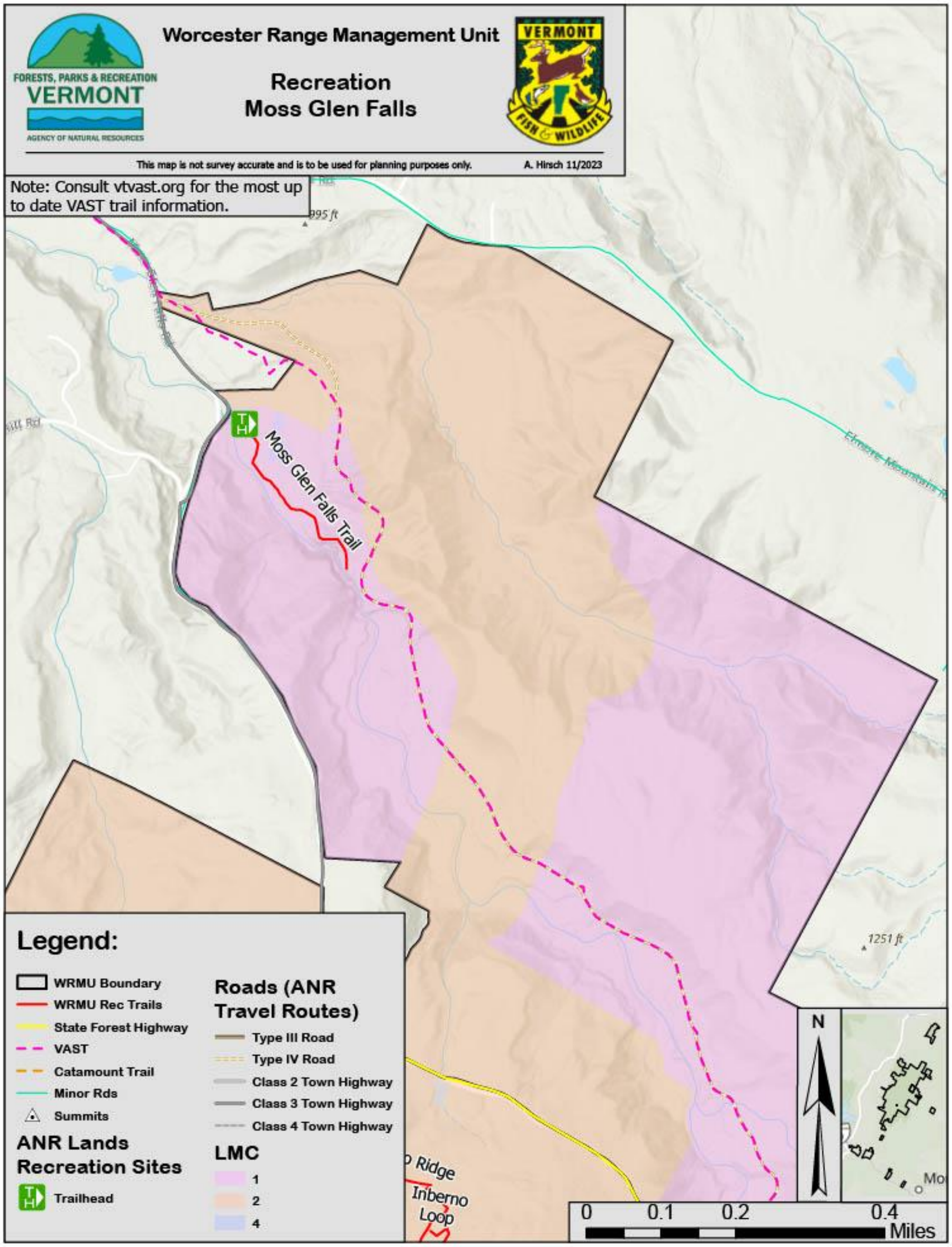
Map 46: Recreation – Elmore State Park



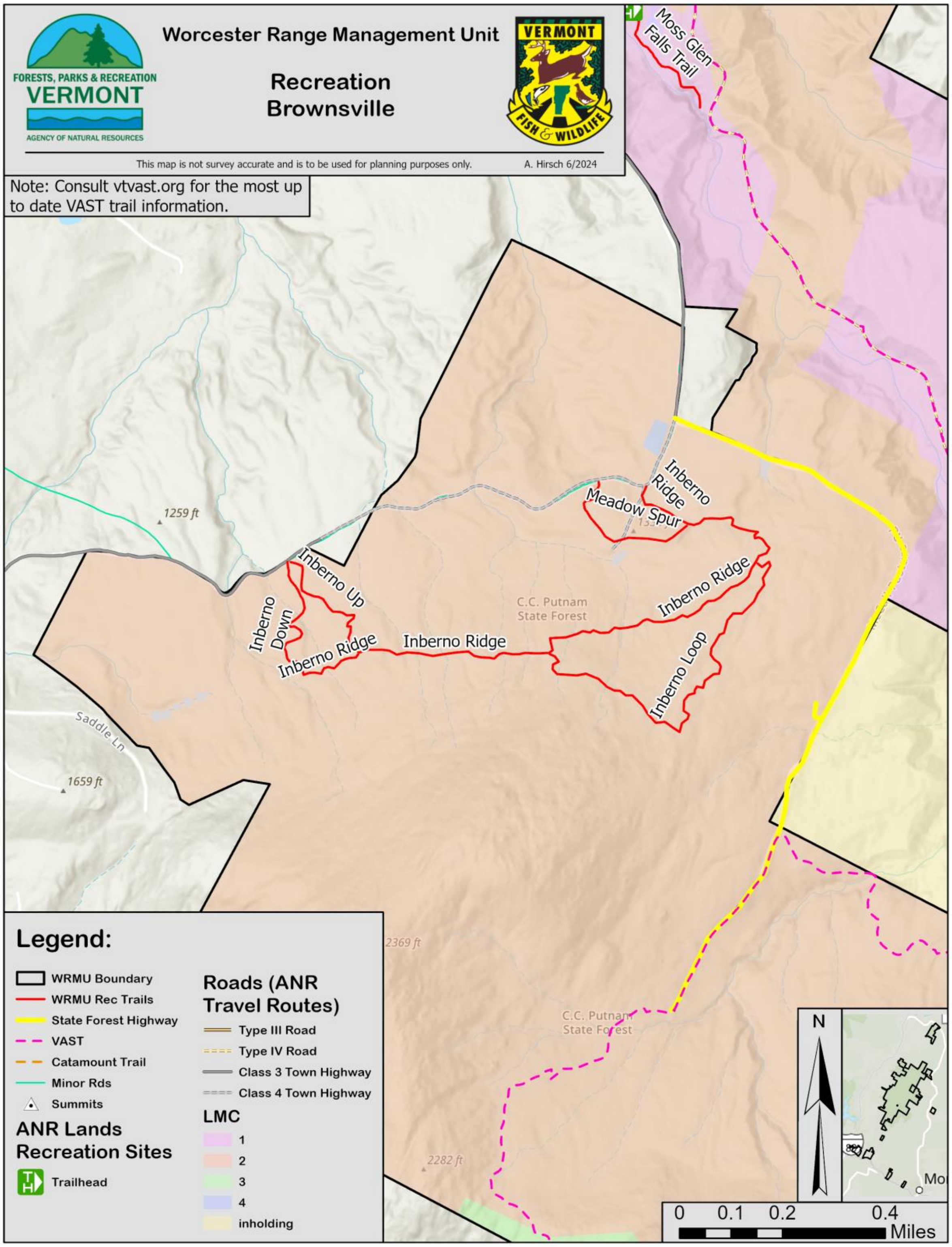
Map 47: Recreation – Worcester Range



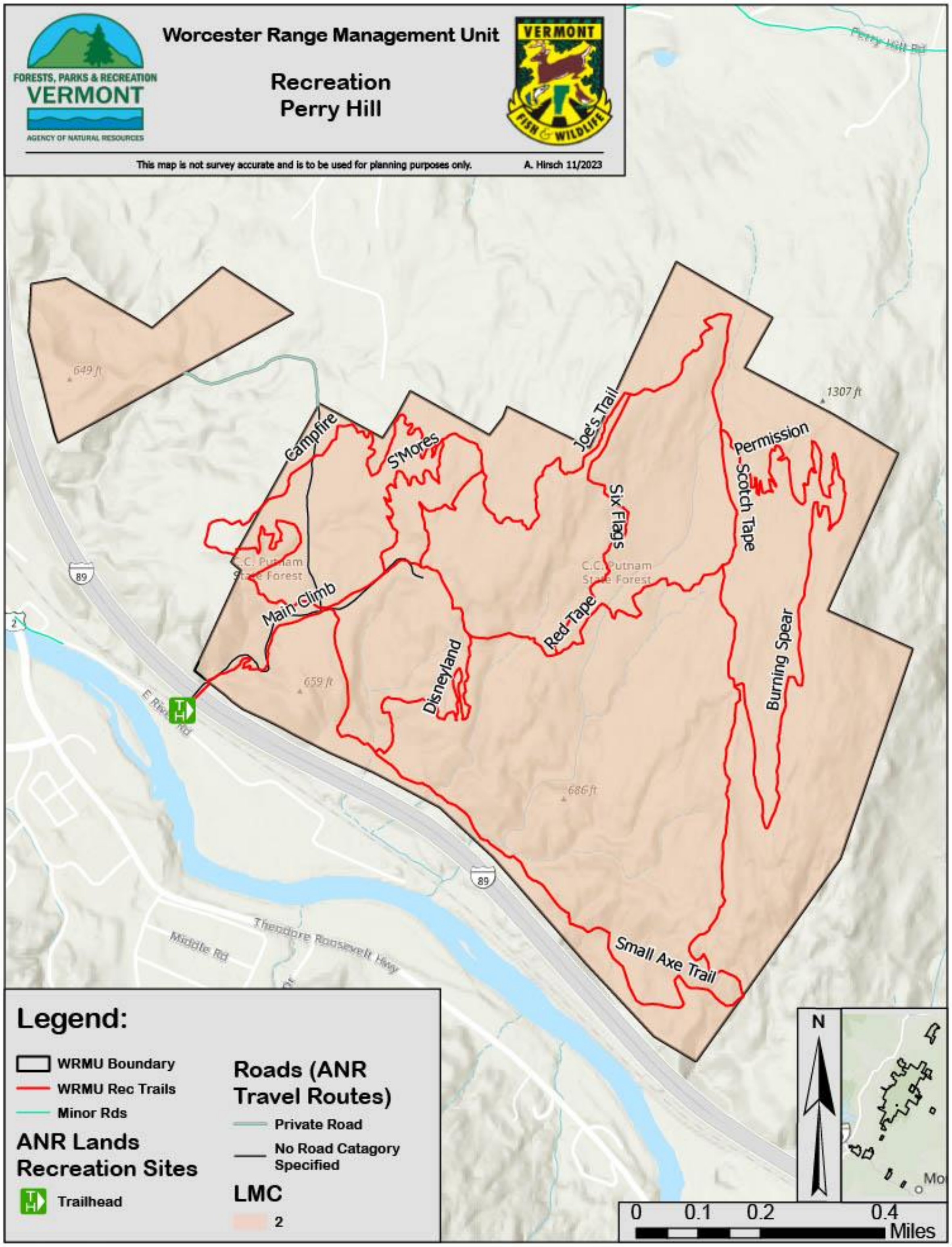
Map 48: Recreation – Moss Glen Falls



Map 49: Recreation – Brownsville



Map 50: Recreation – Perry Hill



G. Road Infrastructure Management Actions

During the lifespan of this LRMP there are no plans to increase the footprint of the State Forest Highway system within the WRMU. The current road network satisfies the needs for the management activities and maintained access proposed within the WRMU. General upkeep and maintenance will be conducted as needed and as identified during our annual monitoring assessments. Projects that fall outside of general upkeep and maintenance will depend on funding opportunities and staff availability to complete. Several projects outlined below have been identified as priorities to complete during this planning period provided funding is available.

Table 34: Road Infrastructure Management Actions

Parcel	Road Name	Road Type	Treatment	Primary Benefit	Secondary Benefits	Potential Funding Source
Elmore SP	Fire Tower Road	Type III	Replace undersized culverts, add ditch relief culverts, Re-grade and resurface	Reduce risk and impacts from weather related events	Improved water quality, road resiliency, public access, and management access	Clean Water Funds
C.C. Putnam SF	C-100 Lancaster ROW to McCall Pasture Rd	Type IV	Upgrade stream crossing structures, install ditch relief culverts, install additional waterbars, and regrade as needed	Reduce risk and impacts from weather related events	Improved water quality, road resiliency, public access, and management access	Clean Water Funds

C.C. Putnam SF	C-100 McCall Pasture Rd to Moss Glen Road	Type IV	Upgrade stream crossing structures, install ditch relief culverts, install additional waterbars, and regrade as needed	Reduce risk and impacts from weather related events	Improved water quality, road resiliency, public access, and management access	Clean Water Funds
C.C. Putnam SF	McCall Pasture Rd	Town Highway (Class IV)	Upgrade stream crossing structures, install ditch relief culverts, install additional waterbars, and regrade and spot gravel as needed	Reduce risk and impacts from weather related events and damage from public motorist.	Improved water quality, road resiliency, public access, and management access	Clean Water Funds
C.C. Putnam SF	C-100 Spur	Type IV	Remove existing culverts, maintain and install waterbars close out road until next management event.	Reduce risk and impacts from weather related events	Improved water quality	Clean Water Funds
C.C. Putnam SF	Patterson Brook Road Spur	Type IV (Winter Use)	Improve road surface drainage, ditch drainage and spot gravel as necessary	Improve management access	Improve water quality, and road resiliency	State Forest Highway Funds

V. MONITORING AND EVALUATION

During the life of the LRMP for the WRMU, periodic monitoring and evaluation will be conducted to ensure that the resources are protected from fire, insects and disease, encroachments, or unforeseen problems that may occur within the WRMU. Management activities will be evaluated to determine how closely the results matched those projected within the plan. Minor adjustments in management may be made to reflect changed conditions or unanticipated results.

As long-term management for the WRMU continues, inventory, monitoring, assessment, and research are necessary to: evaluate the status of the resource; assess progress toward achieving stated goals; and determine the effectiveness of management actions and activities.

- Were proposed strategies and actions carried out?
- Did the strategies and actions have the intended effect?
- Were the results consistent with expectations and predictive models?
- Do we have the necessary information to understand and evaluate actions taken on the WRMU?

Obtaining quality information is critical to making informed decisions and conducting sound, thoughtful management actions. Research projects on the WRMU are directed by the Barre District Stewardship Team (DST) to ensure that they do not conflict with the goals and objectives for the WRMU as set forth in the LRMP. It is important that individual research projects be assessed for their effects on the resource, potential conflicts with other uses or users, and consist of quality proposals from credible institutions and individuals. All data from private research will be shared with the Agency of Natural Resources.

A. Ecological/Wildlife

Maintaining the biological diversity of the WRMU requires long-term research and monitoring projects in a number of areas. Some of the efforts at meeting these goals include:

Strategies and Actions:

- Continue ongoing inventory and assessment projects promoting the collection and documentation of quality long-term information critical to the assessment and evaluation of management on the WRMU (including forest inventory, aerial insect and disease surveys, amphibian and reptile surveys, water quality assessments as part of the tactical basin planning cycle).
- Monitor rare, threatened, and endangered species and natural communities.
- Consider and support appropriate, credible research project proposals which further understanding of ecological elements and wildlife habitat on the WRMU and the impacts of management activities.

B. Timber and Wildlife Habitat

Timber management and harvest is an important tool used to achieve wildlife habitat and forest management objectives. An effective monitoring and assessment program is essential for ensuring the long-term sustainability of a quality timber management program. Careful analysis of the forest, its resource capabilities, potential impacts on other important management goals, protection of rare and/or threatened endangered species, water quality, management or protection of rare and/or state significant natural communities, and the documentation of the occurrence of natural processes (i.e., insect and disease outbreaks, blowdown events) is important in the execution and understanding of the effects of timber management actions.

Timber harvests and wildlife management activities completed within the WRMU will be periodically reviewed by the stewardship forester and the DST to determine how well management objectives are being met. If monitoring results indicate that there is a significant difference between the outcomes predicted by the plan and actual conditions, changes to the plan may be recommended.

Strategies and Actions:

- Continue to support ongoing assessment and mapping efforts (e.g., forest inventory, aerial insect and disease surveys).
- Conduct periodic, standardized post-practice assessments to assess effectiveness of management activities.
- Support proposals for appropriate research addressing long-term evaluation of forest management activities. Gather baseline data as necessary and practical to support assessment of management effectiveness and impacts.

C. Recreation

Public recreation will be periodically monitored across the property by the Barre DST to identify where recreational uses conflict with or may be compromising natural resources. Changes in recreational uses may be implemented including new management strategies designed to minimize or eliminate conflicts. State game wardens will be utilized to assist with maintaining compliance with state laws where specific and/or ongoing problems are occurring.

Strategies and Actions:

- Document illegal use and damage of resources.
- Support appropriate research projects including the collection of baseline data to expand knowledge of recreational carrying capacity, resource impacts, and user conflicts.

D. Historic

There are both historic and suspected pre-contact resources within the WRMU. Current understanding and documentation of these resources varies by site. Detailed documentation and study of field evidence is an important component to the understanding, protection, and interpretation of the individual sites and the greater historic context of the WRMU and surrounding areas.

Strategies and Actions:

- Continue to inventory, map, and document historic features.
- Monitor and document condition of known historic features using standardized forms and photo documentation.
- Support efforts to research the history of the WRMU.

E. Invasive Exotic Species

Invasive exotic species are known to be a problem in many areas of the state negatively impacting wildlife habitat, timber management, natural community composition, recreation, and economics. The DST will monitor the WRMU for the presence of invasive exotic species and work with cooperating partner organizations to develop a monitoring protocol. The DST will work to identify populations of invasive exotic species and implement control measures where feasible.

Strategies and Actions:

- Identify invasive species when populations are small. Develop and implement control goals.
- Assess and document levels of introduction of invasive exotic plants by species and location.
- Monitor timber harvest areas before and after timber sale activities, controlling invasive species as necessary and practical.
    - All timber sale contracts include a requirement for any logging and earth moving equipment to be cleaned and inspected prior to entering state property
    - All timber sale contracts specify the use of seed free straw mulch to be used for close out on state property
- Evaluate invasive species control projects for effectiveness.

F. Climate Change

If the most conservative current models of climate change are accurate, the WRMU, like the rest of the region, will experience strong impacts over the next 50-100 years.[71] These changes may have important consequences for forest nutrient cycling, timber productivity, forest pest ecology, wildlife habitat, and our enjoyment of the forest.

Strategies and Actions:

- Monitor ground conditions, results of management, research, and adaptations of silvicultural guides to inform management decisions and adapt treatment prescriptions as appropriate.

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[71] Iverson, L., Prasad, A., Hale, B., & Sutherland, E. (1999). *Atlas of Current and Potential Future Distributions of Common Trees of Eastern United States. General Technical Report NE-265.* Northeaster Research Station, USDA, Forest Service, Radnor, PA.

- Support appropriate research project proposals which further understanding of climate change on the WRMU.

G. State Forest Highway Infrastructure

Forest access roads need regular maintenance and repair. Two factors influence the amount of maintenance that a particular section of road requires—road design and level of use. Roads that receive only light traffic, and that are designed with appropriately sized and located drainage structures, will require the least maintenance over time. But even the best roads require maintenance. FPR performs routine maintenance during the spring, after snowmelt, and after heavy rain events, when waterbars are repaired and culverts are cleared of debris using hand tools. During this time, roads, ditches, culverts, and bridges are inspected for greater levels of damage that requires excavation. Some of the most common excavation projects include replacing old or damaged culverts, cleaning ditches, smoothing and crowning road surfaces, and repairing waterbars, broad-based dips and turnouts.

Strategies and Actions:

- Perform annual maintenance inspections on all SFH's and multi-use trails.
- Evaluate SFH's and multi-use trails after storm events.
- Coordinate with VAST to maintain trails.
- Complete maintenance and upgrades as funding allows.
- Schedule large projects in Annual Stewardship Plan as needed.

H. New Uses and Plan Amendment Process

The LRMP provides guidance for the long-term management and development of a parcel of state land. However, the future cannot be fully determined at the time of plan development. The department of Forests, Parks, and Recreation and the Fish & Wildlife Department undertake an amendment or plan update process when significant changes to the current LRMP are proposed. These may include:

1) Substantial changes to any goals, management objectives, and implementation actions contained in the current plan.
2) Major change in land use, land classification, or species management direction.
3) Designation of non-developed camping sites (via statute regarding camping on state lands).
4) Permanent closure of existing trails and/or permanent creation of new recreation corridors not identified in the current plan.
5) Major rerouting, reclassification, permanent closing or creation of new roads (not including forest management access roads not meant for normal vehicle traffic) within state land boundaries not identified in current plan.
6) Major land acquisitions added to the existing parcel.
7) Major capital expenditures for new projects.
8) Facility closures.
9) Transfers in fee ownership.
10) Leasing of new acreage (e.g., ski resort).

11) Renaming of natural features (prior to recommendation to the Department of Libraries) or lands.

When the amendment process is triggered, a public involvement process begins. The type of process is determined at the time and is dependent upon the extent and type of amendment. If applicable, the easement holders are notified to discuss the proposed amendment.

There may be times when public input and comments are sought regarding plan changes that are less significant than those triggering the plan amendment process. This is left to the discretion of the DST.

I. Future Acquisition/Disposition

Through its October 1999 *Vermont Agency of Natural Resources Lands Conservation Plan,* the Agency outlined priorities for acquiring new lands as well as for acquiring additions to existing ANR lands. It is the State's policy to acquire additions to ANR state lands parcels that are:

1) Necessary for maintaining or enhancing the integrity of existing state holdings.
2) Lands, such as inholdings and other parcels that serve to consolidate or connect existing state holdings and contain important public values and/or facilitate more efficient ANR land management.
3) Parcels that enhance or facilitate public access to ANR lands.
4) Parcels that serve an identified facility, infrastructure, or program need.

All new acquisitions of land to the WRMU will be guided by this plan and must have a willing seller, as the Agency does not have the authority to exercise eminent domain. They will also be done in consultation with the regional planning commissions and the town(s) in which the parcel is located.

Any future disposition of land from the WRMU will be approved by the Agency of Natural Resources Land Acquisition Review Committee (LARC) and the Secretary of the ANR after consultation with the regional planning commission and the town(s) in which the parcel is located.

APPENDICES

APPENDIX 1: Natural Community Descriptions

Alder Swamp

Two patches of Alder Swamp are found along Moss Glen, each covering only about one acre and together forming one occurrence. These are very small patches of a common community type in Vermont. It is not an example of statewide significance.

Very little ecological data was collected in these patches, but Alder Swamps generally occur on saturated soils and typically have a thick canopy of speckled alder (*Alnus incana*). Some species noted in association with this community at these occurrences include willows (*Salix* sp.), meadowsweet (*Spiraea alba* var. *latifolia*), bluejoint grass (*Calamagrostis canadensis*), jewelweed (*Impatiens capensis*), and Joe-pye weed (*Eupatorium maculatum*). This community can provide habitat for wildlife such as mink, muskrat, and beaver. Many birds likely use this community too, including migratory songbirds such as alder flycatcher and common yellowthroat.

These community patches could warrant further study. The landscape position along a high-energy stream suggests that alluvial processes may favor a shrub-dominated community. If that is indeed the case, then these patches may be better classified as Alluvial Shrub Swamp.

Beaver Wetland

These wetlands are dynamic systems, constantly changing in response to the activities of beavers. Since dramatic change within a short time frame is an expected natural process in beaver wetlands, they are not mapped as a natural community type; instead they are separately identified to indicate their dynamic nature. 46 acres of beaver wetland have been mapped, but this number will change as beavers occupy and abandon sites over time.

Many of the beaver wetlands observed during inventory have fairly deep (18-40”) muck or peat soils. When associated with streams, there is often a coarse layer of gravel underneath the organic soil. Shrubs and herbs are the most abundant vegetation, though some sites had a sparse (<5%) cover of trees such as yellow birch (*Betula alleghaniensis*), red spruce (*Picea rubens*), and red maple (*Acer rubrum*). Shrub cover is sparse in recently abandoned wetlands and seems to become more abundant over time. Species include meadowsweet (*Spiraea alba* var. *latifolia*), red spruce, balsam fir (*Abies balsamea*), and yellow birch (*Betula alleghaniensis*). Herbs are diverse, and species noted include blue flag iris (*Iris versicolor*), crested wood fern (*Dryopteris cristata*), sensitive fern (*Onoclea sensibilis*), jewelweed (*Impatiens capensis*), round-leaved sundew (*Drosera rotundifolia*), several sedge species (*Carex canescens*, *Carex stricta*, and *Carex lacustris*, along with other species), and two species of grasses (*Glyceria canadensis*, *Calamagrostis canadensis*).
Beaver wetlands provide important habitat for a wide variety of animal species including birds, bats, small mammals, moose, amphibians, and many species of invertebrates. In an otherwise

forested landscape, these open wetlands can be local “hotspots” for wildlife diversity. Some species directly observed in these wetlands include common yellowthroat, wood frog, and pickerel frog.

Peters noted the following for beaver wetlands in the Brownsville Forest parcel:

> Beaver clearing around the wetlands created early successional habitat that fosters other species, especially shrubland nesting songbirds such as Chestnut-Sided Warbler and Common Yellowthroat, both of which were observed and likely breed here. American Bittern and waterfowl were observed in the central pond complex. All three beaver wetland complexes provide good to excellent amphibian breeding habitat, especially for spotted salamanders, which had deposited many hundreds of egg masses among the various pools. Additionally, the uncommon (S3) blue-spotted salamander (*Ambystoma laterale*) may be present in the western beaver wetland. This western wetland also hosts a rare moss, *Ephemerum spp*.[72]

The beaver wetlands mapped in this report are not state-significant examples of any natural community types, but they are highly important for their ecological values.

Boreal Acidic Cliff

Three Boreal Acidic Cliffs (forming two distinct occurrences) were mapped in the WRMU. Both are examples of statewide significance. Given the rugged nature of the terrain, it is likely that other small cliffs can be found within the unit.

The mapped cliffs range in height from about 20-50 feet and are exposures of the schist bedrock that underlies most of the Worcester Range. Because these are not very tall cliffs, they are shady, damp, and probably generally seepy places. Plant species on the cliff and at the immediate base include red spruce (*Picea rubens*), balsam fir (*Abies balsamea*), white birch (*Betula papyrifera*), mountain ash (*Sorbus americana*), skunk currant (*Ribes glandulosum*), mountain wood fern (*Dryopteris campyloptera*), common wood sorrel (*Oxalis acetosella*), and several species of mosses, including *Sphagnum* spp.

Large examples of Boreal Acidic Cliffs can provide habitat for wildlife species such as peregrine falcon or common raven. These smaller examples mapped in the Worcester Range, however, are likely little used by birds.

Boreal Outcrop

The Worcester Range contains several excellent examples of Boreal Outcrops, most notably near the summits of Stowe Pinnacle, White Rock Mountain, and Mount Hunger. Other Boreal Outcrops are scattered in the range, and there are likely additional examples that were not

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[72] Peters, M. (2019). *Brownsville Forest Rapid Ecological Assessment; Stowe, VT.* Prepared for Stowe Land Trust.

detected during this mapping effort. There are nine occurrences, eight of which are state-significant.

This community is characterized by sparse tree cover (generally no more than 25% cover) and exposed rock. The bedrock of the Worcester Range is primarily metamorphic schist that is erosion resistant and not especially nutrient rich. Red spruce (*Picea rubens*), balsam fir (*Abies balsamea*), mountain ash (*Sorbus americana*), and heart-leaved paper birch (*Betula papyrifera* var. *cordifolia*) are the primary tree species present, and they usually reach a height of only 15-20 feet. Other trees sometimes present include red maple (*Acer rubrum*) and Bartram's shadbush (*Amelanchier bartramiana*). Tall shrubs include wild raisin (*Viburnum nudum* var. *cassinoides*), mountain holly (*Ilex mucronata*), and the low shrub velvetleaf blueberry (*Vaccinium myrtilloides*) is generally abundant. Herbs (generally <10% cover) include bunchberry (*Cornus canadensis*), hayscented fern (*Dennstaedtia punctilobula*), bracken fern (*Pteridium aquilinum*), and sedges (*Carex* spp.). Lichens can be frequent on the exposed rock.

Several rare plants are known from Boreal Outcrop occurrences in the WRMU. Mount Hunger supports boreal bentgrass (*Agrostis mertensii*), Bigelow's sedge (*Carex bigelowii*), and alpine bilberry (*Vaccinium uliginosum*). These three species are all associated with alpine and sub-alpine habitat, indicating the alpine affinities of the relatively low elevation, but very exposed, peaks in the Worcester Range. In addition, an outcrop at the summit of Mount Elmore has mountain cranberry (*Vaccinium vitis-idaea*). Hiker trampling is a threat to all four of these species. The boreal bentgrass population on Mount Hunger appears to have been substantially reduced and perhaps even extirpated due to trampling. Ongoing monitoring and management are needed for these rare species.

High-elevation songbirds, such as northern junco, white-throated sparrow, blackpoll warbler, might occasionally make use of these Boreal Outcrops. The uncommon Bicknell's thrush has been reported around Mount Hunger, and this species could find nesting habitat in the dense spruce-fir surrounding this community.

Boreal Talus Woodland

Three occurrences of Boreal Talus Woodland are found in the Worcester Range. The largest example covers eight acres on the south face of Elmore Mountain. Because of the remote landscape setting and limited disturbance history, all three occurrences are state-significant.

Large boulders (some reaching 10 feet on the longest side) and deep crevices characterize these sites. Tree cover averages around 60-70%, with stunted (20-25' tall) red spruce (*Picea rubens*), heart-leaved paper birch (*Betula papyrifera* var. *cordifolia*), mountain maple (*Acer spicatum*), striped maple (*Acer pensylvanicum*), and mountain ash (*Sorbus americana*). Blueberries (*Vaccinium* spp.) are present at some sites. Herbs noted include whorled aster (*Oclemena acuminata*), common polypody (*Polypodium appalachianum*), mountain wood fern (*Dryopteris campyloptera*), creeping snowberry (*Gaultheria hispidula*), and common wood sorrel (*Oxalis acetosella*). Mosses are abundant on the boulders at some sites.

Both the long-tailed shrew and the rock vole are small mammal species associated with this natural community, and which are known from areas around Stowe, Vermont, making it possible that either one or both species could be present in the Worcester Range.

Hemlock Floodplain Forest

Peters (2019) described this community on the Brownsville Forest parcel:

> A 1.7-acre patch of floodplain forest occurs along the small section of frontage on Moss Glen Brook in the northeast corner of the property. This unusual area does not fit within the existing natural community classification system and thus is not ranked for significance; however, it is an interesting and unusual feature of the Brownsville Forest property. This area of relatively flat alluvial soils is crossed by a natural flood chute channel and intermittent tributary streams. It has a closed canopy dominated by hemlock with small amounts of balsam fir, yellow birch, and red maple. No shrub layer is present, and, as is typical with hemlock dominated communities, the herb layer is sparse, including patches of oak fern (*Gymnocarpium dryopteris*) and ostrich fern (*Matteuccia struthiopteris*) along with occasional peduncled sedge (*Carex pedunculata*), wood anemone (*Anemone quinquefolia*), starflower (*Lysimachia borealis*), wood-sorrel (*Oxalis montana*), common toothwort (*Cardamine diphylla*), Canada mayflower (*Maianthemum canadense*), bearded shorthusk (*Brachyelytrum aristosum*), and red trillium (*Trillium erectum*). In many ways the composition is similar to Hemlock Forest, but it is differentiated by the floodplain location with fairly coarse alluvial soils of sand, silt, and gravel that appear to receive occasional flood inundation.

Hemlock Forest

Approximately 565 acres of Hemlock Forest are found in the WRMU, at lower elevations. The largest patches are found in Middlesex WMA, Worcester Woods WMA, and around Moss Glen Falls. All occurrences of Hemlock Forest in the WRMU are considered examples of statewide significance.

Within the WRMU, this community is found on both till and glaciofluvial-derived soils. While in other areas it is often restricted to steep slopes, in Worcester Woods WMA it is found on flatter, rolling terrain. Hemlock (*Tsuga canadensis*) is always dominant in the canopy, which averages 60 feet tall and nearly 100% cover. In some places, red spruce (*Picea rubens*) can be co-dominant. Other tree species sometimes present include white pine (*Pinus strobus*), red oak (*Quercus rubra*), yellow birch (*Betula alleghaniensis*), and red maple (*Acer rubrum*). Tall shrubs are typically less than 5% cover. They include canopy tree saplings along with striped maple (*Acer pensylvanicum*) and beech (*Fagus grandifolia*). Herb cover is sparse (<5%) and species include Canada mayflower (*Maianthemum canadense*), intermediate wood fern (*Dryopteris intermedia*), sarsaparilla (*Aralia nudicaulis*), and Indian pipe (*Monotropa uniflora*).

The dense cover of Hemlock Forest can provide important wintering habitat for white-tailed deer. South-facing patches of this community in the Winooski Valley may be very heavily used.

Other animals likely found in this natural community include red squirrel, porcupine, Blackburnian warbler, and northern saw-whet owl.

Hemlock-Balsam Fir-Black Ash Seepage Swamp

Two occurrences of this community type are found in the WRMU: one in Worcester Woods WMA and the other in CC Putnam SF in the vicinity of Moss Glen Falls. Both examples are small (approximately one and three acres, respectively). Both examples are state-significant.

These swamps are characterized by groundwater seepage and a mixed tree canopy. In the WRMU, hemlock (*Tsuga canadensis*) is the most abundant tree, but black ash (*Fraxinus nigra*), balsam fir (*Abies balsamea*), red maple (*Acer rubrum*) and yellow birch (*Betula alleghaniensis*) also are present. Shrub cover is limited (approx. 15%), with species including saplings of the canopy species, and speckled alder (*Alnus incana*). Herbs noted include foamflower (*Tiarella cordifolia*), water avens (*Geum rivale*), sensitive fern (*Onoclea sensibilis*), cinnamon fern (*Osmunda cinnamomea*), and a horsetail (*Equisetum* sp.). Mosses are abundant but *Sphagnum* species are notably absent. Wildlife in this community likely includes foraging songbirds and insects. Winter wrens may nest in tip-up mounds. Black bears use seepage areas for early spring foraging, as the relatively warm groundwater seepage results in an early spring growth of sedges and herbs.

Black ash is especially susceptible to the invasive emerald ash borer.

Hemlock-Northern Hardwood Forest

Hemlock-Northern Hardwood Forest is found at lower elevations throughout the WRMU. Just less than 1,200 acres have been mapped in this inventory, comprising ten occurrences. No examples of this very common community type are considered state-significant in the WRMU.

This community is typically found on shallow or well-drained soils. In the WRMU, soil samples indicated that it is found on silt loams and sand loams. The canopy is usually closed, with around 80-90% cover, and averages about 60 feet in height. Hemlock (*Tsuga canadensis*) is common, but intermixed with sugar maple (*Acer saccharum*), beech (*Fagus grandifolia*), white ash (*Fraxinus americana*), and yellow birch (*Betula alleghaniensis*). Red spruce (*Picea rubens*) is also sometimes present. Shrub cover averages around 30-40% cover (though this varies widely), and species noted include striped maple (*Acer pensylvanicum*) and saplings of the canopy trees. Low shrub cover was minimal (5-10%) but species noted include balsam fir (*Abies balsamea*), hobblebush (*Viburnum lantanoides*), and mountain ash (*Sorbus americana*). The herb layer averages around 30% cover, with species including Christmas fern (*Polystichum acrostichoides*), bluebead lily (*Clintonia borealis*), goldthread (*Coptis trifolia*), and Indian cucumber (*Medeola virginiana*).

Hemlock-Northern Hardwood Forests provide important deer wintering habitat, and this is especially the case for the patches on the south-facing slopes of the Winooski Valley.

Lowland Spruce-Fir Forest

This community is found on 143 acres in the WRMU, in scattered small patches where the topography creates areas of cold air drainage. The six occurrences within the WRMU are relatively small. Three of these are state-significant.

In the WRMU, this community is found on both mesic sandy loam and clay loam soils. As the name suggests, red spruce (*Picea rubens*) and balsam fir (*Abies balsamea*) are the dominant trees. Heart-leaved paper birch (*Betula papyrifera* var. *cordifolia*), yellow birch (*Betula alleghaniensis*), hemlock (*Tsuga canadensis*) and even the occasional sugar maple (*Acer saccharum*) can also be present. The canopy averages 40 feet in height and 80-90% closure. Tall shrub cover averages around 30% cover, primarily composed of spruce and fir saplings. Low shrub cover is sparse and limited to tree seedlings. Herbs include mountain wood fern (*Dryopteris campyloptera*), sarsaparilla (*Aralia nudicaulis*), goldthread (*Coptis trifolia*), intermediate wood fern (*Dryopteris intermedia*), and bracken fern (*Pteridium aquilinum*). Mosses and lichen cover averages around 50%, with *Sphagnum* species noted in low hollows.

As with any dense conifer cover, some patches of this community type may be used by white-tailed deer for winter cover. Extensive areas of Lowland Spruce-Fir Forest can host several rare or uncommon wildlife species (such as black-backed woodpecker). In general, given the small size of the patches in the WRMU, it is unlikely that such species will be found in the management unit.

Montane Spruce-Fir Forest

More than 2,300 acres of this high-elevation forest are found in the Worcester Range, split between a relatively small (103 acres) occurrence on Elmore Mountain and a much larger occurrence that extends from Densmore Mountain north beyond Mount Worcester. Both are state-significant, but this latter occurrence is a notably large, high quality, A-ranked example.

Montane Spruce-Fir Forest is generally found at elevations above 2,500 feet, where the mountain climate is cold, cloudy, windy and damp. This combination results in a short summer growing season and harsh winter conditions. Soils are typically thin and saturated, and usually have a gray eluviated layer. The predominant trees in this community are red spruce (*Picea rubens*) and balsam fir (*Abies balsamea*). Canopy cover varies, with most locations having a relatively short (30-40' tall) closed canopy (>70% cover). Some places, however, are more open and have sparse canopy cover. Paper birch (*Betula papyrifera*) is a common canopy associate. Shrubs in the community include mountain ash (*Sorbus americana*), bush honeysuckle (*Diervilla lonicera*), and mountain holly (*Ilex mucronata*). Herb cover is generally sparse because of the dense evergreen canopy, with only a handful of abundant species including goldthread (*Coptis trifolia*), bunchberry (*Cornus canadensis*), Canada mayflower (*Maianthemum canadense*), bracken fern (*Pteridium aquilinum*), and bluebead lily (*Clintonia borealis*). Moss species often form a dense carpet in this forest, and lichens – including the epiphytic beard lichens (*Usnea* spp.) – are frequently present as well. The uncommon showy mountain ash (*Sorbus decora*) is occasional in this community, and probably often overlooked because of its similarity to the common mountain ash (*Sorbus americana*).

Montane Spruce-Fir Forest can provide habitat for many migratory songbirds, including blackpoll warbler and yellow-rumped warbler. The uncommon Bicknell's thrush has been found near Mount Hunger in some years as well.

Parts of this forest burned during intense forest fires that happened in the early 20th century. Some patches (such as near the summit of Mount Worcester), however, have old forest characteristics with abundant dead and downed wood, and tall, large-diameter trees.

Montane Yellow Birch-Red Spruce Forest

This forest is found at the middle elevations of the Worcester Range, or roughly between 2000 and 3000 feet. While not exposed to the extremes of temperature, precipitation and wind that characterize the Montane Spruce-Fir Forest, this forest is still influenced by its landscape position on mountain slopes and low summits. Over 4,300 acres of this community are found in the WRMU. These are split between two occurrences: one on the slopes of Elmore Mountain and another that extends from Densmore Mountain north to Mount Worcester. Both are high-quality and considered to be examples of statewide significance.

Red spruce (*Picea rubens*) and yellow birch (*Betula alleghaniensis*) are typically the dominant trees in this community. Areas with disturbance history, particularly those that burned in the early 20th century, can have a canopy of white birch (*Betula papyrifera*). At lower elevations, sugar maple (*Acer saccharum*) can be co-dominant in the canopy. Shrub cover in this community includes hobblebush (*Viburnum lantanoides*) which can often reach nearly 100% cover. Other shrub species include striped maple (*Acer pensylvanicum*), mountain maple (*Acer spicatum*), and mountain holly (*Ilex mucronata*). Herbs include the characteristic mountain wood fern (*Dryopteris campyloptera*), along with common bluebead lily (*Clintonia borealis*), common wood sorrel (*Oxalis acetosella*), bunchberry (*Cornus canadensis*), and hay-scented fern (*Dennstaedtia punctilobula*).

Animals found in this community include moose –abundant evidence of which was observed during inventories – along with many species of warblers and other songbirds. Areas with concentrations of mountain ash can attract bears, which eat the fruits in the fall.

Northern Hardwood Forest

Northern hardwood forest forms the "matrix" into which all other communities in the WRMU fit. This forest type is also the most common type in Vermont. Over 6,000 acres of Northern Hardwood Forest were mapped within the WRMU, all as part of a single occurrence of very high ecological quality (A-ranked). This example is of statewide significance.

Since it is widespread, Northern Hardwood Forest is a highly variable community, with species and structural composition determined by landscape position and stage of succession. Some portions of this community in the WRMU are young forest recovering from recent natural or human disturbance, but there is also much older, maturing forest. Typically, the canopy is composed of sugar maple (*Acer saccharum*), beech (*Fagus grandifolia*) and yellow birch (*Betula* *alleghaniensis*). Red oak (*Quercus rubra*) can occasionally be found on drier sites, and slightly enriched sites tend to have white ash (*Fraxinus americana*) and basswood (*Tilia americana*). The canopy can reach 60 feet in height and averages 80% closure. Regeneration of canopy tree species—particularly beech—is common, but the shrub layer can also include striped maple (*Acer pensylvanicum*) and hobblebush (*Viburnum lantanoides*). Herb cover, while not dense (average 30% cover), can be diverse. Twenty-five herb species were recorded in one location. Some of the commonly encountered species include intermediate wood fern (*Dryopteris intermedia*), sarsaparilla (*Aralia nudicaulis*), trout lily (*Erythronium americanum*), wild oats (*Uvularia sessilifolia*), and drooping woodreed (*Cinna latifolia*). Soils vary from dry, shallow and rocky, to poorly drained clay loam, though a mesic and rocky substrate is probably most common.

Wildlife in this community type is nearly as diverse as the vegetation, with species including white-tailed deer, black bear, moose, chipmunk, porcupine, northern flying squirrel, hermit thrush, black-throated blue warbler, red-eyed vireo, among many other species of mammals and birds. Reptiles and amphibians are also present, and the forest likely hosts species such as red-backed salamander, eastern newt, and wood frog.

Northern Hardwood Seepage Forest

Ten occurrences of Northern Hardwood Seepage Forest cover 287 acres in the WRMU. Many of these occurrences need additional study of their composition and extent. Four occurrences have been assessed as state significant.

One example of this community at Elmore SP covers about 36 acres and is found on a 2- to 5-degree slope with mostly mineral soil. Soil samples found an inch of organic matter over 14 inches of gray clay loam, over 6 inches of orange coarse pebbly loam. Hard pan or rock was found below this. The canopy consists of an emergent overstory (80' tall, 5% closure) of white pine (*Pinus strobus*) above a 55-foot tall, 80% closed canopy of red maple (*Acer rubrum*), white ash (*Fraxinus americana*), quaking aspen (*Populus tremuloides*), yellow birch (*Betula alleghaniensis),* and white birch (*Betula papyrifera*). A tertiary canopy dominated by yellow birch reaches 30-40 feet in height and about 50% cover. Shrubs (<10% cover) include red spruce (*Picea rubens*), striped maple (*Acer pensylvanicum*), alternate-leaf dogwood (*Cornus alternafolia*), and beech (*Fagus grandifolia*). Herbs (85% cover) include sensitive fern (*Onoclea sensibilis*), lady fern (*Athyrium felix-feminina*), New York fern (*Thelypteris noveboracensis*). This community also includes a dense patch of eastern hemlock to the northeast within the overstory. Small inclusions of upland were not mapped within this community to allow for the protection of the integrity of the seepage swamp's extensive drainage system when evaluating vegetation management options.

Peters describes two Hemlock Seepage Forest variants in the Brownsville Forest:

> One of these occurs at the northern tip of the property as an extensive (3.2 acre) section of sloping, seepy valley bottom forest flanking an unnamed, 9-12ft wide stream channel, which is a somewhat atypical physical setting. In one area the stream channel braids

through the valley bottom blending the lines between Seepage Forest and floodplain forest physical processes. This narrow valley bottom forest has a gappy canopy dominated by eastern hemlock (*Tsuga canadensis*) with lesser amounts of yellow birch (*Betula alleghaniensis*), sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), white ash (*Fraxinus americana*), black ash (*Fraxinus nigra*), red spruce (*Picea rubens*), and balsam fir (*Abies balsamea*). Shrubs are sparse and include the native American fly-honeysuckle (*Lonicera canadensis*) and a single large invasive honeysuckle in a riparian canopy gap. Herbs are predominantly species of seepage wetlands, including sensitive fern (*Onoclea sensibilis*), rough sedge (*Carex scabrata*), water carpet (*Chrysosplenium americanum*), silvery glade fern (*Deparia acrostichoides*), lady fern (*Athyrium filix-femina* var. *angustum*), dwarf scouring-rush (*Equisetum scirpoides*), common jewelweed (*Impatiens capensis*), zig-zag goldenrod (*Solidago flexicaulis*), ostrich fern (*Matteuccia struthiopteris*), dwarf raspberry (*Rubus pubescens*), and foam flower (*Tiarella cordifolia*), with sparse upland herbs on hummocks. This occurrence continues down-valley off the subject property.

The second, small (1.9 acre) State-Significant occurrence lies on a small northeast sloping bench where runoff and groundwater fans out from a small channel at the slope break then re-channelizes below and also spreads to drain into a secondary drainage network. The canopy here is patchy, dominated by hemlock with red spruce, yellow and paper birch. The composition is variable. The southern section has many enrichment indicator herbs, while the northern section lacks these, has more red spruce, drier hummocks covered by boreal bryophytes, such as the liverwort *Bazzania trilobata,* and hollows filled with *Sphagnum* moss. Herbs include common jewelweed (*Impatiens capensis*), sensitive fern (*Onoclea sensibilis*), dwarf raspberry (*Rubus pubescens*), cinnamon fern (*Osmundastrum cinnamomeum*), rough sedge (*Carex scabrata*), gynandrous sedge (*Carex gynandra*), common toothwort (*Cardamine diphylla*), water carpet (*Chrysosplenium americanum*), and northeastern manna grass (*Glyceria melicaria*), with intermediate woodfern (*Dryopteris intermedia*) and trout lily (*Erythronium americanum*) on dry hummocks. About 70-80% of the area is wetland with 18 inches of organic muck soil over mottled, silty, fine sand that grades down into dense, mottled, fine sandy loam.[73]

Northern Hardwood Seepage Forests can be important wildlife habitat. The relatively warm groundwater seepage makes these some of the first places to green up in the spring. The fresh growth of sedges and herbs feeds black bears and turkeys. Several salamander species, including northern two-lined salamanders, use moist seepage areas. Rare dragonflies, such as the arrowhead spiketail, are associated with seeps, though these species have not been documented in the WRMU.

Red Maple-Black Ash Seepage Swamp

Peters noted the following occurrence, which is not state significant:

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[73] Peters, M. (2019). *Brownsville Forest Rapid Ecological Assessment; Stowe, VT.* Prepared for Stowe Land Trust.

One small (0.3 acre) area is mapped as Red Maple-Black Ash Seepage Swamp; this is a potential community type designation as the area was heavily affected by prior clearing. This swamp is far from a mature natural composition and structure with only minor canopy cover and hummock/hollow development at present. It is currently a mix of shrub willow thickets and open herbaceous seepage vegetation. This wetland receives some runoff from Brownsville Road.[74]

Red Maple-Sphagnum Acidic Basin Swamp

Two occurrences of Red Maple-Sphagnum Acidic Basin Swamp are found in the WRMU. One, consisting of several different small patches totaling 5.4 acres, is found at Worcester Woods WMA. The second is a small (1.1 acre) basin swamp found on the eastern slope of the Worcester Range. Basin swamps are generally small in size, and since these are in good ecological condition and surrounded by an intact landscape, both occurrences are considered to be examples of statewide significance.

Only limited field data was collected for this community type in the WRMU. Red maple (*Acer rubrum*), yellow birch (*Betula alleghaniensis*), and paper birch (*Betula papyrifera*) were noted in the canopy. Associated herbs include cinnamon fern (*Osmunda cinnamomea*), two-seeded sedge (*Carex disperma*), a manna grass (*Glyceria melicaria*), and sensitive fern (*Onoclea sensibilis*). Sphagnum mosses (including *Sphagnum squarrosum*) are abundant. In addition, the uncommon species small bedstraw (*Galium trifidum*) is found in the occurrence of this community in CC Putnam SF. No data was collected on soils, but they are likely a very deep, acidic, saturated peat. These swamps may serve as important amphibian habitat.

Red Oak-Northern Hardwood Forest

Red Oak-Northern Hardwood Forest is found on warm and dry sites that favor red oak (*Quercus rubra*). In the WRMU, this is primarily along the south-facing slopes of the Winooski Valley, where there is over 800 acres of this community type found on state lands. Most of this acreage is part of one large occurrence that extends over the Perry Hill Block of CC Putnam SF and Middlesex Notch WMA; this occurrence is an example of statewide significance.

In the WRMU, this community is primarily found on shallow till soils, and the coarse sands deposited by the post-glacial lake in the Winooski Valley. The canopy is often short with well-spaced trees (around 75% cover). Red oak is the dominant species, but sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), white ash (*Fraxinus americana*), and beech (*Fagus grandifolia*) are also usually present in low abundance. A sparse and short sub-canopy is present in places, with red oak, sugar maple, and hophornbeam (*Ostrya virginiana*). Shrubs can include canopy species saplings, along with striped maple (*Acer pensylvanicum*), and shadbushes (*Amelanchier* spp.) Maple-leaf viburnum (*Viburnum acerifolium*) was not noted in this community in the WRMU, though it is characteristically found in Red Oak-Northern Hardwood Forest. Herb cover ranged from nearly absent to nearly 90% cover depending on the

[74] Peters, M. (2019). *Brownsville Forest Rapid Ecological Assessment; Stowe, VT.* Prepared for Stowe Land Trust.

site, and species include grasses of the genera *Bromus*, *Deschampsia*, and *Poa*, along with many types of sedge (*Carex* spp.). Bracken fern (*Pteridium aquilinum*), silverrod (*Solidago bicolor*), marginal wood fern (*Dryopteris marginalis*), and blue stemmed goldenrod (*Solidago caesia*) are other species noted in these patches. Mosses and lichens are abundant in places, particularly where thin till soil is found over bedrock.

Red oak acorns provide an important food source for many wildlife species, including white-tailed deer and black bear. Abundant evidence of these species was observed during inventories. Birds likely found in these forests include turkey, ovenbird, scarlet tanager, and blue jay. White-tailed deer use the south-facing oak slopes for winter habitat; because of the abundant food source and because the sunny, warm aspect may speed snow melt and limit snow depth.

Red Pine Forest

A one-acre natural stand of red pine (*Pinus resinosa*) is found on a small ridge in the Perry Hill Block of CC Putnam SF, where it is above a small cliff and talus slope. This is a rare community type in Vermont, and thus even though this example is small and C-ranked, it is still considered to be state significant.

Along with red pine, which reach 15-20 inches dbh, the canopy (55-60' tall, 95% cover) includes lesser amounts of white pine (*Pinus strobus*), hemlock (*Tsuga canadensis*), red oak (*Quercus rubra*), and red spruce (*Picea rubens*). A 30-foot tall subcanopy has red oak, red maple, and red pine. Tall shrubs are sparse (less than 5% cover), with witch hazel (*Hamamelis virginiana*) and striped maple (*Acer pensylvanicum*) in addition to saplings red spruce, hemlock, and white pine. Low shrub cover was slightly more abundant (15% cover) and species include maple-leaf viburnum (*Viburnum acerifolium*), sheep laurel (*Kalmia angustifolia*) a shadbush (*Amelanchier* sp.) and trailing arbutus (*Epigaea repens*). Herb cover (10%) includes Canada mayflower (*Maianthemum canadense*), sarsaparilla (*Aralia nudicaulis*), and roughleaf ricegrass (*Oryzopsis asperifolia*). This community is probably too small to host many unique wildlife species, but it may host specialized invertebrate species, such as ants, moths, or butterflies.

Red pine is a fire-adapted species that can out-compete other species in fire-prone areas. In the absence of disturbance, other species tend to replace the red pine. Further study of the disturbance history of this site would be needed in order to determine if the red pine is likely to naturally persist over time.

Red Spruce-Cinnamon Fern Swamp

In the WRMU, Red Spruce-Cinnamon Fern Swamps are found at high elevations and in cold basin and valley locations. In the WRMU these are small patches, with individual swamps averaging only about 2 acres in size. Twenty-nine swamps are grouped into 15 occurrences, the largest of which is 21 acres spread over several patches on the ridge north of Mount Worcester. All field-verified occurrences are state significant. Several occurrences need additional inventory, and it is likely that additional small Red Spruce-Cinnamon Fern Swamps occur in the unit but were not detected during inventories.

These swamps are characterized by moderately deep peat accumulations. The canopy averages 40 feet in height, and 60% cover. Red spruce (*Picea rubens*), balsam fir (*Abies balsamea*), and yellow birch (*Betula alleghaniensis*) are the dominant species. Black spruce (*Picea mariana*) may also be present. A subcanopy with similar species (20% cover) is present at some sites. Tall shrubs (40% cover) include mountain ash (*Sorbus americana*), speckled alder (*Alnus incana*), winterberry (*Ilex verticillata*), mountain holly (*Ilex mucronata*) and wild raisin (*Viburnum nudum* var. *cassinoides*). Low shrubs (25% cover) noted include wild raisin, northern fly honeysuckle (*Lonicera canadensis*), and a blueberry (*Vaccinium* sp.). Herb cover is variable (average 50%) and species noted include three-seeded sedge (*Carex trisperma*), cinnamon fern (*Osmunda cinnamomea*), mountain wood fern (*Dryopteris campyloptera*), a manna grass (*Glyceria* c.f. *striata*), and goldthread (*Coptis trifolia*). Bryophytes cover is very high, and species include *Sphagnum* species, *Dicranum* species, *Bazzania trilobata*, *Hylocomium splendens*, and *Ptilium crista-castrensis*.

The rare plant species dwarf mistletoe (*Arceuthobium pusillum*) was found growing on spruce trees in these swamps in Worcester Woods WMA.

These small swamps likely provide habitat for a number of wildlife species, including winter wren, northern saw-whet owl, red squirrel, and snowshoe hare. They are also potential nesting habitat for the uncommon yellow-bellied flycatcher.

Red Spruce-Heath Rocky Ridge

Red Spruce-Heath Rocky Ridges are dry, exposed places with little soil. In the WRMU, this community is found on knobs, ridges, and summits at middle to high elevations. It is a distinctive community of some of the most popular hiking destinations in the Worcester Range; it is well-developed near the summits of Stowe Pinnacle, White Rock Mountain, Mount Hunger, and Mount Worcester. Though these places appear alpine in character, and indeed even support a few rare plant species typically associated with alpine areas, the droughty bedrock substrate is the primary driver of this community, rather than the extreme cold and wind that characterizes truly alpine and subalpine natural communities.

Twenty-six patches of this community, forming nine occurrences, have been mapped. It is likely that additional patches occur around the WRMU but were not detected during inventories. Six occurrences are state-significant, the remaining three need additional field inventory before they can be ranked.

Red Spruce-Heath Rocky Ridge is a variable community type in the WRMU, encompassing everything from dense stands of red spruce (*Picea rubens*) that appear like Montane Spruce-Fir Forest, to open woodlands on exposed bedrock that can resemble Subalpine Krummholz. The dense patches have a 40- foot tall, 70% closed canopy comprised of red spruce, white birch (*Betula papyrifera*), and occasionally yellow birch (*Betula alleghaniensis*). A subcanopy of similar species, plus balsam fir (*Abies balsamea*), is sometimes present. Shrub cover (30%) includes striped maple (*Acer pensylvanicum*) and hobblebush (*Viburnum lantanoides*). Herbs noted include sarsaparilla (*Aralia nudicaulis*), bracken fern (*Pteridium aquilinum*), and bluebead lily (*Clintonia borealis*).

The woodland patches are best expressed on the mountain summits, where there is a stunted and sometimes sparse canopy of red spruce. Balsam fir, mountain ash (*Sorbus americana*) and white pine (*Pinus strobus*) are occasional. Tall shrubs include Bartram's shadbush (*Amelanchier bartramiana*) and mountain holly (*Ilex mucronata*). Velvetleaf blueberry (*Vaccinium myrtilloides*) is a widespread low shrub (25% cover). Herbs include brownish sedge (*Carex brunescens*), hairgrass (*Deschampsia flexuosa*), three-toothed cinquefoil (*Sibbaldia tridentata*), and bunchberry (*Cornus canadensis*). Mosses and lichens are abundant.

The thin soils of this community are very susceptible to hiker trampling. Management efforts to keep hikers on exposed bedrock will help minimize future impacts.
Red Spruce-Heath Rocky Ridge provides habitat for birds such as dark-eyed junco, yellow-rumped warbler, and white-throated sparrow. Snowshoe hare can be abundant, finding cover in the dense spruce trees. This community may also be important invertebrate habitat, but this has not been studied.

Red Spruce-Northern Hardwood Forest

Over 2,000 acres of this community are found in the WRMU, forming a single A-ranked occurrence that is considered to be an example of statewide-significance.

This community is generally found at slightly higher elevations than Northern Hardwood Forest, but below Montane Yellow Birch-Red Spruce Forest. It is found on till soils that are often wet-mesic, though this is not a wetland. It has a canopy that averages 60 feet tall and 85% cover. Red spruce (*Picea rubens*), yellow birch (*Betula alleghaniensis*), beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*) and red maple (*Acer rubrum*) are all common in the canopy. Heart-leaved paper birch (*Betula papyrifera* var. *cordifolia*) can be abundant, especially in areas that burned in the early 20th century. Tall shrubs include hobblebush (*Viburnum lantanoides*), striped maple (*Acer pensylvanicum*), and red spruce. Herb cover is very dense (near 100%) and species include mountain wood fern (*Dryopteris campyloptera*), common wood sorrel (*Oxalis acetosella*), and largeleaf goldenrod (*Solidago macrophylla*). Small, saturated soil inclusions can have interrupted fern (*Osmunda claytoniana*) and turtlehead (*Chelone glabra*). Wildlife in Red Spruce-Northern Hardwood Forests includes moose, black bear, and—during the summer months—many songbirds. While dense conifer cover can provide important deer wintering habitat, this community is located at relatively high elevations, and the cold, snowy weather would generally make it unsuitable for wintering deer.

Rich Northern Hardwood Forest

Four occurrences of this community type are found in the WRMU. Most are relatively small, covering just a few dozen acres. One occurrence is larger (160 acres) and is an example of statewide significance.

Rich Northern Hardwood Forest in the Worcester Range is primarily the result of downslope movement and concentration of soil and nutrients. The enrichment results in tall, large trees and a diverse suite of herbs. Sugar maple (*Acer saccharum*) and white ash (*Fraxinus americana*) are the most common canopy trees, though basswood (*Tilia americana*) and yellow birch (*Betula alleghaniensis*) are also sometimes present. The canopy can reach 75 feet in height and averages around 70% closure. Shrubs are generally not abundant, but species present include an elderberry (*Sambucus* sp.) and striped maple (*Acer pensylvanicum*). Herb cover can be quite dense (near 100%) and diverse. Some characteristic species noted include maidenhair fern (*Adientum pedatum*), silvery spleenwort (*Deparia acrostichoides*), wood nettle (*Laportea canadensis*), wild leeks (*Allium tricoccum*) and a grass (*Milium effusum*). The uncommon (S3) cut-leaved toothwort (*Cardamine concatenata*) is found in one patch of this community. These forests likely support many of the same wildlife species as Northern Hardwood Forests.

Colluvial Rich Northern Hardwood Forests such as these are dependent on the downslope flow of nutrients. Disturbances that impede or alter the flow of soil, water, and nutrients—including roads and trails—could negatively impact this community.

Shallow Emergent Marsh

Three small occurrences of Shallow Emergent Marsh are found in the WRMU: two near Moss Glen Falls, and one small disturbed marsh near Interstate 89 in Middlesex WMA. None is an example of statewide significance.

These are open, herbaceous marshes found on seasonally flooded muck soils. A few shrub species are sometimes present, including speckled alder (*Alnus incana*), meadowsweet (*Spiraea alba* var. *latifolia*), and willows (*Salix* sp.). Herbs include bluejoint grass (*Calamagrostis canadensis*), jewelweed (*Impatiens capensis*), Joe-pye weed (*Eupatorium maculatum*), Canada manna grass (*Glyceria canadensis*), and a bur reed (*Sparganium* sp.). The small examples of this community in the WRMU are probably used by wildlife such as common yellowthroat, and amphibians (such as wood frog and eastern newt) that find suitable breeding habitat when the marshes are flooded in the spring.

Temperate Acidic Cliff

Two occurrences of this community have been mapped in the WRMU. These are small cliffs, not more than 25 feet tall, and are not considered examples of statewide significance. Given the nature of the mountainous terrain, there are almost certainly other small cliffs in the WRMU that were not detected during inventories.

These cliffs are acidic, metamorphic schist and quartzite. Since these cliffs are short, they are shaded by the surrounding tree canopy. Species growing on the cliff face and on small benches include common polypody (*Polypodium appalachianum*), marginal wood fern (*Dryopteris marginalis*), a sedge (*Carex* c.f. *brunescens*), rock tripe (*Umbilicaria* sp.), a windswept moss (*Dicranum* sp.), and a liverwort (*Bazzania triolabata*).

Temperate Acidic Outcrop

Temperate Acidic Outcrops are found in the warmer parts of the WRMU, with the most notable examples found on the south-facing slopes of the Winooski Valley. Of the four occurrences mapped during inventory, only one (the example at Middlesex Notch WMA) is of statewide significance.

These outcrops are found in dry, nutrient-poor sites on both convex knobs and sloping hogback ridges, with bedrock of the acidic Stowe or Missisquoi formations. Some of these sites, particularly in the Winooski Valley, may have originally had shallow soil but then eroded as a result of sheep grazing and trampling during the 19th century. In the WRMU, Temperate Acidic Outcrops are characterized by scattered red oak (*Quercus rubra*), white pine (*Pinus strobus*) and red spruce (*Picea rubens*). Shrubby red maple (*Acer rubrum*), white birch (*Betula papyrifera*), and black cherry (*Prunus serotina*) are also sometimes present. Low shrubs include blackberries (*Rubus* spp.), and blueberries (*Vaccinium* spp.). Herbs noted include marginal wood fern (*Dryopteris marginalis*), poverty grass (*Danthonia spicata*), pale corydalis (*Corydalis sempervirens*), and sheep sorrel (*Rumex acetosella*). Moss and lichen cover can be abundant, reaching 75% cover at some sites. These sites are probably of limited importance to most birds and mammals, though they may provide important habitat for some snake species, and for species of invertebrates such as bees, ants, moths or butterflies.

Vernal Pool

Thirty Vernal Pools were mapped in the WRMU. Many of these were clustered close together, and so they form nine occurrences. Since Vernal Pools must be evaluated during the amphibian breeding period to determine if they are of statewide significance, it is not known if any of the pools described in this inventory are significant examples. Further inventory of these pools is recommended.

Vernal pools form in small basins that are often dry but fill with water in the spring (and occasionally in other seasons) due to heavy rain and snowmelt. Because they lack fish, these pools are excellent breeding habitat for amphibians—frogs and salamanders—that migrate to the pools to reproduce and lay eggs. Unlike other natural communities, which are typically defined and assessed based on vegetation, vernal pools are better characterized by the amphibian and invertebrate species present, such as wood frogs, spotted salamanders, fingernail clams, caddis flies, and fairy shrimp. Detailed vegetation data was not collected at these pools in the WRMU, but some species commonly associated with Vernal Pools in Vermont include sensitive fern (*Onoclea sensibilis*), marsh fern (*Thelypteris palustris*), cinnamon fern (*Osmunda cinnamomea*), and bladder sedge (*Carex intumescens*).

Woodland Seep

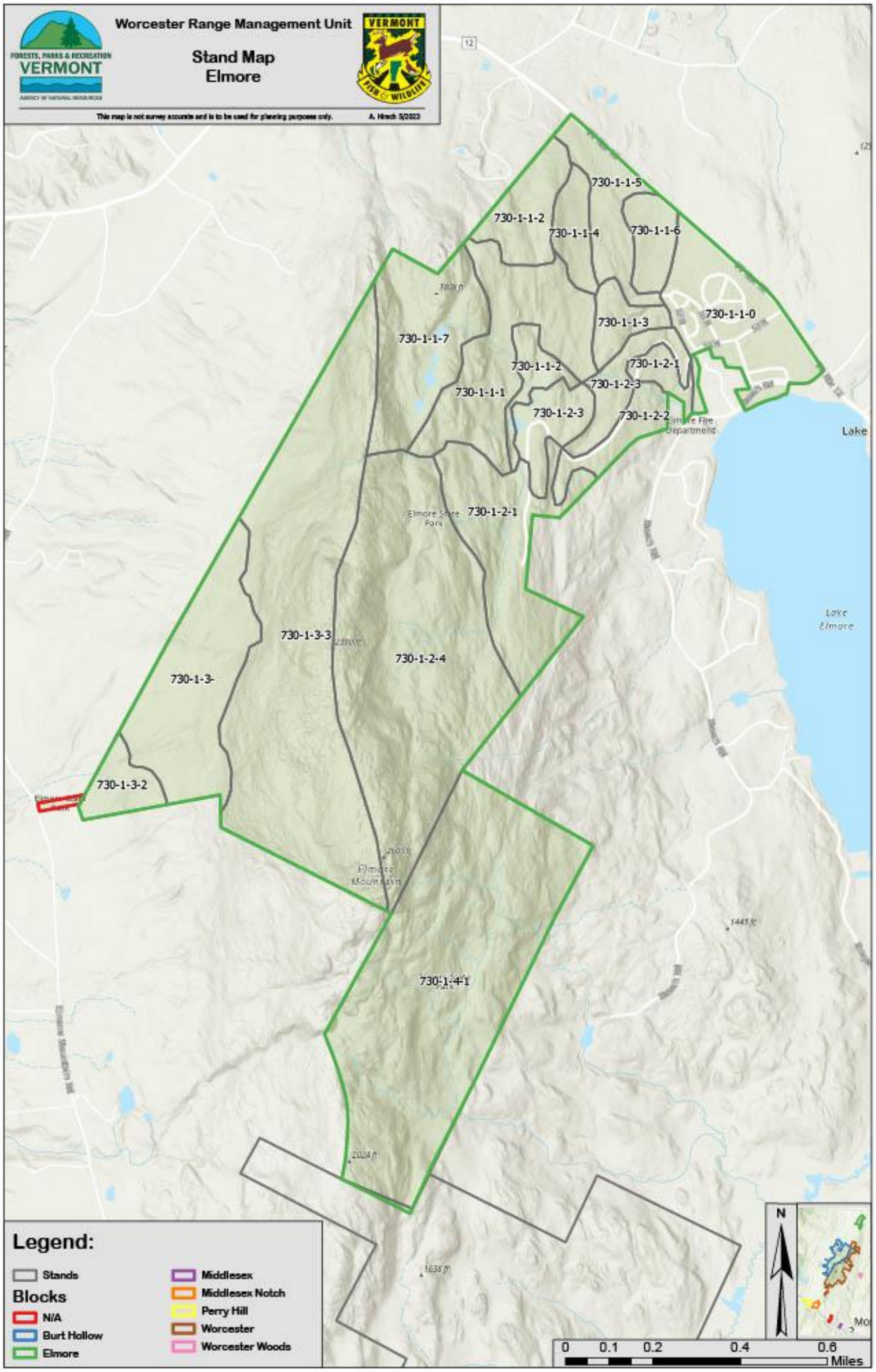
Woodland Seeps are abundant in the WRMU: 98 patches of this community have been mapped during inventories. However, since seeps are often impossible to map remotely, and must be detected during on-the-ground surveys, it is likely that this number only represents a small fraction of the total seeps in the management unit. Many of the mapped seeps are considered to be examples of statewide significance.

Woodland Seeps are found in a variety of settings, including on slopes, benches, and in narrow valleys. Soils are typically a saturated muck, with a hardpan layer beneath. Trees and shrubs are generally absent, but herbs can be abundant. Commonly observed species include golden saxifrage (*Chrysosplenium americanum*), false hellebore (*Veratrum viride*), foamflower (*Tiarella cordifolia*), sensitive fern (*Onoclea sensibilis*), and a manna-grass (*Glyceria melicaria*). Moss cover is generally limited, with exposed muck common. Several seeps at higher elevations were distinctive, being characterized by *Sphagnum* mosses, false hellebore (*Veratrum viride*), mountain wood fern (*Dryopteris campyloptera*), and occasional red spruce (*Picea rubens*), balsam fir (*Abies balsamea*), and mountain maple (*Acer spicatum*). These “high-elevation seeps” were typically embedded within Montane Spruce-Fir Forest or Montane Yellow Birch-Red Spruce Forest. The uncommon boreal bedstraw (*Galium kamtschaticum*) occurs in several seeps in the Worcester Range.

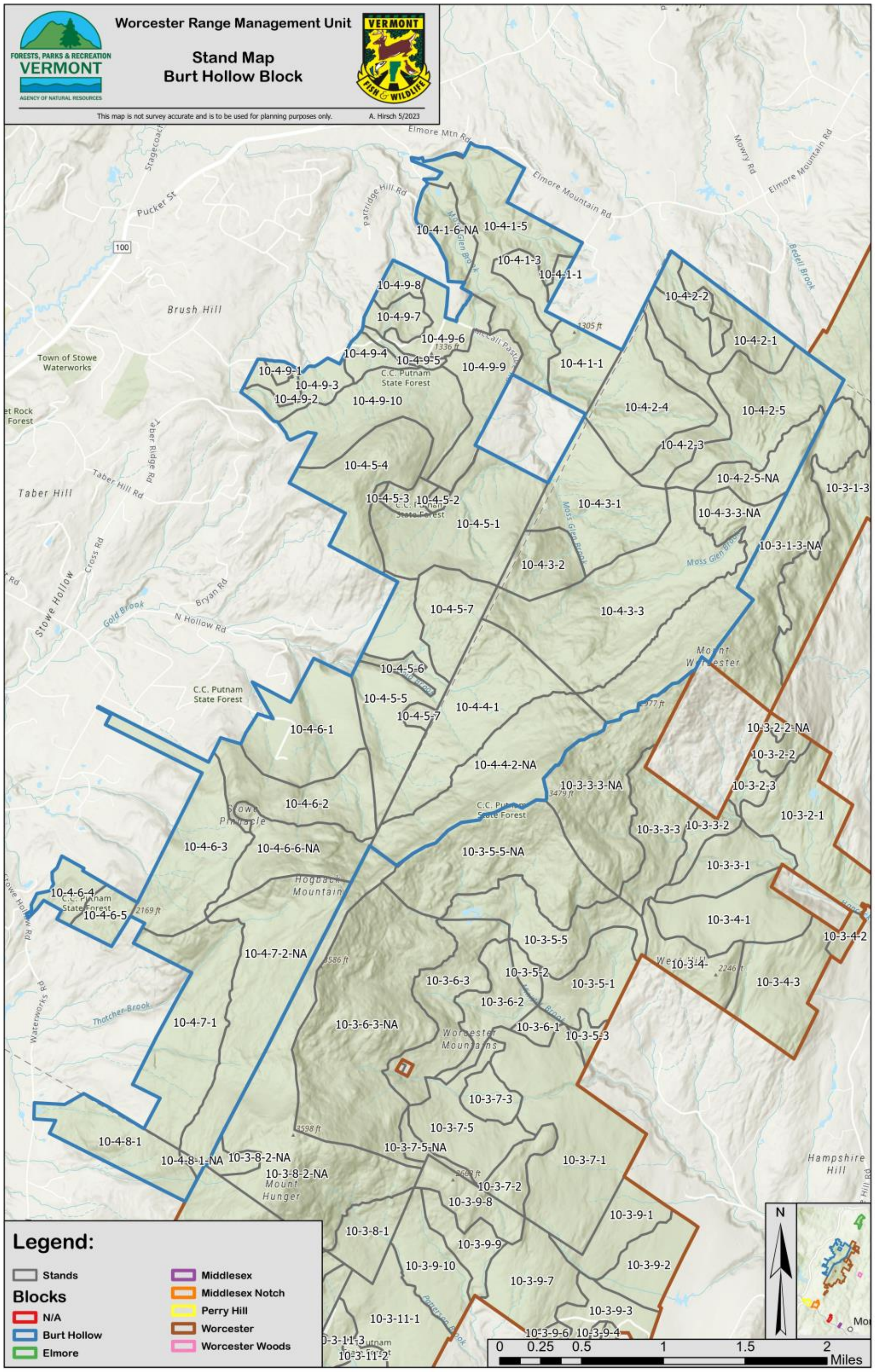
Because groundwater flow moderates the soil temperature in seeps, these can be among the first places to have plant growth in spring. This early vegetation is an important food source for black bears in spring and into summer. Seeps also provide habitat for several amphibians, including spring salamander, dusky salamander, and northern two-lined salamander.

APPENDIX 2: Forest Inventory Data and Stand Map(s)

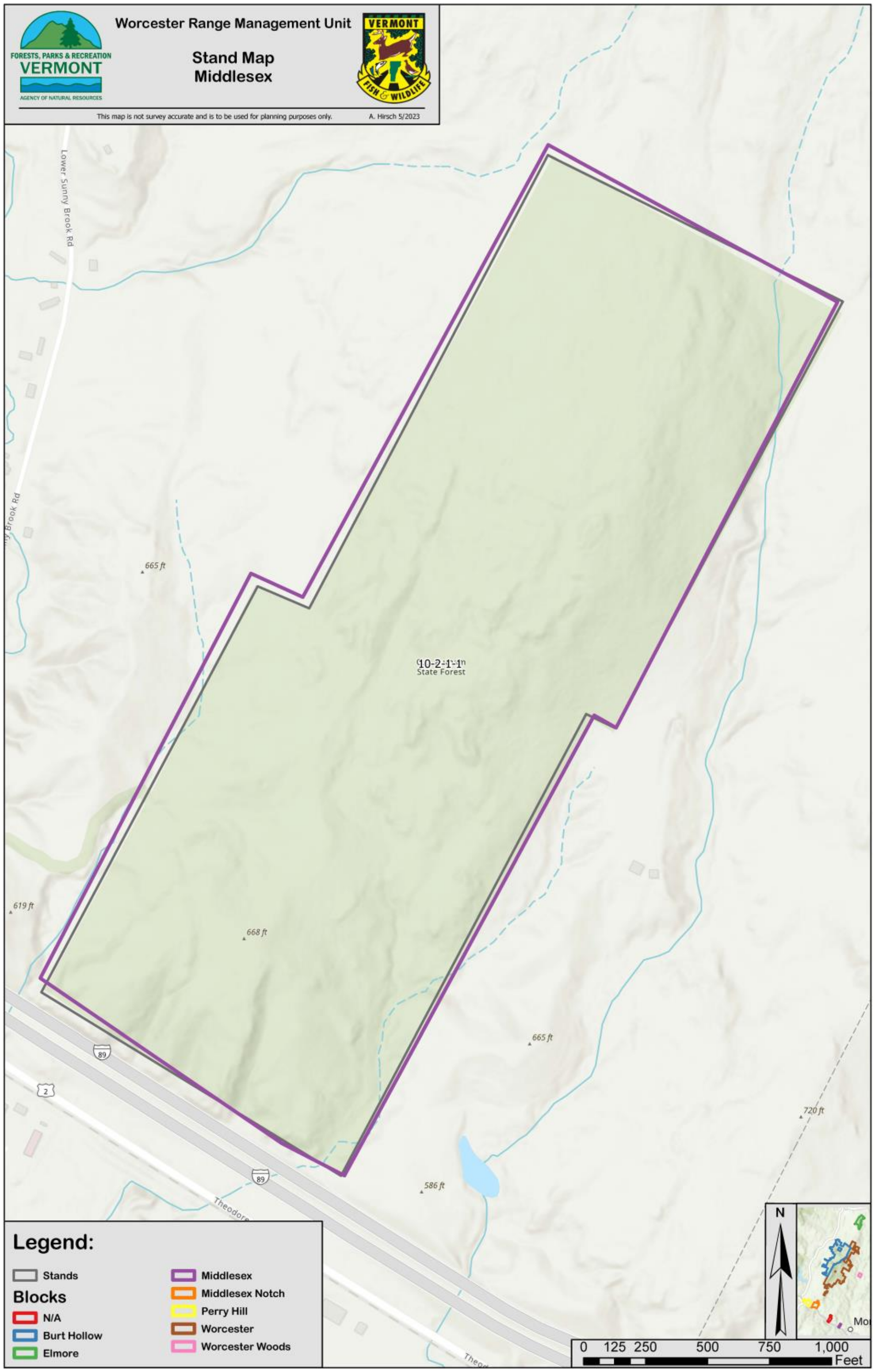
Map 51: Stand Map – Elmore Block



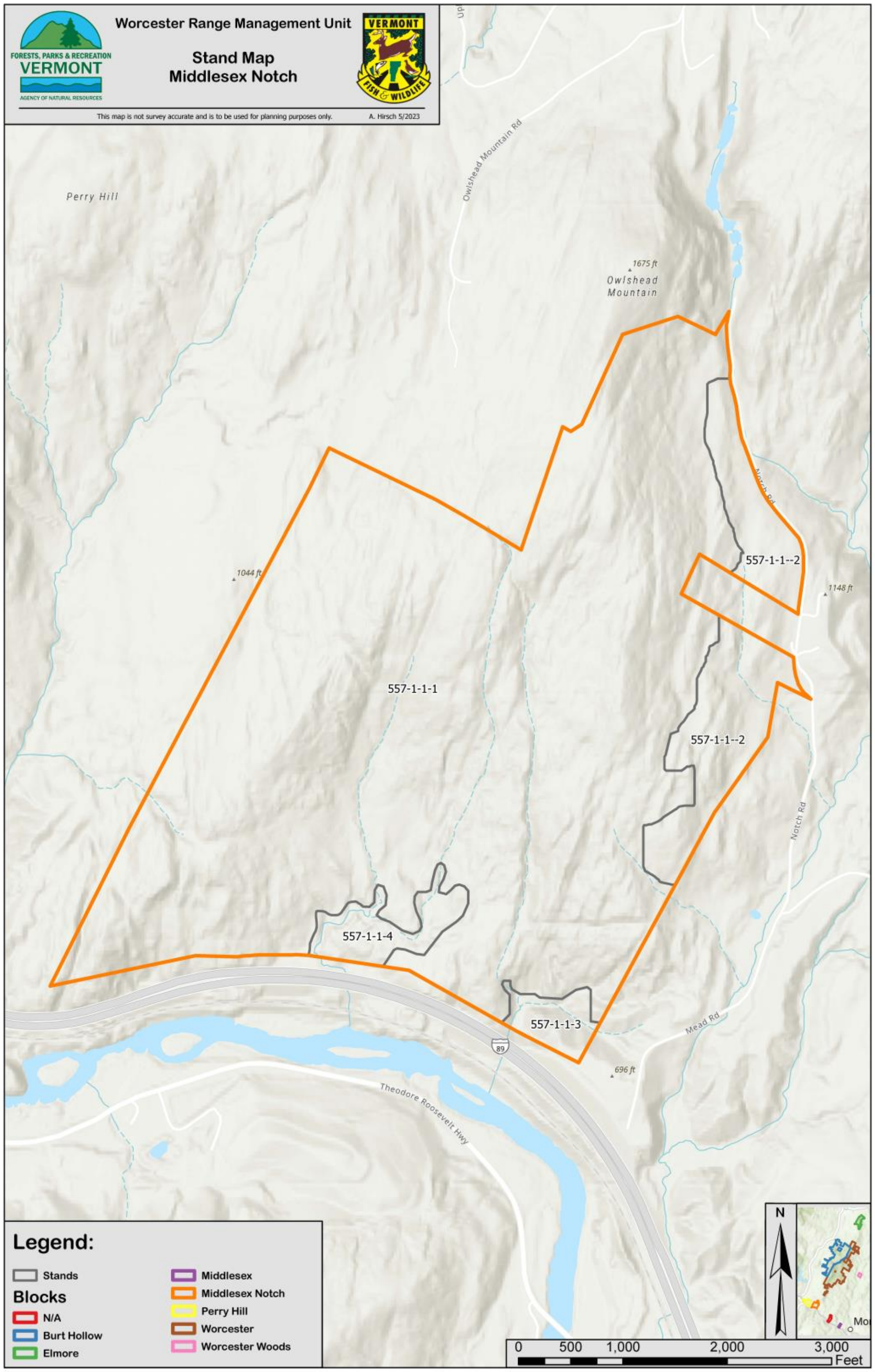
Map 52: Stand Map – Burt Hollow Block



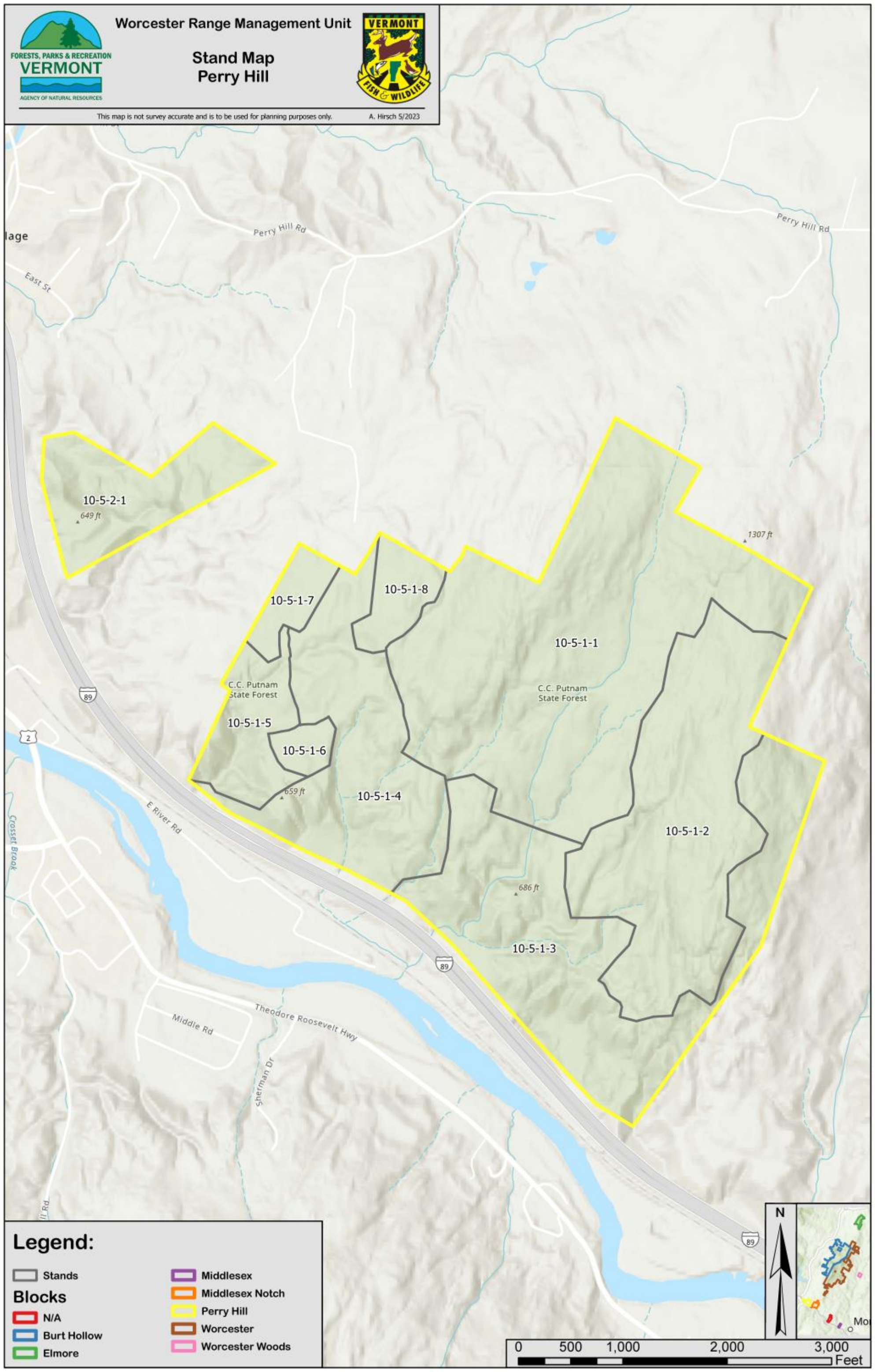
Map 53: Stand Map – Middlesex Block



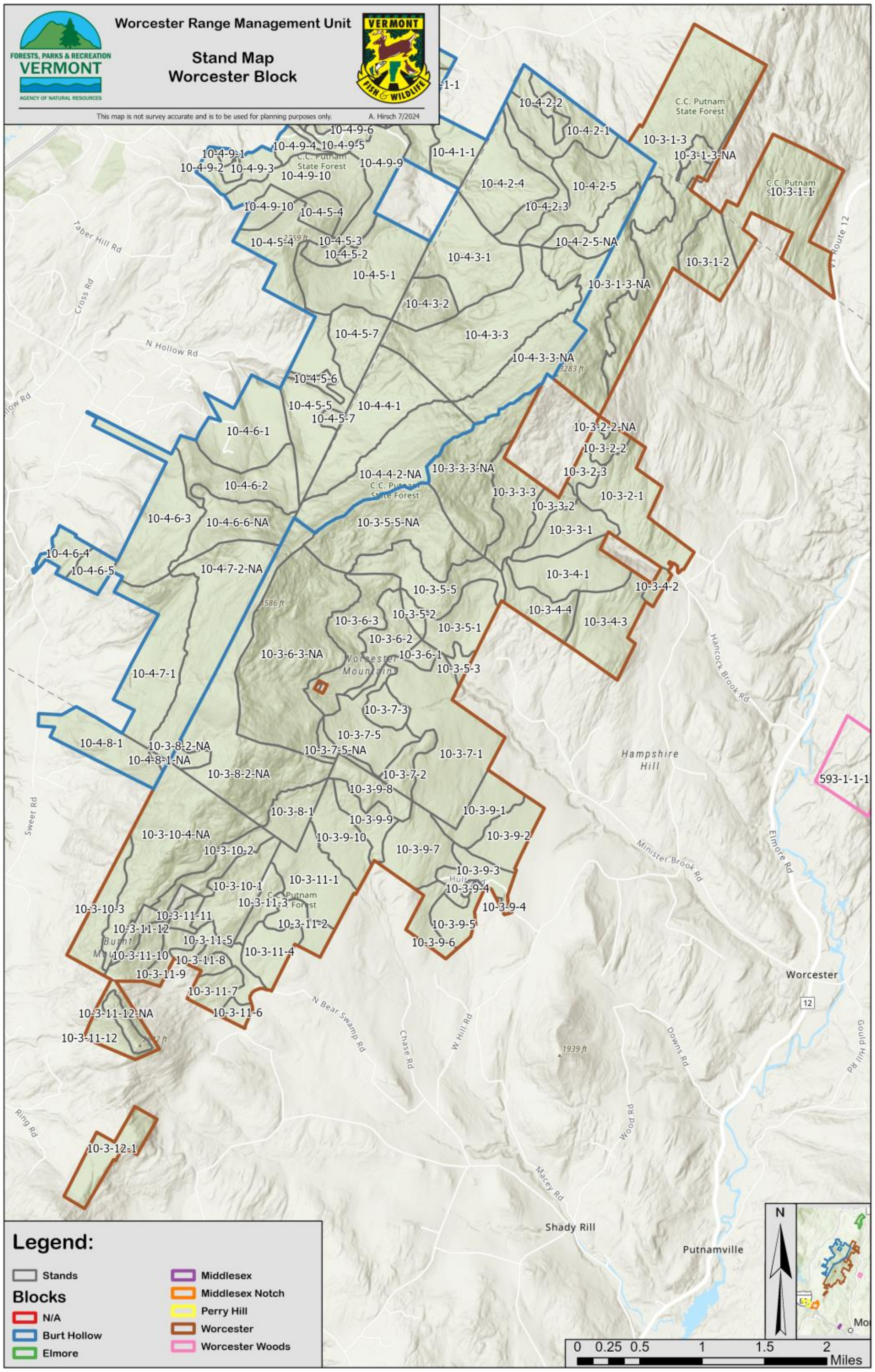
Map 54: Stand Map – Middlesex Notch Block



Map 55: Stand Map – Perry Hill Block



Map 56: Stand Map – Worcester Block



Map 57: Stand Map – Worcester Woods Block

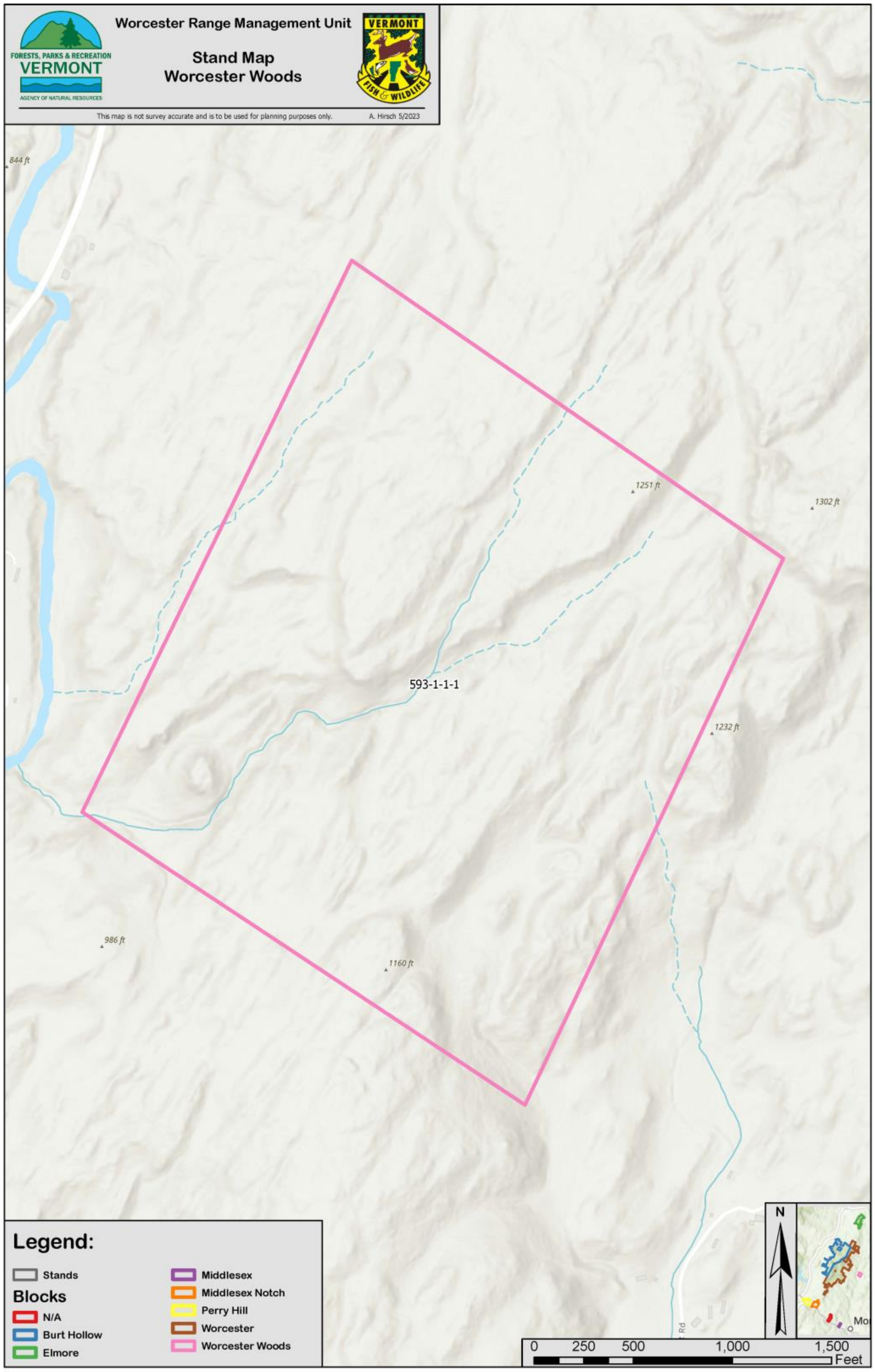


Table 35: Stand data for the WRMU

WORCESTER RANGE MANAGEMENT UNIT - STAND DATA								
Elmore State Park								
STAND	ACRES	FOREST TYPE	QMD	TOTAL BA	AGS BA	UGS BA	RELATIVE DENSITY	TREES PER ACRE
1-1	60	BEECH-Y.BIRCH-SUG.MAPLE	10.7	60	26.7	33.3	46.9	96.1
1-2	22	PAPER B-RED S-BALSAM	7.7	98	66	32	69.7	300.4
1-3	12	EASTERN HEMLOCK	8.1	118	62	56	75.2	332.8
1-4	13	BEECH-Y.BIRCH-SUG.MAPLE	13.7	100	90.0	10.0	79.4	97.94
1-5	25	MIXED (25%-65% SOFTWOOD)	10.1	102.5	27.5	75.0	74.2	183.8
1-6	14	WHITE PINE	8.32	156	116	40	90.4	413
2-1	65	BEECH-Y.BIRCH-SUG.MAPLE	7.5	133.8	62.5	71.3	112.8	439.3
2-2	19	PAPER B-RED S-BALSAM	6.5	144	64	80	118.4	627.9
3-1	66	SUGAR MAPLE	6.1	141	73	68	123.9	686.8
3-2	14	MIXED (25%-65% SOFTWOOD)	5	137.5	60	77.5	112	1008.8
Middlesex Notch WMA								
STAND	ACRES	FOREST TYPE	QMD	TOTAL BA	AGS BA	UGS BA	RELATIVE DENSITY	TREES PER ACRE
1-2	56	MIXED (25%-65% SOFTWOOD)	9	140	72	68	101.2	319.6
1-1	225	BEECH-RED MAPLE	10	193.3	93.3	100	148.7	352

Worcester Woods WMA								
STAND	ACRES	FOREST TYPE	QMD	TOTAL BA	AGS BA	UGS BA	RELATIVE DENSITY	TREES PER ACRE
1-1	183	MIXED (25%-65% SOFTWOOD)	9.5	152	88	64	86.3	307.5

C.C. Putnam State Forest								
BURT HOLLOW BLOCK								
STAND	ACRES	FOREST TYPE	QMD	TOTAL BA	AGS BA	UGS BA	RELATIVE DENSITY	TREES PER ACRE
1-1	113	RED S-SUGAR M-BEECH	9.5	120	70	50	85.2	243.4
1-3	52	HEMLOCK-YELLOW BIRCH	7.4	152.5	70	82.5	91.8	505.3
1-5	328	MIXED (25%-65% SOFTWOOD)	10.3	158	114	44	109.8	273.3
2-1	170	RED S-SUGAR M-BEECH	14.1	125	95	30	98.8	115.3
2-2	50	HEMLOCK-YELLOW BIRCH	11.5	150	40	110	114.6	208.5
2-3	121	PAPER B-RED S-BALSAM	8.9	116.7	53.3	63.3	82.6	271.3
2-4	226	BEECH-Y.BIRCH-SUG.MAPLE	7.4	124	38	86	105.2	417.4
3-1	271	BEECH-Y.BIRCH-SUG.MAPLE	10.2	118	50	68	95.5	207.6
3-2	102	PAPER B-RED S-BALSAM	7.7	136.7	63.3	73.3	88.1	428.3
3-3	495	MIXED (25%-65% SOFTWOOD)	8.7	76.7	60	16.7	58.8	184.8
4-1	305	RED S-SUGAR M-BEECH	9.1	108	92	16	91.6	241
5-1	320	BEECH-Y.BIRCH-SUG.MAPLE	9.2	128	76	52	106.6	277.5
5-2	10	BEECH-Y.BIRCH-SUG.MAPLE	9.8	85	57.5	27.5	70.6	163
5-3	33	RED S-SUGAR M-BEECH	9.5	96.7	43.3	53.3	69.6	196
5-4	217	BEECH-Y.BIRCH-SUG.MAPLE	9.9	93.3	40	53.3	62	175.9
5-5	255	BEECH-Y.BIRCH-SUG.MAPLE	9.2	140	82.2	57.8	116.6	304.2
9-2	28	RED MAPLE	8.6	97.5	35.0	62.5	76.4	244.8
9-9	142	MIXED (25%-65% SOFTWOOD)	9.6	116.9	63.9	53.1	82.7	232.1

9-10	259	SUGAR MAPLE	9.3	111.7	80.0	31.7	90.1	236.8

C.C. Putnam State Forest								
MIDDLESEX BLOCK								
STAND	ACRES	FOREST TYPE	QMD	TOTAL BA	AGS BA	UGS BA	RELATIVE DENSITY	TREES PER ACRE
1-1	125	WHITE PINE-HEMLOCK	12.7	149.2	80	69.2	83.7	169.8

C.C. Putnam State Forest								
PERRY HILL BLOCK								
STAND	ACRES	FOREST TYPE	QMD	TOTAL BA	AGS BA	UGS BA	RELATIVE DENSITY	TREES PER ACRE
1-1	176	MIXED (25%-65% SOFTWOOD)	5.6	105	35	70	94.5	610.6
1-2	101	MIXED (25%-65% SOFTWOOD)	12.6	186.7	46.7	140	104	216
1-3	112	MIXED (25%-65% SOFTWOOD)	11	136.7	63.3	73.3	95.1	205.6
1-4	70	MIXED (25%-65% SOFTWOOD)	13.5	153.3	86.7	66.7	93.6	154.7
1-5	23	WHITE PINE	7.4	290	250	40	162.3	972.4
1-6	6	WHITE PINE	10.6	190	130	60	84.9	309.1
1-7	10	WHITE PINE	14.3	320	80	240	125.6	288.1
1-8	13	WHITE PINE	10.2	420	360	60	198.6	735
2-1	36	MIXED (25%-65% SOFTWOOD)	12.4	135	80	55	75.4	160.4

C.C. Putnam State Forest								
WORCESTER BLOCK								
STAND	ACRES	FOREST TYPE	QMD	TOTAL BA	AGS BA	UGS BA	RELATIVE DENSITY	TREES PER ACRE
1-1	384	BEECH-RED MAPLE	7	63.3	26.7	36.7	56.6	237.4

1-2	139	BEECH-Y.BIRCH-SUG.MAPLE	8	108	48	60	90.1	311.8
2-1	253	BEECH-Y.BIRCH-SUG.MAPLE	7.9	97.5	52.5	45.0	78.8	286.9
2-3	35	BEECH-Y.BIRCH-SUG.MAPLE	9.3	133.3	46.7	86.7	105.9	281.9
3-1	126	BEECH-Y.BIRCH-SUG.MAPLE	9.7	90	50	40	73.3	176.2
3-2	50	PAPER BIRCH	10.2	116	62	54	98.9	205.0
4-1	184	BEECH-Y.BIRCH-SUG.MAPLE	9.8	100.8	68.3	32.5	83.1	193.7
4-2	22	PAPER BIRCH	6.3	152	76	76	136.3	712.3
4-3	205	RED SPRUCE	5.8	220	145	75	127.4	1183.3
5-1	142	BEECH-Y.BIRCH-SUG.MAPLE	11.9	87.3	43	44	69.4	113.2
5-2	26	BEECH-Y.BIRCH-SUG.MAPLE	9.2	92	60	32	77.3	197.8
5-3	21	RED SPR.-BALSAM FIR	4.9	166.7	70	96.7	120.2	1258.7
5-4	194	RED SPR.-BALSAM FIR	6.7	123	46	78	98.4	502.0
6-1	27	BEECH-Y.BIRCH-SUG.MAPLE	9.5	93.3	40.7	52.7	77.0	191.6
6-2	114	PAPER BIRCH	8.1	126.4	50	76.4	110.8	350.2
7-1	424	BEECH-Y.BIRCH-SUG.MAPLE	10.8	96.2	45.4	50.7	78.2	151.2
7-2	63	RED SPR.-YELLOW BIR.	8.8	110	35	75	81.7	260.7
7-3	55	RED SPR.-BALSAM FIR	10.4	104	76	28	55.2	176
9-1	110	BEECH-Y.BIRCH-SUG.MAPLE	10.1	44.1	25.8	18.2	35.6	78.72
9-2	116	PAPER BIRCH	5.3	120	22	98	102.3	789.1
11-4	101	RED MAPLE	10.0	95.6	28.9	66.7	79.9	176.8
11-6	23	RED SPR. - BALSAM FIR	8.2	80.0	60.0	20.0	55.0	219.6
11-7	66	SUGAR MAPLE	9.7	88.9	37.8	51.1	68.6	175.1

APPENDIX 3: Historic Resources Assessment Methods and Data

Table 36. Previously conducted CRM projects in the Worcester Range Management Unit

Project No.	Date	Author	Management Unit	Project	Map	RTP No.*	Summary
8	2017	Knight	Elmore SP	Trailhead parking	Yes		Expansion of trailhead parking and installation of toilet facility. Review conducted in wrong location. See Project No. 496.
64	2010a; 2010b	Llewellyn	Elmore SP	Bath House and Beach House project	Yes		Repair and rehabilitation of Bath House to meet contemporary uses.
75	2011	Scharoun and Bartone	Elmore SP	Social Trail new construction rehab	Yes	VT12-D4-9	New trail construction and rehab of Social Trail.
83	2014	Knight	CC Putnam CF	Small Axe Trail (formerly known as the Rastaman Trail)	Yes	VT15-D4-7	Repairs and rehab to Small Axe Trail including rerouting trail and construction of retaining walls.
89	2015	N/A	CC Putnam CF	Waterbury Trail	Yes	VT16-D4-8	Expand trailhead parking area, adding 100-85 feet to hold approx. 20 cars.
92	2016a	Knight	CC Putnam CF	Campfire and Main Trails	Yes	DR5-16-2016	Re-route on Campfire Trail including several switchbacks as well as corner maintenance. Also, emplacement of switchbacks on Main Trail. Mapping approximate.

93	2016b	Knight	CC Putnam CF	Trail #3	Yes	No ID No.	Construction and re-route of Trail #3, Perry Hill Block.
299	1988	N/A	Elmore SP	Beach Retaining Wall	Yes		Reconstruction of retaining wall at beach. Extent of repairs uncertain since no map available.
301	1985	Hight	Elmore SP	Preliminary Archaeological Assessment	Yes		Brief summary of cultural resources at Elmore SP.
304	1999	MacCallu m	Elmore SP	NRHP Registration Form	Yes		NRHP Nomination Form for Elmore SP.
387	2013	N/A	Elmore SP	Fire Tower Steps and Platform Boards Replacement	Yes	VT14-D0-C STC9	Replacement of wood stair treads and landings at Elmore Mountain Fire Tower.
388	2013	N/A	Elmore SP	Roving District 4	No	VT14-D0-C STC8	Roving trail maintenance throughout Elmore SP. Not mapped in GIS.
420	2002	N/A	Elmore SP	Trail maintenance	No	VT03-D4W	Maintenance to Nature Trail, Fire Tower Trail, and Balancing Rock Trail. No map available - location of repairs uncertain and not mapped in GIS.
421	2002	N/A	Elmore SP	Beachfront walkway	Yes	VT03-D4B	Complete repair of CCC stone walkway. No map available - extent of repairs uncertain.
422	2001	N/A	Elmore SP	State Park improvements	Yes	VT02-D4N	Repair CCC stone beach wall and stone walkway. No map available - extent of repairs uncertain.
423	2003	N/A	Elmore SP	Trail maintenance	Yes	VT04-D4K	Maintenance to Fire Tower and

							Balancing Rock Trails.
424	2007	N/A	Elmore SP	Elmore Mountain Trail	Yes	VT08-D4J	Maintenance on Mountain Trail.
425	2001	N/A	CC Putnam CF	Plow Bear swamp parking lot	Yes	VT02-D4J	Plow Bear Swamp parking lot.
426	2005	N/A	Elmore SP	Elmore Mountain Trail	No	VT06-D4E	Maintenance on Mountain Trail. No map available - location of repairs uncertain and not mapped in GIS.
427	2004	N/A	Elmore SP	Elmore Fire Tower	Yes	VT05-D4D	Rebuild on Fire Tower Trail.
428	2002	N/A	CC Putnam CF	Plow Bear Swamp parking lot	Yes	VT03-D4K	Plow Bear Swamp parking lot.
429	2002	N/A	CC Putnam CF	Stowe Pinnacle Trail	Yes	VT03-D4C	Construction of stone steps, continuation of work from previous including reduction of trail width.
430	2001	N/A	CC Putnam CF	Stowe Pinnacle Trail	No	VT02-D4C	Trail reconstruction project. No map available.
431	2001	N/A	CC Putnam CF	Middlesex and Worcester Trails	No	VT02-D4H	Trail maintenance project. No maps available.
432	2001	N/A	CC Putnam CF	Middlesex and Worcester Trails	No	VT02-D4G	Upgrade Bear Swamp Road to improve trail parking.
433	2003	N/A	CC Putnam CF	Stowe Pinnacle Trail	Yes	VT04-D4B	Continuation of earlier project to build stone steps to address erosion problems.
434	2011	N/A	CC Putnam CF	Waterbury Trail	Yes	FPR4-6	Install leg puncheons over wet sections of trail where heavy erosion is occurring, and trees are falling in.

435	2011	N/A	CC Putnam CF	Pinnacle Meadow and Stowe Pinnacle Trails	Yes	VT12 D4-4	Trail maintenance with new stone steps, cribbing, and rock water bars.
437	2009	N/A	CC Putnam CF	Perry Hill Block Trail	Yes	VT10 D4-9	Maintenance on sections of mountain bike trails including the Main Climb Trail and the Burning Spear trail.
438	2009	N/A	CC Putnam CF	Stowe Pinnacle Trail	Yes	VT10-D4-5	Continue work on reconstruction of treadway including work on stone staircases, cribbing, and waterbars.
439	2008	N/A	CC Putnam CF	Stowe Pinnacle Trail	Yes	VT09-D4-G	Replace waterbars, installing cribbing and stone staircases to address erosion problems.
440	2007	N/A	CC Putnam CF	Stowe Pinnacle Trail	No	No ID No.	Continue reconstruction of treadway, including stone staircases, cribbing and water bars.
441	2007	N/A	CC Putnam CF	Perry Hill Mountain Bike Trail	Yes	VT06 D4M	Described as Rastaman Trail (now called Small Axe Trail) but map included with report places trail outside of State Forest boundaries.
442	2005	N/A	CC Putnam CF	Stowe Pinnacle Trail	No	VT07 D4L	Continuation of previous work including the replacement of water bars and the construction of stone staircase.
443	2006	N/A	CC Putnam CF	Stowe Pinnacle Trail	Yes	VT07 D4L	Construction of stone water bars to reduce erosion.

444	2005	N/A	CC Putnam CF	Perry Hill trails	Yes	VT06 D4F	Installation of rolling water bars on the Main Trail and Desert Double Track trails.
445	2003	N/A	CC Putnam CF	Middlesex and Worcester Mountain trails	Yes	VT05 D4F	Installation of stepping stones, log ladder, and replacement of water bars.
446	2003	N/A	CC Putnam CF	Worcester Block Trail	Yes	VT04 D4D	Installation and rebuilding of water bars, stone steps, as well as brushing and blazing.
448	2016	N/A	CC Putnam CF	Waterbury Trail	Yes	VT15 D4-3	Maintenance of switchback above the waterfalls.
449	2014	N/A	CC Putnam CF	Middlesex Trail	Yes	VT15 D4-4	Construction of stairs and ladders as well as water diversion along the length of the trail.
451	2015	N/A	CC Putnam CF	Waterbury Trail	Yes	VT16 D4-3	Install boulders within the trail and along the sidewalls, as well as build new drainage structures to stabilize the trail.
452	2015	N/A	CC Putnam CF	White Rocks Trail	Yes	VT16 D4-4	Trail maintenance White Rocks Trail.
453	2013	N/A	CC Putnam CF	Roving trails review District 4	Yes	VT14-D0-C STC8	Roving trails review for District 4. No mapping available.
454	2014	N/A	CC Putnam CF	Waterbury trail	Yes	VT15 D4-4	Rebuild switchback above the waterfall, including installation of a water diversion, rebuild the staircase, remove berms and install water diversion structures.
496	2020	Knight	Elmore SP	Monitoring	Yes		Installation of Clivus toilet and

							associated ADA trail

* All listed RTP projects were conducted before 2019

Table 37: Structures Including Map-Documented Structures (MDS)

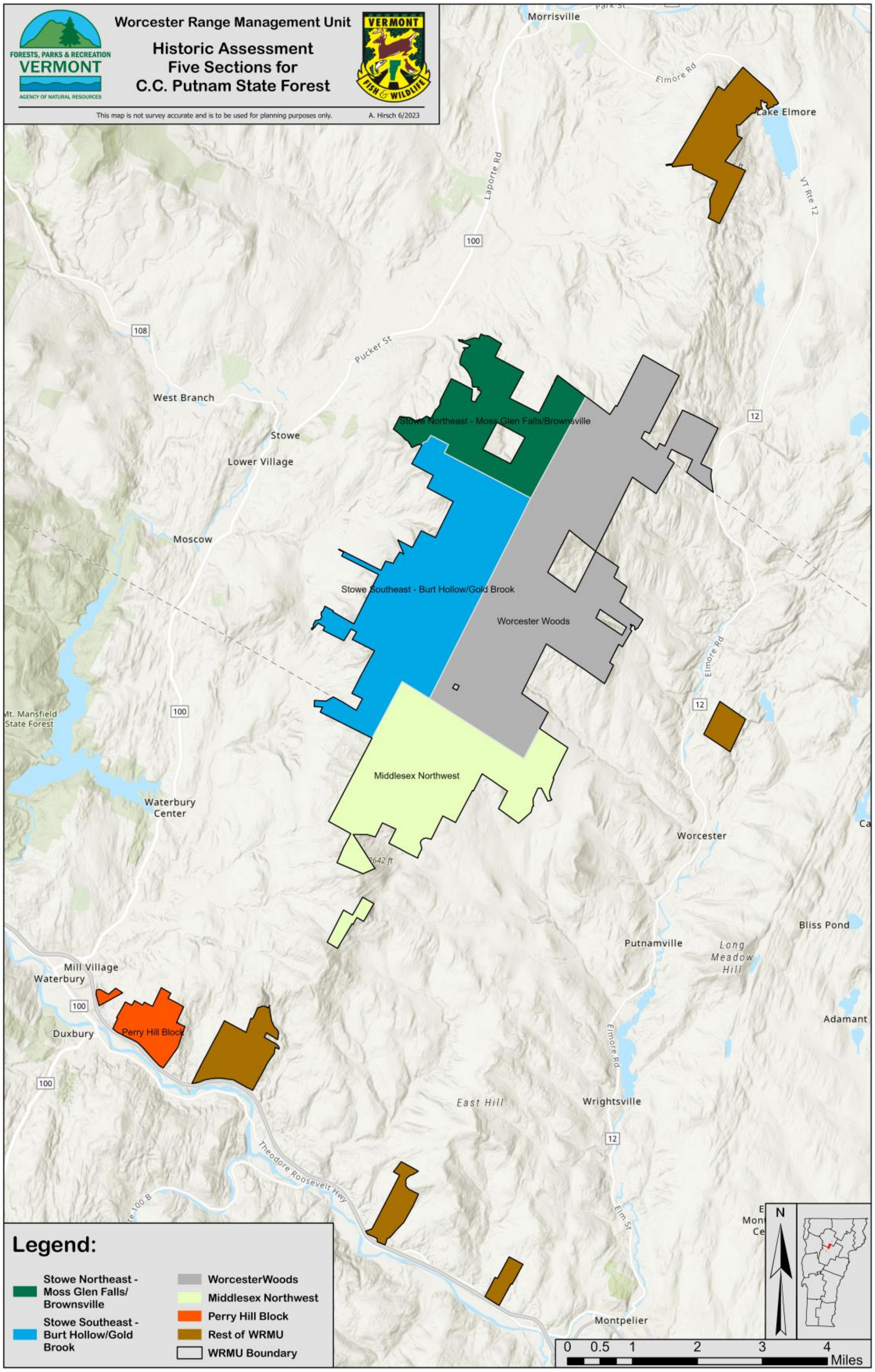
Structure No.	Town	Management Unit	Description	Source
10-1	Waterbury	C.C. Putnam SF	Cellar hole, location approximate. Identified in Knight 2014, adjacent to Rastaman Trail (now called Small Axe Trail). See 10-34	Knight 2014 (Report No. 83)
10-2	Stowe	C.C. Putnam SF	MDS attributed to C. Marshall and No Name in Walling	Beers 1878; Walling 1859
10-3	Stowe	C.C. Putnam SF	MDS attributed to O. Spaulding in Beers and J.W. Spaulding in Walling	Beers 1878; USGS 1919
10-4	Stowe	C.C. Putnam SF	MDS attributed to Sawmill	Beers 1878
10-5	Stowe	C.C. Putnam SF	MDS identified as Starch Factory	Beers 1878
10-6	Stowe	C.C. Putnam SF	MDS identified as School	Beers 1878; Walling 1859; USGS 1919
10-7	Stowe	C.C. Putnam SF	MDS identified as F.J.B.	Beers 1878; USGS 1919
10-8	Stowe	C.C. Putnam SF	MDS attributed to No Name	Beers 1878
10-9	Stowe	C.C. Putnam SF	MDS attributed to W. Warren - located on boundary line	Beers 1878; USGS 1919
10-10	Stowe	C.C. Putnam SF	MDS attributed to No Name in Beers and Walling	Beers 1878; Walling 1859
10-11	Stowe	C.C. Putnam SF	MDS attributed to H.D. Brown in Beers and D. Brown Walling	Beers 1878; Walling 1859
10-12	Stowe	C.C. Putnam SF	MDS attributed to Mrs. Jewett. Either 10-12 or 10-13 are present on USGS 1919	Beers 1878
10-13	Stowe	C.C. Putnam SF	MDS attributed to C&G Thetford - located on boundary line, east side of McCall Pasture Lane. Either 10-12 or 10-13 are present on USGS 1919	Beers 1878
10-14	Stowe	C.C. Putnam SF	MDS attributed to O. Loomis - located on boundary line, east side of McCall Pasture Lane	Beers 1878
10-15	Stowe	C.C. Putnam SF	MDS attributed to Jos. Goodyear - located on boundary line, east side of McCall Pasture Lane	Beers 1878l; USGS 1919
10-16	Stowe	C.C. Putnam SF	MDS attributed to Town of Waterbury - located on boundary line, east side of McCall Pasture Lane	Beers 1878; USGS 1919

10-17	Middlesex	C.C. Putnam SF	MDS attributed to J. Vaughn (sic)	Walling 1858
10-18	Middlesex	C.C. Putnam SF	MDS attributed to J.J. Vaughan	Beers 1873
10-19	Middlesex	C.C. Putnam SF	MDS attributed to J.L. Bruce	Beers 1873
10-20	Worcester	C.C. Putnam SF	MDS attributed to J. Slattery. According to LIDAR, possible cellar hole identified about 200 feet to the east	Beers 1873; LIDAR
10-21	Worcester	C.C. Putnam SF	MDS attributed to J. McAvoy in Beers; W. Clifford in Walling. According to LIDAR, possible cellar hole identified about 140 feet to the north.	Beers 1873; Walling 1858; LIDAR
10-22	Worcester	C.C. Putnam SF	MDS attributed A. (or H?) Hurlburt in Beers and Walling. According to LIDAR, possible cellar hole identified about 140 feet to the north	Beers 1873; Walling 1858; LIDAR
10-23	Worcester	C.C. Putnam SF	MDS attributed to S. Hall in Beers and Walling. According to LIDAR, possible cellar hole identified about 100 feet to the southeast, as well as another cellar hole about 200 feet to the southwest	Beers 1873; Walling 1858; LIDAR
10-24	Worcester	C.C. Putnam SF	MDS identified as School in Beers and Walling. Possible cellar holes identified with LIDAR. See entry for 10-23.	Beers 1873: Walling 1858
10-25	Waterbury	C.C. Putnam SF	Cemetery	Beers 1873
10-26	Worcester	C.C. Putnam SF	MDS identified as School	Beers 1873
10-27	Worcester	C.C. Putnam SF	MDS attributed to W. Burrell	Beers 1873
10-28	Worcester	C.C. Putnam SF	MDS attributed to H.H. Colyer in Beers; H.H. Collier in Walling	Beers 1873; Walling 1858
10-29	Waterbury	C.C. Putnam SF	MDS identified as School	Beers 1873
10-30	Worcester	C.C. Putnam SF	Logging camp remains as identified by Ron Wells	Ron Wells; Scharoun and Cowie 2007
10-31	Worcester	C.C. Putnam SF	Logging camp remains as identified by Ron Wells	Ron Wells; Scharoun and Cowie 2007
10-32	Worcester	C.C. Putnam SF	MDS attributed to R. Jones	Walling 1858; LIDAR
10-33	Stowe	C.C. Putnam SF	MDS attributed to Blacksmith Shop	Walling 1859
10-34	Waterbury	C.C. Putnam SF	MDS attributed to Mrs. Johnson in Beers; E. Johnson in Walling	Beers 1873; Walling 1858

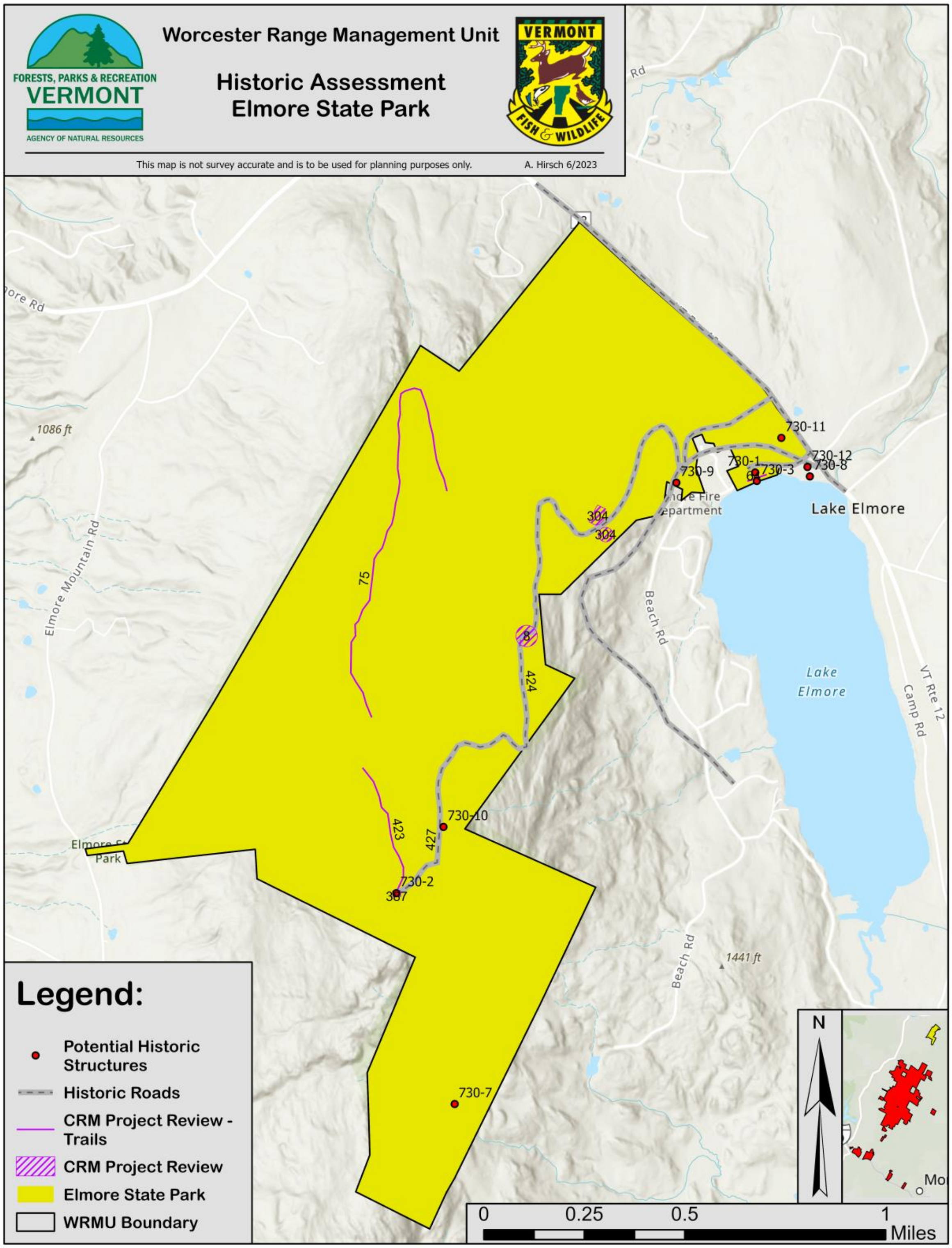
10-35	Waterbury	C.C. Putnam SF	MDS attributed to T. Dwyer	Beers 1873
10-37	Waterbury	C.C. Putnam SF	MDS attributed to J. Jewett	Walling 1858
10-39	Stowe	C.C. Putnam SF	MDS attributed to Fuller & Boyington	Walling 1859
10-40	Stowe	C.C. Putnam SF	MDS attributed to J. Byinton (probably misspelling of Boyington)	Walling 1859
10-41	Stowe	C.C. Putnam SF	MDS attributed to No Name	Walling 1859
10-42	Stowe	C.C. Putnam SF	Possible structure or pen (55x50 feet)	LIDAR
10-43	Stowe	C.C. Putnam SF	Possible cellar hole, possibly Structure 10-10	LIDAR
10-44	Stowe	C.C. Putnam SF	Possible pen in association with Structures 10-10 and 10-42	LIDAR
10-45	Stowe	C.C. Putnam SF	Possible cellar hole	LIDAR
10-46	Stowe	C.C. Putnam SF	Possible cellar hole with possible adjacent structure	LIDAR
10-47	Stowe	C.C. Putnam SF	Cellar hole near intersection of 2 roads	LIDAR
10-48	Stowe	C.C. Putnam SF	Cellar hole to west of unnamed road	LIDAR
10-49	Stowe	C.C. Putnam SF	Possible cellar hoe or other structural remains on northside of road	LIDAR
10-50	Stowe	C.C. Putnam SF	Cellar hole west of Pinnacle Meadow Road	LIDAR
10-51	Stowe	C.C. Putnam SF	Mine for Amphibolite and Schist ore, past producer. Unknown date. MRDS W033950	USGS
10-52	Stowe	C.C. Putnam SF	Copper mine, past producer. Unknown date. MRDS W102103	USGS
10-53	Waterbury	C.C. Putnam SF	Unknown feature, large rectangular shape in close proximity to 10-29	LIDAR
10-54	Waterbury	C.C. Putnam SF	Unknown feature, large right angle approximately 40x40 feet	LIDAR
10-55	Elmore	C.C. Putnam SF	Logging camp remains as identified by Ron Wells	Ron Wells; Scharoun and Cowie 2007
10-56	Worcester	C.C. Putnam SF	Logging camp remains as identified by Ron Wells	Ron Wells; Scharoun and Cowie 2007
10-57	Worcester	C.C. Putnam SF	Remains of mill as identified by Ron Wells	Ron Wells; Scharoun and Cowie 2007
10-58	Worcester	C.C. Putnam SF	Logging camp remains as identified by Ron Wells	Ron Wells; Scharoun and Cowie 2007

10-59	Worcester	C.C. Putnam SF	Logging camp remains as identified by Ron Wells	Ron Wells; Scharoun and Cowie 2007
10-60	Worcester	C.C. Putnam SF	Logging camp remains as identified by Ron Wells	Ron Wells; Scharoun and Cowie 2007
10-61	Worcester	C.C. Putnam SF	Possible cellar hole	LIDAR
10-62	Middlesex	C.C. Putnam SF	Possible cellar hole	LIDAR
556-1	Middlesex	Middlesex WMA	MDS attributed to A. Warren	Beers 1873, Walling 1858
557-1	Middlesex	Middlesex Notch WMA	MDS attributed to Mrs. Donovan in Beers and P. Moran in Walling. LIDAR mapping identifies a cellar hole about 100 feet to the NW and may be the physical remains of 557-1	Beers 1873; Walling 1858; LIDAR
557-2	Middlesex	Middlesex Notch WMA	MDS attributed to M. Rafter (spelling?) in Beers	Beers 1873
557-3	Middlesex	Middlesex Notch WMA	MDS attributed to E. Jones	Walling 1858
557-4	Middlesex	Middlesex Notch WMA	Possible cellar hole identified with LIDAR, with adjacent smaller cellar hole. Possibly 557-3	LIDAR
557-5	Middlesex	Middlesex Notch WMA	Possible cellar hole located along stream and possible road	LIDAR
557-6	Middlesex	Middlesex Notch WMA	Large area 500x200 ft. Possibly mined for I-89 with ramp and push piles	LIDAR
730-1	Elmore	Elmore SP	CCC Bath House	MacCallum 1999
730-2	Elmore	Elmore SP	Fire Tower	MacCallum 1999
730-3	Elmore	Elmore SP	CCC Beach	MacCallum 1999
730-4	Elmore	Elmore SP	CCC Access Road to CCC Camp and Fire Tower	MacCallum 1999
730-5	Elmore	Elmore SP	CCC Access Road to Beach and Bath House	MacCallum 1999
730-6	Elmore	Elmore SP	MDS with no name attributed in either Beers or Walling	Beers 1878; Walling 1859
730-7	Elmore	Elmore SP	Possible cellar hole identified through LIDAR	LIDAR
730-8	Elmore	Elmore SP	MDS with no name attributed at the intersection of Rt 12 and Beach Rd	Beers 1878
730-9	Elmore	Elmore SP	Elmore Post Office	Beers 1878
730-10	Elmore	Elmore SP	Location of old Ranger's Cabin	Bulmer Pers Comm; LIDAR
730-11	Elmore	Elmore SP	Structure attributed to I. Darling	Walling 1859
730-12	Elmore	Elmore SP	Structure defined as Blacksmith Shop in Walling, No Name in Beers	Beers 1878; Walling 1859
730-13	Elmore	Elmore SP	Unnamed structure mapped along Route 12	USGS 1930
801-1	Elmore	Atlas FL	MDS attributed to J. Scofield	Beers 1878
801-2	Elmore	Atlas FL	MDS attributed to D. Bellyville	Beers 1878

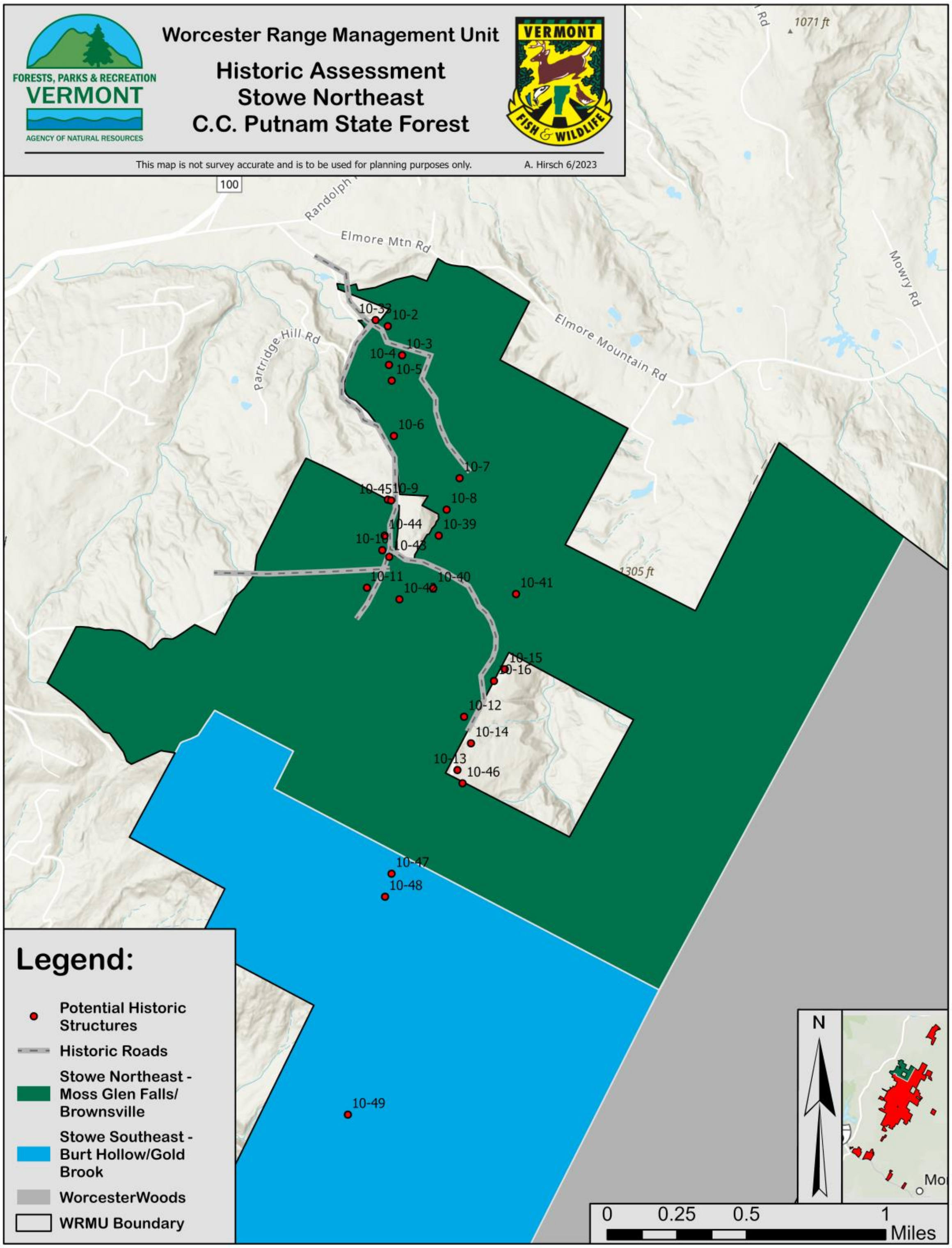
Map 58: Historic Resources Assessment – Five Sections of CC Putnam



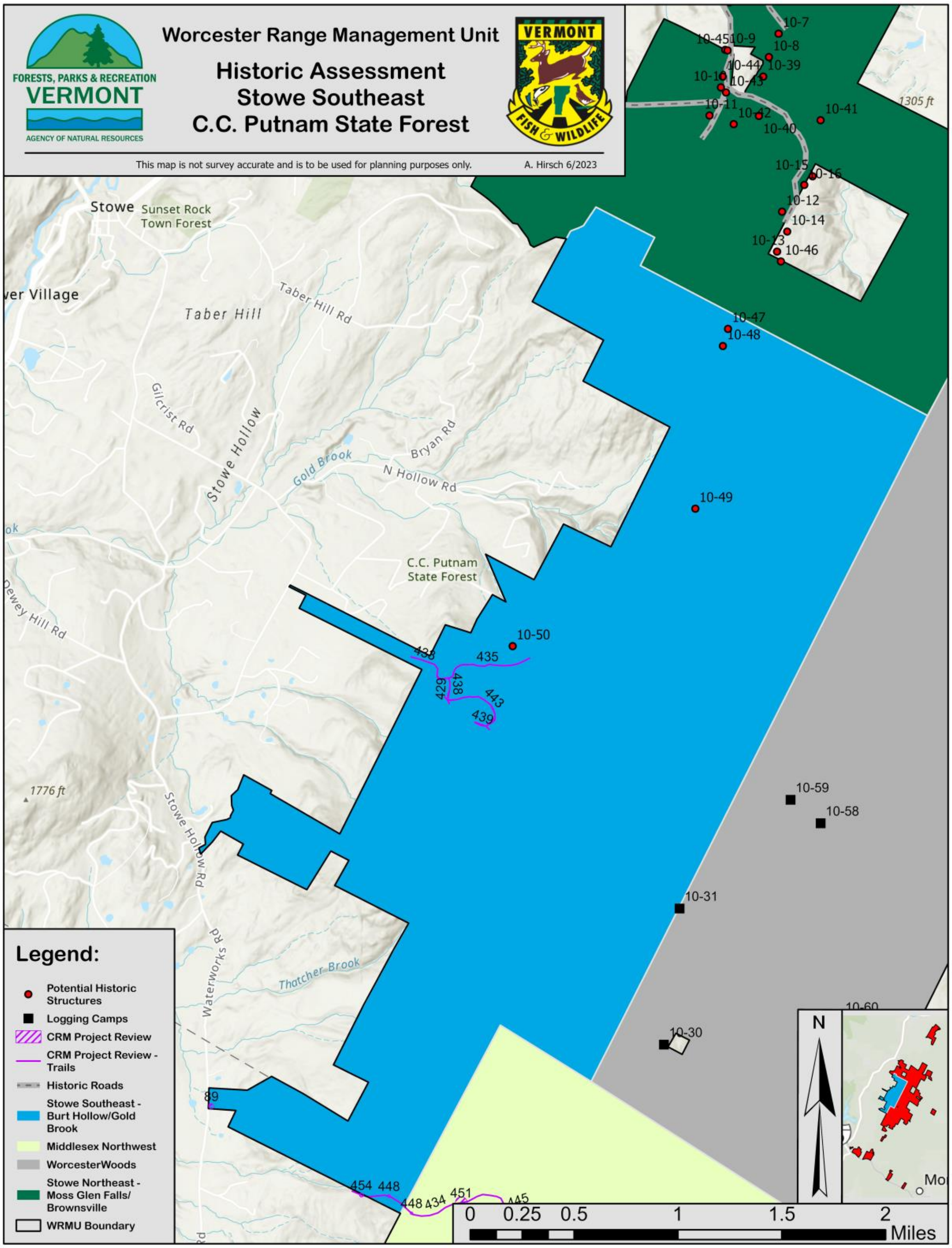
Map 59: Historic Resources Assessment – Elmore State Park



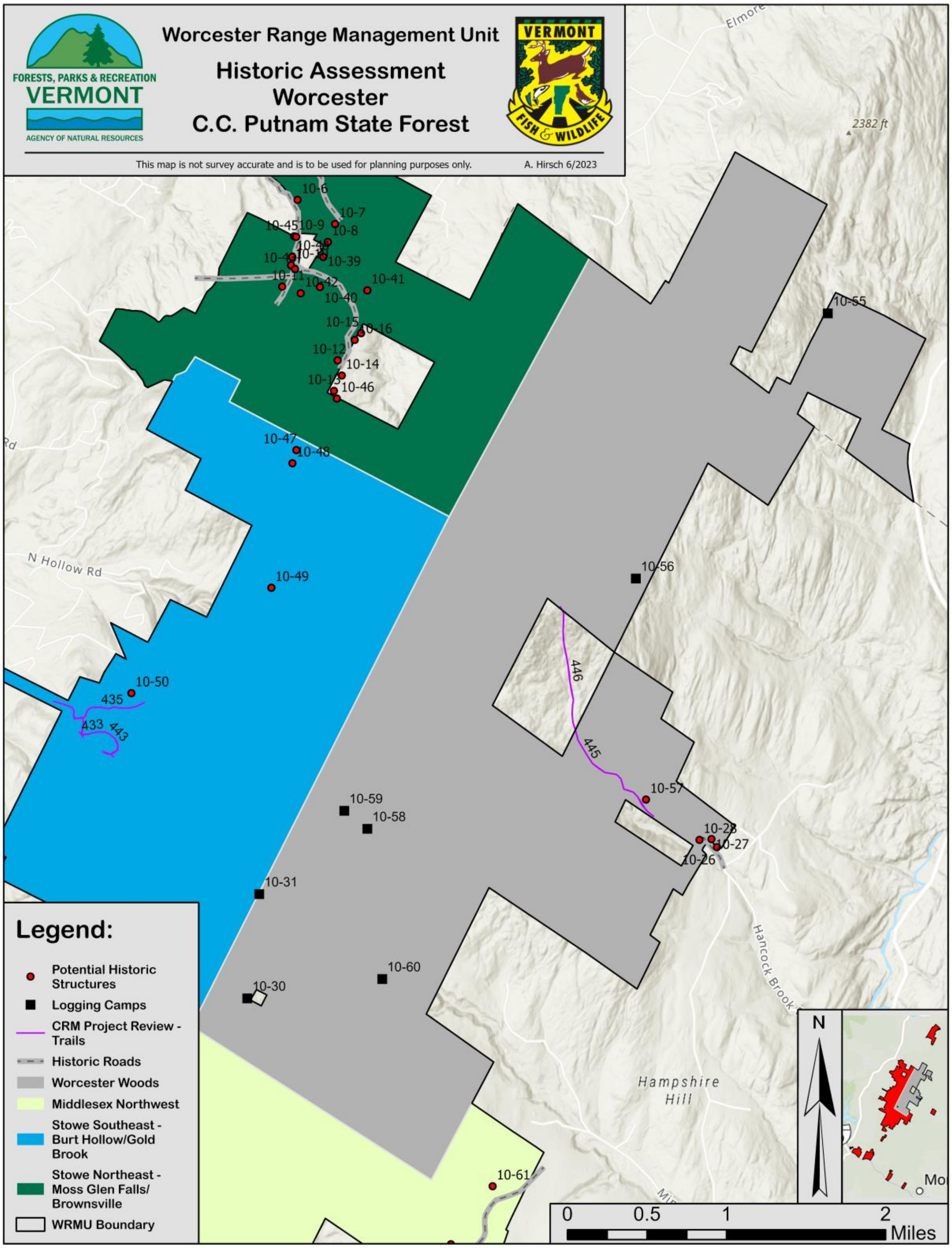
Map 60: Historic Resources Assessment – Stowe Northeast CC Putnam



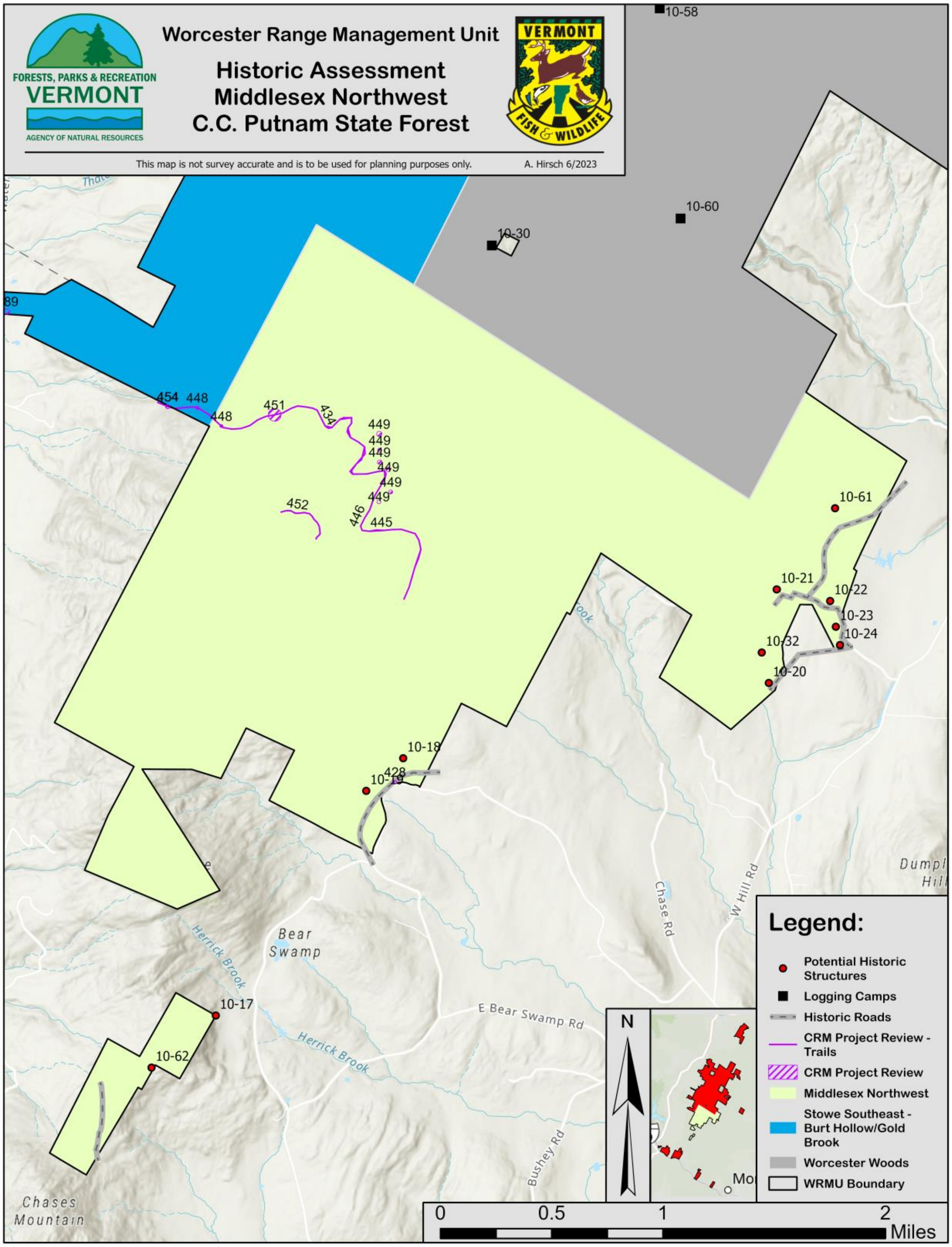
Map 61: Historic Resources Assessment – Stowe Southeast CC Putnam



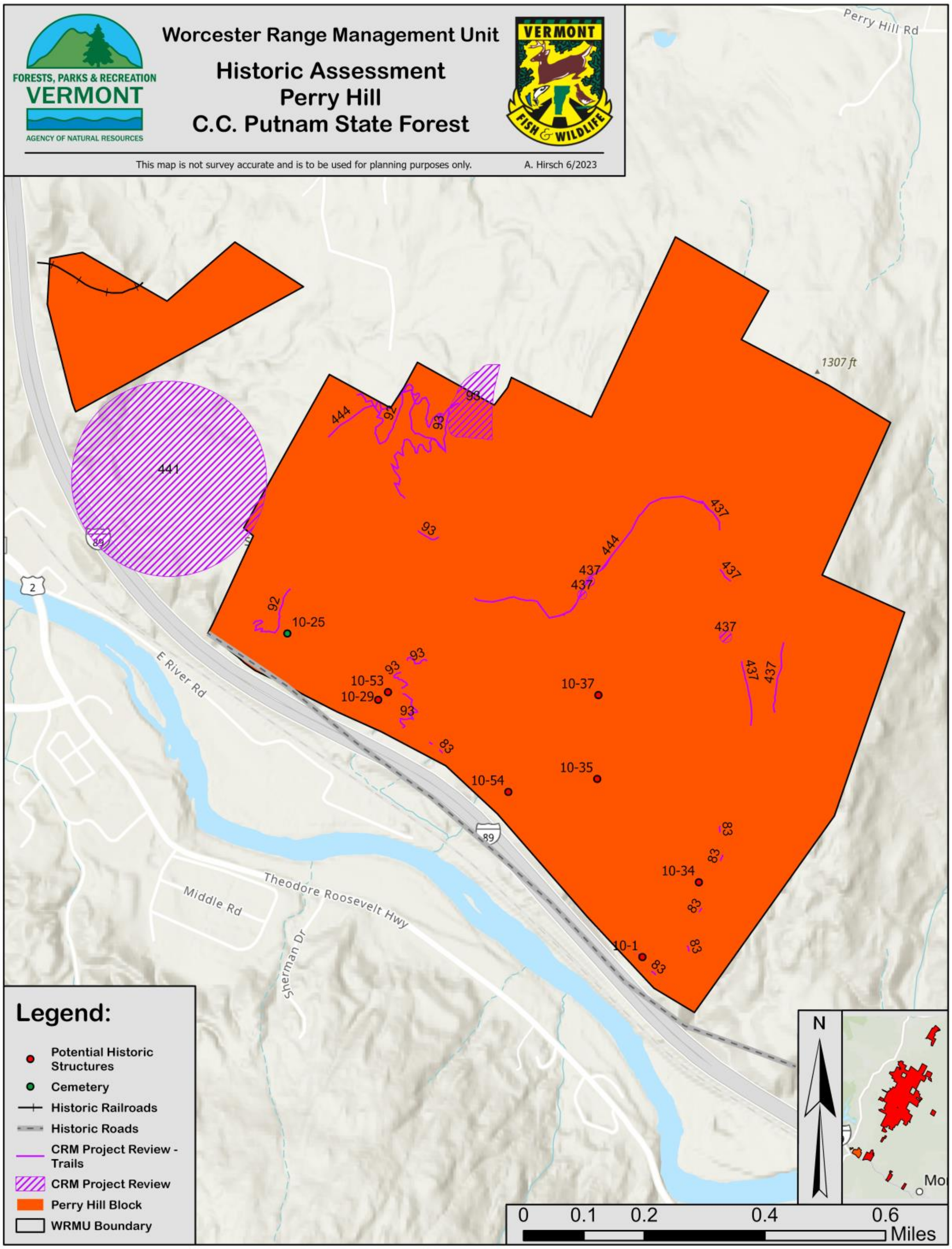
Map 62: Historic Resources Assessment – Worcester



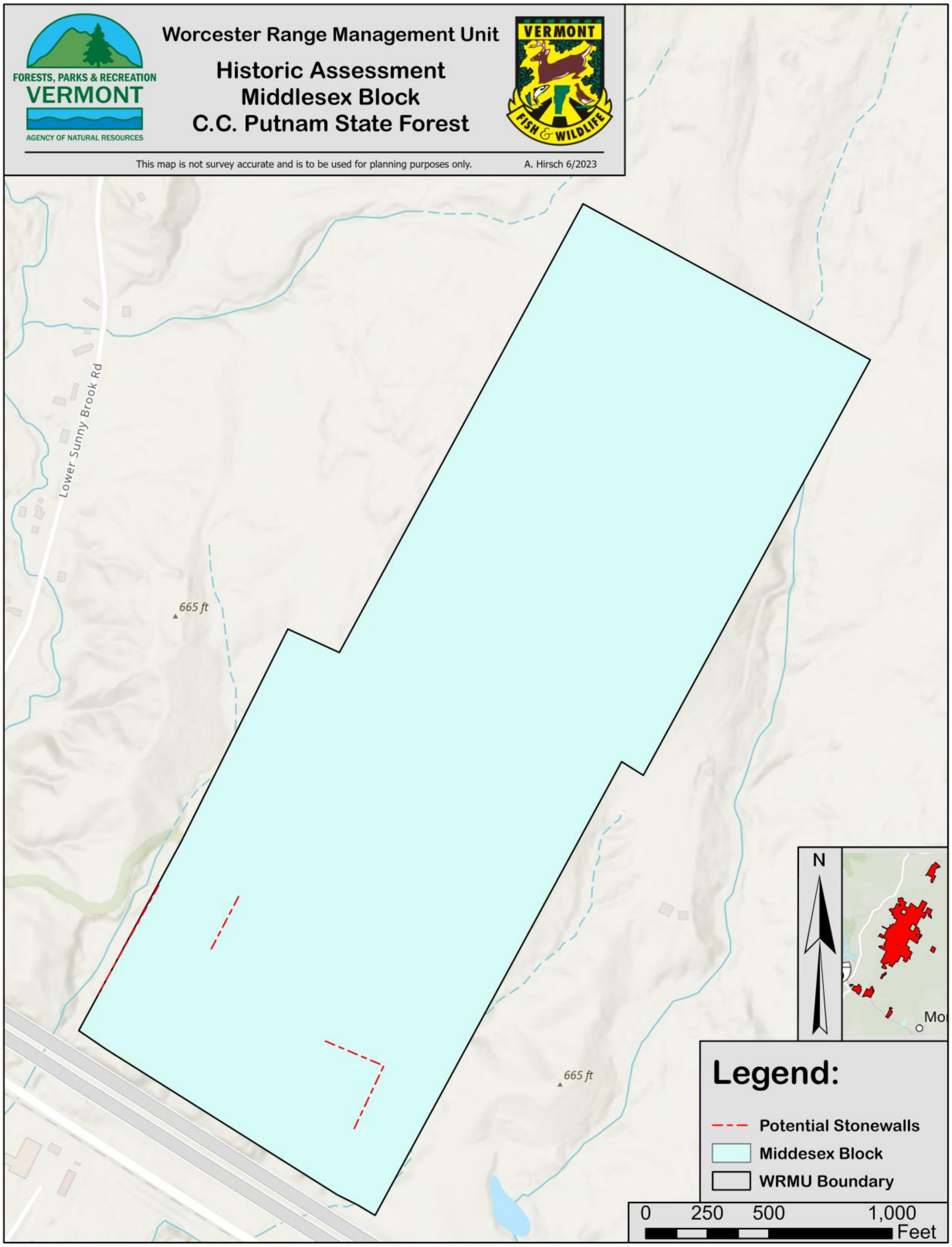
Map 63: Historic Resources Assessment – Middlesex Northwest



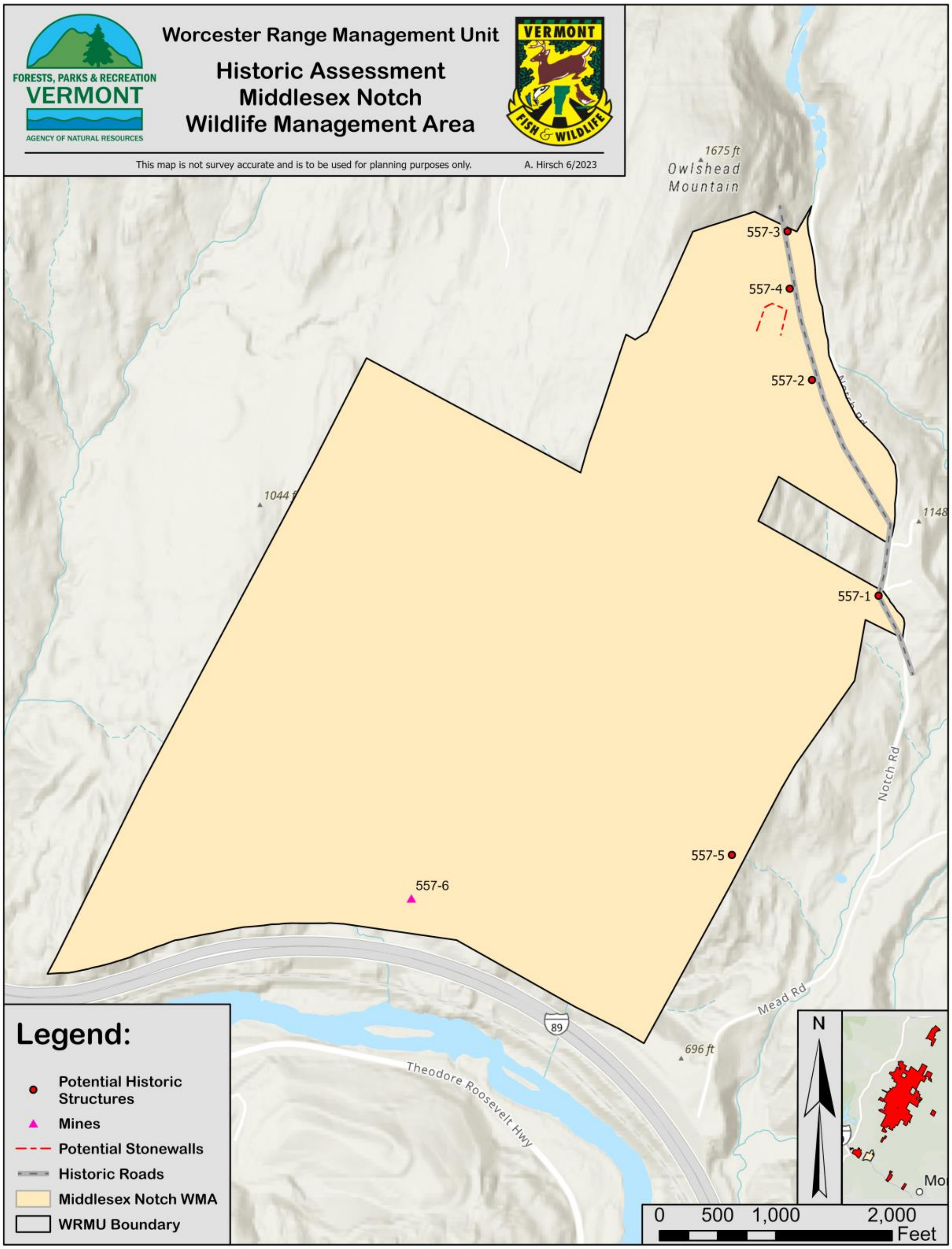
Map 64: Historic Resources Assessment – Perry Hill



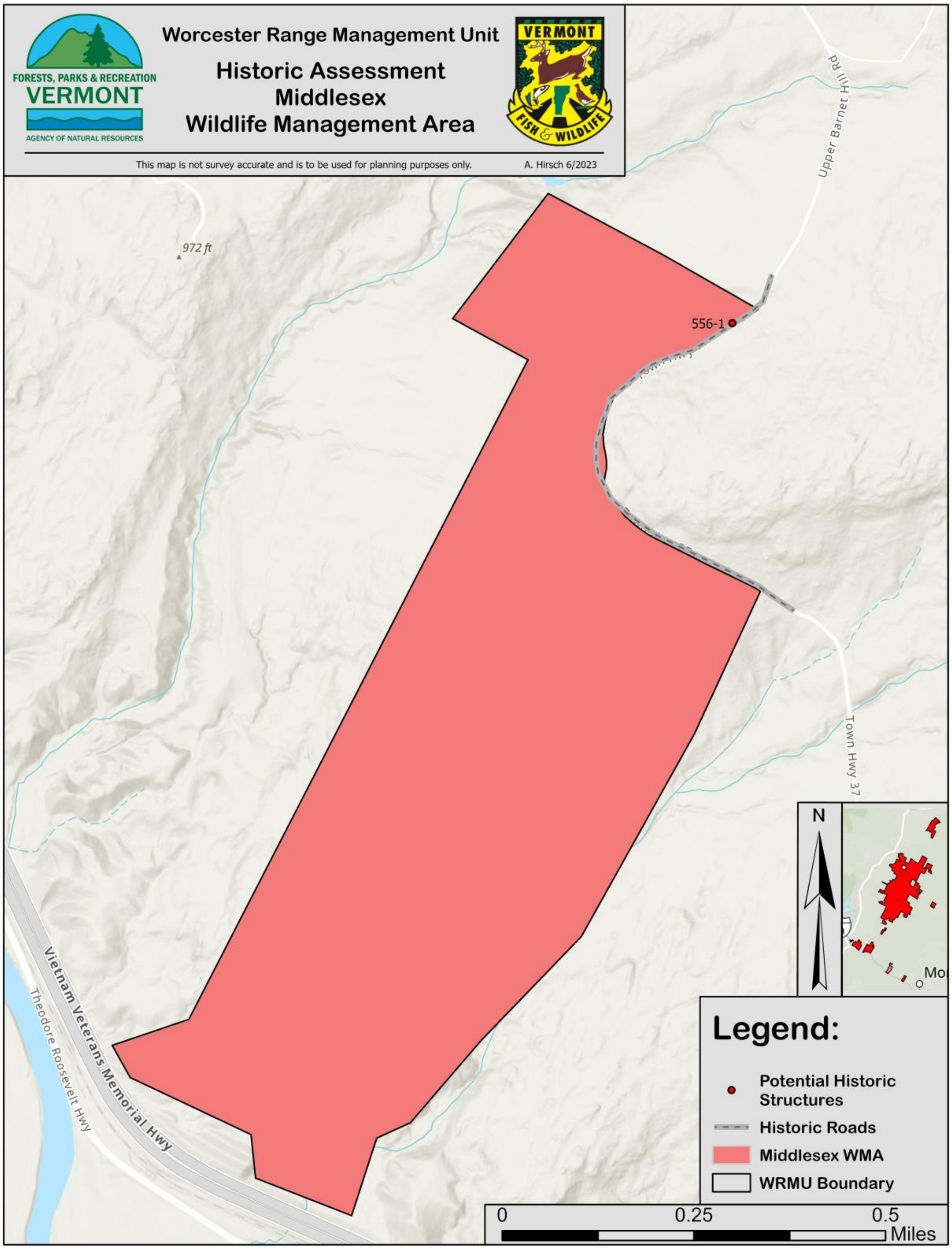
Map 65: Historic Resources Assessment – Middlesex Block



Map 66: Historic Resources Assessment – Middlesex Notch WMA



Map 67: Historic Resources Assessment – Middlesex WMA



APPENDIX 4: Recreation Assessment Methods and Data

WRMU Recreation Data Collection Methods

A. Overview

In 2014 the Department of Forests, Parks, and Recreation (FPR) integrated systems of objective measurement to quantify certain aspects of State Lands recreation use and management. Data capture efforts were focused in the following areas: trail infrastructure quality, trail infrastructure needs, trail use, parking area pressure, and user experience. Prior to this data capture effort much of the understanding of our State Lands recreation assets and use were based on direct user feedback, sign-in box data, or direct land manager observation. To prepare for the development of the WRMU (WRMU) Long-Range Management Plan (LRMP) a concerted effort was made to apply these data collection techniques at priority locations within the management unit to support understanding current demand and infrastructure condition. The following is a summary of the methods used to collect data that has been integrated into the WRMU Recreation Assessment.

B. Trail Features and Impacts Data

A resource condition assessment was supported by University of Vermont intern, Alec Moloznik, and implemented by Vermont Youth Conservation Corps (VYCC) crews and FPR staff between 2017 and 2019. Data was collected using the ESRI Collector App. VYCC crews were trained to use the ESRI Collect App and to interpret the condition of trail infrastructure and locations that require infrastructure. To collect the data crews would hike trails and when they encountered trail infrastructure, or locations that need infrastructure, they would take a GPS point, record descriptive data associated with the location, and document the location with georeferenced pictures.

Trail features represent infrastructure in place and the good/fair/poor rating is based on condition and timeframe until action is needed. Poor requires immediate attention, fair would require attention within five years, and good would require attention in 10+ years. The infrastructure condition is based on the time of assessment. Assessments occurred in 2018 and 2019.

Trail impacts are locations where there is an issue that needs to be addressed, typically through the installation of infrastructure such as a waterbar or stone or lumber steps. The good/fair/poor rating for trail impacts is scaled with how impactful to the trail and natural environment the issue is. A good rating is not causing excessive damage, is not impacting the user experience, and should be addressed in 5+ years. A fair rating is an issue that is showing gradual annual degradation and should be addressed within 5 years. A poor rating is an issue that is causing excessive annual degradation, is impacting the user experience, and should be addressed within 1-2 years to limit impact to the trail and natural environment.
The data represented in the document entitled “WRMU Trail and Usage Data” is a representation of the condition of infrastructure during the period between 2017-2019. As changes are made and infrastructure is upgraded and replaced the ESRI Collector App data has been edited but changes that have occurred post 2019 are not included in this report.

C. Trail Use

Prior to 2014 the Vermont Department of Forests, Parks, and Recreation (FPR) relied on sign-in sheets, signs of use by way of infrastructure degradation, and the occasional opportunities for direct observation to understand the amount of use occurring on State Lands recreation trails. In 2014 infrared and metal sensors were used for the first time by land managers on State Lands to aid in the capture of objective use data. The intent of securing this data is to aid in management decisions associated with State Lands recreation trails and their amenities.

i. Infrared TRAFx Sensors

The TRAFx infrared trail counter uses an infrared scope to detect the infrared wavelengths emitted by hikers, joggers, and cyclists. This sensor can also count wildlife and any other infrared signature that passes in front of the sensor. It has a max range of 20 ft with no need for a receiver or reflector piece. It is designed for outdoor remote use, is weather tolerant, and has large battery life and storage capabilities.

During the 2018 summer season, TRAFx infrared sensors were installed following TRAFx manual protocols.

ii. TRAFx Metal Sensors

Metal sensors can be used to better understand mountain bike and snowmobile use. They can be paired with an infrared sensor to compare pedestrian use with mechanized/motorized use. They can also be used to count vehicles. When used on trails to compare pedestrian and mechanized use the metal sensor is installed within 10ft of the infrared sensor on the trail. This process was used on the Perry Hill trail network. During the installation process we followed these protocols; a hole was dug approximately 1ft deep in the middle of the trail as recommended in “Option A” for installation of metal sensors in the TRAFx Manual: Part II - Mountain Bike Counter. The sensor was then placed within an additional waterproof casing and placed above 2-3 inches of drainage rocks.

D. Trailhead Parking Pressure Data

In 2020, FPR worked with University of Vermont (UVM) students (Maggie Wertheimer, Kevin Ostrander, Kyla Schmeck, and George Essex) to process trail infrastructure and trail usage data to integrate dashboard information into this recreation assessment. All pie charts and spreadsheet data that describe trail features, trail impacts, degree of use and parking lot capacity are a product of this effort. Several Vermont Youth Conservation Corps crews aided FPR in securing the data through monitoring and managing infrared sensors, performing in-person trail user surveys, and performing trailhead parking area observations.

Parking pressure was determined by assessing the maximum available parking area, and through observation, creating an appropriate vehicle to use ratio for the location. In some instances, vehicle to user ratios created at one location were applied to another if the trailhead parking area and recreation trail had similar attributes (distance from population center, trail distance and type). Through user surveys the average amount of time a user spent on specific trails was developed. The average time on trail represents the average amount of time a vehicle is at the trailhead. The vehicle to user ratio was multiplied by collected sensor data grouped in average usage windows to create an estimate of vehicles at the trail during any given timeframe.

The vehicle to user ratio represents the number of vehicles in the parking area compared to the number of people on the trail or trail network at any given time. To find an accurate estimate of the vehicle to user ratio the following protocols were used:

- At least 2-3 full days, focusing on core hours of use, were spent recording vehicle counts at the trailhead parking area.
- The average amount of time visitors spent on the trail or trail network was developed. This information was generated directly from user surveys. To confirm accuracy the data was also compared to information that users provided on-line and in guidebooks.
- We ensured that accurate sensor data from the same period the vehicle counts are occurring was collected.

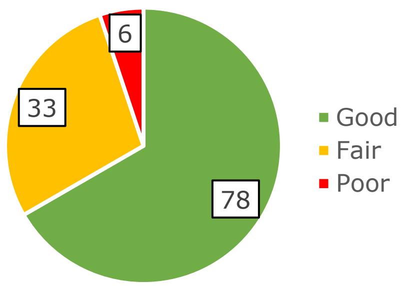
The vehicle counts and the trail use data were captured in hour increments. To allow for the correlation of vehicles at the parking area and trail users on trail, the average time spent on trail was averaged to the nearest hour. The number of vehicles at the trailhead parking area for an hour is divided by the number of people estimated to be on the trail or trail network. This is done for each hour interval where both data points have been recorded. The number created represents the car to user ratio for that hour. The vehicle to user ratio for the site was then used to identify the maximum parking lot pressure by identifying the maximum number of vehicles at the parking lot in an hour window during each day. This maximum number was compared to the managed number of parking stalls. The available managed parking stalls for a particular trailhead parking area were developed using a standard vehicle stall size of 9’x20’ with an assigned logical parking pattern.

Trail usage, and subsequently parking lot pressure, are impacted by the quality of data collected with the sensors. FPR has used best practices and followed guidance provided by the sensor manufacturer to ensure high quality data is being recorded. We have found that there are uncontrollable factors that can impact the quality of the sensor data such as vandalism, low batteries, and vegetation growth. Every effort has been made to remove tainted data by searching for data spikes and removing data that is well above the threshold of maximum use. For this reason, there may be months missing data on the “WRMU Trail and Usage Data” document.

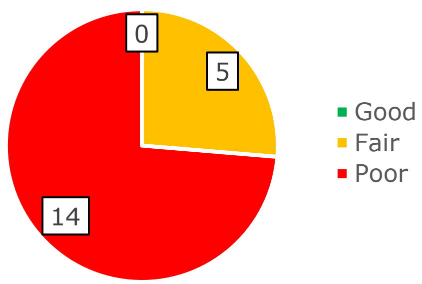
WRMU Trail and Usage Data

Elmore State Park

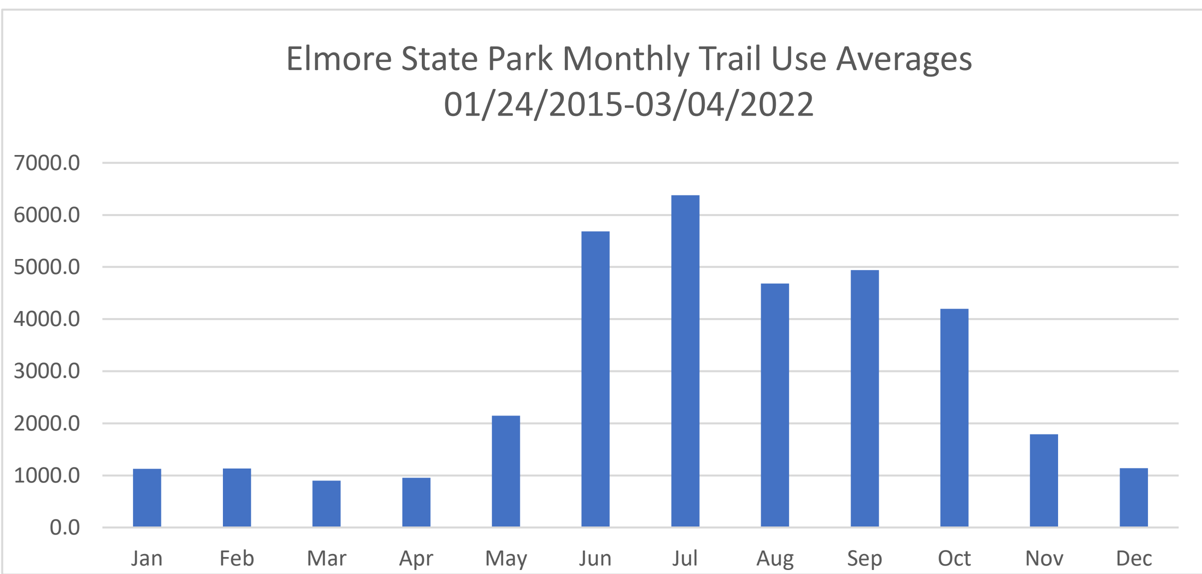
Elmore Trail Feature Conditions



Elmore Trail Impacts Conditions

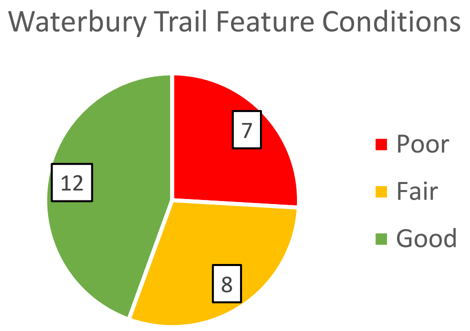


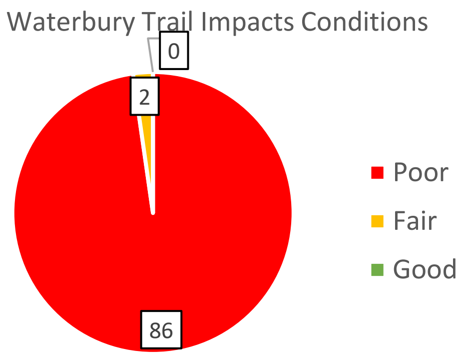
Trail Feature Type	Count
Armored Drain	2
Armored Trail	13
Drainage Ditch	2
Puncheon	21
Retaining Wall	2
Steps	19
Water Bar	42
Bridge	4
Sign	12
Trail Impact: Multiple Treads	4
Trail Impact: Soil Erosion	2
Trail Impact: Wet Soil/Drainage	13



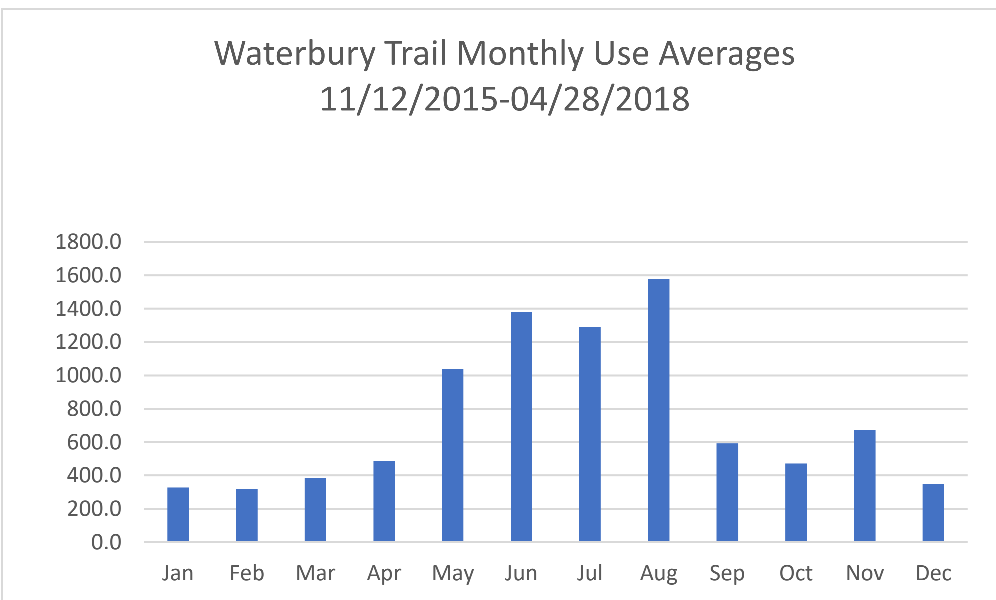
Worcester Range

Waterbury Trail

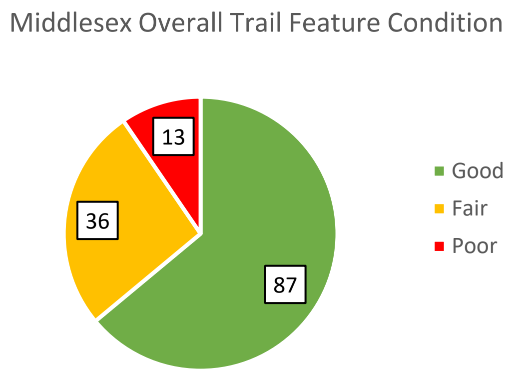




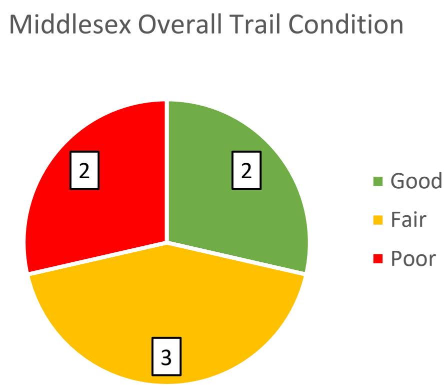
Trail Feature Type	Count
Armored Drain	1
Armored Trail	2
Puncheon	14
Steps	2
French Drain	4
Open Drain	1
Retention wall	1
Infrared counter	1
Stone Wall	1
Total	27
Excessive grade	13
Soil Erosion	6
Wet Soil/Drainage	63
Root Tripping hazard	1
Blow Down	2
Check steps	3

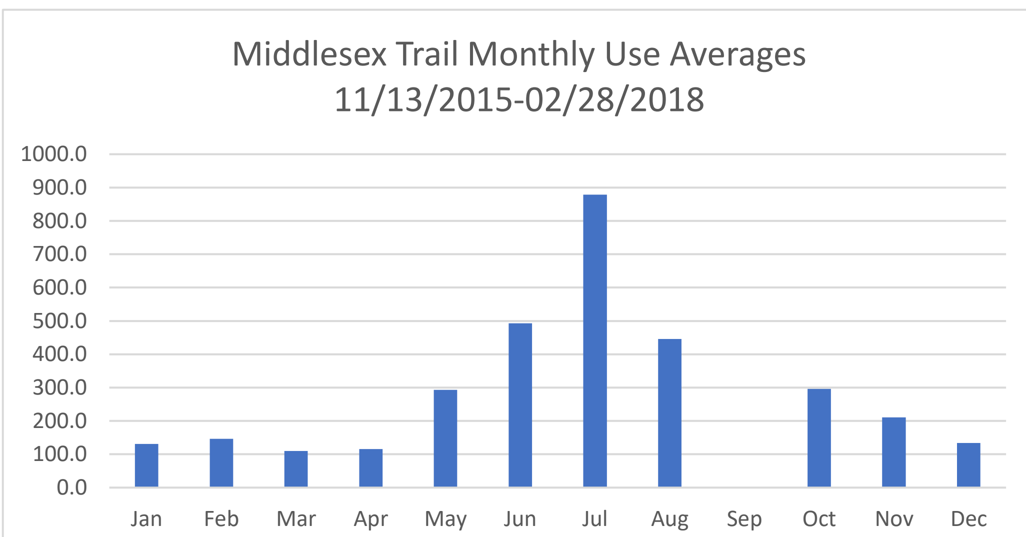


Middlesex Trail

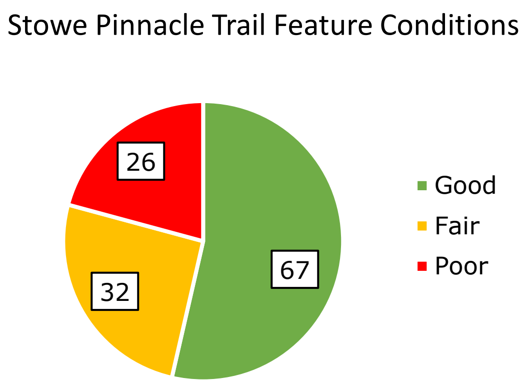


Trail Feature Type	Count
Armored Trail	7
Drainage Ditch	17
Grade Dip	2
Puncheon	2
Retaining Wall	3
Steps	8
Trail Impact: Soil Erosion	1
Trail Impact: Wet Soil/Drainage	6
Trail Register	1
Water Bar	83
Culvert	13

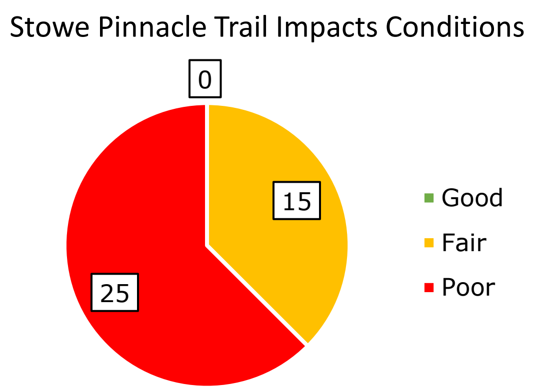


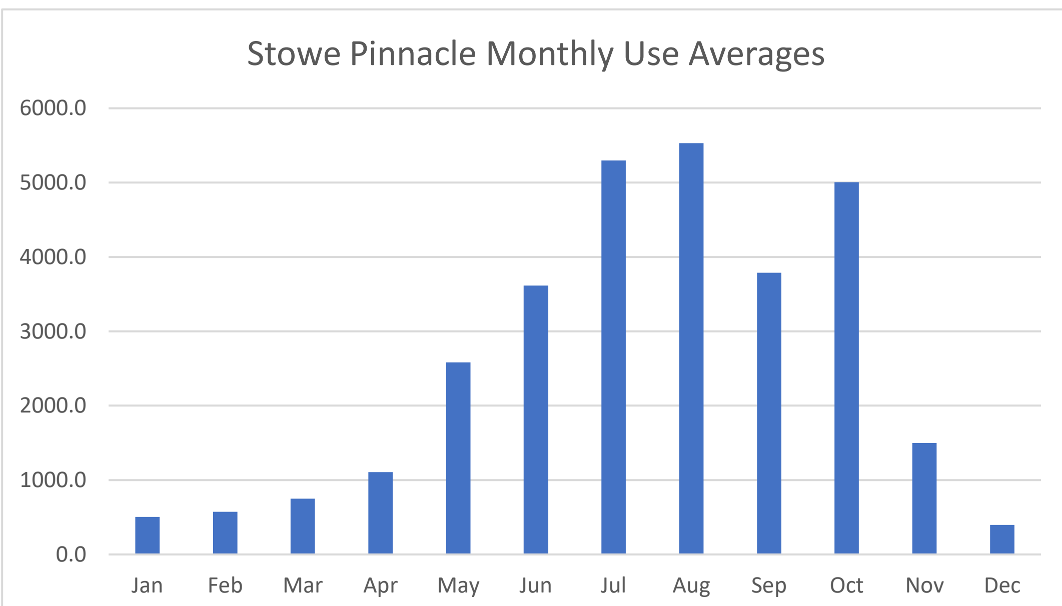


Stowe Pinnacle Trail



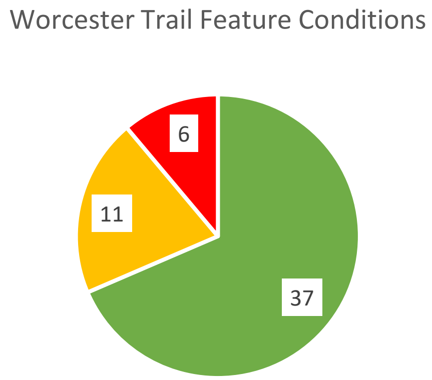
Trail Feature	Count
Armored Trail	13
Drainage Ditch	4
Puncheon	35
Retaining Wall	8
Steps	19
Trail Impact: Excessive Grade >20%	8
Trail Impact: Multiple Treads	8
Trail Impact: Soil Erosion	2
Trail Impact: Wet Soil/Drainage	22
Trail Register	1
Water Bar	37
French Drain	8

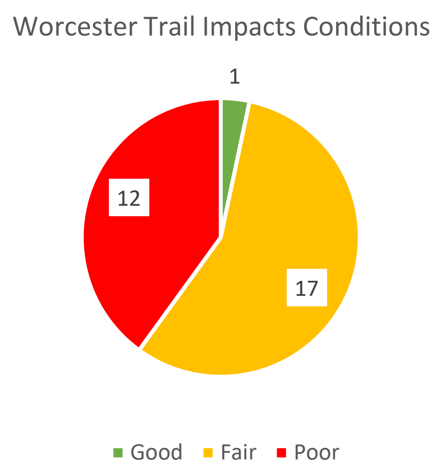




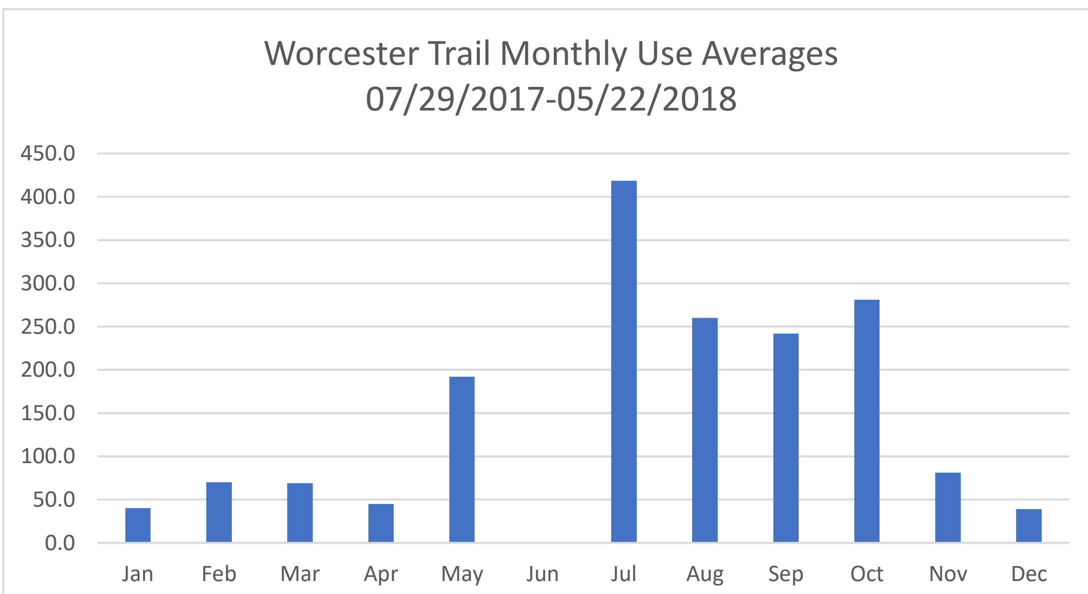
Stowe Pinnacle Trail data represents infrastructure and use data tied to both the Stowe Pinnacle and Pinnacle Meadows Trail.

Worcester Trail



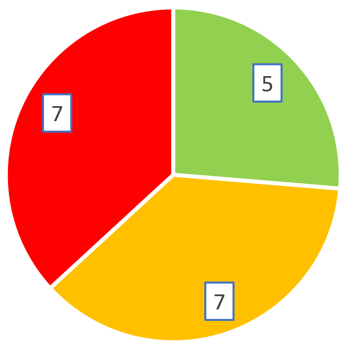


Feature Type	Count
Armored Trail	9
Drainage Dip	9
Grade Dip	1
Retaining Wall	2
Steps	6
Water Bar	27
Trail Impact: Soil Erosion	7
Trail Impact: Wet Soil/Drainage	23



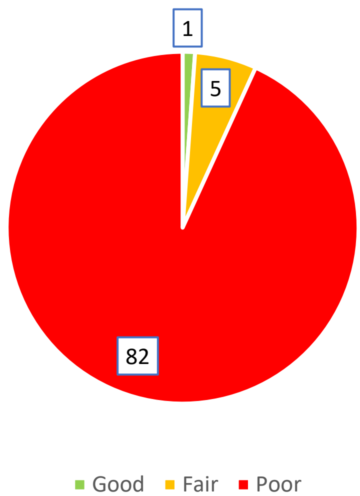
Skyline Trail

Skyline Trail Feature Conditions



Feature Type	Count
Puncheon	14
Steps/Staircase	2
Armored Trail	3

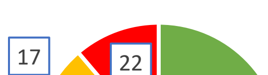
Skyline Trail Impact Conditions



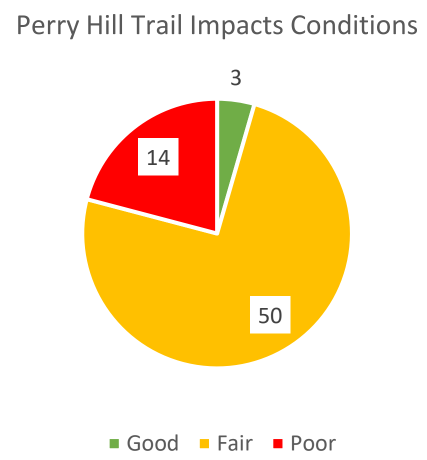
The sensor that was placed at the Skyline Trail mid-point malfunctioned and usage data was not secured for this trail.

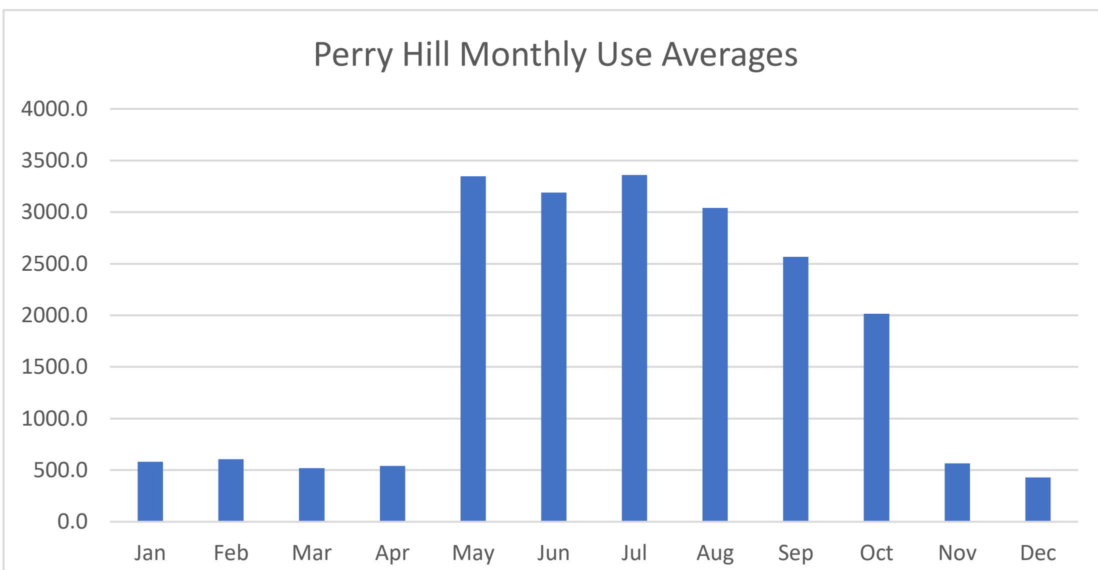
Perry Hill

Perry Hill Trail Feature Conditions



Feature Type	Count
Water Bar	41
Bridge	23
Retainer Wall	26
In-slope Turn	24
Berm	32
Armored Drain	12
Culvert	13
Trail Impact: Wet Soil/Drainage	30
Trail Impact: Soil Erosion	33
Trail Impact: Multiple Treads	4

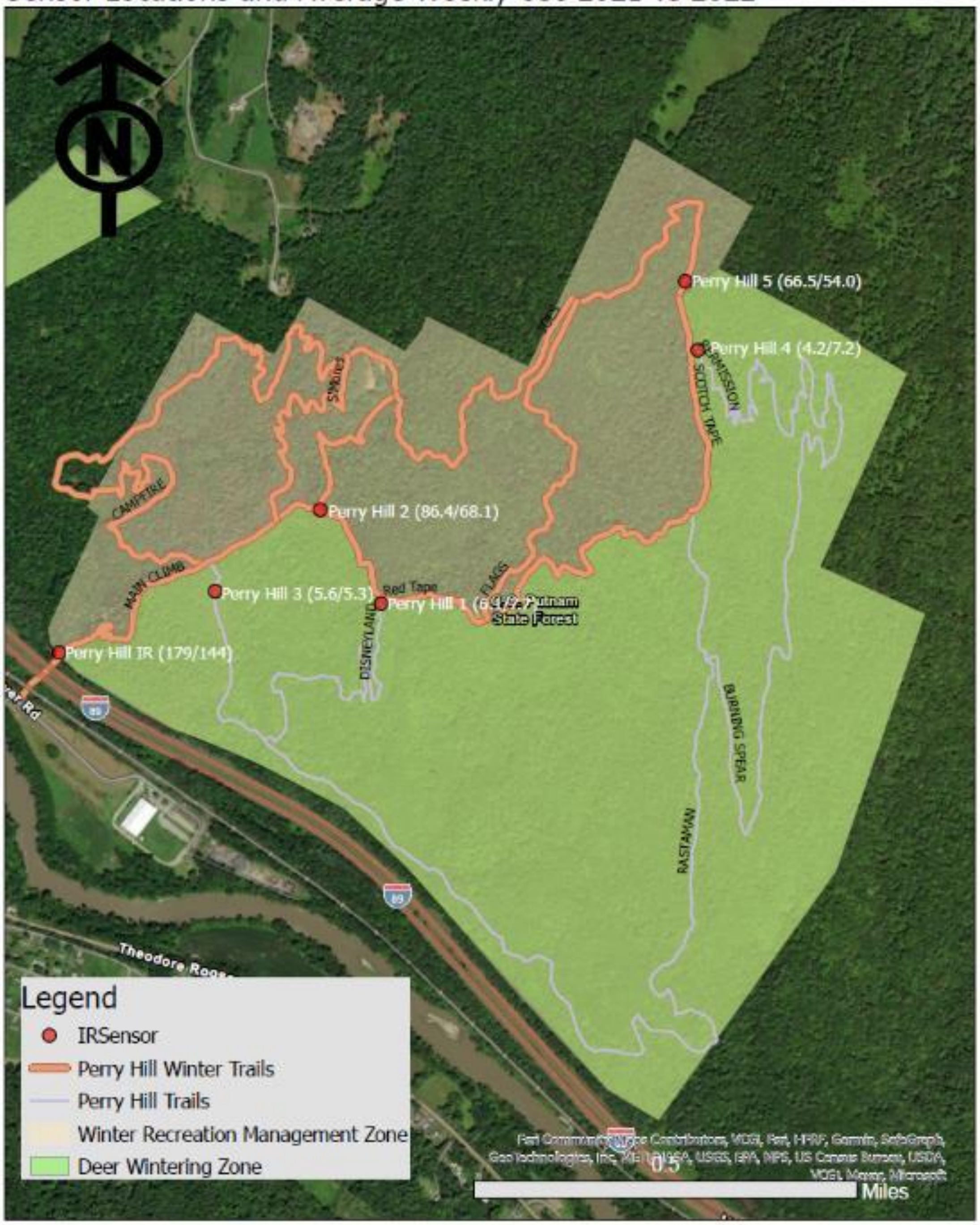




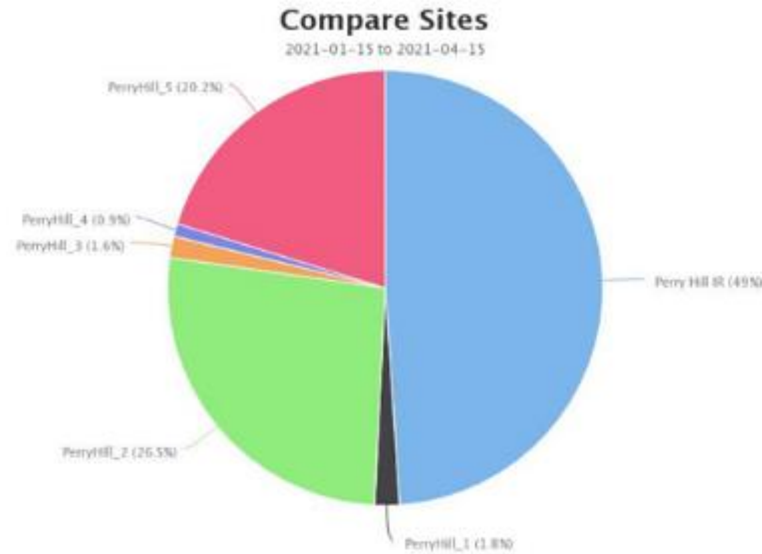
Map 68: Data Associated with the Perry Hill Winter Recreation Management Pilot Program. sensor locations and the average weekly use from each season of the pilot program.

Perry Hill Winter Recreation Use Monitoring

Sensor Locations and Average Weekly Use 2021 vs 2022



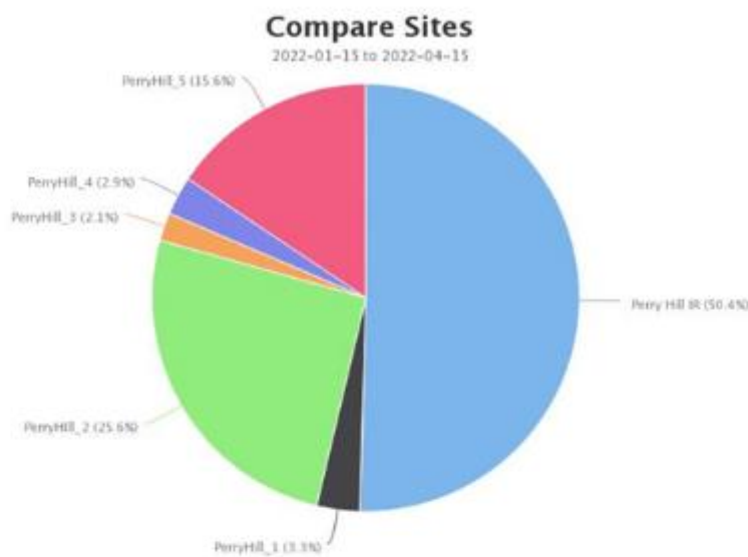
2021 Comparison Data



Site Name	Daily Average
Perry Hill IR	25.5 (49.0%)
PerryHill_1	1 (1.8%)
PerryHill_2	13.8 (26.5%)
PerryHill_3	0.8 (1.6%)
PerryHill_4	0.5 (0.9%)
PerryHill_5	10.5 (20.2%)

(A) = adjustment applied (D) = divide by 2 applied

2022 Comparison Data



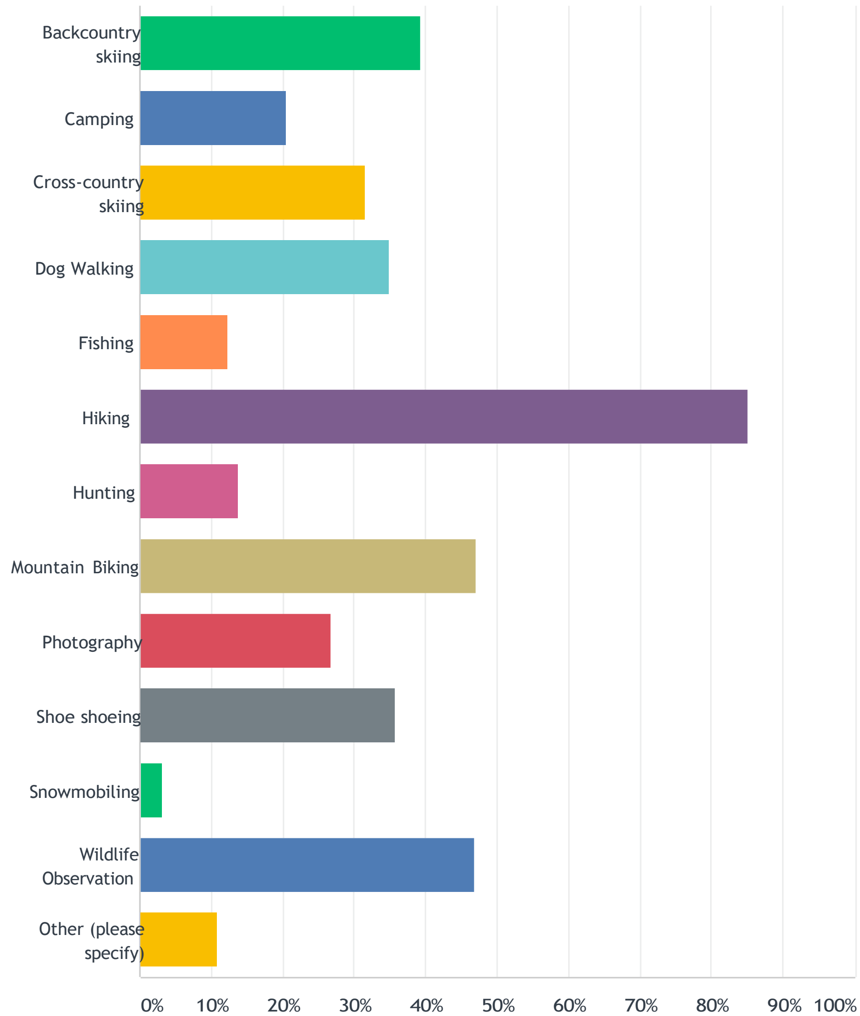
Site Name	Daily Average
Perry Hill IR	17.5 (50.4%)
PerryHill_1	1.1 (3.3%)
PerryHill_2	8.9 (25.6%)
PerryHill_3	0.7 (2.1%)
PerryHill_4	1 (2.9%)
PerryHill_5	5.4 (15.6%)

(A) = adjustment applied (D) = divide by 2 applied

APPENDIX 5: Public Scoping Summary

Q1 How do you use the Worcester Range Management Unit (WRMU)?

Answered: 718   Skipped: 5

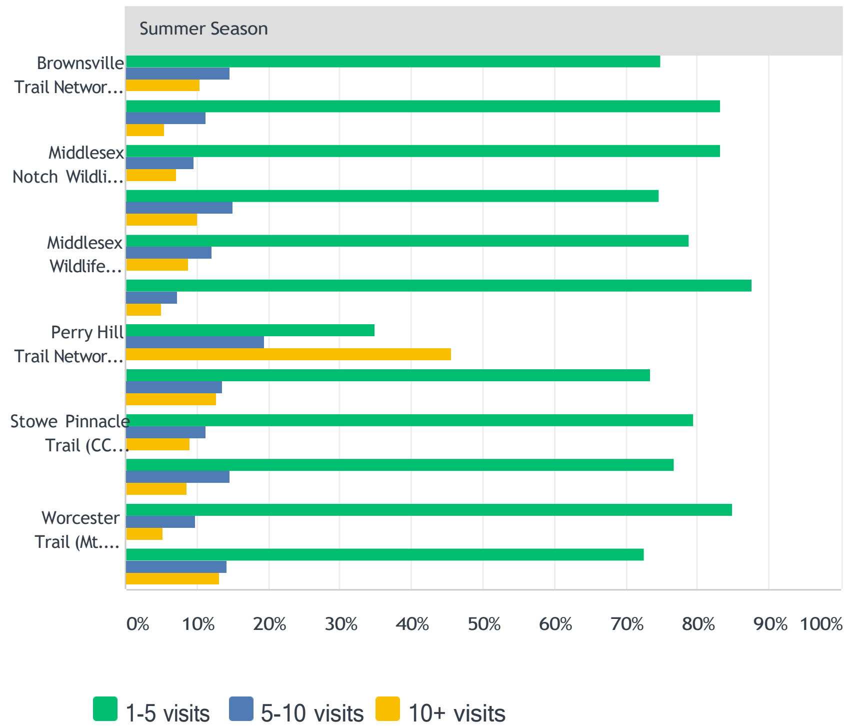


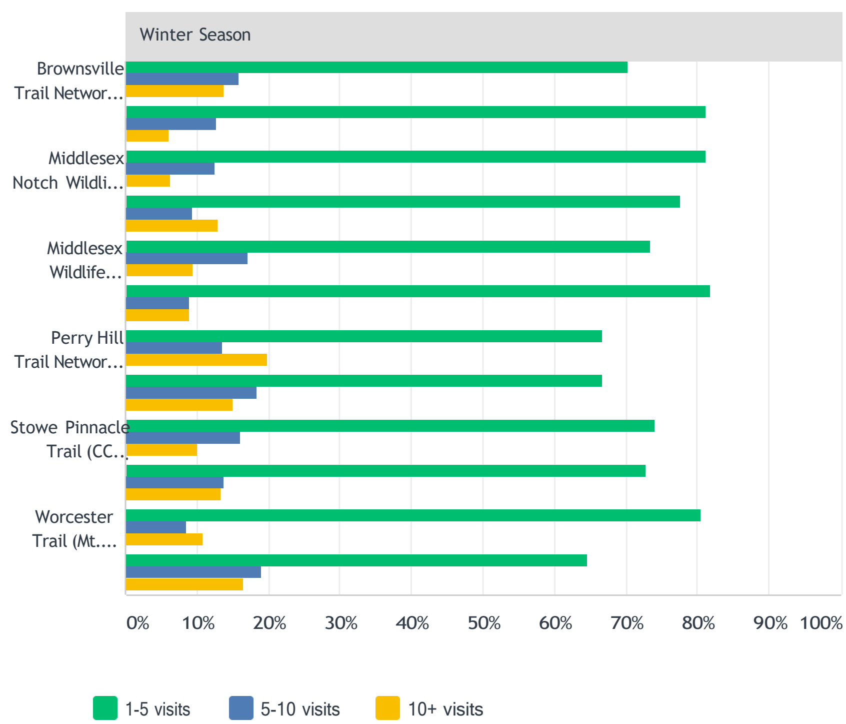
Question 1 Summary Table

ANSWER CHOICES	RESPONSES	
Backcountry skiing	39.28%	282
Camping	20.47%	147
Cross-country skiing	31.62%	227
Dog Walking	34.96%	251
Fishing	12.26%	88
Hiking	85.10%	611
Hunting	13.79%	99
Mountain Biking	47.08%	338
Photography	26.88%	193
Shoe shoeing	35.79%	257
Snowmobiling	3.20%	23
Wildlife Observation	46.80%	336
Other (please specify)	10.86%	78
Total Respondents: 718		

Q2 How do you access the WRMU and at what season and frequency?

Answered: 696 Skipped: 27





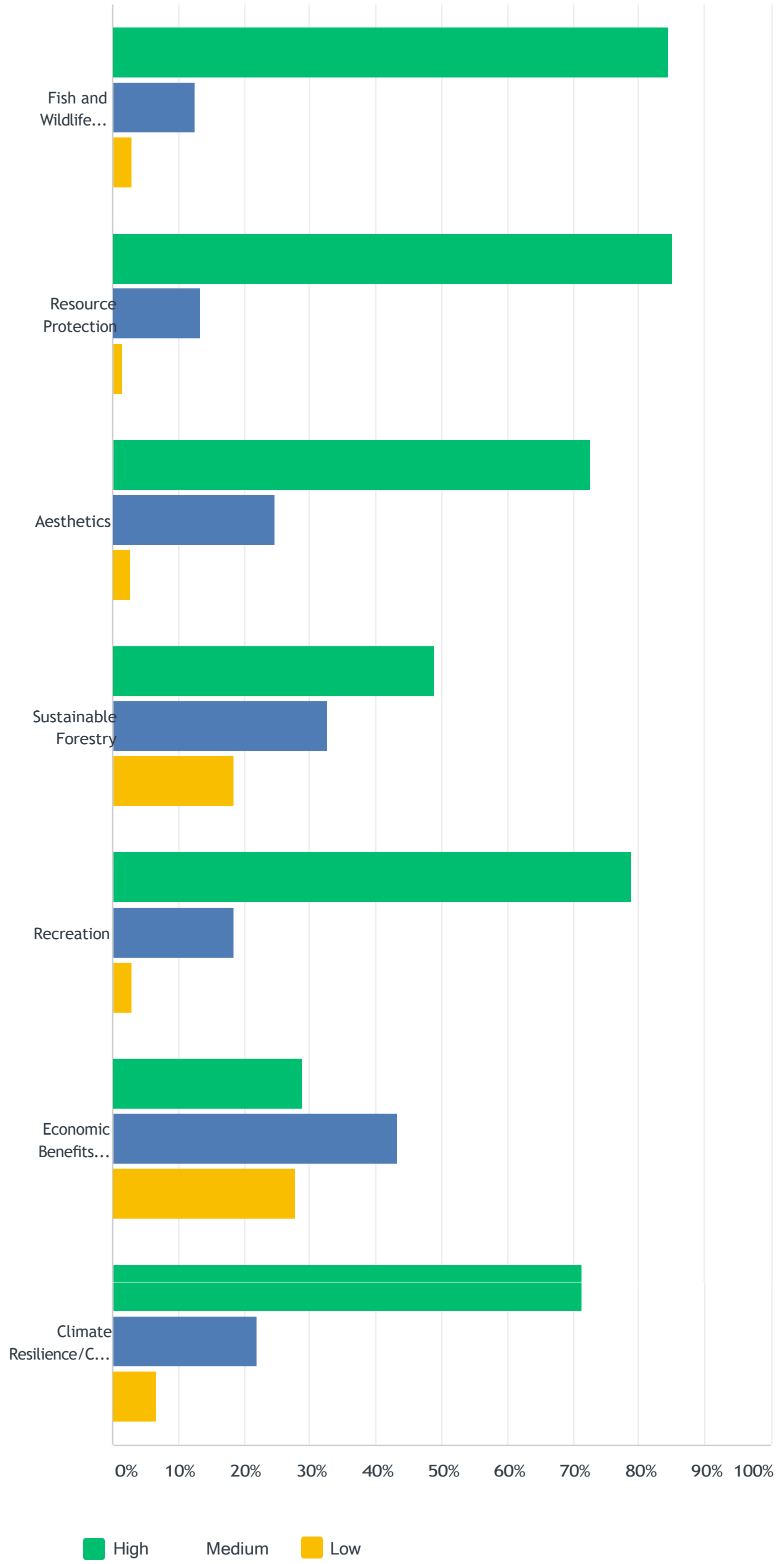
Question 2 Summary Tables

Summer Season	1-5 VISITS	5-10 VISITS	10+ VISITS	TOTAL
Brownsville Trail Network (CC Putnam State Forest)	74.88% 158	14.69% 31	10.43% 22	211
Elmore State Park	83.24% 303	11.26% 41	5.49% 20	364
Middlesex Notch Wildlife Management Area	83.23% 129	9.68% 15	7.10% 11	155
Middlesex Trail (Mt. Hunger/White Rock-CC Putnam State Forest)	74.78% 252	15.13% 51	10.09% 34	337
Middlesex Wildlife Management Area	78.89% 71	12.22% 11	8.89% 8	90
Moss Glen Falls Trail (CC Putnam State Forest)	87.73% 243	7.22% 20	5.05% 14	277
Perry Hill Trail Network (CC Putnam State Forest)	34.93% 117	19.40% 65	45.67% 153	335
Pinnacle Meadows Trail (CC Putnam State Forest)	73.49% 183	13.65% 34	12.85% 32	249
Stowe Pinnacle Trail (CC Putnam State Forest)	79.57% 335	11.40% 48	9.03% 38	421
Waterbury Trail (Mt. Hunger/White Rock-CC Putnam State Forest)	76.79% 301	14.54% 57	8.67% 34	392
Worcester Trail (Mt. Worcester-CC Putnam State Forest)	84.86% 241	9.86% 28	5.28% 15	284
Worcester Woods Wildlife Management Area				

Winter Season	1-5 VISITS	5-10 VISITS	10+ VISITS	TOTAL
Brownsville Trail Network (CC Putnam State Forest)	70.29% 97	15.94% 22	13.77% 19	138
Elmore State Park	81.08% 120	12.84% 19	6.08% 9	148
Middlesex Notch Wildlife Management Area	81.25% 78	12.50% 12	6.25% 6	96
Middlesex Trail (Mt. Hunger/White Rock-CC Putnam State Forest)	77.60% 149	9.38% 18	13.02% 25	192
Middlesex Wildlife Management Area	73.44% 47	17.19% 11	9.38% 6	64
Moss Glen Falls Trail (CC Putnam State Forest)	81.82% 72	9.09% 8	9.09% 8	88
Perry Hill Trail Network (CC Putnam State Forest)	66.67% 74	13.51% 15	19.82% 22	111
Pinnacle Meadows Trail (CC Putnam State Forest)	66.67% 80	18.33% 22	15.00% 18	120
Stowe Pinnacle Trail (CC Putnam State Forest)	74.03% 134	16.02% 29	9.94% 18	181
Waterbury Trail (Mt. Hunger/White Rock-CC Putnam State Forest)	72.83% 126	13.87% 24	13.29% 23	173
Worcester Trail (Mt. Worcester-CC Putnam State Forest)	80.62% 104	8.53% 11	10.85% 14	129
Worcester Woods Wildlife Management Area				

Q3 What value do you place on the following WRMU resources?

Answered: 722 Skipped: 1

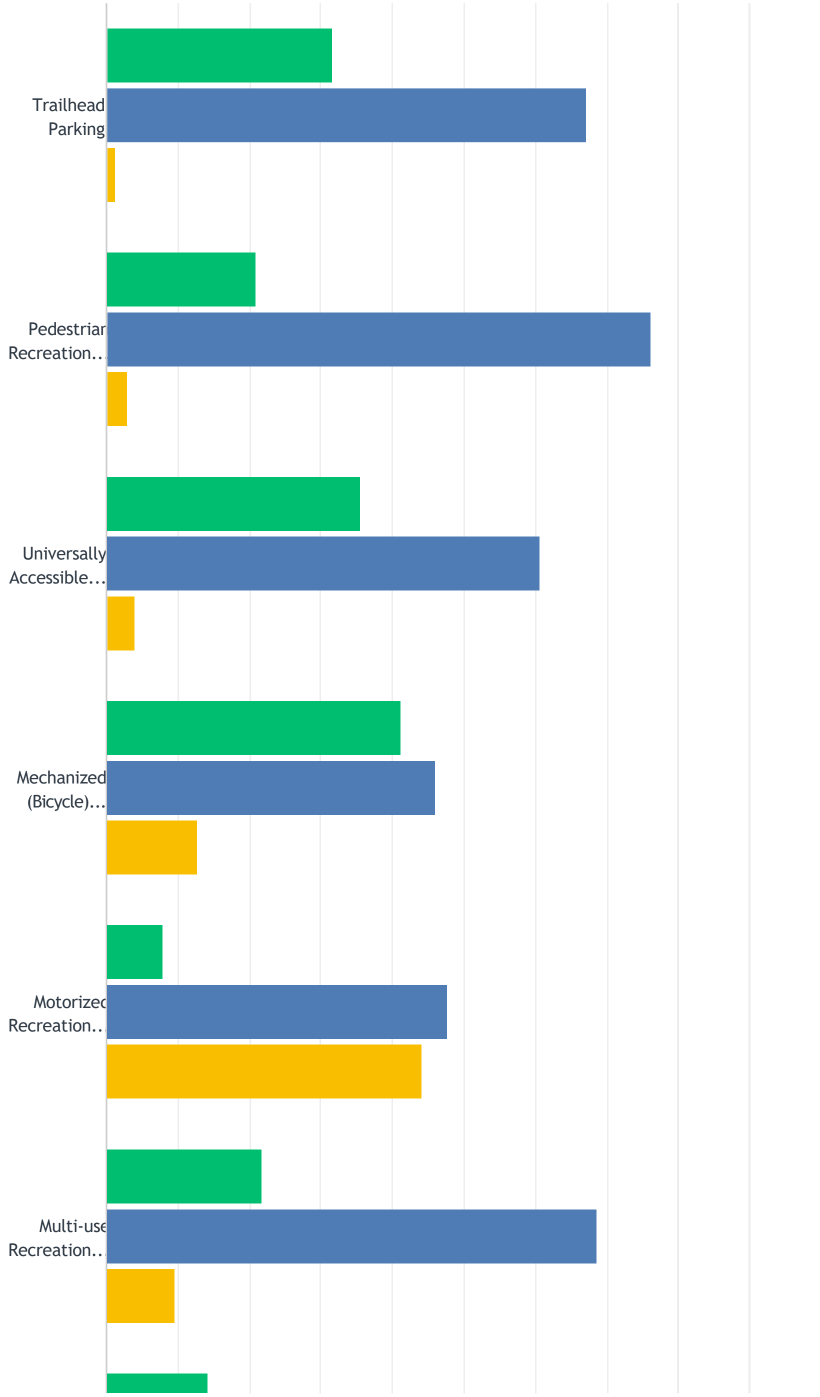


Question 3 Summary Table

Fish and Wildlife Habitat	84.52% 595	12.64% 89	2.84% 20	704	1.18
Resource Protection	85.23% 600	13.35% 94	1.42% 10	704	1.16
Aesthetics	72.62% 504	24.64% 171	2.74% 19	694	1.30
Sustainable Forestry	48.99% 339	32.66% 226	18.35% 127	692	1.69
Recreation	78.77% 553	18.38% 129	2.85% 20	702	1.24
Economic Benefits (Direct and Indirect)	28.84% 197	43.34% 296	27.82% 190	683	1.99

Q4 Are there too little or too much of the following resources?

Answered: 714 Skipped: 9



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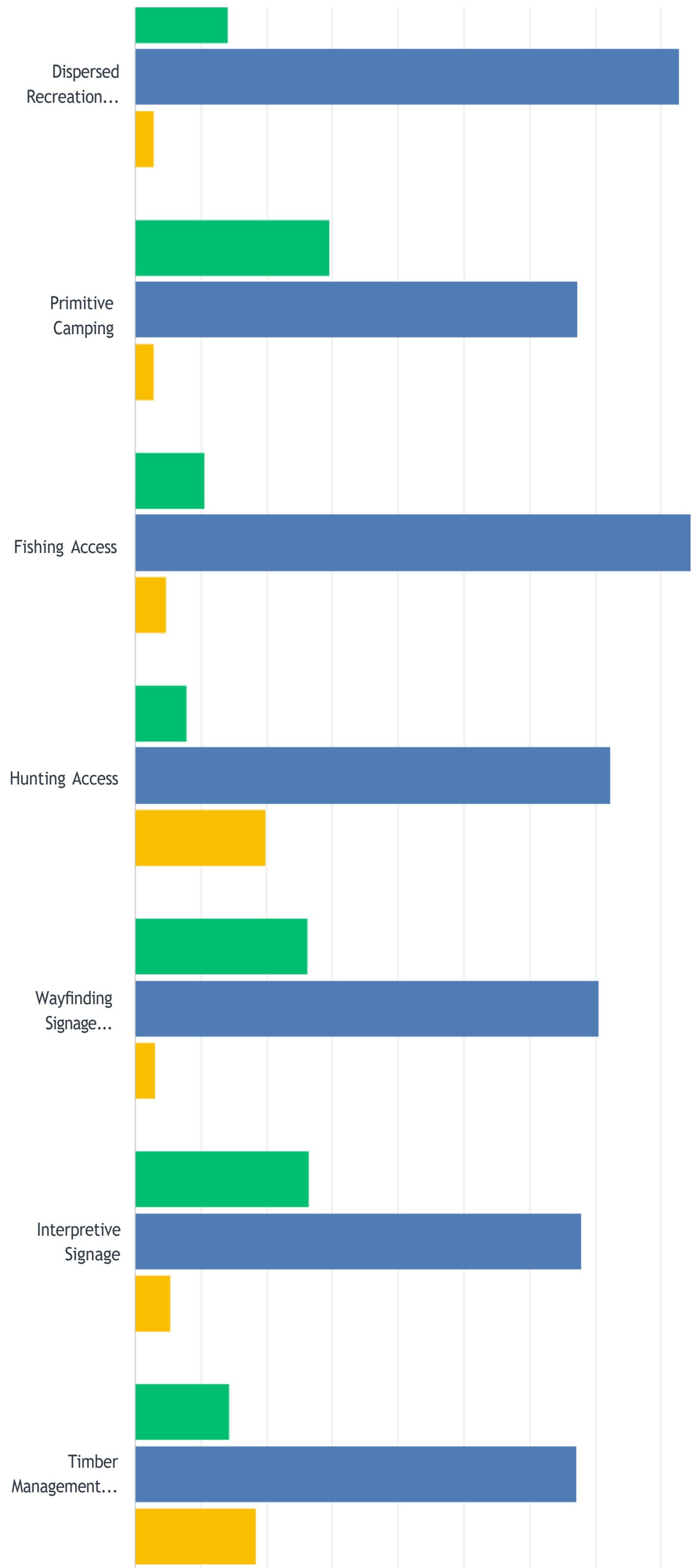
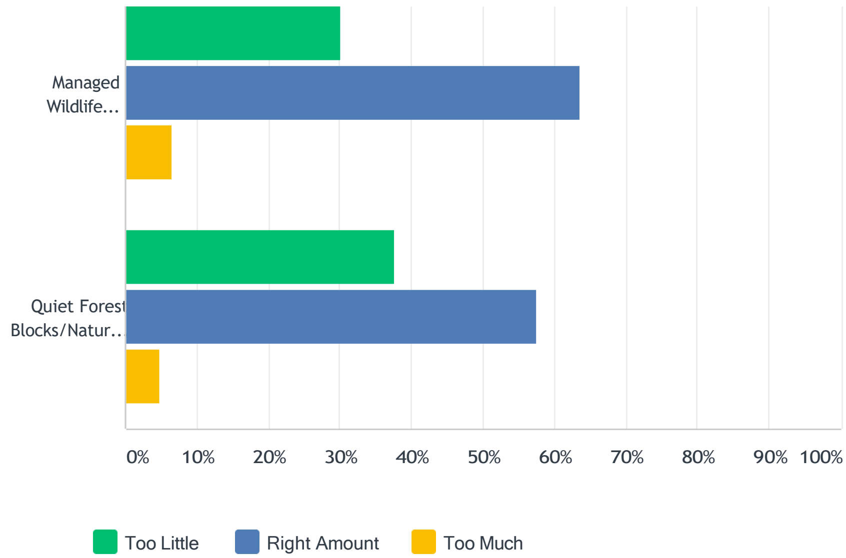




Question 4 Summary Table

Trailhead Parking	31.57% 215	67.25% 458	1.17% 8	681
Pedestrian Recreation Trails	20.97% 143	76.10% 519	2.93% 20	682
Universally Accessible Trails	35.49% 219	60.62% 374	3.89% 24	617
Mechanized (Bicycle) Recreation Trails	41.17% 268	46.08% 300	12.75% 83	651
Motorized Recreation Trails	7.99% 49	47.80% 293	44.21% 271	613
Multi-use Recreation Trails	21.82% 137	68.63% 431	9.55% 60	628
Dispersed Recreation Opportunities (off-trail hiking, bushwhacking, etc)	14.29% 88	82.79% 510	2.92% 18	616
Primitive Camping	29.70% 177	67.45% 402	2.85% 17	596
Fishing Access	10.62% 60	84.60% 478	4.78% 27	565
Hunting Access	7.88% 45	72.33% 413	19.79% 113	571
Wayfinding Signage (mileage marker, place name markers, etc)	26.31% 166	70.52% 445	3.17% 20	631
Interpretive Signage	26.52% 157	68.07% 403	5.41% 32	592
Timber Management Areas	14.41% 81	67.08% 377	18.51% 104	562
Managed Wildlife Habitat	30.05% 177	63.50% 374	6.45% 38	589

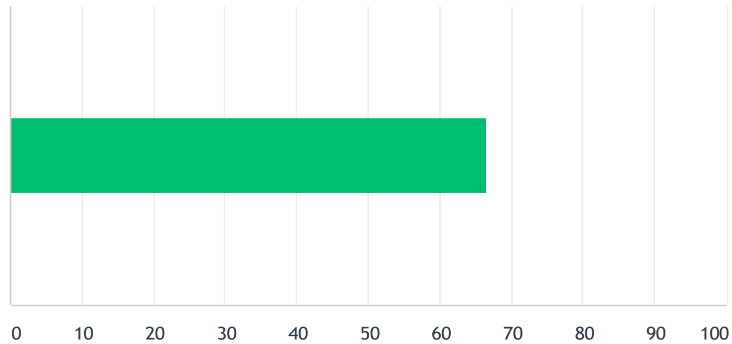
Q5 How would you like to see the following resources managed?

Answered: 451 Skipped: 272

ANSWER CHOICES	RESPONSES	
Recreation	89.36%	403
Fish and Wildlife Habitat	59.65%	269
Resource Protection	52.11%	235
Aesthetics	46.12%	208
Sustainable Forestry	54.77%	247

Q6 Based on your observations how would you rate the Agency of Natural Resources effort to manage the WRMU?

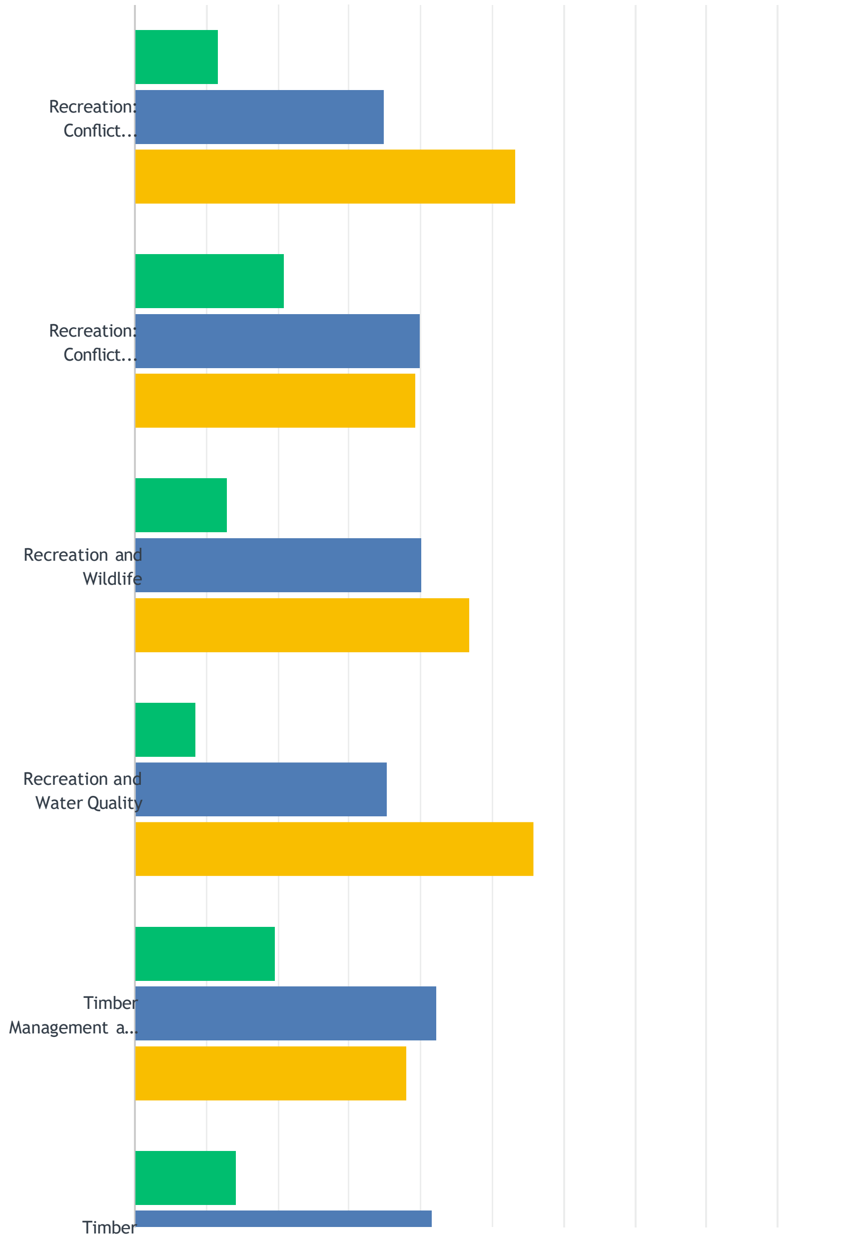
Answered: 668 Skipped: 55

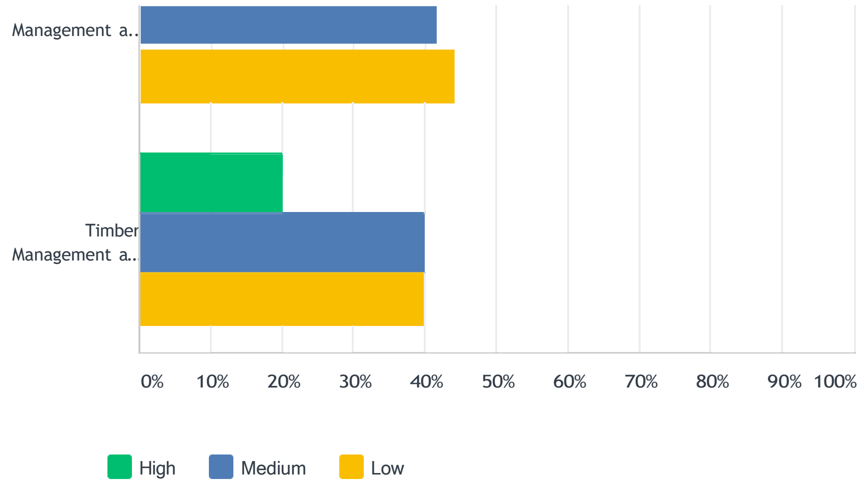


ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
	67	44,452	668
Total Respondents: 668			

Q7 State Lands require a balanced approach to management to ensure public access and protection of the resource. This balanced approach can lead to conflicts. Understanding conflicts can support appropriate management actions. Please consider the following areas and let us know if you perceive the conflict to be high, medium, or low.

Answered: 668 Skipped: 55





Question 7 Summary Table

	HIGH	MEDIUM	LOW	TOTAL
Recreation: Conflict between user groups	11.69%	34.92%	53.38%	
	76	227	347	650
Recreation: Conflict between pedestrian/mechanized/motorized	20.86%	39.88%	39.26%	
	136	260	256	652
Recreation and Wildlife	12.89%	40.22%	46.89%	
	83	259	302	644
Recreation and Water Quality	8.59%	35.45%	55.96%	
	54	223	352	629
Timber Management and Wildlife	19.65%	42.17%	38.18%	
	123	264	239	626
Timber Management and Recreation	14.24%	41.60%	44.16%	
	89	260	276	625

Q8 If you identified conflicts in the previous question, what solutions do you propose?

Answered: 331 Skipped: 392

Answers to this question are available upon request due to the large quantity of text responses.

Q9 In the past year FPR has acquired three new parcels to add to the CC Putnam State Forest: Brownsville Forest, Patterson Brook Forest, and Upper Hollow Forest. Do you have any specific visions for how these acquisitions should be managed? Please include the name of the location in your reply.

Answered: 305 Skipped: 418

Answers to this question are available upon request due to the large quantity of text responses.

Q10 Do you have any history, stories or general observations you would like to share about the WRMU?

Answered: 206 Skipped: 517

Answers to this question are available upon request due to the large quantity of text responses.

Q11 If you would like to receive more information about the WRMU Long Range Management Plan including future opportunities to provide feedback, please provide your email address:

Answered: 311 Skipped: 412

ANSWER CHOICES	RESPONSES	
Email Address:	100.00%	311

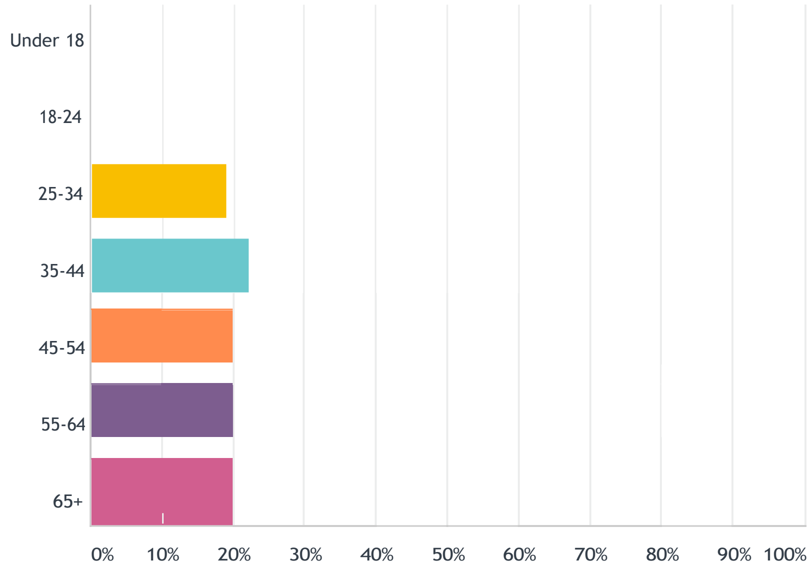
Q12 Help us understand how well our survey distribution is by answering the following questions:

Answered: 671 Skipped: 52

ANSWER CHOICES	RESPONSES	
What state do you live in? (Please use your state's two letter abbreviation)	100.00%	671
What town are you from?	97.32%	653

Q13 How old are you?

Answered: 711 Skipped: 12

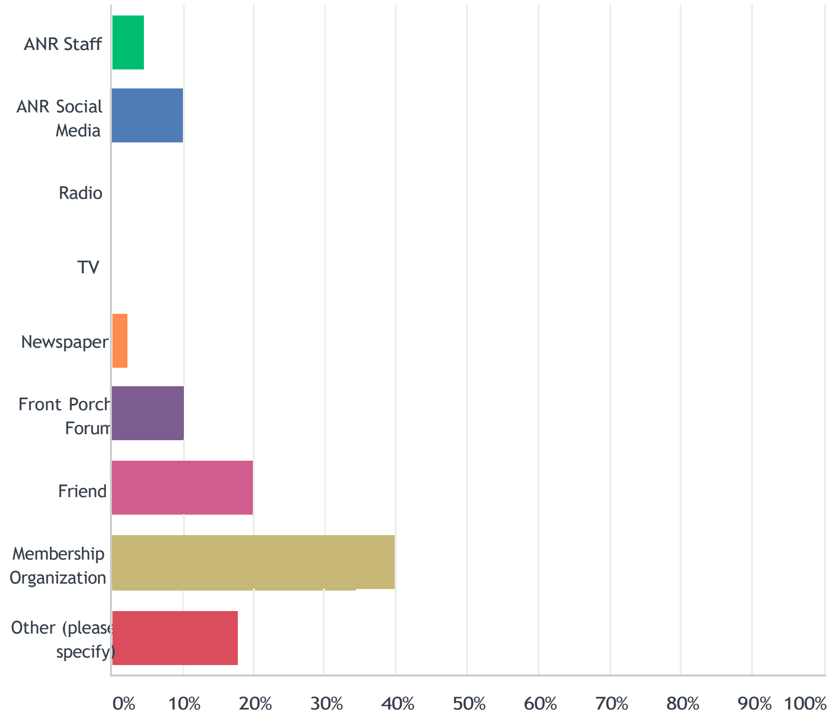


Question 13 Summary Table

ANSWER CHOICES	RESPONSES	
Under 18	0.14%	1
18-24	1.13%	8
25-34	18.99%	135
35-44	22.08%	157
45-54	19.69%	140
55-64	20.11%	143
65+	17.86%	127
TOTAL		711

Q14 How did you hear about this survey?

Answered: 711 Skipped: 12



ANSWER CHOICES	RESPONSES	
ANR Staff	4.64%	33
ANR Social Media	9.42%	67
Radio	0.28%	2
TV	0.00%	0
Newspaper	2.39%	17
Front Porch Forum	11.39%	81
Friend	19.83%	141
Membership Organization	34.32%	244
Other (please specify)	17.72%	126
TOTAL		711

APPENDIX 6: Public Responsiveness Summary

PUBLIC RESPONSIVENESS SUMMARY TABLE OF CONTENTS

Introduction

The purpose of this document is to provide a summary of all public comments received during the Public Comment Period for the Worcester Range Management Unit (WRMU) Long-Range Management Plan (LRMP) and the Agency of Natural Resources (ANR or Agency) response to those public comments. The Draft Plan was released on December 1, 2023, and public comments were accepted between December 13, 2023, and February 2, 2024. Two public meetings were held on December 13 in Worcester and December 19 in Stowe. Additionally, ANR staff responded to questions from the public during the Public Comment Period.

The Agency received over 650 public comments on the Draft WRMU LRMP. All public comments received were reviewed, discussed and responses drafted by members of the Barre District Stewardship Team (DST). The DST is an interdisciplinary group of natural resource professionals from the Departments of Environmental Conservation (DEC), Fish and Wildlife (FWD) and Forests, Parks and Recreation (FPR), and is responsible for planning and management of lands located within the Barre District. When necessary, the DST seeks input from other ANR professionals.

Due to the large number of public comments received, and the fact that many of the comments had common themes and issues, the DST grouped the public comments by topic area and summarized the comment topic to capture the sentiment and issues raised. For that reason, commenters may not see their exact words below. This document organizes comments by themes and provides a response from the Agency to those comment themes. Where edits or changes were made in the WRMU Plan in response to comments, this is clearly stated. Also, many comment themes overlap and thus responses may overlap to other comment themes. ANR staff have attempted to cross-reference various responses rather than repeat in full all responsive statements for each response. A failure to cross reference each response does not mean that a given response or topic area is not applicable to another comment response.

Finally, some of the public comments received included legal arguments and issues. This Public Responsiveness Summary is not intended to be a forum to brief legal issues, provide legal interpretation or provide the Agency response to legal arguments raised by commenters. Rather, the Responsiveness Summary provides the Agency's response to resource and land management issues on a technical and scientific basis. The Agency and DST staff comply with all applicable laws, rules, policies and procedures in drafting the WRMU Plan and proposing the various management proposals therein. To the extent that some legal issues raised may be addressed in a general manner, they have been included below.

Forests

Forest Management

A number of comments addressed forest management, in particular timber harvests, that were part of the plan. Before addressing specific comments related to forest management, an overview of the science and practice of forest management is provided at the end of the Public Responsiveness Summary in a section titled, *Additional Information: Active Forest Management as a Tool to Increase Climate Resilience* in our Forests. We encourage readers to begin by reading this overview, as this information is referenced in the comment responses below.

Comment Theme 1. Timber harvested on state lands is de minimis and wood production should occur on private lands.

Economic gain is not the sole purpose of any harvest on state lands. Commercial harvests are designed and used as a tool to improve forest health, resiliency, diversify species and structure, and many other benefits (see Additional Information: Active Forest Management as a Tool to Increase Climate Resilience in our Forests). Sustainably managed forests, while providing those benefits, can, at the same time, contribute high-quality wood products to our local economy. While the state provides a small percent of Vermont's wood supply, it can be a meaningful amount of work in a rural economy and aligns with FPR's mission to support the working forested landscape. Over the past two main operating seasons (2022-2023 and 2023-2024), there have been at least 17 sales engaging 26 contractors employing 33 people in four of our five districts. This is a conservative estimate. For example, it generally excludes trucking, site prep, timber stand improvement, and other related aspects.

Many harvests also incorporate a donation to the Woods Warms initiative. Wood Warms partners with Vermont's state-owned lands, utilizing responsibly harvested timber to promote forest health and resilience. We enhance sustainability by incorporating Wood Warms donations into planned harvests, benefiting both the environment and local communities. This harvested wood is then processed and distributed to local organizations specializing in providing heating assistance to Vermonters in need. These organizations, in turn, ensure that the firewood reaches the homes of those who require assistance staying warm.

Another benefit of silviculture on state lands is an opportunity to participate in research studies or provide demonstrations that can help guide forestry on private lands. As we navigate challenges such as climate change, invasive plants, insects, etc. it becomes increasingly important to have a land base where we can conduct research and foster climate adaptation to better inform management practices. Since we are not focused solely on timber production, we can participate in experiments that help advance the field of sustainable forestry. As on other ANR lands, the WRMU provides space to conduct research experiments in collaboration with partners, like the University of Vermont, focused on climate adaptive strategies to add resilience to the landscape and provide demonstration sites for landowners, forest managers, and other stakeholders.

Lastly, as discussed in more detail elsewhere in this document, producing high-quality timber is generally an outcome of the type of active forest management used to achieve the goals of the WRMU because active management promotes the continued establishment and growth of healthy trees of many native species. Thus, producing high quality timber often aligns with many other management goals, such as managing for carbon sequestration and storage, forest health, and more. Past management in much of Vermont's forests included high grading, which removed the largest, most vigorous trees and left the forest in a more vulnerable position. While FPR can reinvest revenue from timber harvests directly back into land management, financial considerations are not the primary driving force behind these management decisions.

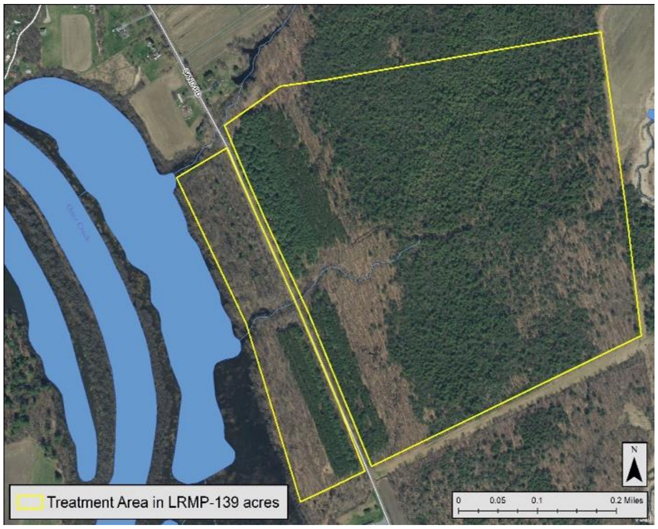
Once a LRMP is approved that identifies an area for timber harvesting, a commercial harvest goes through an extensive review process by many professionals from within ANR. There are many steps to moving a harvest forward on state lands that private lands are not required to go through, including review by the Division of Historic Preservation, biologists and ecologists, and other environmental specialists. Commercial harvests on state lands are done with the highest level of scrutiny and, therefore, while the percentage of total wood is small, wood from state lands is sustainably produced and done in such a way to improve the forests for the future.

Comment Theme 2. Concern and/or perception that all trees within the timber harvest treatment areas depicted on the maps will be cut and that sensitive areas within those areas are not being considered.

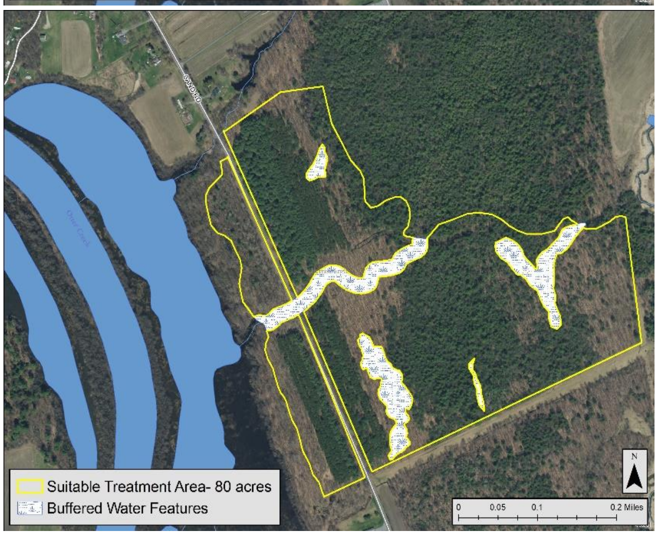
The treatment areas depicted in Map 42: Timber Harvest Implementation of the Plan represent an area that will be further analyzed and assessed for a range of factors before forest management operations begin. A full description of this process can be found on page 169 of the plan. This site-specific analysis may identify several reasons to exclude certain portions of the area from harvesting, often resulting in a smaller area of actual tree cutting when the harvest is implemented than is shown in the LRMP. Some examples of features that could be excluded from a proposed harvest area after site-specific analysis include historic structures or archeological sites, riparian buffers and wetlands, the presence of rare, threatened, or endangered plants or species, vernal pools, or areas of forest where the current size and distribution of trees don't warrant cutting according to current silvicultural guides.

Based on the results of the site-specific analyses, FPR foresters then select the appropriate silvicultural strategy to achieve the management goals identified in the LRMP for those areas that are deemed suitable for operations. The silvicultural strategy and the goals determine the nature of the tree cutting in any given treatment area. This can range from selectively cutting single trees, to creating small openings by cutting a group of trees, to cutting larger groups, patches or areas of trees to spur vigorous regrowth of a new generation of trees. The selection of the silvicultural strategy, and thus the nature of the cutting, includes consideration of the resource analyses and assessments discussed above, and thus, sensitive areas will be avoided in proposed timber harvest treatment areas. The amount of live tree retention and the resulting appearance post-harvest will depend on the silvicultural strategy and goals of the harvest.

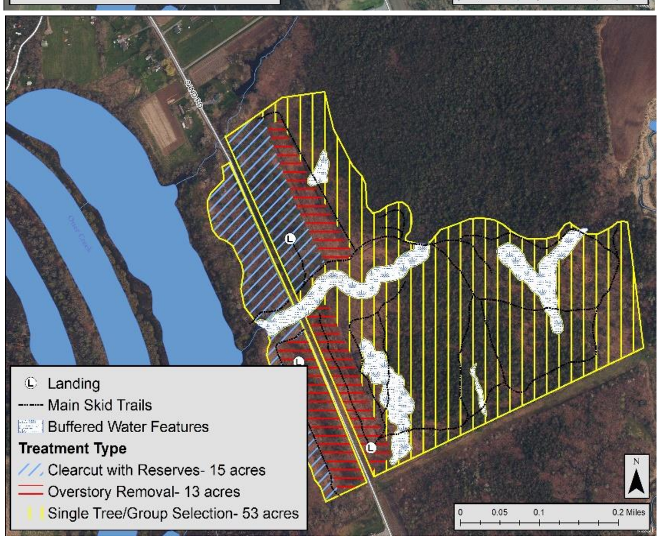
Combined, the process of narrowing down the overall treatment area through site reviews and selecting the right silvicultural treatments based on the management objectives results in a much more detailed timber harvest plan and map than what is shown in the LRMP. The figure below gives an example of the timber sale development process from the Lower Otter Creek Wildlife Management Area. The process of review and assessment of the area prior to the timber harvest resulted in a more refined and specific silvicultural treatment that fully considered existing natural resources.



This is the treatment area as depicted in the Long-Range Management Plan. This area was selected based on the goals of the plan and the general inventory and assessments done during the planning process.



A more detailed site-level inventory and review excluded the northeast portion from cutting, identified water features that would be avoided, and developed more detailed boundaries for cutting based on the conditions of the forest stands. The imagery underneath shows the forest cover prior to the harvest.



Treatment types were selected based on the site-level inventory and goals of the plan and then implemented. All trees were cut in the blue hatched area, the overstory of mature trees was removed to release the understory in the red hatched area, and individual trees or small clusters were cut in the yellow hatched area. The areas between weren't cut at all, and no cutting occurred in the water feature buffers. The imagery underneath shows the forest cover after the harvest, reflecting this variation in the nature of tree-cutting across the treatment area.

Comment Theme 3. Timber harvests, including creation of young forests, and ATV use will increase the spread of invasive plants and insects onto state land.
It is well established that vehicles can play a role in dispersal of invasive plants.[75] However, ANR implements specific controls to ensure timber harvesting on the WRMU will not lead to an increase in invasive plants and insects.

The harvest design/implementation phase of a timber harvest is often the best time for ANR staff to locate invasive plant populations and develop a control plan to reduce or eliminate invasives in the area as part of the treatment. These inventories and control efforts occur on most of our harvests. In addition to these efforts, all logging and earth moving equipment are required to be cleaned and inspected prior to moving on to state land to avoid spreading invasive plant material and/or seed. Any mulch used during close out is required to be seed-free straw. And finally, following a harvest operation, FPR continues to monitor and treat any lingering invasive plants on site. These common practices are consistent with best management practices for preventing introduction and spread of invasive plants from forestry operation.[76]

Authorized ATV use is unlikely to be a vector for invasive plant dispersal on state lands due to existing policies and practices. ATV use is prohibited on state lands by statute as reflected in FPR Policy #1: *All Terrain Vehicles (Motorized)*, FWD rule CVR 12-010-062 and ANR's *Use of Mobility Devices on ANR Fee-Owned Lands by Persons with Mobility Disabilities Policy* (2015). Exceptions include access for emergency personnel for rescue purposes, management use by ANR staff and their designees, and users of other power-driven mobility devices for individuals with mobility disabilities. Thus, there is limited, or no ATV use on State lands that will serve as a vector for invasive plants.

Regarding invasive pests and pathogens of trees, the primary method of dispersal for many pests and pathogens is human movement of infested material. ANR land management activities adhere to all regulations for movement of material infested with invasive pests or pathogens including 6 V.S.A. § 1035, and follow slow-the-spread guidance for emerald ash borer to further reduce likelihood of accidental spread. Novel invasive pests and pathogens are detected and monitored through extensive surveying and monitoring by FPR Forest Health specialists and their partners who identify and respond to invasive pest occurrences on and off state lands and provide guidance and advice on management practices to prevent further spread. For these many reasons, harvesting on state lands will not contribute to the movement from or to state lands of invasive pests or pathogens.

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[75] Ansong M., Pickering C. 2013. Are Weeds Hitchhiking a Ride on Your Car? A Systematic Review of Seed Dispersal on Cars. PLoS ONE 8(11): e80275. https://doi.org/10.1371/journal.pone.0080275, and Kahn, I., Navie, S., George, D., O'Donnell, C. and Adkins, S.W. 2018. Alien and native plant seed dispersal by vehicles. Austral Ecology, 43: 76-88. https://doi.org/10.1111/aec.12545.
[76] For example, LeDoux, C.B. and D. K. Martin. 2013. Proposed BMPs for Invasive Plant Mitigation during Timber Harvesting Operations. Gen. Tech. Rep. NRS-118. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 12 p. https://doi.org/10.2737/NRS-GTR-118.

For more information regarding strategies for invasive species monitoring and control, please see Section IV (E): MONITORING AND EVALUATION- Invasive Exotic Species within the LRMP.

Comment Theme 4. Cutting trees is mainly done to generate revenue for the state. The harvests planned in this LRMP will not benefit the Worcester Range but will do damage to the forests and to the state.
Timber harvests on state land and in the WRMU are developed purposefully to avoid damage to forest health, mitigate future forest stressors, and are never planned solely for financial returns (see Comment Theme 1). Commercial harvests can be used as a tool to diversify species assemblages, age classes, and forest structure which can contribute to improving forest health, increasing resiliency, and producing a broad range of ecosystem services one of which includes sustainably produced forest products.

ANR uses the science and practice of silviculture to manage its forests sustainably. Silviculture uses scientific understanding of forest ecosystems to guide decisions on vegetation management to achieve long-term goals such as increasing species and size diversity. When achieving a management goal calls for intervention based on silviculture and forest science, various tools are used to implement that management. The tools include commercial timber harvests, which generate revenue for the state; non-commercial timber harvests, which incur costs to the state; and non-commercial vegetation treatments, which also incur costs. This last category can involve a wide range of actions, such as invasive plant control, crop tree or mast tree release, tree regeneration treatments, and hazard tree removals. The practices used to meet the goals and objectives of the LRMP are selected and applied based on conditions on the ground, forest science, and silviculture. Please see, *Additional Information: Active Forest Management as a Tool to Increase Climate Resilience* in our Forests for more details around forest health and sustainable forest management strategies.

While some non-commercial treatments are difficult or impossible to implement due to costs, commercial timber harvests are never planned solely for financial returns. When there are financial gains from commercial timber harvests on state forests, the money is directly reinvested into state lands. Revenue from commercial harvests on State Forests goes into ANRs Land and Facilities Trust Fund. This fund is used to pay for a variety of beneficial projects, including State Park infrastructure work, the creation of accessible trails, other trail renovation projects, and non-commercial vegetation management like invasive plant control and brush hogging. Revenue from commercial harvests within State Parks goes into the Parks Special Fund, which is solely used for parks infrastructure projects. Revenue from harvests within Wildlife Management Areas goes into the Fish and Wildlife Fund, which is used for habitat improvement projects.

The process by which a timber sale is developed and reviewed is described in Comment Theme 2. Whenever forest management activities are planned, DST members identify opportunities not only for ecological protection, but also for ecological benefit. This happens in both the long-range management planning process and the harvest area analysis and timber sale development process. Forest management practices can create a greater variety of tree species, size and density across the landscape, and spatial arrangement, leading to forest conditions that support a greater variety of birds, insects, bats, plants and other species.[77] This diversity also increases the resilience—or recovery following a disturbance such as drought or pest outbreak—by providing a more diverse mix of tree species and sizes that together help a forest have more recovery pathways in response to climate change.[78] See the section "Additional Information: Active Forest Management as a Tool to Increase Climate Resilience in our Forests", for more information on how harvesting supports forest health and resilience. See also the following pages in the WRMU plan.

- Table 29 for a list of specific ecological benefits of treatments.
- Page 135, for a complete list of the land management strategies ANR will use within the WRMU.
- Climate Change Adaptation Strategies through Forest Management on page 148, for a complete list of climate adaptive management strategies ANR will use within the WRMU

Comment Theme 5. We should not log on State Land. State lands should be managed using passive management instead of active management.

State lands are to be managed for multiple uses according to Vermont statute, and on FPR lands management should "promote and protect the natural, productive and recreational values of such lands, and provide for multiple uses of the lands in the public interest" (10 VSA 2603). It is also our mission to monitor and maintain the health, integrity and diversity of important species, natural communities, and ecological processes. Many of Vermont's forests are recovering from past-use history, such as extensive clear cutting, farm abandonment, or high-grading (a common, historic practice that involved removing the best trees and leaving the rest). As a result, the forests we see today are often even aged (the dominant trees in the forest are all close in age), with many of the largest, most vigorous trees removed. Many lack snags (standing dead trees) and coarse, woody material (logs and branches in varying stages of decay on the forest floor). This condition can result in ecosystems lacking in diversity, structure, and resiliency. See "Additional Information: Active Forest Management as a Tool to Increase Climate Resilience in our Forests" for more information.

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[77] Messier, C., Bauhus, J., Doyon, F., Maure, F., Sousa-Silva, R., Nolet, P., Mina, M., Aquilué, N., Fortin, M.-J., & Puettmann, K. 2019. The functional complex network approach to foster forest resilience to global changes. *Forest Ecosystems.* **6**, 21. https://doi.org/10.1186/s40663-019-0166-2, Puettmann, K. J., & Messier, C. 2020. Simple Guidelines to Prepare Forests for Global Change: The Dog and the Frisbee. *Northwest Science*, *93*(3–4), 209. https://doi.org/10.3955/046.093.0305, Wikle, J. L., & D'Amato, A. W. 2023. Stand spatial structure outcomes of forest adaptation treatments in northern hardwood forests in North America. *Canadian Journal of Forest Research*, *53*(9), 721–734. https://doi.org/10.1139/cjfr-2022-0274.

[78] Messier, C., Bauhus, J., Doyon, F., Maure, F., Sousa-Silva, R., Nolet, P., Mina, M., Aquilué, N., Fortin, M.-J., & Puettmann, K. 2019. The functional complex network approach to foster forest resilience to global changes. *Forest Ecosystems.* **6**, 21. https://doi.org/10.1186/s40663-019-0166-2, Palik, B. J., & D'Amato, A. W. 2023. *Ecological Silvicultural Systems: Exemplary Models for Sustainable Forest Management*. John Wiley & Sons., Puettmann, K. J., & Messier, C. 2020. Simple Guidelines to Prepare Forests for Global Change: The Dog and the Frisbee. *Northwest Science*, *93*(3–4), 209. https://doi.org/10.3955/046.093.0305.

Active management is a tool that can be used to address these issues by restoring diversity in age and species composition, and in some cases, passive management may fail to achieve the best ecological outcomes. Through commercial and non-commercial management, we can increase forest health and complexity and create a forest ecosystem that can better withstand the challenges of climate change, invasive species, and more. See "Additional Information: Active Forest Management as a Tool to Increase Climate Resilience in our Forests" for more information.

There is no one-size-fits-all approach to forest management. We support a balanced approach, using ***both passive and active strategies***, where appropriate. The draft LRMP identifies 9,961 acres, more than half of the management unit, as suitable for largely passive management. In other areas, our management strategies provide numerous benefits. For example, creating openings in the forest canopy can enhance wildlife habitat, and add tree species diversity and structure to the forest. In another example, we can use management to create old-growth characteristics in forests, such as adding large, dead wood to the forest floor, using crown thinning to promote growth of large trees, and using regeneration methods to create or maintain an uneven-aged forest.[79] This type of management can be used to accelerate the natural processes that take place in passive management, while being able to mitigate invasive plants, choose regeneration methods that promote many different species, and make site-specific decisions.

Our forests provide numerous benefits to the people of Vermont and require a diversity of management strategies. This balanced approach is a collaboration of numerous professionals, including wildlife biologists, ecologists, foresters, and watershed scientists. Active management on state lands is subject to an extensive review process and demonstrates exemplary forestry.

Comment Theme 6. There were some comments that forest management is focused in Worcester and not in Stowe. Additionally, some commenters expressed concern about the disproportionate impacts of trucking to one area or town. There were requests for more explanation of these decisions.

FPR does not decide the location of timber harvests based on what town the harvest may be prescribed in. Decisions about where timber harvests will occur are based on access, suitable ground conditions, slope, soil drainage, forest conditions such as health of the forest, species composition, stand age and forest structure, soil characteristics, information on forest product quality and distribution as well as wildlife habitat considerations.

An analysis of proposed timber harvests shows percentages of harvest acreages prescribed in the three towns with the largest acreages of land within the WRMU are relatively equal – Worcester at 12.6%, Middlesex at 11%, and Stowe at 8.5%.

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[79] Urbano, Andrea & Keeton, William. 2017. Carbon dynamics and structural development in recovering secondary forests of the northeastern U.S. Forest Ecology and Management. 392. 21-35. https://doi.org/10.1016/j.foreco.2017.02.037.

It is true that there are more harvests prescribed on the eastern side (Worcester and Middlesex) of the Worcester Range compared to the western side (Stowe) of the Worcester Range. This would be expected as a total of 9,234 acres of the 18,772-acre WRMU lies in the town of Worcester (49%), compared to 4,088 acres, or 22%, in Stowe. The acreages of the other three towns in which the WRMU is located is as follows: Middlesex (2,807 acres or 15%), Elmore (1,831 acres or 10%), and Waterbury (812 acres or 4%). The three towns on the eastern side of the Worcester Range - Worcester, Middlesex, and Elmore - comprise 13,872 acres or 74% of the unit compared to 4,900 acres or 26% in the towns of Stowe and Waterbury on the western side of the Worcester Range.

There are 12 timber sales scheduled on 1,928 acres over the 20-year life span of the LRMP for the WRMU. The average size of these prescribed harvests is 161 acres, ranging in size from 74 acres to 298 acres. The table below shows the breakdown by town. See Table 33: Commercial Vegetation Management Schedule (2025-2045)on Page 172 of the Plan for the details of individual treatments.

Town	WRMU area in the town (acres)	# of treatments	Total treatment area (acres)	Average treatment area (acres)	% of WRMU acres in town identified for treatment
Worcester	9,234	5	1,172	234	12.6%
Stowe	4,088	3	375	125	9%
Middlesex	2,807	3	307	102	10.9%
Elmore	1,831	1	74	74	4%
Waterbury	812	0	0	0	0%

Also, an additional 2,250 acres of land have been added to the WRMU since 2019 through land acquisition. The majority of this acreage, 1,877 acres (83%), was added to the eastern side of the Worcester Range.

To address concerns about trucking in areas of proposed timber activity, the schedule of prescribed timber harvests (Table 33) has been adjusted to space harvests out more evenly to not have trucking occurring over an extended period of time in one area. Further discussion of forest products trucking can be found in Comment Theme 28.

Comment Theme 7. Why is the state spending large amounts of money subsidizing the timber industry?

ANR does not subsidize the timber industry through its forest management and timber harvesting. Inventory data collected as part of harvest development (see Comment Theme 2) is used to quantify volumes and expected forest products on sales to inform potential contractors about what is in the harvest area, and standard minimum pricing is applied to those volumes to set a minimum required bid for the contract.

Comment Theme 8. Who is being hired to do the logging and processing?

To ensure the best outcomes and operations on a timber harvest on state lands, an independent contractor is selected through a competitive public bid process, in compliance with Agency of Administration Bulletin 3.5. FPR prioritizes transparency and fairness by clearly defining sale boundaries, trees for harvest, and harvesting guidelines and requiring attendance at a bid showing for all bidders. Following these procedures, timber harvests are executed efficiently and at the best price possible. See https://fpr.vermont.gov/forest/state-forests/forest-management-timber-harvests-state-lands for more information.

Comment Theme 9. Concern that the Plan only allows for timber harvesting in 10% of the WRMU over a long period of time. Given the benefits of timber harvesting to the WRMU ecosystem, and the public, and its compatibility with many of the other planned uses, increasing the amount of area that is under active management, at the discretion of the DST, would be a prudent amendment to the plan.

The DST considered multiple factors in determining the proposed amount of timber harvesting for the WRMU, as described in Comment Theme 4. Additionally, current staffing levels and other work demands requires balancing vegetation management with other management activities. There is a balance that must be struck between meeting landscape level management goals and prescribing an achievable amount of work based on existing staffing levels.

Comment Theme 10. The next draft of the plan should include details on the intended prescriptions for the stands, including descriptions of the current and desired future conditions based on the inventory table, and how the intended treatments will promote that desired future condition.

In response to this feedback the Site-Specific Forest Management Activities section (page 170) was edited for clarity and additions were made to Table 33 (page 172), which now includes primary and secondary management objectives for each of the planned treatments that speak to desired future conditions for those stands. Detailed prescriptions are not developed for LRMPs, as the LRMP is intended to establish overarching management goals that serve as the foundation for developing detailed prescriptions. See Comment Theme 2 and Comment Theme 4 for more information on how LRMPs and prescriptions are connected.

Comment Theme 11. How much timber will be harvested?

This LRMP does not pre-determine how much timber will be harvested on a scheduled treatment. Through the planning process, ANR selects the areas scheduled for timber harvest analysis, as well as the vegetation management goals and objectives. During the implementation phase, the DST plans out the harvest based on these goals and objectives combined with conditions on the ground (see Comment Theme 2 for more information on this process) to develop a detailed harvesting prescription. It is at this time that the amount of timber to be harvested in a treatment is determined based on the trees that will be cut to achieve the management goals for the stand.

Comment Theme 12. If both logging and recreation are compatible with Land Management Classification 3.0, why is there only logging (and no recreation) proposed in the parcels on the east side of the range?

Additional recreation trails or alterations to existing recreation trails were not identified as goals on the east side of the Worcester Range because our recreation assessment did not identify a need here. The recreation assessment evaluates public demands for existing and new resources, existing infrastructure and tradeoffs between recreational and natural resource considerations. The recreation assessment did not identify highly impacted trails with parking areas unable to accommodate average parking demand in this area, nor has FPR received requests from the public for additional infrastructure in this area of the WRMU (please see page 99 of the Plan for more information about the recreation assessment). New trails and existing trail adjustments have been focused on areas where user impacts threaten the resource or where new acquisitions have occurred with previous concentrated recreation use that would benefit from more proactive management. FPR's focus on the trail network on the eastern side of the range is to continue managing the existing resource, improve the sustainability of trail infrastructure, and monitor use and trail infrastructure conditions. See Comment Theme 6 for more information about the geographical distribution of timber harvests in the WRMU.

Comment Theme 13. How many more parcels will be proposed to be logged in future 20-year increments? After multiple 20-year management periods, what percentage of the WRMU will get logged?

The locations and extent of future harvests will be determined when the next LRMP is developed based on surveys and assessments of forest, wildlife, and ecological resources, as well as public scoping. It is not possible at this time to quantify a number of parcels or proportion of the WRMU that will be hypothetically treated in the future.

Comment Theme 14. Are there smaller-scale, lower-footprint options other than industrial scale logging that can achieve our management goals? One commenter suggested traditional harvesting by horses; another commenter suggested the use of hand crews.

To achieve the forest management goals of the proposed plan at the necessary scale and at a cost that the taxpayers can bear, commercial vegetation management is required. This means that the value of the products cut from a timber harvest can cover the costs of doing the cutting. While planning for vegetation management FPR will consider what types of equipment and harvesting methods are appropriate for each unit, meet the management objectives of the harvest, meet the environmental requirements, and meet any requirements or restrictions set by the Forester-in-Charge. Anyone who bids on a timber harvesting contract can propose methods that will meet the requirements or restrictions on equipment set by the Forester-in-Charge. If there are no restrictions on equipment, mechanized equipment is generally preferred by the contractor to make timber harvesting commercially viable. There are very few logging contractors using animal powered harvesting systems and the ones that do provide a very niche service. If FPR restricted all commercial harvest to this method, it would almost eliminate the ability to achieve the forest management goals of the Plan and the Agency in general.

ANR does consider whether an individual project may be achieved using hand crews rather than commercial vegetation management, and there are some instances where vegetation management is conducted with hand tools at a higher cost to the State. This most often occurs as a "non-commercial vegetation management" project. The costs of this type of work can range from $300 to $500 an acre for selective tree cutting for stand improvement and up to $1,500 an acre for grinding work needed to maintain early successional habitat. This is compared to commercial timber harvests which usually result in net payments to the state that can be reinvested in land management that improves forest condition and provides public access and recreational opportunities.

A number of edits were made to Section IV detailing other vegetation management approaches that will be used on the WRMU, complementing commercial vegetation management. An edit has also been made to Section III.D of the plan to indicate that the access and operability considerations refer primarily to viable *commercial* vegetation management.

Comment Theme 15. While timber harvest is assumed to occur on nearly every acre where it is not considered infeasible because of site constraints, it is not clear whether timber harvest is appropriate in all these areas without any kind of stand assessment. The State would do well to conduct a site-specific resource assessment before determining the location of timber harvests and codifying those assessments in the Plan.
It is not accurate to assume that timber harvests will "occur on nearly every acre where it is not considered infeasible because of site constraints". As part of the assessment process in developing the LRMP, many areas are excluded from further consideration of timber harvest for other reasons such as the presence of sensitive natural or cultural resources, special habitat features, important landscape features, etc. Of those areas where general conditions are compatible and management goals can be achieved with timber harvests, detailed, site-specific assessments do occur on all areas scheduled for vegetation management, however, this level of analysis does not occur during the LRMP development process and is therefore not included in this plan. Detailed stand assessments are not developed for LRMPs, as the LRMP is intended as the guiding document that serves as the foundation for defining the management goals. The stand assessments provide the detailed information needed by ANR staff to outline and identify the specific management approach (e.g. silvicultural prescription) to achieve the LRMP management goals. See Comment Theme 2 and page 170 in the plan for additional information.

Comment Theme 16. One commenter noted: "Under FPR ownership only three harvests have occurred to date within the Burt Hollow Block, covering 201 acres. The former Storey parcel was a working forest and managed by the previous owner for forest products." This would make it appear that this unit is available for harvest and likely having stand and access conditions that would support future timber harvest. It is unclear why this unit is not considered for active management. We encourage the State to look more closely at the available management options for this Block.
Treatment areas 8 and 10 are located within the former Storey parcel and are currently scheduled for commercial management during the planning cycle of the LRMP. Please refer to the Management Strategies and Actions section in the LRMP for further details about these two areas.

Comment Theme 17. One commenter noted: "The Perry Hill Block is described as having infeasible access, though it is not clear what makes this so since the block has previously had timber harvests using the existing road and access. We would encourage the State to consider active management to address the serious red pine decline occurring on this block. This may

or may not include timber extraction, and that decision should be made based on site constraints and resource goals."

The Agency's current access to the Perry Hill Block is very restricted. The only road access consists of a narrow roadway that passes through a small tunnel under the interstate highway that is too small for current-day log trucks to navigate. Historically, the State owned the parking area which could be used as a landing and used smaller trucks to access the site for timber sale, but neither of those are options today. There is also no developed landing area on the parcel nor is there a place to create one due to the topography of the site. These constraints make active management where wood products are extracted unlikely unless other means of access are found. Although no commercial activities are planned during the LRMP, non-commercial activities to address the red pine decline can and will be completed as funding, opportunity, and resource conditions allow when compatible with the LRMP. For example, FPR has identified an area where forest stand improvement will be conducted by Agency personnel during chainsaw training events to meet the goals and objective of the LRMP. FPR is also managing the risks associated with the red pine decline and their proximity to the recreation trail network.

Comment Theme 18. It is my opinion that Vermont should harvest more on state lands. It would help mitigate blow downs and create better wildlife habitat.

ANR works to balance the many benefits that forests and forest management can provide. Part of that balancing effort is to utilize both active and passive management strategies. While less than half of the WRMU is classified in a way that allows for commercial timber harvests, all these acres were analyzed and considered for treatment based on the overarching natural and cultural resource goals of the LRMP. After extensive review, ANR has determined that the final forest management implementation schedule appropriately balances all the goals and objectives of this LRMP. See Comment Theme 4, Comment Theme 5 and Comment Theme 47, as well as the Additional Information: Active Forest Management as a Tool to Increase Climate Resilience in our Forests section for additional explanation.

Comment Theme 19. One comment noted: "Each of the 12 planned commercial vegetation management treatments included in the draft LRMP describe the use of uneven-aged silvicultural systems. This approach is highly supportive of developing a compositionally and structurally diverse forest condition over time. The General Strategies and Tactics presented on page 124 of the plan include examples of even-aged silviculture; regular shelterwood, seed tree, and possibly, patch cutting (depending on definition). We recommend removing these even-aged systems from the list of options and replacing with examples such as those provided in Silviculture with Birds in Mind (Audubon VT and VT Dept. Forests, Parks, and Recreation 2011) and Ecological Silviculture: Foundations and Applications.[80]"

Given the current conditions and history of the forests found within the WRMU all basic traditional silvicultural systems are listed as available to meet the goals and objectives of the plan. Text on page 132 was added to clarify the range of silvicultural systems and examples of when they might be used, and the Implementation Schedule on page 172 includes additional

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[80] Palik, B. J., D'Amato, A. W., Franklin, J. F., & Johnson, K. N. 2020. *Ecological Silviculture: Foundations and Applications*. Waveland Press.

details on general goals for each treatment that will inform the selection of silvicultural techniques. While the above referenced documents are relevant and contain techniques and variations that will be used to reach a portion of our goals and objectives, ANR does not feel it is necessary to restrict silvicultural options at the broad planning level to techniques that favor specific objectives as ANR manages for a wide range of goals and objectives.

Comment Theme 20. One comment noted: "Gap sizes can be variable in ecological/uneven-aged silviculture, ranging from 1/10 acre up to 2 acres. Gap sizes >1 acre, particularly when multiple gaps occur within a small area, are likely to move structural conditions from closed-canopy mature forest to open-canopy young forest. While a component of young forest on the WRMU is deemed appropriate… we recommend the majority of gap sizes to be <1/2 acre in size to better align with natural process dynamics of the matrix northern hardwood forest type."
Given the current conditions, size of parcel and history of the forests found within the WRMU restricting canopy openings at this broad planning level could prohibit ANR from meeting the goals and objectives of the plan. Canopy opening size will be determined at the sale development stage when a silvicultural prescription is developed to address site specific goals and objectives (see Comment Theme 2 for more information on this process). Many factors are considered when making this decision and include desired tree species to regenerate, specific wildlife habitat required, existing condition of the forest, browse pressure, location on the landscape, and aesthetics.

Comment Theme 21. One comment noted: "We appreciate the incorporation of timing of silvicultural treatments, winter vs summer, to support other management goals such as water quality protection, desired species for regeneration, and reducing conflict with recreation. We encourage the added consideration of harvesting impacts to nesting songbirds. When and where possible we recommend harvesting outside of the primary breeding season (May-July)."
Each proposed timber sale area is reviewed by experts from across ANR following the timber sale development process (see Comment Theme 2). If a resource concern such as impacts to nesting songbirds is identified through the Annual Stewardship Plan review and subsequent resource reviews, the prescription is modified to address the concern.

Comment Theme 22. One comment noted: "Since forest inventory data and site visits have been conducted, we suggest amending the LRMP to provide more detailed information about age classes and forest composition and condition. We would value the opportunity to comment on this information, especially if another round of public comment is afforded."
The previous draft of the LRMP included data in Appendix 2 on forest cover types and comparisons of acceptable growing stock to unacceptable growing stock by stand, outlining forest composition and condition information. Additional summary of the data to generate information about age classes of stands and more detailed species composition breakdowns would not change the assessment of the forest resource and the management strategies in the LRMP, so we have not added the requested information to the Appendix in the updated LRMP.

Comment Theme 23. One comment noted: "We understand the ability of timber harvest to create species and age class diversity within forested areas, and if this is the intent behind the harvest activities, we would encourage the State to describe the desired future conditions for the unit including the distribution of age classes or forest developmental stages to ensure that harvest planning will promote that desired condition."
The decisions about what stands to treat are based on the individual stand conditions found during the forest resource assessment and the considerations outlined above following existing silvicultural guides. Creating age and species diversity is one of many goals in the treatments, and these are included because they are generally aligned with improving forest health and climate resilience, rather than because they move the entire WRMU towards a specific desired age and species diversity condition by forest type at a landscape scale. ANR agrees that this could be interesting and useful information to first assess and then set targets against and will consider this suggestion in future discussions around planning, but this is not the approach currently used in determining stands for treatment on ANR lands.

Forestry Operations

Comment Theme 24. Comments asking for more information about road infrastructure management/planning.

No new additions to the State Forest Highway (SFH) system are planned within the WRMU during the lifecycle of this plan. The current road infrastructure meets our management and public access needs. Additional information on the management, creation and closeout of road infrastructure was added into the LRMP and can be found in the Infrastructure and Access section of the plan, as well as within Table 25: WRMU Access Road Information: Maintainer, Length, Needs.

Maintenance and upgrades to the existing road infrastructure will continue across the WRMU throughout the life of the plan as need and funding allows. General maintenance work includes annual tasks of cleaning ditches and culverts, removal of hazard trees, and maintaining waterbars where applicable. Roadside vegetation is maintained as needed (typically every three years) by mowing, tree cutting, and mastication. Road surfaces are maintained as needed by grading, shaping, smoothing, and re-surfacing to ensure the roadway maintains positive drainage. Larger projects such as road infrastructure improvements are completed based on need and funding.

In 2022, the road infrastructure of the WRMU was inventoried to establish baseline conditions and identify priority areas where improvements could be made to bring the roads into compliance with Vermont's Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in Vermont (AMPs), improve road resiliency during storm related events, reduce sediment movement, and improve water quality. These projects can consist of replacing undersized culverts, disconnecting roadside ditches from discharging into streams, installing ditch relief culverts, and resurfacing/re-grading road surfaces where erosion is present.

Comment Theme 25. One comment noted: "It is not clear to us if new road construction is anticipated as part of vegetation management on the LRMP. We do not support the

development of new permanent roads that could fragment the forest, and we have an overall concern for how proposed treatment areas will be accessed in areas where there are no roads. For example, how will skid roads be designed and laid out and how will these areas (some well above 1,500 ft and on steep slopes) protect small, high gradient, cold-water streams? We have a specific concern related to wetlands off Bear Swamp Road, and headwater streams off of Brownville Road (nine headwater streams originate within proposed harvest area). If new roads are proposed, which we do not support, the public should have the opportunity to weigh in on the proposed location and extent of roadbuilding."

All management roads on State Lands are classified as State Forest Highways and are equivalent to "permanent truck roads" as defined in AMPs (CVR 12-020-010). Language was added to the LRMP to clarify that no new additions to the State Forest Highway system are proposed as part of the management plan and that the current infrastructure meets our management needs. Please see further discussion in Comment Theme 24.

Temporary truck roads and skid trails as defined in the AMPs are used to access logging operations, and must be properly constructed, sited, maintained and closed out according to the AMPs (CVR 12-020-010) and the Riparian Management Guidelines for Agency of Natural Resources Lands (VT ANR, 2015). The sufficiency of the existing temporary truck roads and skid trails to meet these requirements and guidelines as well as considerations around equipment types, seasonality of operations and terrain is assessed as part of the site-specific timber harvest development process. A full description of this process can be found on page 170 of the plan. Any skid trails or temporary truck roads constructed to accomplish the management goals of the harvest area would comply with all applicable regulations, guidelines, and policies. For more information about how the AMPs and the Riparian Management Guidelines intersect with protection of water quality please see Comment Theme 63 and Comment Theme 66.

Concerns about fragmentation associated with forest management activity are addressed in Comment Theme 55. Concerns about impacts of forestry operations to wetlands and headwater streams are addressed in Comment Theme 65 and elsewhere throughout the Water Resources section of the Public Responsiveness Summary.

Comment Theme 26. Has the State considered and analyzed the potential impacts of logging truck traffic on Middlesex Road infrastructure (including bridges) and community safety and wellbeing (dust, noise).

The state has not analyzed the potential impacts of truck traffic on road infrastructure or dust and noise. In response to several public comments, FPR evaluated the draft forest management activity schedule and how traffic may impact the road network and neighborhoods. The schedule was revised to reduce impacts to the greatest extent possible and avoid having treatment units operating consecutively to reduce the duration of trucking in any one community. In addition, FPR attempts to work with towns to manage interactions with other road users to the extent possible when conducting logging operations. More information can be found in Comment Theme 27.

Comment Theme 27. Concerns about road damage and heavy vehicle traffic in Worcester resulting from the transport of logging equipment, noting the presence of walkers, cyclists, and school buses. One commenter requested that the State communicate with the Worcester town road commissioner regarding heavy vehicle passage, provide remuneration for road repairs, and refrain from using heavy vehicles on the road during winter and mud season.
Truck traffic on public roads and highways (including truck traffic associated with forest management) is neither governed nor regulated by ANR. While conducting forest management activities does increase truck traffic during active operations, timber harvest contractors are required to abide by all applicable federal, state, and local laws. These laws govern speed, width, height and weight while on public roads and ensure that the trucks operate safely on the highway during all seasons and carry insurance. Forestry operations are generally inactive during times of year when public roads are not well equipped to support heavy machinery (e.g., mud season) to protect the forest resource and reduce or eliminate trucking on sensitive road conditions. In addition, FPR attempts to work with towns to manage interactions with other road users to the extent possible when conducting logging operations. Like any other user of a town road, ANR or contracted logging operators do not provide financial compensation to towns for use of town roads.

Comment Theme 28. How many logging trucks can we expect to see on our roads, what routes through our community will the lumber trucks take and how far is the lumber being transported?
ANR does not estimate the number of loads of forest products that may be harvested in a scheduled treatment during the LRMP development process. During the LRMP development process, ANR determines land management goals and objectives and the areas that will be analyzed for vegetation management treatments. Once the plan is approved, ANR follows the implementation schedule to develop projects, such as timber harvests. See Comment Theme 2 for details regarding the timber sale development process.

Comment Theme 29. Considering the large impact forest roads have on hydrology, we would encourage the State to conduct a more detailed inventory and assessment of roads on the Unit, and to prioritize projects based on that assessment.
FPR is currently conducting a Road Erosion Inventory of all State Forest Highways on state lands. This inventory identifies segments of roads that do not meet current AMP standards and provides information to help staff prioritize projects in terms of both water quality benefits and other considerations. See Comment Theme 66 and page 118 of the Plan for more details and information.

Forest Economy

Comment Theme 30. What forest products are being harvested?

Timber harvests on state lands have the potential to provide a full range of forest products. This can include veneer logs; higher-quality sawlogs that can be cut into boards; moderate-quality logs suitable for making posts and pallets; pulpwood that can be used to make paper, paperboard, packaging, tissue and sanitary paper, or composite materials; and fuelwood that can be processed into pellets, cordwood, or chips and used to produce heat and electricity for residential, commercial, municipal, and institutional users. When State Lands Foresters set up a timber harvest, they mark trees for harvest based on their forest management goals, and tally the marked trees based on broad classes of sawlogs or pulp/pallet. Consistent inventory standards guide the tallying to provide a clear and consistent picture to potential contract bidders regarding estimates available for harvest. The decision about where to send logs is made by the contractor, and the decision about what to do with that log is made by the receiving processors, such as a mill. Estimated volumes from timber sale prospectuses from the past 10 years for timber sales on state lands indicates that an average of 1,365 million board feet of sawlogs and 3,223 cords of pulp/pallet were tallied prior to harvest. The actual utilization of the harvested wood is determined by the contractor, and thus the actual products harvested may differ from the figures above.

Comment Theme 31. What is the market for those products?
Markets for forest products change regularly based on numerous factors, including the season during which the harvest occurs, local economic activity, and global trade conditions.[81]

Comment Theme 32. How far is lumber being transported?
ANR does not determine, or dictate in a contract, the distance or locations to which a contractor transports forest products that are harvested as part of a state timber sale contract. Likewise, ANR does not determine which mills or other facilities a contractor may use as part of its business operation. Logging contractors structure their businesses in a variety of ways and utilize numerous regional sawmills, local sawmills, pulp mills, biomass facilities, and firewood processors to develop marketable forest products. One exception is when the State donates firewood through its Woods Warms program for heating assistance. In this case, the State identifies the delivery location for a specified amount of firewood in the contract.

Comment Theme 33. No proof or standard is included in this document to show that the extracted lumber will stay in Vermont.
The purpose of a LRMP is to outline management goals and activities for the Plan period, not to provide an economic analysis of the forest products industry in Vermont. The destination of wood products harvested from state lands is a business decision made by the contractor. However, more information about the destination of wood products harvested in Vermont in general (not just from state lands) can be found in FPR's Harvest Reports (available online at https://fpr.vermont.gov/harvest-reports) and information about how contractors decide where wood goes can be found in Comment Theme 30 and Comment Theme 32.

Comment Theme 34. Is any effort being made to create or support local jobs?
This question was posed in the context of timber harvesting specifically. The Division of Forests in FPR has a program devoted to assessing and supporting the forest economy in the State, from highlighting manufacturers and processors to supporting businesses with data and

[81] A summary and review of the differences in consumption and production of wood products between states in New England can be found in Littlefield, C., Donahue, B., Catanzaro, P., Foster, D., D'Amato, T., Laustsen, K., Hall, B. 2024. Beyond the "Illusion of Preservation": Taking Regional Responsibility by Protecting Forests, Reducing Consumption, and Expanding Ecological Forestry in New England.

information to engaging in training and safety efforts. More information can be found at https://fpr.vermont.gov/forest/working-landscape.

As timber harvests on state lands are bid competitively in compliance with the Agency of Administration Bulletin 3.5, no preference is given based on the business location of the bidder, but the location-specific nature of the work tends to make it easier for contractors within the state to be competitive. Most contractors working on state lands timber harvests are located within Vermont or nearby, and the offering of timber harvests in and of themselves is an action that supports the creation and maintenance of local jobs, including loggers, truckers, mill workers, other forest product processors, wood products manufacturers, mechanics, and other adjacent industries. Further description of the bid process can be found in Comment Theme 8.

Comment Theme 35. The perennial revenues generated by recreation and other non-timber uses far outweigh the revenues generated by logging. There seems a fiduciary responsibility here that is being overlooked.
FPR's primary charge on state lands is long-term sustainable management of natural and cultural resources for multiple uses, not balancing revenue considerations across different uses. There is no economic analysis of the revenues of one type of activity on state land against another, as this would not account for the underlying natural resource values supported by the proposed management.

Comment Theme 36. The State should limit large scale logging contractors that do whole tree chipping to give the smaller operations an opportunity.
Decisions about operational constraints on a given timber harvest are up to the forester developing the harvest. In general, potential bidders are given flexibility to determine the harvesting equipment and utilization strategies, provided the management outcomes and site condition requirements can be met. Setting operational constraints to favor one type of contractor over another would contradict the competitive bidding principles underpinning the Agency of Administration's Bulletin 3.5 governing contracting and procurement by the State. See Comment Theme 8 for more information on contracting and state lands timber harvests.

Comment Theme 37. Is it possible to reduce the carbon footprint of this proposed logging by setting up local mill operations?
Transportation costs can be significant, and contractors will typically seek to reduce these costs by using the closest mills and processors. FPR promotes the establishment and maintenance of local processing capacity as part of its core work related to the forest economy (see Comment Theme 34) and will continue to do so. State lands timber harvests are an important support for these local operations by providing a predictable supply of a range of wood products.

Forest Health

Comment Theme 38. One commenter expressed concern about the impact of jumping worms on forest health and a question about measures the state uses to control the spread of jumping worms.
See Comment Theme 3 for information about general controls for invasive plant spread that will be effective for preventing spread of jumping worms as well. More information on

preventing the spread of jumping worms can be found at https://vtinvasives.org/invasive/jumping-worms.

Comment Theme 39. One commenter expressed concern about "a lack of cutting and new growth [leading] to higher risk of fires," when faced with summer drought.
Climate models strongly suggest that the Northeast will be receiving more precipitation in the future, punctuated by periods of drought.[82] Predictions of future wildfires in Vermont are somewhat more complicated. Although there is concern of wildfire, we are not currently seeing increasing trends in fire occurrence. While we do not have data to show an increase in forest fires, we are working with partners to look at other indicators of change such as the correlation between flash drought and fire potential under future climate scenarios. We hope to have more information on this soon that could help identify any increases in risk and subsequent strategies we can implement to mitigate these challenges—emphasizing the importance of our ability to conduct forest management on our state lands as the commenter has suggested. Another aspect that makes risk of wildfires in Vermont difficult to quantify is the fact that our fires are primarily human caused. Our Wildland Fire team is actively involved in assessing these threats. Also see Comment Theme 43 for further information.

Comment Theme 40. Non-native and invasive plants and pests are among the greatest threats to supporting biodiversity and forest health. The draft LRMP describes current and potential future occurrences of these plants and pests within the WRMU, however, the current plan provides little detail on how current or anticipated presence of non-native and invasive plants and pests will influence management. We recommend additional detail on non-native and invasive plant management scenarios along with a description of how exotic pests, such as emerald ash borer, will influence management during the planning period covered by the plan.
The impact, monitoring, and treatment of invasive pest are covered in Comment Theme 3 and additional language was added to the LRMP and can be found on page 197.

Comment Theme 41. In the climate change adaptation section of the draft LRMP, deer browse patterns affecting forest regeneration are named as an immediate climate change impact due to reduced snow winter depths. There is a need to balance deer habitat management with forest regeneration and to ensure that if deer browse impacts forest regeneration that it is addressed. We recommend listing browse pressure as a condition to inform management planning, monitoring browse of regenerating forest patches, and considering alternatives to only recreational hunting, as currently regulated, to manage the deer herd if regeneration is affected.
Deer browse impacts on forest regeneration is a general concern due to warming climate and is an issue in some places in VT. However, ANR staff have not observed evidence that deer browse is currently a concern within the WRMU. ANR staff will include strategies to protect regeneration in harvest areas. If browse pressure is a concern at a site, ANR will consider

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[82] Hayhoe et al. 2007. Regional climate change projections for the northeast USA, Mitigation and Adaptation Strategies for Global Change, vol. 13, no. 5-6, pp. 425–436. https://doi.org/10.1007/s11027-007-9133-2.

management strategies such as leaving whole treetops following harvest to inhibit deer movement and emphasize continued control on browse pressure by more broadly encouraging hunting on state lands.

Comment Theme 42. Can we put in a blueberry management area like in Goshen? That is a phenomenal recreational area, as well as critical habitat for fire adapted plants and open herbaceous species.

Blueberry management in the WRMU would be a significant challenge due to intertwined ecological and environmental factors. The lack of deep sandy soils, cooler climate, mountainous terrain, and resulting economic constraints makes blueberry management in the WRMU particularly unfeasible compared to more naturally suitable sites, like the one managed in Goshen. Blueberries can be found growing naturally in the unit on the Red Spruce-Heath Rocky Ridge, Boreal Outcrops, Red Spruce-Cinnamon Fern Swamps, and Temperate Acidic Outcrops.

Comment Theme 43. No mention of fire control measures under Vegetation Management. Uncontrolled forest undergrowth can be a fire hazard.

Currently, we are not seeing trends towards more frequent or more severe fires in Vermont. FPR has a Wildland Fire team that monitors fire trends and dangers, and this information can inform management decisions if fire trends change. Presently, we are more likely to see other types of stand-level disturbance than fires, such as wind events, forest pests and disease, or ice storms. We do not rule out the possibility of a large fire, but, based on existing conditions in this region, managing forests to resist catastrophic fire or reduce intensity of potential future forest fire is not currently a priority. Fire has been and will continue to be used on some state lands for management purposes in natural communities adapted to fire as a disturbance, such as Sandbar Wildlife Management Area and West Mountain Wildlife Management Area.

As for articles about western fires, fire regimes vary greatly depending on region and vegetation community within each region. Species that evolve with regular fire develop adaptations to survive fires. As a result, where you find fire-adapted species, there are more frequent fire regimes. Places with infrequent or rare fires, such as the Northeast and particularly northern hardwood forests (the dominant forest type of the WRMU), are not adapted to fire.

The USDA Forest Service Fire Effects Information System (FEIS) brings together information about fire ecology and fire regimes in the United States. The FEIS breaks down the fire regime by region and plant community. Within each vegetation community, this table shows the fire severity regimes seen for that community, with a percentage of how often each occur, and the interval of time between fires.[83]

Fire severity regimes are broken into three categories:

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[83] Fryer, Janet L and Luensmann, Peggy S. (2012, February). Fire regimes of the conterminous United States. U.S. Department of Agriculture, Forest Service, FEIS. https://www.fs.usda.gov/database/feis/fire_regime_table/fire_regime_table.html#Northeast

- Replacement: Any fire that causes greater than 75% top removal of a vegetation-fuel type, resulting in general replacement of existing vegetation; and may or may not cause a lethal effect on the plants.
- Mixed: Any fire burning more than 5% of an area that does not qualify as a replacement, surface, or low-severity fire; includes mosaic and other fires that are intermediate in effects.
- Surface or low: Any fire that causes less than 25% upper layer replacement and/or removal in a vegetation-fuel class but burns 5% or more of the area.

As an example, within the Northeast region, the northern hardwoods vegetation community has replacement fires 39% of the time, with a mean interval between fires of more than 1,000 years. The other 61% of the time is a mixed fire regime and occurs with a mean interval of 650 years. Northern hardwoods do not have surface or low fire severity regimes; mostly there are mixed fire regimes occurring infrequently, and replacement fires regimes occurring at the most infrequent time scale provided by the FEIS.

By comparison, if you look at the California Ponderosa Pine vegetation community, a fire-adapted species, there are replacement fires 5% of the time with a mean interval of 200 years, mixed fires 17% of the time with a mean interval of 60 years, and a surface or low severity fire 78% with a mean interval of 13 years. This tells us that there are frequent low severity fires most of the time, with mixed fires happening every 60 years. Ponderosa Pines, being a fire-adapted species, have developed to survive fire with age, due to features such as such as increased bark thickness and root depth. These examples illustrate the difference in fire regime for a fire-adapted species compared to a fire regime in a region that rarely sees large fires.[84]

Comment Theme 44. My comment is really a question or concern about timber harvesting and impacts on forest fires. I regularly read articles about the big western fires and how the best resiliency plans seem to include plans to preserve the mature trees as they are more likely to survive fires and play a key role in recovery. I don't think the presentation got into the weeds on the harvesting methods, but will that be identified in the plan? My concern also applies to remediation requirements to prevent erosion.
Please see the response to Comment Theme 43 for more discussion about the nature of fire regimes in general in Vermont as compared to the western US. Forests that are adapted to frequent low-intensity fires have species within them that tolerate fire. An example common in western forests are ponderosa pines, which have thick bark insulating them from lower-heat fires. In Vermont, species like oaks and red pine are similarly adapted to surviving low-intensity fires, while other mature trees common on the WRMU such as beech and yellow birch are not. The decisions about what trees to retain after a harvest consider a range of science and silvicultural guides based on how forest ecosystems in the Northeast function, and where fire is a consideration, that will be factored into the decision making. There are limited examples of

[84] Fryer, Janet L. 2018. Pinus ponderosa var. benthamiana, P. p. var. ponderosa: Ponderosa pine. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Missoula Fire Sciences Laboratory (Producer). Available: www.fs.usda.gov/database/feis/plants/tree/pinponp/all.html

fire-adapted species in the WRMU, and the harvests proposed in this plan do not occur in those forest types.

Conservation Planning

Comment Theme 45. The draft LRMP lacks mention (or depiction) of adjacent and nearby conserved land. Considering the landscape context of the WRMU is an essential starting point for management and should guide decision making at all scales during the development and implementation of the plan.
Landscape context is described in the Vermont Conservation Design section of the Executive Summary, and in detail in the Ecological Assessment of Natural Communities, and the Wildlife and Habitat Assessment. This information is the foundation of the comprehensive lists of management strategies and actions on page 135. Additionally, a paragraph and a map were added to the Vermont Conservation Design section in the Executive Summary to illustrate the location and connectivity of adjacent conserved land (pages x-xi).

Comment Theme 46. Consider compatibility between land management classifications and the values of interior forest blocks and connectivity blocks, and wildlife corridor function.
The compatibility between management classifications and ecological functions is carefully evaluated during the planning process. The proposed classifications and management activities are developed with consideration for wildlife linkages and corridors. See Comment Themes Comment Theme 47, Comment Theme 48, and Comment Theme 55 for further explanation.

Vermont Conservation Design – Old Forest Targets

Comment Theme 47. The plan should align with Vermont Conservation Design and adequately help to meet targets for old forest in the WRMU, particularly in low-elevation areas.
The draft plan is consistent with Vermont Conservation Design (VCD) and a section has been added to the executive summary (page x) to more specifically highlight this alignment. More information describing this alignment can be found on page 135 in the Unit-Wide Goals, pages 136-139 in General Management Strategies and Actions, and page 182 in the Site-Specific Recreation Management Actions.

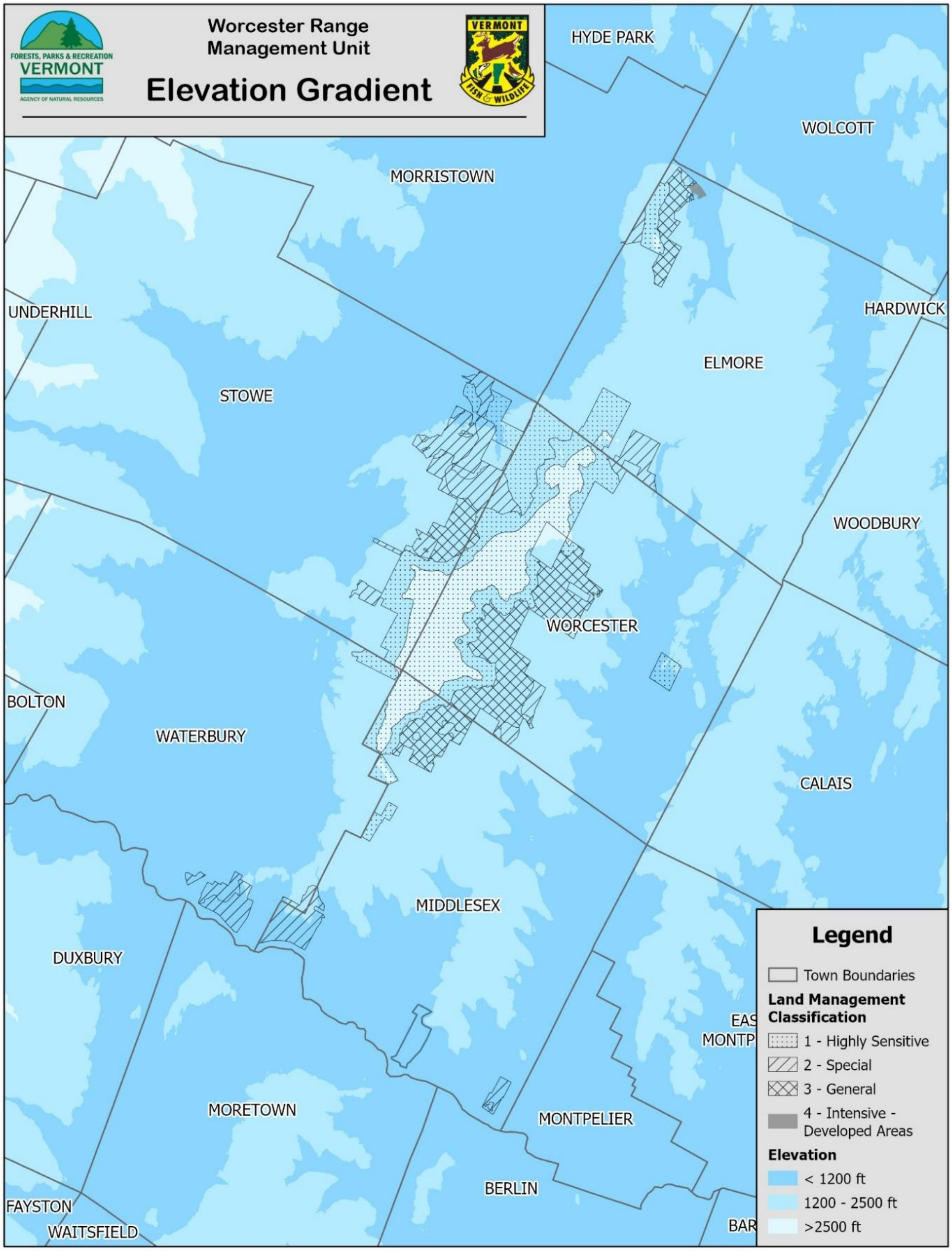
VCD outlines priority features at various scales to maintain ecological function statewide and regionally. These features and guidelines are detailed in the VCD Summary Report and two technical reports available at https://vtfishandwildlife.com/conserve/vermont-conservation-design.

VCD aims to restore 95,000 acres of old forest in the Northern Green Mountains biophysical region, where the WRMU is located. As of 2021, the Vermont Department of Fish and Wildlife identified 75,087 acres (79% of the target) already conserved and managed to develop into old forest. This includes state-owned Natural Areas in the WRMU, such as the 4,057-acre Worcester Range Natural Area and the 80-acre Moss Glen Falls Natural Area. The draft LRMP proposes managing an additional 5,821 acres in the WRMU as Highly Sensitive Management

Areas (HSMA), which will more than double the area designated for old forest development in the WRMU and contribute significantly to the VCD target.

While the WRMU constitutes only 1% of the Northern Green Mountain region, it contributes 10% towards the region’s old forest target, playing a substantial role in achieving VCD goals. Currently, the target for the region is primarily met through protecting Montane Spruce-Fir Forest, Montane Yellow Birch-Red Spruce Forest, and Northern Hardwood Forest (78%). Most of the WRMU is above 1,200 feet in elevation and consists mainly of these common forest types. Areas below 1,200 feet, like Moss Glen Headwaters and Worcester Woods WMA, enhance the diversity and representation of natural communities needed for the region's targets, including Hemlock Forest, Hemlock-Northern Hardwood Forest, and Lowland Spruce-Fir Forest.

Active and passive management for old forest characteristics will be applied to Special and General Management Areas in the WRMU, such as Moss Glen Falls Headwaters, Wetlands, and Mast Areas and Bobcat Habitat. Passive management, except for invasive species removal, is the primary approach for wetland features covering over 350 acres. For more details, see pages 151-155 of the plan.



Worcester Range
Management Unit
Elevation Gradient
FORESTS, PARKS & RECREATION
VERMONT
AGENCY OF NATURAL RESOURCES
VERMONT
FISH & WILDLIFE
HYDE PARK
WOLCOTT
MORRISTOWN
UNDERHILL
HARDWICK
ELMORE
STOWE
WOODBURY
WORCESTER
BOLTON
WATERBURY
CALAIS
MIDDLESEX
DUXBURY
EAS
MONTP
MORETOWN
MONTPELIER
BERLIN
FAYSTON
WAITSFIELD
BAR
Legend
Town Boundaries
Land Management Classification
1 - Highly Sensitive
2 - Special
3 - General
4 - Intensive - Developed Areas
Elevation
< 1200 ft
1200 - 2500 ft
>2500 ft

Comment Theme 48. Designate ~3,000 additional acres for the establishment or maintenance of old forest. As described previously, the WRMU provides a rare opportunity to manage for old forest in a context that meaningfully advances the targets presented in Vermont Conservation Design and enhances the conservation value of the landscape.
This suggestion has been incorporated. We have added over 5,775 acres into passive management in this management planning process: 5,492 acres were identified in this first draft of the LRMP, and an additional 309 acres were added in the final draft of the Plan. In total, this LRMP identifies 9,961 acres, more than half of the management unit, as suitable for passive management. Please see Comment Theme 47 and Comment Theme 5 for information on VCD and on passive management within the WRMU.

Comment Theme 49. The State should use the new Forest Reserve category of the Current Use Program as a model. It requires that woodlands be managed to encourage mature, diverse, "old growth" forests, allowing the owners to eliminate invasive species and other diseased or problem plants, to encourage such woodlands.
Although the forest reserve category concept was developed for use on private lands to accelerate the development of old forest conditions, the associated management practices are also implemented on state lands and will be utilized during prescription development where appropriate. The creation of this category in Vermont's Use Value Appraisal (UVA) Program, often referred to as Current Use, allows private landowners to manage their land for old growth forest conditions rather than active long-term forest management for the purpose of growing and harvesting repeated forest crops. As such, landowners who manage for old growth forest are eligible to receive the benefit of taxation at current use value rather than fair market value. Although the UVA Program requirements do not apply to State lands, the Agency manages for old forest conditions that align with the management goals and objectives of the LRMP and the condition of the forests.

Comment Theme 49. The future representation of old forest across a range of elevations, aspects, and geophysical settings in the WRMU could be strengthened by eventually including some of the lower elevation, gently sloping lands on the eastern flanks of the Worcester Range. We recognize that these are also the lands best suited for timber production and for deploying commercial management as a tool to enhance climate resilience and forest health. In the areas proposed for commercial harvest we recommend the plan explicitly state that the goal of every harvest is to increase climate resiliency as well as produce timber products and improve terrestrial and aquatic habitats.
The unit wide goals listed in the LRMP have been edited to clearly reflect the goals of improving climate resiliency and wildlife habitat as well as producing forest products. The unit wide goals can be found on page 135 of the plan. See Comment Theme 47 for additional information on the application of Vermont Conservation Design's old forest targets in the Worcester Range.

Comment Theme 50. We also encourage the DST to consider conducting an inventory to identify suitable stands with similar landscape position outside of the proposed harvest areas that could be more formally directed to old forest conditions in the next LRMP. Depending on existing conditions, this could include both passive management and active restoration of old forest characteristics.

Due to a) capacity constraints, b) the size of the unit, and c) the very limited extent of vegetation management outside treatment areas, this was not pursued. The combination of limited staff capacity to conduct inventory and the large acreage of the unit outside treatment areas, conducting additional inventory at this level of intensity was infeasible. Furthermore, the actual outcomes on the ground of designating additional stands for passive management is unlikely to differ from what will happen under the current designations, as no large-scale manipulation of vegetation will occur in any of the areas not designated for treatment. Designating additional stands for active management would require more capacity to implement than currently available. The proposed nature and timing of treatments represents a reasonable balance of resource needs and capacity to implement management.

Comment Theme 51. The State should consider sharing a state-wide strategy for how it envisions Agency lands, both new and existing, can contribute toward the old forest targets identified in VCD.
Decisions about HSMA designations within the WRMU (many of which will become old forest) were informed by an analysis of the distribution of forest types within the Northern Green Mountains Biophysical Region, the relative distribution of forest types within the biophysical region that are on a path to become old forest based on their designation or land protection status, and the "opportunity" that the WRMU forests present to contribute to the distribution and overall old forest targets within the biophysical region. A more detailed description of this analysis can be found in Comment Theme 47.

Vermont Conservation Design – Young Forest Targets

Comment Theme 52. The plan should include the creation of more young forest habitats to help meet Vermont Conservation Design young forest targets and provide a more diverse array of habitat types for wildlife.
Young forest is an important habitat feature in Vermont and one that is under-represented in the Northern Green Mountain Biophysical Region (VCD Part 2: Natural Communities and Habitats Technical Report, 2018). In Vermont's Wildlife Action Plan (2015), fifty-four Species of Greatest Conservation Need are supported by young forest. Opportunities to create young forest in the unit will be informed by forest stand conditions, ecological habitat requirements, and harvest logistics. ANR will work to opportunistically identify places on the WRMU where young forest creation can be incorporated in planned forest management projects, when consistent with management objectives and silvicultural guides.

Comment Theme 53. Active management will compromise the old growth and wilderness aesthetic of the WRMU.
The forest aesthetics described by commenters and conveyed by the WRMU's forested peaks, ridges, and wetlands, are a result of both natural processes and several types of forest management since the land was settled by colonizers over 200 years ago.

While there are areas that exhibit old forest characteristics, no areas of true old growth – areas with no history of intensive land use – have been documented within the WRMU. Areas that exhibit old forest characteristics will be managed to support those features consistent with the management approaches outlined in the land management classification and any newly

documented areas will be managed similarly. The beneficial functions of old forest will also be created by accelerating the development of structure and composition reflective of old forest characteristics using active old-growth forest restoration techniques (D'Amato and Catanzaro 2023) where identified in the LRMP. More information about this type of management can be found in the Management Strategies and Actions section under General and Site-Specific Management Strategies and Actions (beginning on page 135) and Table 33.
More information about the history of forest management on the WRMU is found in the Forest and Timber Resource Assessment (page 54). This section describes a brief forest history of the land area that has been actively managed within the WRMU.

Wildlife

Comment Theme 54. Timber harvesting should not cause forest fragmentation, impact wildlife habitat, or impede movement within wildlife corridors in the unit.
When forests are sustainably managed and trees are harvested, the forest remains as forest—tree regeneration is occurring, and a new age class develops. For this reason, sustainable forest management is not the same as fragmentation or deforestation which is defined as the conversion of forest land to non-forest land as defined by the Intergovernmental Panel on Climate Change (IPCC). This new age class is beneficial for many species - deer and moose, ruffed grouse, elfin butterflies, and a variety of songbirds. Pages 135 to 136 of the plan outline general strategies aimed at preserving the WRMU's role in Vermont's ecologically functional landscape, while pages 136-139 detail broad-scale strategies intended to create high-quality wildlife habitats across the WRMU. These aim to support overall wildlife connectivity throughout the unit.

During the Annual Stewardship Plan (ASP) review, the interdisciplinary DST, in accordance with the *Riparian Management Guidelines for Agency of Natural Resources Lands* (2015) and the *Memorandum of Agreement Regarding Administration of State Lands* (2012), assesses the needs of various species before implementing timber harvests.

Following the ASP review, a specialized subset of the DST, including wildlife biologists and the State Lands Ecologist, evaluates potential harvest sites to provide recommendations aligned with the LRMP's strategies. These recommendations aim to support an ecologically functional landscape and wildlife connectivity, foster high-quality habitat, and safeguard rare, threatened, and endangered species, as well as sensitive state-significant natural communities.

Comment Theme 55. Maintaining connectivity for wildlife should be explicitly included as a management strategy in management area 2.5C. Consider similar strategies to manage for connectivity elsewhere in the WRMU, particularly along the northeastern portions where State lands approach VT Route 12.
Special Management 2.5C, the North Branch Headwaters Property Conservation Easement Area, in the draft plan, was changed to Special Management 2.2C, Wildlife Corridors, where the strategy, "ensure that management actions promote these wildlife corridor functions" was added to the Management Strategies and Actions. Additionally, a Vermont Conservation Design

section was added to the Executive Summary to further clarify the importance of wildlife movement and ecological connectivity in these areas.

The plan also includes unit-wide general management strategies promoting both aquatic and terrestrial wildlife connectivity to protect the WRMU's contributions to Vermont's ecologically functional landscape (pages 135-142).

Comment Theme 56. The plan should comply with the Federal Endangered Species Act and the implementation of rare, threatened, and endangered species surveys should be completed.

The WRMU LRMP complies with all applicable regulations and laws, including the Federal Endangered Species Act. Management activities are subjected to a range of resource reviews. One review includes screening for potential impacts to federally listed endangered bat species following the consultative framework established by the US Fish and Wildlife Service (USFWS) for federally funded (USFWS 2024) projects and applying those criteria to all potentially impactful projects regardless of funding. When potential impacts are found, the DST consults with the state Bat Biologist to identify any needed modifications to the activity to avoid the 'take' of an endangered species. In addition, staff incorporate guidance from USFWS on habitat modification to further minimize risks to endangered bat species (USFWS 2023).

Additionally, each year, the State Land Ecologist conducts a desktop review to assess potential impacts on rare, threatened, or endangered (RTE) plant species or state-significant natural communities in proposed management areas. Projects with potential conflicts undergo a field review by the State Lands Ecologist. During this field review, focused surveys for Vermont's RTE plant species are conducted as part of project implementation. Subsequently, we adjust our activities based on the survey findings. As of the writing of this plan, no legally protected plant species are known to occur within the WRMU (page 27). In fact, of the three federally endangered plant species that occur in Vermont, only one is found on state lands. This species occurs in wetland habitats that are protected through the *Riparian Management Guidelines for Agency of Natural Resources Lands* (2015) and the VT Wetland Rules (2023). Page 35 of the plan includes the section on Listed Bird and Mammal Species (T&E) and Species of Greatest Conservation Need (SGCN) and page 170 of the plan includes additional information on project review for vegetation management activities.

Comment Theme 57. Wintering areas for many species need to be identified and updated, then protected from too much incursion.

Every winter the DST meets to review all projects that are proposed for implementation in the coming year through the Annual Stewardship Plan review process. ANR specialists review maps of the proposed project work, conduct a thorough desk review, and request a site visit if field review is necessary to further refine the details of the project to minimize impacts to other natural resources. It is through this process that species and habitat such as deer wintering areas would be considered by ANR's wildlife biologists, and project adjustments made to reduce or eliminate impacts to deer wintering areas.

Climate

Comment Theme 58. My concerns center around the species that will be viable over the next 100 years, what has grown well for the last 100 will likely not thrive in the next 100. If we don't harvest some and maybe consider thoughtful plantings, will we have just a large standing dead forest?

As this comment theme suggests, the disparity in the rate of changing climate regimes and tree migration will affect forest growth and composition in the future, leading to significant implications for management and conservation efforts.[85] Model projections are being utilized to better inform management strategies and identify species that are both vulnerable and adapted to climate change.[86] These shifts in species composition are largely reflected in the understory layer where seedling regeneration will have the greatest vulnerability to shifting climate regimes. Species that are at the southern extent of their range or located on marginal sites may have greater susceptibility and may be targeted for intervention. At the landscape-scale, spatial, structural, and compositional diversity within intact forests is much more resilient to climate change threats.[87]

As part of the WRMU management strategies, managing for climate adaptation is an essential part of our planning to increase resilient characteristics within our forest ecosystems. Further, the LRMP will enable implementation of research experiments in partnership with the University of Vermont focused on climate adaptive strategies, including plantings of future-adapted species and adaptive silviculture techniques to add resilience to the landscape and provide demonstration sites for landowners, forest managers, and other stakeholders.

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[85] Oswald, W. W., Foster, D. R., Shuman, B. N., Doughty, E. D., Faison, E. K., Hall, B. R., Hansen, B. C. S., Lindbladh, M., Marroquin, A., & Truebe, S. A. 2018. Subregional variability in the response of New England vegetation to postglacial climate change. *Journal of Biogeography*, *45*(10), 2375–2388. https://doi.org/10.1111/jbi.13407, And Williams, M. I., & Dumroese, R. K. 2013. Preparing for climate change: Forestry and assisted migration. *Journal of Forestry*. 111(4): 287-297. https://doi.org/10.5849/jof.13-016.

[86] Janowiak et al. 2018. New England and northern New York forest ecosystem vulnerability assessment and synthesis: a report from the New England Climate Change Response Framework project. *General Technical Report 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

[87] Allen, C. R., Angeler, D. G., Cumming, G. S., Folke, C., Twidwell, D., & Uden, D. R. (2016). Quantifying spatial resilience. Journal of Applied Ecology, 53(3), 625–635. https://doi.org/10.1111/1365-2664.12634, Messier, C., Bauhus, J., Doyon, F., Maure, F., Sousa-Silva, R., Nolet, P., Mina, M., Aquilué, N., Fortin, M.-J., & Puettmann, K. 2019. The functional complex network approach to foster forest resilience to global changes. *Forest Ecosystems.* **6**, 21. https://doi.org/10.1186/s40663-019-0166-2,
Seidl, R., Spies, T. A., Peterson, D. L., Stephens, S. L., & Hicke, J. A. (2016). Searching for resilience: Addressing the impacts of changing disturbance regimes on forest ecosystem services. The Journal of Applied Ecology, 53(1), 120–129. https://doi.org/10.1111/1365-2664.12511, and Timpane-Padgham, B. L., Beechie, T., & Klinger, T. (2017). A systematic review of ecological attributes that confer resilience to climate change in environmental restoration. PLOS ONE, 12(3), e0173812. https://doi.org/10.1371/journal.pone.0173812.

Comment Theme 59. The LRMP does not satisfactorily account for climate change and carbon in general goals and planning.
ANR considers many objectives when making management decisions and manages forests for a variety of benefits, and in many cases it's possible to use active management to achieve multiple benefits at the same time. Managing forests to be resilient to climate change is a critical component of sustainable forest management and achieving many of the goals of the Plan. Although the plan broadly accounts for climate change, climate related goals and strategies have been added to the Management Strategies and Actions, Executive Summary, and incorporated into the Resource Analysis section and Management Strategies and Actions from the Climate Adaptation section from the previous draft. These additions better reflect ANR's consideration and implementation of these strategies to address climate change and carbon on the landscape. Climate change related strategies can also be found throughout the other unit-wide goals within the plan (e.g., wildlife, water resources, forest management, etc.).

For example, increasing forest complexity is one such strategy for climate change (see "Additional Information: Active Forest Management as a Tool to Increase Climate Resilience in our Forests"). Forest complexity is generally based on the following characteristics: tree species diversity, tree size and age, tree functional traits, tree arrangement, and deadwood accumulation. This may be accomplished through reserves, single-tree and group selection, matrix thinning, or larger patch cuts that prioritize the establishment of shade-intolerant and intermediate species that have valuable adaptive characteristics. These strategies for adding or maintaining structural and species diversity are achieved through both active and passive management. For more information on specific strategies with greater detail, please refer to the aforementioned pages in the management plan.

Forests can also serve as a natural solution to climate change by providing carbon sequestration and storage. Healthy, resilient forests that remain forests into the future will both sequester and store carbon securely over long time periods, and many of the management strategies and actions outlined above will yield increases in either or both carbon sequestration and storage at the stand and landscape scale. See Comment Theme 60 and Comment Theme 61 for more details on balancing carbon sequestration and storage with other management goals.

Comment Theme 60. Request for more information regarding the plan's impact on carbon. Vermont should halt all commercial logging on state land to maximize carbon sequestration in the forest.
The ability of a forest to store carbon and the rate at which forests accumulate or sequester carbon peak at different stages of forest development. Young forests accumulate carbon at a higher rate but have less storage, while old forests have a lower rate of accumulation but can store greater amounts of carbon.[88] See Comment Theme 61 for a greater explanation of these differences.

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[88] Hoover, C.M., Smith, J.E. 2023. Aboveground live tree carbon stock and change in forests of conterminous United States: influence of stand age. Carbon Balance Manage 18, 7. https://doi.org/10.1186/s13021-023-00227-z.

Both the rate of accumulation (sequestration) and storage of carbon are critical pieces of the equation for carbon mitigation and resiliency, emphasizing the importance of having a range of forest structural and compositional diversity, as well as age classes across the landscape. Forests with both young and old trees possess a combination of these characteristics—high rates of sequestration and high rates of storage. It's important to note that forests are more than their carbon content or the timber products they provide; they are complex systems that provide an array of ecosystem services and should be managed tactically to achieve a balanced approach and not through the narrow lens of a single-objective approach to maximize one service over the other (e.g., carbon, timber, etc.). The WRMU LRMP will be implemented using sustainable forest management practices. These practices can be used to enhance or maintain forest and carbon resilience by diversifying both species and structural composition while addressing social and ecological needs (e.g., wildlife habitat, forest products, carbon storage and accumulation, recreation, etc.).

Carbon benefits are dependent upon the temporal and spatial scale being considered. Different perspectives in time and in scale lead to very different conclusions about management activities on carbon. Although timber harvests initially reduce the amount of carbon stored in the forest during a snapshot in time following the harvest, this carbon is transferred into wood products harvested from state lands which can be used for building materials, energy, heat and other uses, that continue to store carbon or either displacing fossil fuels directly or substituting for greenhouse gas emission-intensive manufactured products that have a role to play in overall approaches to reducing emissions and/or storing carbon.[89]

According to the International Panel on Climate Change (IPCC), the effects of forest management on the atmosphere are best understood by considering the carbon dynamics that the atmosphere experiences. This involves examining how management practices affect forest carbon stocks, the emissions from harvesting activities, and the carbon storage in harvested wood products as well as the scale of management. Additionally, this perspective includes assessing whether there is a permanent change in land use or land cover (e.g., development) that impacts the ability of the harvested area to regenerate as a forest and continue sequestering carbon into the future.

Comment Theme 61. Old forests store and sequester more carbon than young forests and old forests should be prioritized over the establishment of young forests.

As mentioned in Comment Theme 60, the ability of a forest to store carbon and the rate at which forests accumulate or sequester carbon peak at different stages of forest development. Young forests accumulate carbon at a higher rate but have less storage, while old forests have a lower rate of accumulation but can store greater amounts of carbon.[90]

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[89] Johnston, C. and Radeloff, V. 2019. Global mitigation potential of carbon stored in harvested wood products. Proceedings of the National Academy of Sciences 116 (29). https://doi.org/10.1073/pnas.1904231116.

[90] Hoover, C.M., Smith, J.E. 2023. Aboveground live tree carbon stock and change in forests of conterminous United States: influence of stand age. Carbon Balance Manage 18, 7. https://doi.org/10.1186/s13021-023-00227-z.

A common point of confusion when trying to understand forest sequestration and storage is conflating the rate of sequestration and storage for individual trees to that of a forest stand. An individual tree with no competition can increase in biomass at an accelerating rate, having high rates of sequestration, until they reach old age at which time their growth rates slow along with the rate of sequestration. However, in a forest, things are more complex: many small trees can occupy the same amount of space as one large tree and young trees usually have the most vigorous growth because there is high competition for resources (this is also the period where the amount of leaf area and rate of photosynthesis peaks.[91] The ability of dominant individuals to continue growing and sequestering is an important attribute to consider but it is not to be confused with forest-level growth and sequestration rates, which generally decline with age. The outcome is a decline in both the growth and sequestration rate of the forest as a whole. Acre for acre, a forest with the greatest carbon sequestration capacity is a young forest compared to an old forest, while old forests have the greatest carbon storage capacity.[92] These higher rates of sequestration generally occur when the forest is approximately 30 -70 years old or the trees are approximately 4”-16” in diameter, although specific age and size ranges are dependent upon site factors and land-use history.

Both young forests and old forests are an important part of the carbon equation. Beyond their carbon contributions, young and old forests are a critical part of the landscape mosaic and contribute to wildlife habitat, climate resilience, and habitat connectivity.

Comment Theme 62. Forest management exacerbates climate change problems.
Establish a top-line goal of promoting climate resilience and orient planned management activities around that. The first draft LRMP had a dedicated climate adaptation and resilience section, however, it was determined that this information needed to be incorporated more broadly across the strategies to reflect the fact that climate resilience and adaptation is a goal that is consistent with and considered by ANR staff in conjunction with other management goals. The plan has been rearranged and clarifying language has been added to explicitly address climate resilience and adaptation goals that were not clearly identified in the first draft Plan to better reflect the consideration of climate adaptation goals of ANR. See Comment Theme 59 for more information.

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[91] Binkley, D., Stape, J., Ryan, M. *et al.* 2002. Age-related Decline in Forest Ecosystem Growth: An Individual-Tree, Stand-Structure Hypothesis. *Ecosystems* **5**, 58–67. https://doi.org/10.1007/s10021-001-0055-7

[92] Catanzaro, P., & D’Amato, A. W. (2019). Forest Carbon: An Essential Natural Solution for Climate Change. University of Massachusetts Amherst. https://masswoods.org/sites/default/files/pdf-doc-ppt/Forest%20Carbon%202022.pdf, Hoover, C.M., Smith, J.E. 2023. Aboveground live tree carbon stock and change in forests of conterminous United States: influence of stand age. Carbon Balance Manage 18, 7. https://doi.org/10.1186/s13021-023-00227-z, Smith, J.E., Heath, L.S, Skog, K.E., Birdsey, R.A. 2006. Methods for calculating forest ecosystem and harvested carbon with standard estimates for forest types of the United States. Gen. Tech. Rep. NE-343. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station. 216 p. https://doi.org/10.2737/NE-GTR-343.

Water Resources

Comment Theme 63. Proposed forest management in the WRMU LRMP will exacerbate downstream flooding and threaten human communities. ANR should identify flood resilience as an overall management goal for the WRMU.

As detailed below, existing management guidelines and a plan-specific analysis ensure that the proposed activities of the WRMU LRMP will have de minimis effects on the potential for downstream flooding.

Managing for flood resilience is an important component of sustainable forest management that underlies multiple goals for the WRMU. The Plan recognizes the impacts that flooding can have on human and natural communities (Page 65), the likelihood that flooding will become more frequent with climate change (Page 46), and the need to implement flood resilient actions to achieve multiple overall management goals of the WRMU (Pages 135-135). These flood resilience strategies— maintaining riparian and river corridor areas, wetlands, and adjacent upland forest buffers; upsizing culverts; maintaining woody debris and other complex in-stream habitat features that dissipate energy and spread flows; and improving or hydrologically disconnecting forest road and trail network infrastructure— are explicitly identified in the Plan's Management Strategies and Actions section and within other documents guiding ANR land management (see paragraphs below).

Furthermore, to assess whether the draft Plan's proposed forest management activities could potentially exacerbate downstream flooding at Wrightsville Reservoir on the North Branch of the Winooski, the Vermont Department of Environmental Conservation modeled the potential impacts of the LRMP's proposed forestry treatments on downstream water levels in the reservoir using USDA Natural Resource Conservation Service's curve number method (USDA NRCS 2021). The curve number method models the total event volume of runoff from a given depth of precipitation. This method makes a number of conservative assumptions including that the total acreage of a single proposed treatment area is harvested simultaneously and removes all trees from the area. In addition, the model reflects that unique treatment area harvests are staggered through the 20-year life of the plan, that harvested areas regenerate young forest cover through time, and that different soil types have different effects on the water storage capacity of harvested areas. This modeling approach does not account for Vermont's implementation of the *Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in Vermont* (AMPs; VT FPR, 2018) and the *Riparian Management Guidelines for Agency of Natural Resources Lands* (RMGs; VT ANR, 2015) which together reduce harvest areas adjacent to waterways and the runoff generated from them during state harvest operations. The modeled precipitation event was a 100-year rainfall event of 0.5ft of rain in 24 hours, according to NOAA's Atlas-14 tool.

Under these conservative assumptions, DEC found that harvesting the proposed Plan treatment areas could increase the level of Wrightsville Reservoir during the 100-year rainfall by 0.075 feet (0.9 inches) relative to a no-harvest management scenario. Although this analysis is neither a formal prediction of flood levels or peak streamflow, it does shed light on the relative impact that various land use change scenarios within treatment areas can have on total flood volumes at the reservoir. In reality, FPR uses selective silvicultural techniques that avoid sensitive areas within a treatment such that harvest areas will usually be smaller than treatment areas. Therefore, changes in reservoir levels are likely smaller than the model indicated.

While the modeled effect of the Plan's treatment plans on downstream inundation flooding was relatively small (i.e., less than 1 inch in Wrightsville Reservoir), an active forest harvest may lead to transient increases in peak flow rates in smaller sub-watersheds. Available literature values suggest that increases in peak flows may be detectable after more than 20-30% of a stream's watershed area is harvested, though effects on peak flow change are likely dependent on ecoregion as well as implementation of varied management practices regarding cutting technique, compaction and infiltration capacity of forest floor, hydrologic connectivity of the forest road network, and proximity of harvests to wetlands and streams (e.g., Guillemette et al. 2005, Grant et al. 2008). The total proposed treatment areas of the Plan as a proportion of total watershed area are all less than 20%: Minister Brook: 13.5%; Hancock Brook: 17.7%; Martins Brook: 2.3%; Moss Glen Brook: 5.3%; Gold Brook: 1.4%.

In reality, FPR uses various selective silvicultural techniques such that actual harvest areas will be smaller than would be with a complete clearcut of the Plan's proposed treatment areas. In addition, treatments are also staggered in time such that the total proportions of watershed area listed above will not be treated simultaneously, further reducing the impact on peak flow rates during extreme weather events.

FPR's foresters also implement AMP, RMG, and other Plan strategies to further minimize treatment area impacts on runoff volume and reduce potential increases in stream flow during harvest periods. The RMGs and AMPs identify various strategies for foresters to slow, spread, and store stormwater runoff from silvicultural treatment areas and reduce in-stream volumes and velocities during high flows. Such strategies listed in the RMGs and AMPs include disconnecting or reducing runoff from hydrologically connected roads and trails; maintaining or restoring intact, forested buffers of 50-100+ feet, depending on local slopes; restoring channelized streams, ditched wetlands, or rip-rapped shores; designing culverts and bridges on perennial streams to meet the design principles of Vermont's Stream Alteration General Permit;[93] maintaining forest floor cover especially within riparian zones and river corridors, and maintaining in-stream complexity through leaving or adding in-stream wood to improve

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[93] Dixon, SJ, Sear, DA, Odoni, NA, Sykes, T, & SN Lane. 2016. The effects of river restoration on catchment scale flood risk and flood hydrology. Earth Surfaces Processes and Landforms 41, 997-1008. doi: 10.1002/esp.3919, Gillespie, N, Unhtank, A, Campbell, L, Anderson, P, Gubernick, R, Weinhold, M, Cenderelli, D, Austin, B, McKinley, D, Wells, S, Rowan, J, Orvis, C, Hudy, M, Bowden, A, Singler, A, Fretz, E, Levine, J, & R Kirn. 2014. Flood effects on road-stream crossing infrastructure: economic and ecological benefits of stream simulation designs. Fisheries 39, 62-76. doi: 10.1080/03632415.2013.874527, Kastridis, A. 2020. Impact of forest roads on hydrological processes. Forests 11, 1201. doi: 10.3390/f11111201, Salemi, LF, Groppo, JD, Trevisan, R, Marcos de Moraes, J, de Paula Lima, W, & LA Martinelli. 2012. Riparian vegetation and water yield: a synthesis. Journal of Hydrology 454, 195-202. doi: 10.1016/j.hydrol.2012.05.061, and Singh, NK, Wemple, BC, Bomblies, A, & TH Ricketts. 2018. Simulating stream responses to floodplain connectivity and revegetation from reach to watershed scales: implications for stream management. Science of The Total Environment 633, 716-727. doi: 10.1016/j.scitotenv.2018.03.198.

floodplain connection and in-stream roughness.[94] The provided references are just examples from a rich literature evaluating how these natural resource management practices can beneficially influence watershed hydrology.[95]

FPR's foresters receive support to protect water resources from other ANR staff. The Department of Fish & Wildlife's (FWD) State Lands Ecologist reviews all treatment plans in part to ensure that the plans sufficiently protect aquatic habitats, which generally has co-benefits for flood resilience and water quality functions. The Department of Environmental Conservation's Watershed Planner and the FWD's Fish Biologist play similar roles in reviewing treatment plans for water resource considerations as members of the Barre DST that oversees decisions on state lands management.

Comment Theme 64. The LRMP does not incorporate the Vermont Hazard Mitigation Plan. While the Plan acknowledges the importance of adhering to and supporting the implementation of other regional planning efforts (page 5), it does not attempt to reference all the pertinent local, regional, and state planning efforts directly. However, the Plan does share common general strategies with the Vermont State Hazard Mitigation Plan and the Local Hazard Mitigation Plans for Worcester, Middlesex, Waterbury, Stowe, and Elmore.

All these local hazard mitigation plans emphasize the importance of right-sizing road infrastructure to increase local flood capacity and reduce the acceleration of flood velocities and downstream erosion. Likewise, the Plan notes the critical importance of upgrading forest road and trail infrastructure to increase flood resiliency. The Plan formalizes this work through adherence with AMPs, assessment and prioritization of road and trail work through forest road and trail erosion inventories, and adherence to permitting requirements and the VT Road and Bridge Standards for all new permanent crossings on perennial streams.

The flood resilience benefits of road infrastructure upgrades have been demonstrable on ANR's Barre District lands during the recent July 2024 flooding. So far, FPR staff have not documented any damage or adjacent natural resource impacts to road and trail infrastructure projects recently improved, up-sized, or up-graded with Clean Water funding, whereas damage has been documented in unimproved areas in the same region. These include road and trail segments in: Middlesex (Carriage Road/Middlesex Trail to Mt. Hunger); Waterbury (three miles of Cotton Brook Road to McCaffrey Orchard; Dalley Road and Compartment One Road in the Ricker Block); Stowe (roads to and above the Pinnacle Meadows parking area; New Michigan Brook Road); and Groton, Orange, and Topsham (roads in the Butterfield Mountain Block).

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[94] Dixon, SJ, Sear, DA, Odoni, NA, Sykes, T, & SN Lane. 2016. The effects of river restoration on catchment scale flood risk and flood hydrology. Earth Surfaces Processes and Landforms 41, 997-1008. doi: 10.1002/esp.3919, and Lo, HW, Smith, M, Klaar, M, & C Woulds. 2021. Potential secondary effects of in-stream wood structures installed for natural flood management: a conceptual model. WIREs Water 8, e1546. doi: 10.1002/wat2.1546.
[95] Lane, SN. 2017. Natural flood management. WIREs WATER 4, e1211. doi: 10.1002/wat2.1211, and Nilsson, C, Riis, T, Sarneel, JM, Svavarsdóttir. 2018. Ecological restoration as a means of managing inland flood hazards. BioScience 68, 89-99. doi: 10.1093/biosci/bix148.

Some municipalities also prioritize hazard mitigation strategies that protect floodplain and river corridor conditions to allow for natural attenuation of flood waters. To this end, following the RMGs, all proposed management activities on state lands must limit encroachments into both the existing and potential future riparian management zones: i.e., the river corridor. More information on the various types of Riparian Management Zones, how they are delineated, their protective buffer widths, and the allowed activities within these zones is available in the RMGs. These Guidelines support numerous riparian, floodplain, and river corridor functions that can confer flood resilience including water storage, energy dissipation, reduced erosion, and reduced flow velocities.

Comment Theme 65. The LRMP does not address how the plan relates to the Lake Champlain Phosphorus TMDL, how the proposed management activities would impact, or be designed to mitigate impacts to, stream health (sedimentation, quality, and habitat), or planned avoidance and restoration measures with the TMDL. Forest harvest will increase phosphorus generation from state-managed forested lands and slow progress toward TMDL achievement. The 2023 Winooski Tactical Basin Plan serves as the implementation plan of the Lake Champlain Phosphorus TMDL and describes the most updated perspective on forestlands phosphorus accounting. The Plan is updated on page 143 to summarize how proposed management activities relate to the Lake Champlain TMDL.

In brief, the TMDL anticipates that the forestlands phosphorus reduction target in the Winooski basin will be fully achieved by state, town, and private landowner compliance with the AMPs. The AMPs were revised in 2018 to meet the intent of Vermont’s 2015 Clean Water Act (Act 64) and implementation of the AMPs will ensure that all logging operations, on both public and private forestland, are designed to prevent or minimize discharges of sediment, petroleum products, and woody debris (logging slash) from entering streams and other bodies of water; improve soil health of forestland; protect aquatic habitat and aquatic wildlife; and prevent erosion and maintain natural water temperature. ANR implements the AMPs on all logging jobs on State lands.

The TMDL developed the forestlands phosphorus reduction target with the expectation that land development, agriculture, and forestry operations would continue to operate over the lifetime of the TMDL. The forestlands sector is currently on track to meet, or even exceed, its 2036 phosphorus target for the Winooski basin (1,293 kg/yr achieved as of SFY2023 out of the total 2036 target of 1,904 kg/yr, or approximately 68% of the 2036 TMDL target achieved as of SFY2023). These estimated phosphorus reductions to date are conservative, as ANR currently only accounts for reductions from parcels enrolled in the Use Value Appraisal program after the TMDL baseline period and has not yet credited AMP implementation elsewhere, including on state lands. Estimated annual phosphorus reductions are anticipated to increase as phosphorus accounting methods are implemented for other types of projects in the forest sector.

Comment Theme 66. This LRMP will increase erosion, sedimentation, and water quality decline due to management and development of forest road infrastructure, poor on-site logging practices, and failure to protect riparian buffer zones and wetlands.
Adherence to the AMPs and RMGs will minimize increases in erosion, sedimentation, and phosphorus runoff during Plan implementation. As described above in Comment Theme 65, FPR foresters and timber sale contractors comply with the updated AMPs to minimize water quality impacts from forest lands management and silvicultural activity. AMP compliance reduces sediment and phosphorus runoff from forestry activity by approximately 80% relative to forestry activity that does not implement AMPs (VT DEC 2022 Standard Operating Procedures for Tracking and Accounting of Natural Resource Restoration Projects). AMPs set standards for the maintenance of forested buffer zones around water features; planning harvests near wetlands; the development, maintenance, and closeout of new forest roads, trails, and log landings; and the handling and storage of hazardous wastes. Where active logging is occurring, historic forest road infrastructure that may not otherwise have been addressed must also be brought into compliance with the AMPs providing further reducing erosion and sediment loss.

Comment Theme 67. Not all known water resources are mapped in the LRMP, leading to potential impacts from management activities.
Management actions proposed on state lands generally receive both desktop mapping reviews during project planning as well as field reconnaissance/review by a variety of ANR staff on the DST before harvest of a treatment area is initiated. Therefore, water resources that may not be specifically identified in early planning stages because they are unmapped are still identified and accounted for in the field as a project progresses.

Specifically, areas identified for treatment in this LRMP will receive additional review, inventory and analysis prior to implementing a harvest. A detailed review of special wildlife habitat (e.g., habitat for rare, threatened, or endangered species), significant natural communities, important historical or cultural sites, and sensitive natural features (e.g., streams, steep slopes, wetlands, etc.) will be conducted on each treatment area. A more detailed pre-harvest inventory will also be conducted on each treatment area to collect data and information related to forest health, species composition, stand age, forest structure, soil characteristics, wildlife habitat, and information on forest product quality, value and distribution.

Comment Theme 68. Allowing increased recreational resource development and trail use will impact water resources.
Trail development and maintenance on state lands follow a variety of BMPs to facilitate the user experience while reducing natural resource impacts, including mitigating stormwater runoff. Recommended Trail Standards are available on FPR's webpage and include specific VTDEC Guidance for trail building around wetlands and in riparian areas. All newly proposed or LRMP-sourced trail development and management activities are also reviewed by the Barre DST, including the DEC Watershed Planner, FWD Fisheries Biologist, and FWD State Lands Ecologist to ensure that trail impacts to natural and water resources are minimized.

An overarching strategy of the Plan is to create more resilient trail systems by addressing erosion- and flood-resilience via increasing the size and number of appropriate water diversion structures (e.g., water bars, bridges and culverts: page 143). Likewise, a variety of more detailed trail management activities described in the Plan (Site-Specific Recreation Management Actions: page 182) include goals of increasing the sustainability of the trail treadway and reducing trail encroachment in wetted areas. Potential trail condition issues have been identified during 2017-2019 assessment work and will be addressed as needed and as resources allow (Plan Appendix 4: “Recreation Assessment Methods and Data”). Such examples of implemented trail management activities in the WRMU, including those with a water quality focus, are available in the Plan (Appendix 2, Table 35: Stand data for the WRMU).

Comment Theme 69. The LRMP's forest management activities will impact aquatic habitat and recreational fishery resources.
As described in the Plan (e.g., Pages 118, 145), the RMGs, AMPs, VT’s Road and Bridge Standards, and adherence to state and federal water-related permit requirements guide the maintenance and enhancement of aquatic habitat on state lands within and beyond active timber harvest areas. The benefits of following these guidelines include protected riparian corridors that shade streams, capture overland runoff, stabilize streambanks, and provide organic inputs; improved hydrologically connected forest road and trail infrastructure that supports aquatic organism passage and reduces direct stormwater discharges to streams. Given these guidelines and practices laid out in the RMGs, DFW anticipates the proposed forest management activities will have no impact on the WRMU’s recreational fishery. See the Plan’s Fisheries Resource Assessment Page 70 and the Vermont Stream Crossing Handbook (VT FWD, 2016) for more information.

Comment Theme 70. ANR should specify its plans for monitoring water quality under the "Monitoring and Evaluation" section of the draft plan to evaluate and adaptively manage LRMP impacts to water resources.
ANR water resource monitoring and assessment is carried out in a five-year cycle for each of Vermont’s 15 major tactical basins as described on DEC’s basin planning webpage and in more detail within each Tactical Basin Plan (2023 Winooski Tactical Basin Plan; 2021 Lamoille Tactical Basin Plan). Tactical Basin Plans include a table of possible water resource monitoring needs identified by various state staff and water resource partners, and ANR staff meet before each assessment cycle to prioritize these and other identified monitoring needs.

ANR does not have the capacity for detailed before-after control-impact studies for every management action it takes on public lands. However, baseline water resource data are available in most of the WRMU’s major watersheds for both water quality and fisheries resources (see Fisheries Resource Assessment Plan, page 70). We have also updated the Water Resource Assessment section (beginning page 65) describe the location and condition of DEC’s available geomorphic and biomonitoring data for streams draining the WRMU, and 2) identify WRMU watersheds that have been identified as a monitoring priority by the Tactical Basin Plan because they lack baseline biomonitoring data (beginning page 68).

Where periodic reassessments of water resource condition indicate any changes beyond expected normal variation in biomonitoring data, further investigation may be warranted. As the Plan states, if monitoring results indicate that there is a significant difference between the outcomes predicted by the plan and actual conditions, changes to the plan may be recommended. Likewise, the DST can review and support appropriate, more detailed research proposals addressing the long-term evaluation of management activities if proposed by partnering organizations.

Comment Theme 71. Including the Water Resources and Flood Resiliency Assessment section should not be at the discretion of ANR, as currently indicated.
Our intention was to indicate that some ANR-managed lands without significant water resources may not include a Water Resources and Flood Resiliency section; this clearly does not apply to the WRMU. We've deleted this unclear statement from the Plan (Page 65).

Comment Theme 72. Plan management actions are currently protective of the WRMU's Source Protection Area (SPA) for Waterbury, managed by the Edward Farrar Utility District (EFUD). It should continue to protect this and other adjacent sources of public water by minimizing incompatible uses in SPAs and by regularly coordinating with the appropriate SPA managers. The Plan should also address if and how the proposed management activities will impact upland recharge for the protection of groundwater resources and downhill wells.
ANR concurs that the Edward Farrar Utility District (EFUD) Source Protection Area will be minimally impacted by the LRMP's proposed management activities and will coordinate with EFUD if significant management activities are proposed in the vicinity of the Source Protection Area. No management activities are proposed within any other surface water or groundwater Source Protection Area (no others exist within the WRMU), and adherence to the AMPs and RMGs will contribute to reducing hydrologic impacts to all surface and groundwater resources by slowing, spreading, and sinking overland flows in wetland and stream riparian zones as well as actively managed areas (Comment Themes 63, 65 and 66).

Comment Theme 73. Your agency management plan must acknowledge the under-appreciated role of wetland / riparian buffer zones. With weather and extreme events becoming more unpredictable and severe, the importance of buffering on water retention and water quality must be acknowledged in future management efforts. The emphasis on buffer zones translates into making them universally larger, perhaps double what we have done in the past.
ANR agrees with the importance of riparian buffers to provide multiple water retention, runoff reduction, stream equilibrium, water quality, and wildlife habitat functions. Foresters follow *VTANR's 2015 Riparian Management Guidelines* when establishing buffer zones during forest management activities. ANR's reliance on these guidelines for achieving water quality and water retention goals are further discussed in Comment Theme 63, 65 and 66 and in the revised Water Resources Assessment section of the Plan.

These guidelines were established after extensive review of the available scientific literature evaluating the widths necessary to achieve a variety of ecological functions. These findings and references are provided in *VTANR's Riparian Buffers and Corridors: Technical Papers* (VT ANR, 2005) and in Appendices *B: Research Notes* (Pages 28-43), *C: Measuring Stream Riparian Management Zones* (Pages 44-47), and *D: Literature Cited and Bibliography* (Pages 48-57) of the RMGs.

Recreation

Mountain Bikes

Comment Theme 74. There should be more mountain bike trails identified to be built during the span of the next Long-Range Management Plan.
Our assessment of current trails in the Worcester Range Management Unit shows that there is much work that needs to be done to current infrastructure. Because of current staff capacity and funding limitations, the plan focuses on improving existing trails during the next management cycle except for the proposed sustainable loop trail at Stowe Pinnacle (1.11A CE, 3.0, SM 2.5A) and the potential endorsement of an additional 2.5 miles (in addition to the existing 2.5 miles of currently endorsed pedestrian trail) of trail in the Brownsville network (SM 2.5.B). We are open to considering new trails through our recreation proposal process and recognize that new trails can be necessary to make connections and disperse use.

The draft plan also proposes approximately 5 miles of trail on the Brownsville parcel be designated for mechanized management pending infrastructure improvements and the identification of a partner group to support maintenance and management. This approximately 5 miles of trail represents the total allowed trail mileage on the acquired parcel (2.5 currently authorized for pedestrian use and 2.5 additional miles available for authorization with trail improvements).

Based on feedback to the draft plan we have also added a statement of support for the concept of a connector trail between Perry Hill (SM 2.9A) and Little River State Park to the LRMP. A feasibility assessment for this connector trail was performed by the Town of Waterbury and partner groups.

Comment Theme 75. Class 1 electric bicycles should be allowed on mountain bike trails.
Use of electric bicycles cannot be allowed through a LRMP as this is governed by State Land policy. Electric bicycles are not included in Policy 4 which clarifies the use of mountain bikes on State Land. As such, electric bikes are currently categorized as motorized equipment.

Ecological Impacts

Comment Theme 76. The plan should limit additional impacts to the Highly Sensitive Management Areas due to ecological impact concerns.
We recognize that improper trail location, design or use can impact Highly Sensitive Management Areas (HSMAs). Much of the WRMU has no trails, and no expansion of trails are planned in any of the HSMAs in this plan. The DST thoroughly reviews the routes of any proposed new trails and considers the impact on important ecological features, fish and wildlife, habitat, wetlands, water quality, and forest health.

Comment Theme 77. Trails should be updated to the latest standards for sustainability with reroutes and relocations considered as needed.
The infrastructure assessment that was performed to support this plan is also being used to focus maintenance, new infrastructure, and potential reroute efforts aimed at improving

resource sustainability. The installation of trail reroutes is one strategy that will be utilized to reduce user impacts for sections of trail that are susceptible to erosion due to trail layout.

Comment Theme 78. Additional development of trails described in this plan should not occur due to concerns with impact to wildlife.
We recognize that improper trail location, design or use can impact important wildlife habitats. All new trail proposals, both in the LRMP and proposed through the recreation proposal process, are reviewed by the DST, which includes wildlife biologists. Potential impacts to wildlife habitat are considered through the LRMP and recreation proposal processes.

Comment Theme 79. The plan should include more specifically identified new trails instead of relying on the "consideration" of new trails.
The word "consider" is used because review of trail proposals requires rigorous site-specific evaluation by the DST. The DST is a multidisciplinary group of specialists with expertise in the many values of state lands. New trail proposals can be submitted to the DST using FPR's recreation proposal process. We also routinely vet these proposals with partner organizations representing use types. New proposed trails may be significant enough to require an amendment to the WRMU LRMP to allow for public process.

There are a limited number of new trails included in this draft LRMP because, based on our assessment of existing trails, we need to address current infrastructure needs and sustainability improvements in the next management cycle. New trails such as the Brownsville network (SM 2.5B), a sustainable loop at Stowe Pinnacle (1.11A CE, 3.0, SM 2.5A), and the potential for a boardwalk at Moss Glen Falls (HSM 1.8B, HSM 1.11D) have been included because they have been identified as areas requiring management action and have had initial evaluation and reviews performed.

Consideration of additional trails will require a significant commitment from a partner group to support funding, installation, and long-term maintenance and management.

Based on the feedback we have received as part of the draft LRMP review process we will be including the support of a connector trail between Perry Hill and Little River State Park. The initial concept for this route was developed through a FEMA grant issued to the Town of Waterbury. This project will likely require amendment or update to the Mt. Mansfield LRMP.

Comment Theme 80. Protect ecological resources by prioritizing existing trails over new development.
The plan proposes new trails (Stowe Pinnacle loop, Brownsville extension, Moss Glen boardwalk) to address use issues, reduce ecological impact, and manage existing recreation. These new trails address unmanaged and/or excessive use problems and prioritize stewardship of existing resources. In each circumstance land managers have determined that more ecological impacts would occur if no new trails were installed.

Brownsville Forest

Comment Theme 81. Mountain bike use should be allowed at the Brownsville Forest trail network.

The plan proposes that mountain bike use be an endorsed and managed use at the Brownsville network pending:

- An upgrade to infrastructure to achieve sustainable standards and best practices.
- Development of a formal partnership with a maintenance/management group.
- The installation of adequate four-season parking.

Comment Theme 82. Mountain bike use should not be allowed at the Brownsville Forest trail network.

When FPR acquired the parcel and performed an initial assessment there were several factors that made the pre-existing trail network ideal for mechanized designation. It was clear that based on grades, the flow of the trail, and integrated turn radiuses that the existing trail was laid out to accommodate mountain bike use. The Inberno Trail is recognized as the first mountain bike trail installed in Stowe and it has been expressed that this history is important to the user group. The terrain is not steep and as such, allows for a network that could be rated for beginner and intermediate riders, as well as reducing potential erosion issues. In addition, it is also possible for a majority of the network to be built to adaptive mountain bike standards. Limiting the size of the network to five miles and managing for beginner/intermediate use will limit the number of mountain bikes on the network. Allowing for both pedestrian and mountain bike use on this network will also create more support for long-term maintenance and management. For these reasons we will work toward mechanized endorsement of the Brownsville network by upgrading the infrastructure to achieve sustainable standards and best practices, formalizing partnership with a maintenance/management group, and installing adequate four-season parking.

Comment Theme 83. Managed winter use for pedestrian and mechanized activity should be considered at the Brownsville network through this LRMP.

Once a management partner is established and mechanized use is established through the improvement of trail standards, winter recreation management can be considered through DST review and approval.

Perry Hill

Comment Theme 84. More specific new trail corridors at Perry Hill should be provided in the plan.

During the development of the draft LRMP, specific trail corridors were not identified and reviewed by the DST for inclusion in the Plan. General guidance has been included to support partner group planning efforts. New trail proposals will be reviewed by the DST using the state lands new trail proposal process.

Comment Theme 85. Winter use management should continue at Perry Hill.

FPR intends to make the current pilot winter recreation management plan a part of standard management through the WRMU LRMP.

Trailhead Parking

Comment Theme 86. Expanding trailhead parking areas can lead to increased trail use.
Trailhead parking expansion is proposed to occur at locations where overflow parking is causing safety concerns for users and impacts on adjacent landowners. Observation of WRMU trailhead parking areas shows that the size of the parking area does not limit the degree of trail use.

Comment Theme 87. The plan does not call for enough detail for implementing parking solutions associated with the Stowe Pinnacle Trailhead.
Solutions to insufficient parking are typically complex and involve the development of enforceable parking bans, the design and permitting of additional parking area, fundraising, and construction. It is FPR's intent to further develop the Pinnacle Meadow Trailhead to accommodate the overflow that is occurring at the Stowe Pinnacle Trail. Finalization of the WRMU LRMP is the next step in what will be a multi-year process to upgrade the parking area.

Logging Impacts

Comment Theme 88. Trails should be formally buffered from impacts to logging by having a 500' buffer on each side of the trail, conducting harvests in the winter or low use times of the year, and avoiding skid and haul road crossings.
ANR manages state lands for multiple uses*,* users, and management activities. There are times when uses/management actions overlap and in these circumstances the goals of each use or management action are considered and plans are developed to mitigate conflicts. FPR does not have specific policy for buffering recreation trails from timber harvest activities. Recreation staff work with State Lands Foresters on a site-specific basis to ensure the impacts from timber harvests are minimized.

Comment Theme 89. The recreation values that Hancock and Minister Brook provide should be protected from logging impacts.
Hancock Brook and Minister Brook provide opportunities for recreational fishing and swimming and the setting for other activities, such as hiking. As described on page 119 of the LRMP, ANR's *Riparian Management Guidelines for Agency of Natural Resources Lands* (2015), *Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in Vermont* (AMPs; VT FPR, 2018), VT's Road and Bridge Standards, and state and federal water-related permit requirements guide the stewardship and enhancement of aquatic habitat on state lands within and beyond active timber harvest areas. The benefits of following the guidelines include protected riparian corridors that shade streams, capture overland runoff, stabilize streambanks, and provide organic inputs; well-designed forest road and trail infrastructure that permits fish passage and reduces direct stormwater discharges to streams; and, where appropriate, in-stream manipulations like strategic wood addition that increase aquatic habitat complexity with various flood resilience, water quality, and fisheries co-benefits. Given these guidelines and practices laid out in ANR's Riparian Management Guidelines, DFW anticipates the proposed forest management activities will have no negative impact on the WRMU's recreational fishery.

In addition to the water resource protections on ANR lands, ANR's foresters consider impacts to adjacent recreational infrastructure and experiences when designing timber sales to preserve the desired recreational experience. The Recreation Opportunity Spectrum (ROS) (Page 99) describes the visitor experience that state land managers seek to provide. The state land around Hancock Brook and Minister Brook is designated Semi-Developed Natural, and Semi-Developed Non-Motorized, which are characterized as follows:

- Semi-Developed Natural: Area is a natural-appearing environment. Evidence of the sights and sounds of people are moderate. Sights and sounds of people usually harmonize with the natural environment.
- Semi-Developed Non-Motorized: Area appears to be a predominantly natural or natural-appearing environment of relatively medium-to-large size.

The timber sale near Hancock Brook and Minister Brook will be designed to adhere to these ROS classes to protect the recreation values of the area.

Comment Theme 90. If some timber harvests need to be conducted, eliminate Timber Harvest Tracts #3 (138 acres) and #6 (124 acres) in the Brownsville Recreation Area. These tracts are where the only hiking trails are located (see the maps on pages 149 and 161 of the Draft Plan). The construction and use of logging roads and the harvesting of timber in the vicinity of the trails would degrade the aesthetics and the character of the forest for many years.

ANR manages state lands for multiple uses*,* users, and management activities. There are times when uses/management actions overlap and in these circumstances the goals of each use or management action are carefully considered and plans are developed to avoid, minimize or mitigate conflicts. During these times each situation is evaluated and support for mitigation efforts can be developed by ANR staff and partner groups. Recreation staff will work with state lands foresters on designing specific operational plans for Treatment Areas #3 and #6 that ensure continued recreational use of the trail before and after the harvest and consider the Recreational Opportunity Spectrum ("semi-developed natural") in layout and tree marking. The importance of recreation on these two treatment areas was highlighted with an update to the implementation schedule starting on page 172, and this schedule also enumerates the natural resource benefits of these harvests.

Comment Theme 91. For Timber Harvest Tracts #9 (264 acres) and #12 (166 acres) near the Mt. Worcester Trail, maintain a wide buffer zone to protect the trail and the streams. Take other steps as determined by the DST to minimize the impact that harvesting will have on these trails.

Recreation staff will work with state lands foresters on designing specific operational plans for Treatment Areas #9 and #12 that ensure continued recreational use of the trail before and after harvest and consider the Recreational Opportunity Spectrum ("semi-developed natural" and "semi-primitive non-motorized") in layout and tree marking. The importance of recreation within these two treatment areas was highlighted with an update to the implementation schedule starting on page 172, and this schedule also enumerates the natural resource benefits of these harvests.

Comment Theme 92. Concerns about impacts of proposed timber harvests on hiking trails, with requests to maintain a 500' buffer on either side of the hiking trail, to conduct harvests in winter when possible, to schedule forestry activities to avoid peak trail use, to refrain from skidding on recreation trails and minimize crossings, to avoid permanent road crossings of recreation trails, and to apply stricter forestry management practices near recreation assets to minimize impacts to hikers.

For each prescribed timber management project that is implemented, FPR develops a plan to limit impacts to recreation resources. Plans are developed by State Lands Foresters with support from the District Outdoor Recreation Specialist and are reviewed by the DST. Typical tactics to reduce recreation asset and user experience impacts include:

- Laying out skid roads to cross recreation trails perpendicular to the path of travel when a trail crossing is necessary.
- Linking visual and noise impacts of timber management activities to management objectives and user experience goals described within the Recreation Opportunity Spectrum. Examples of how this could be applied are buffering management impacts (visual/noise) in more primitive designations, linking trail users to managed areas in more developed settings for educational purposes.
- Conducting timber management in winter when appropriate to reduce impacts to soils and have work occur at a time of year with less recreational use.

Other

Comment Theme 93. The plan should directly address the need for more accessible recreation.

Based on draft feedback from the public we have added further support for accessible recreation in the WRMU LRMP. This includes the evaluation of current and proposed mountain bike trails for adaptive bicycle accessibility, identifying the opportunity to create an accessible trail at the Brownsville network that would allow for access to a managed meadow with overlooks of a beaver pond and views of the Mansfield Range and installing a beach mat that would allow wheelchair access to the water at Elmore State Park beach.

Comment Theme 94. The plan limits the ability to have new trails in Highly Sensitive Management Areas.

The protection of areas that contain uncommon or outstanding biological, ecological, geological, scenic, cultural, or historic significance is typically the primary consideration for management within Highly Sensitive Management Areas (HSMAs). The primary management values are identified in the land management classification. New recreation trails and corridors can be considered in the HSMA land management classification if the impacts of the recreation resource on the primary values for which the HSMA was designated will not compromise the exceptional features highlighted in the HSMA.

Comment Theme 95. ATV and snowmobile access for emergency response to Worcester Range peaks should be integrated into the LRMP.
FPR works with the Department of Public Safety and local emergency response to ensure first responders have vehicular access to the WRMU. Recent work occurred to Pinnacle Meadows and Middlesex forestry roads to support management and emergency access. If an additional access corridor is desired, proposals can be submitted through the recreation proposal process. ATV use is allowed on FPR managed lands for management purposes, and emergency response.

Comment Theme 96. Can more information be provided about what best practices and sustainable design are for trails?
Sustainable guidelines set forth best practices and standards for the development and management of trails, to reduce degradation to the tread and adjacent resources, and limit the need for annual maintenance. Many trails within the WRMU were built before current sustainable guidelines and best practices were developed. To achieve sustainable trails constructed in accordance with best practices we either improve current trail infrastructure, add trail infrastructure where needed, install reroutes of short sections of trail, or create new trails built to current standards. Sustainable guidelines and best practices used by state land recreation managers to upgrade or build new trails include those developed by the US Forest Service, the Professional Trail Builders Association, and by representative organizations for the wide variety of user groups that help maintain and manage trails, depending on what type of trail is being constructed. Recreation managers also follow permitting requirements, OSHA and other building regulations, and specifications and standards unique to trail infrastructure. FPR maintains a list of trail standards on the department's website: https://fpr.vermont.gov/recommended-trail-standards.

Comment Theme 97. Backcountry skiing should be considered a primary management goal for the WRMU. This includes allocating land usage and allowing trail development and stewardship in all management zones including the Highly Sensitive Management Areas (land use category 1) shown on Map 36. In particular for all the 1.11 (A, B, C, D) areas, 1.8(A, B) areas, 2.5A areas, and the 3.0 areas.
Backcountry skiing without trail development or tree cutting or trimming can occur anywhere on the landscape in winter. As such, it is considered a dispersed use that is allowed on state lands unless otherwise noted. Given the many objectives for the WRMU, and the goal of managing for multiple uses, the DST is not designating this single activity as a primary management objective. Additionally, cutting and/or pruning trees to improve backcountry skiing is a managed use that can only legally occur if permitted by FPR.

It is understood that legal backcountry skiing is occurring throughout the WRMU. Unfortunately, illegal cutting, and a pattern of use that has contributed to management issues, has been identified in the Stowe Pinnacle area. For this reason, this geographic area was called out in the draft plan. To manage this use FPR seeks to work with a partner group representing the backcountry ski user-base. FPR District 4 land managers aim to engage with representatives of the user-group to better plan for this activity and evaluate potential locations for management through the recreation project proposal process and apply management guidance developed in the Backcountry Ski Manual.

Other managed backcountry ski trail/glade locations can be proposed to the DST through the recreation proposal process. These locations may require an amendment to the LRMP.

Comment Theme 98. The management action of "monitoring for unauthorized cutting of trees and shrubs for the purposes of backcountry skiing" should be changed to "collaborate with local backcountry skiers and organizations to approve permission to create new backcountry ski trails following the guidelines including in the Vermont Backcountry Ski Handbook."

Cutting trees on State Land is illegal unless done with specific permission from the State. Any person who cuts, trims, or damages any vegetation on State land without permission may be subject to civil or criminal prosecution including violations and fines. This prohibition applies to unauthorized cutting associated with backcountry skiing, which can include cutting trees or shrubs, pruning or trimming trees or shrubs or causing any damage to vegetation. The so-called "Timber Trespass Law," Chapter 77 of Title 13 of the Vermont Statutes Annotated, also applies, and defines "timber" as including "sprouts from which trees may grow, seedlings, saplings, bushes, or shrubs that have been planted or cultivated by a person who owns or controls the property where they are located." Other criminal and civil statutory provisions may also apply to unauthorized cutting or trimming of vegetation on State lands, and the Agency has and will pursue such violations, on a case-by-case basis. Illegal cutting is not acceptable. Illegal cutting associated with backcountry skiing has been observed on many State Lands parcels, which is why the management action of monitoring for unauthorized cutting of trees and shrubs was identified and included in the Plan.

FPR is willing to work collaboratively with any well-organized backcountry skier user group to address recreational needs/desires and to identify and propose potential areas where management of this activity could include the establishment of backcountry ski trails through the recreation trail proposal process. However, such uses have not been included in the Draft Plan because evaluation of potential resource impacts and the identification of a partner group to support management have not yet occurred.

Management Planning Process

Comment Theme 99. Request for clearer description of next steps in the process.

The current process for developing a LRMP is described on the Department of Forests, Parks and Recreation website, and in FPR Policy #21: State Lands Management Planning.

The timeline for the WRMU LRMP planning process is outlined below:

- *Natural Resource Assessments:* 2019-2020. Some assessments were completed before this date, but compiling of the assessments began in 2019.
- *Public Scoping:* June 20-August 3, 2020. This process is described on page 10 of the LRMP.
- *Draft Plan Development:* August 4, 2020 – December 2023.
- *Public Comment:* December 13, 2023-February 2, 2024.
- *Final Draft Development:* In Progress.

- *Final Draft Release:* TBD.
- *Implementation:* As outlined in the LRMP.

Comment Theme 100. Perception that the WRMU LRMP process is fundamentally flawed.
ANR staff complied with all requirements of statute, rule, procedures and policies applicable to planning for the management and use of State lands. ANR staff provided public scoping input opportunities as well as public comment public meetings and opportunity to provide written public comments. ANR staff have reviewed, considered and responded to all public comments received and, where appropriate, have modified the Draft LRMP. ANR staff also responded to questions of the public after the scheduled public meetings were held on the WRMU Draft Plan to answer questions and assist the public in their understanding of the Draft Plan and provide their written public comment.

There is no statutory requirement for ANR to provide a public scoping or input process related to land management planning. Rather, the General Assembly has authorized ANR and the Commissioners of FPR and FWD to manage and plan for the use of public lands consistent with the statutory policies associated with those Departments and lands (Chapter 83 and 103 of Title 10 of the Vermont Statutes Annotated). FPR adopted *Policy #21: State Lands Management Planning* (1995) to establish the process and requirements for land management planning for public lands. FPR Policy #21 includes a public involvement component for land management planning and *ANR Policy: Public Involvement in ANR Lands Management* (2002) guides the public involvement process.

This planning process has entailed the opportunity for extensive public input, including responding to individual questions and communications after the public meetings. ANR has considered all public comments and has made changes to the plan in response to suggestions that are compatible with ANR and its Departments' missions, ANR lands management principles, and fiscal constraints. Therefore, not all public comments and suggestions are incorporated into a final LRMP.

Comment Theme 101. The WRMU LRMP effort should not proceed until a LRMP rule is in place.
There is no statutory requirement to adopt rules governing the Long-Range Management Planning process. See Comment Theme 103 below. ANR and its Departments have policies that provide for the LRMP process, including public involvement. See Comment Theme 100. These policies allow ANR to plan for the management of public lands, in a manner that provides opportunity for public input and considers a broad range of public uses and benefits. The General Assembly has authorized FPR to manage and plan for the multiple uses of state forest and park lands consistent with the statutory policies and purposes set forth in Chapter 83 of Title 10. This specifically includes providing for the conservation of forest lands and simultaneously providing for multiple uses of those lands in the public interest, including recreational uses and forest management activities.

ANR initiated pre-rulemaking public engagement on a draft LRMP rule in August 2024 and anticipates beginning rulemaking in winter 2025. ANR has policies and procedures in place to guide our management planning that will continue to be followed until a new LRMP rule is in place. Public pressures on state-owned lands are only increasing; it would be irresponsible to halt all management planning and use of state lands while ANR proceeds with any rulemaking process.

Comment Theme 102. Perception that the LRMP process is being rushed. Requests to slow process down, generally.
The timeline of the development of the WRMU LRMP, as set forth above in Comment Theme 101, is consistent with our average pace of planning. Finalizing the LRMP will allow the ANR to proceed with implementation of the plan and will provide clear public benefits. These benefits include enhancing forest resilience, wildlife habitat and recreational infrastructure.

Comment Theme 103. Comments raising legal issues, including stating that ANR is required to adopt rules governing the Long-Range Management Planning process for state lands; timber harvesting is not mandated by statute; water quality monitoring, AMPs and public trust doctrine.
As stated in the introduction section, the Responsiveness Summary is not intended to provide a judicial review of all legal requirements and is not a form for full legal briefing of any legal issues raised in public comments. However, ANR responds in general to some legal issues raised below.

Title 10 V.S.A. §2603 does not require FPR to adopt rules governing the land management planning process. 10 V.S.A. §2603(a) directs the Commissioner to implement the policy and purposes set forth in 10 V.S.A. §2601 which includes the economic management of its forests and woodlands, to sustain long-term forest health, integrity and productivity, to maintain, conserve and protect soil resources, control forest pests, alleviate flood, soil erosion and lessen forest fire hazards. There is no statutory requirement to adopt a rule to address these policies and related activities in 10 V.S.A. §2603(a). Likewise, 10 V.S.A. §2603(b) does not require the adoption of rules, but explicitly authorizes the Commissioner to implement the policies and purposes of the chapter, to promote and protect the natural, productive and recreational values of state lands and to provide for multiple uses of state lands in the public interest. Further, 10 V.S.A. §2603(b) specifically authorizes the Commissioner to sell forest products from state lands and does not require the adoption of a rule to do so. Finally, 10 V.S.A. §2603(c) requires the adoption of rules for the use of state forest and park lands, including reasonable fees for such uses. All the language in 10 V.S.A. §2603(c) relates to the establishment of fees for uses of state lands, including for state parks and for timber sales.

As noted above, 10 V.S.A. §2601 specifically requires the Commissioner to comply with and implement the policies and purposes of chapter 83 of Title 10. Productive and economic management of forests and woodlands including on state lands, is an express policy and purpose of 10 V.S.A. §2601. Additionally, there are many other statutory provisions in Title 10 that support the productive and sustainable forest management of state lands. The Commissioner is required to implement these policies in effecting and planning for the management of state lands.

Water quality monitoring for logging or forest management activities is not required by the Public Trust Doctrine, the Clean Water Act (as delegated to ANR and implemented in Chapter 47 of the Vermont Statutes Annotated) and the AMPs.

The EPA delegated implementation of the Clean Water Act to ANR DEC through the Vermont Water Quality statutes (see VSA Chapter 47, et.seq) and the Vermont Water Quality Standards. Logging operations that are in compliance with the AMPs are exempt from the discharge permit requirements of 10 V.S.A. §1259(f), the stream alteration permit requirements of 10 V.S.A. §1021(f), and the stormwater permit requirements of 10 V.S.A. §1264(d)(1)(C). Monitoring of every logging operation for water quality impacts is not required by these laws and rules. The AMPs are designed to assure compliance with the Vermont Water Quality Standards. The Vermont Legislature has approved this approach in the above cited statutes and in 10 V.S.A. §2622(b) and through LCAR approval of the AMP Rule in 2018 (and prior adopted versions).

ANR received references to various scientific literature in support of some comments. In some cases, the cited literature has been misapplied or mischaracterized and does not support the commenters' claims. ANR staff relied on their education and years of expertise in making these determinations. For example, Lamoille County Vt., Landscape-Based Forest Stewardship: Lamoille County Vermont, (2012), was cited for the proposition that "[t]imber harvesting in unfragmented forests is known to have negative effects on water quality." The referenced citation states, "Poor forestry practices on one parcel can have negative impacts on water quality and forest health on an entire watershed." The preceding sentence states that "Forests can be managed and harvested responsibly, and there are many responsible foresters and loggers in Lamoille County." See Lamoille County VT, pages 44-45. Other cited sources likewise support the fact that implementation of the AMPs mitigate impacts of logging and are protective of water quality[96]. ANR ensures and requires that the AMPs are appropriately implemented on all timber harvesting and forest management activities that occur on State lands, protecting water quality and preventing soil erosion, and in compliance with State laws and Rules.

Similarly, the TMDL does not require water quality monitoring on every logging job in Vermont, including on State lands. The TMDL anticipates that the forestlands phosphorus reduction target in the Winooski basin will be fully achieved by state, town, and private landowner compliance with the *Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in Vermont* (AMPs; VT FPR 2018). The TMDL developed the forestlands phosphorus reduction target with the expectation that land development, agriculture, and forestry operations would continue to operate over the lifetime of the TMDL. See response to Comment Theme 65 for a complete discussion of this topic.

Finally, the Public Trust Doctrine does not require water quality monitoring on every logging job on state lands and does not require that ANR conduct pre-decisional water quality analyses

[96] Shah et al. (2022). The effects of forest management on water quality. Forest Ecology and Management 522: 120397. https://doi.org/10.1016/j.foreco.2022.120397

prior to timber harvesting on state lands. The Vermont constitution provides "The inhabitants of this State shall have liberty in seasonable times, to hunt and fowl on the lands they hold, and on other lands not enclosed, and in like manner to fish in all boatable and other waters (not private property) under proper regulations, to be made and provided by the General Assembly" (Vermont constitution Chapter II §67).

The Vermont General Assembly has codified many regulations, or laws, governing water quality protection, none of which require pre-decisional or ongoing monitoring for timber harvests or logging. Rather, the General Assembly has codified statutory requirements, and through LCAR has approved the AMP Rules. Additionally, the Vermont General Assembly supports the sustainable management of the State's forests in numerous statutory provisions and has declared that the conservation and the sustainable economic management of the State's forests and woodlands is in the public interest. For example, see Chapters 82, 83, 85, 87 of Title 10, Chapter 207 of Title 6, Chapter 196 of Title 12, Chapter 117 of Title 24, and Chapter 124 of Title 32 of the Vermont Statutes Annotated.

Comment Theme 104. How will ANR keep the public up-to-date on its management successes and difficulties regarding LRMP goals? How often will the ANR seek public input about its management of the Worcester Range?

DSTs develop Annual Stewardship Plans (ASPs) each winter to catalog the suite of management actions that will occur in the upcoming year. These are typically finalized by April and are available upon request. There is no public comment associated with the development of Annual Stewardship Plans, although Agency staff will receive public comment at any time regarding ANR lands management. The LRMP also articulates ongoing monitoring goals for the LRMP which are tied to the management goals (see Section V: page 195); results of these monitoring efforts are available upon request. ANR's Policy on *Public Involvement in ANR Lands Management* provides a helpful overview of the public involvement principles that guide our work.

Comment Theme 105. I ask for a full series of public hearings to learn more from all quarters of the state on the wisdom of this draft plan.

Residents from the across the State of Vermont have been provided with an opportunity to review and comment on this draft plan. The in-person public information meetings were recorded and posted on our website so that anyone who was not able to attend in person could learn more about the plan and provide public comment. Attendance at the public meeting was not required to submit a public comment. More information about the public process supporting the development of this plan can be found on page 10 of the LRMP.

Comment Theme 106. Continue to use Story Maps and other online mapping platforms to solicit input and share information. This was an effective and engaging way to share a wealth of critical information about the WRMU with the public. We hope the State will continue to use this platform to engage the public and its partners in the development of Long-Range Management Plans. It is especially helpful to have the maps presented as interactive data, as it is often hard to present a similar level of detail in page-map format. If possible, it would also helpful to present the all of the planning and resource data together in an interactive

web map, such as ANR Atlas, to facilitate toggling layers on and off and seeing how various plan elements overlap with each other.
This is a great suggestion; we will attempt to incorporate this in future planning efforts, though our success may depend on budget, staff capacity and skill.

Comment Theme 107. How are the management actions in the plan executed? What happens after the plan is approved?
Once a LRMP is approved by ANR leadership, management actions identified in the plans are planned and executed based on the goals, strategies, and actions of the plan. Each of the ANR's five district offices prepare Annual Stewardship Plans (ASPs) which describe all planned stewardship activities for ANR lands in the district for the upcoming year. The ASP includes activities from all current LRMPs based on the timing of activities as identified in the plan, the availability of staff and/or funding to accomplish LRMP goals, and/or to respond to new conditions on the ground provided they are consistent with existing LRMPs. In addition to complying with all statutes, regulations, policies, procedures, conservation easements, deed restrictions and permit requirements, ASPs undergo a thorough review by resource specialists and leadership from ANR. New recreation proposals can be submitted through the recreation project proposal process; see Comment Theme 79 for more information. More information on the planning process can be found at https://fpr.vermont.gov/state_lands/lands-management-planning.

Comment Theme 108. Request to more explicitly incorporate the Tropical Storm Irene report.
The commenter did not identify the report they are referencing. If it is the *Enhancing Flood Resiliency of Vermont State Lands* report, we refer the commenter to Comment Theme 109.

Comment Theme 109. ANR should follow the recommendations from the 2015 Enhancing Flood Resiliency of Vermont State Lands report.
Response: ANR occasionally commissions reports by experts external to the Agency to advise on topics of interest or importance. These reports generate new concepts or ideas for consideration and discussion by Agency staff. When these concepts are compatible with Agency or Department missions, goals, policies, procedures, practice, and statute or rules, some of the proposals may be incorporated into those policies and practices. However, some proposals may not be consistent with Agency missions, goals, policies, practice and statute or rules, particularly with respect to the balancing of multiple uses and purposes of the management of state lands, and thus may not be reflected in such policies and management actions in whole or in part.

Many of the flood resilience concepts identified in the 2015 Flood Resiliency Report either already existed, or have since been incorporated into, our practices for managing state-owned lands. The AMPs were updated in 2018 to reflect best practices for management of water quality on logging jobs in Vermont. The 2015 ANR Riparian Management Guidelines reflect best practices for protecting riparian areas on Agency-owned lands.

Comment Theme 110. The plan does not detail how it aligns with the Global Warming Solutions Act and/or the Vermont Climate Action Plan.

The Climate Action Plan (CAP) required by the Global Warming Solutions Act (GWSA) promotes the conservation and restoration of Vermont forests as well as utilization of forest management practices that sequester and store carbon on forest land. In addition to the CAP, the GWSA sets a net-zero target for the state by 2050. In service of that requirement, staff from the Climate Action Office are collaborating with experts across state government and other states to better understand the role that Vermont's natural and working lands play in carbon sequestration and storage, climate adaptation, and ecosystem and community resilience, as well as what types of businesses depend on these forest resources. This LRMP is well aligned with relevant goals from the GWSA and the CAP to achieve long-term sequestration and storage of carbon and to achieve climate mitigation, adaption, and resilience on natural working lands with the goal to incorporate a balanced approach of both passive management and active management strategies during the plan cycle to increase long-term sequestration and promote carbon storage. In areas where active management is implemented, harvested timber will produce durable wood products storing carbon or replacing fossil fuel usage in heat and electricity. Further, forest management can contribute to increased sequestration through thinning practices or by producing young forests.

Of the more than 120 actions developed by the Agriculture and Ecosystems Subcommittee as part of Vermont's Climate Action Plan (CAP), three specific actions are the responsibility of state lands directly, and an additional 13 more general actions will connect to, depend on, or inform state lands management. Many of the actions in the CAP are formulated to affect policy and practice at a higher level than individual unit plans, but some actions can be tied to unit-level strategies. There are five actions listed in the CAP that align with or will be supported by the strategies and actions within the WRMU LRMP:

<table>
<tr><td colspan="2">19 Pathway 1 – Adaptation: Sustain, restore, and enhance the health and function of Vermont's natural and working lands to help both natural and human communities adapt to climate change</td></tr>
<tr><td colspan="2">19b Promote and incentivize Climate-Adaptation forest management practices</td></tr>
<tr><td>Vermont CAP Action</td><td>Connection to the WRMU LRMP</td></tr>
<tr><td>Where appropriate, promote planting future climate adapted tree and crop species</td><td>Where compatible with policies and natural resource management goals, planting of climate adapted tree species may accompany forest management activities, as has been done in Groton State Forest as part of a co-produced study with UVM on the effects of climate change on regeneration and forestry practices.</td></tr>
<tr><td colspan="2">19c Promote funding for nature-based solutions and traditional ecological knowledge efforts and incorporate into state funding and planning efforts (merged two strategies)</td></tr>
<tr><td>Vermont CAP Action</td><td>Connection to the WRMU LRMP</td></tr>
</table>

Include Tribal members, traditional ecological knowledge traditional ecological knowledge (TEK), youth in state, regional and municipal resource management planning	The state lands LRMP process includes public involvement steps in a variety of media and a range of venues and methods for learning about the plan and providing comments, with an intended outcome of incorporating input as many voices as possible in the state.
19d Manage natural and working lands for biodiversity, forest health and climate resilience	
Vermont CAP Action	**Connection to the WRMU LRMP**
Support research efforts to better understand forest ecosystems, local climate change and impacts to forests and ecosystem services	Overall unit-wide goals for forest management include providing opportunities for research (p 124), as well as specific plans to support appropriate and compatible research on long-term outcomes of forest management (p. 187) and climate change impacts on forest ecosystems (p. 188). ANR has historically worked with a number of academic research partners to conduct a range of environmental research on state lands, including ongoing work on Groton State Forest and Camel's Hump State Park.
Through direction to VT Fish & Wildlife and VT Forests, Parks and Recreation, establish primary land management objectives of protecting and improving forest health and biodiversity on state lands, and private lands enrolled in UVA; and promote adoption of these objectives through outreach to regional and municipal planners.	This plan establishes primary land management objectives centered on protecting and improving forest health and biodiversity on state lands through multiple goals and strategies. The draft plan is also consistent with Vermont Conservation Design (VCD) which identifies a range of features at multiple scales that are highest priority for maintaining ecological function. Numerous unit-wide strategies related to these goals can be found on pages 134 through 138, and are further enumerated by resource or focus area (wildlife, forest management, climate change) on pages 138 to 147.
22 Pathway 4 – Landuse: Shape land use and development that support carbon sequestration and storge, climate resilience and adaptation, and natural and human communities for a sustainable and equitable future	
22b Include biodiversity and resilience goals in the planning and management of natural and working lands (both public and private).	
Vermont CAP Action	**Connection to the WRMU LRMP**
Improve statewide forest planning efforts on State and Federal Lands, including development of an action plan by ANR for how state lands will help accomplish Vermont Conservation Design targets by 2030 and 2050, and collaborate with the U.S. Forest Service (Green Mountain National Forest)	While this LRMP does not set a statewide action plan for how state lands will help accomplish VCD targets, there is ample discussion of how this plan is designed to contribute to VCD goals throughout. Refer to . There were some comments that forest management is focused in Worcester and not in

planners for more unified forest planning across the state.	Stowe. Additionally, some commenters expressed concern about the disproportionate impacts of trucking to one area or town. There were requests for more explanation of these decisions. for more discussion of the incorporation of VCD goals within the LRMP.

Comment Theme 111. The WRMU planning process should not proceed until the Act 59 conservation planning effort is complete.

Act 59, the Community Resilience and Biodiversity Protection Act (CRBPA), was enacted to require a detailed assessment of existing conserved lands and to develop a conservation plan to achieve a balanced portfolio of conserved lands with a target of 30% conserved lands by 2030 and 50% conserved lands by 2050. Act 59 provides definitions of three conservation categories: ecological reserve area, biodiversity conservation area, and natural resource management area. The legislature tasks the Vermont Housing & Conservation Board (VHCB), in consultation with ANR, with creating "an inventory of Vermont's conserved land and conservation policies..." by (or before) July 1, 2024. The inventory includes "an assessment of how State lands will be used to increase conserved ecological reserve areas." The Act also requires VHCB and ANR to "develop a plan to implement the conservation goals of Vermont Conservation Design" on or before December 31, 2025. ANR staff are actively engaged in this inventory and planning effort alongside many other conservation partners. All lands that comprise the WRMU are among the existing conserved lands in Vermont that will be inventoried and count toward the total land currently conserved - becoming the baseline for the conservation plan which will serve as the road map to meet the 30x30 goal.

The legislature specifically recognized the critical role that working lands play in overall land conservation in Vermont, as well as the importance of sustainably managing state and private conserved lands to achieve the goals of Act 59. The biodiversity conservation area and natural resource management area categories specifically include sustainable management to achieve the goals, including sustainable forest management activities. Also, the ecological reserve area does not prohibit management activities but requires that the goal of any management be to maintain a natural state where ecological processes may proceed with minimal interference. The Legislative Findings of Section 2 of Act 59 recognize the importance of sustainable forest and land management activities and require VHCB and ANR to consider the Forest Futures Strategic Roadmap and how that interacts with and supports the goals of the Vermont Conservation Design and Staying Connected Initiatives in establishing a balanced portfolio of conserved lands.

Some public comments oppose harvesting timber in the WRMU and call for ANR to halt the LRMP process until the Act 59 conservation planning effort is complete. It would be impractical to pause management planning for state lands until the Act 59 conservation planning effort is complete. In addition to the Act 59 inventory and planning effort, there are a number of other important planning efforts in varying stages that have the potential to inform state land management activities including the Forest Futures Roadmap, Move Forward Together Vermont, the Wildlife Action Plan and Parks Modernization Study. There will never be a time when the next guiding plan is not in progress; if ANR made the decision to pause planning to capture the outcomes of related plans, we would never develop LRMPs and ANR would halt all management actions on state lands, including wildlife habitat improvement, forest roads and water quality improvements, recreational improvements, and others. This could include potentially restricting some public uses of the state lands as well. Act 59 does not require such a pause, and the impact from such a pause could be contradictory to the overall goals of Act 59.

Similarly, if ANR applied a rationale for pausing any activity with the potential to be informed by other planning efforts, much of the work carried out by ANR focused on state land including land conservation would also be affected. These statewide plans are incorporated into the LRMP efforts, as relevant, on a rolling basis and as they are adopted. Additionally, ongoing land conservation efforts of VHCB and ANR that continue to conserve lands in Vermont that will ultimately contribute to the goals of Act 59, should, under this theory of the commenters, also be paused until the conservation plan is completed to ensure that conservation efforts match the conservation plan. This would also be counter-productive to the overall purpose and goals of Act 59.

Act 59 does not require that VHCB and ANR halt all ongoing land conservation effort or halt all land management activities on state lands, including preparing and adopting updated Long-Range Management Plans.

Comment Theme 112. Designate the Worcester Range an Ecological Reserve.
We believe these comments are specifically referencing the “Ecological Reserve” category in Act 59. The Department of Forests, Parks and Recreation has a mission to manage for multiple uses, purposes and goals (see generally 10 VSA 2603). FPR conducts land management planning efforts in collaboration with Fish and Wildlife and Environmental Conservation staff of ANR (as discussed more fully in other comment responses) to achieve conservation of all natural resources, improvements to those resources to achieve the multiple goals of all three departments in ANR. The WRMU LRMP identifies areas and proposed management that contributes to multiple conservation goals and strategies and aligns with the goals of Act 59 and Vermont Conservation Design, among other planning efforts.

The WRMU specifically increases the acreage of the Highly Sensitive Management Area, which is consistent with Act 59. Designating the entire WRMU as an Ecological Reserve would not be consistent with Act 59 or statutory requirements of FPR to provide for multiple uses and purposes of state land and would likely result in a significant change to existing recreational uses on the WRMU itself that may not be supported by the public. For all of these reasons, ANR declines to designate the entire WRMU as an ecological reserve as defined by Act 59 but has increased the acreage of land that will qualify as that designation by 309 acres in the final Plan. See Comment Theme 111 regarding requests to pause the WRMU LRMP process until the Act 59 process is complete.

Comment Theme 113. It appears that the land use classification was done based on constraints rather than opportunities, and any area that was not described as infeasible for active timber management is scheduled for a timber harvest. We do not believe that this

approach will lead to the best resource outcomes and would encourage the State to adopt an approach based on establishing desired future conditions and opportunities to advance them, and planning management activities around those.

As part of the planning process, the lands, resources, and facilities held by the ANR are evaluated and assigned to the appropriate land management category. The DST assigned the management categories based on resource goals and the characteristics of resources identified on the WRMU. The resources that are assessed in developing the LMC include natural communities, plants, and wildlife as well as recreation, historic, forest, and water resources. While classifications are based on resources and related goals, the LRMP creates opportunities to sustain and enhance resources by implementing strategies such as managing for forest resilience, old growth forests, wildlife habitats, and recreation.

Comment Theme 114. Timber harvests are to occur in 13 designated parcels over a 12–14-year period, the annual harvests averaging 0.5% of the entire MU area. These harvests appear to be targets. What is to prevent the ANR from unilaterally deciding to increase the size and scope of any of these planned cuts?

ANR initiates an LRMP amendment process when "significant changes to the plan are proposed," which include: "1) substantial changes to any goals, management objectives, and implementation actions contained in the current plan; 2) major change in land use, land classification, or species management direction…" (ANR LRMP Planning Binder). The scenario described in the comment would require an amendment to the LRMP. The LRMP amendment process involves public comment.

Comment Theme 115. All long-range plans should … document the amount of CO2 each project area sequesters.

The sequestration rate of a project areas is not the only determinant of forest condition and associated management needs, and quantifying carbon sequestration with accuracy is a resource-intensive endeavor, making this recommendation impractical. Further, measuring carbon sequestration involves monitoring changes in biomass, soil organic carbon, and carbon fluxes over time requiring long-term datasets which we do not have to implement in this LRMP. Sequestration is one of many services provided by forests related to climate change mitigation and resilience; see the Additional Information: Active Forest Management as a Tool to Increase Climate Resilience in our Forests for how the forest management in the WRMU Plan supports resilience and adaptation of forests to climate change. Carbon is sequestered and stored in growing vegetation and soils.

Quantifying the carbon sequestration by trees in a specific project area requires either modeling based on current composition and general site conditions or measurements requiring extreme precision of tree growth over time.[97] The level of effort required to collect detailed

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[97] Smith, J.E., Heath, L.S, Skog, K.E., Birdsey, R.A. 2006. Methods for calculating forest ecosystem and harvested carbon with standard estimates for forest types of the United States. Gen. Tech. Rep. NE-343. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station. 216 p. https://doi.org/10.2737/NE-GTR-343, and Pearson, T. R. H., Brown, S. L., & Birdsey, R. A. (2007). Measurement

tree measurements over time that can quantify sequestration on a specific project area is beyond the capacity of ANR staff and is not the best use of resources given the many competing demands on state lands management. Modeling can be helpful for understanding sequestration rates for larger areas but will not represent a harvest area accurately without detailed underlying forest inventory data. The data collected for LRMP development cannot support this modeling. Carbon storage can be estimated more accurately from the finer scale inventory data collected during project development) but cannot quantify sequestration accurately. Given that a more detailed pre-harvest inventory will be conducted after the LRMP is adopted as part of the development and analysis of proposed timber sales, this data collected—forest health, species composition, stand age, forest structure, soil characteristics, wildlife habitat, and information on forest product quality, value and distribution—may then be utilized to account for rough estimates of carbon storage dependent on staff capacity.

Other

Land Conservation

Comment Theme 116. The community worked to expand the protection of the CC Putnam State Forest that covers the Worcester. Those donating had the understanding that the land would be protected. Yes, primarily from development, but also from logging.
The Vermont Department of Forests, Parks and Recreation secured funding for the Hunger Mountain Headwaters conservation project through the federal Forest Legacy Program. The Forest Legacy funding application emphasized the benefit of continued forest management on this parcel and the selection and funding of the project was based in part on continued forest management (Forest Legacy LWCF Application: Hunger Mountain Headwaters, 2017). This funding made the project possible and ultimately led to the protection of 1,877 acres as additions to C.C. Putnam State Forest. VT FPR administers the Forest Legacy Program as a working forest conservation program and no forest management restrictions were imposed on any of the project's tracts prior to acquisition. The parcels acquired through the Hunger Mountain Headwaters conservation project are now subject to the public planning process for the long-range management of the Worcester Range Management Unit.

Comment Theme 117. Some commenters requested more information about the Department's land acquisition strategy, including information about conservation project identification, funding strategies, and conservation partnerships. These same commenters stated their support for ongoing land acquisition as a management strategy to protect unsecured lands with significant resource values and to advance management goals related to public access, timber harvest, and wildlife habitats.
FPR works with a variety of partners to protect land around the Worcester Range Management Unit. In recent conservation efforts involving the Worcester Range, VT FPR has worked with Stowe Land Trust, Trust for Public Land, The Nature Conservancy, Vermont Land Trust, Waterbury Land Initiative, and Vermont River Conservancy. FPR has also used, and continues to explore, a suite of funding sources to protect land in the Worcester Range, including the federal

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guidelines for the sequestration of forest carbon (NRS-GTR-18; p. NRS-GTR-18). U.S. Department of Agriculture, Forest Service, Northern Research Station. https://doi.org/10.2737/NRS-GTR-18.

Forest Legacy Program, the federal Land and Water Conservation Fund, state funds from the Vermont Housing and Conservation Board, and local funds raised by FPR's conservation partners. FPR acquires land and interests in land to protect a wide range of conservation values, including natural values, scenic values, recreational values, and historic values, and uses Vermont Conservation Design to review and guide its conservation efforts. See section VIII. Future Acquisition/Disposition in the WRMU LRMP for reference (page 232). Long-range management plans are primarily focused on the management of existing lands, not as a tool for future acquisition which may be impacted by many factors not considered within an LRMP, including partner organizations, funding, conservation goals, etc.

Comment Theme 118. Northeast Wilderness Trust is currently working to donate a permanent forever-wild easement on the Woodbury Mountain Wilderness Preserve, making two reputable conservation organizations responsible for its protection and ensuring that this protection is as durable and permanent as possible. We challenge the state to do the same with the Natural Area and HSMAs in the Worcester Range Management Unit.
We appreciate that the Northeast Wilderness Trust is working to further protect certain values at its Woodbury Mountain Wilderness Preserve. As an owner of public land, the State of Vermont manages its lands for a suite of public uses and values. In some situations, ANR acquires land that is subject to a conservation easement typically required by the funding source for the acquisition, but ANR does not convey conservation easements on land currently owned and managed for multiple public uses and benefits. Instead, ANR, through the LRMP development process, assigns Land Management Classifications that guide management to appropriately protect natural resources and allow for a range of public uses.

Management Goals

Comment Theme 119. Add to ANR goals: To protect Vermont's spectacular viewsheds as viewed from strategic locations.
Please see the Scenic Resource Assessment, available on page 131.

Comment Theme 120. We would encourage the State to consider its resource-based goals when determining land use classification and let funding and capacity restrictions inform implementation. The State should not prevent itself from the possibility of doing good work because of prejudgment around financial feasibility.
This is an accurate characterization of our current process. Land use classifications are assigned with "resource-based goals" in mind, and implementation actions more accurately reflect staff capacity and funding realities.

Comment Theme 121. Why is providing wood products a goal specifically for this Unit?
One of the many uses for state lands in the public interest includes demonstrating exemplary forestry and providing sustainably produced wood products when compatible with resource management objectives and all the other demands on public land. Specifically, 10 VSA 2603(b) provides that "[t]he Commissioner shall manage and plan for the use of publicly owned forests and park lands in order to implement the policy and purposes of this chapter, promote and protect the natural, productive and recreational values of such lands, and provide for multiple uses of the lands in the public interest." As sustainable forest management includes the use of

timber harvests to achieve long-term goals efficiently and at scale, producing forest products is a complementary goal with the other forest management activities FPR undertakes. See Timber harvested on state lands is de minimis and wood production should occur on private lands.for more information about the role state lands plan in the overall forest products economy in Vermont.

Comment Theme 122. A specific suggestion: could we create an additional Land Management Classification between the Highly Sensitive Management and the Special Management? It would include recreation and wildlife management, but not forestry harvesting with the specific goal of aiding the return of our old-growth forests.
The Land Management Classifications are not prescriptive about what specific types of management can/cannot occur within each LMC. Rather, they define the primary focus for management based on the sensitivity of the resources present.

Forest management is an important tool for wildlife management, carbon, restoration, etc. and can be used both actively and passively to contribute to old-growth forests and old-growth characteristics (Keeton 2006, D'Amato and Catanzaro 2022). Passive management to maintain or reserve forest stands is a form of sustainable forest management. Although active forest management does result in the production of timber products and harvesting of trees, it can be utilized to achieve multiple objectives. Please see, *Additional Information: Active Forest Management as a Tool to Increase Climate Resilience* in our Forests, for more information.

Fact-Checking

Comment Theme 123. One Fact-checking Correction Needed (Page 153) Under the heading of "Concerns and Unauthorized Uses" near the bottom of Page 153, there is a statement that "The Water Works parcel is owned and managed by the Town of Waterbury for its public water supply values and is available for dispersed pedestrian recreation." Please note that the Edward Farrar Utility District, which replaced the Village of Waterbury through a legislative mandate several years ago, manages the Water Works parcel. The Town of Waterbury does not own or manage a Public Water System.
This correction has been made.

Comment Theme 124. Error in first draft: Mt Putnam is the high point at 3642', and Mt Worcester is 3293'.
The LRMP was updated to state the highest elevation within the WRMU is an unnamed peak, elevation 3,642 ft. The highest named peak is Mt. Hunger, 3,539 ft.

Other

Comment Theme 125. I'd also like to have a better understanding of how the large parcel of former VLT land, the Forest Legacy land in Worcester / Elmore now sold, I believe, with a conservation easement - how does that dovetail with this large tract of Vermont wild land, in terms of both ecological stewardship and recreation?
FPR holds two easements that were acquired from VLT in 2021 as part of the federal Forest Legacy Program "Worcester Woods" project that are located on the east side of the Worcester

Range. One of these easement parcels directly abuts the WRMU, and the other is nearby. These parcels are privately owned, managed forest lands and are not part of the State-owned Worcester Range Management Unit, which is the subject of the Draft LRMP. The conservation easements on these private forest lands are designed to support the property's forest resources, biological diversity, wildlife habitats, and scenic and outdoor recreation resources. A third easement was acquired by the Forest Service in 1994 for the Atlas Timberland Partnership parcel. This parcel directly abuts CC Putnam and Elmore SP. FPR manages the Forest Legacy easement for the Forest Service. This parcel was previously owned by Vermont Land Trust and The Nature Conservancy through the Atlas Timberlands Partnership but has now been sold to private owners. Each easement is different, but all permanently protect the land from development and allow dispersed pedestrian public access. These protected lands contribute to the large, forested block that provides key habitat linkages within the Northern Appalachians region, while also supporting forestry, and public access for recreation.

Comment Theme 126. Isn't the point of a state park to protect it from natural resource extraction? Why any logging in Elmore state park? Eliminate Timber Harvest Tract #8 (49 acres) in Elmore State Park to preserve the integrity and aesthetics of the State Park. Let Elmore State Park become old growth forest.

State Parks are managed for a variety of uses and a range of management tools are used depending on the conditions on the ground and the goals of the LRMP. This variability is reflected in the range of Land Management Classifications applied to State Parks owned by FPR, which has parks ranging from a few acres to thousands of acres. In less developed portions of the park, forest management can be utilized to address a suite of social and ecological objectives including timber harvesting, recreation and trail maintenance, forest health improvement, invasives management, etc. This is also consistent with the statutory requirement that FPR maintain State Forests and Parks to sustain the long-term health, integrity and productivity of forests, regardless of whether those forests are located within a designated State Forest or State Park. ANR confirmed that Treatment Area #8 is appropriate for further analysis based on the management goals of the plan and conditions on the ground. For more information, see . Concern and/or perception that all trees within the timber harvest treatment areas depicted on the maps will be cut and that sensitive areas within those areas are not being considered. and the addition to the Implementation Schedule on page 172.

Comment Theme 127. Consider updating its AMPs to include the techniques described in the "Emergency Erosion Control Techniques for Dealing with Severe Weather Conditions During an Active Timber Harvest" report developed by UNH Cooperative Extension.

ANR is evaluating the recommendations of this report as it does all emerging tools, techniques and science related to reducing erosion from timber harvests. Any changes to the AMP Rules would be proposed through the Administrative Procedures Act rulemaking process, which includes public input. Since the AMPs are applicable to all logging jobs in Vermont, including on private lands, any amendment to the AMP Rules would not occur as part of the WRMU LRMP process, and no change was made to the plan to address this comment.

Comment Theme 128. Landscapes that have experienced essentially no pesticide application since the World War II era should be off limits to pesticide usage as a general guideline. Such

landscapes offer a unique scientific opportunity from a comparison reference standpoint. Again those lands should not be contaminated with pesticides, especially in light of their PFAS chemical composition and five-fold impact on global warming.
Pesticides are one important tool in our toolbox to control the spread of invasive species and maintain forest health and integrity in the face of climate change. When use of pesticides is warranted to achieve the goals of the plan, their application is governed by all existing rules and regulations as well as the Use of Pesticides on ANR Lands Policy (2019).

Comment Theme 129. The State should retain all the tools available and apply them as appropriate to meet the resource goals of the Unit. The generation of wood products seems to limit the availability of all management tools.
The LRMP top-level goals have been edited for clarity, including the way wood product production is evaluated along with other goals and uses of the LRMP. ANR uses an array of management practices and tools to achieve the stated goals in the LRMP and timber harvesting and production of forest products is one of these management practices, but it does not limit the use of other management practices where appropriate. See Consider compatibility between land management classifications and the values of interior forest blocks and connectivity blocks, and wildlife corridor function. See Additional Information: Active Forest Management as a Tool to Increase Climate Resilience in our Forests, for more information.

Comment Theme 130. Consider forest carbon as a revenue source to sustain management of the WRMU. Many of the proposals above, and perhaps other potential forest management actions for the WRMU, could also improve carbon stocking at a scale that makes a carbon project viable for existing markets. Revenue from such a project could provide a new extended source of funding that could be used to support the State's stewardship of the WRMU. TNC has a successful track record of implementing carbon projects in the Northeast and our office has been exploring carbon management on our own lands in Vermont. If carbon emerges as a management priority, or as an opportunity resulting from other management decisions, we would be happy to contribute our experience and resources to help assess the viability of a carbon project on the WRMU and potentially bring it to market.
We appreciate the offer of assistance for assessment, and this evolving sector is certainly something that ANR will continue to monitor and engage with moving forward. Pursuing revenue from carbon sequestration and storage is not currently a practice on state lands. The staffing and infrastructure required to inventory, monitor, and verify accumulation and security of carbon beyond baseline rates is a substantial undertaking that ANR currently lacks capacity to execute.

Comment Theme 131. I would like to see a more succinct description of: decisions that have been made and embedded in the plan; alternatives that were considered; and reasons why the planners choose specific alternatives from among those available?
The long-range management planning process is described in the Executive Summary of the LRMP, as well as in FPR Policy #21: State Lands Management Planning (1995). The state management planning process contains no formal consideration of alternatives, but rather represents what the DST collectively believes represents the best possible management outcome for the property based on the natural resource assessments, the desired future

conditions (as determined by management goals, objectives and public vision), staff expertise, Agency and Department missions, and public opinion.

The Public Responsiveness Summary provides feedback about other “alternatives” proposed by commenters, notes when a comment resulted in a change to the final draft of the plan, and provides a rationale for the decision made.

Comment Theme 132. Great plan…. Please make sure that decisions are made based on the science and not emotions.

Long-range management plans are written by staff with topical and scientific expertise in their field. Management of public lands is a responsibility conferred upon ANR on behalf of the people of Vermont in recognition of this expertise, and in service to the mission of the ANR. Public engagement in state lands management is a critical part of the management planning process to ensure that we understand the public’s desires and interests and are providing for those opportunities where they are compatible with the other natural resource goals of the property and are compatible with the Agency and Department missions.

ADDITIONAL INFORMATION: ACTIVE FOREST MANAGEMENT AS A TOOL TO INCREASE CLIMATE RESILIENCE IN OUR FORESTS

Active forest management plays a critical role in preparing and maintaining healthy and resilient forests in the face of a changing climate and other stressors such as pests, pathogens, and invasive plants. Past land use—including agricultural clearing of more than 80% of the Vermont landscape in the 19th and 20th centuries—and previous land use policies in the late 20th century have left many forests lacking the ecosystem characteristics that increase the likelihood of forest resilience in response to current and future stressors based on current scientific knowledge. Sustainable forest management can be used to address the lack of complexity in many Vermont forests and increase resilience to climate change and other forest health threats.

Forests Through the Lens of the Past and Present

To the lay person, a glance into a typical Vermont forest may seem like a thriving and healthy ecosystem, teeming with plants and animals; however, this may not be the case ecologically. This glance may miss a deeper picture of the forest's overall health and resilience, including the spatial arrangement of open and closed canopies, crown structures of individual trees, diversity of tree species, tree age, understory and leaf litter composition, and the number of dead trees in the canopy and on the ground—all important characteristics of ecosystem function and health. These complexities have not only gone unnoticed by many people but have not always been the primary focus of management efforts until the last few decades.[98] Since the latter half of the twentieth century, societal shifts supported by an increased scientific understanding of the complex dynamics of forest ecosystems have led to shifts in forestry practices.[99] This greater recognition of ecosystem services has spurred a shift in forest management objectives to encompass a broader range of values, such as creating a healthy, sustainable, and resilient forest; and maintaining biodiversity, providing wildlife habitat and recreational opportunities, regulating surface water flow, and optimizing carbon sequestration and storage.

Further, past land use history has led to homogenized (i.e., similar) forests with simple age structure and lack of species diversity. In Vermont, the extirpation of indigenous knowledge and practices on the landscape, followed by the clearing of 80% of Vermont's forests and subsequent farm abandonment in Vermont in the 19th and 20th century led to regrowth of forests across the landscape that fall into this homogenized category. This landscape-scale disturbance leading to homogenous conditions across the state increases risk of forest degradation under a changing climate. Forests with minimal species diversity and similar age and structural composition have increased vulnerability to climate-related disturbances due to reduced recovery pathways (e.g., a forest containing a greater diversity of species has an

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[98] Bengston, D. (1994). Changing Forest Values and Ecosystem Management. *Society & Natural Resources - SOC NATUR RESOUR*, *7*, 515–533. https://doi.org/10.1080/08941929409380885 and Palik, B. J., D'Amato, A. W., Franklin, J. F., & Johnson, K. N. 2020. *Ecological Silviculture: Foundations and Applications*. Waveland Press.

[99] Puettmann, K. J., Coates, K. D., & Messier, C. C. (2009). *A Critique of Silviculture: Managing for Complexity*. Island Press.

increased capacity to adapt to warmer conditions or a pest outbreak compared to a forest containing one species, highlighting the importance of a landscape of heterogenous forest.[100]

Forests in a Changing Climate
Our forests are now facing significant threats from climate change, with changes in temperature and precipitation patterns as well as increases in human-introduced insects, pathogens, and plants. Response to these stressors is often thought of in the context of 'resilience'—the recovery and trajectory following a disturbance event.[101] A resilient forest is one that can recover quickly with minimal change to the forest. Therefore, an important element of any strategy to promote resilience in our forests is to increase heterogeneity—through adding species and age diversity, improving tree vigor, reducing competition, etc.—to increase the likelihood of a forest to recover from climate change and other disturbances and remain as an intact forest into the future.[102]

To add resilient characteristics to our forests, forests should be managed to improve structural characteristics. Structural complexity at both the stand and landscape scale is important and has been linked to increased resilience (Liang et al. 2016, Senf et al. 2019, Wikle and D'Amato 2023). On the landscape scale, structural complexity includes the presence of young, mature, and old forests which creates a dynamic and resilient landscape that supports rich biodiversity, contributes to climate regulation, and enhances ecological stability. At the stand-scale, "structure" refers to the physical arrangement and organization of various components within the ecosystem including the following:

1. **Vertical structure** includes the different canopy layers such as the forest floor, understory, midstory, and canopy which represents different age classes. A range of age classes and vertical structure adds resilience to a forest.

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[100] Oliver, T. H., Heard, M. S., Isaac, N. J. B., Roy, D. B., Procter, D., Eigenbrod, F., Freckleton, R., Hector, A., Orme, C. D. L., Petchey, O. L., Proença, V., Raffaelli, D., Suttle, K. B., Mace, G. M., Martín-López, B., Woodcock, B. A., & Bullock, J. M. (2015). Biodiversity and Resilience of Ecosystem Functions. *Trends in Ecology & Evolution*, *30*(11), 673–684. https://doi.org/10.1016/j.tree.2015.08.009 and Tilman, D., Isbell, F., & Cowles, J. M. (2014). Biodiversity and Ecosystem Functioning. *Annual Review of Ecology, Evolution, and Systematics*, *45*(1), 471–493. https://doi.org/10.1146/annurev-ecolsys-120213-091917.
[101] Gunderson, L. H. (2000). Ecological Resilience—In Theory and Application. *Annual Review of Ecology, Evolution, and Systematics*, *31*(Volume 31, 2000), 425–439. https://doi.org/10.1146/annurev.ecolsys.31.1.425 , and Lloret, F., Siscart, D., & Dalmases, C. (2004). Canopy recovery after drought dieback in holm-oak Mediterranean forests of Catalonia (NE Spain). *Global Change Biology*, *10*(12), 2092–2099. https://doi.org/10.1111/j.1365-2486.2004.00870.x
[102] Messier, C., Bauhus, J., Doyon, F., Maure, F., Sousa-Silva, R., Nolet, P., Mina, M., Aquilué, N., Fortin, M.-J., & Puettmann, K. 2019. The functional complex network approach to foster forest resilience to global changes. *Forest Ecosystems.* **6**, 21. https://doi.org/10.1186/s40663-019-0166-2, Nagel, L. M., Palik, B. J., Battaglia, M. A., D'Amato, A. W., Guldin, J. M., Swanston, C. W., Janowiak, M. K., Powers, M. P., Joyce, L. A., Millar, C. I., Peterson, D. L., Ganio, L. M., Kirschbaum, C., & Roske, M. R. (2017). Adaptive Silviculture for Climate Change: A National Experiment in Manager-Scientist Partnerships to Apply an Adaptation Framework. *Journal of Forestry*, *115*(3), 167–178. https://doi.org/10.5849/jof.16-039, and Puettmann, K. J., & Messier, C. 2020. Simple Guidelines to Prepare Forests for Global Change: The Dog and the Frisbee. *Northwest Science*, *93*(3–4), 209. https://doi.org/10.3955/046.093.0305

2. **Horizontal structure** includes the spatial arrangement of trees and plants across the landscape which can be uniform, random, or clumped. Through varying arrangements of forests (e.g., canopy gaps, retention trees in openings, thinned canopies), there are variable combinations of light, moisture, and temperature which in turn support a diversity of regeneration conditions and habitat opportunities.[103]
3. **Diversity of species and age classes** is important given different species have different characteristics and vulnerabilities. For example, having a monoculture of one species can lead to greater vulnerability to drought or a certain pest or pathogen and carries increased risk of reduced tree vigor and, in some cases, widespread mortality.
4. **Increased deadwood,** such as snags (standing dead trees) and downed logs, provides habitat for wildlife and arthropods, and contributes to nutrient cycling that supports healthy and diverse soils and plants. Deadwood is an incredibly important structural feature that improves water infiltration in the soil and can act as a 'nurse log' for the establishment of future seedlings.

All these structural elements can provide successful recovery (i.e., resilience) in the face of novel stressors such as climate change while also supporting broader biodiversity and a greater range of wildlife habitat.[104]

Active Forest Management as a Tool for Invasive Species-Related Forest Health Threats
Invasive pests and pathogens threaten to reduce or even eliminate tree species from our forests. Active management can mitigate these losses by promoting tree vigor and increasing age class and species diversity that are critical for resilience to current and future stressors. For example, designing active management strategies for forests threatened by Emerald Ash Borer (EAB) should account for ecological function, genetic diversity, cultural integrity, and ethical responsibility.[105] For pests like hemlock woolly adelgid (HWA), timing forest management with the release of HWA predators (i.e., parasitic wasps) can improve tree health and success of treatments.

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Active Forest Management Can Increase Structural Complexity in a Forest

Although it may seem counterintuitive, active, sustainable forest management can enhance or maintain these structural characteristics in a forest landscape, thereby directly contributing to forest resilience and climate adaptation. One aspect of sustainable forest management is harvesting trees in a manner that promotes both regeneration and a healthy post-harvest forest ecosystem, via silvicultural methods[106] that avoid soil compaction, create site conditions beneficial for the regeneration of species, leave some trees and downed logs for wildlife habitat, and create breaks in the canopy to give regenerating seedlings access to sunlight. It's important to note that when forests are sustainably managed and trees are harvested and then allowed to regenerate, the forested landscape persists and continues to provide ecosystem services, such as water regulation, wildlife habitat, and carbon sequestration. For this reason, sustainable forest management is not the same as fragmentation or deforestation which is defined as the conversion of forest land to non-forest land by the Intergovernmental Panel on Climate Change (IPCC). By actively managing forests with timber harvests, we can add more structural diversity—both horizontal and vertical—as well as species and age diversity. This may be accomplished through varying silvicultural practices such as the following:[107]

1. **Reserves**: reserving healthy individual trees or groups of trees within gaps or patch cuts to serve as seed source for future regeneration, or support continuity of species associated with individual trees or groups of trees like lichen, mycorrhizae, wildflowers and others. Reserves may also apply to stands with high structural diversity as part of a suite of management strategies.
2. **Single-tree selection and group selection**: small to moderate gap openings that mimic moderate disturbances like wind throw. Smaller gaps favor shade-tolerant species and larger gaps favor shade intolerant and intermediate intolerant species have valuable adaptive characteristics.[108]
3. **Patch cuts**: larger cuts that are beneficial for wildlife species and young forest habitat. In areas with high concentration of diseased beech and granitic soils, larger patch cuts are recommended for the regeneration of a more diverse forest.[109]

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[106] Silviculture is the art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands to meet the diverse needs and values of landowners and society such as wildlife habitat, timber, water resources, restoration, and recreation on a sustainable basis as defined by the USDA Forest Service.

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4. **Strip cuts**: harvesting long, narrow strips of forest, leaving adjacent areas intact to provide seed sources and protection for regeneration. This technique aims to promote natural regeneration, reduce soil erosion, and maintain biodiversity. Shade-intolerant and intermediate-tolerant species benefit from the increased light and space provided by strip cuts, which mimic natural disturbances such as windthrows and small-scale fires.
5. **Shelterwood**: variable size cuts through which a new generation of trees is established naturally under the shelter of older trees by a series of partial cuttings intended to stimulate seed production and create favorable seedbed conditions.

These examples are not an exhaustive list but are representative of common silvicultural practices used on state lands. All these strategies—including forest reserves—require careful consideration of forest regeneration, site conditions, invasive species, and future climatic conditions. Active sustainable forest management coupled with passive management strategies can be used where needed on the landscape to increase structural complexity, create a more resilient landscape that improves and maintains an array of ecosystem services and addresses social (e.g., wood consumption and production) and ecological (e.g., promoting forest health and resilience, carbon sequestration and storage, biodiversity) needs while also bolstering resilience to climate change impacts and other forest health stressors.

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APPENDIX 8: Glossary

The following is a series of key words and their definitions used in the development of Long-Range Management Plans for Vermont Agency of Natural Resource lands.

Acceptable Management Practices (AMPs). In this plan, a series of erosion control measures for timber harvesting operations, as identified in state statutes. The AMPs are the proper method for the control and dispersal of water collecting on logging roads, skid trails, and log landings to minimize erosion and reduce sediment and temperature changes in streams.

Acceptable Growing Stock (AGS). AGS trees exhibit form and appearance that suggests they will maintain and/or improve their quality and can be expected to contribute significantly to future timber crops in the form of vigorous high-quality stems. They contain or may potentially produce high or medium quality sawlogs.

Age Class. One of the intervals, commonly 10 to 20 years, into which the age range of forest trees are divided for classification or use. Also pertains to the trees included in such an interval. For example, trees ranging in age from 21 to 40 years fall into a 30-year age class; 30 designates the midpoint of the 20-year interval from 21 to 40 years.

All-aged (Uneven-aged) system. Timber management which produces a stand or forest composed of a variety of ages and sizes. Regeneration cutting methods in this system include single tree selection and group selection.

Basal area. A measure of the density of trees on an area. It is determined by estimating the total cross-sectional area of all trees measured at breast height (4.5 feet) expressed in square feet per acre.

Best management practices. A practice or combination of practices determined to be the most effective and practicable means of preventing negative impacts of silvicultural activities.

Biodiversity. The variety of plants and animals, their genetic variability, their interrelationships, and the biological and physical systems, communities, and landscapes in which they exist.

Biophysical region. A region with shared characteristics of climate, geology, soils, and natural vegetation. There are currently eight biophysical regions recognized in Vermont.

Block. A land management planning unit.

Browse. The part of leaf and twig growth of shrubs, vines, and trees available for animal consumption.

Canopy. The continuous cover of branches and foliage formed collectively by the crowns of adjacent trees and other woody growth.

Capability. The potential of an area to produce resources, supply goods and services, and allow resource uses under an assumed set of management practices and at a given level of management intensity. Capability depends on current conditions and site conditions such as climate, slope, landform, soils, and geology as well as the application of management practices such as silvicultural protection from fire, insects, and disease.

Cleaning (Weeding). Regulating the composition of a young stand by eliminating some trees and encouraging others, and freeing seedlings or saplings from competition with ground vegetation, vines, and shrubs.

Clearcutting. A cut which removes all trees from a designated area at one time, for the purpose of creating a new, even-aged stand.

Commercial forest land. Land declared suitable for producing timber crops and not withdrawn from timber production by statute or administrative regulation.

Conservation. The careful protection, planned management, and use of natural resources to prevent their depletion, destruction, or waste.

Conservation easement. Acquisition of some rights on a parcel of land designed to keep the property undeveloped in perpetuity.

Cover. Vegetation which provides concealment and protection to wild animals.

Cull Tree. Tree that does not meet regional merchantability standards because of excessive unsound cull. May include noncommercial tree species.

Cultural operation. The manipulation of vegetation to control stand composition or structure, such as site improvement, forest tree improvement, increased regeneration, increased growth, or measures to control insects or disease. Examples of methods used are timber stand improvement, cleaning or weeding, release, and site preparation.

DBH (diameter at breast height). The diameter of the stem of the tree measured at breast height (4.5 feet or 1.37 meters) from the ground.

Deer wintering area. Forest area with at least 70 percent conifer that provides suitable, stable habitat to meet deer needs during the winter.

Den tree. A live tree at least 15 inches DBH (diameter at breast height) containing a natural cavity used by wildlife for nesting, brood rearing, hibernating, daily or seasonal shelter, and escape from predators.

Developed (or intensive) recreation. Activities associated with man-made structures and facilities that result in concentrated use of an area. Examples are campgrounds and ski areas.

Diameter at breast height (DBH). The diameter of the stem of the tree measured at breast height (4.5 feet or 1.37 meters) from the ground.

Dispersed recreation. Outdoor recreation activities requiring few, if any, support facilities.
Down woody material (DWM). DWM is also referred to as coarse woody debris, woody material, and down woody debris. DWM is comprised of woody material left in the woods from harvested trees as well as portions or whole trees that die and fall naturally.

Ecological processes. The relationships between living organisms and their environment. Among these processes are natural disturbances such as periodic fire, flooding, or beaver activity; natural stresses such as disease or insects; catastrophic weather-related events such as severe storms or lightning strikes; or more subtle ongoing processes such as succession, hydrology, and nutrient cycling.

Ecological reserve. An area of land managed primarily for long-term conservation of biodiversity.

Ecosystem. A complex array of organisms, their natural environment, the interactions between them, the home of all living things, including humans, and the ecological processes that sustain the system.

Ecosystem management. The careful and skillful use of ecological, economic, social, and managerial principles in managing ecosystems to produce, restore, or sustain ecosystem integrity, uses, products, and services over the long-term.

Endangered species. A species listed on the current state or Federal endangered species list (VSA Title 10, chapter 123). Endangered species are those which are in danger of becoming extinct within the foreseeable future throughout all or a significant portion of their range.

Even-aged system. Timber management that produces a forest or stand composed of trees having relatively small differences in age. Regeneration cutting methods in this system include clearcutting, seed tree (seed cut) method, and shelterwood method.

Forest health. Condition in which forest ecosystems sustain their complexity, diversity, resiliency, and productivity.

Forest type. A natural group or association of different species of trees which commonly occur together over a large area. Forest types are defined and named after the one or more dominant species of trees, such as the spruce-fir and the birch-beech-maple types.

Forestry. The art and science of growing and managing forests and forest lands for the continuing use of their resources.

Fragmentation. Division of a large, forested area into smaller patches separated by areas converted to a different land use.

Game species. Animals habitually hunted for food, particular products, sport, or trophies.

Gap. An opening in the forest canopy caused by the death or harvest of one or several overstory trees.

Geographic Information Systems. A computer-based means of mapping lands and resources and communicating values associated with them (GIS).

Green certification. A process, sponsored by several international organizations, that promotes sustainable forest management practices, providing a marketplace identify for forest products certified to have been grown and manufactured in a sustainable manner.

Group Selection. The removal of small groups of trees to meet a predetermined goal of size, distribution, and species.

Habitat. A place that provides seasonal or year-round food, water, shelter, or other environmental conditions for an organism, community, or population of plants or animals.

Hardwood. A broad leaved, flowering tree, distinguished from a conifer. Trees belonging to the botanical group of *angiospermae*.

Healthy ecosystem. An ecosystem in which structure and functions allow the maintenance of the desired conditions of biological diversity, biotic integrity, and ecological processes over time.

Heritage Sites. Sites identified by the Vermont Nongame and Natural Heritage Program of the Department of Fish and Wildlife, which have rare, threatened, or endangered species of plants or animals. Heritage sites are identified using a common standards-based methodology, which provides a scientific and universally applicable set of procedures for identifying, inventorying, and mapping these species.

Intensive (or developed) recreation. Outdoor recreation activities requiring major structures and facilities.

Interior dependent species. Those wildlife species that depend on large unbroken tracts of forest land for breeding and long-term survival. The term is also often used in conjunction with neotropical migratory bird species requiring large patches of fairly homogeneous habitat for population viability**.**

Intermediate treatment. Any treatment or tending designed to enhance growth, quality vigor, and composition of the stand after its establishment or regeneration and prior to the final harvest.

Invasive Exotic (Non-native). A species that is 1) non-native (or alien) to the ecoregion or watershed under consideration and 2) whose introduction does or is likely to cause economic or environmental harm or harm to human health.

Land conservation. The acquisition or protection through easements of land for wildlife habitat, developed state parks, and working forests.

Landscape. A heterogeneous area of land containing groups of natural communities and clusters of interacting ecosystems. These can be of widely varying scales but normally include a range of elevations, bedrock, and soils.

Mast. The fruit (including nuts) of such plants as oaks, beech, hickories, dogwood, blueberry, and grape, used for food by certain wildlife species.

Motorized use. Land uses requiring or largely dependent on motor vehicles and roads.

Multiple-use forestry. Any practice of forestry fulfilling two or more objectives of management, more particularly in forest utilization (e.g. production of both wood products and deer browse).

Multiple-use management. An onsite management strategy that encourages a complementary mix of several uses on a parcel of land or water within a larger geographic area.

Native (species). A plant or animal indigenous to a particular locality.

Natural Area. Limited areas of land, designated by Vermont statute, which have retained their wilderness character, although not necessarily completely natural and undisturbed, or have rare or vanishing species of plant or animal life or similar features of interest which are worthy of preservation for the use of present and future residents of the state. They may include unique ecological, geological, scenic, and contemplative recreational areas on state lands.

Natural community. An assemblage of plants and animals that is found recurring across the landscape under similar environmental conditions, where natural processes, rather than human disturbances, prevail.

Nongame species. Animal species that are not hunted, fished, or trapped in this state. This classification is determined by the state legislature.

Northern hardwood. Primarily sugar maple, yellow birch, and beech. May include red maple, white ash, white birch, black cherry, red spruce, and hemlock.

Old growth forest. A forest stand in which natural processes and succession have occurred over a long period of time relatively undisturbed by human intervention.

Outdoor recreation. Leisure time activities that occur outdoors or utilize an outdoor area or facility.

Overstory. That portion of the trees, in a forest of more than one story, forming the upper or upper-most canopy layer.

Patch Clearcut (Patch-cut). Under an even-aged method, a modification of the clearcutting method where patches (groups) are clearcut in an individual stand boundary in two or more entries. Under a two-aged method, varying numbers of reserve trees are not harvested in the patches (groups), to attain goals other than regeneration.

Pole. A tree of a size between a sapling and a mature tree.

Pole timber. As used in timber survey, a size class definition; trees 5.0 to 8.9 inches (varies by species) at DBH. As used in logging operations, trees from which pole products are produced, such as telephone poles, pilings, etc.

Regeneration. Seedlings or saplings existing in a stand. Regeneration may be artificial (direct seeding or planting) or natural (natural seeding, coppice, or root suckers).

Regeneration treatment (harvest cut). Trees are removed from the stand to create conditions that will allow the forest to renew or reproduce itself. This is accomplished under either an even-aged management system or an uneven-aged management system. The four basic methods used to regenerate a forest are clearcutting, seed-tree, shelterwood, and selection (group selection or single tree selection).

Regeneration methods. Timber management practices employed to either regenerate a new stand (regeneration cutting) or to improve the composition and increase the growth of the existing forest (intermediate treatment).

Regulated Hunting/Fishing/Trapping. The harvest of wildlife under regulations stipulating setting of seasons, time frame of lawful harvest, open and closed zones, methods of take, bag limits, possession limits, and reporting or tagging of species.

Release (release operation). The freeing of well-established cover trees, usually large seedlings or saplings, from closely surrounding growth.

Removal cut. The final cut of the shelterwood system that removes the remaining mature trees, completely releasing the young stand. An even-aged stand results.

Riparian Area. "The word "riparian" means of or pertaining to the bank of a river or lake. Riparian areas are ecosystems comprised of streams, rivers, lakes, wetlands, and floodplains that form a complex and interrelated hydrologic system. They extend up and down streams and along lakeshores from the bottom of the water table to the top of the vegetation canopy, and include all land that is directly affected by surface water. Riparian areas are unique in their high biological diversity. They are "characterized by frequent disturbances related to inundation, transport of sediments, and the abrasive and erosive forces of water and ice movement that, in turn, create habitat complexity and variability…resulting in ecologically diverse communities" (Verry, E.S., J.W. Hornbeck, and C.A. Dolloff (eds). 2000. Riparian management in forests of the continental Eastern United States. Lewis Publishers, Boca Raton, FL. 402p.)

Riparian Management Zone (RMZ). The width of land adjacent to streams or lakes between the top of the bank or top of slope or mean water level and the edge of other land uses. Riparian management zones are typically areas of minimal disturbance, consisting of trees, shrubs, groundcover plants, duff layer, and a naturally vegetated uneven ground surface, that protect the water body and the adjacent riparian area from the impact of these land uses.

Salvage Cutting. The removal of dead, dying, and damaged trees after a natural disaster such as fire, insect or disease attack, or wind or ice storm to utilize the wood before it rots.

Sanitation cutting. The removal of dead, damaged, or susceptible trees to improve stand health by stopping or reducing the spread of insects or disease.

Sapling. As used in timber surveys, a size class definition. A usually young tree larger than seedling but smaller than pole, often 1.0 to 4.9 inches at DBH.

Sawlog or Sawtimber. A log or tree that is large enough (usually > than 10 or12 inches DBH) to be sawn into lumber. Minimum log length is typically 8 feet.

Seedling. A very young plant that grew from a seed.

Seed-Tree (Seed Cut) method. The removal of most of the trees in one cut, leaving a few scattered trees of desired species to serve as a seed source to reforest the area.

Shelterwood method. A series of two or three cuttings which open the stand and stimulate natural reproduction. A two cutting series has a seed cut and a removal cut, while a three cutting series has a preparatory cut, a seed cut, and a removal cut.

Silvicultural systems. A management process whereby forests are tended, harvested, and replaced, resulting in a forest of distinctive form. Systems are classified according to the method of carrying out the fellings that remove the mature crop and provide for regeneration and according to the type of forest thereby produced.

Single tree selection method. Individual trees of all size classes are removed more or less uniformly throughout the stand to promote growth of remaining trees and to provide space for regeneration.

Site Preparation. Hand or mechanical manipulation of a site, designed to enhance the success of regeneration.

Site Quality. A broad reference of the potential of forest lands to grow wood. Site class identifies the potential growth more specifically in merchantable cubic feet/acre/year.

Snag. Includes standing dead or partially dead trees that are at least 6 inches in diameter at breast height (DBH) and 20 feet tall.

Softwood. A coniferous tree. Softwood trees belong to the botanical group gymnospermae, including balsam fir, red spruce, and hemlock.

Stand improvement. An intermediate treatment made to improve the composition, structure, condition, health, and growth of even or uneven-aged stands.

Stewardship. Caring for land and associated resources with consideration to future generations.

Stocking. A description of the number of trees, basal area, or volume per acre in the forest stand compared with a desired level for balanced health and growth. Most often used in comparative expressions, such as well-stocked, poorly stocked, or overstocked.

Sustainability. The production and use of resources to meet the needs of present generations without compromising the ability of future generations to meet their needs.

Sustained yield. The yield that a forest can produce continuously at a given intensity of management.

Thinning. Removing some of the trees in a dense immature stand primarily to improve the growth rate and form of the remaining trees and enhance forest health.

Threatened species. A species listed on the state or Federal threatened species list. Threatened species are those likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

Timber lands. Properties that are managed primarily for the maximum production of forest products.

Timber Stand Improvement. Activities conducted in young stands of timber to improve growth rate and form of the remaining trees.

Traditional uses. Those uses of the forest that have characterized the general area in the recent past and present, including an integrated mix of timber and forest products harvesting, outdoor recreation, and recreation camps or residences.

Unacceptable Growing Stock (UGS). UGS trees are high risk and are expected to decline before harvest. UGS trees are of poor form and/or low quality and cannot reasonably be expected to improve. They have the potential to produce only low quality logs or pulp-type products.

Uneven-aged (All-aged) system. Timber management which produces a stand or forest composed of a variety of ages and sizes. Regeneration cutting methods in this system include single tree selection and group selection.

Watershed. The geographic area within which water drains into a particular river, stream, or body of water. A watershed includes both the land and the body of water into which the land drains.

Weeding (cleaning). Regulating the composition of a young stand by eliminating some trees and encouraging others, and freeing seedlings or saplings from competition with ground vegetation, vines, and shrubs.

Wilderness. Areas having pristine and natural characteristics, typically roadless and often with some limits on uses. (This is not the federal definition of wilderness.)

Wildlife habitat. Lands supplying a critical habitat need for any species of wildlife, especially that which requires specific treatment and is of limited acreage.

Working forest. Land primarily used for forestry purposes but also available for recreation, usually where both managed land and land not presently being managed is present.

Working landscape. A landscape dominated by land used for agricultural and/or forestry purposes.

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